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FIG. 8

FIG. 8											FIG. 19		
FIG. 9	FIG. 10	FIG. 11	FIG. 12	FIG. 13	FIG. 14	FIG. 15	FIG. 16	FIG. 17	FIG. 18	FIG. 20	FIG. 21	FIG. 22	
	FIG. 23	FIG. 24	FIG. 25	FIG. 26	FIG. 27	FIG. 28	FIG. 29	FIG. 30	FIG. 31	FIG. 32	FIG. 33	FIG. 34	
FIG. 35	FIG. 36	FIG. 37	FIG. 38	FIG. 39	FIG. 40	FIG. 41	FIG. 42	FIG. 43	FIG. 44	FIG. 45	FIG. 46	FIG. 47	
	FIG. 48	FIG. 49	FIG. 50	FIG. 51	FIG. 52	FIG. 53	FIG. 54	FIG. 55	FIG. 56	FIG. 57	FIG. 58	FIG. 59	
							FIG. 60	FIG. 61	FIG. 62	FIG. 63	FIG. 64	FIG. 65	
				FIG. 5	FIG. 6	FIG. 66	FIG. 67	FIG. 68	FIG. 69	FIG. 70	FIG. 71	FIG. 72	FIG. 73
				FIG. 7	FIG. 74	FIG. 75	FIG. 76	FIG. 77	FIG. 78	FIG. 79	FIG. 80	FIG. 81	
							FIG. 82	FIG. 83	FIG. 84	FIG. 85	FIG. 86	FIG. 87	FIG. 88
										FIG. 89	FIG. 90		

FIG. 1

FIG. 6	FIG. 5	FIG. 2	FIG. 3
FIG. 7			FIG. 4

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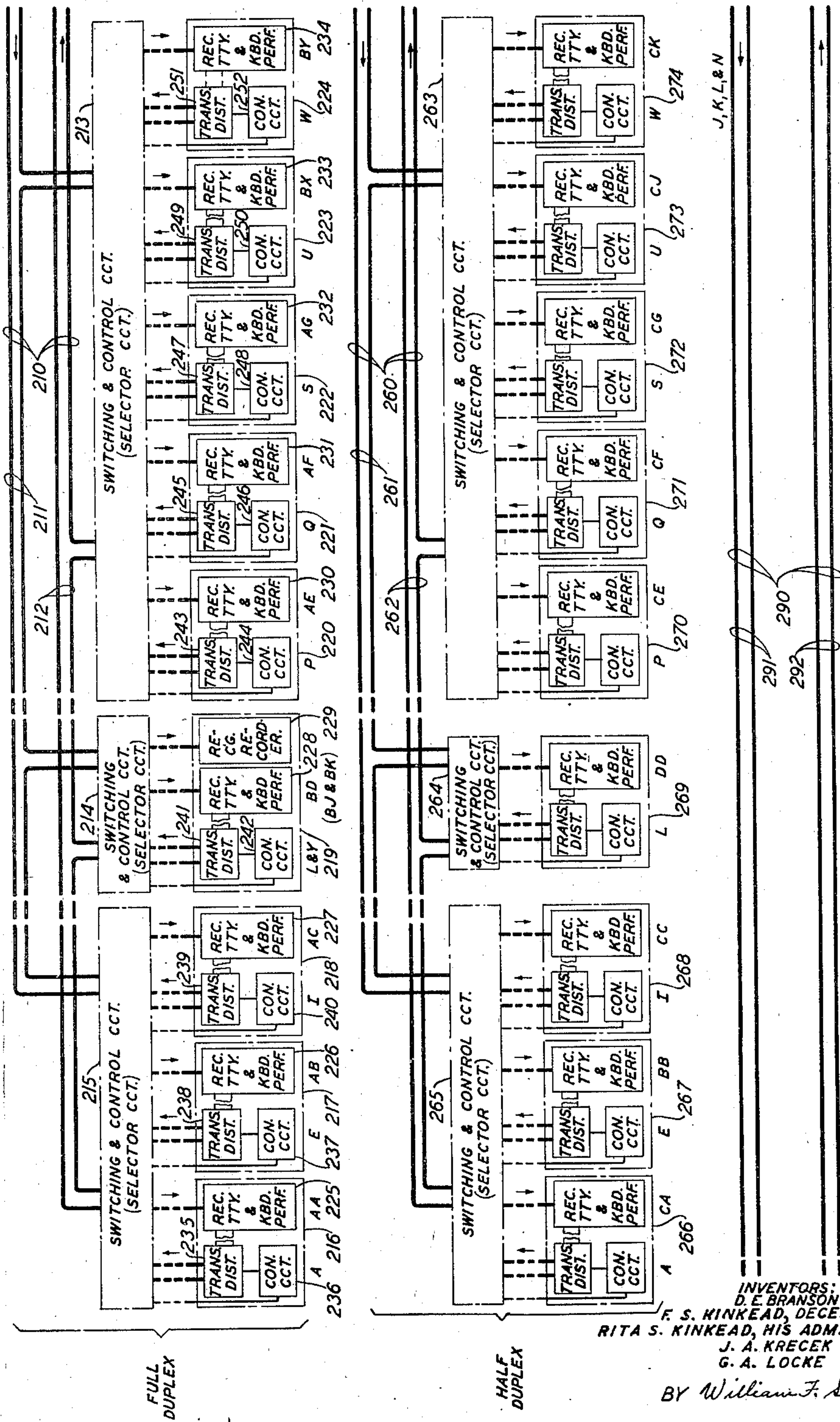


FIG. 2

INVENTORS:
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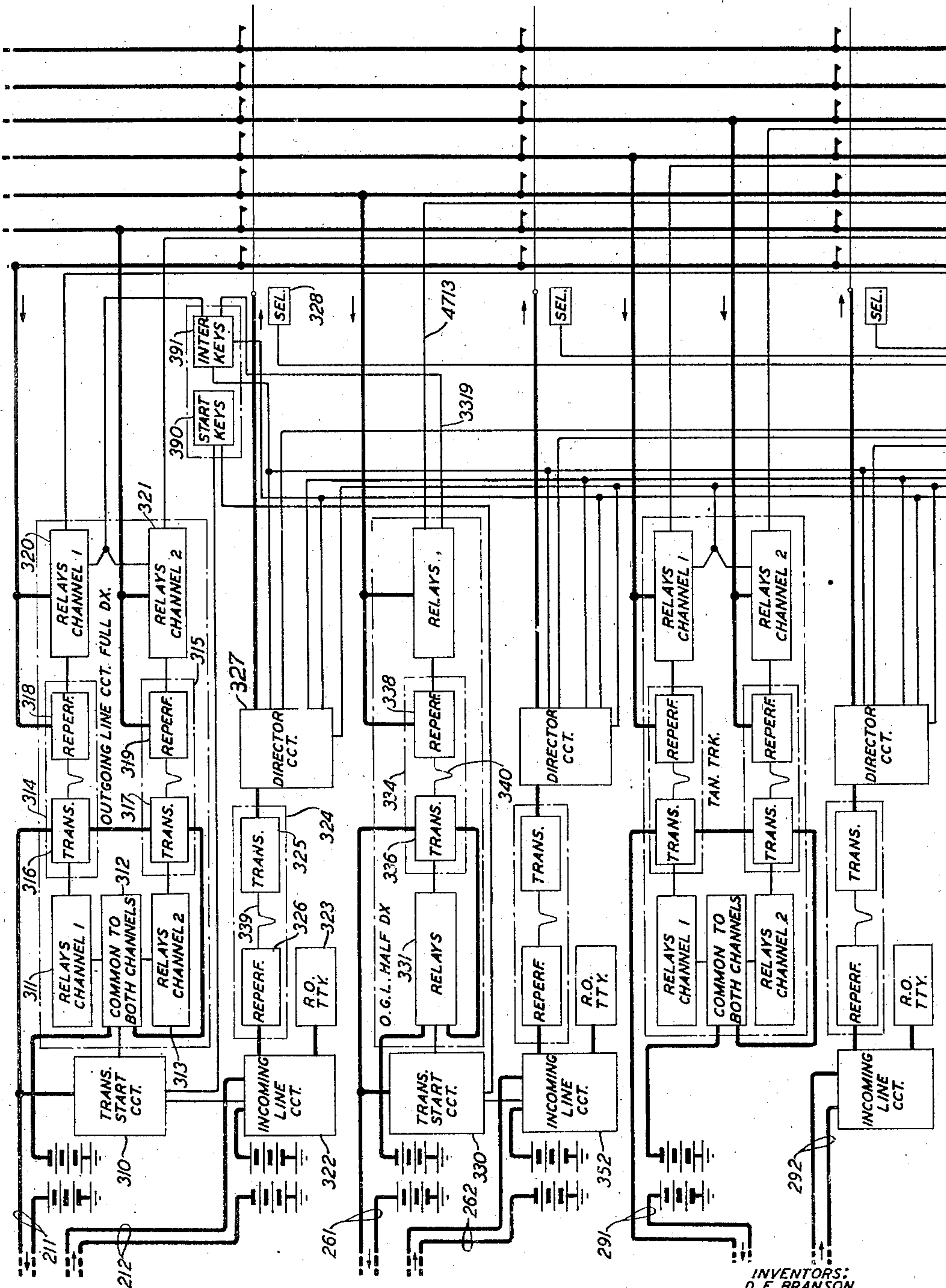


FIG. 3

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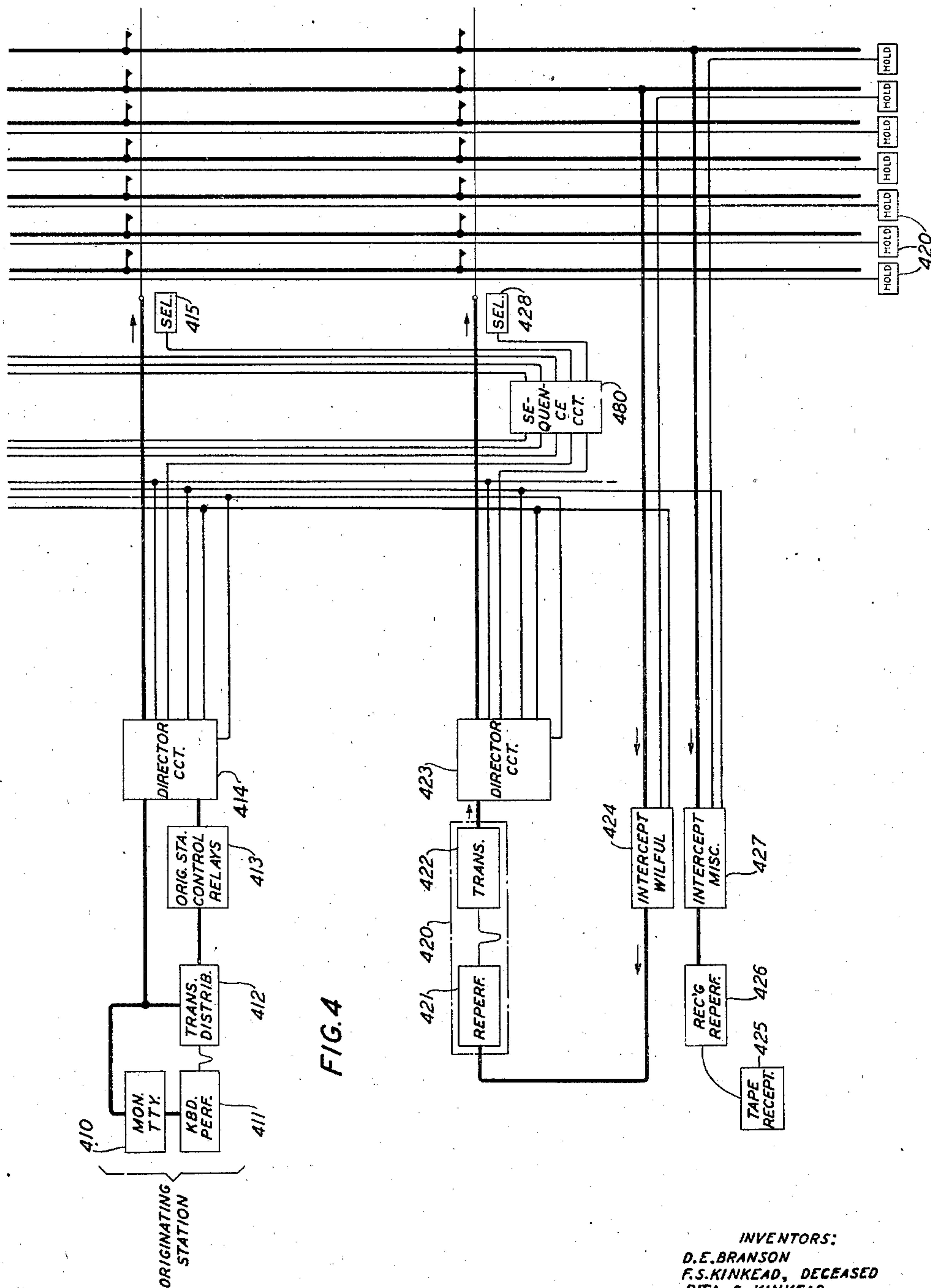
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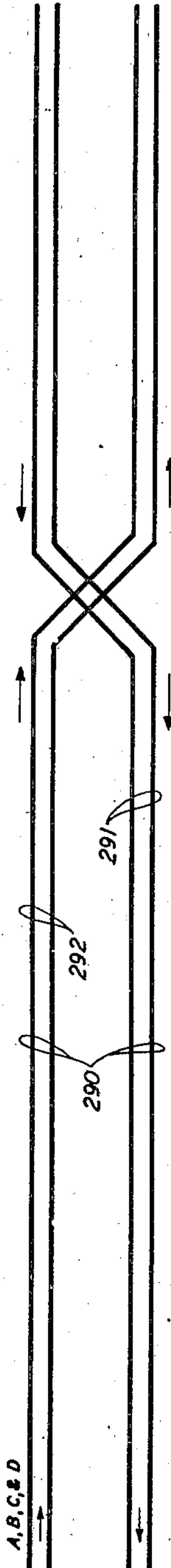
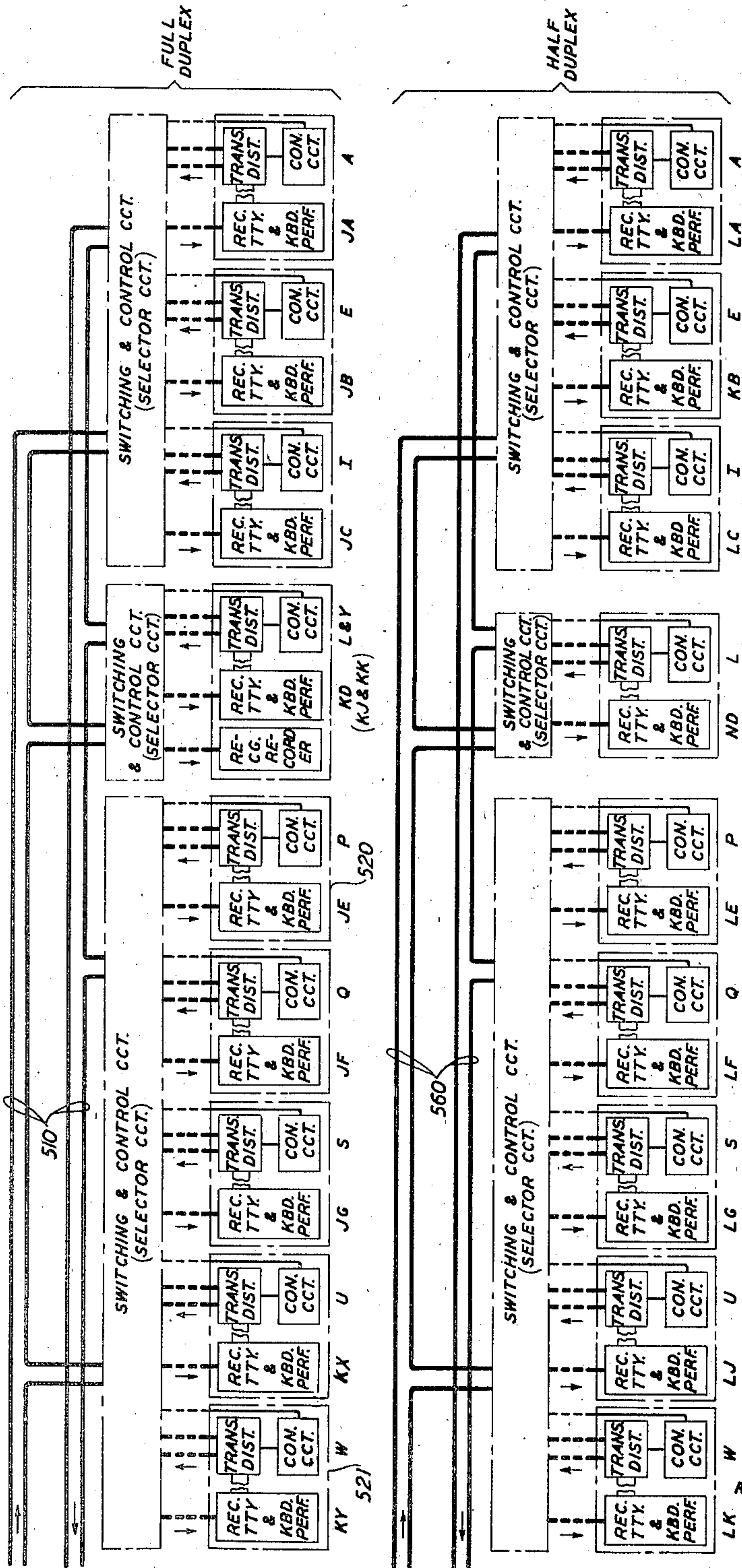


FIG. 5

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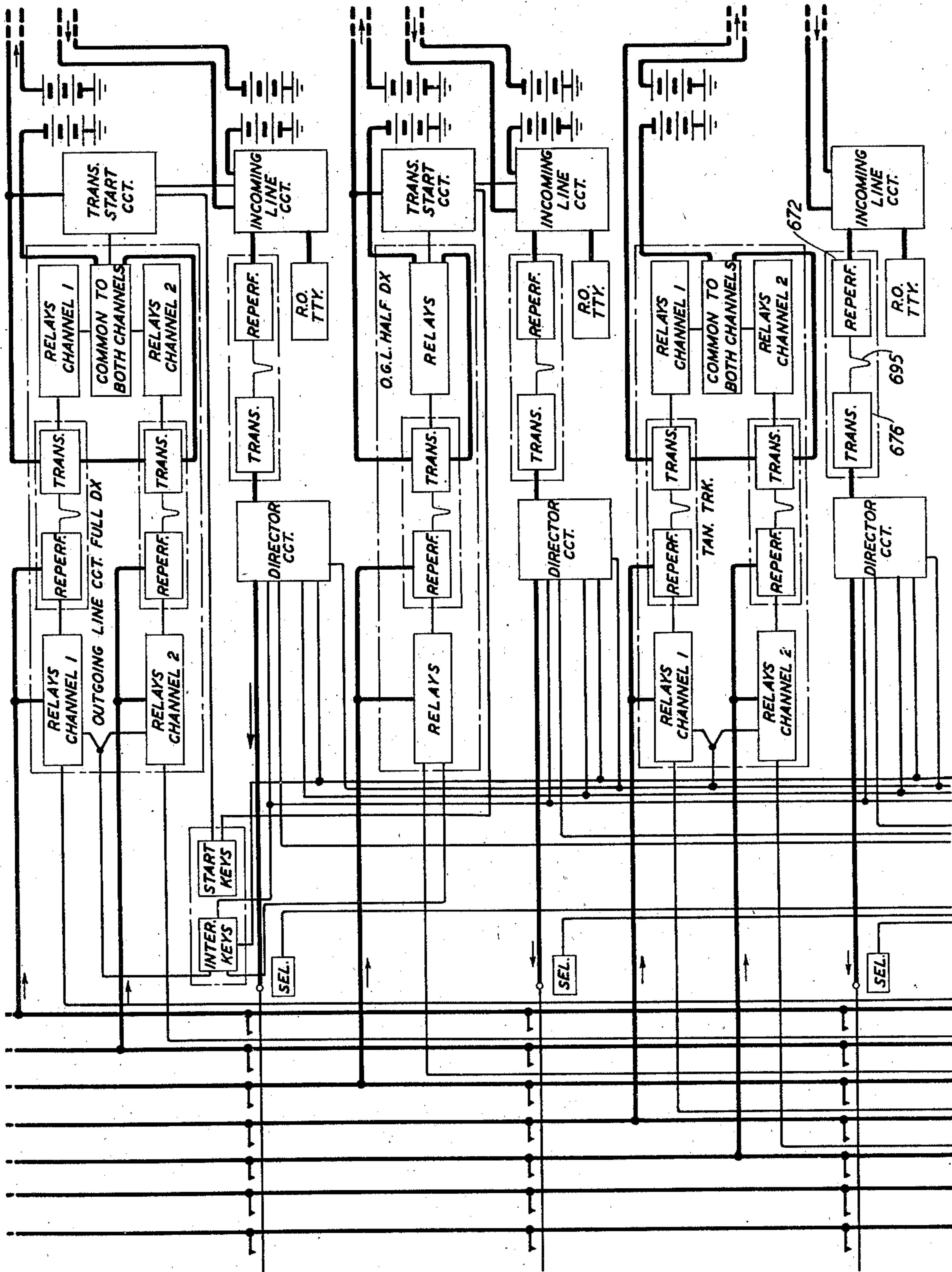


FIG. 6

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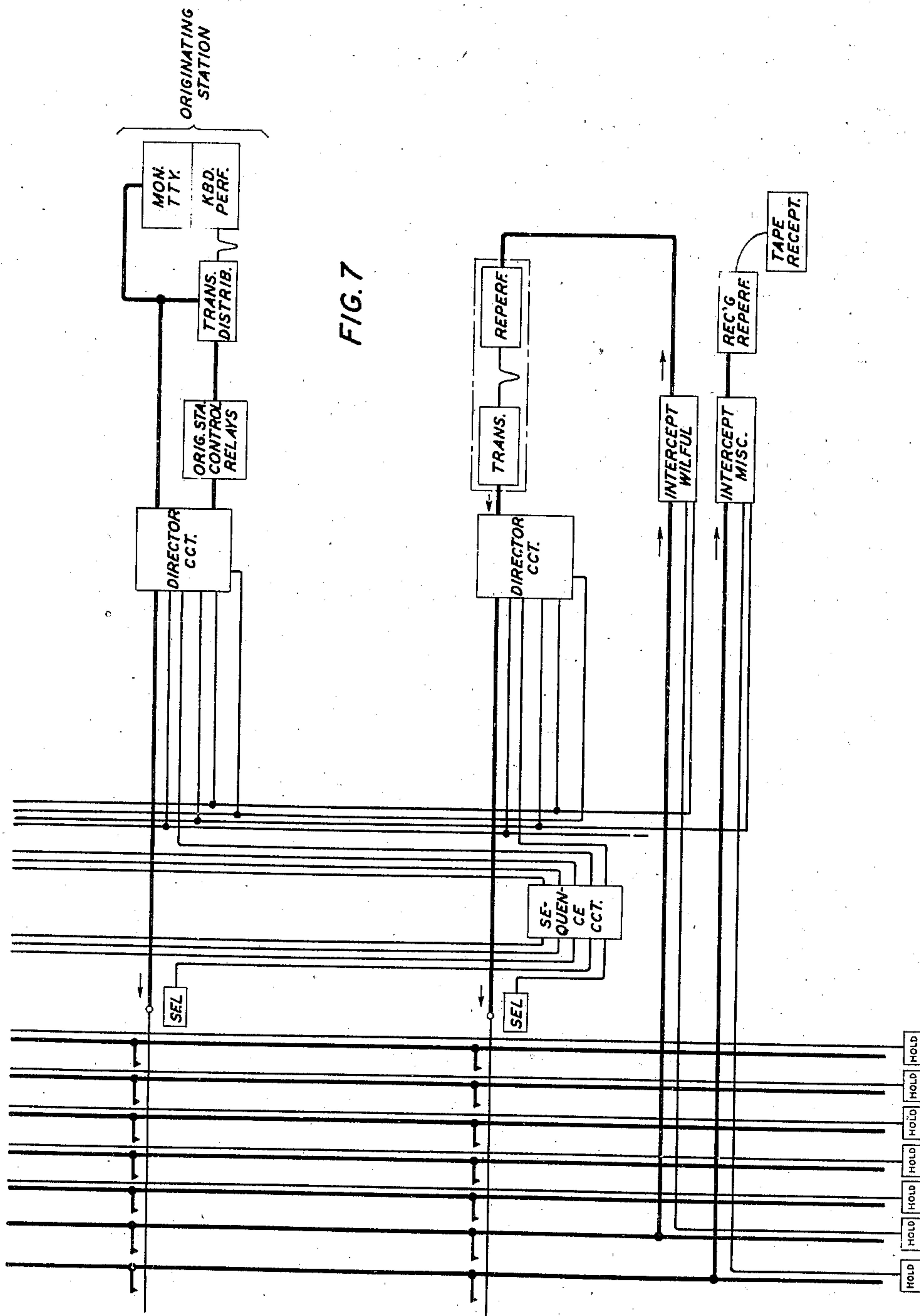
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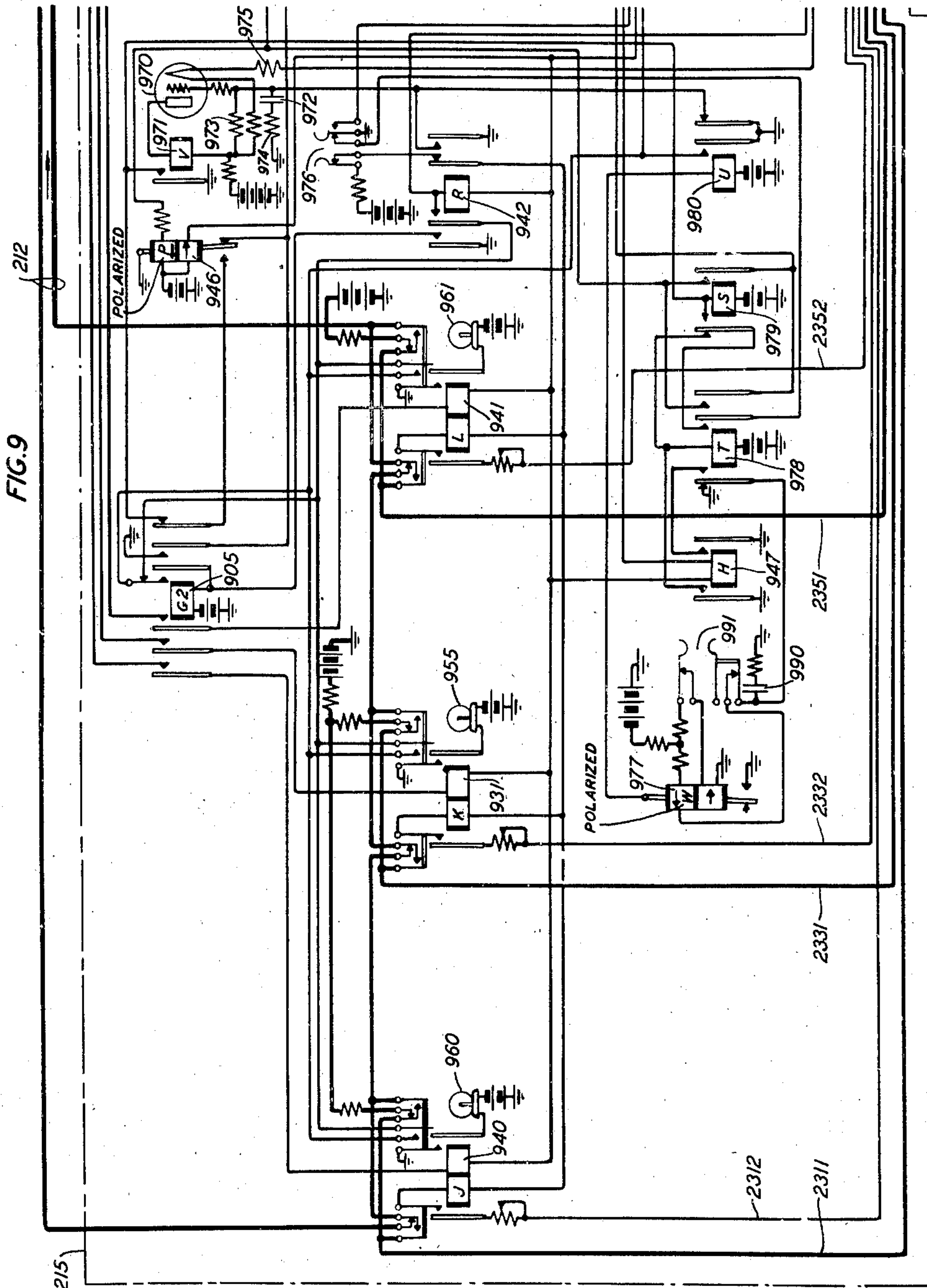
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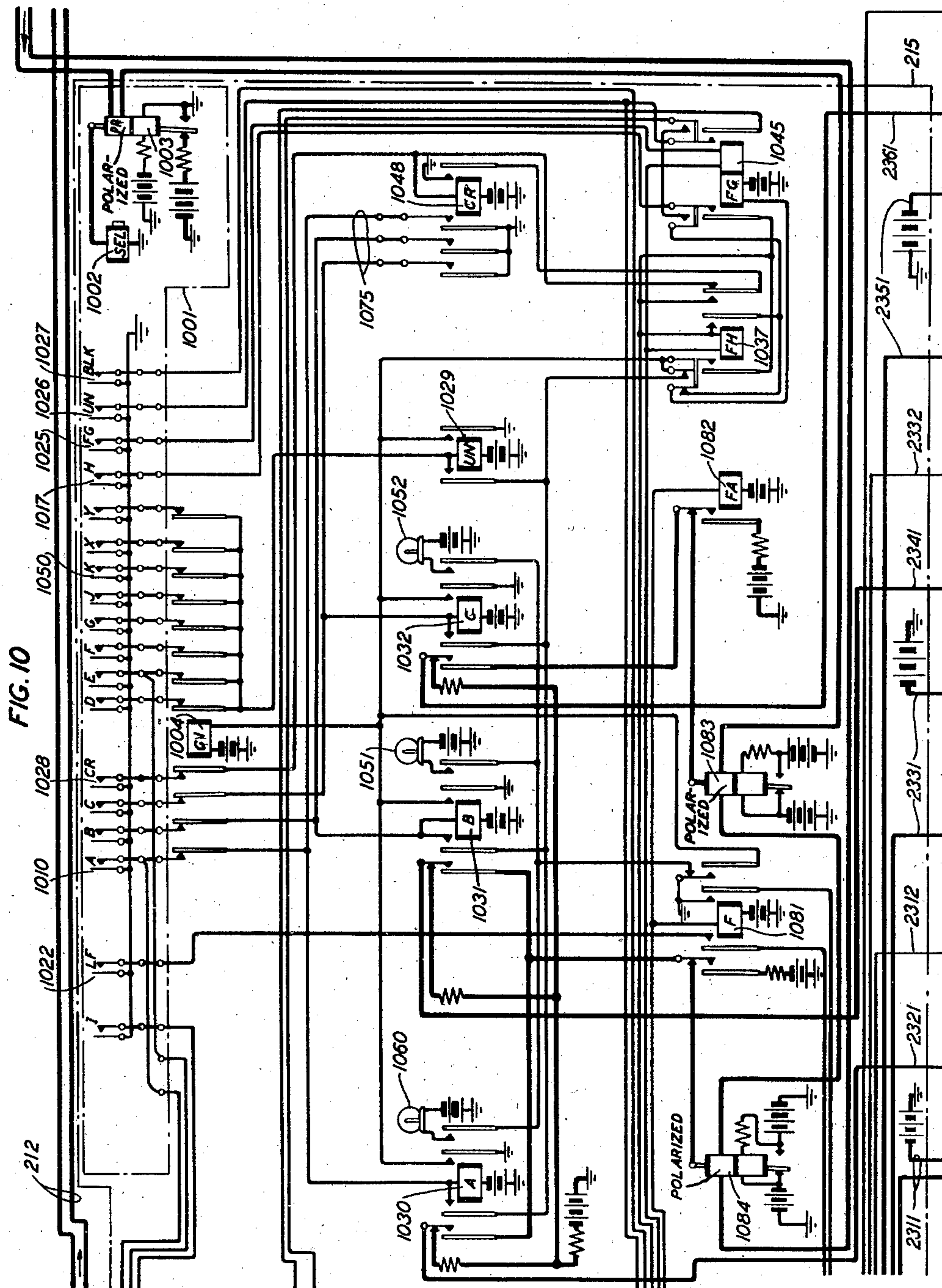
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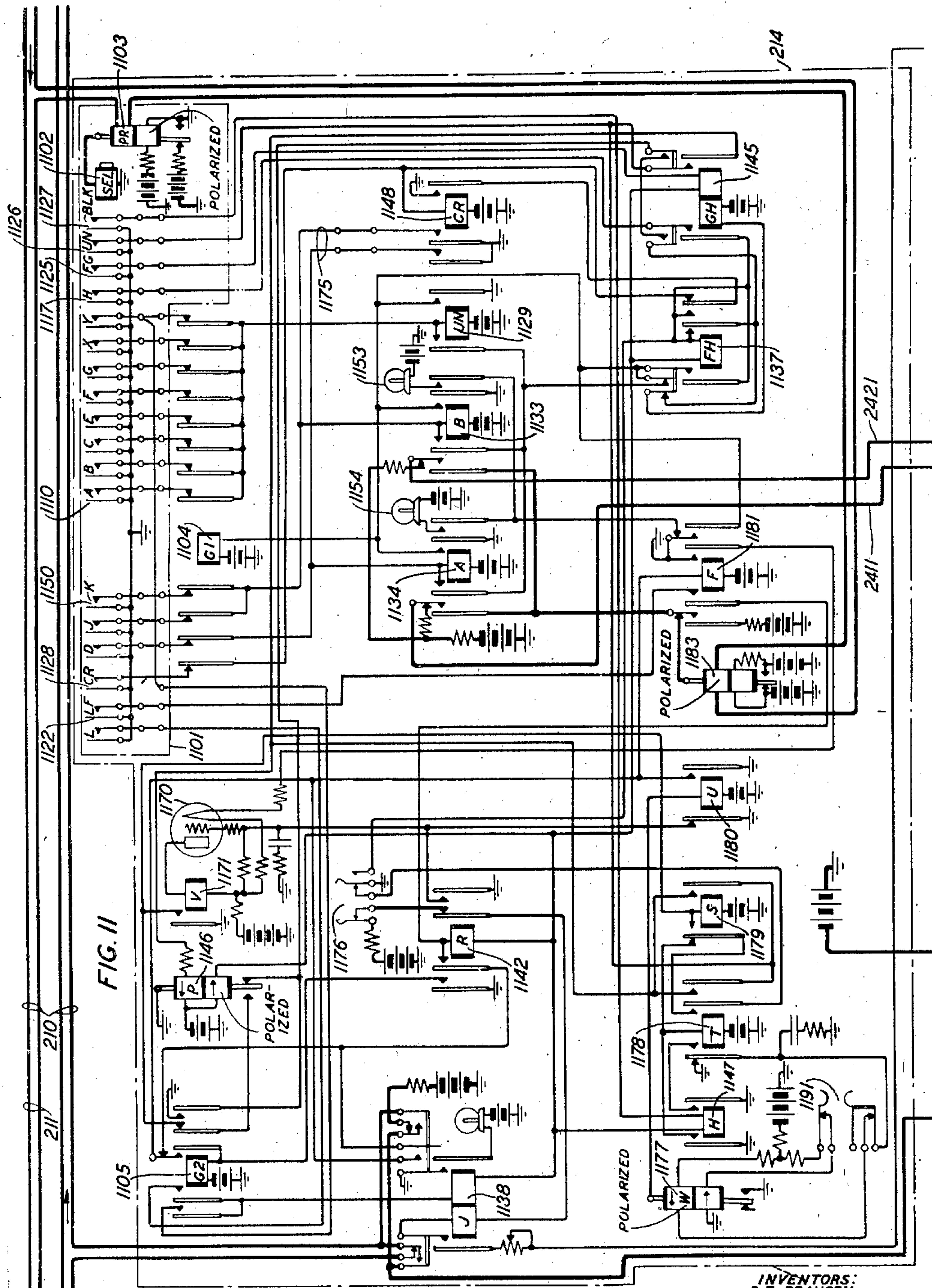


FIG. II

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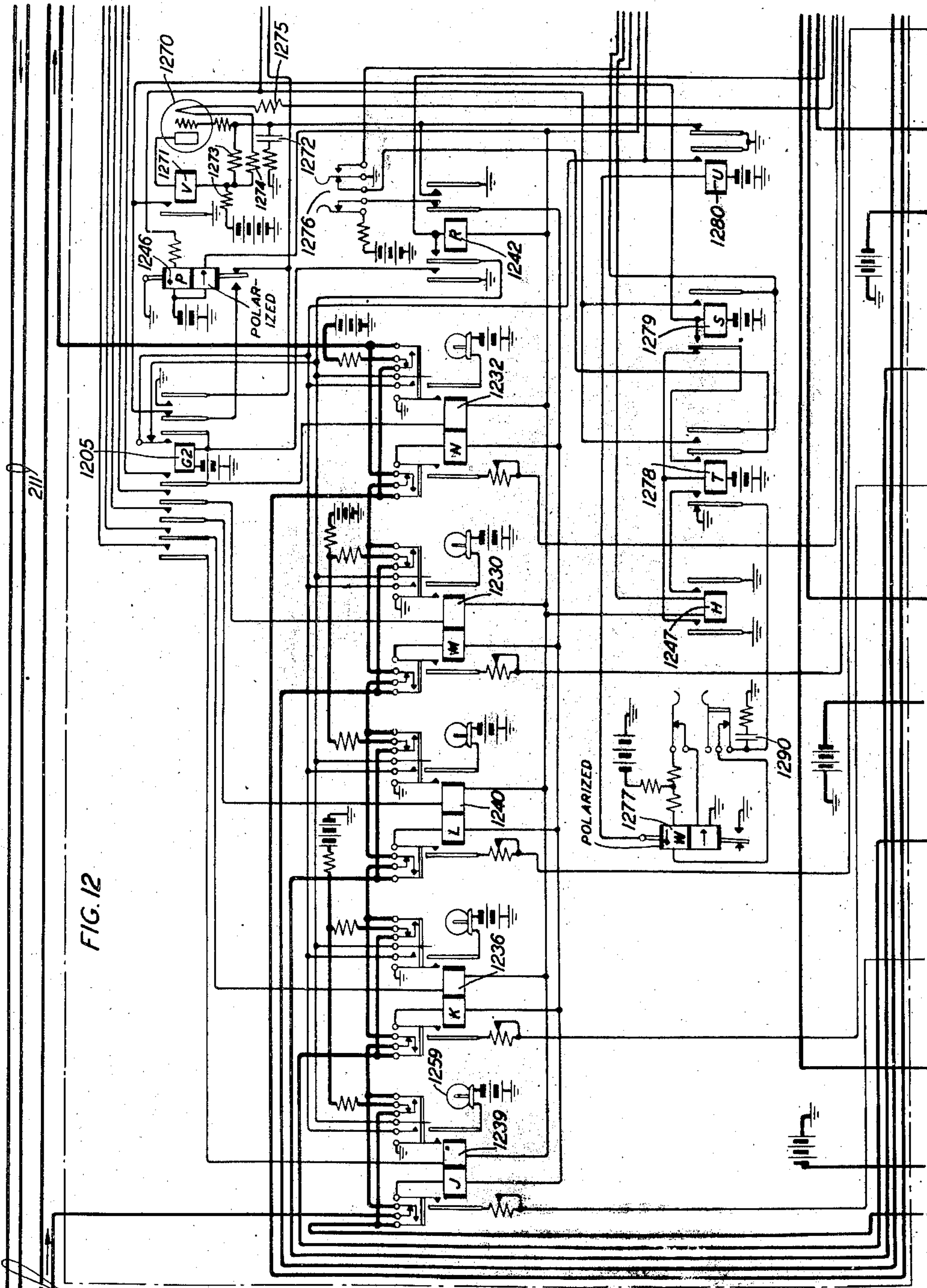
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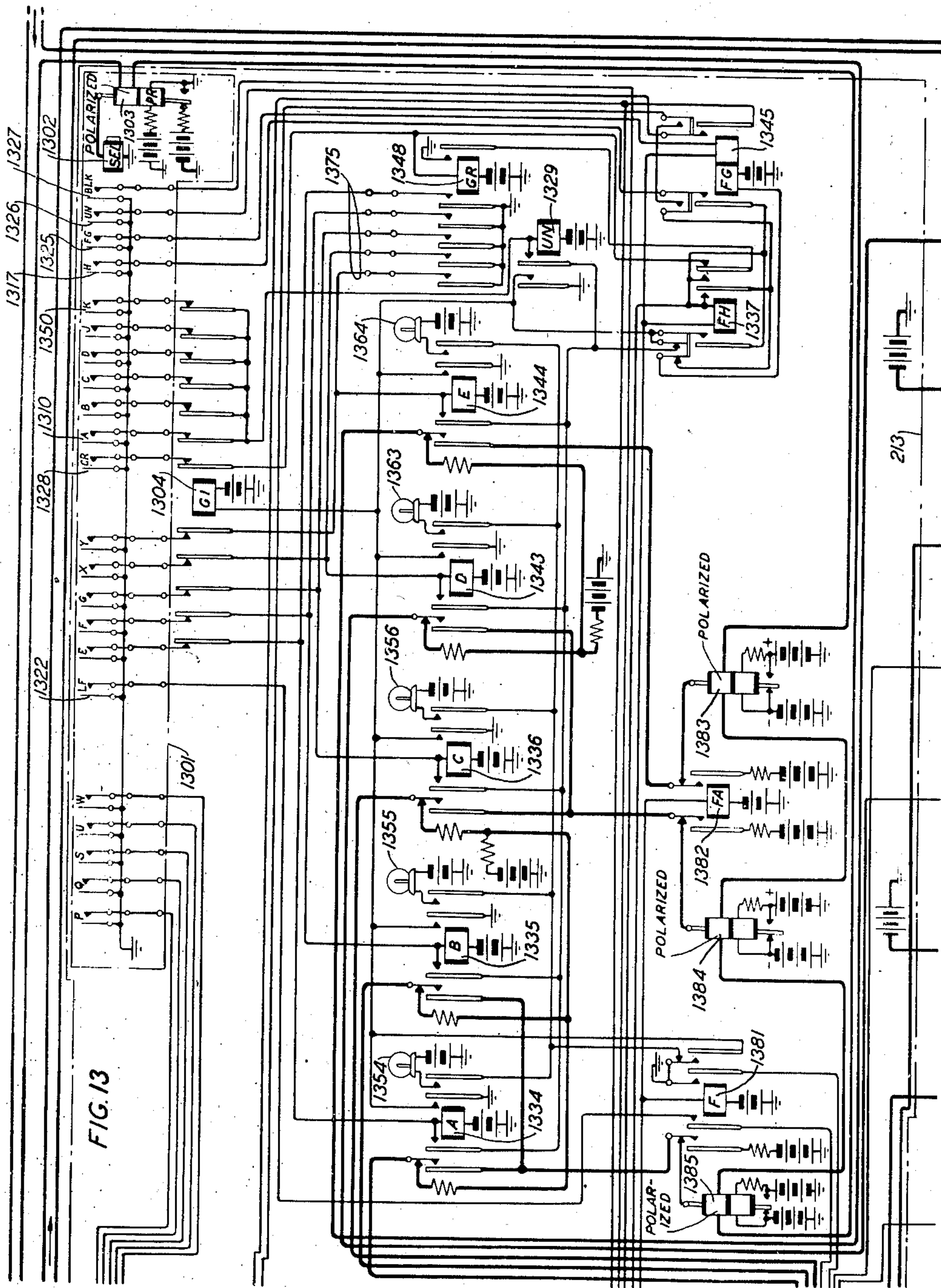
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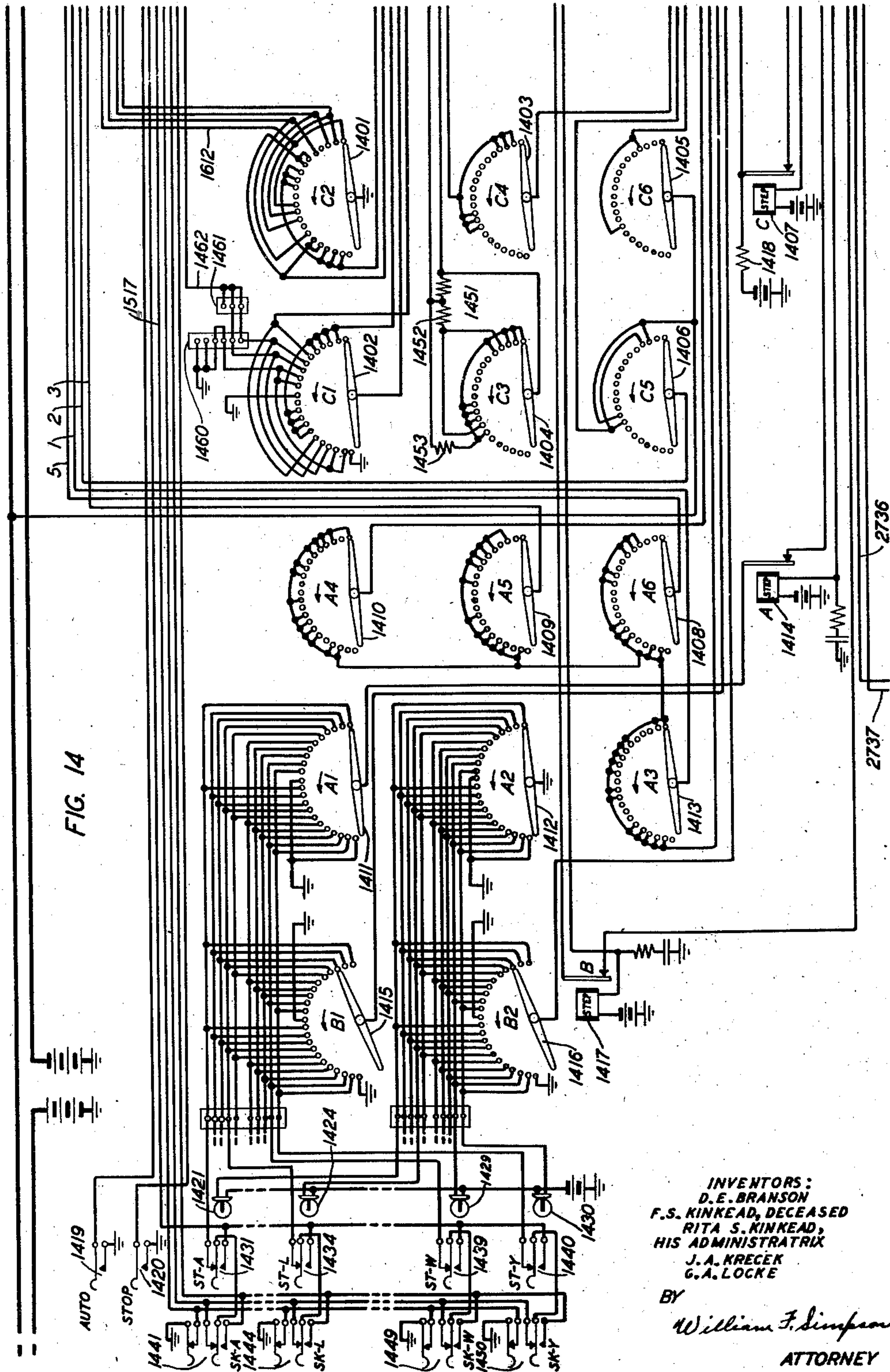
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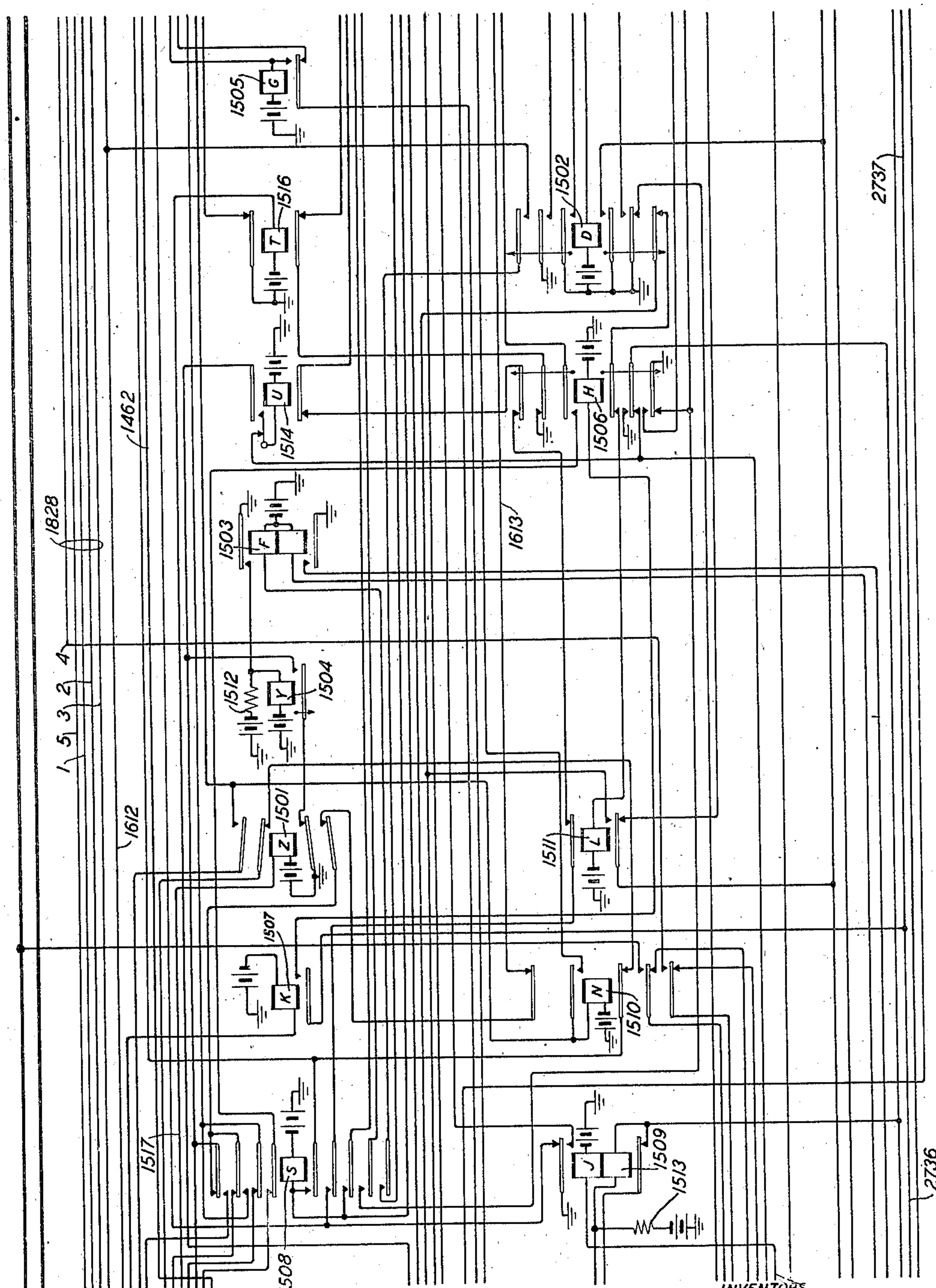


FIG. 15

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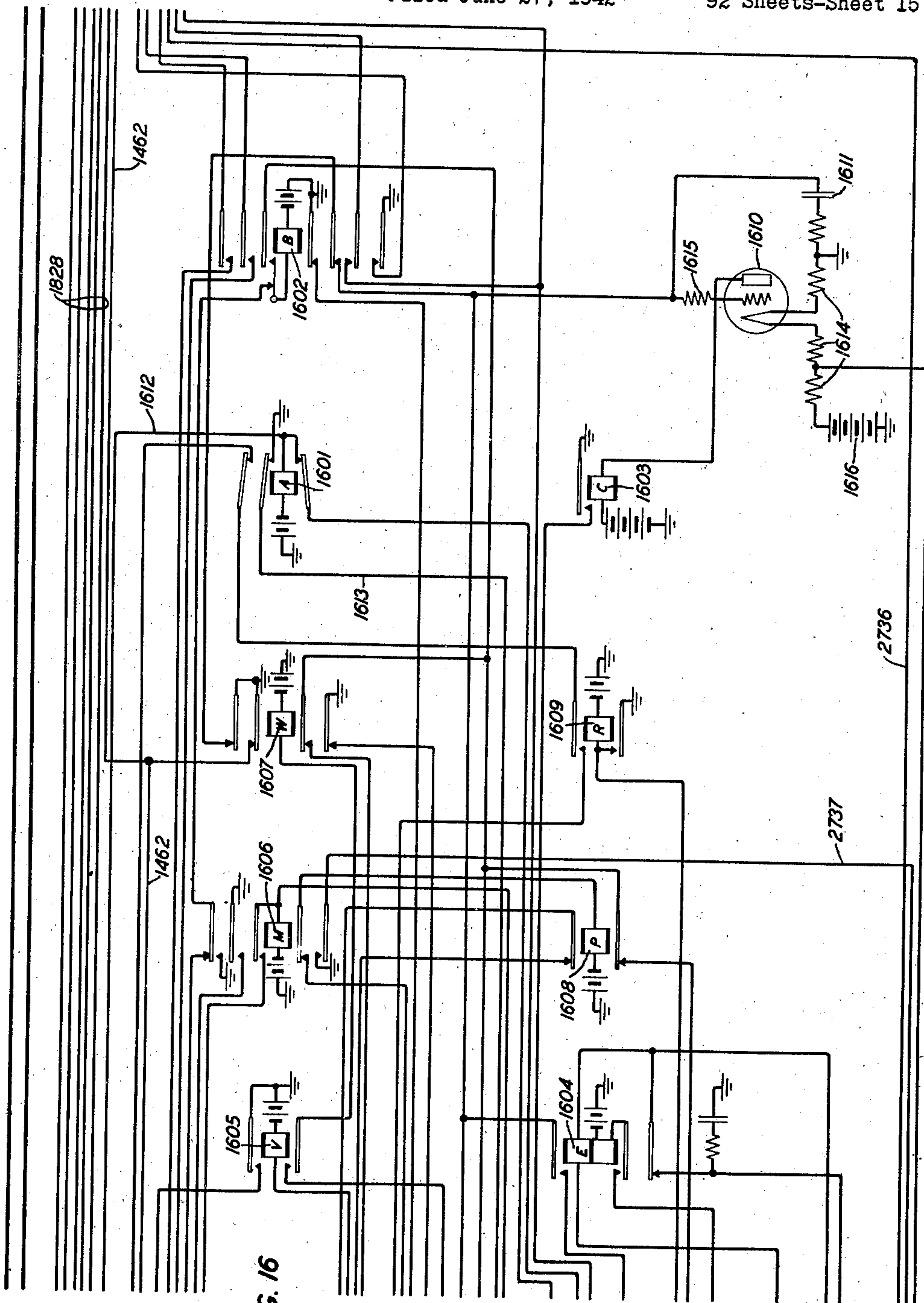


FIG. 16

INVENTORS:
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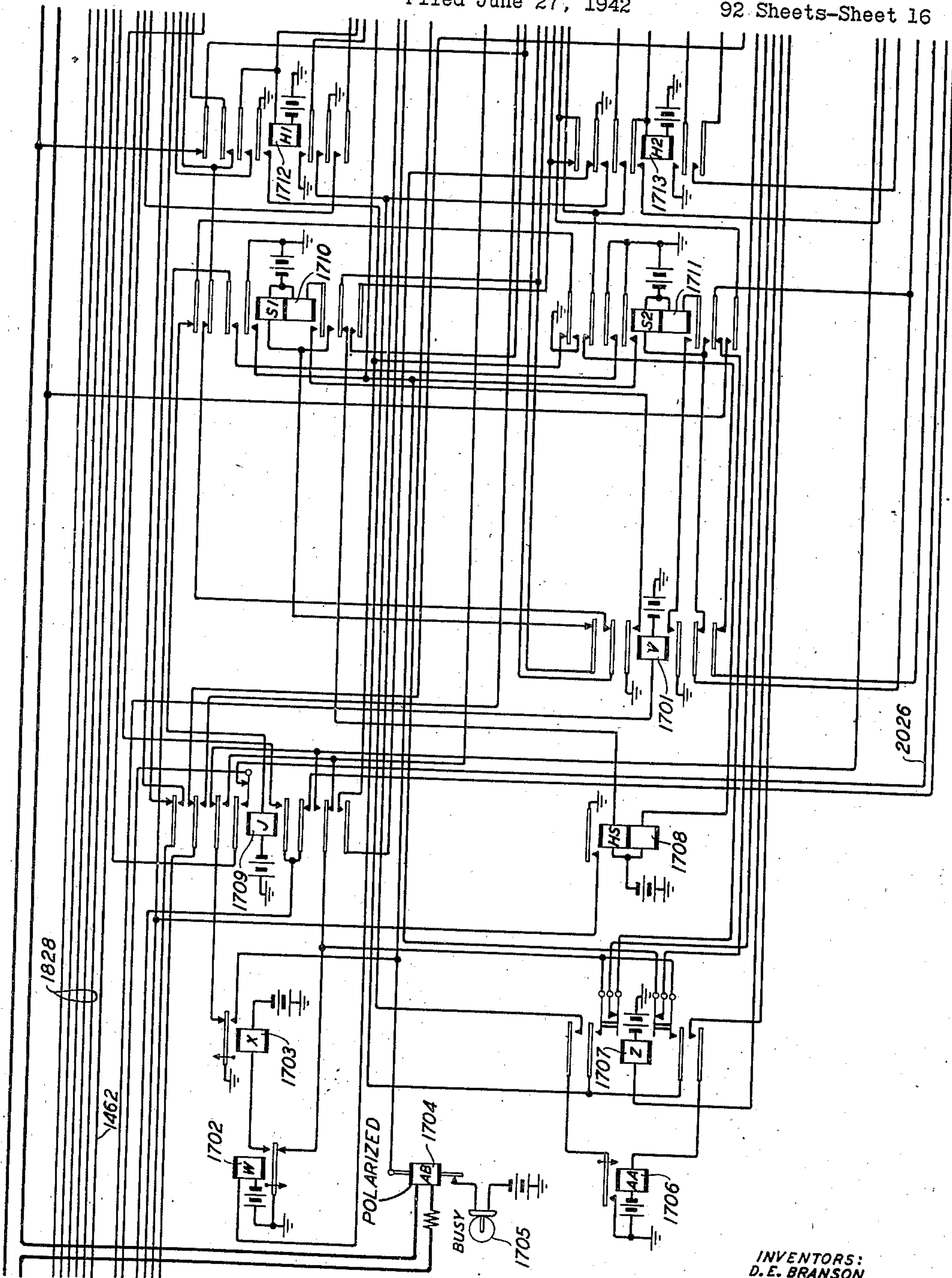


FIG. 17

INVENTORS:
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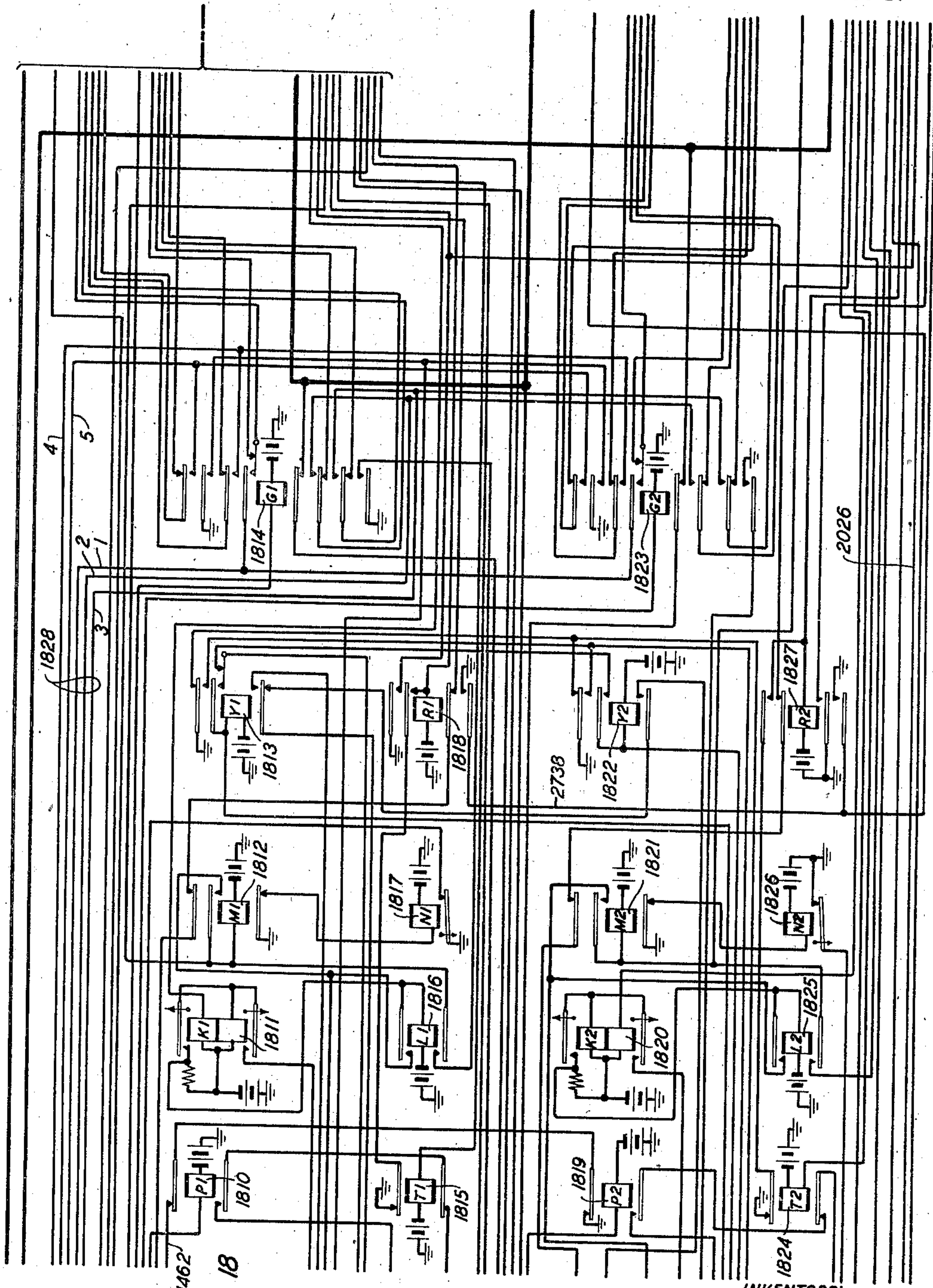


FIG. 18

INVENTORS:
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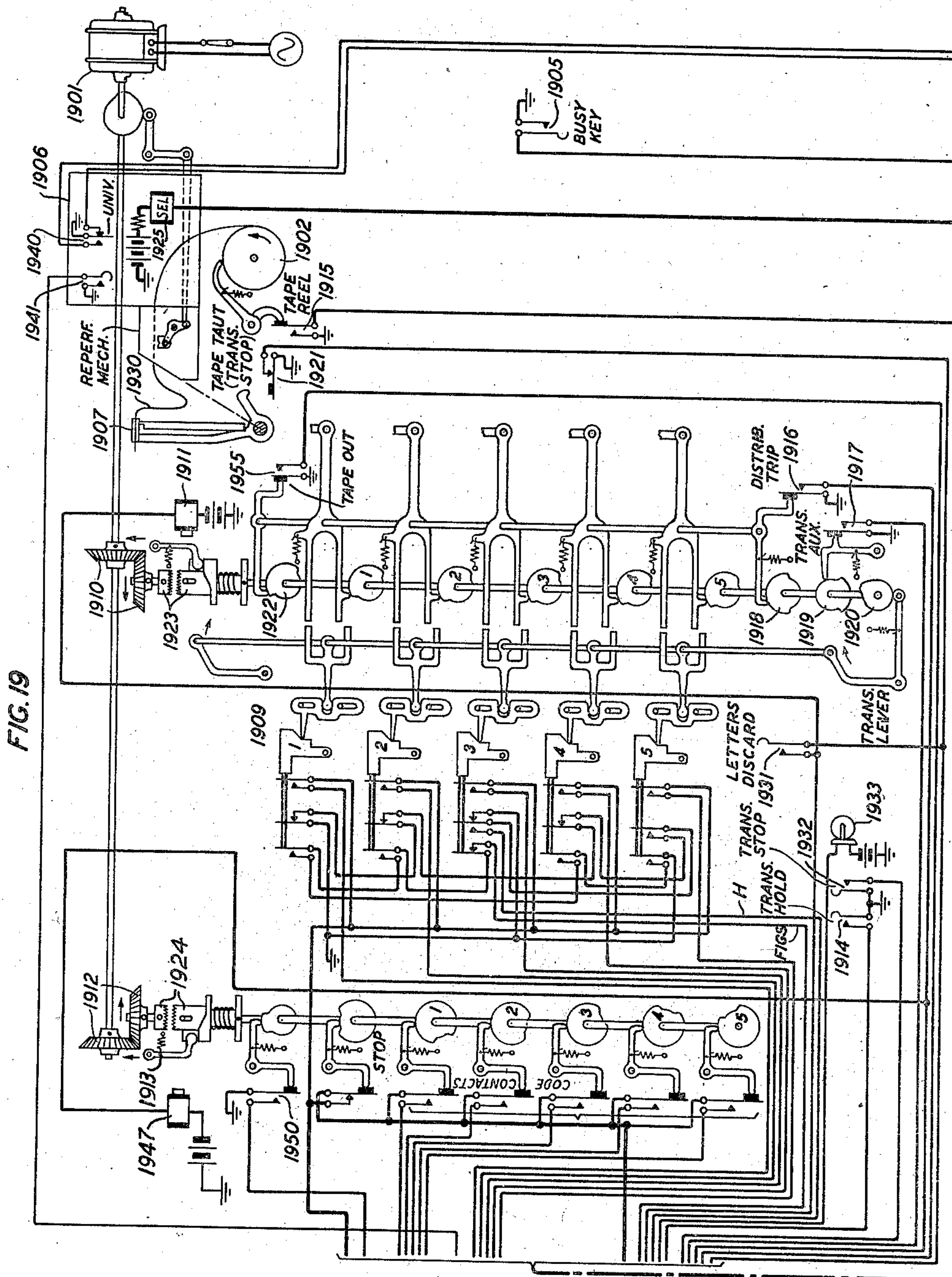


FIG. 19

INVENTORS:
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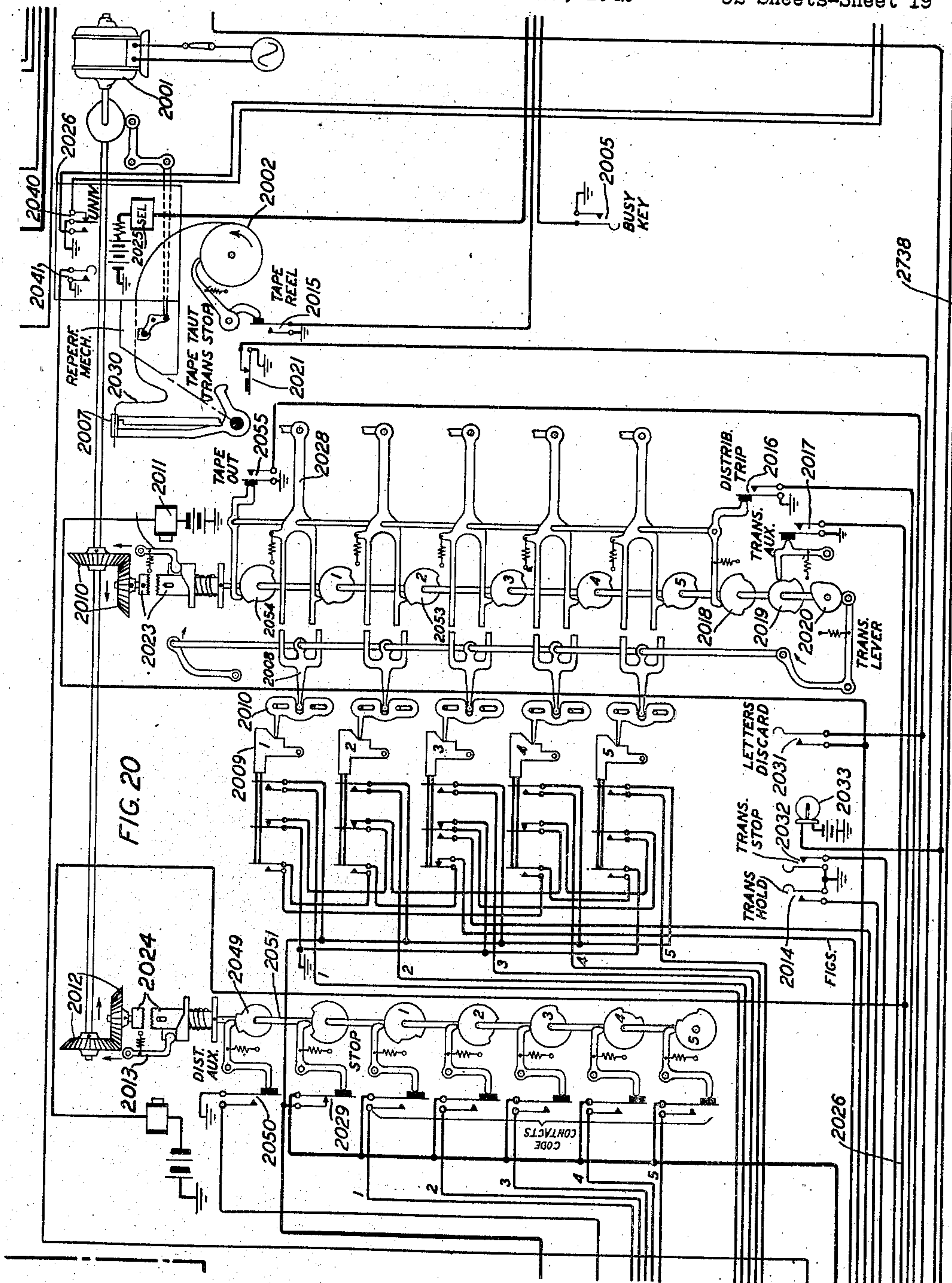
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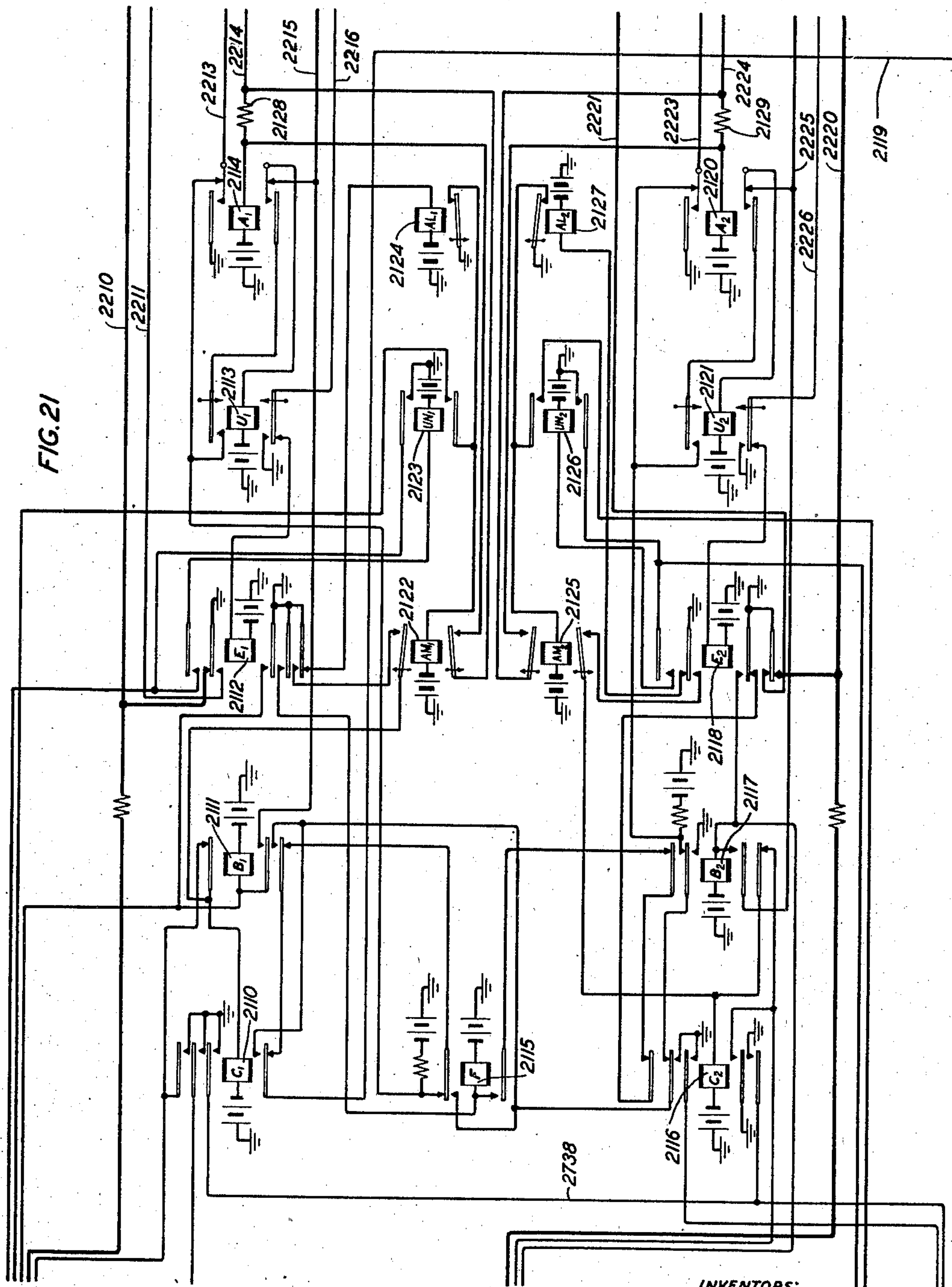
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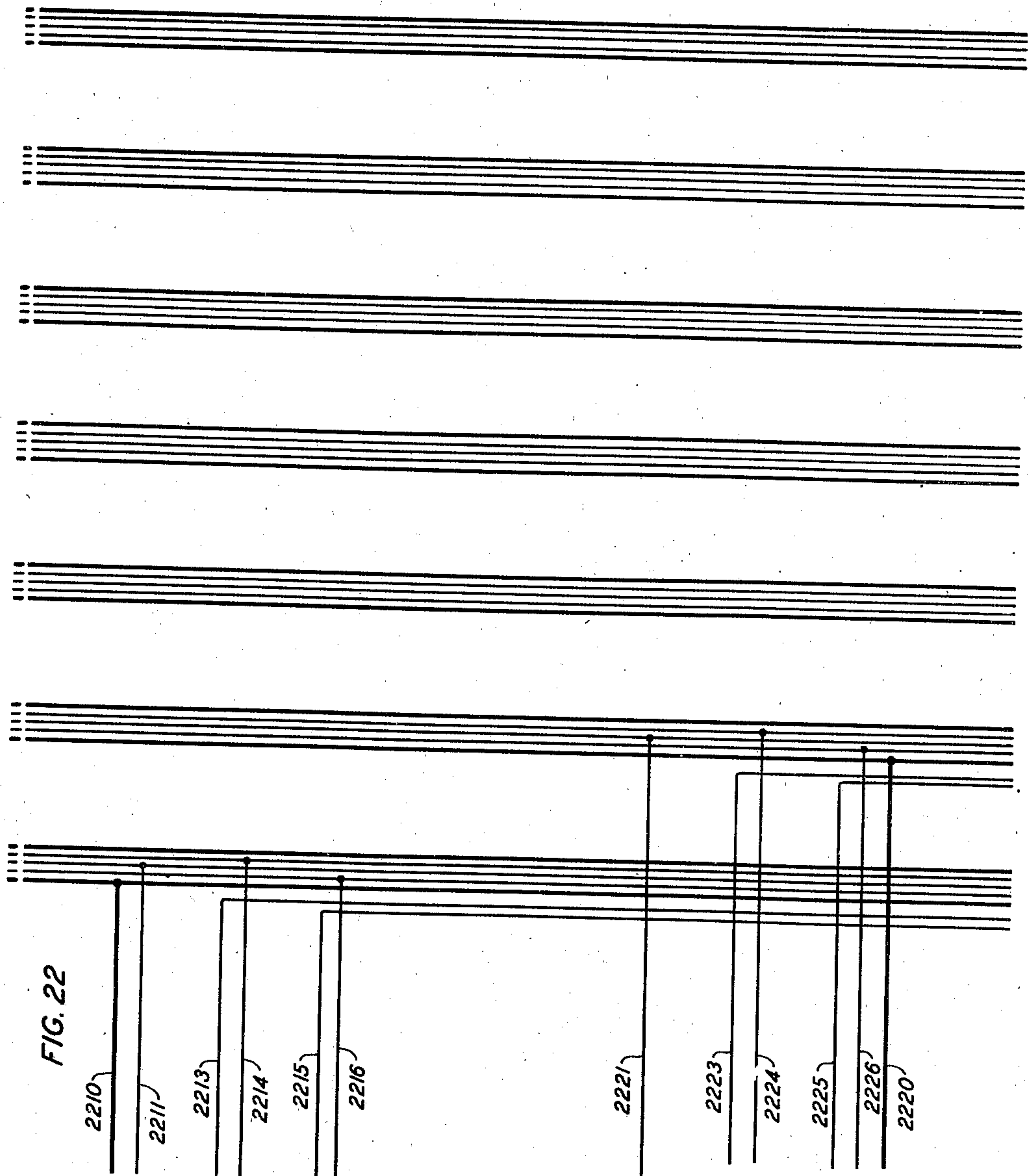


FIG. 22

INVENTORS:
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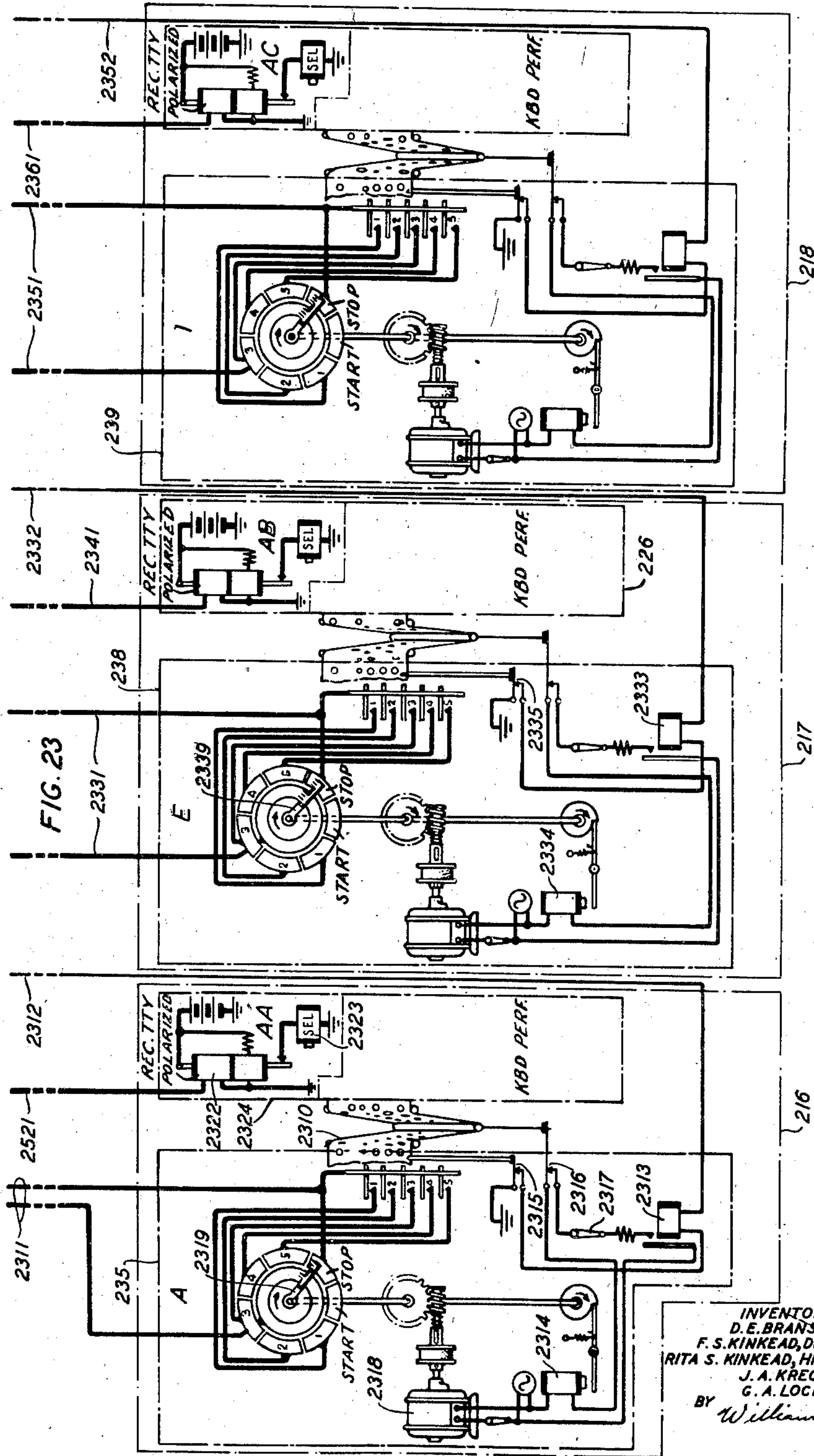
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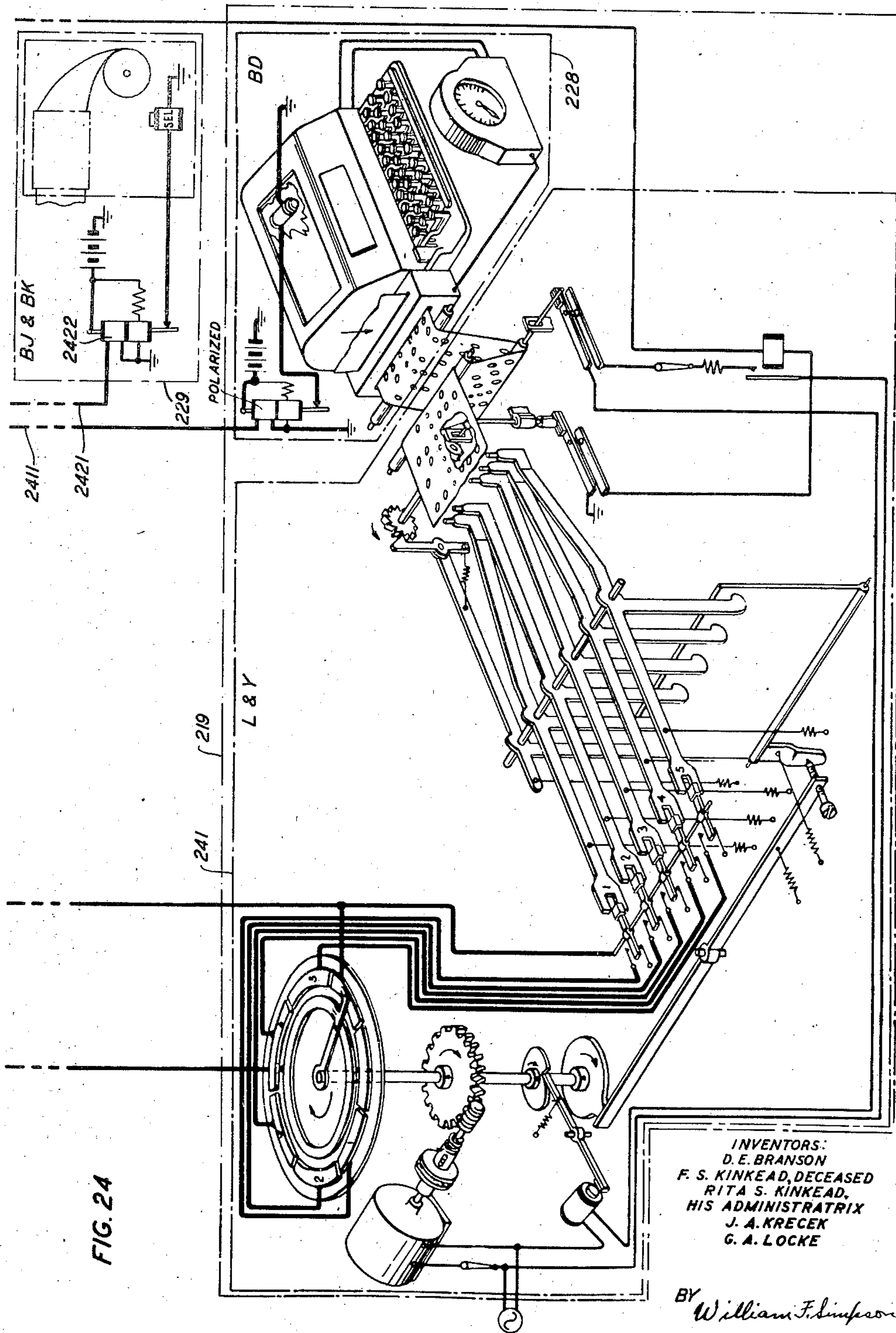


FIG. 24

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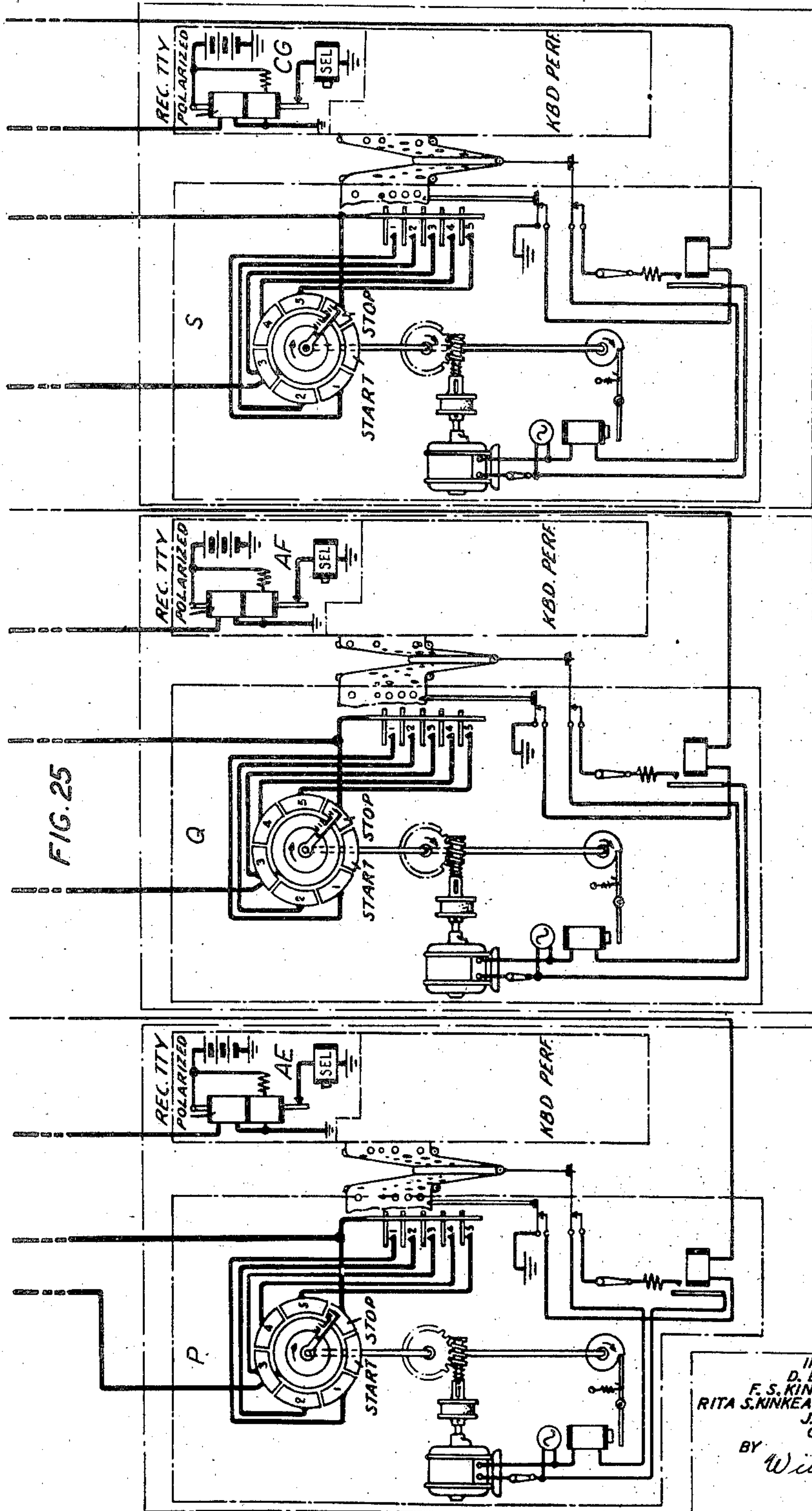
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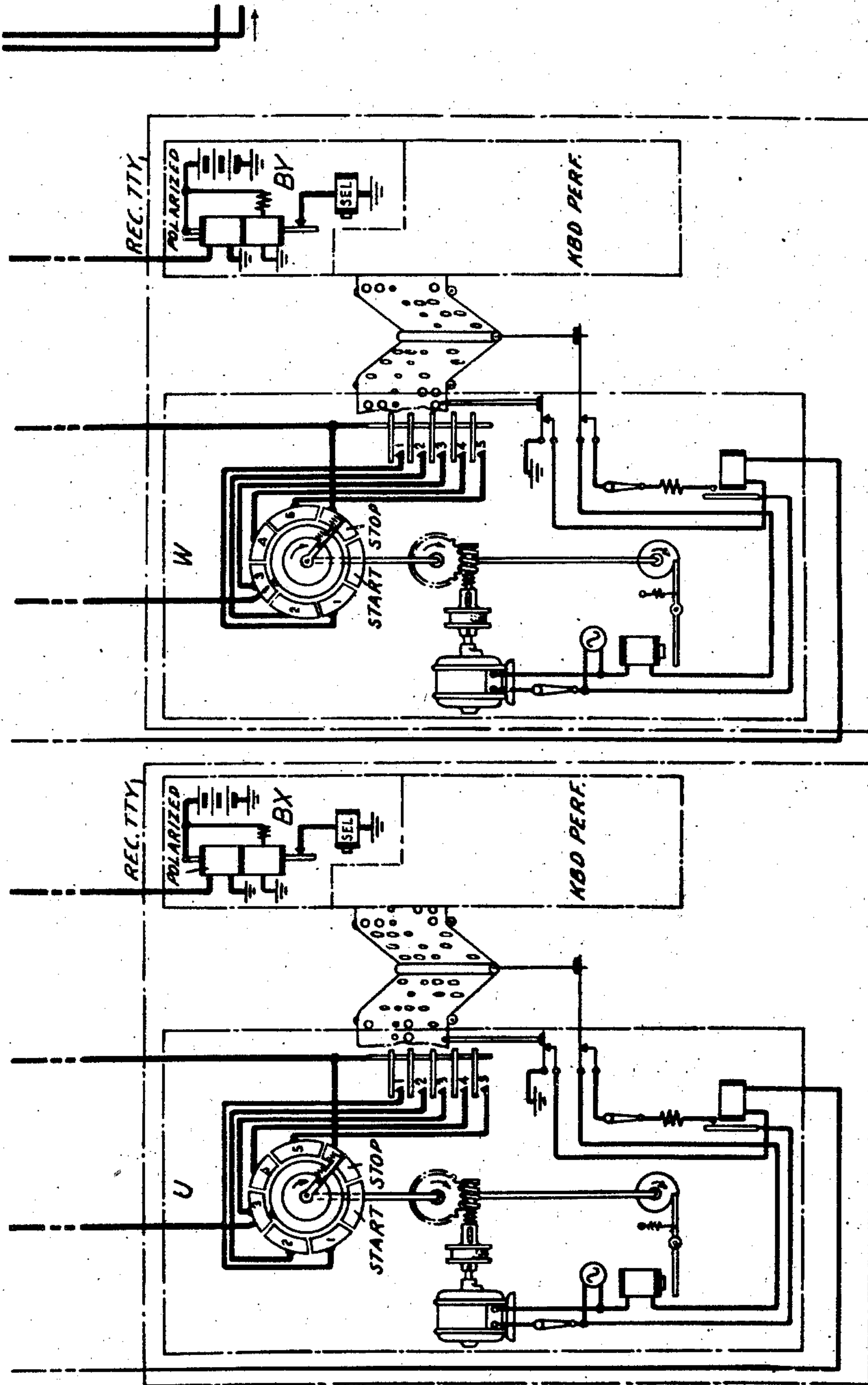


FIG. 26

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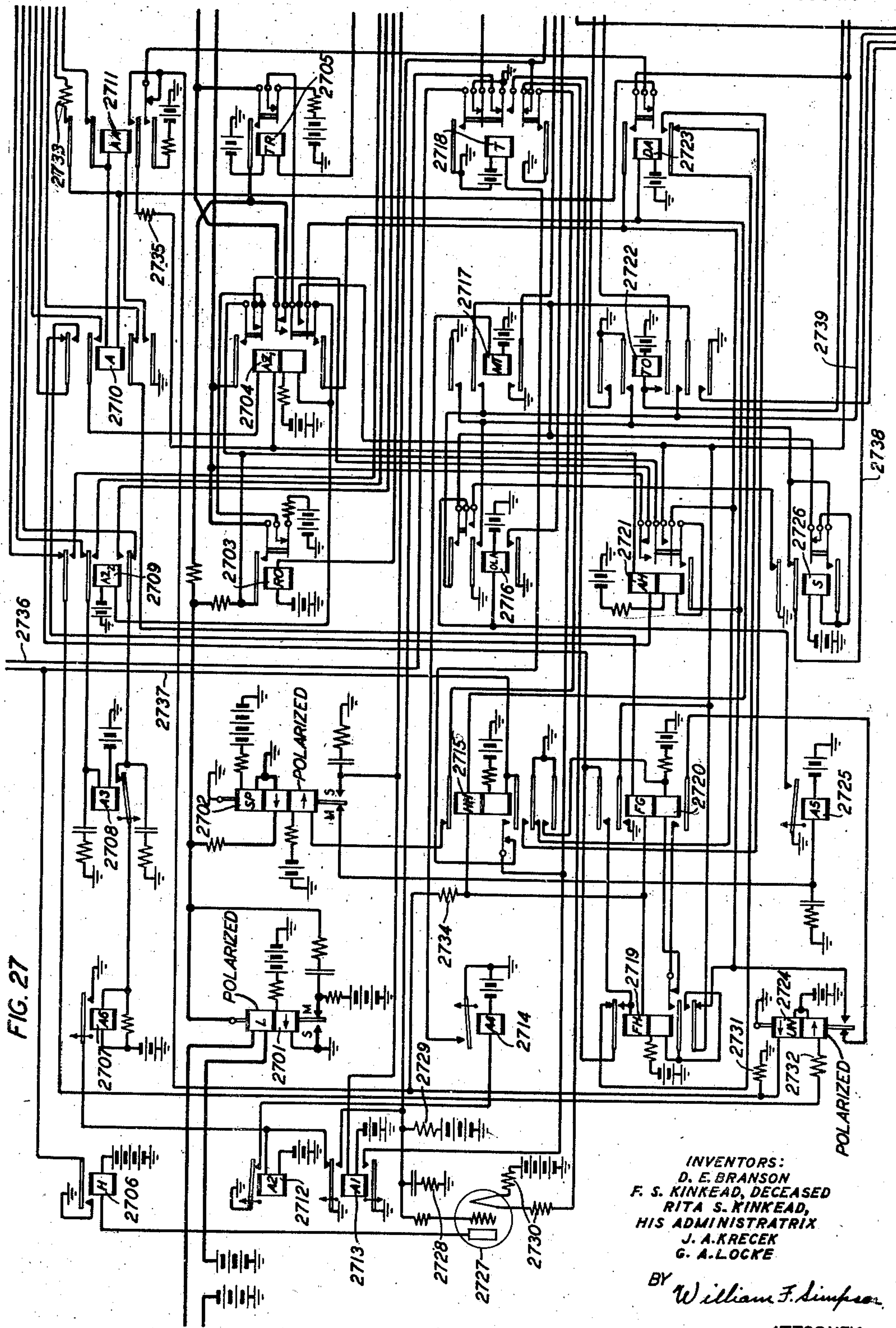
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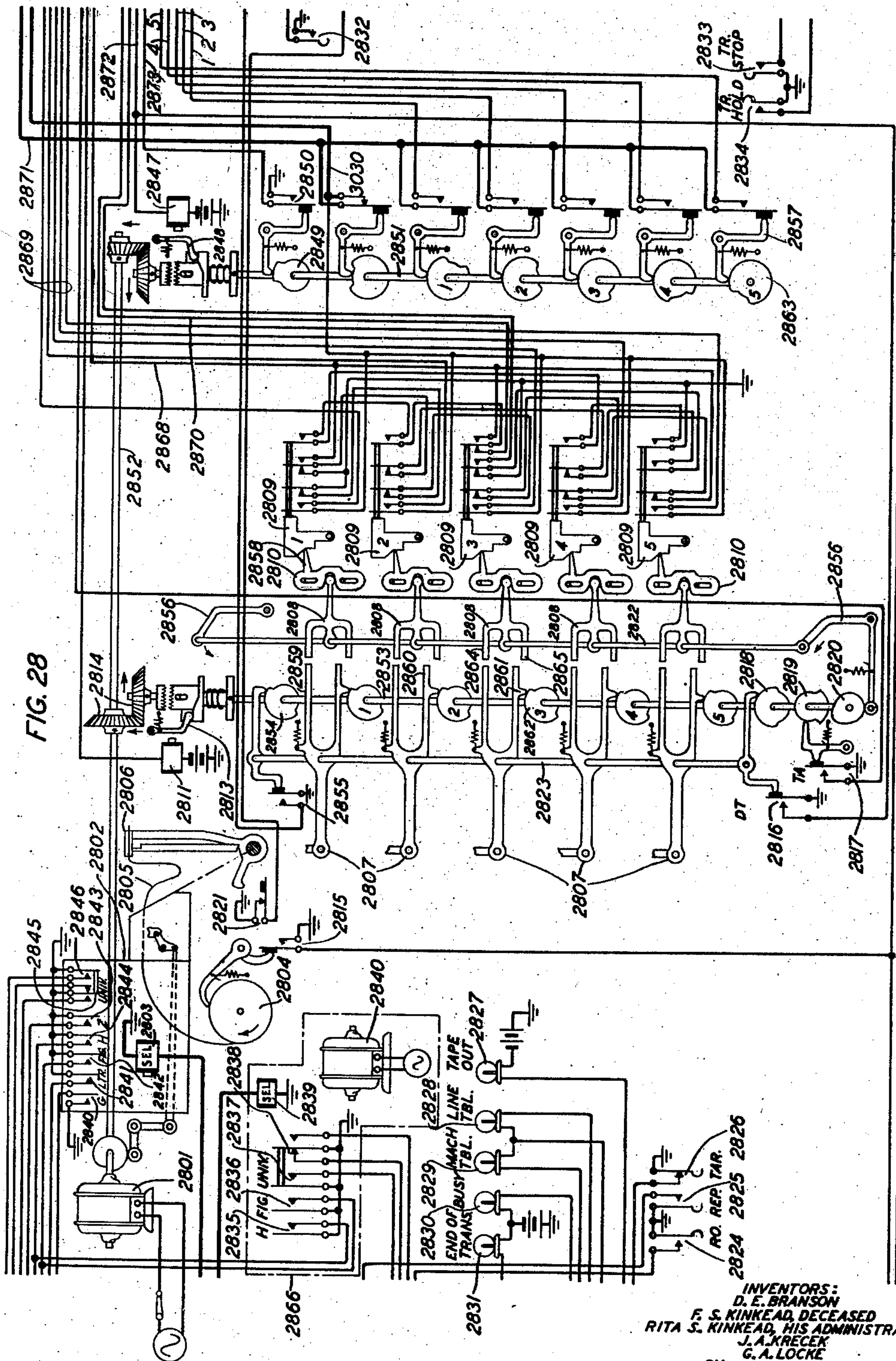
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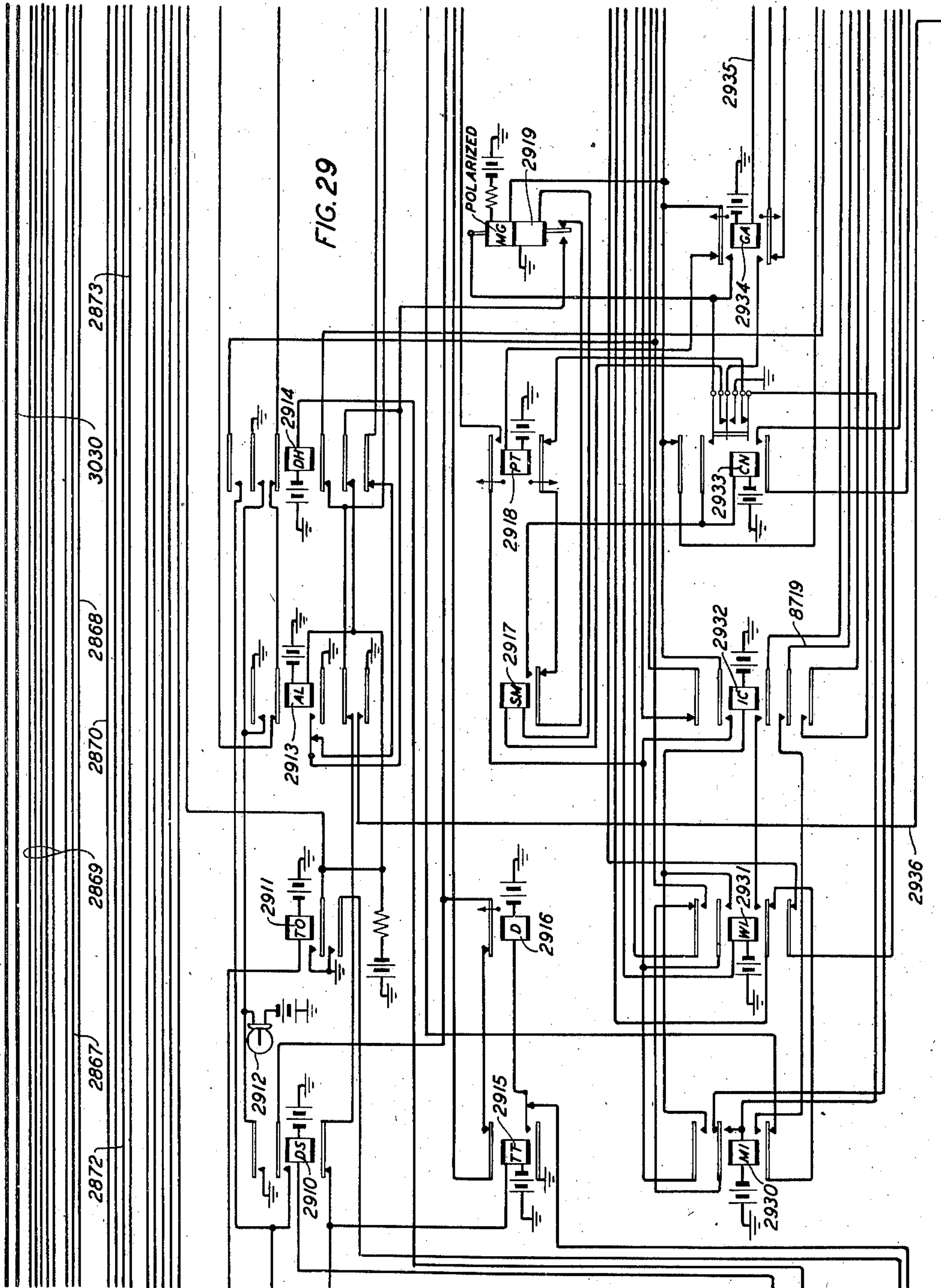
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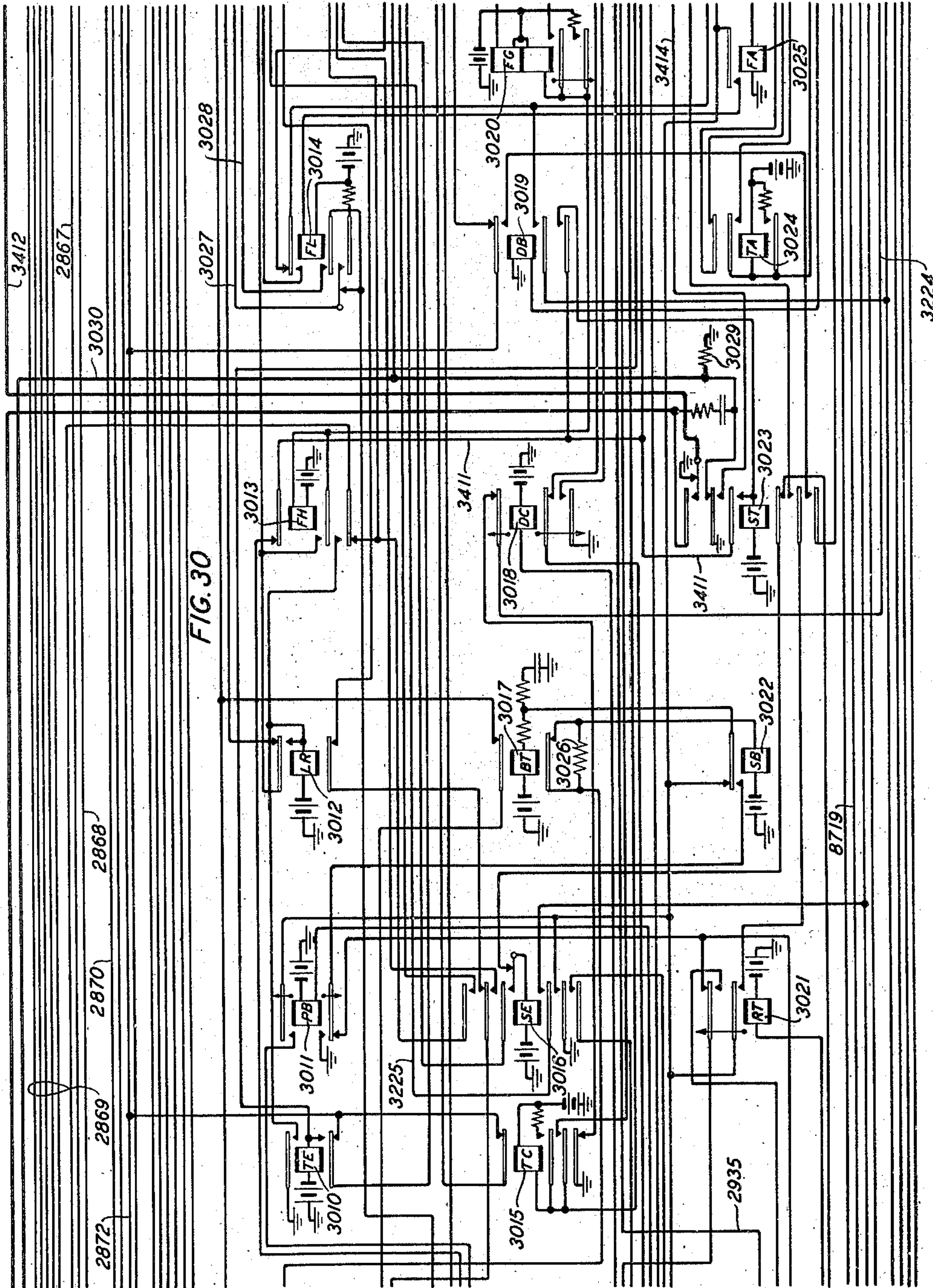
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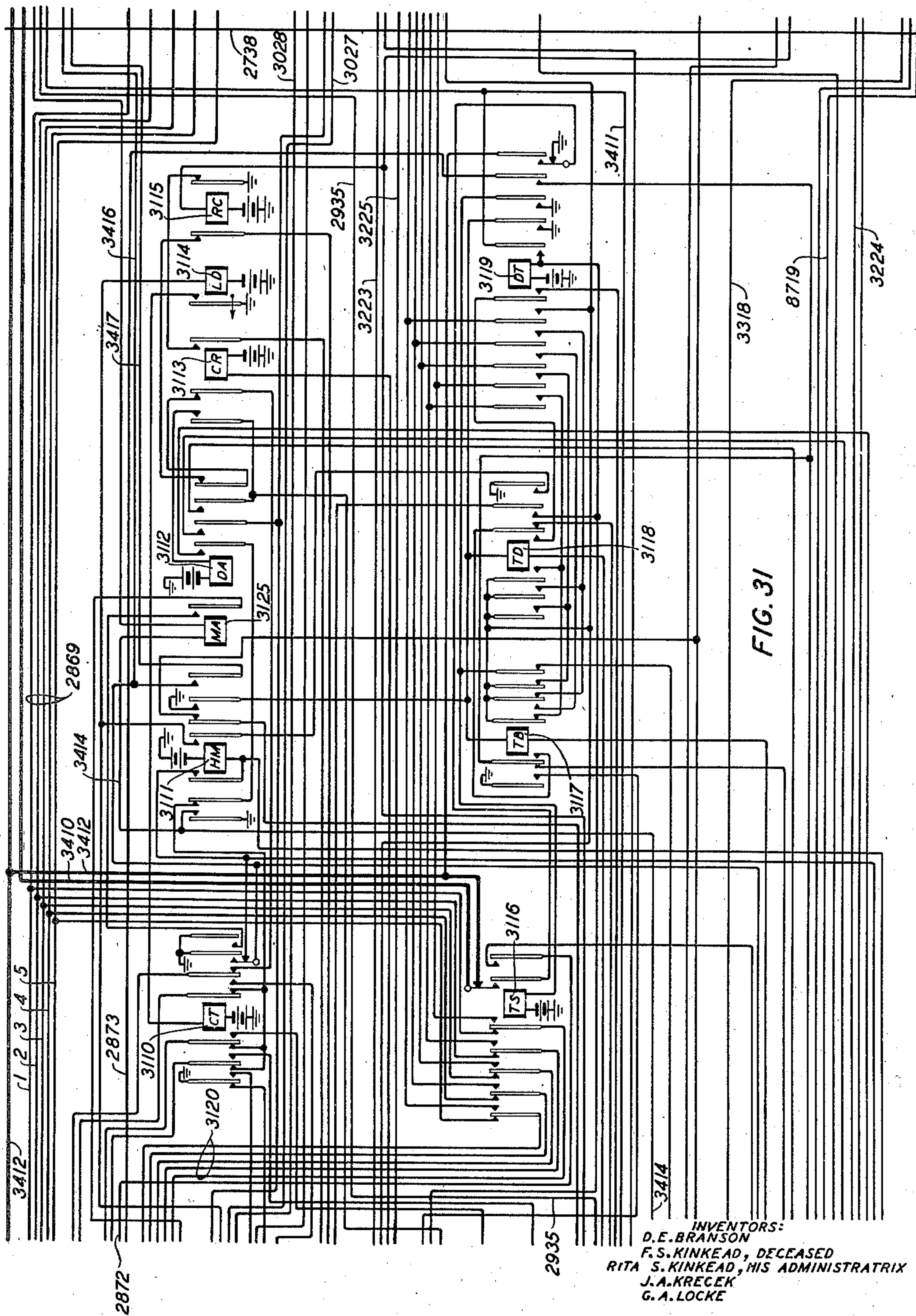
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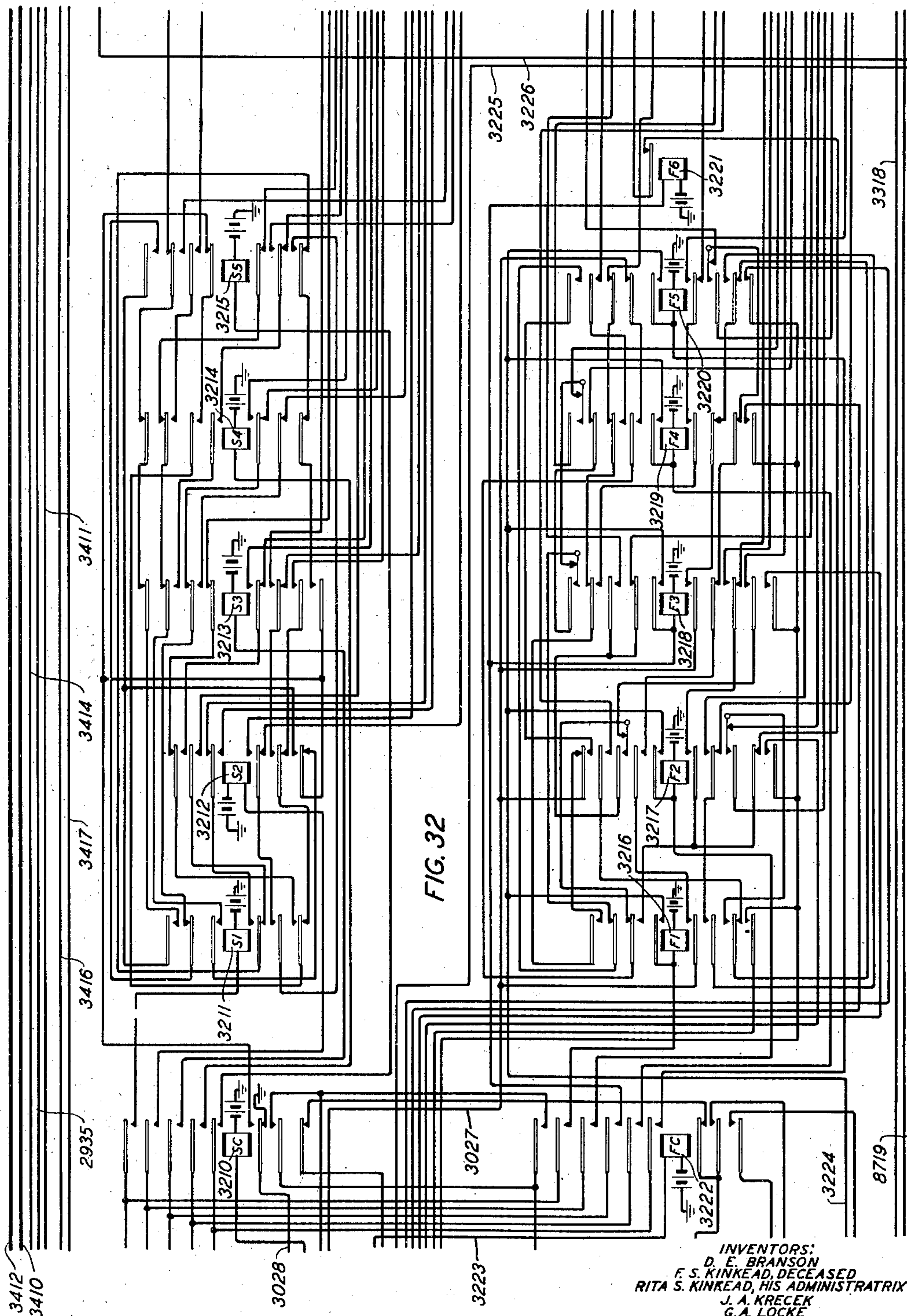
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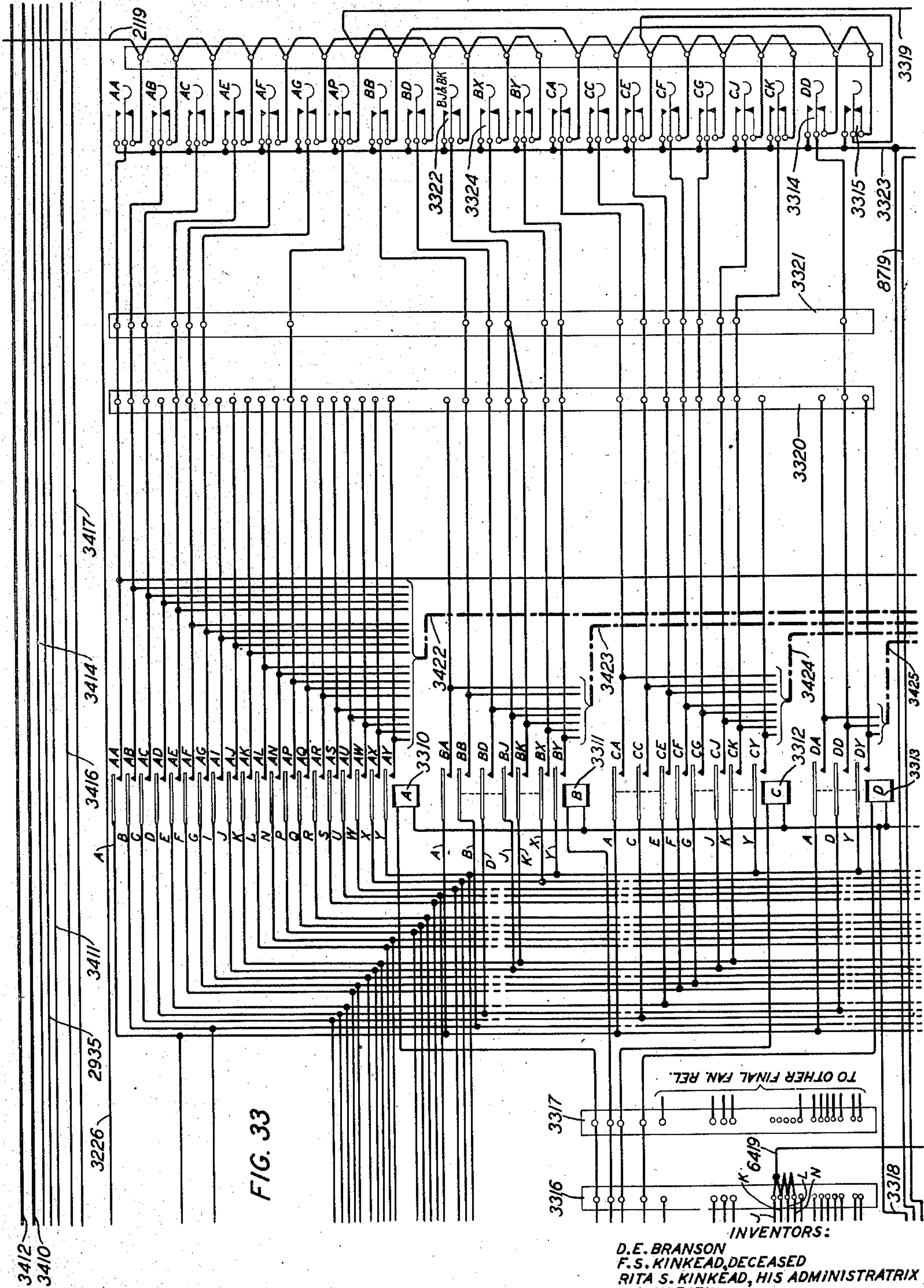


FIG. 33

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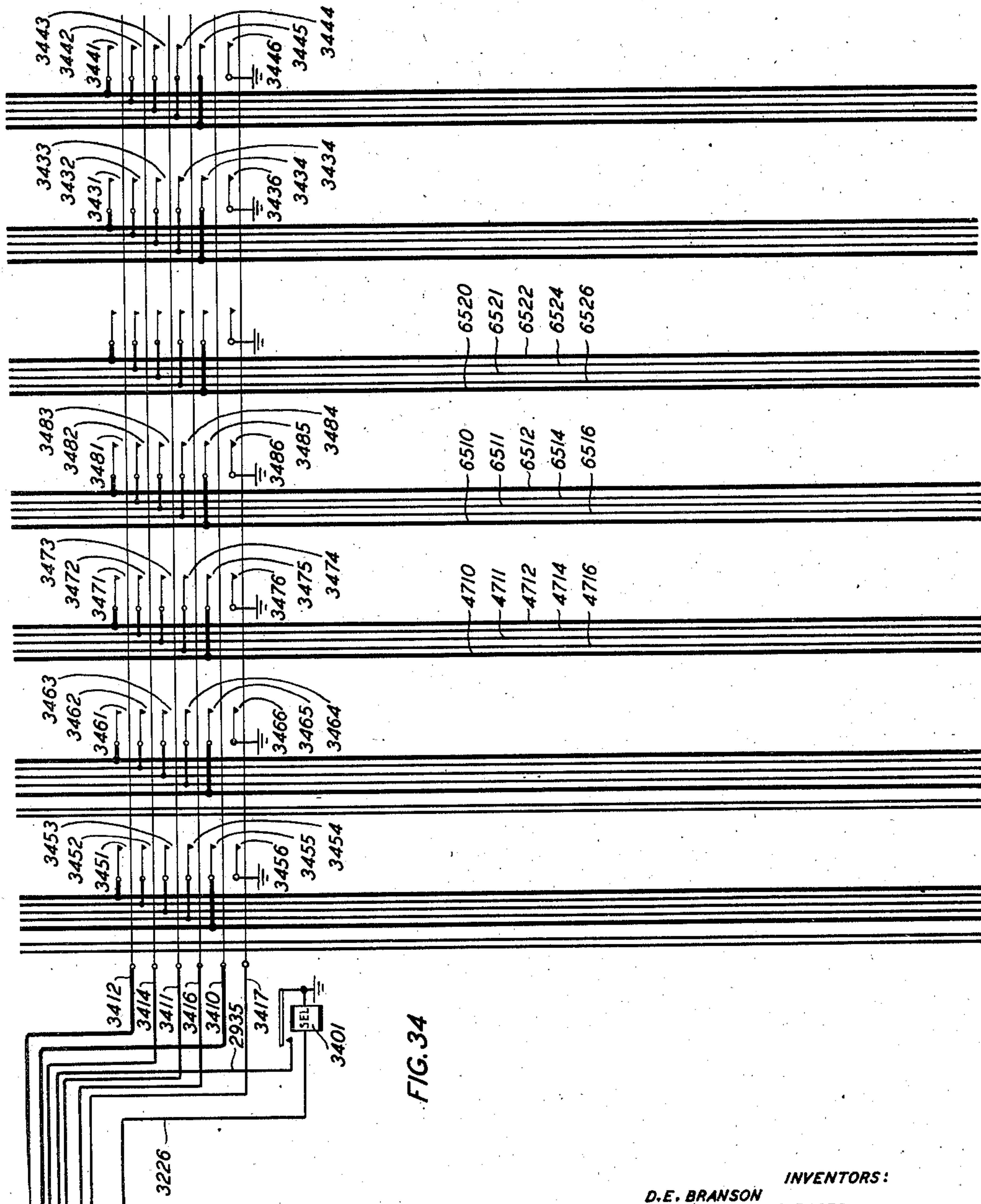


FIG. 34

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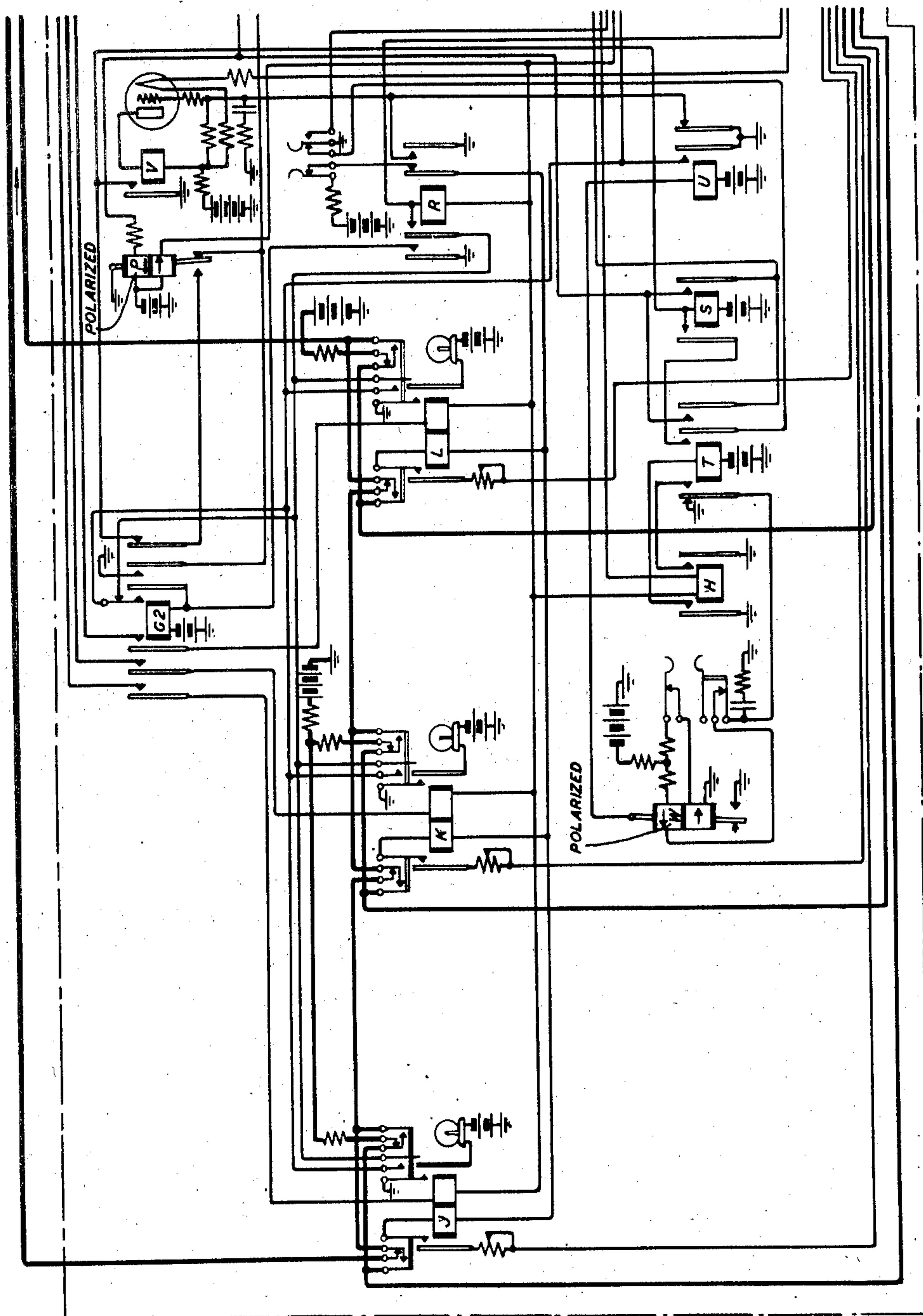
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FIG. 35



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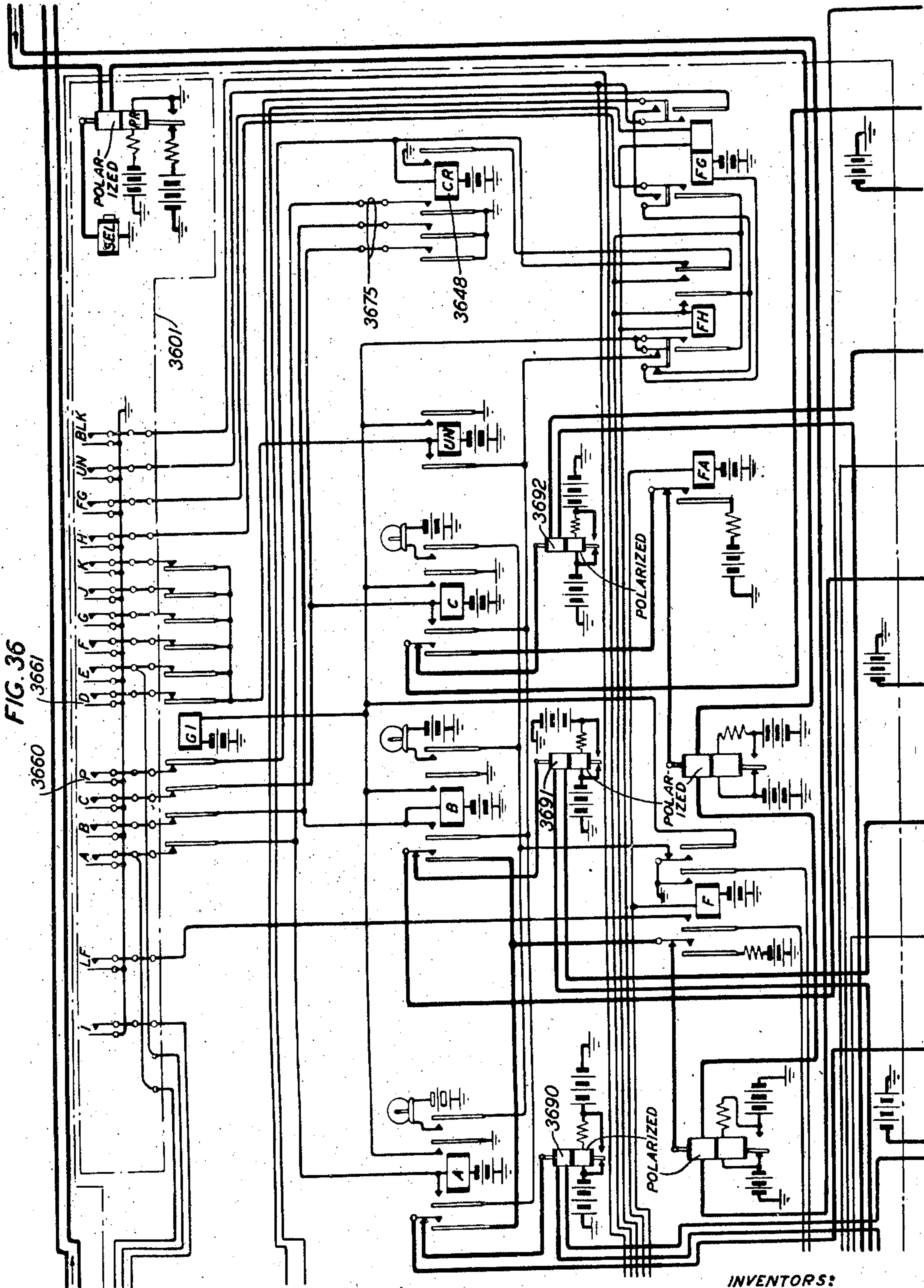
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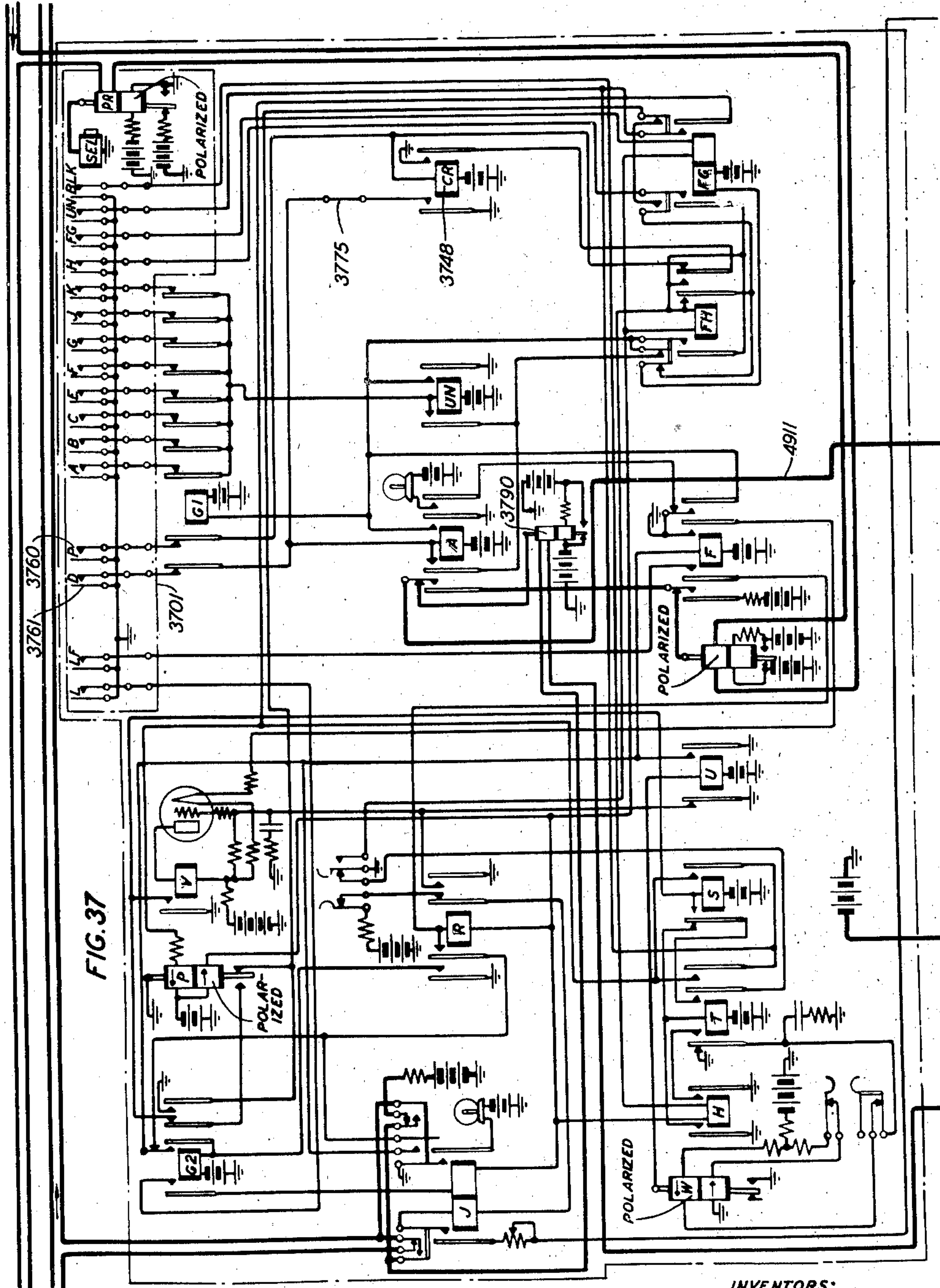
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INVENTORS:
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F.S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J.A. KRECEK
G.A. LOCKE
BY *William F. Simpson*
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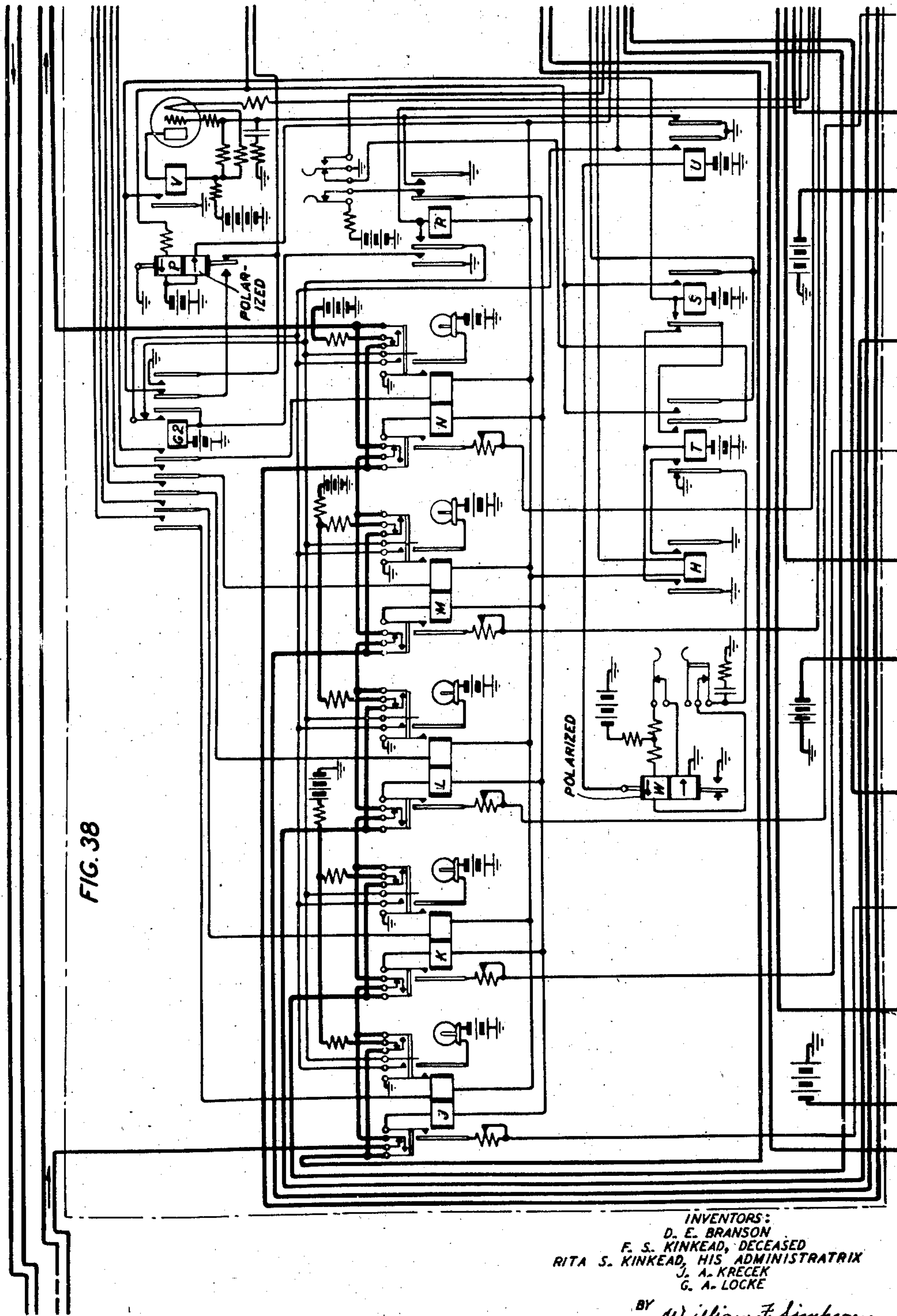


FIG. 38

INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE

BY *William F. Simpson*

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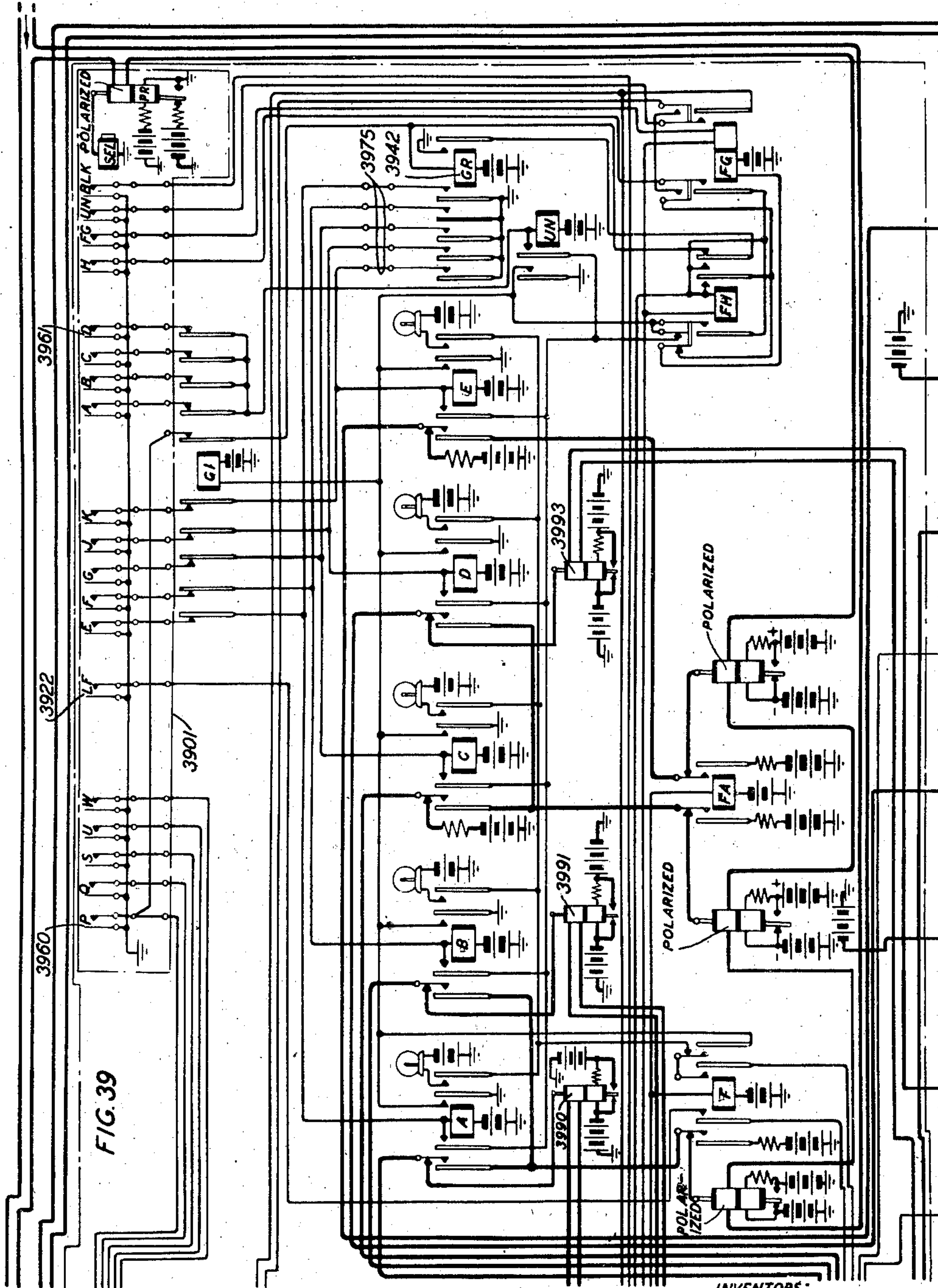
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INVENTORS:
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F. S. KINKEAD, DECEASED
BY RITA S. KINKEAD, HIS ADMINISTRATRIX
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G. A. LOCKE

BY *William F. Simpson*
ATTORNEY

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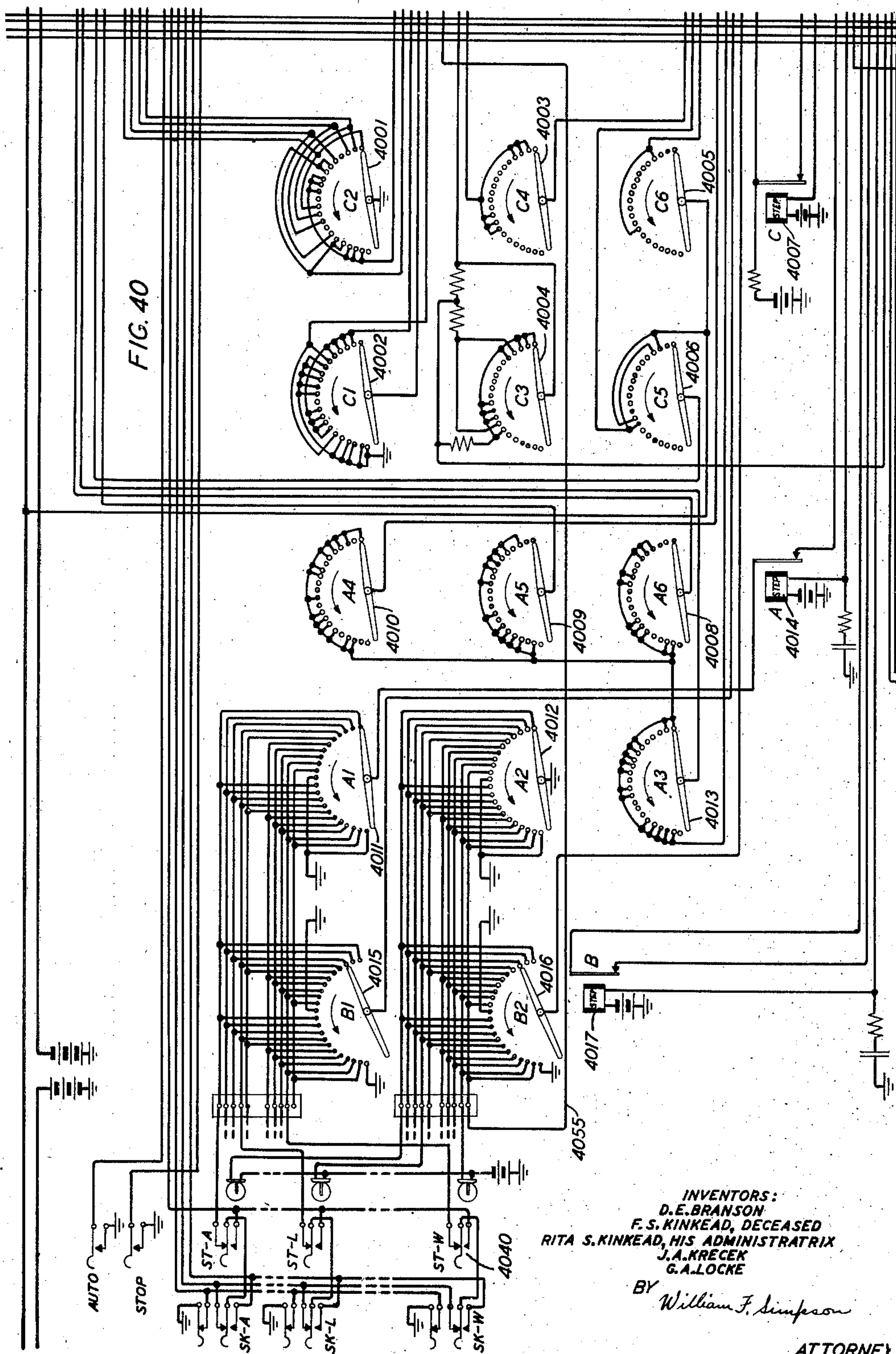
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INVENTORS:
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RITA S. KINKEAD, HIS ADMINISTRATRIX
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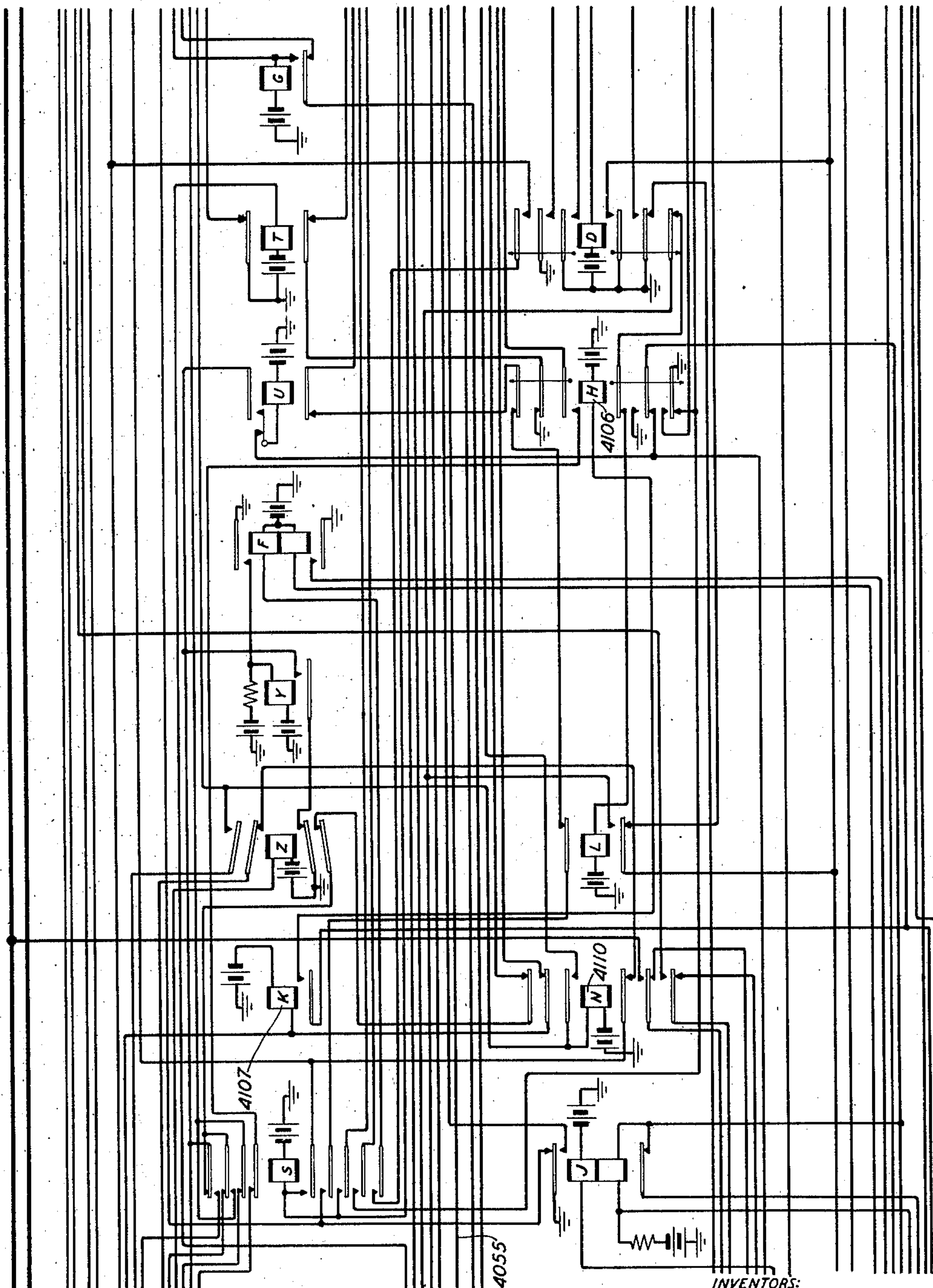


FIG. 41

INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE

BY *William F. Simpson*

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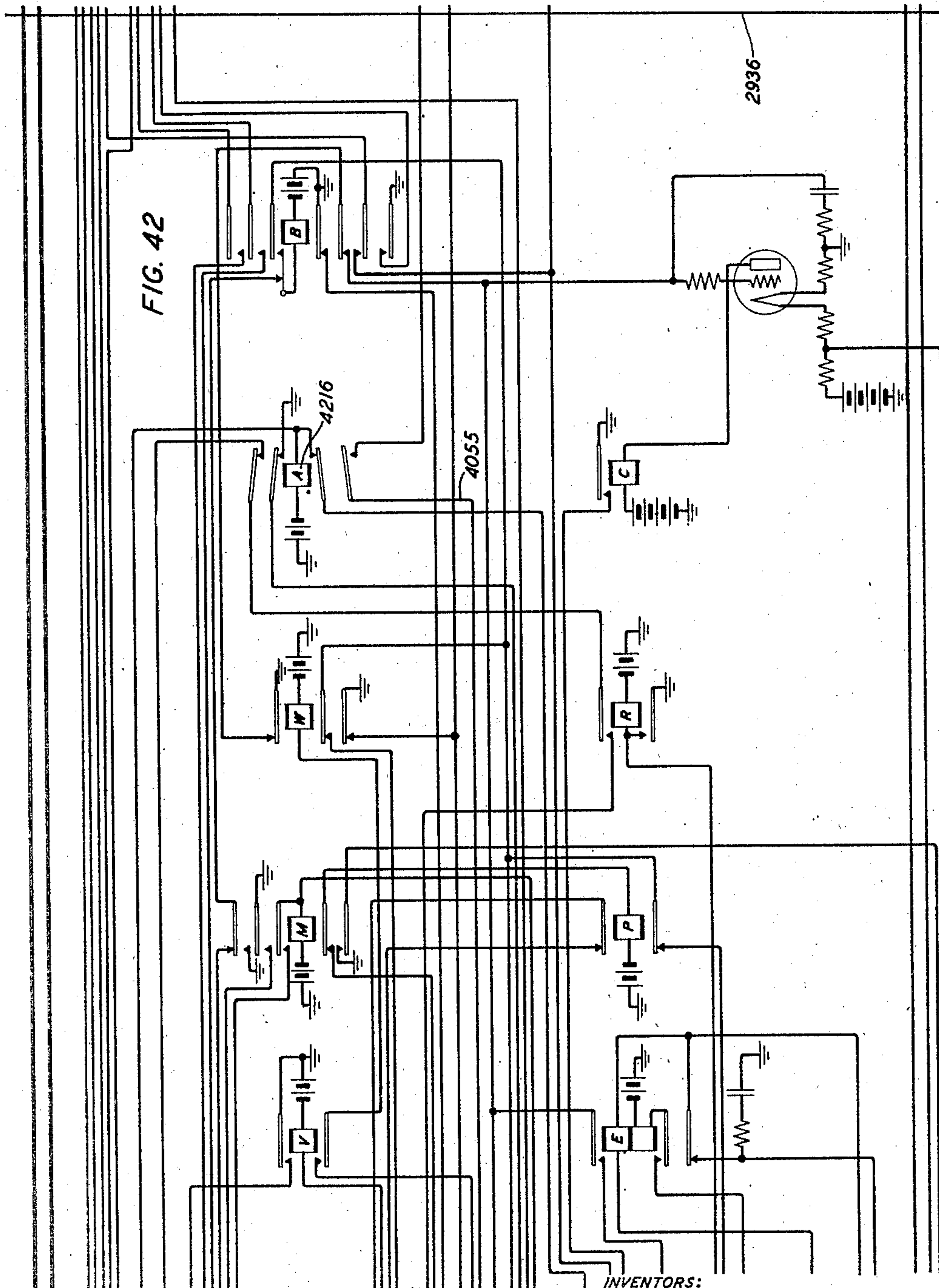
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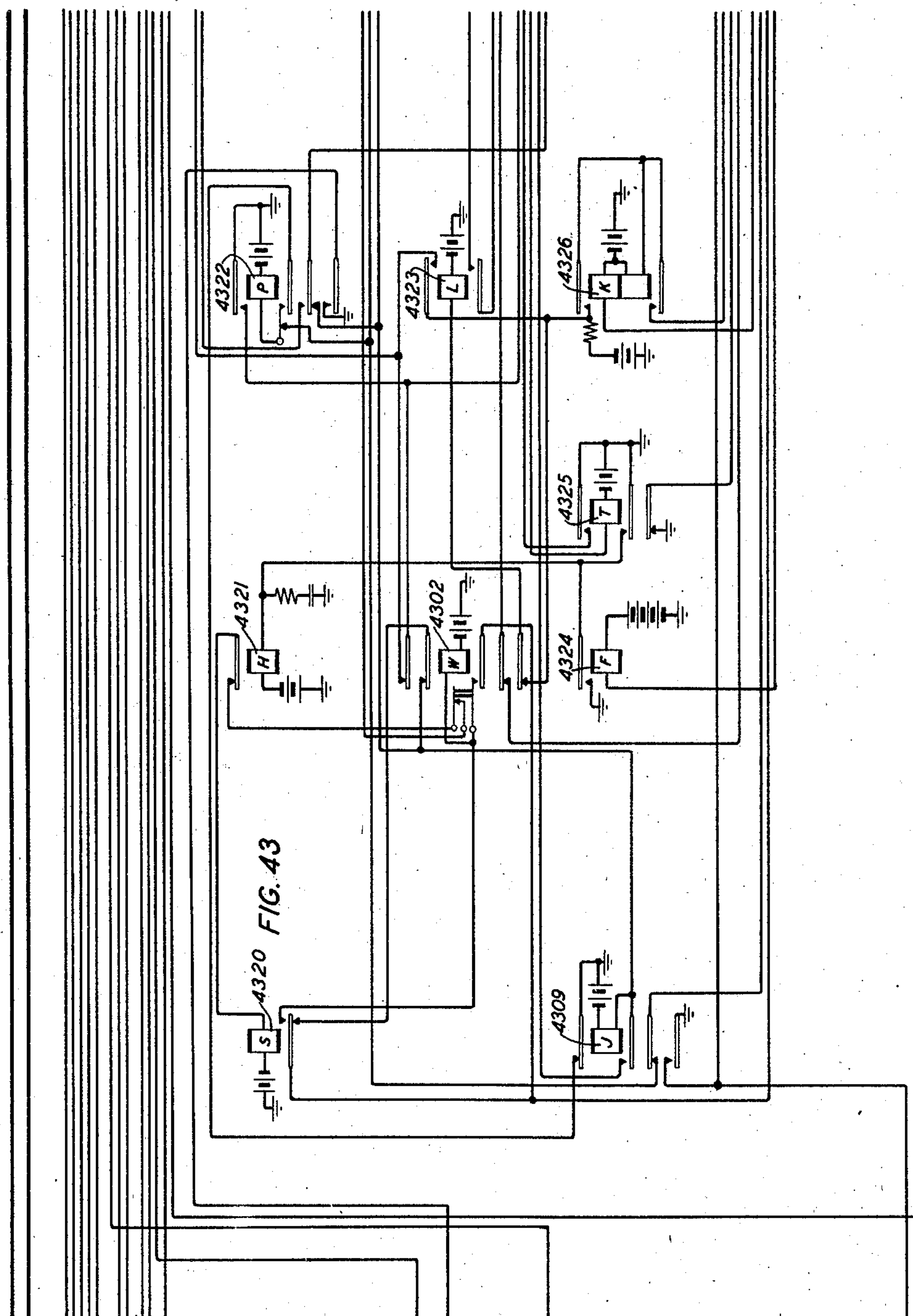
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G.A. LOCKE
BY *William F. Simpson*
ATTORNEY

Nov. 11, 1947.

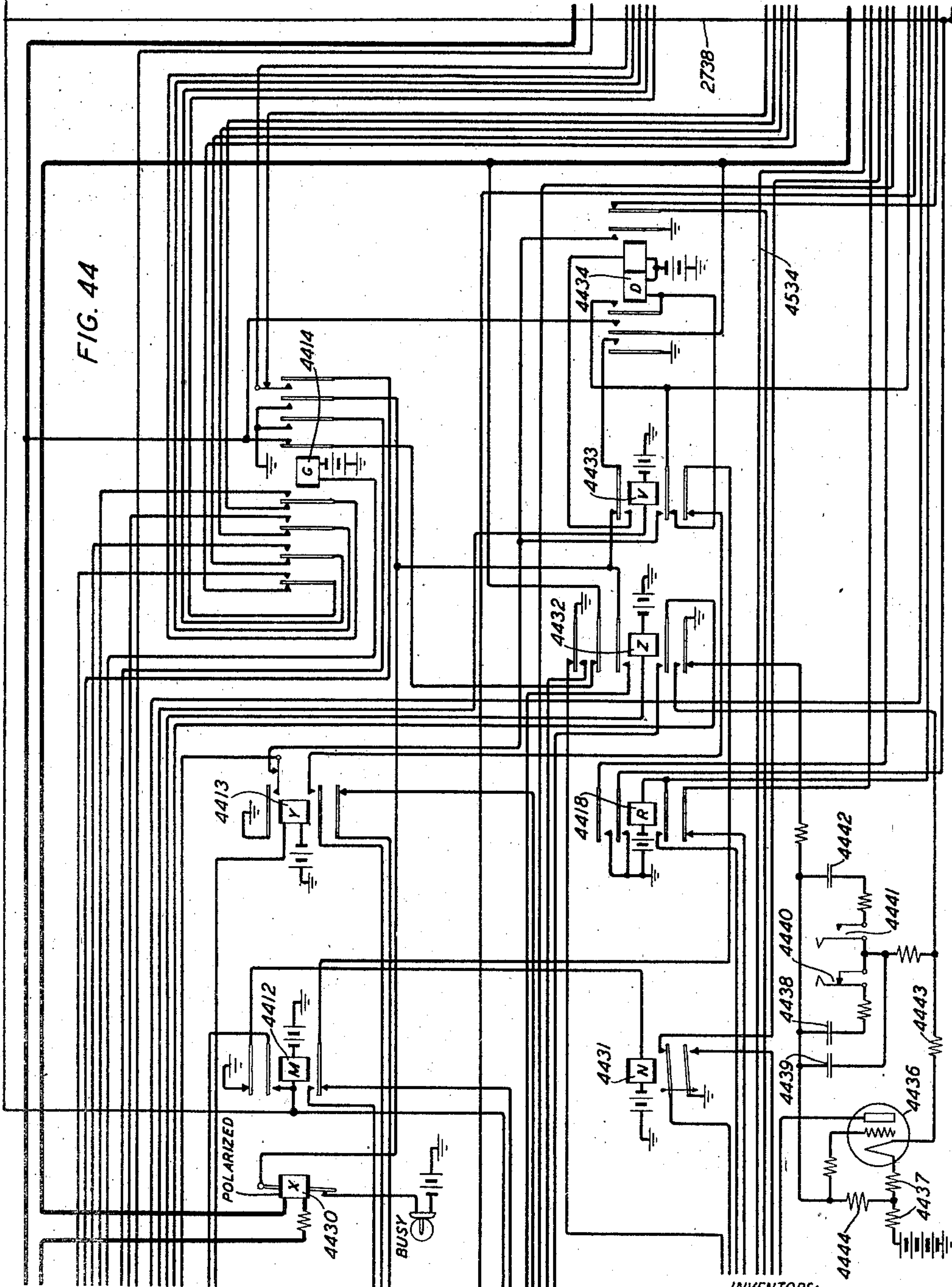
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INVENTORS:
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F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
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G. A. LOCKE

BY

William F. Simpson

ATTORNEY

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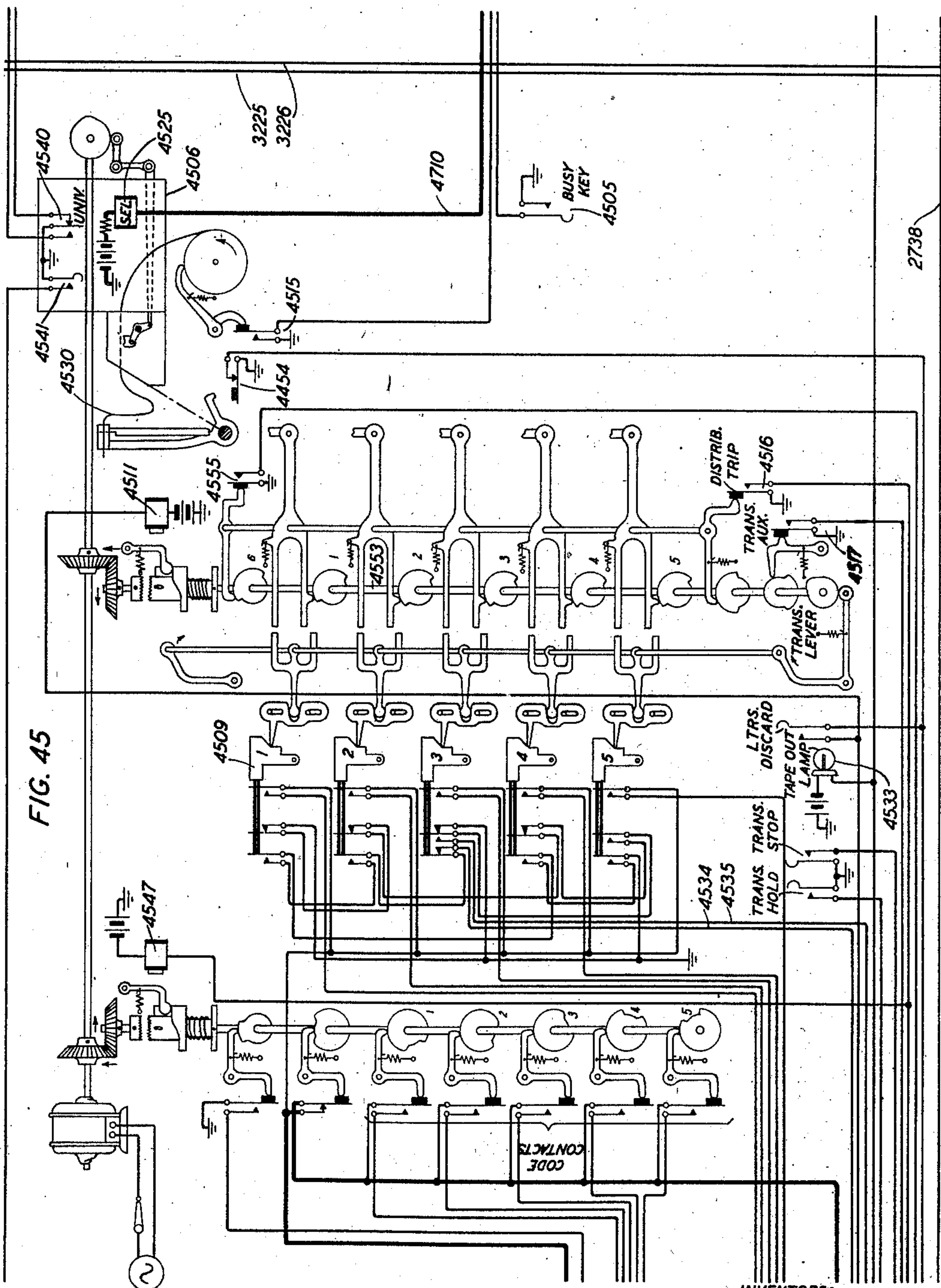
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INVENTORS:
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F. S. KINKEAD, DECEASED
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G. A. LOCKE

BY

William F. Simpson.

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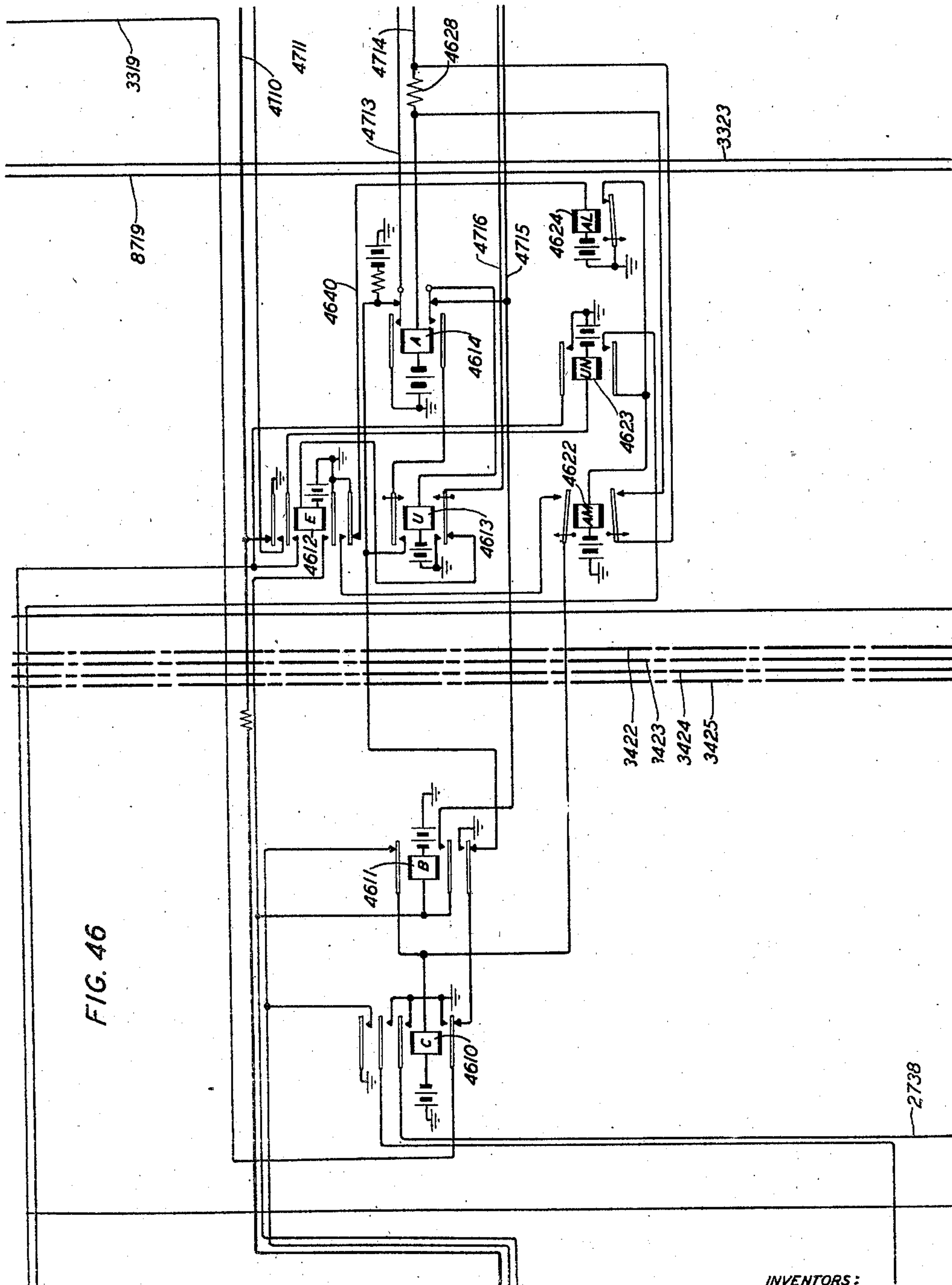


FIG. 46

INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE

BY

William F. Simpson

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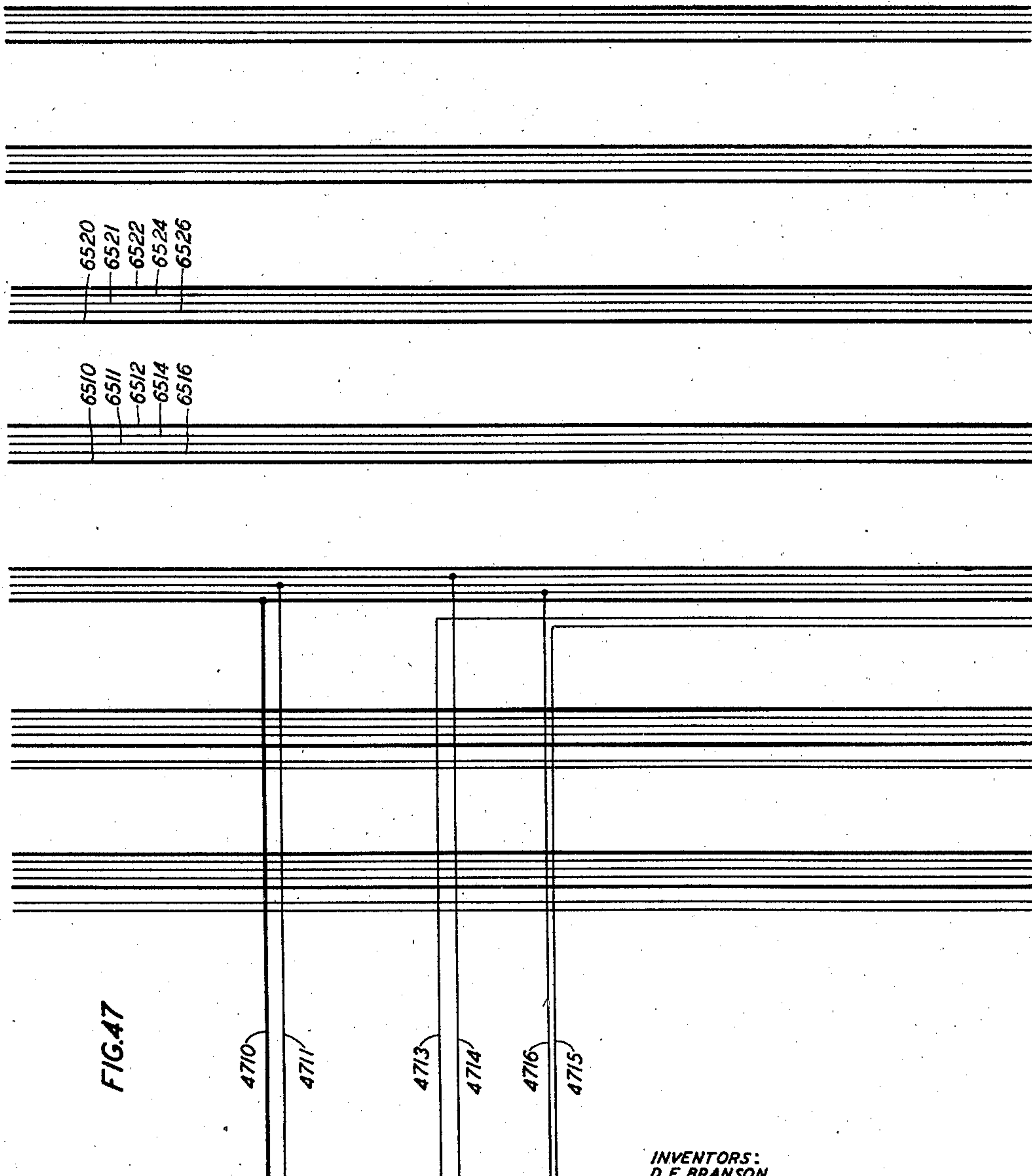
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INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE

BY *William F. Simpson*

ATTORNEY

Nov. 11, 1947.

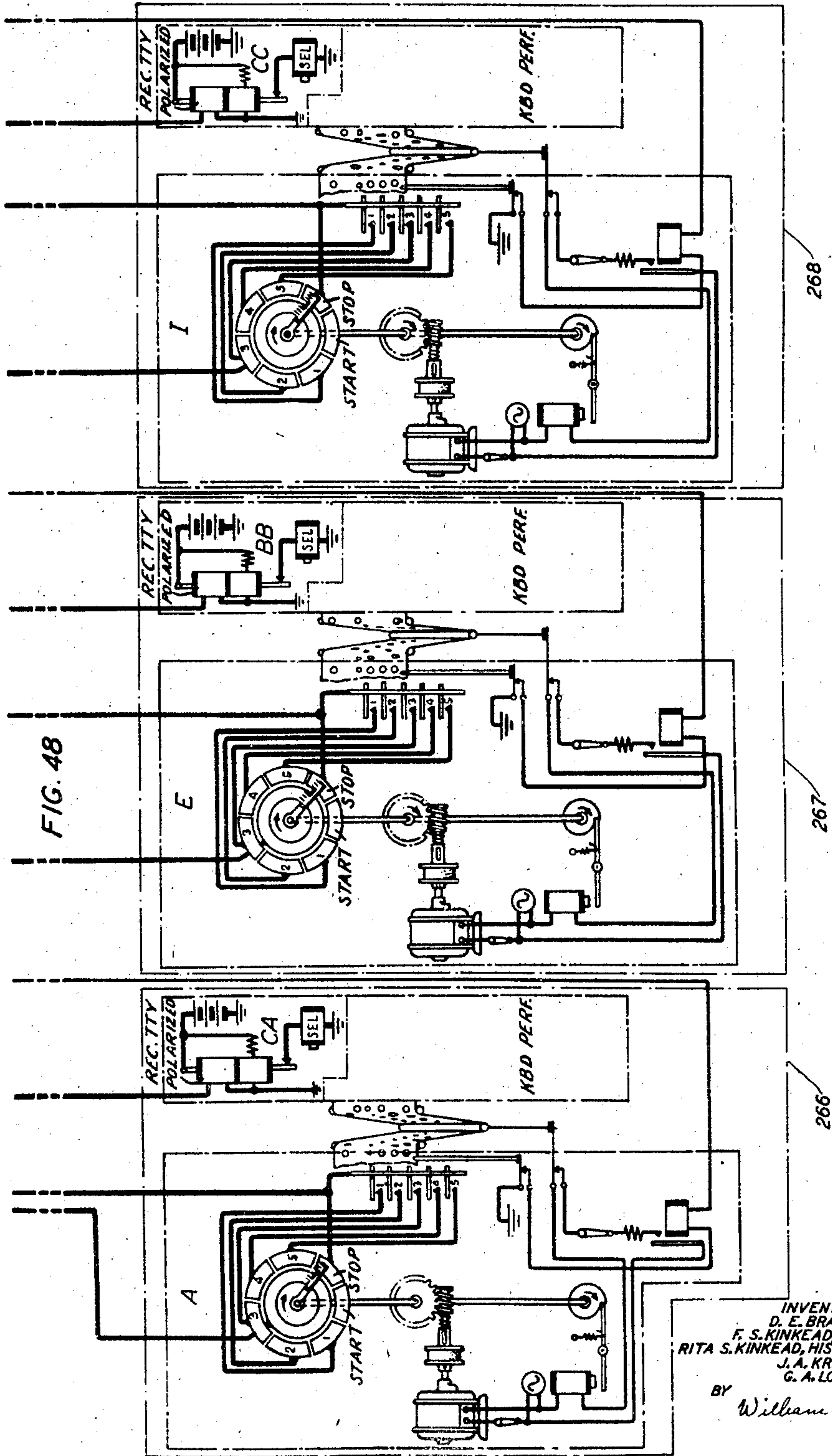
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INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE

BY

William F. Simpson.

ATTORNEY

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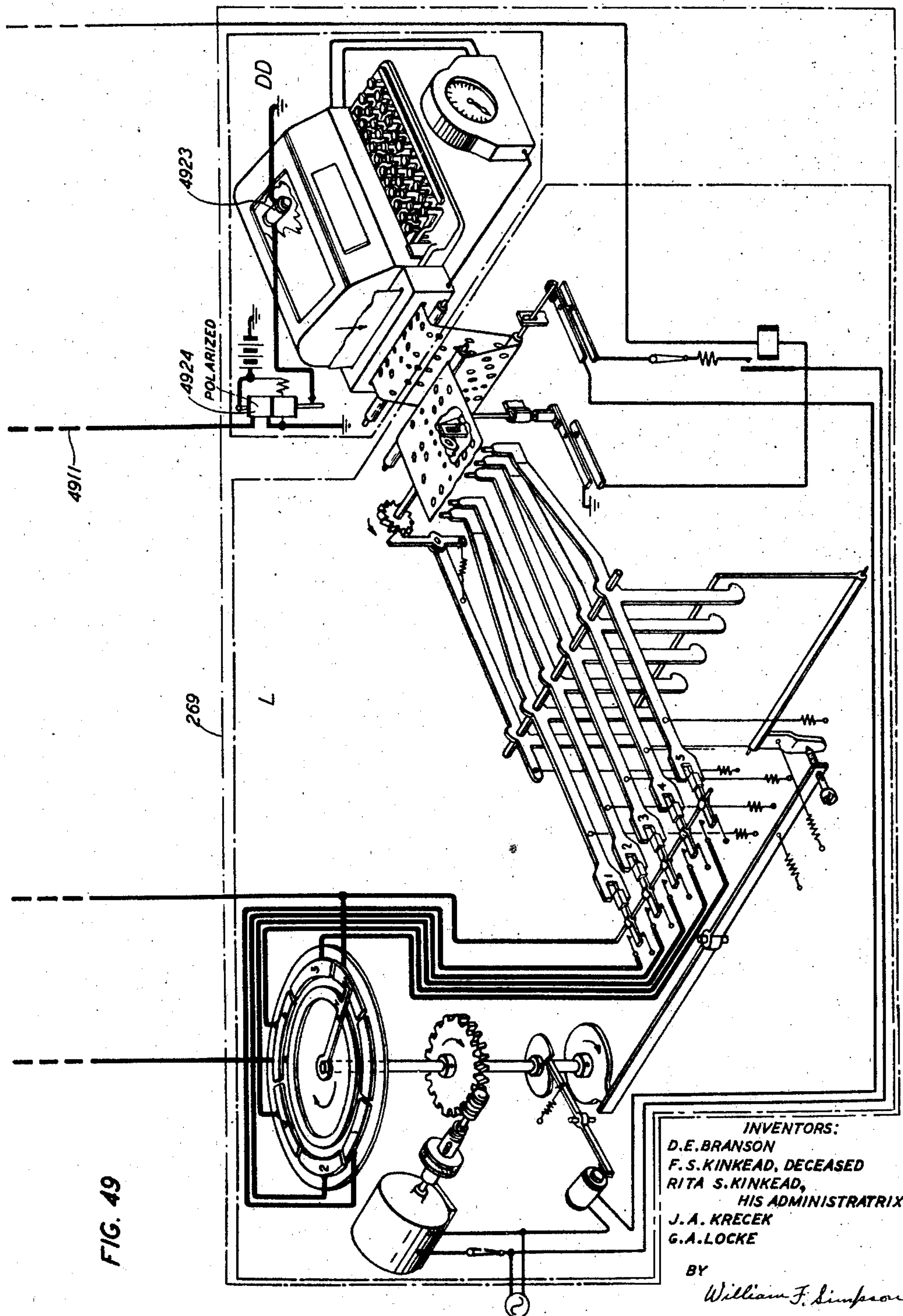
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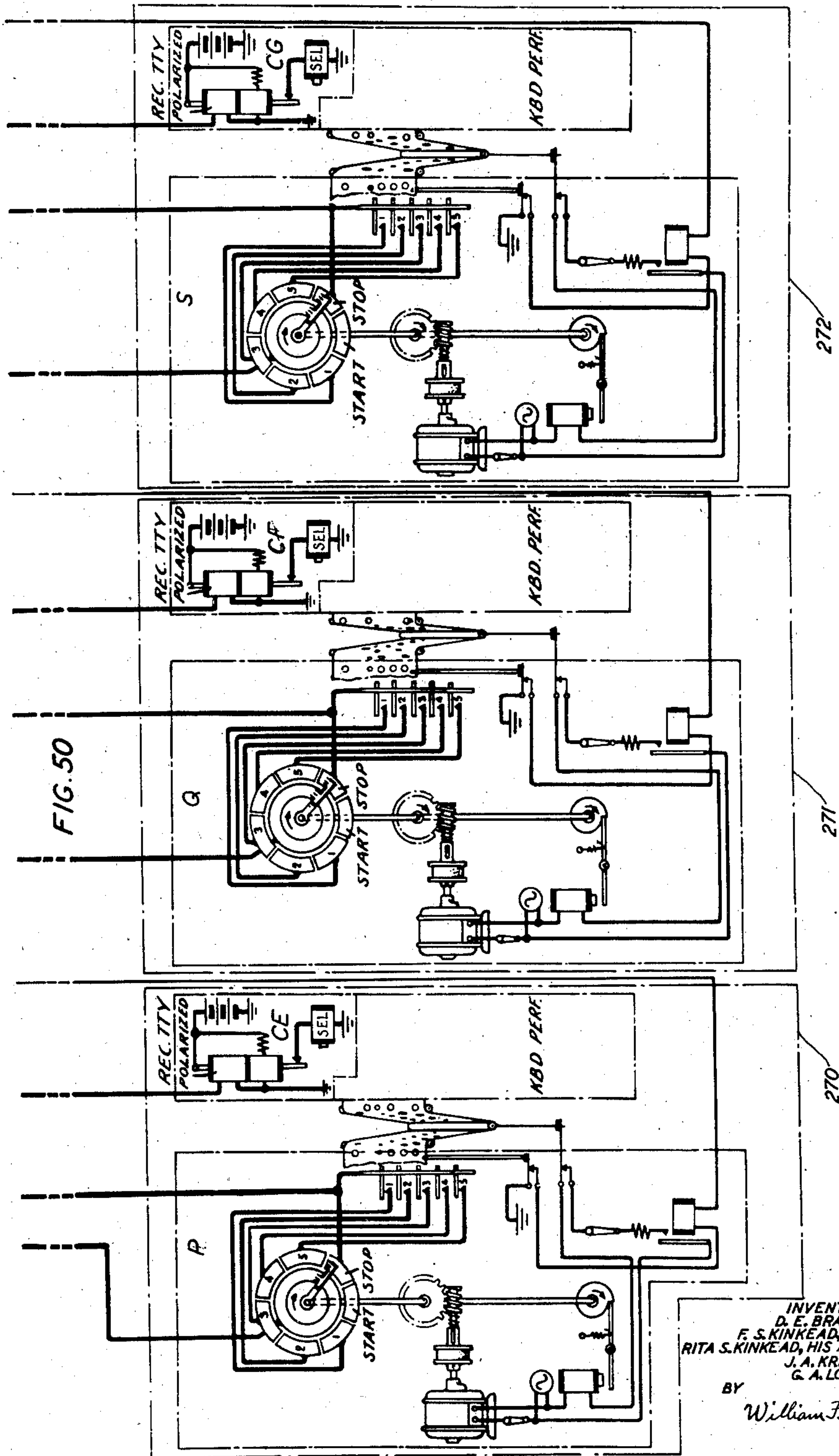
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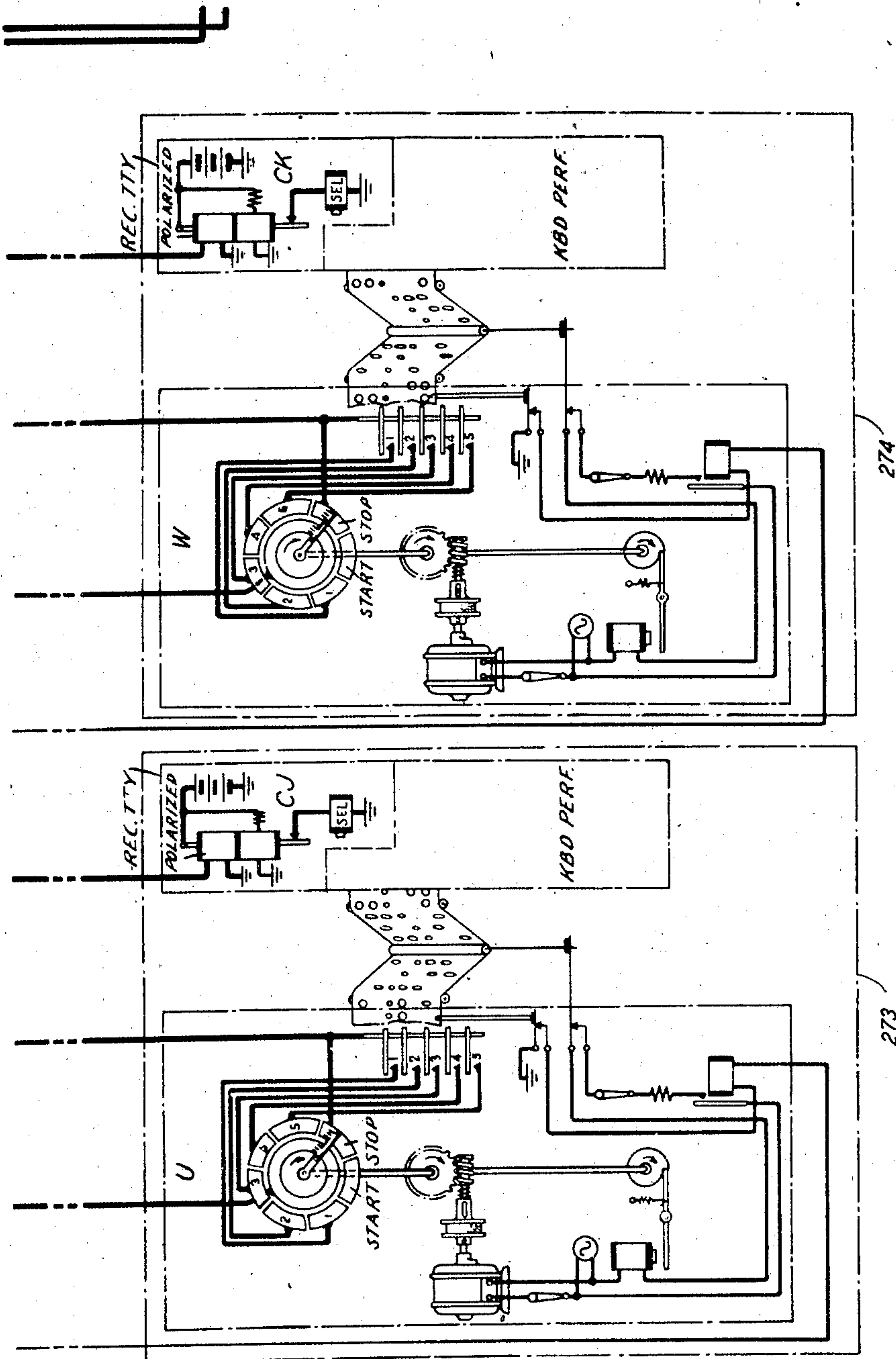


FIG. 51

INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
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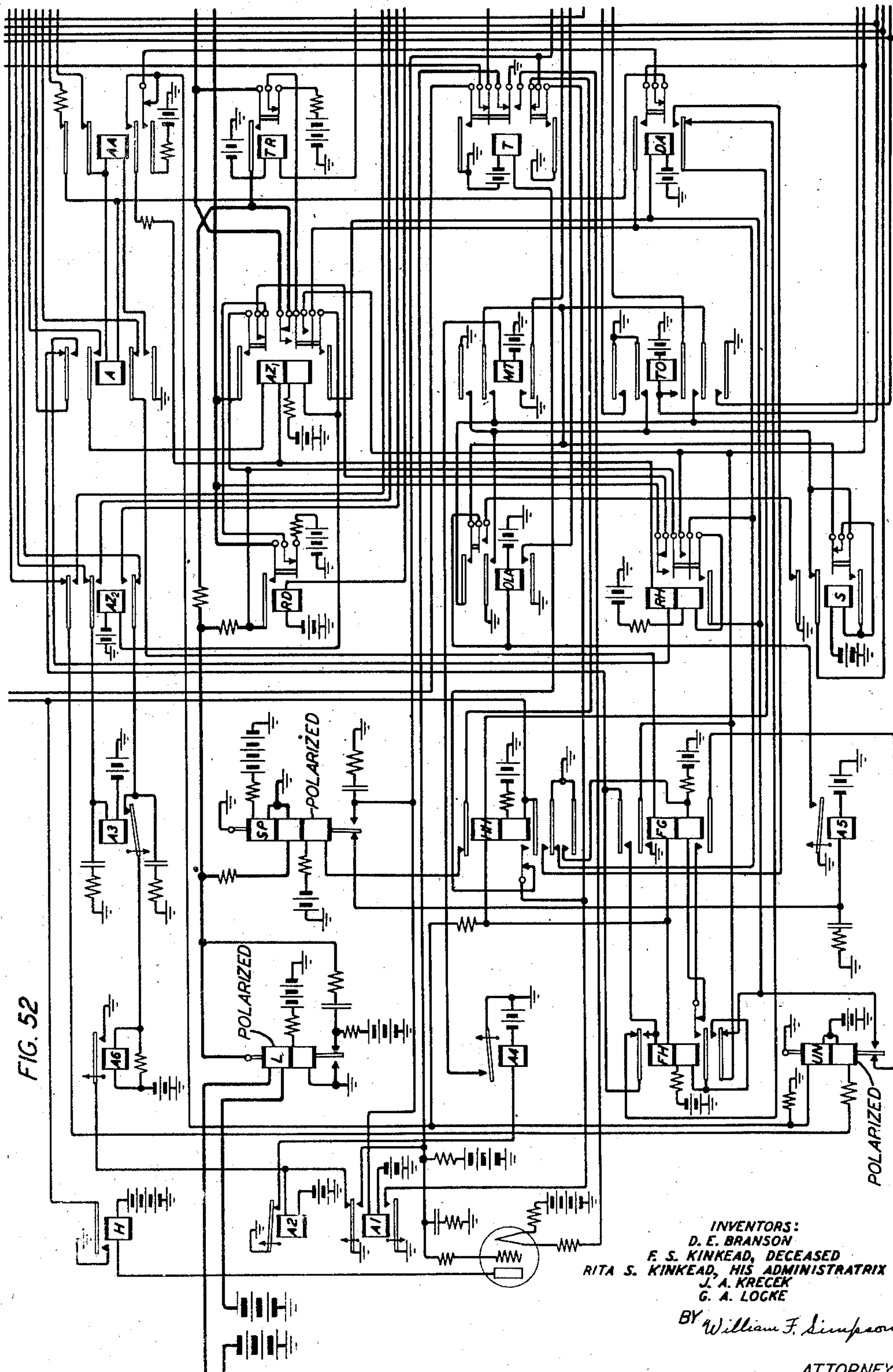


FIG. 52

INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
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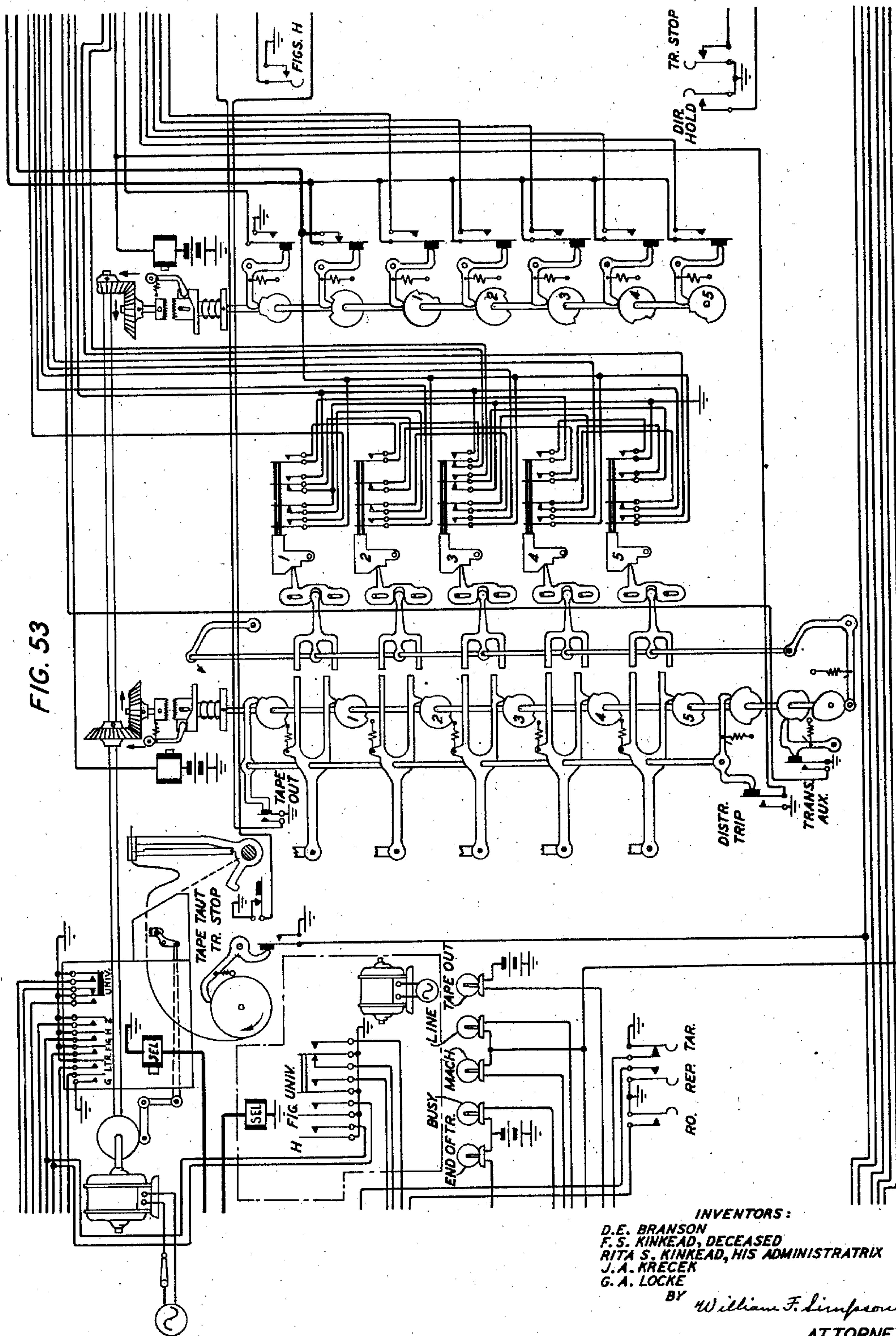
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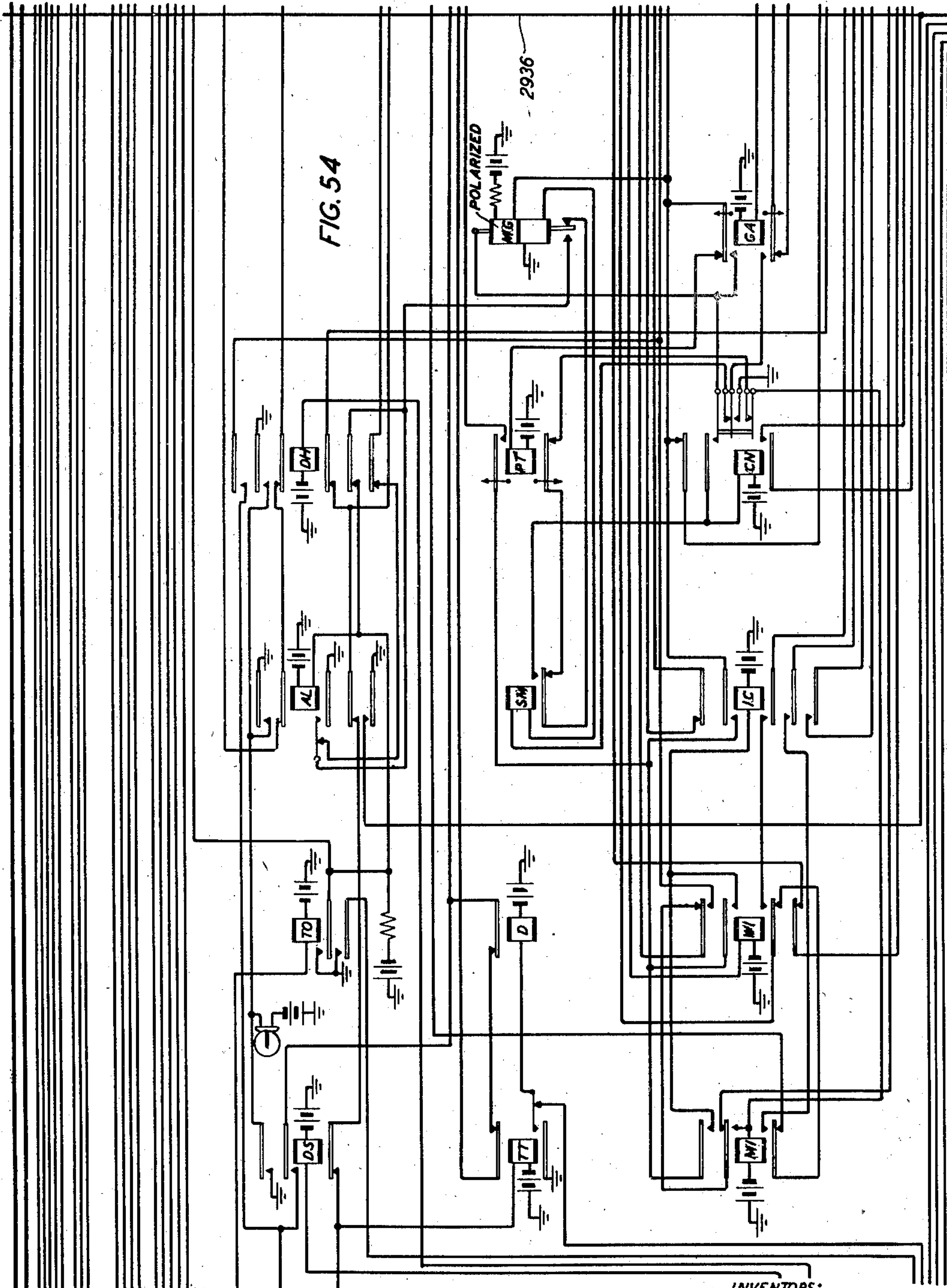
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INVENTORS:
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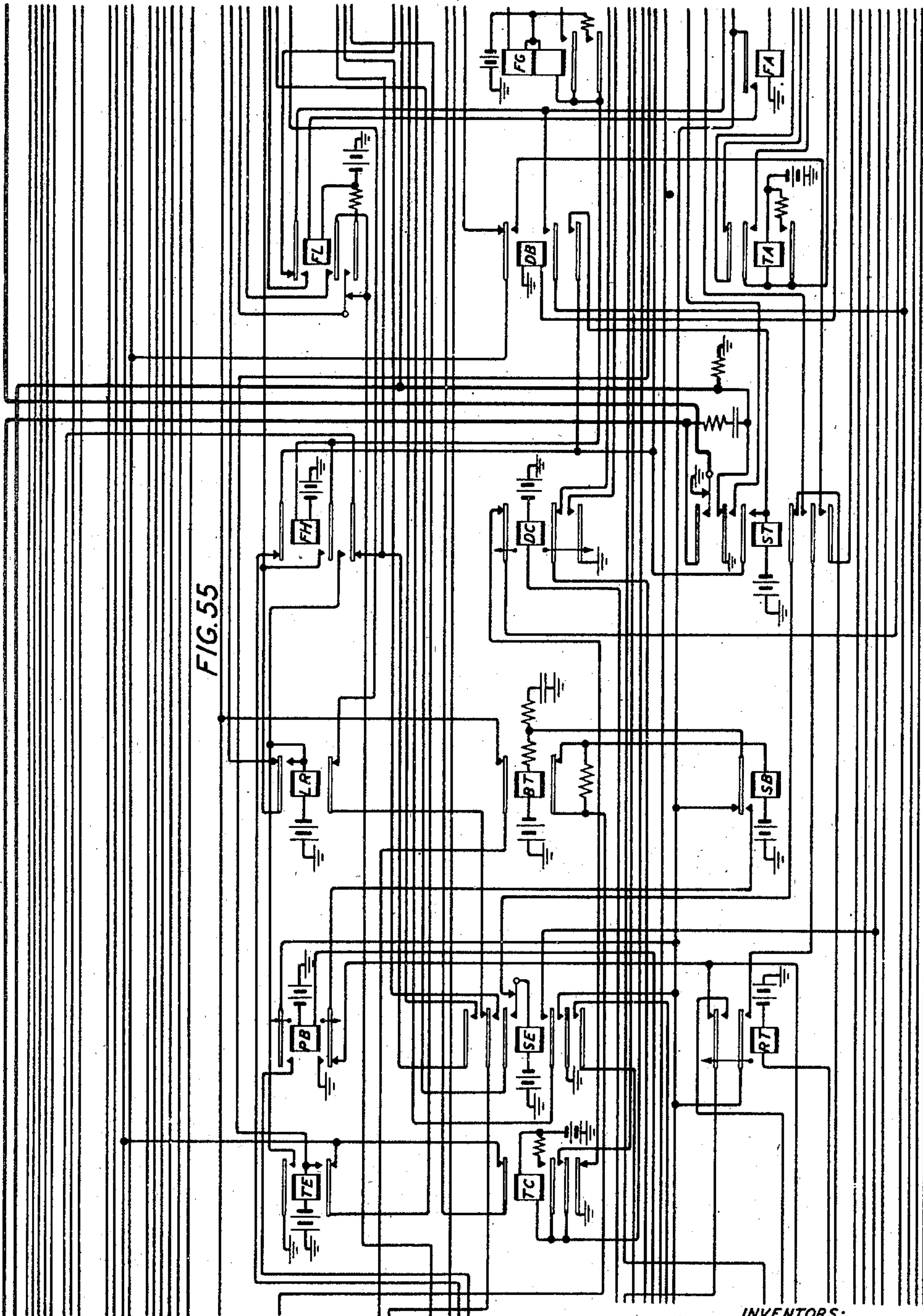
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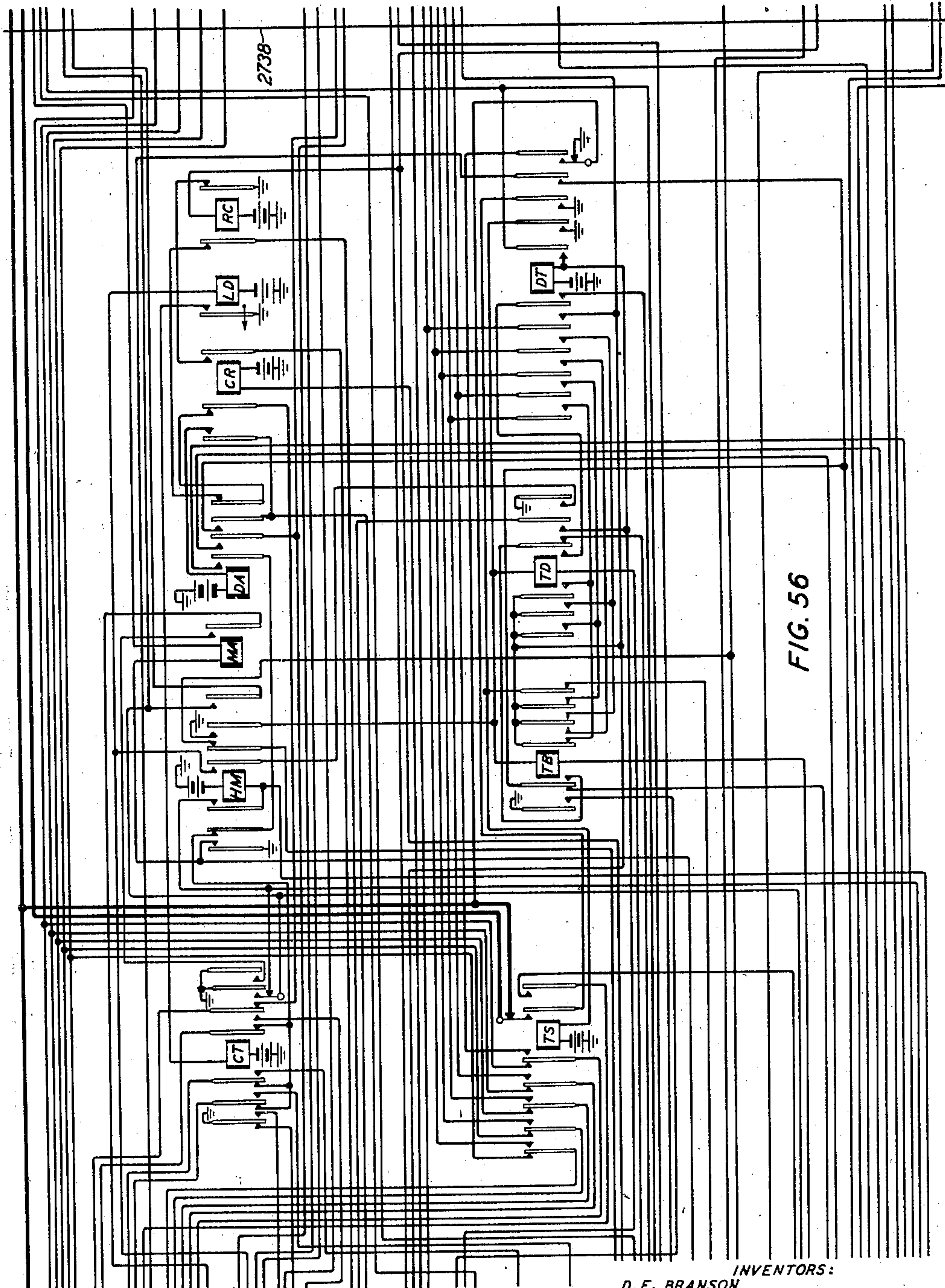
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G. A. LOCKE

BY *William F. Simpson*

ATTORNEY

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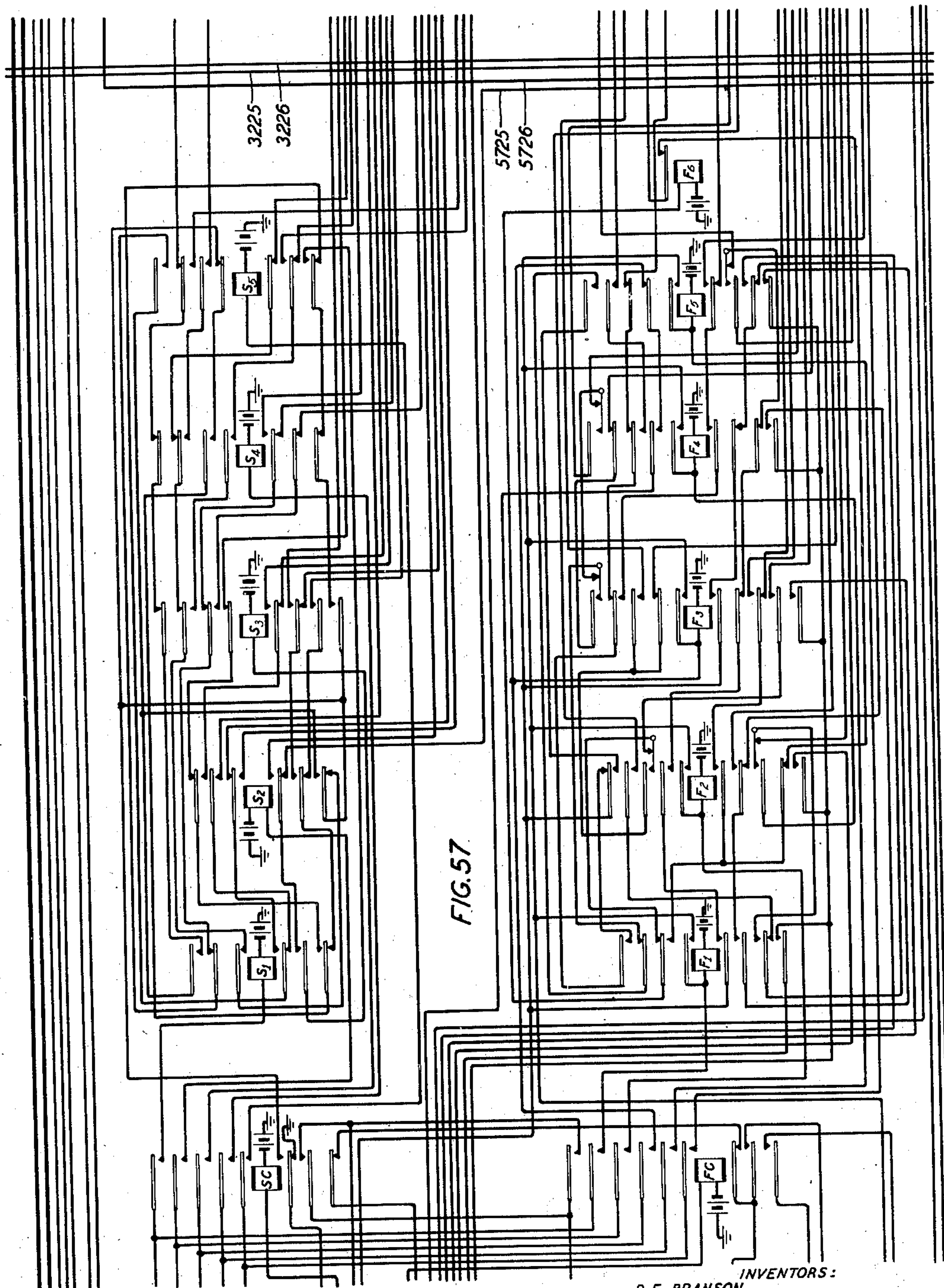
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INVENTORS:
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G. A. LOCKE

BY *William F. Simpson*

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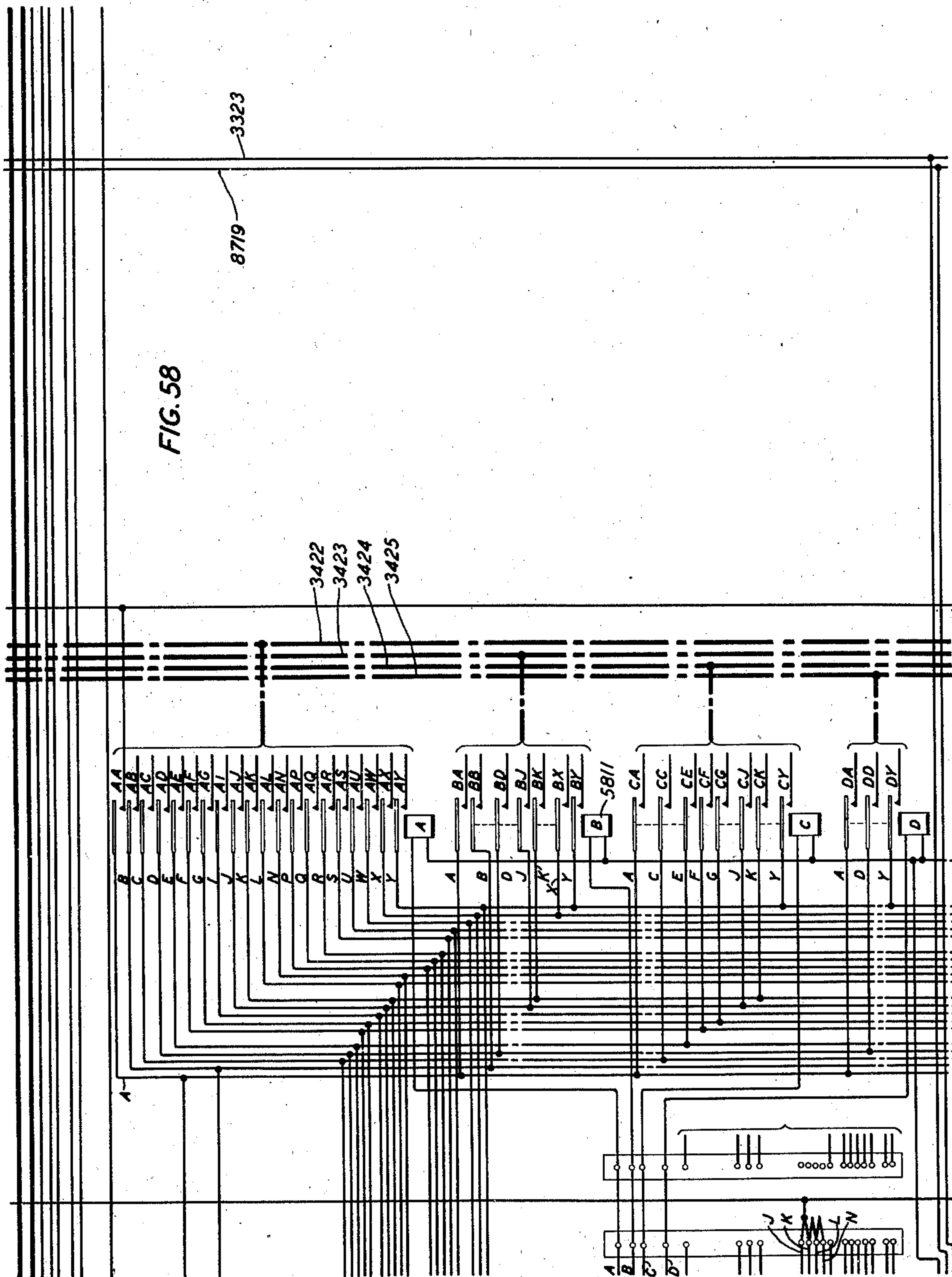
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INVENTORS:
D. E. BRANSON
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RITA S. KINKEAD, HIS ADMINISTRATRIX
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G. A. LOCKE
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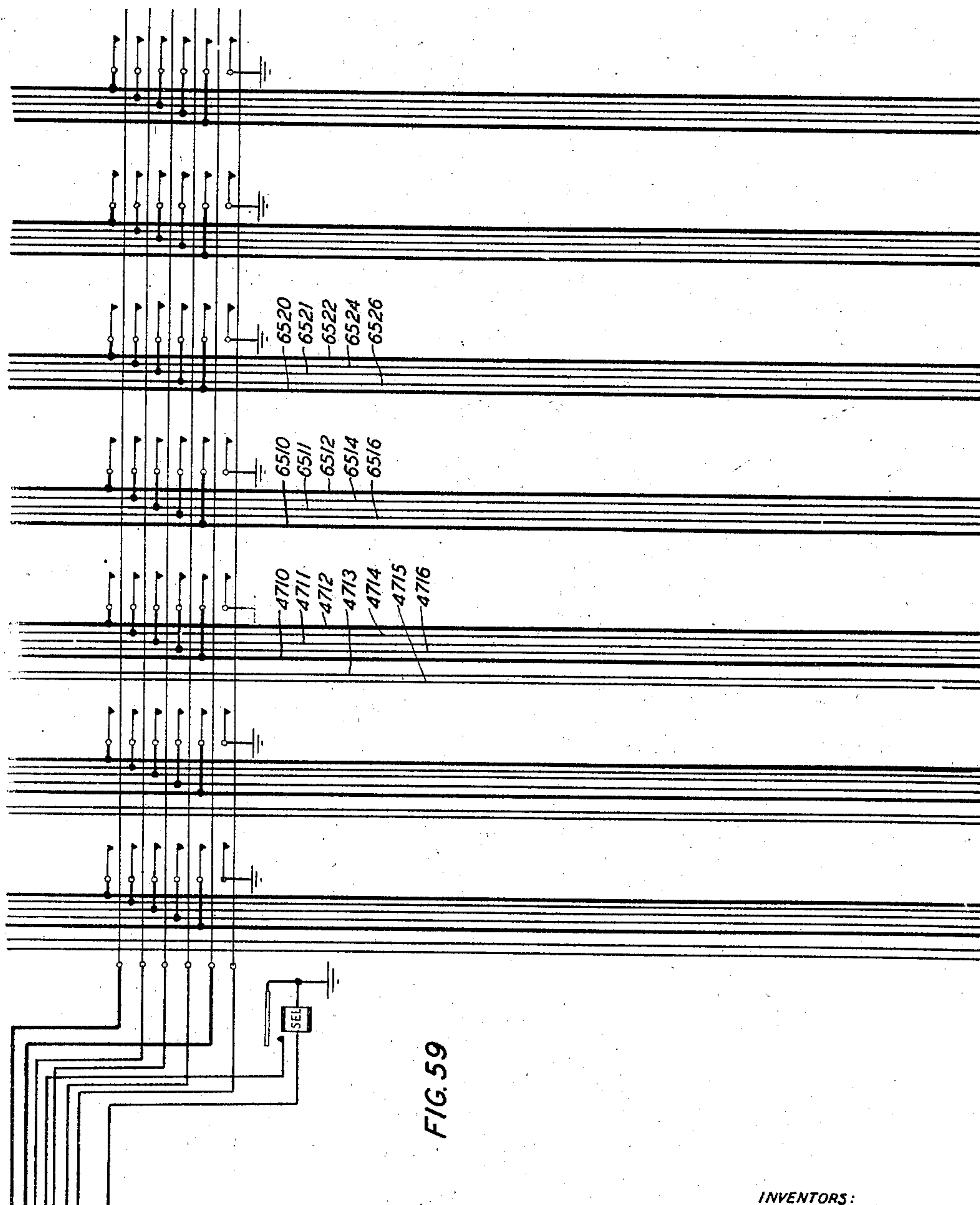
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INVENTORS:
D. E. BRANSON
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RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE

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William F. Simpson

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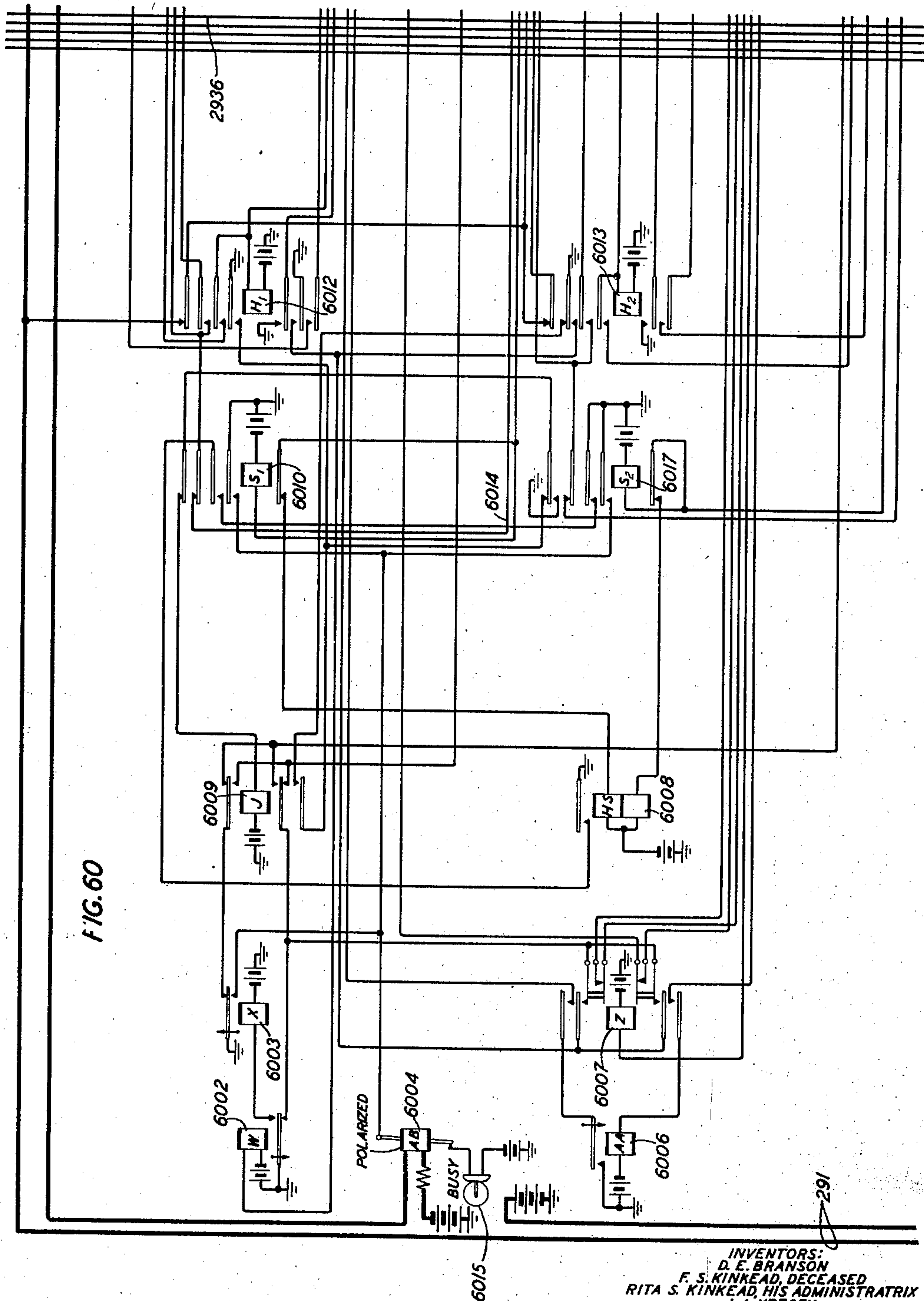
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INVENTORS:
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J. A. KRECEK
G. A. LOCKE

BY

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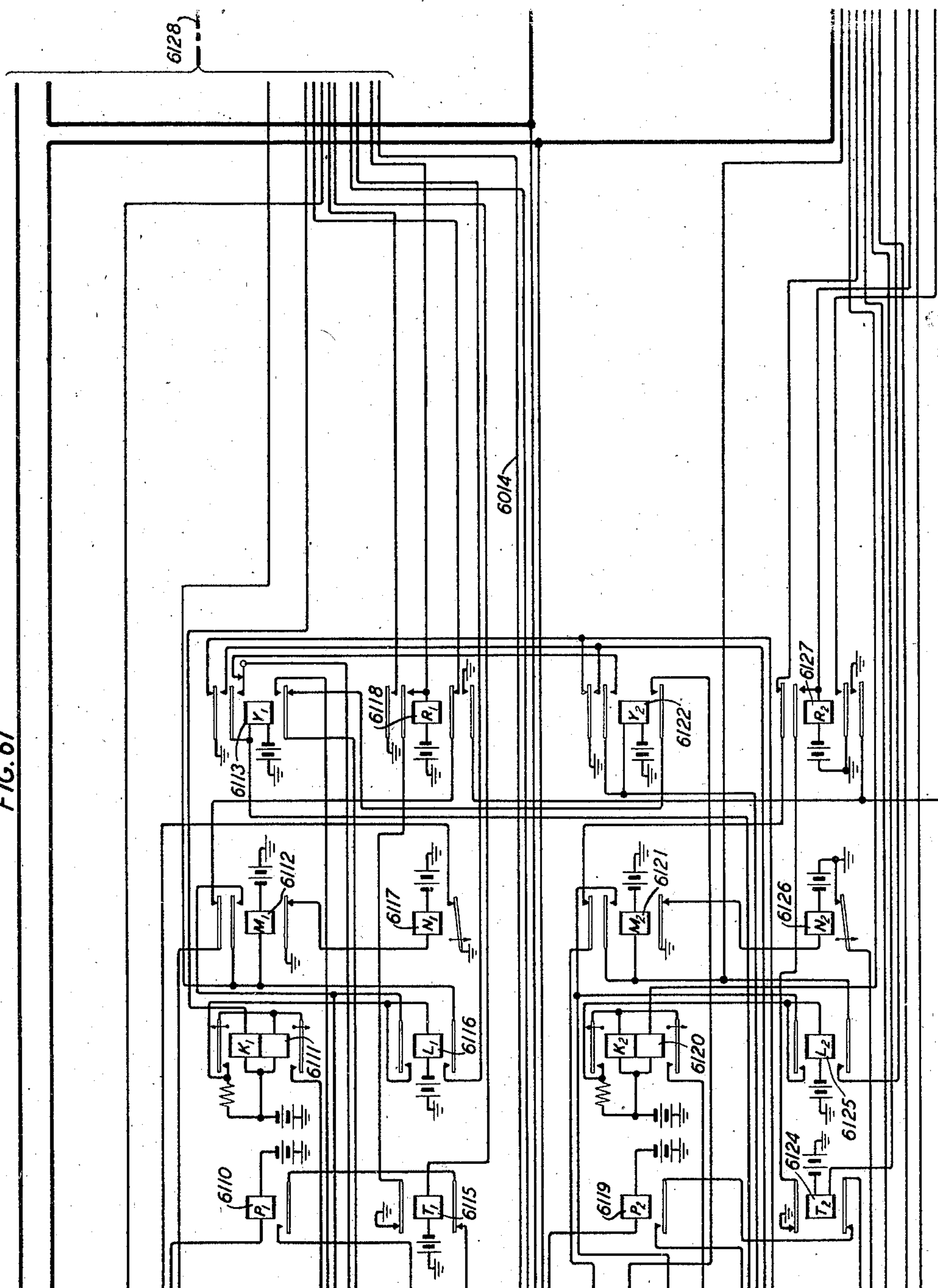
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FIG. 61



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RITA S. KINKEAD, HIS ADMINISTRATRIX
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G. A. LOCKE
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ATTORNEY

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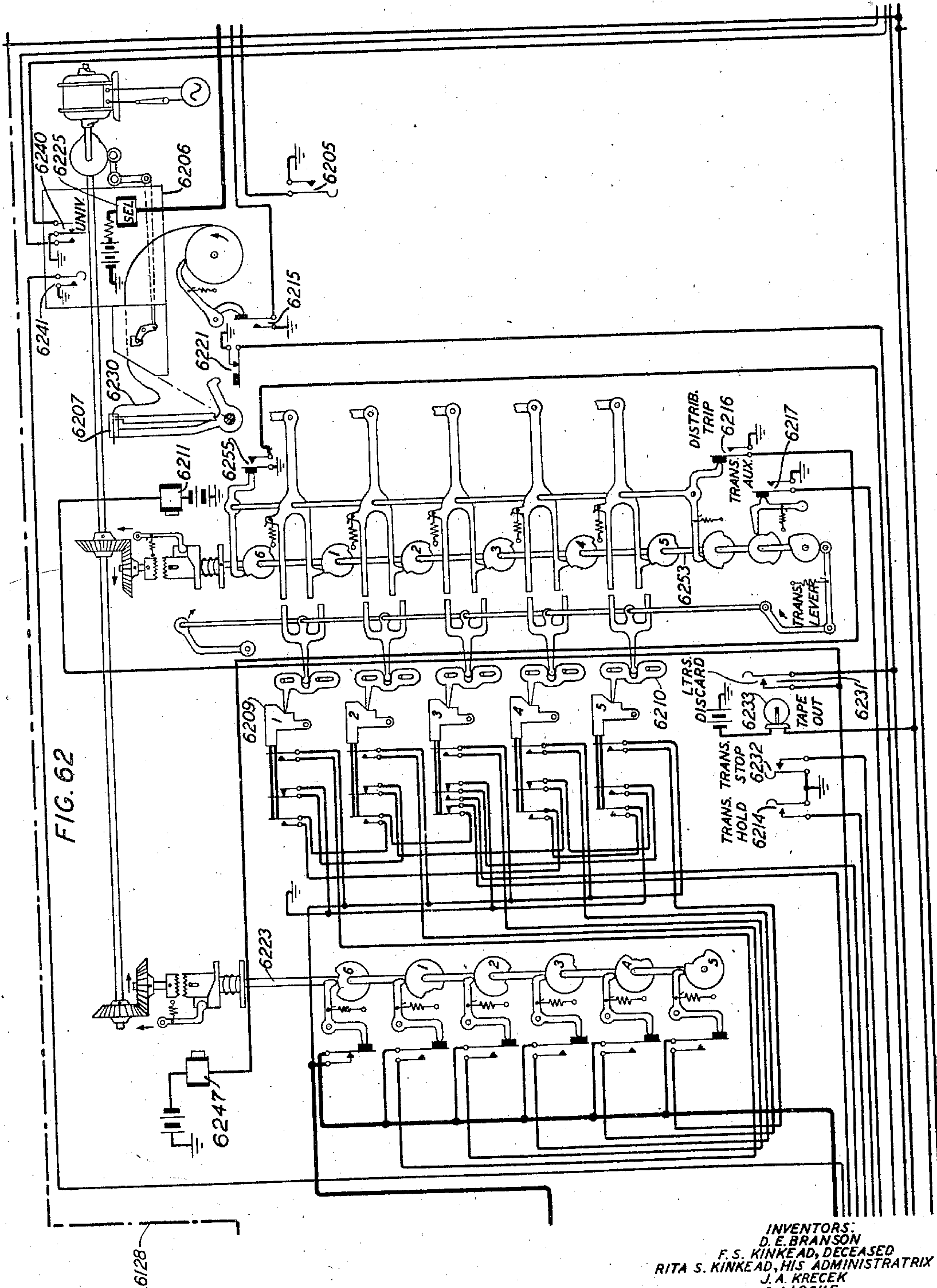
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INVENTORS:
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RITA S. KINKEAD, HIS ADMINISTRATRIX
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G. A. LOCKE

BY *William F. Simpson*

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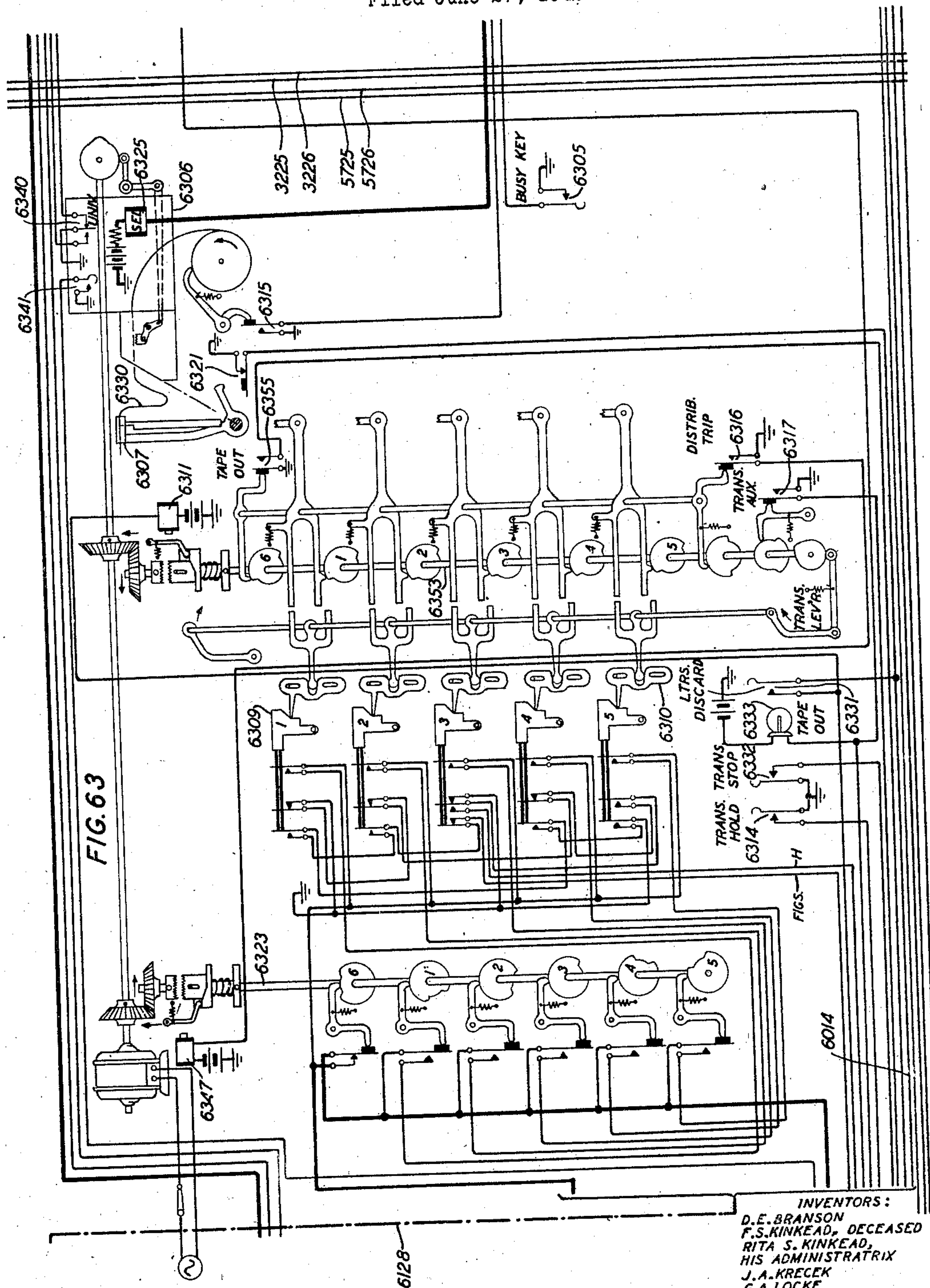
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INVENTORS:
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F.S. KINKEAD, DECEASED
RITA S. KINKEAD,
HIS ADMINISTRATRIX
J.A. KRECEK
G.A. LOCKE

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ATTORNEY

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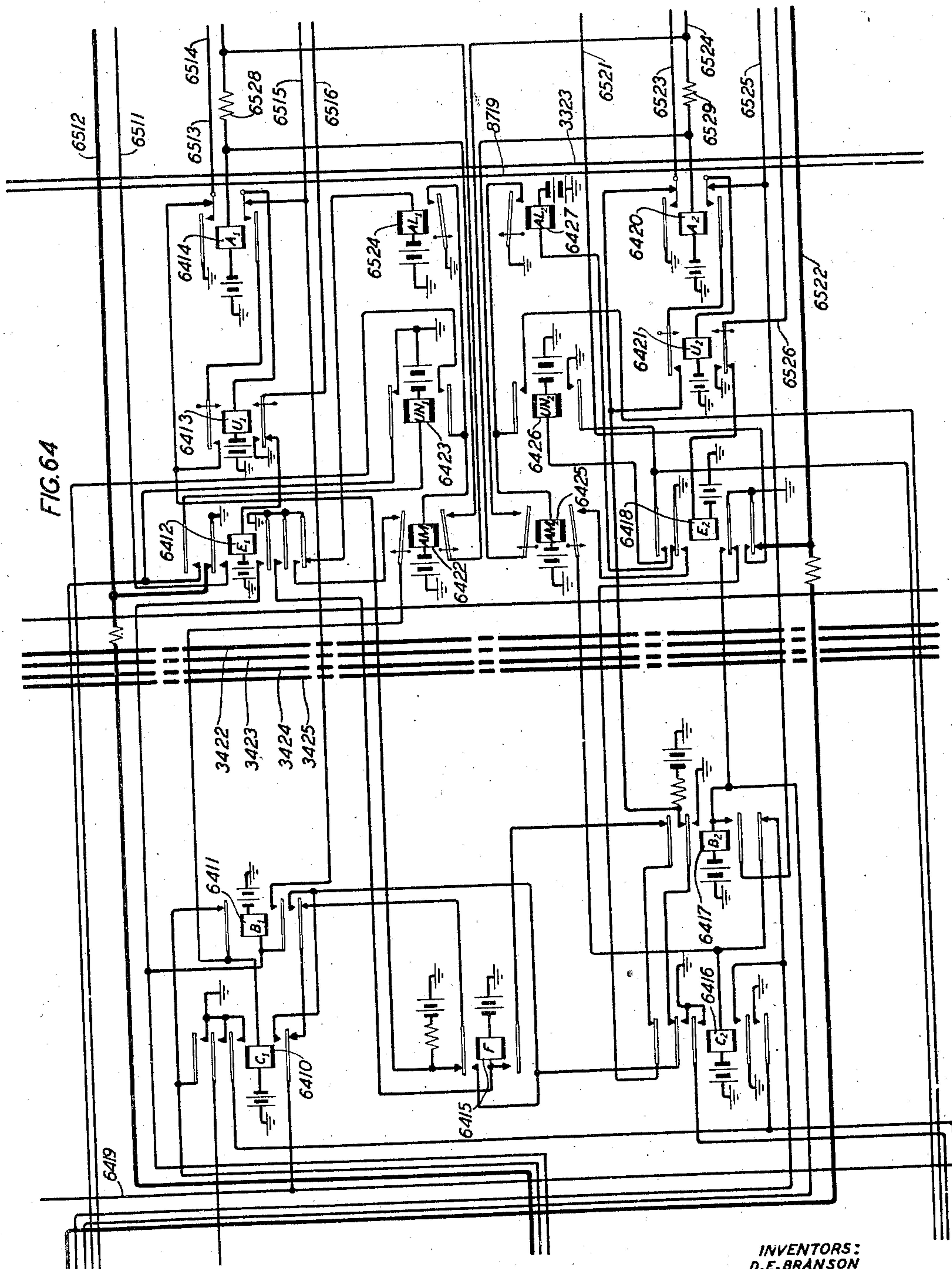
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INVENTORS:
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F.S. KINKEAD, DECEASED
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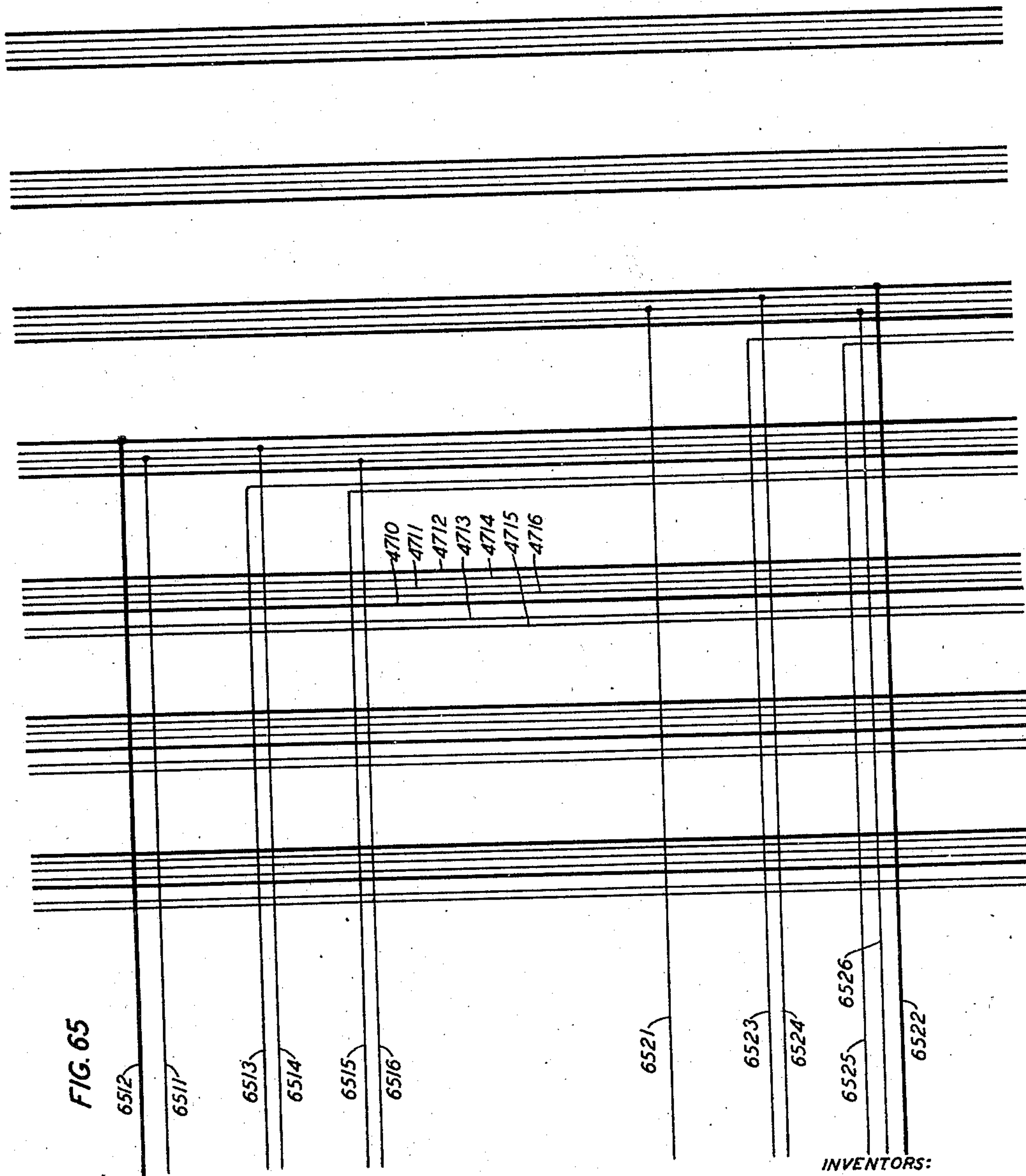


FIG. 65

INVENTORS:

D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE

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William F. Simpson

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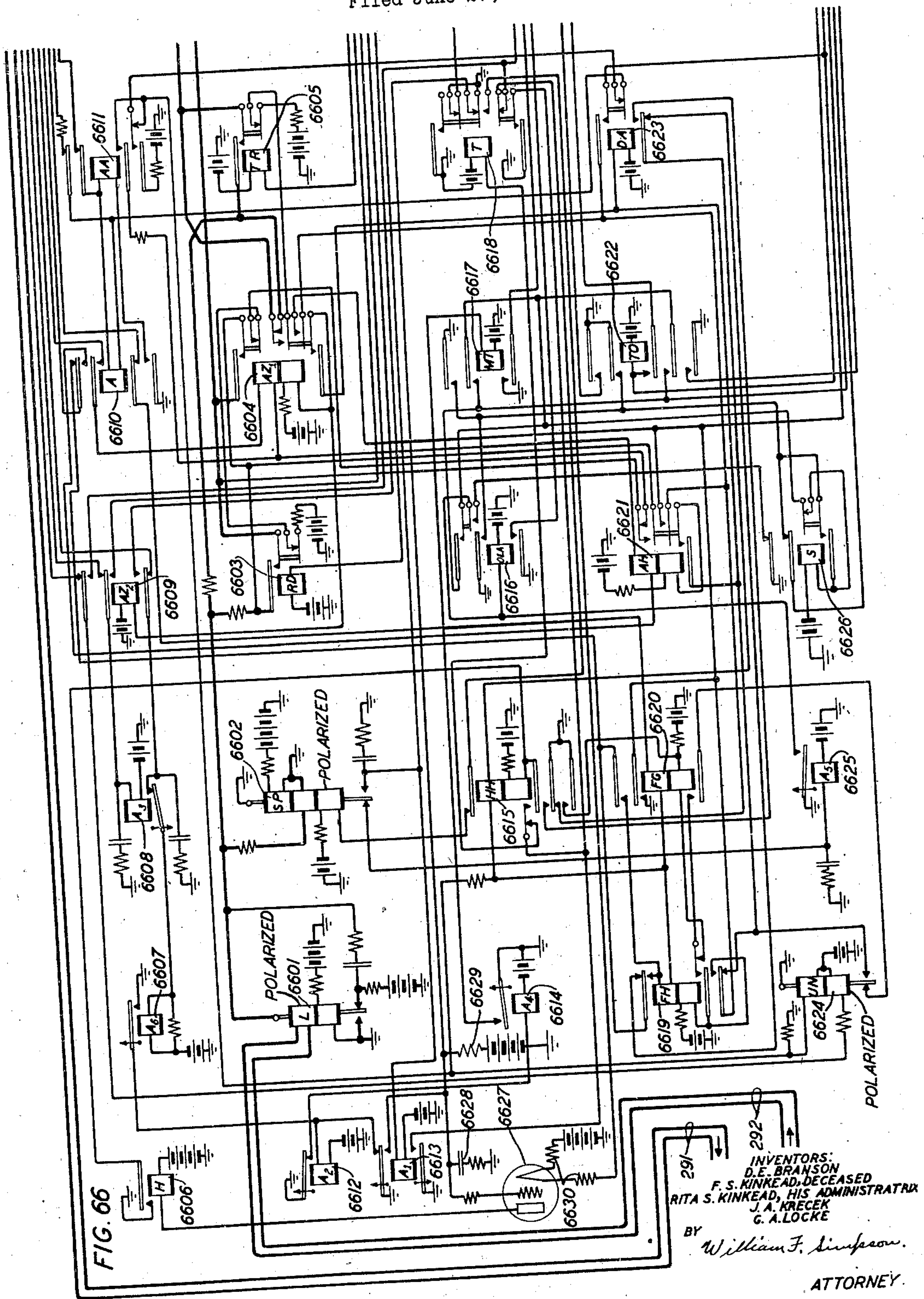
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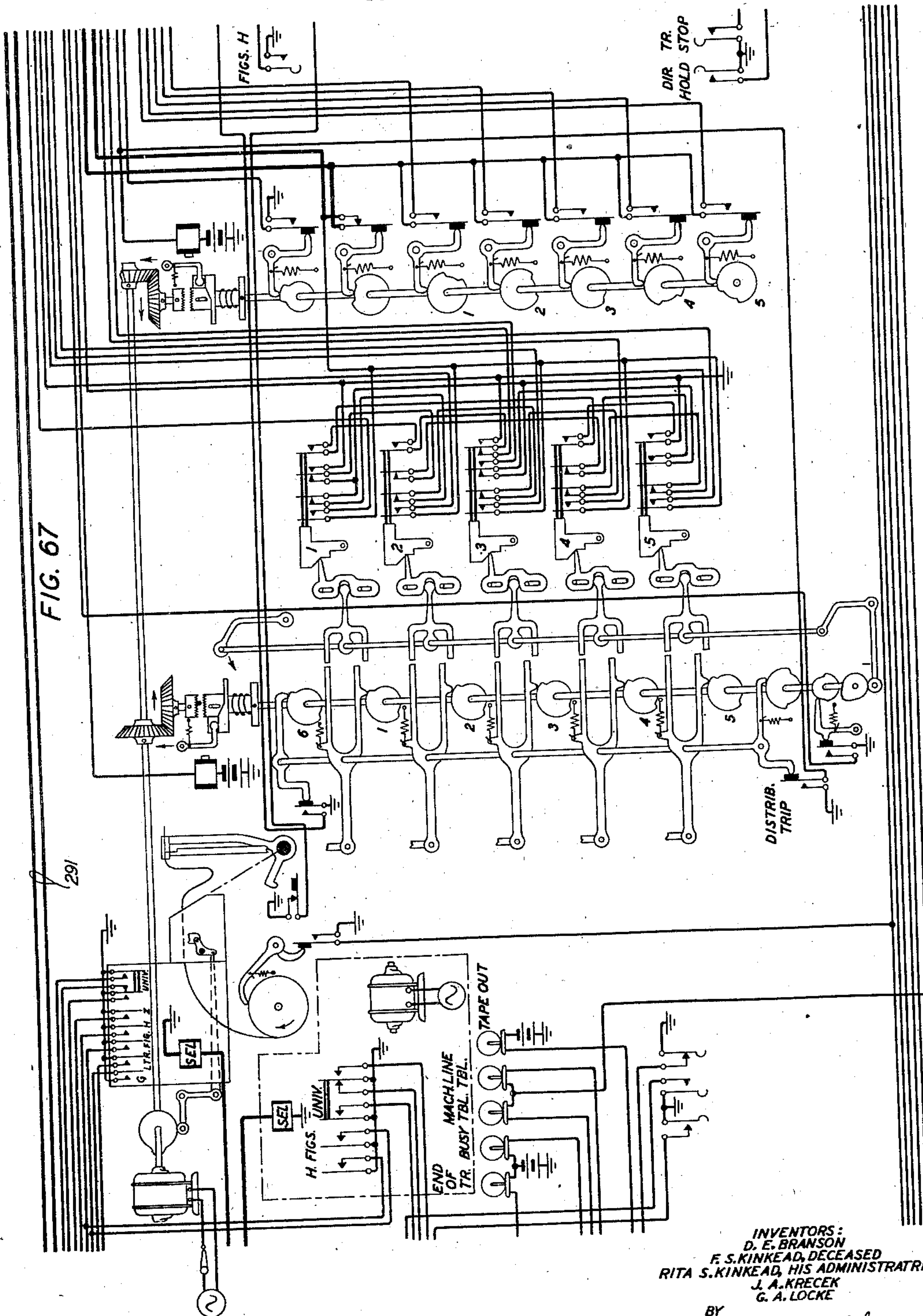
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FIG. 67



INVENTORS:
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J. A. KRECEK
G. A. LOCKE

BY

William F. Simpson.

ATTORNEY

Nov. 11, 1947.

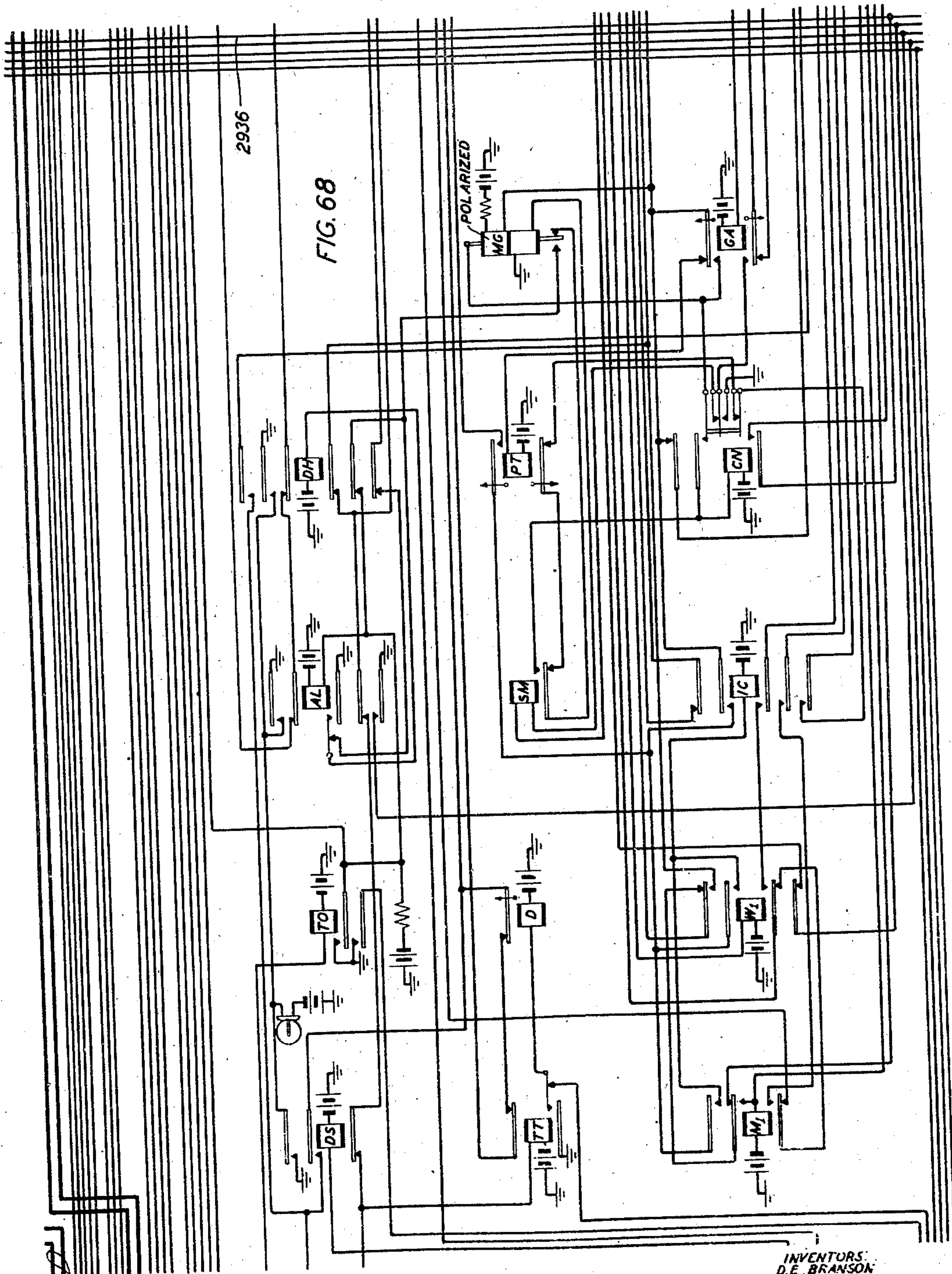
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INVENTORS:
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J.A. KRECEK
G.A. LOCKE
BY *William F. Simpson*
ATTORNEY

BY *William F. Simpson*
ATTORNEY

Nov. 11, 1947.

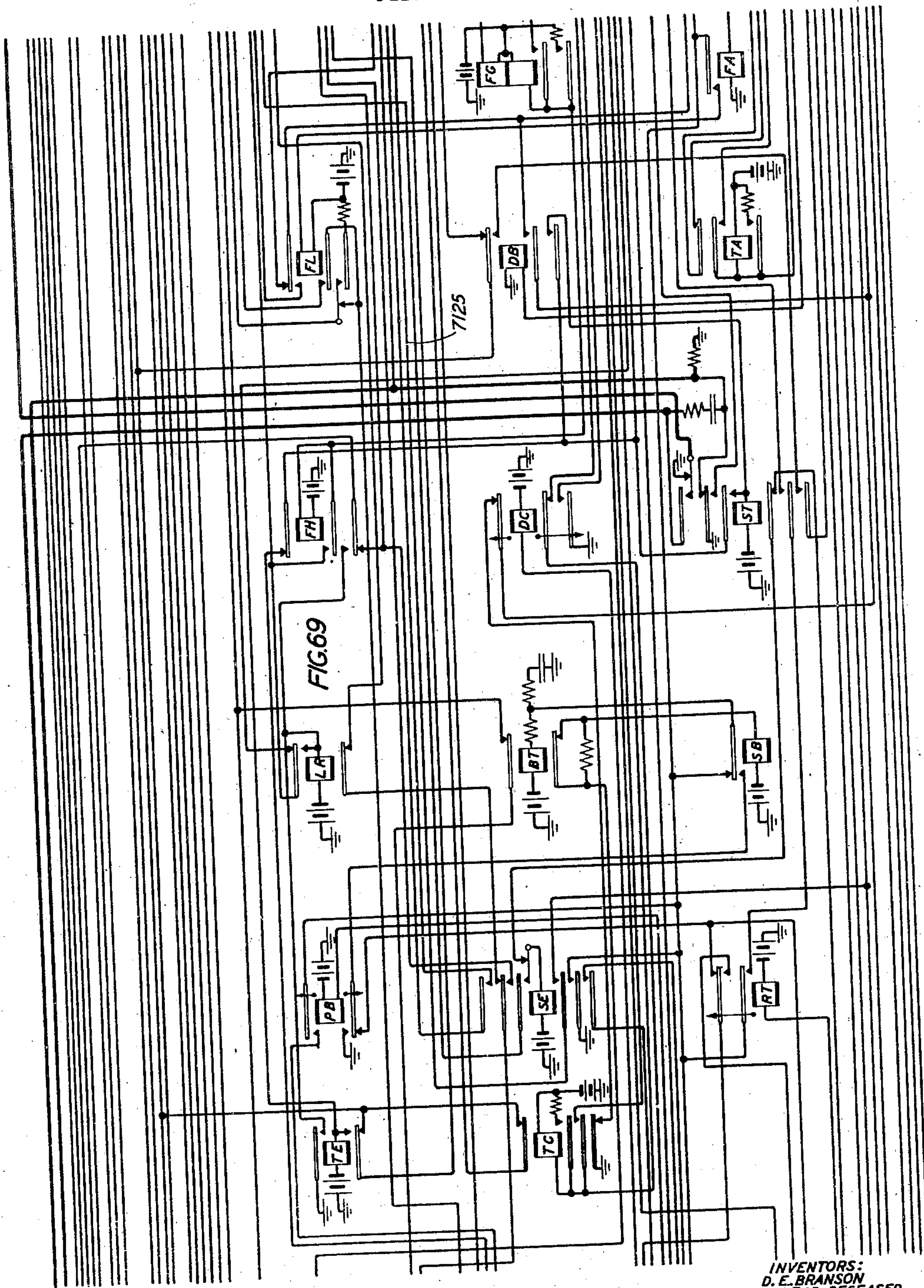
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INVENTORS:
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F. S. KINKEAD, DECEASED
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J. A. KRECEK
G. A. LOCKE

BY *William F. Simpson*
ATTORNEY

Nov. 11, 1947.

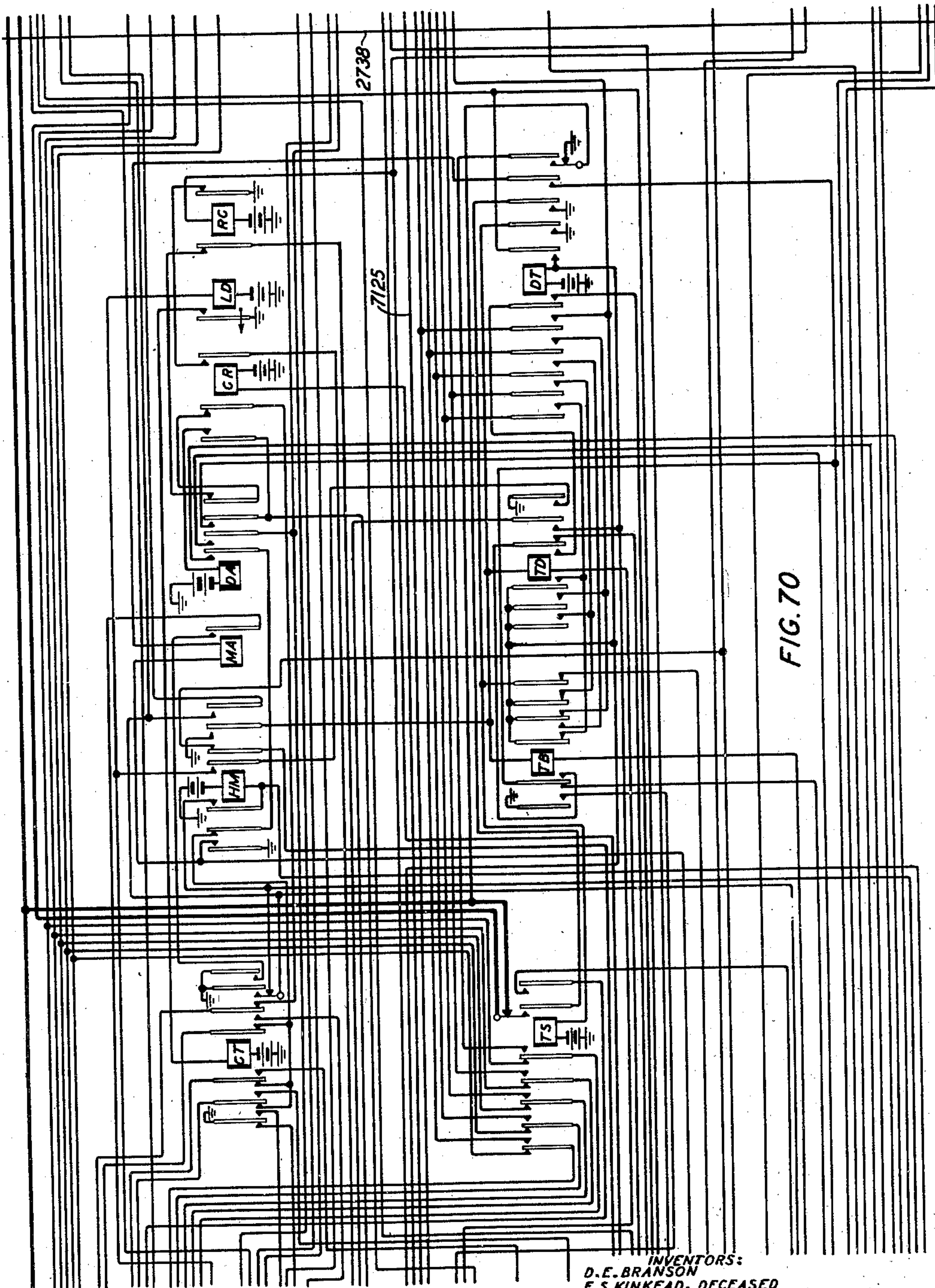
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INVENTORS:
D. E. BRANSON
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G. A. LOCKE

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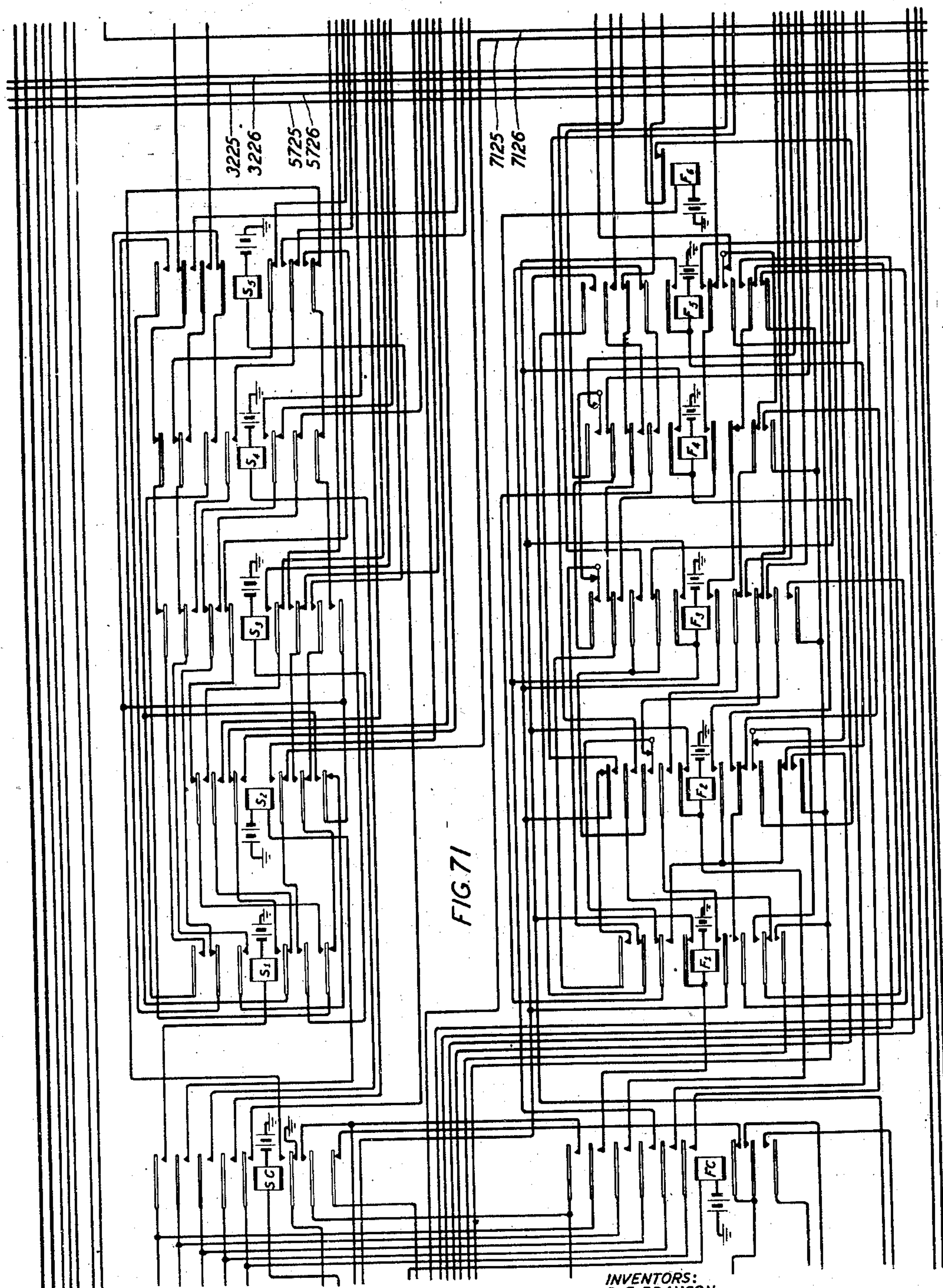


FIG. 71

INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE
BY *William F. Simpson.*
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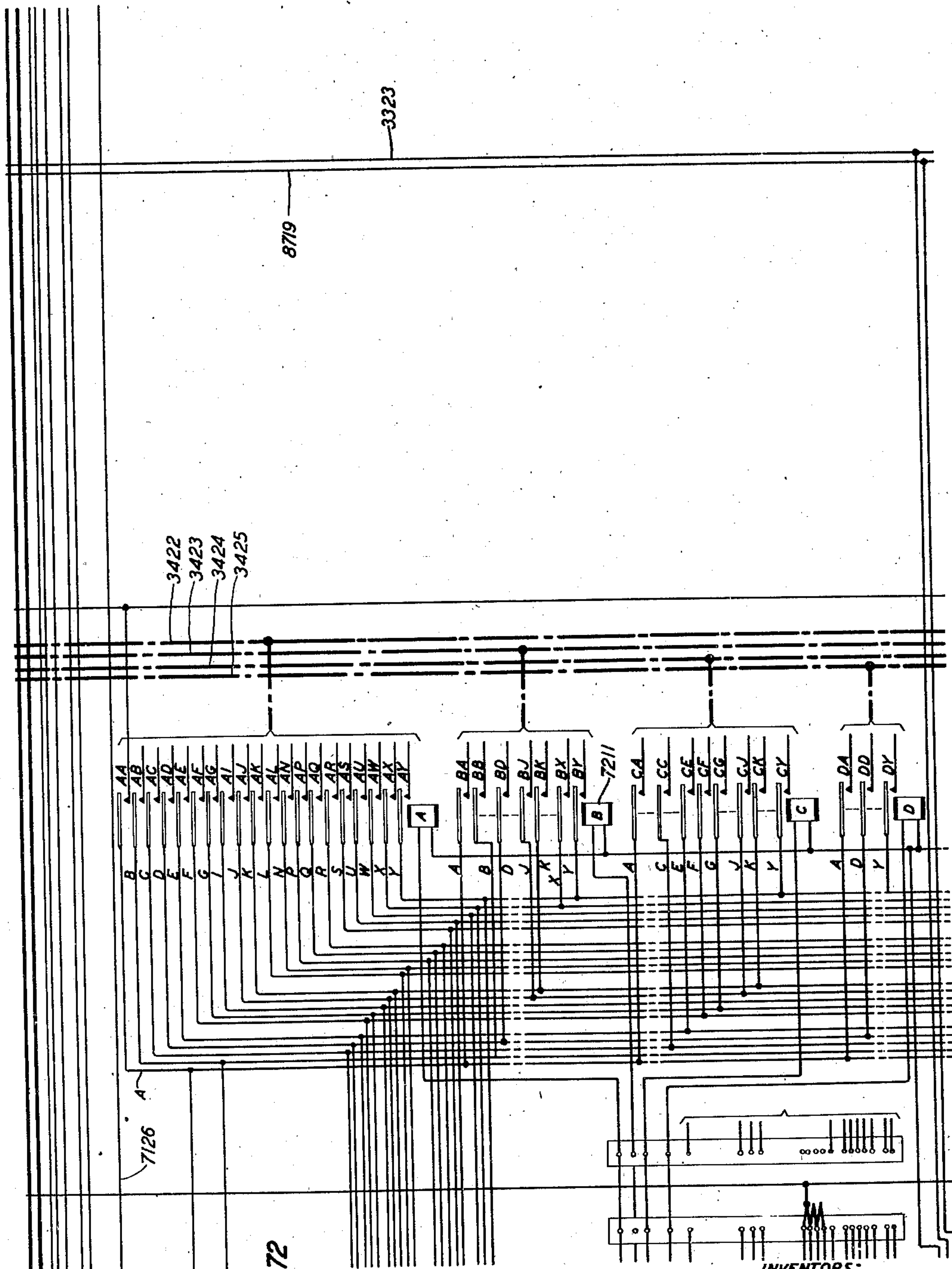


FIG. 72

INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
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G. A. LOCKE

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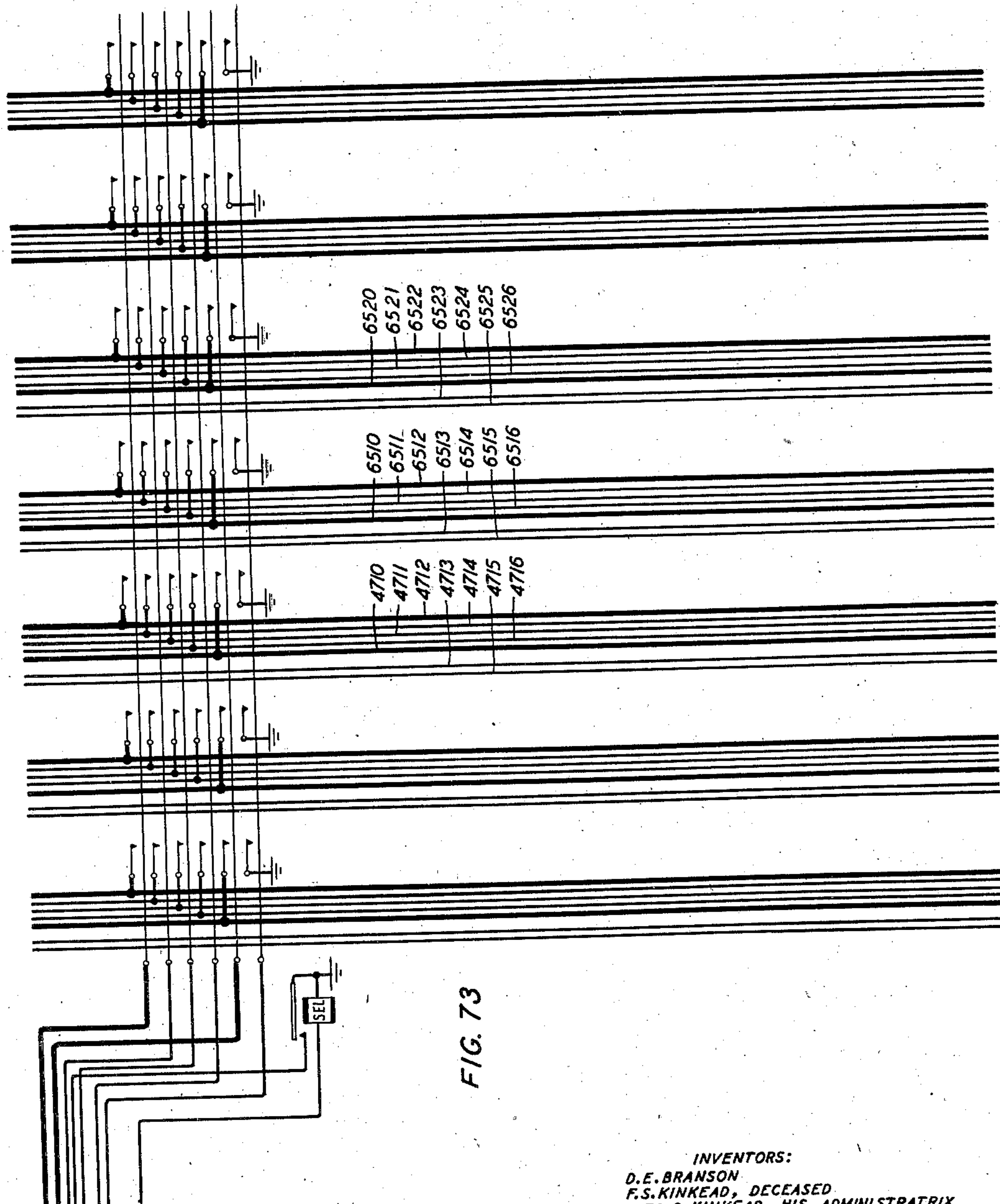


FIG. 73

INVENTORS:
D.E. BRANSON
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RITA S. KINKEAD, HIS ADMINISTRATRIX
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**INVENTORS:
D. E. BRANSON
F. S. KINKEAD, DECEASED
RITA S. KINKEAD, HIS ADMINISTRATRIX
J. A. KRECEK
G. A. LOCKE**

BY *William F. Simpson*

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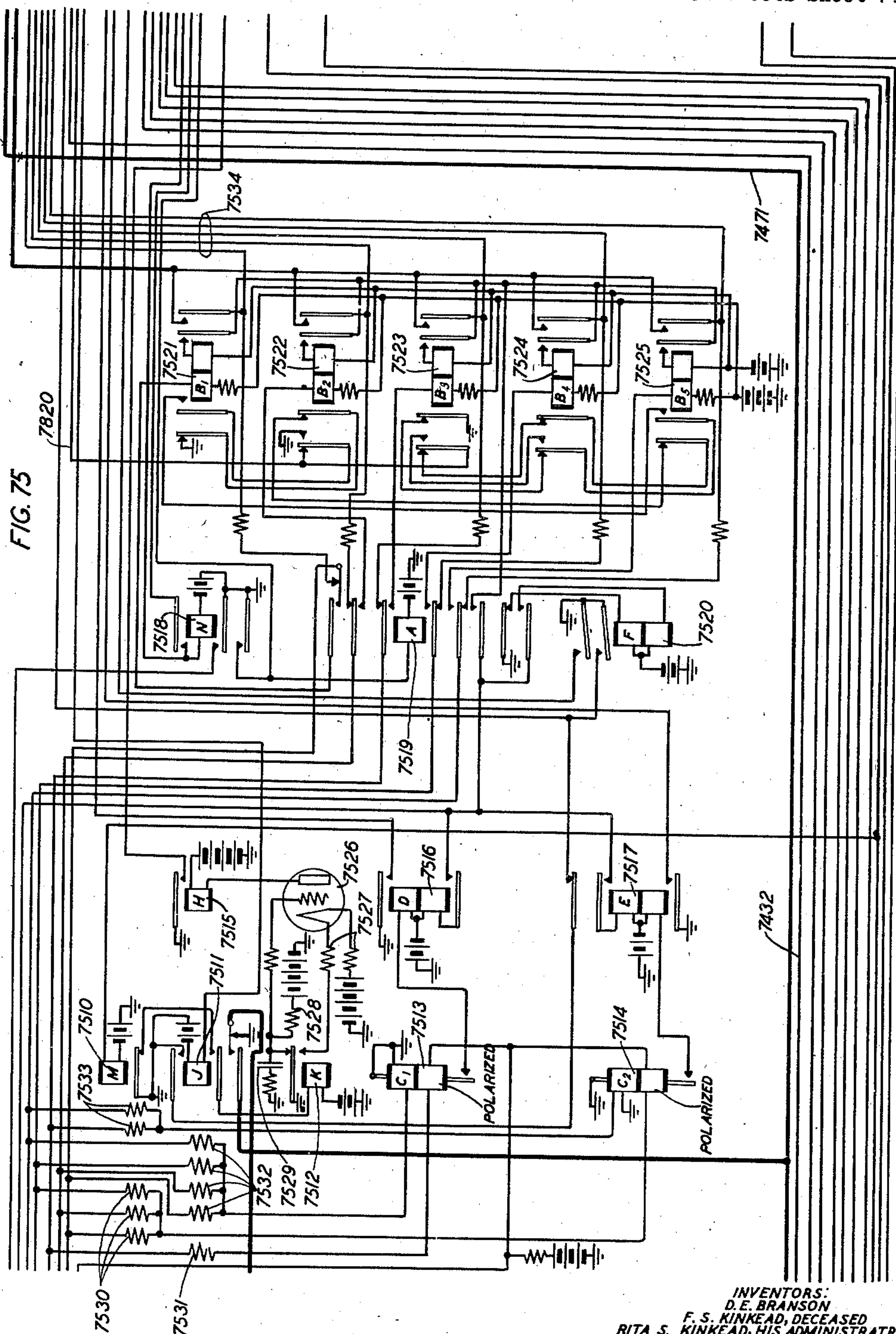
D. E. BRANSON ET AL

2,430,447

PRINTING TELEGRAPH AUTOMATIC SWITCHING SYSTEM

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92 Sheets-Sheet 74



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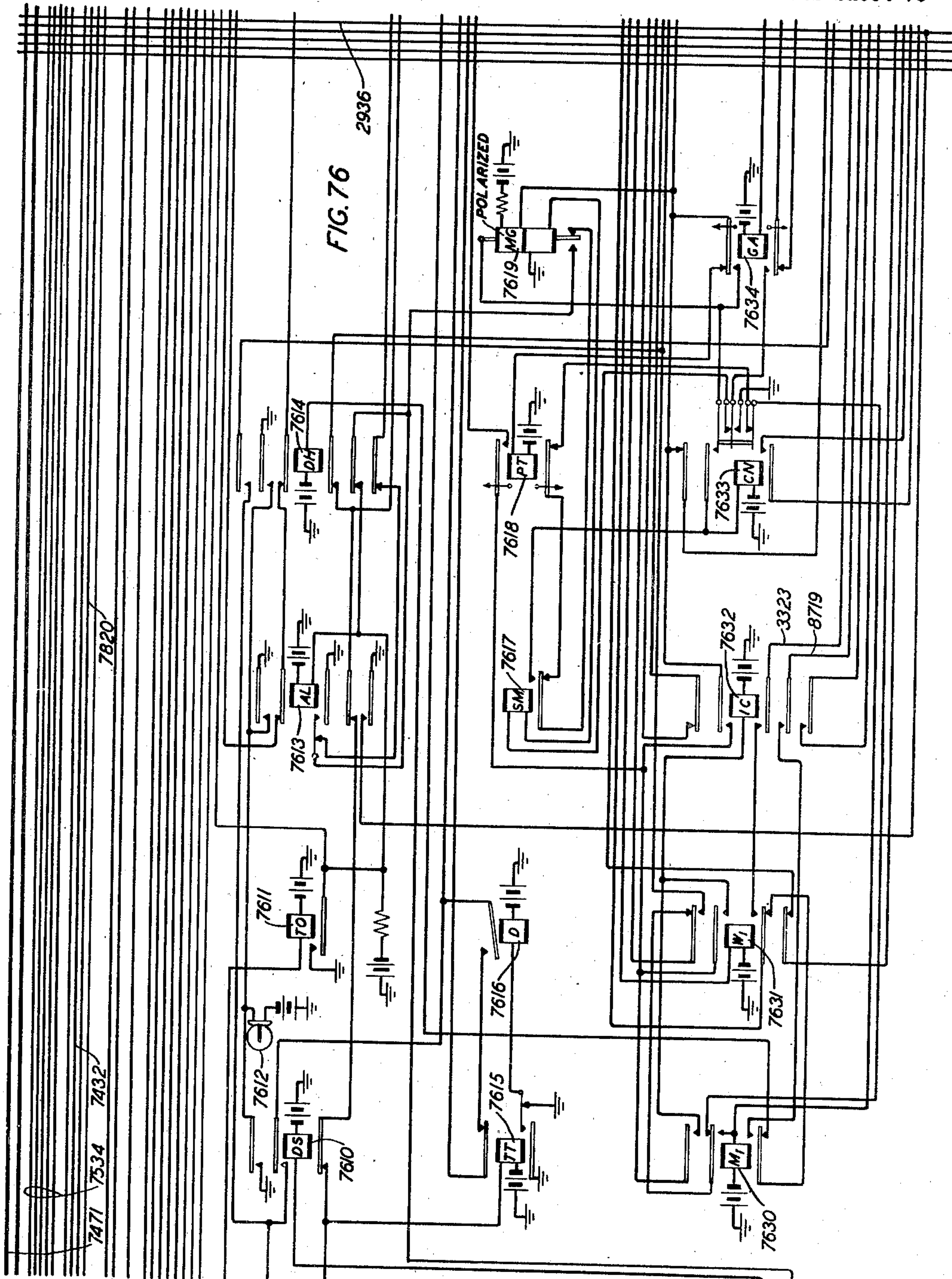
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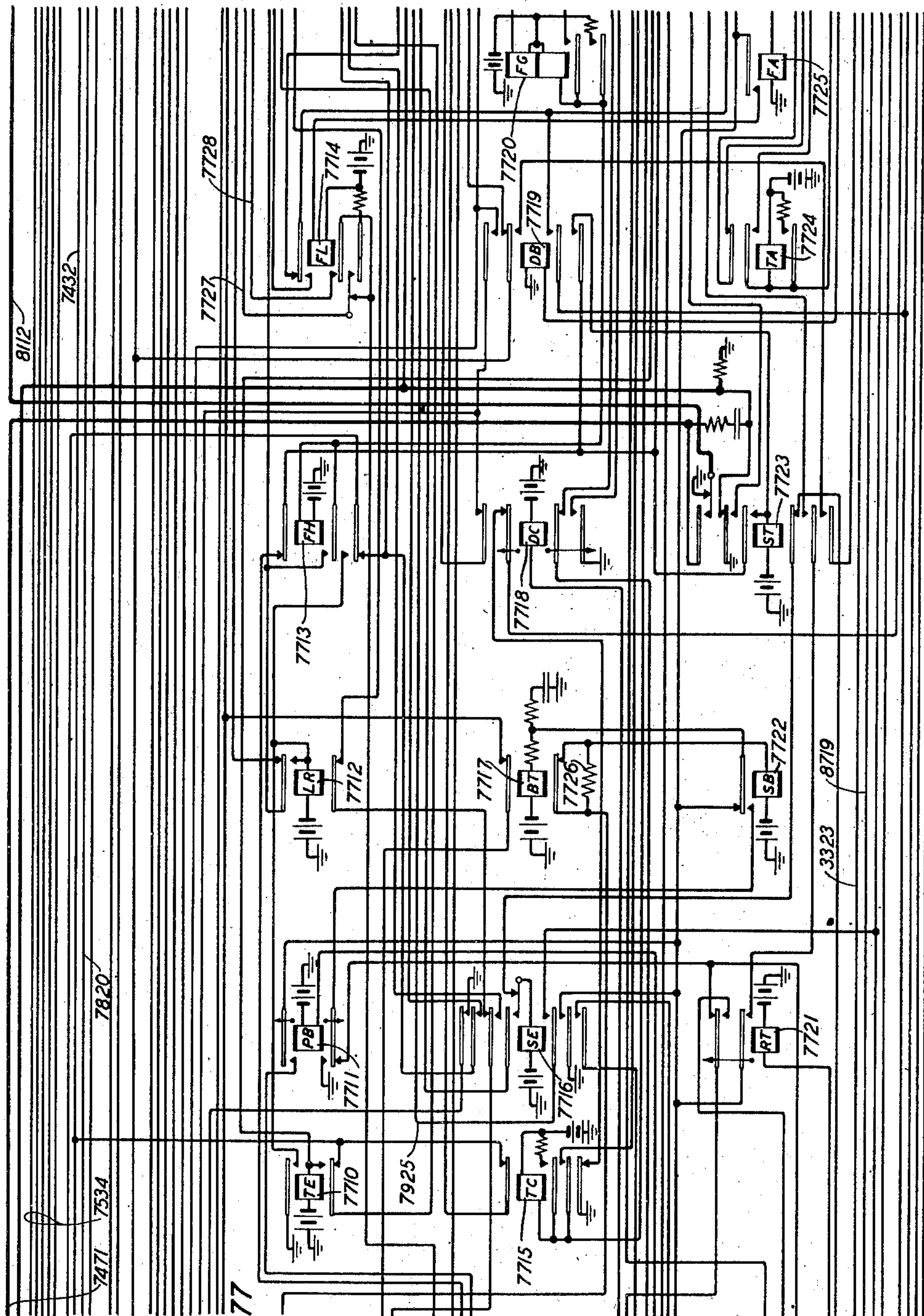


FIG. 77

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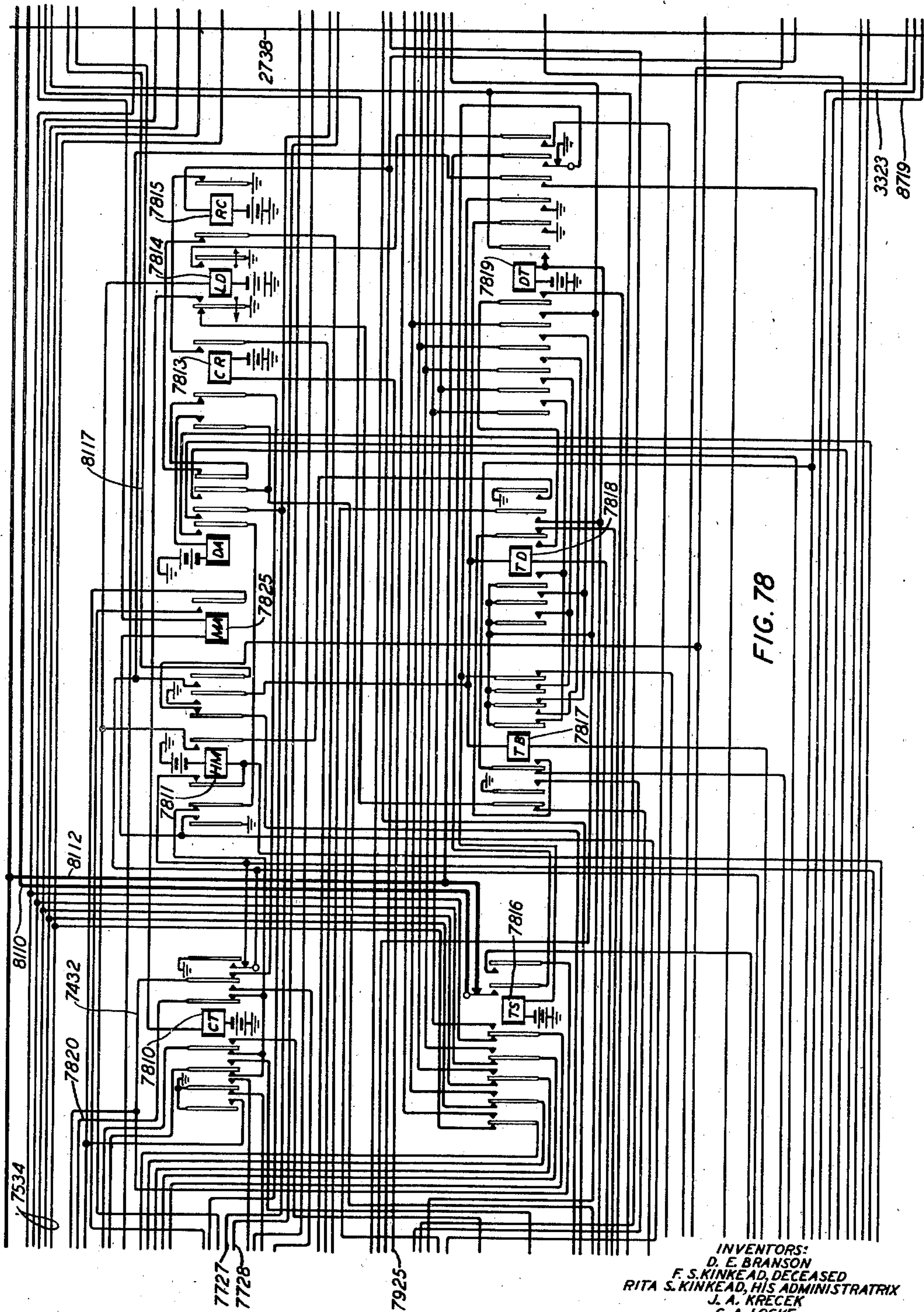
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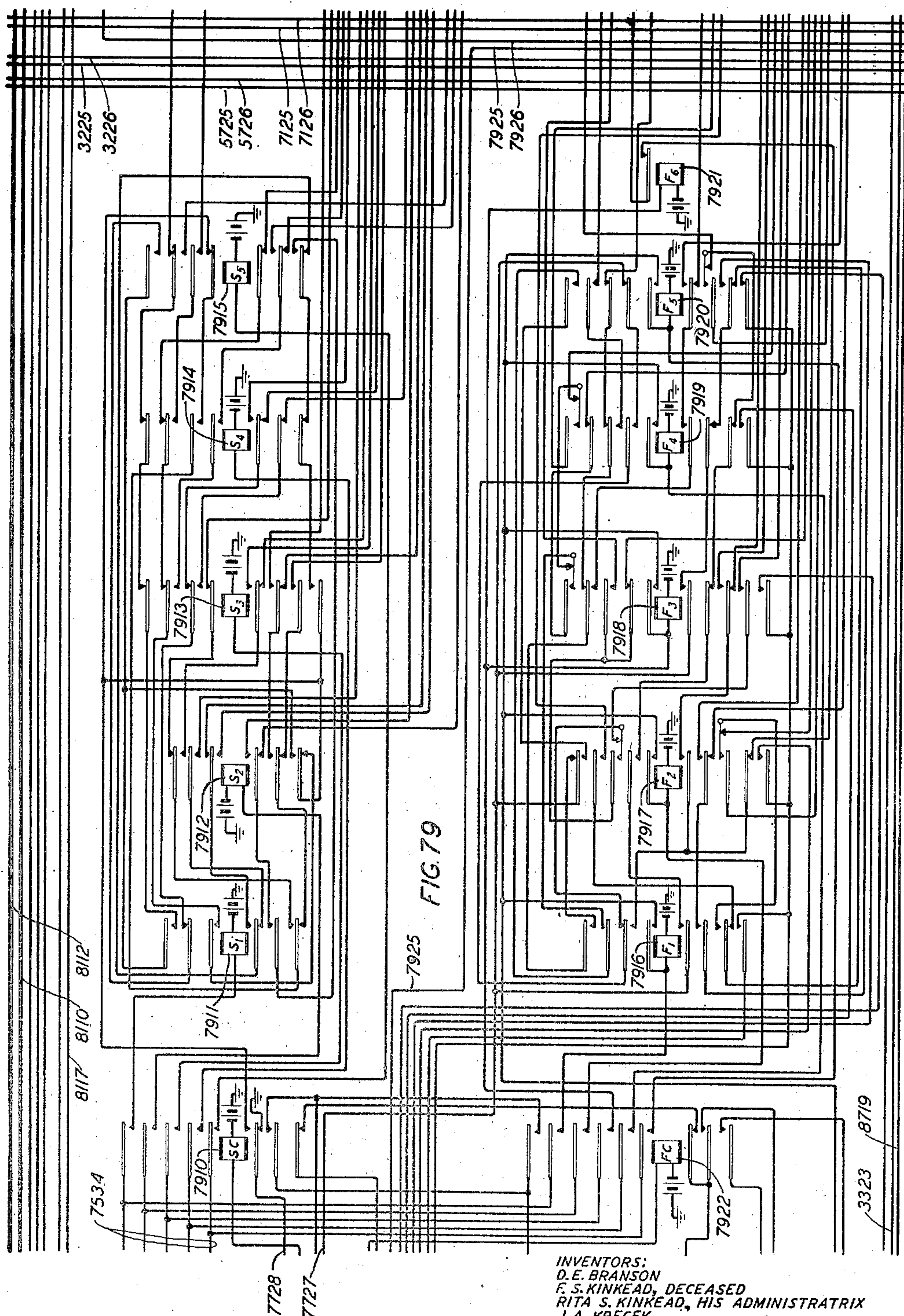
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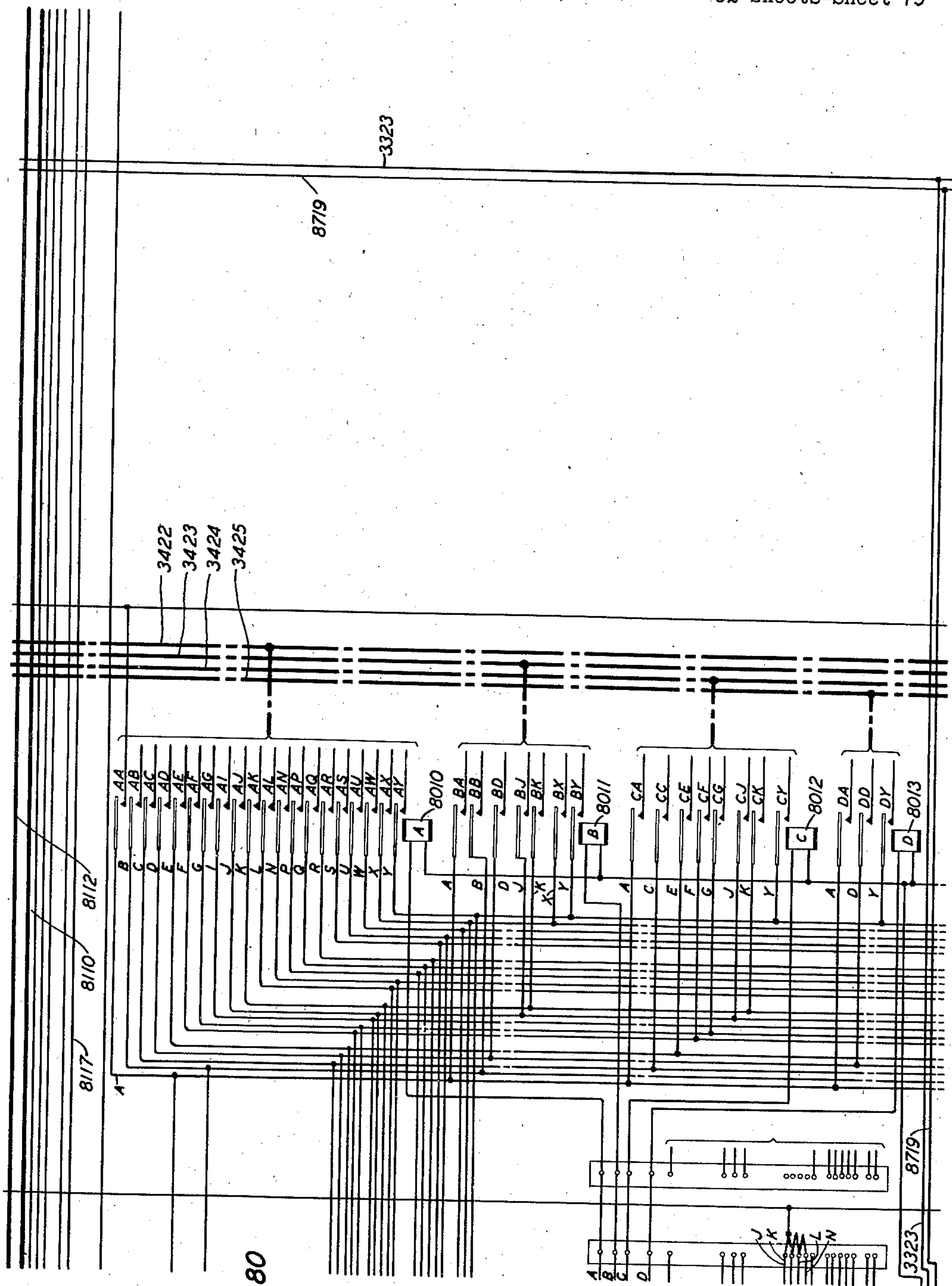
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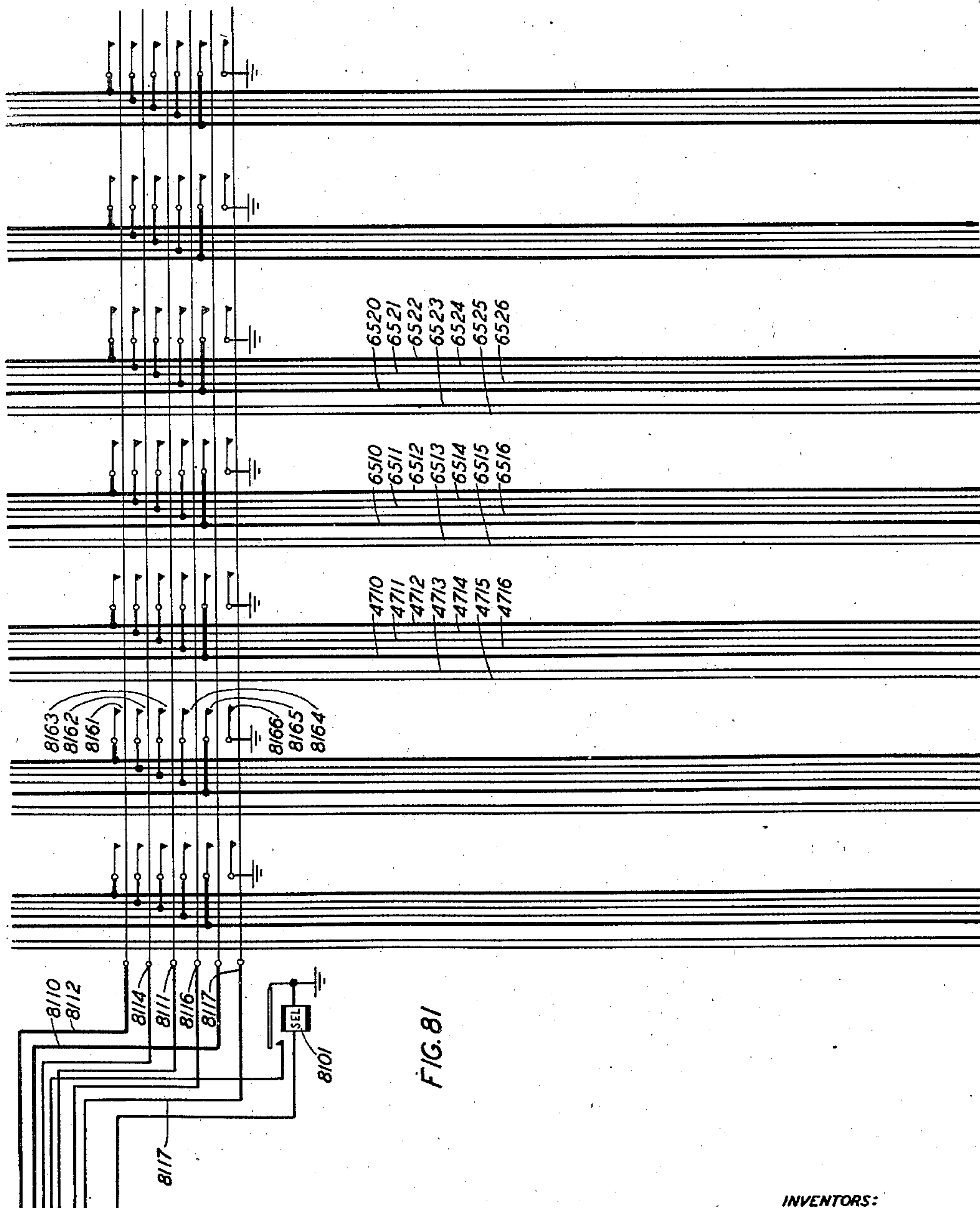


FIG. 81

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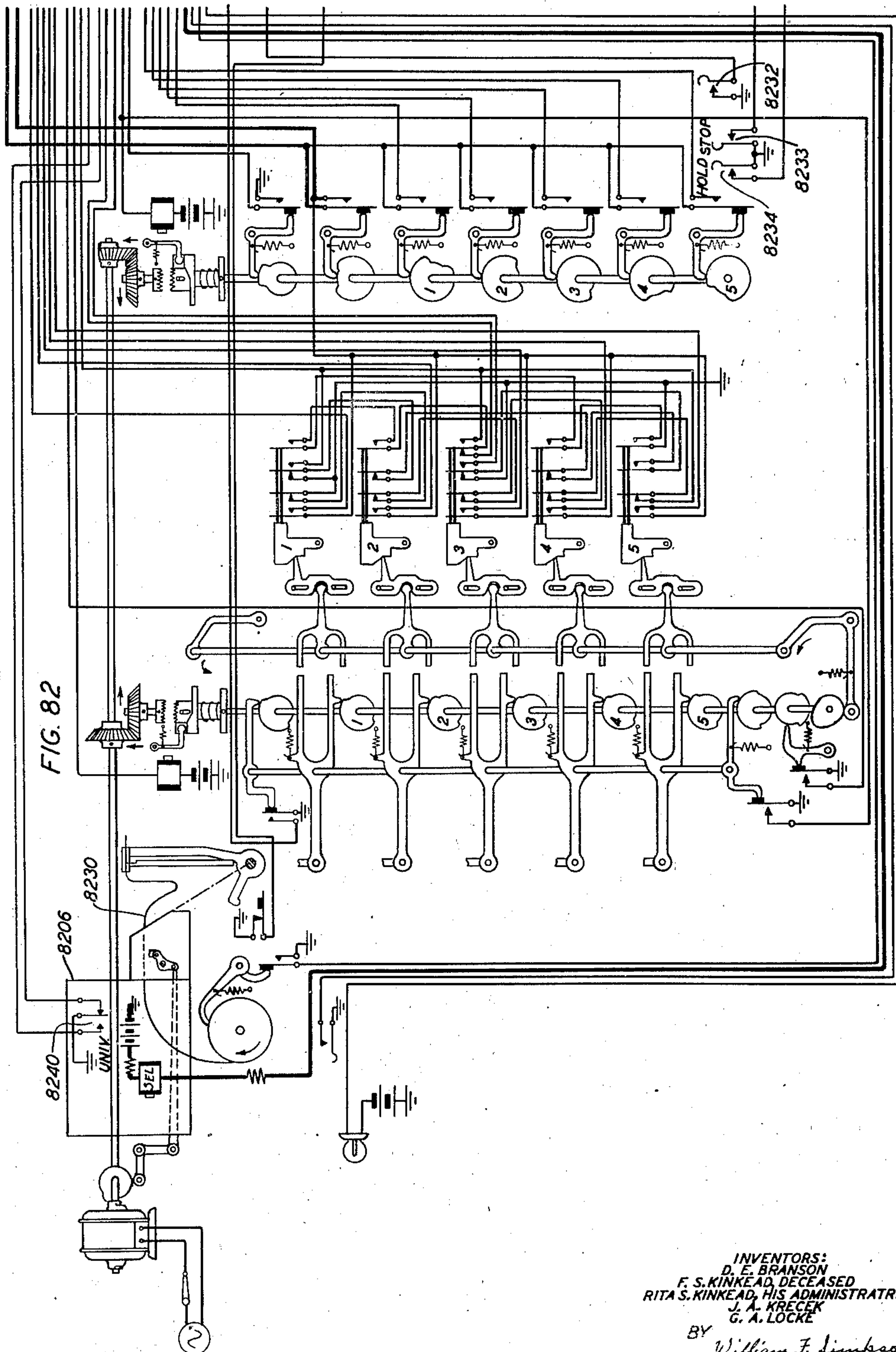
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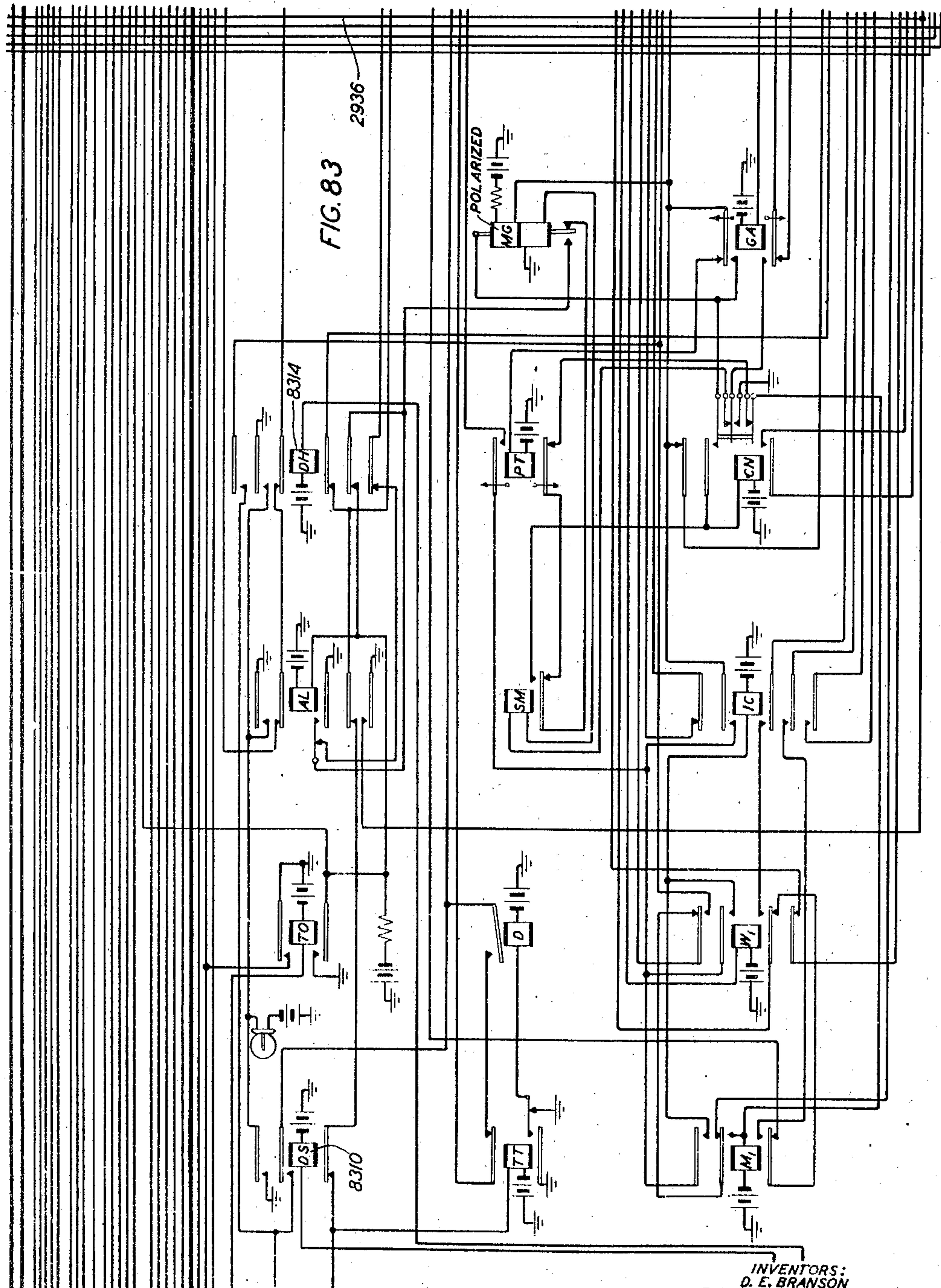
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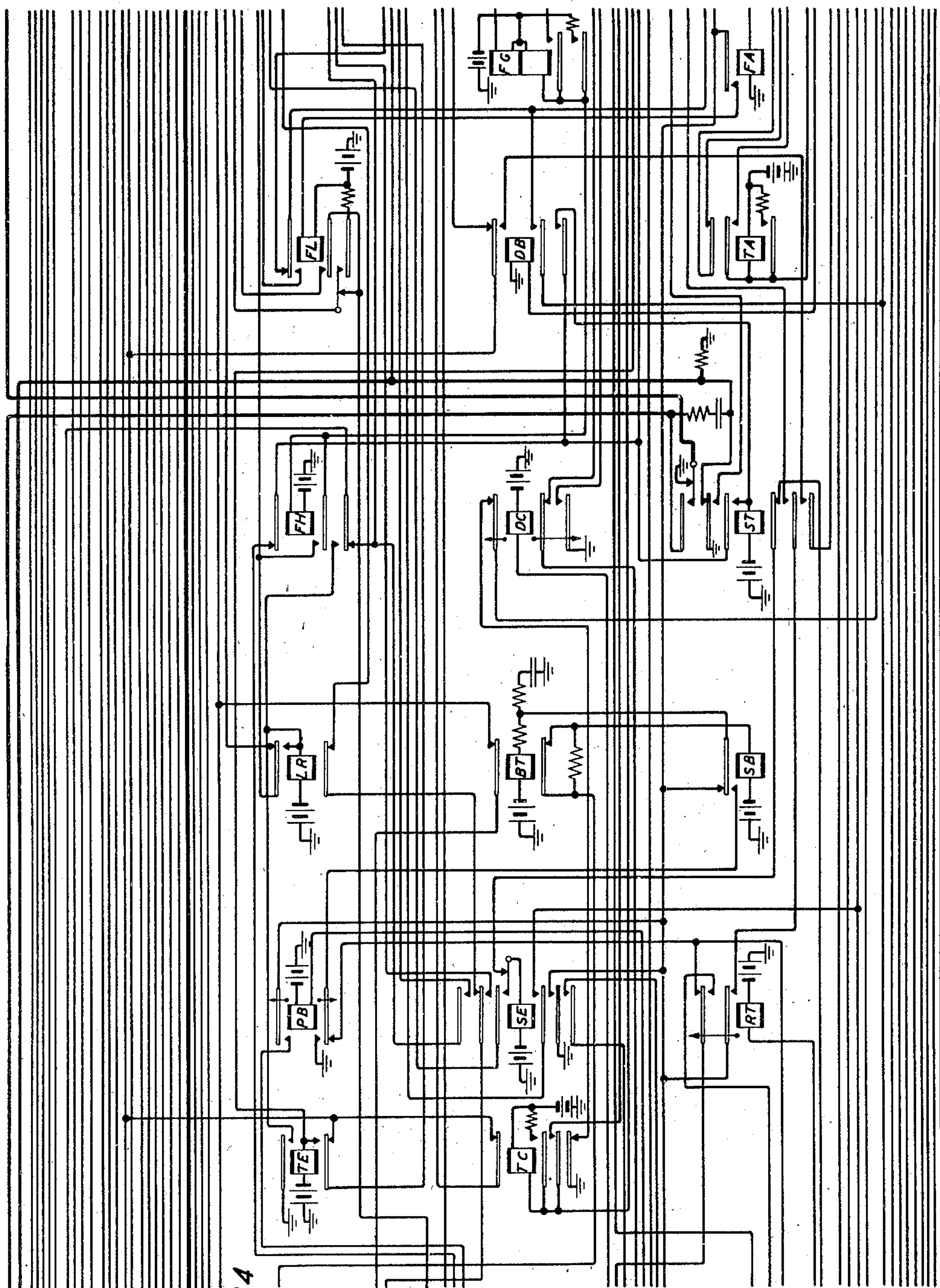


FIG. 84

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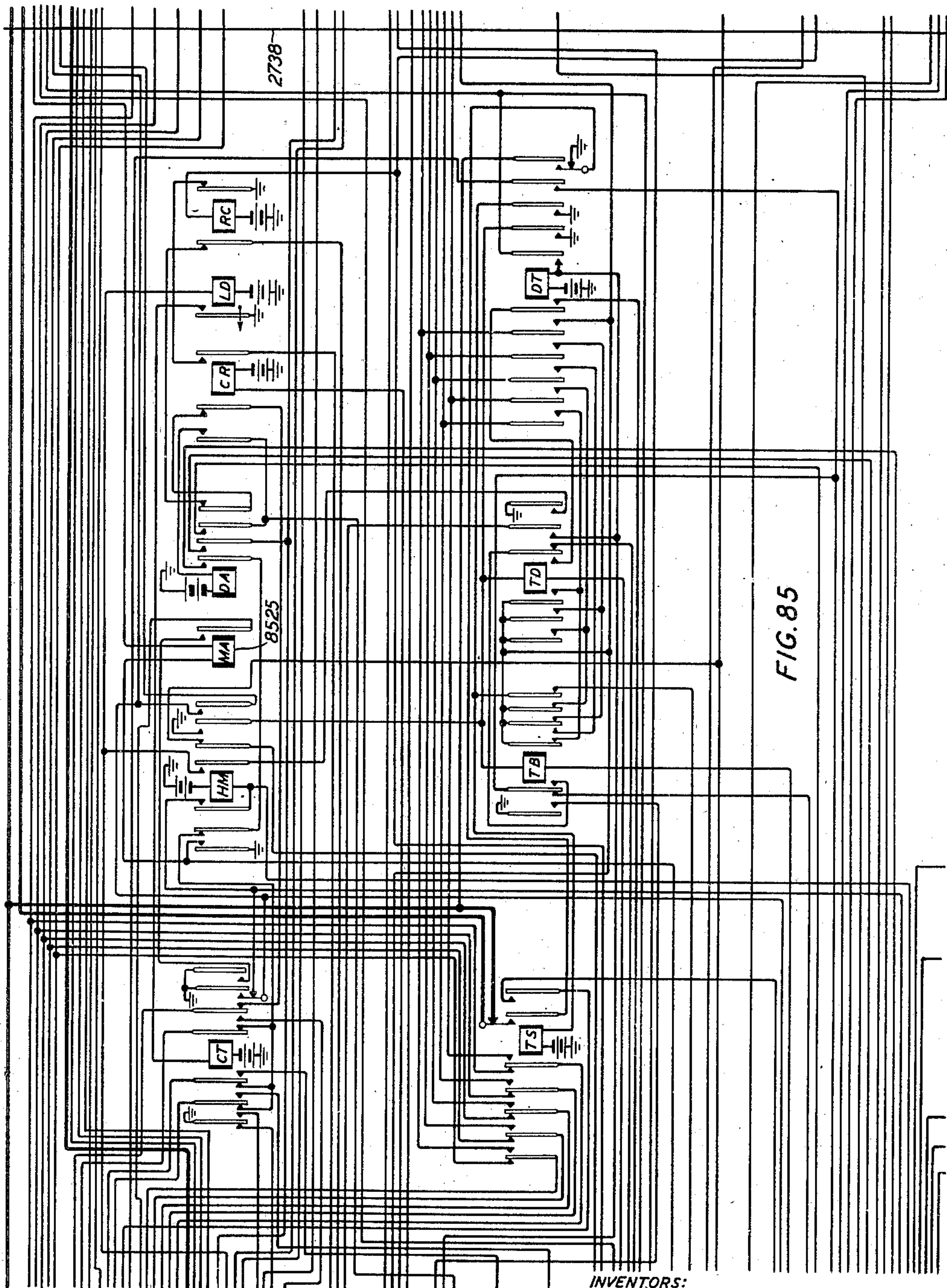
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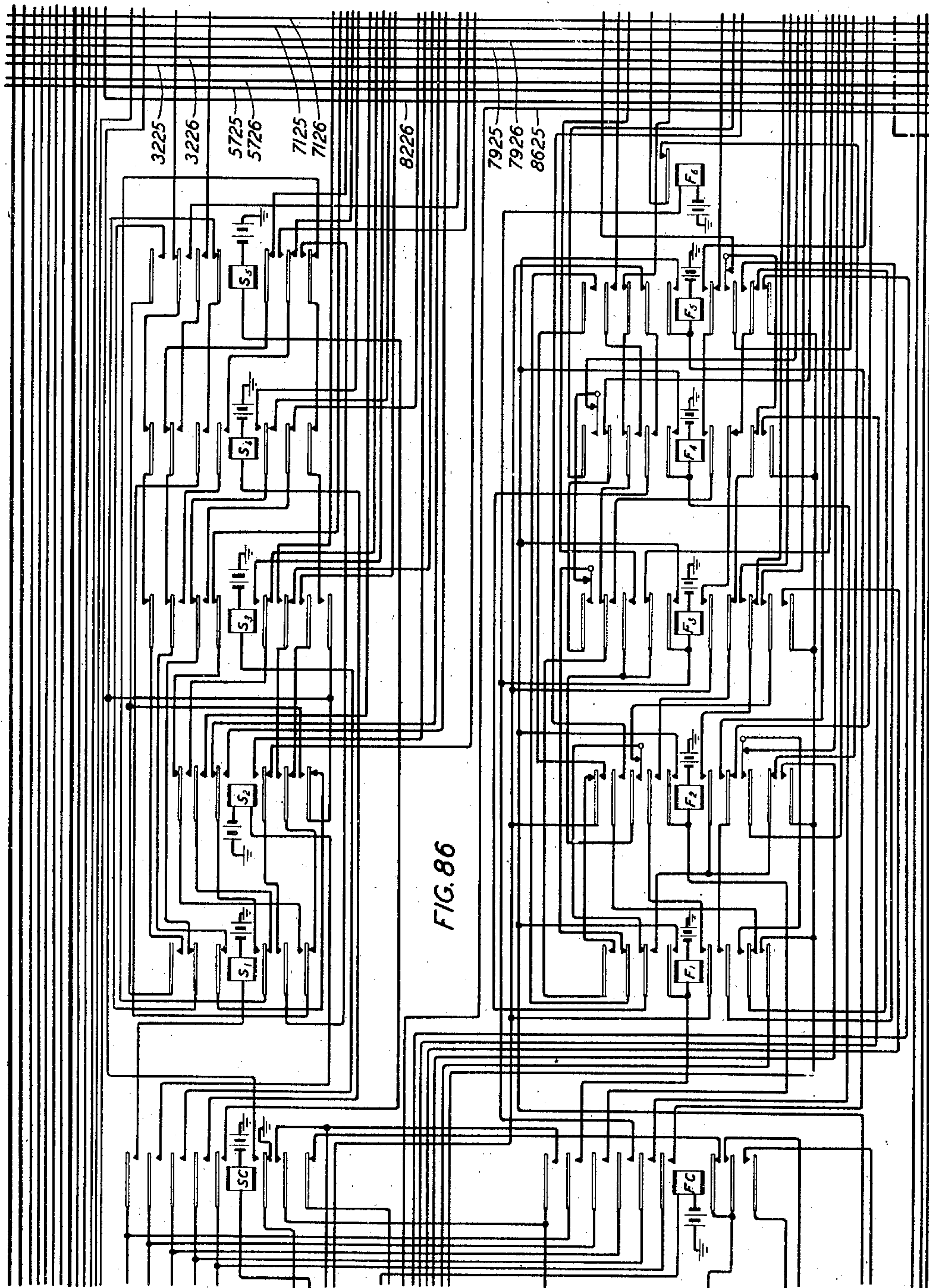
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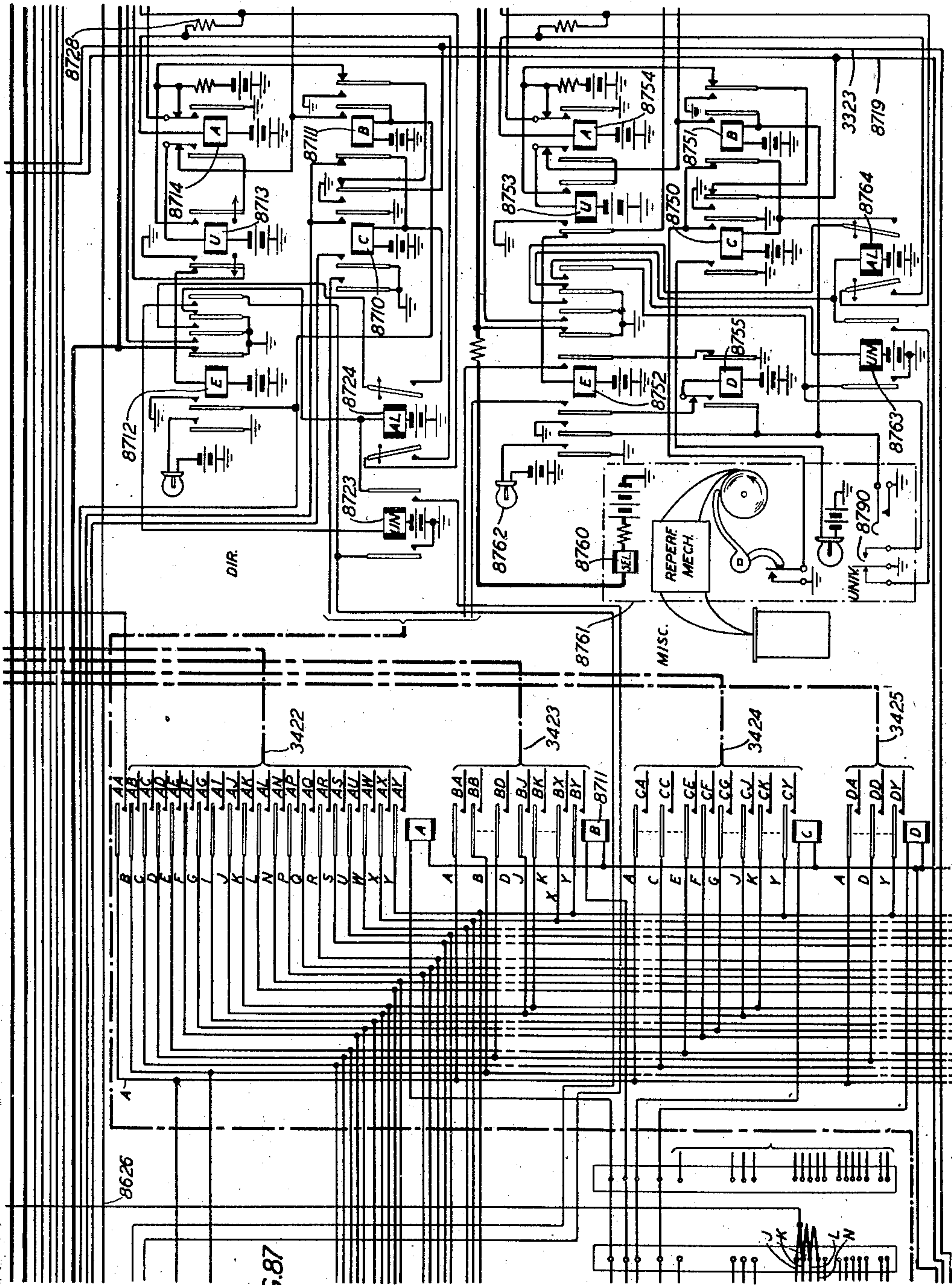


FIG. 87

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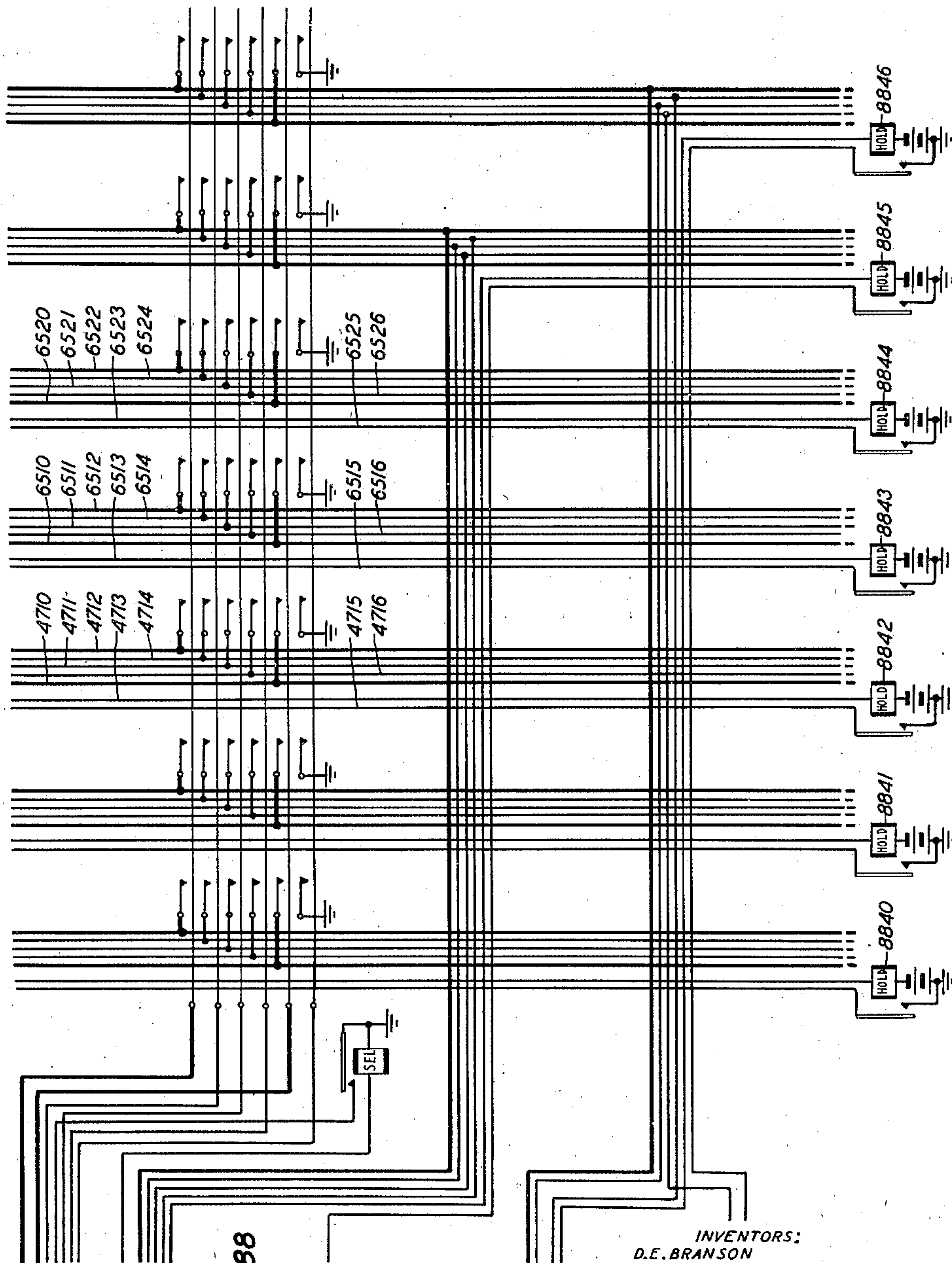


FIG. 88

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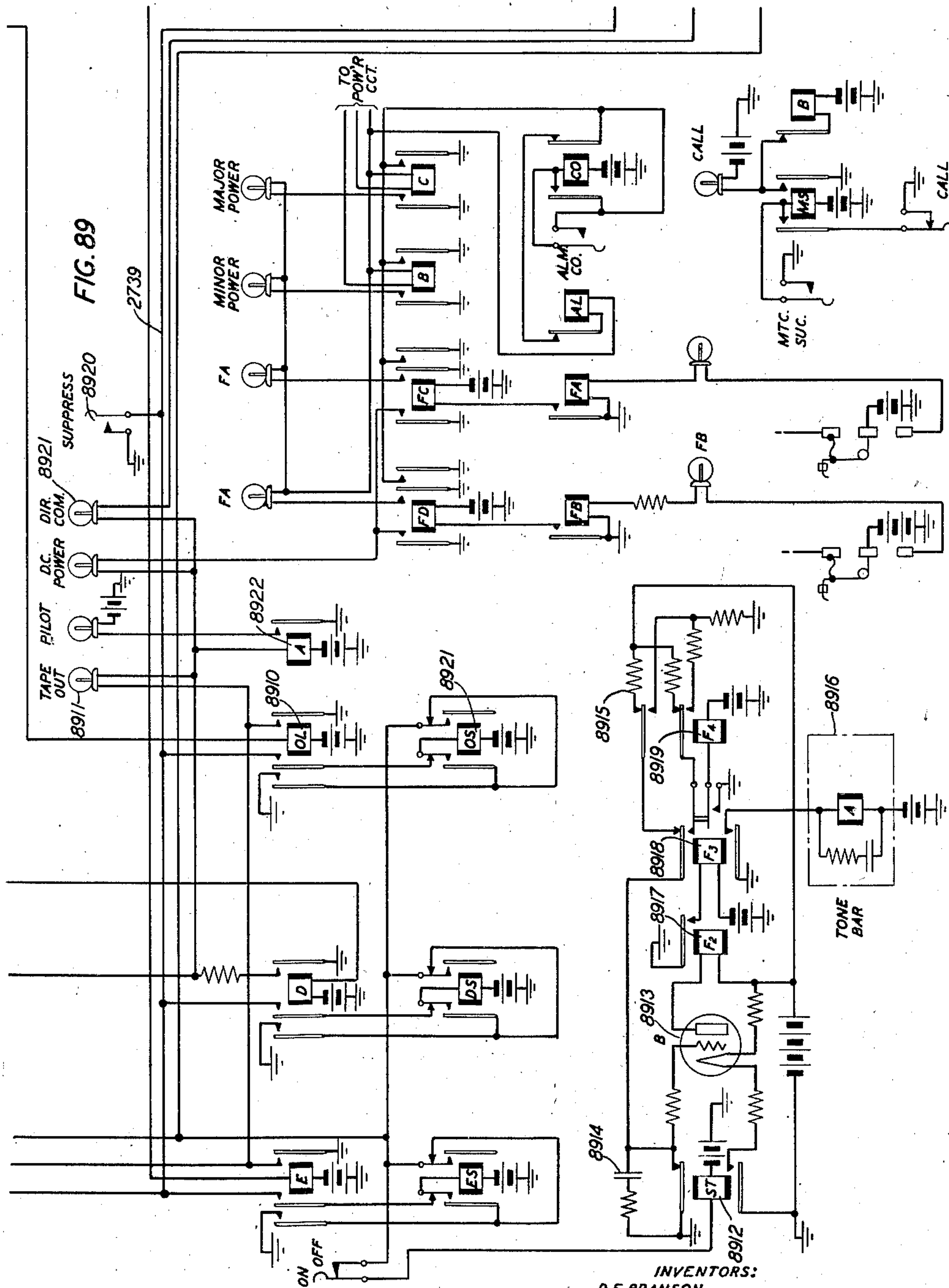
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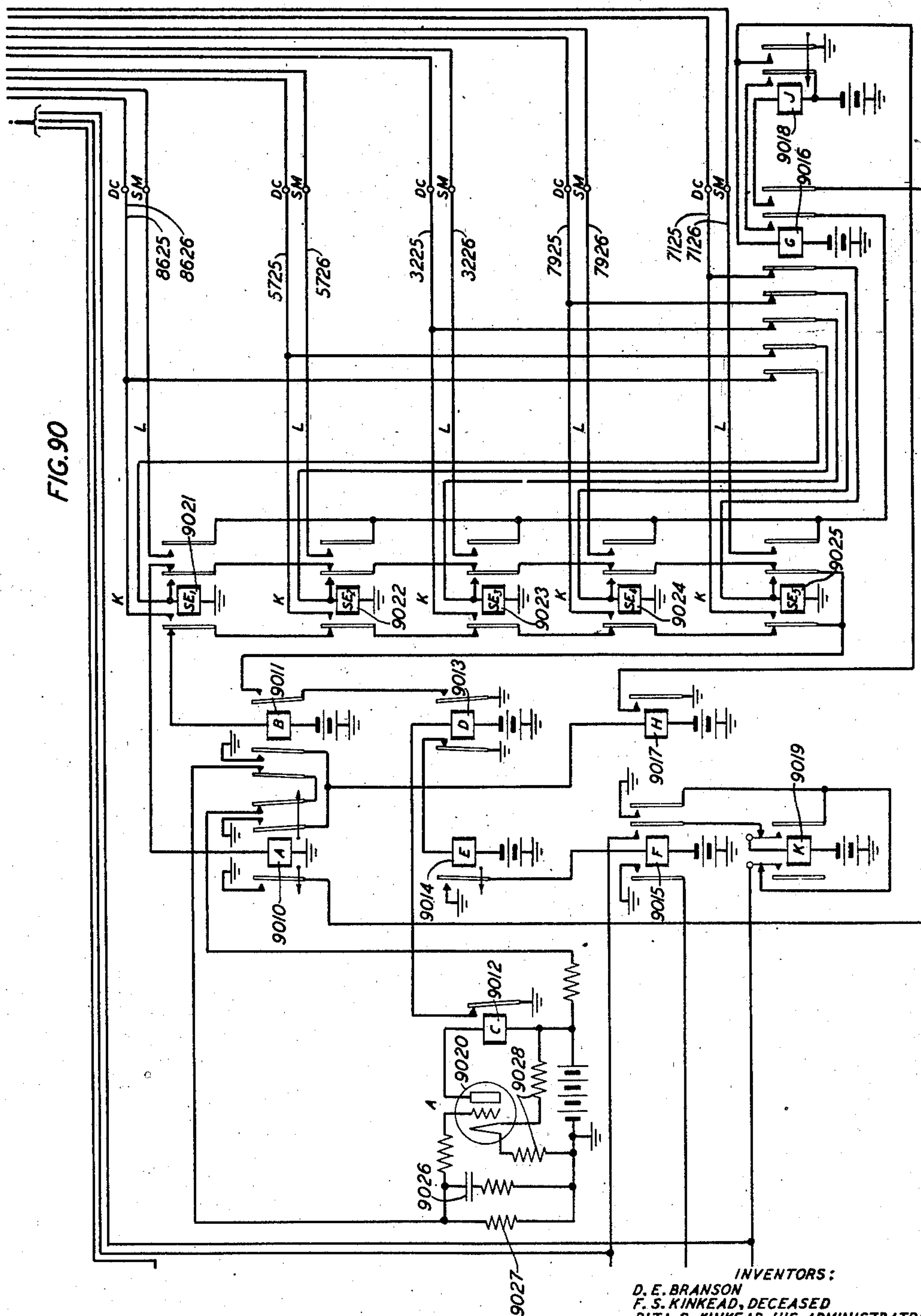
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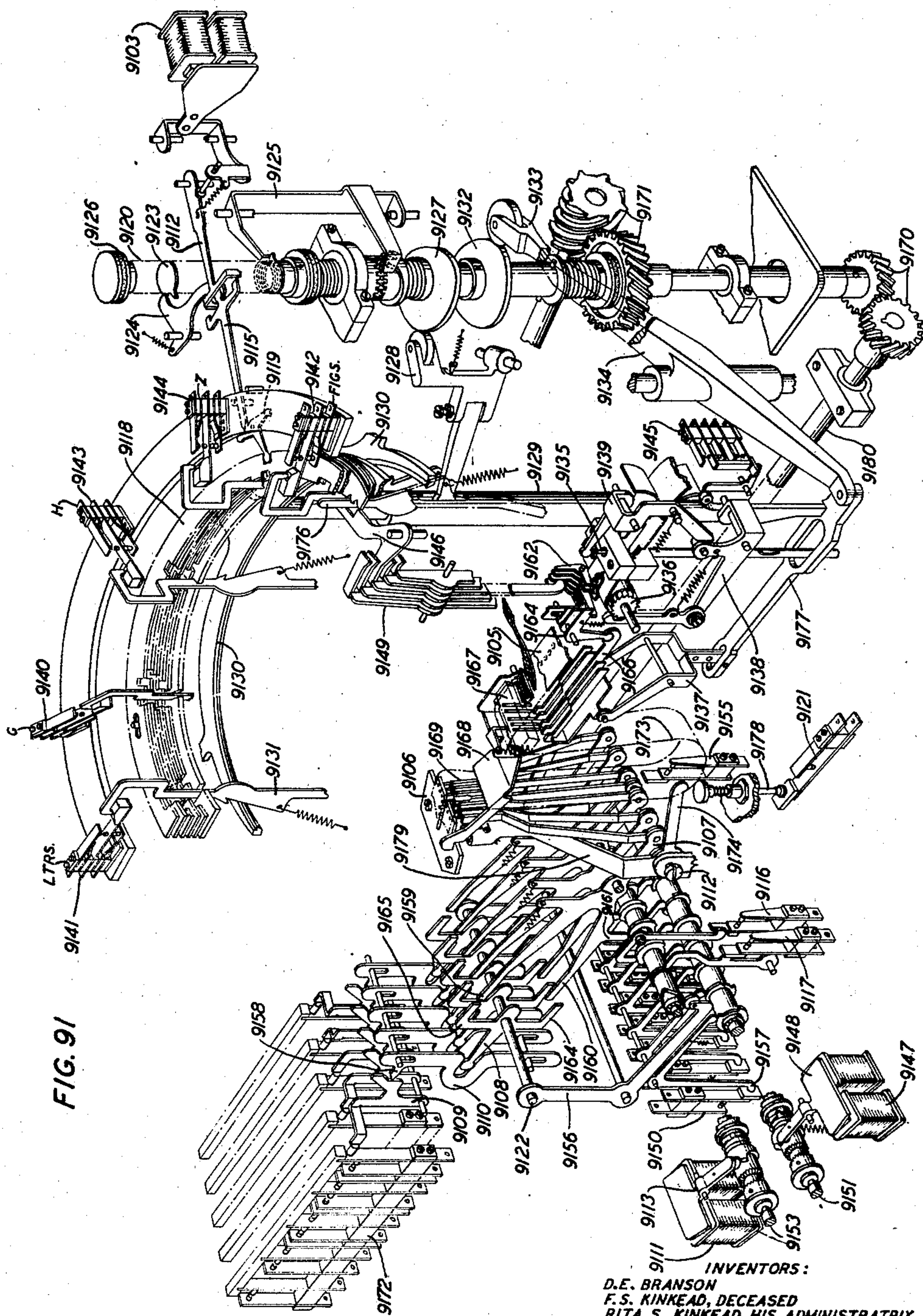
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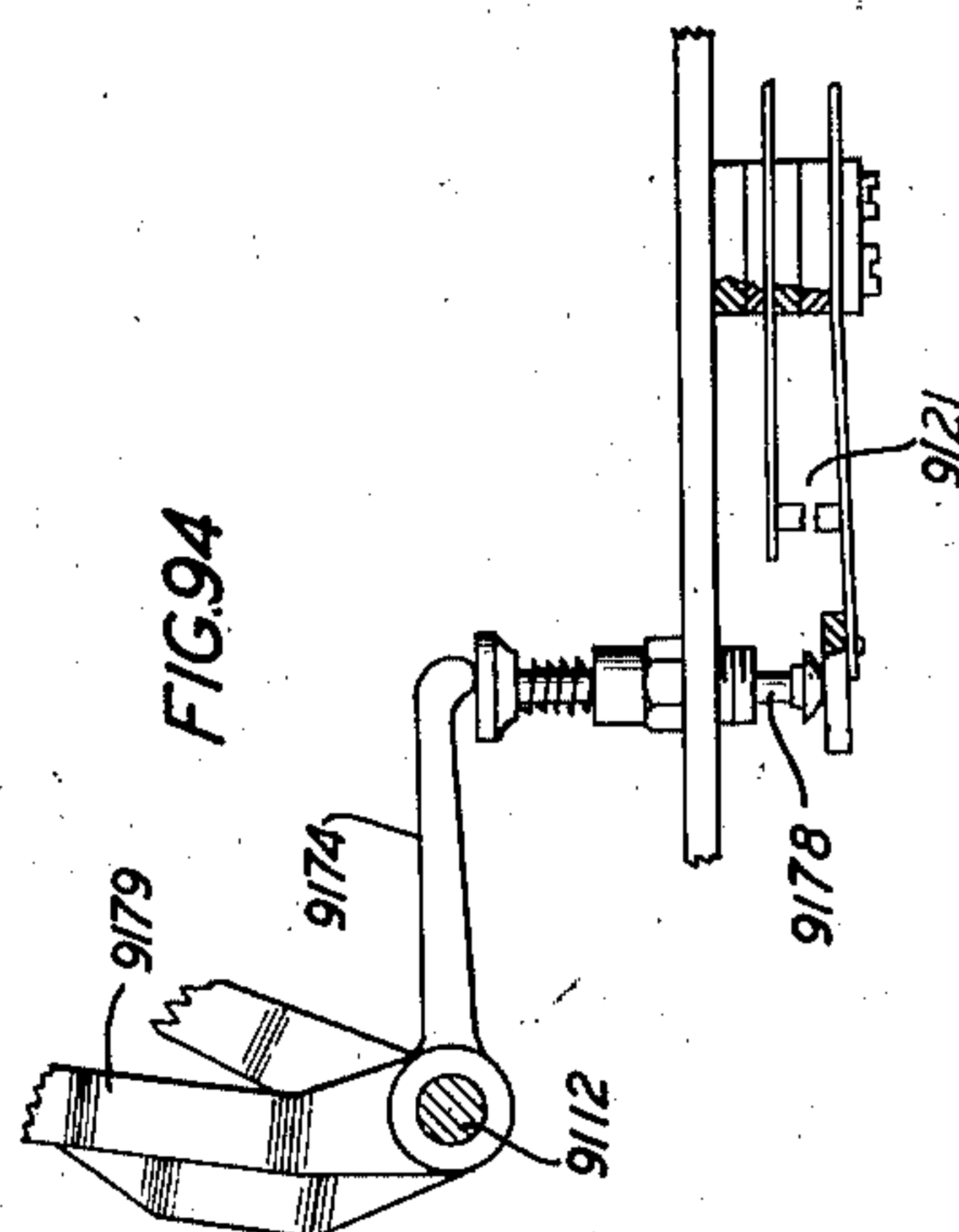
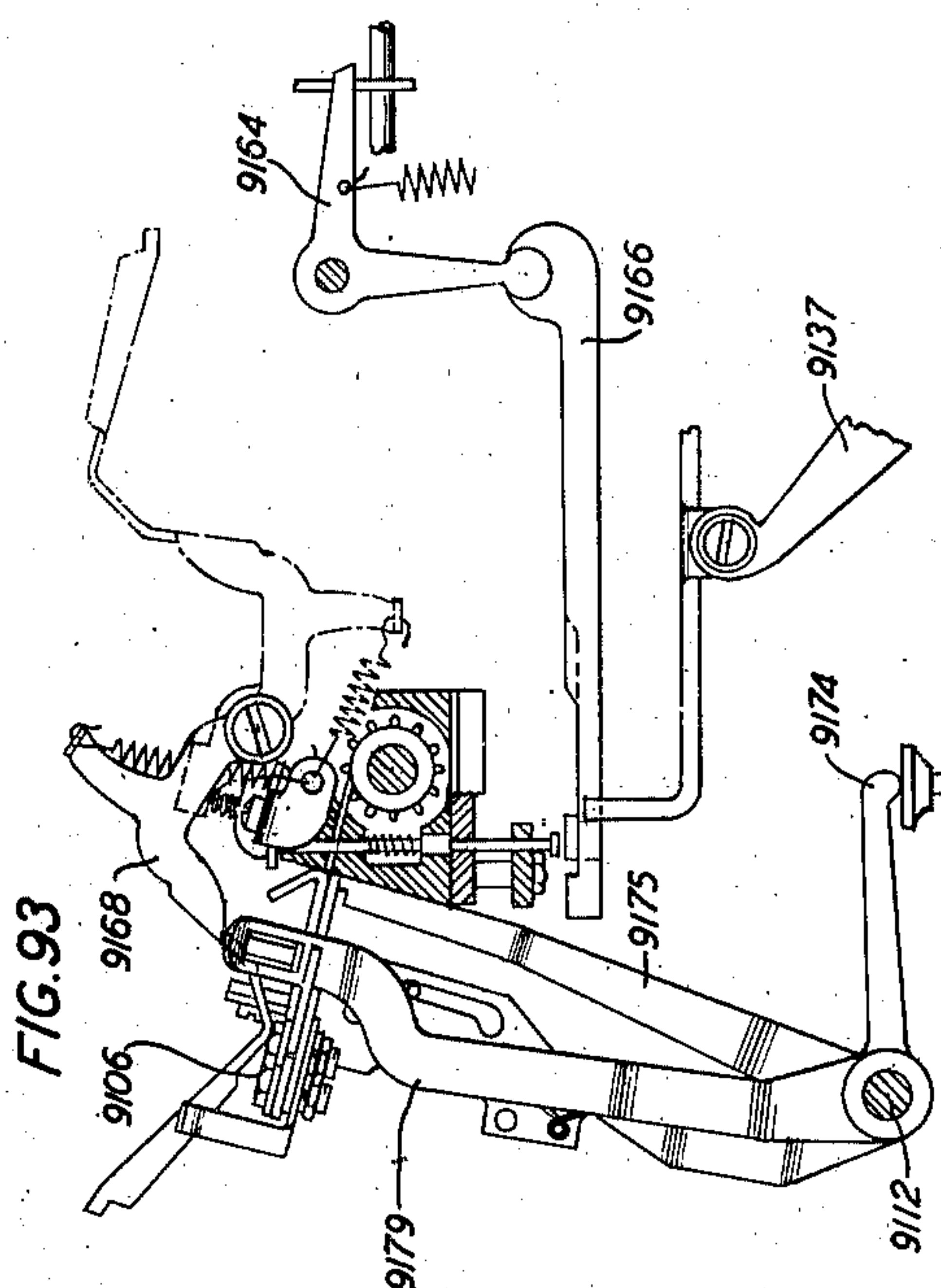
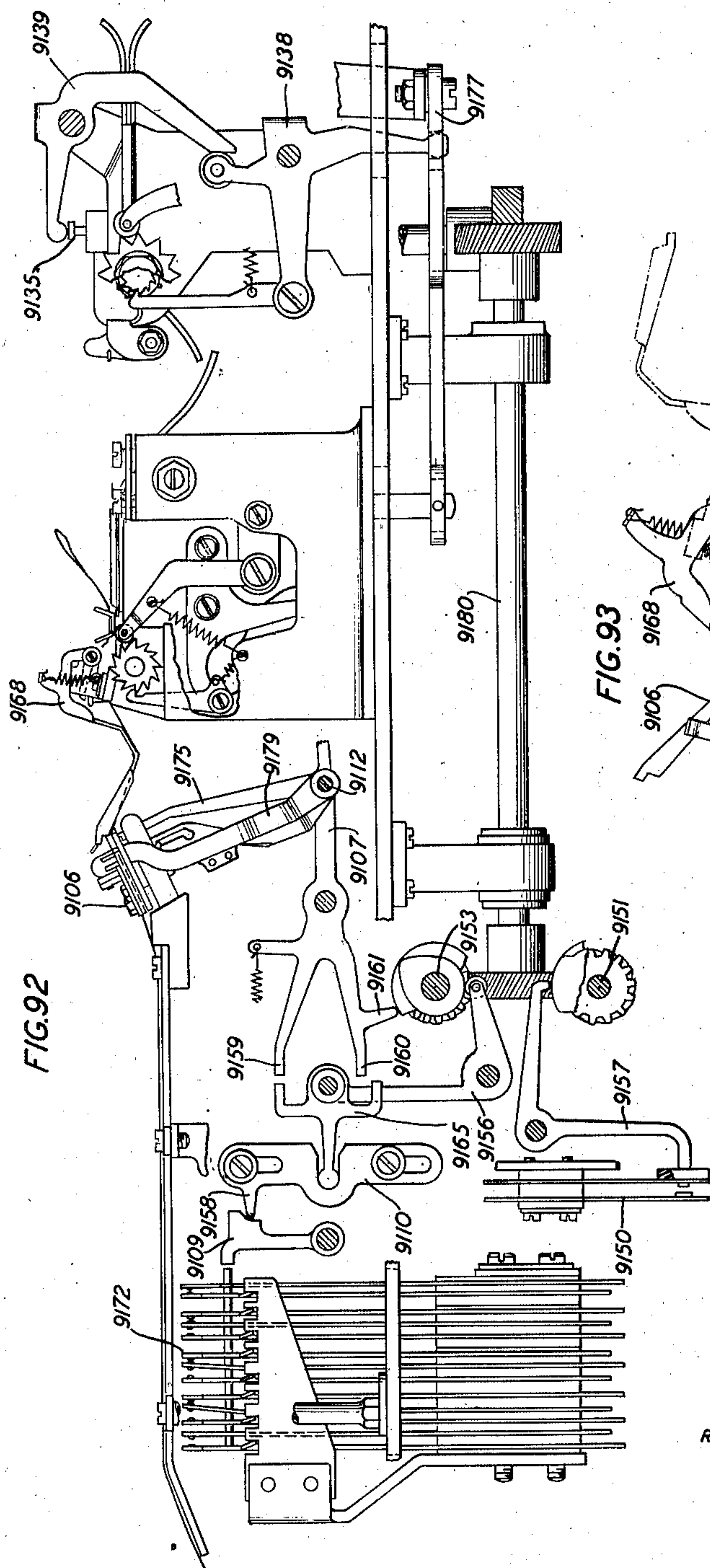
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FIG. 95

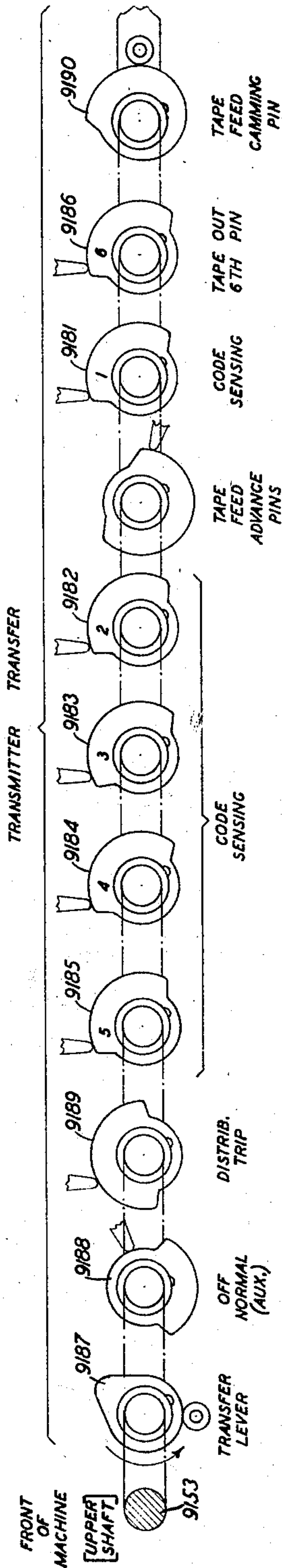
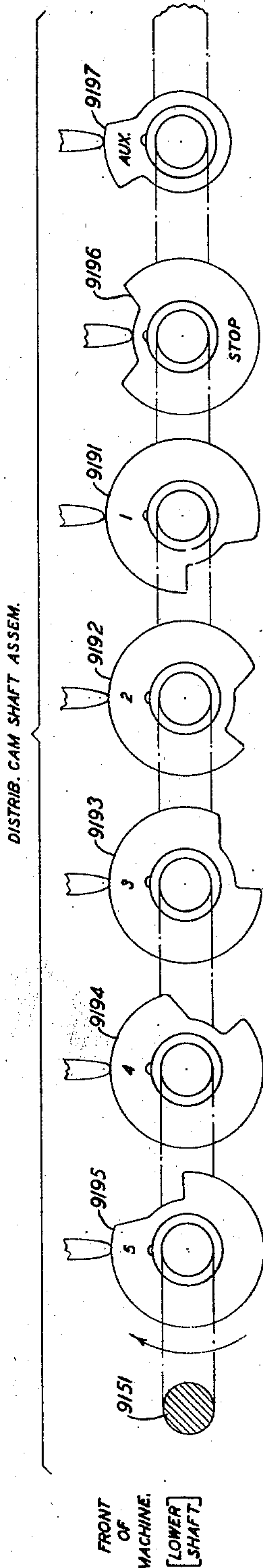


FIG. 96



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UNITED STATES PATENT OFFICE

2,430,447

PRINTING TELEGRAPH AUTOMATIC
SWITCHING SYSTEM

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Application June 27, 1942, Serial No. 448,878

210 Claims. (Cl. 178—4)

1

This invention relates to communication systems and more particularly to telegraph communication systems including switching equipment for automatically directing and transmitting messages from a station of origin to a station of destination through one or more switching centers in accordance with and under control of directing or address characters preceding the message and end of message characters following each message.

It is an object of this invention to provide a comprehensive telegraph switching system and methods of operation thereof for economically directing and transmitting messages automatically from any one of a large number of telegraph stations to any other of said telegraph stations with a minimum of effort on the part of the subscribers, attendants, and operators and with a minimum delay. Among the general objects of the invention are:—To facilitate the inclusion of greater numbers of stations in a system; to reduce the tendency to loss or mutilation of messages; to reduce or eliminate loss of line time; to more effectively utilize transmission paths and channels to the end that a greater quantity of intelligence may be transmitted over the utilized circuits and channels; to reduce the labor of operating and attending personnel; to reduce or eliminate misdirection of messages; to expedite delivery of messages to their destinations; to equalize wear of the mechanisms of the system; to simplify operating routines; and to facilitate location and correction or adjustment of trouble conditions.

Most of the automatic telegraph switching systems in the past have employed only a single character for selecting a path for future transmission of a message. These systems are limited in the number of possible stations or paths for the transmission of messages. These systems also have apparatus limitations which render the systems rather inflexible.

A particular object is to provide a method of communication and a switching system which employs more than one address character for directing the message and controlling its transmission over the paths intermediate the originating station and the station of destination or of address.

A corollary object is to provide for switching

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operation in which a plurality of characters are simultaneously decoded and employed to select any one of a large number of possible transmission paths.

5 An object is to provide a telegraph system having an improved mode of operation which comprises transmitting an address code of a plurality of characters preceding each message and an end of message code following each message, permutatively combining said plurality of address codes, 10 automatically selecting one of a plurality of transmission paths in accordance with the combined codes and automatically transmitting the message over the selected path.

15 Another object is to provide an improved method of automatic switching which comprises selecting a path under control of stored telegraph code combinations; testing the path for a busy condition, applying a continuity test to said path, 20 testing said path for other trouble conditions and finally initiating the operation of a selected switch over said selected and tested path.

Another object is to provide a telegraph system having an improved mode of operation which 25 comprises transmitting a plurality of transmitter start codes over a control channel one after another in rotation for testing a plurality of transmitters for the presence of stored message material and stopping the operation of said transmission apparatus after a complete series of signals have been transmitted including the signals 30 which control the last transmitter to transmit.

Another object is to provide a telegraph party line having an improved mode of operation which 35 comprises periodically transmitting a complete series of transmitter start signals over a control channel for testing the starting transmitters and varying the interval of transmitting said series depending upon the busy condition of the control 40 channel.

Another object is to provide an improved method of operating telegraph switching equipment under control of recorded signals which comprises sensing a first character and transferring 45 the sensing to a group of switching relays, storing the character thereupon, sensing a succeeding stored character and transferring it to a second group of switching devices, operating a single switching device under joint control of said 50 switching devices for selecting a transmission

path and then transmitting said selecting characters over said channel in their proper order.

Another object is to provide telegraph apparatus having an improved method of operation which comprises providing a plurality of similar groups of devices for transmitting messages over telegraph transmission paths and directing messages in rotation to the devices associated with each path.

Another object is to provide improved means of and methods for selecting in which a plurality of separate and individual switching characters or code combinations are employed in permutative combinations to select any one of a large plurality of transmission paths apparatus or stations.

Another object of the invention relates to providing improved equipment for use in systems for automatic direction of messages wherein outlying subscribers or attendants perforate a tape or store messages in physical form or in any other suitable manner and then insert the tape or employ the stored signals to control an automatic transmitter.

In order to effectively use substantially the entire line time and thus provide a more economical system, a number of outlying stations are connected to a single transmission channel or party line and the transmission of signals over the line controlled from the central switching center in such a manner that each of the storage transmitters at the subscriber stations are given an opportunity to transmit any stored signals available for transmission one at a time and in rotation.

An object is to provide improved switching operation to enable these transmitters to start to transmit in rotation and transmit the stored message material with the least amount of delay and with a maximum use of the line time by providing storage equipment at the central switching center so that the messages may be transmitted over the line to this storage equipment at the central switching station independently of the busy condition of any other path over which the message will be transmitted.

It is another object to provide an improved arrangement to further expedite the transmission of messages intended for the central switching station by providing a receiving device at the central switching station for receiving these messages without transmitting them through certain switching equipment used for through messages. This arrangement has a further advantage that it materially reduces the wear on the switching equipment.

It is another object to reduce delay in the transmission of messages through the switching equipment by providing an improved switching system having a plurality of duplicate paths leading to at least the lines which are heavily loaded. Each of these duplicate paths is provided with improved storing equipment for simultaneously receiving and storing a plurality of messages, one by each of the storing devices, and then later causing the messages to be repeated one after another in succession over a transmission path.

Previous systems of this type have directed all of these messages over one of these paths when it is idle and over the second path only when the first path is busy. Such practice has been susceptible of a considerable delay in some messages transmitted over the first path. It is an object of this invention, in order to further reduce the delay and to more uniformly load the

equipment in the various paths, to arrange the circuits so that messages are directed to the various paths in alternation or rotation.

Another object is to provide improved arrangements to secure an economical system by connecting a plurality of stations to most of the lines so that the message material from all of these stations will keep the line busy the major portion of the time. This enables the lines and switching equipment to be loaded near capacity and thus secures an economical handling of telegraph messages.

It is also an object of this invention to provide an improved control system to automatically test and control a plurality of geographically separated transmitters from a central switching point for stored message material and cause them to transmit the available material over a common path, one at a time.

It is a further object to provide switching circuits and apparatus at the central switching station to enable any of the transmitters connected to any line to be skipped when desired.

In previous systems wherein a plurality of transmitters were periodically tested one at a time for message material, the systems have been arranged so that they will test each of the transmitters one at a time as desired, until all of the transmitters have been tested. The usual practice has been to provide a pause or delay period before each of the transmitters is again tested for messages for transmission.

An object is to expedite the transmission of messages by testing each transmitter in turn until all of the transmitters, including the last transmitter to transmit, have been tested before stopping the testing of the transmitters for a predetermined period.

A further object is to provide an improved automatic starting circuit for starting the transmitters by the transmission of predetermined series of signals which will selectively start any of the transmitters connected to the corresponding line.

Another object is to improve switching systems in which each of the line circuits is associated with a plurality of secondary switching points for controlling the transmitting and receiving equipment associated with each line.

It is a further object of this invention to arrange this secondary switching equipment so that the same code combinations may be employed for selectively controlling the transmitters at the various stations as are employed for controlling the receiving equipment at the same or other stations served by the common line.

Another object is to provide control apparatus and circuits for controlling the transmission over a half duplex party line of messages which originate at a plurality of geographically separated points or stations.

The term "half duplex" transmission line, system, or channel as used in this specification means a communication line system, or channel over which signaling currents may be transmitted in either direction but only in one direction at a time. The term "party line" as used in this specification connotes a transmission line, system, or channel extending from the main exchange or control station to a plurality of outlying or way stations sometimes called "subscriber's stations."

Another object is to provide a storage transmitter at each of the stations connected to a half duplex party line and then control the transmitters so that they will be given an opportunity to transmit one at a time and in rotation.

Another object is to provide a circuit having equipment for automatically testing the transmitters located at the subscriber's stations for stored signals for transmission and causing the transmitters, when such signals are found to be available, to transmit them to the central exchange.

It is an object of this invention to further secure adequate loading of equipment of various lines by providing a half duplex line for interconnecting a plurality of stations the traffic from which is insufficient to require a full duplex line. A further object of this invention is to provide special control circuits for controlling the transmitters and receivers associated with the half duplex line so that messages to and from the respective stations will not interfere with each other.

A further object is to provide for the interchangeable interassociation of full duplex and half duplex lines or channels in a system of this type.

A further object is to reduce the time delay and also to simplify the equipment by taking advantage of the beneficial operating features of a specially designed combined printing reperforating equipment and automatic transmitting equipment which is capable of transmitting the last character recorded by the perforating equipment. By employing this type of equipment the usual delay necessary for the recorded signals to travel from the recording point to the transmitting point is eliminated. In addition, this arrangement eliminates the need for causing the recording equipment to feed out an additional supply of storage medium in case no further signals are received so as to insure the complete transmission of the final message recorded in the storage medium; it also simplifies the system by eliminating the necessity for provision of equipment to prevent errors incidental to feeding out tape.

It is a further object of this invention to reduce the switching equipment required by providing a large number of contacts controlled by the transmitter.

It is another object of this invention to provide power operated apparatus to position a group of contacts individual to elements of a signalling code in accordance with stored code elements.

It is a further object of this invention to provide a transmitter controlled by a record medium with a plurality of contacts controlled by each signal element recorded in the recording medium.

A further object is to provide a record controlled transmitter with a plurality of contacts for transmitting signals in accordance with the recorded signals and a further plurality of contacts for automatically scanning the signals recorded in the medium and completing switching circuits in response to predetermined signals stored in the medium.

Another object is to provide means for independently controlling the record controlled apparatus of the above referred to combined receiving recorder and transmitting apparatus and the transmitting distributor thereof.

A feature of simplification of the invention is the employment of a distributor associated with a transmitter for transmitting signals in accordance with the signals stored in said record medium at times and at other times employing this distributor to transmit predetermined series of signals for control purposes.

Another object is to provide for trunking between switching centers.

A feature comprises selecting equipment which decodes addresses directed to lines served by one switching center and messages directed to lines served by another switching center.

A feature of the invention is the reading of the first portion of a plurality of directing characters and their temporary storage and the reading of the remaining portion of the directing characters and their coadjutant employment as read to control the switching equipment.

It is a further object to insure address retransmission by first temporarily restoring the first portion of the address of a message first for controlling the switching equipment and then to control its own retransmission.

A feature of the invention is means for causing a record controlled transmitter to sense the final portion of an address of a stored message for controlling switching circuits and then to resense this same portion of the message for transmission from the distributor after the switching circuits have been established.

It is an object of this invention to provide for the possibility of full selective interception permitting the direction of all the messages directed to any station to an intercept circuit.

It is a further object of this invention to provide for miscellaneous interception in accordance with which all messages improperly directed or addressed, as well as other miscellaneous messages which cause improper operation of the switching equipment and all messages which require the assistance of an operator at the main or central switching station, are automatically transmitted to intercept storage.

A further feature is a simplification in accordance with which switching circuit arrangements permit the testing and connecting of any one of a plurality of record control transmitters to any one of a plurality of transmission circuits by ascertaining the potential condition of a single lead.

A further feature of the switching equipment comprises testing circuits for testing the potential conditions of a single switching lead and recognizing both normal conditions and trouble conditions, including crosses between similar leads.

Another object of this invention is to insure greater accuracy of operation by automatically providing switching signals to clear the switching equipment in case of trouble or improper operation thereof.

Still another object is to prevent loss of time and inaccurate operation and facilitate the work of attending personnel by providing notice of various trouble conditions including exhaustion of the supply of stationery tape for the various machines and apparatus and preventing continued attempts of the system to operate under conditions preventing correct operation.

Another object of this invention is to provide for indicating failure of recording instruments to function when signals are transmitted to them.

A feature consists of circuits responsive to the reception of signals for initiating the operation of a time delay device and other circuits responsive to the operation of a recording device for arresting the operation of the time delay device.

Another object is to prevent message loss by means for maintaining a recording device busy when it does not respond to signals directed to it.

A similar object relates to circuits for stopping the transmission of signals to a recording device

when the device fails to respond to signals transmitted to it.

Another object is to provide against less than a minimum supply of stationery in a recording device by insuring the provision of an additional supply before the supply is completely exhausted.

In accordance with this object a feature comprises circuits for maintaining a recording device busy when the supply of stationery therefor falls below a predetermined minimum quantity and thus preventing additional messages from being directed to this recording device when there may not be sufficient stationery in the device to properly record the entire message.

Another feature is the provision of various keys and circuits for maintaining the recording devices busy during the time an attendant is threading a new supply of recording material through the machines.

Another object is to facilitate the threading of the recording medium through the various elements of the system.

Another object is to provide for indicating the failure of a receiving device to respond to signals within a predetermined period of time after it is connected to a transmission circuit.

Another object is to utilize switching equipment for automatically operatively associating either one or both of two receiving devices with a telegraph transmission channel.

A further object is to provide means for manually associating either of said receiving devices with said channel independently of said automatic apparatus.

Another object is to improve arrangements including lamps or other indicators to indicate to attendants the condition of the switching circuits at various times during the transmission of switching signals and message currents.

Another object is to reduce delays and loss of time by providing apparatus responsive to cessation of transmission of signals over a path for a predetermined interval of time to initiate use of the path by other equipment.

Another object is to provide for restoring the circuits to their normal conditions if a pause in transmission occurs which exceeds a predetermined interval of time.

Another object of this invention is to provide improved means to restore circuits to a predetermined condition in response to the reception of predetermined signals or groups of signals.

Another object of this invention is to provide improved apparatus responsive to certain predetermined groups of signals for rendering a switch responsive to succeeding code combinations.

Another object of this invention is to insure against errors by rendering the switching equipment non-responsive to further signals transmitted over the system.

Another object of this invention is to provide improved arrangements for discarding stored characters which are not significant in the direction or control of switching equipment and are not part of the messages.

Another object of this invention is to provide improved switching circuits for causing stored signals assigned specific functions to be discarded after these functions have been performed.

Another object of this invention is to provide equipment for sensing and decoding the first portion of stored directing and address characters.

Another object of this invention is to provide equipment for sensing the succeeding stored char-

acters while they remain effective to further control transmitting equipment and to decode these following directing characters.

Another object of this invention is to provide apparatus for combining and decoding the directing portions in a permutation arrangement for selecting any one of a plurality of switching circuits.

Included among other features of the invention are:

Equipment for testing the selected circuits to determine whether or not they are busy.

A receiving device and circuit equipment, frequently called a miscellaneous intercept circuit or position, for receiving messages improperly directed through the system.

Still other receiving circuits, equipment, and positions for receiving messages directed to any of the stations of the system when it is so desired. Circuits of this type are sometimes called willful intercept circuits, equipment, and positions.

Means for altering the connection through the switching equipment so that messages addressed to any specified station or stations will be automatically routed to a willful intercept equipment.

Switching circuits for causing messages addressed to one or more stations of a party line to be directed to intercepting apparatus while causing messages addressed to other stations connected to the same party line to be directed to and transmitted thereto in the normal manner.

Switching circuits for automatically routing messages improperly directed or improperly addressed to the miscellaneous intercept position.

Equipment for distinguishing between trunks to distant switching centers and lines to local stations.

Equipment for transmitting the entire address and message signals over certain transmission paths and transmitting only a second portion of the address and the entire message signals over other of said transmission paths.

Equipment for and the method of transmitting all the address and message signals over trunks extending to other switching centers.

Equipment for discarding the first portion or address signals of messages directed to lines which terminate at the respective switching centers.

Circuits and apparatus for transmitting all the stored address message signals to intercept apparatus.

Equipment for responding to an end of message signal following each message.

Apparatus for freeing a transmission path upon the completion of the transmission of each message thereover.

Manually controlled switches and keys for interrupting the operation of the automatic switching equipment.

Equipment for automatically supplying end of message signals after a pause in transmission which exceeds a predetermined interval of time.

Apparatus responsive to the operation of manual keys or switches for automatically supplying end of message signals under trouble conditions.

Manually controlled equipment for interrupting established connections and returning the equipment to its normal condition independently of the completion of the transmission of any message through the equipment.

Means for enabling a plurality of connections to be established through the switching equipment one at a time.

Switching equipment for maintaining connections when once established until an end of message signal is transmitted over the connection.

Apparatus for permitting the establishment of a second connection through a switching office as soon as a previous connection is fully established independently of the maintenance of said first connection.

Equipment for preventing an attempt to establish two connections through the switching equipment simultaneously.

Equipment for detecting improper connections between switching circuits.

Switching circuits for indicating a trouble condition in response to a simultaneous connection to two independent switching circuits.

Switching arrangement having groups of contacts arranged in a plurality of series of groups in which certain of said series of groups of contacts are arranged in a coordinate relationship with other series of groups of said contacts.

A switching arrangement in which any one of a plurality of groups of contacts may be selected by selecting its coordinate position in a plurality of groups of contacts coordinately arranged.

Means for actuating one of a plurality of groups of contacts coordinately arranged and then maintaining said contacts operated and at the same time permitting other contacts having at least one of the same coordinates of said operated contacts to be operated.

A plurality of groups of contacts arranged in a first plurality of series of contacts and a second series of a plurality of contacts coordinately arranged with the contacts of the first series and connecting a transmitter to each of said series of said first plurality of series of contacts and selectable transmitting circuits connected to each series of said second plurality of series of contacts.

A plurality of transmission paths through the switching equipment for the simultaneous transmission of messages intended for transmission over an outgoing line.

Apparatus for directing messages over said paths in rotation when they are idle.

Means for and the method of transmitting messages simultaneously over paths of said plurality of paths to each outgoing line which is idle at the time.

Means to direct messages over the first of said paths to become idle after both of said paths have been busy then to direct messages over said other paths in rotation when they become idle.

Apparatus for transmitting the messages received over said plurality of paths over a single path one at a time.

Apparatus responsive to an end-of-message signal for permitting the transmission of messages over a single channel from another one of said plurality of paths through said switching equipment.

A storage repeater for each of said plurality of paths through said switching equipment.

Means to permit any of the storage repeaters connected to any of the outgoing lines to transmit one at a time and in rotation with the other repeaters associated with said line as long as said repeater has signals stored therein.

Manual means for stopping the operation of any transmitter transmitting over a channel at any time without causing an error.

Manual means for stopping the operation of a transmitter at the end of the message then in progress of transmission by said transmitter.

Improved control means for temporarily inter-

rupting the operation of the storage repeater transmitting message signals and then transmitting control signals over an outgoing circuit and thereafter restarting the operation of said storage repeater.

A storage controlled transmitter and a distributor in combination with a storage receiver individual to each of said plurality of paths through said switching equipment for each outgoing transmission path and a transmitter start circuit having access to said distributor and control means for interrupting the operation of any transmitter controlling the operation of its associated distributor and controlling the operation of said distributor from said start circuit.

A distributor individual to an outgoing circuit and a message transmitter for controlling said distributor and apparatus for transmitting control signals and also capable of controlling said distributor together with control apparatus for interrupting the operation of said message transmitter and permitting the operation of said control transmitting apparatus.

Means for manually advancing the storage medium through the equipment to aid in threading the storage medium through the apparatus.

A start circuit for starting any one of a plurality of storage transmitters connected to a party line extending to a control station.

Manually operable means for selectively conditioning said start circuit to permit any selected one of a plurality of transmitters to start transmitting.

Automatic means for causing said start circuit to automatically test each of said transmitters in rotation for message material available for transmission and apparatus responsive to signals transmitted from each of said transmitters for initiating the operation of said transmitter start circuit.

Equipment responsive to the cessation of signals transmitted from any of said transmitters for a predetermined interval of time for initiating the operation of said transmitter start circuit.

Another object of this invention is to provide apparatus for causing said transmitter start circuit to transmit pauses between selective signals to insure the proper operation of switching equipment associated with the outgoing line.

Signaling means for indicating which of the transmitters connected to a given line is transmitting at any given time.

Control circuits for causing the transmitter start circuit to test all of the transmitters connected to a given line in rotation including the last transmitter to transmit.

Equipment for causing said transmitter start circuit to pause after testing the last transmitter to transmit for further message material in case no further message material is available for transmission from any of the transmitters of any of the lines.

Equipment for automatically varying the length of this pause depending upon whether or not the transmission or control channel is busy.

Switching equipment for causing said test circuit to skip any desired one or more of the transmitters associated with any one line so that this transmitter will not be able to transmit any message material over the line.

Means to cause said transmitter start circuit to transmit signals for stopping the transmission from any of the transmitters which may be transmitting at that time.

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Equipment for preventing interference between the manual control and automatic controlled apparatus of said transmitter start circuit.

Switching equipment located at geographically separated points along the party line for controlling a telegraph apparatus associated with the line.

Switching equipment for connecting receiving apparatus at one or more geographically separated points to a party line.

Means to connect different telegraph apparatus at the same or different points to a party line for transmission or reception thereover one at a time.

Means to maintain the telegraph apparatus not connected to the line in normal condition.

Means to disconnect a receiving device from said line during the time signals are transmitted thereover for controlling the transmitting apparatus associated with the line and thereafter to reconnect the receiving equipment to the line without adding to or subtracting from or mutilating any of the characters of the message being transmitted to said receiving apparatus.

Equipment for cancelling the effect upon said receiving equipment of miscellaneous extraneous currents and interference some of which are sometimes called hits.

Intercept circuits for diverting from transmission and recording or receiving messages improperly addressed.

A receiving circuit for messages to be intentionally intercepted.

Manually controlled switching apparatus for causing messages directed to any chosen station or groups of stations to be automatically directed to an intercept circuit.

A special circuit for originating address signals and message signals at a central control station.

Switching circuits for connecting a storage transmitter to any of the lines extending from a control station.

Terminal circuits for so-called "half duplex" lines designed to cooperate with switching equipment at the central exchange or control station.

Switching equipment which will cooperate with and transmit messages between both full duplex party lines and half duplex party lines.

Circuits for controlling the transmission from the central exchange over a half duplex party line so that the central station is given a turn or opportunity to transmit in rotation along with the transmitters at all of the other stations connected to the line.

Means to prevent the automatic testing of any of the transmitters on a half duplex line during the time any message signals are being transmitted thereover.

Repeater equipment to enable any signals transmitted from any subscriber's station connected to a half duplex line to be recorded thereat as a so-called "home copy."

Circuits and apparatus for limiting the duration of transmission from transmitters connected to a half duplex party line so that at the end of any message after the elapse of the predetermined time interval the transmission from that transmitter will be interrupted and opportunity given to the other transmitters connected thereto to transmit stored message material.

A flexible timing arrangement which may be readily varied to control the time allotted for the transmission of a transmitter at the exchange station individual to a party line.

A flexible and readily adjustable control system for control of transmitters connected to any

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party line so that these transmitters may be arranged to transmit in any desired order.

Control equipment for controlling the transmission from a plurality of transmitters connected to a circuit so that each of the transmitters may be given any desired number of turns for transmission relative to and in such time relation with the turn of the transmission from the other transmitters connected to the circuit as may be desired.

Control equipment and circuits for permitting transmission from each of a plurality of geographically separated stations, connected to a party line, in any desired order and assigning to any station any desired number of turns relative to the turns assigned to the other stations.

Control circuits for controlling the transmitting equipment at geographically separated stations connected to a single party line so arranged so that any one or more of the stations may transmit oftener than other stations connected to the line.

Switching circuits for directing messages preceded by different addresses to the same receiving equipment at any station or stations connected to any line having one or more outlying stations thereon, i. e., a plurality of addresses for one station.

Switching equipment which will permit messages to be selectively directed to receiving equipment at any of the stations of a party line.

Switching equipment which will permit the stations of any party line to be assigned address codes for controlling connections which are independent of the address codes or directing connections assigned to other stations of a party line except that all stations assigned the same address codes will receive all the messages preceded by this address code.

Switching equipment which will properly direct messages preceded by address codes having the first portion thereof the same or different from the first portion of message codes assigned to other stations served by a given party line.

Switching circuits and equipment which will respond to preassigned address signals or code combinations to direct a message to any group of stations connected to any party line which group may consist of any number of stations connected to said line from two to all of the stations connected to said line.

Switching equipment which will direct messages addressed to individual stations to said individual stations and direct messages addressed to a group of said stations to the stations of said group of stations without directing the message to other stations not within said group of stations.

Control arrangements for the transmitter start circuit connected to any half-duplex line organized to control the transmitters connected thereto in substantially the same manner as the start circuit controls the transmitters connected to full duplex party lines.

Control circuits at the central exchange whereby an operator may stop the transmission from any transmitter transmitting over a half-duplex party line and thereafter start the transmission from any other transmitter connected thereto.

A control circuit for half-duplex lines which will limit the transmission to one message transmitted in one direction thereover at a time.

Message-originating circuits and equipment at the central exchange to introduce into the system messages which are thereafter directed through the automatic switching equipment and transmit-

ted over circuits extending towards the stations of address of the respective messages.

Storage controlled transmitters organized to sense a portion of the address signals more than once and utilize the products of the repeated sensing in a useful manner.

Equipment for storing the first portion of an address of a message after it has been sensed by a storage transmitter and then causing the storage transmitter to sense a further portion of the address signals stored therein and supplying all of the address signals to a decoding apparatus for directing the transmission to proper circuits in accordance with the address signals sensed by said storage transmitter.

Circuits for causing a storage transmitter selectively, properly and without error to discard certain stored signals which do not form part of an address of a message and do not form a part of the message or message signals of a subsequent message.

Control circuits for storage transmitters for causing them to discard switching signals which have already fully performed all of the switching functions assigned to them and whose function transmission is not desired and would not be useful.

Circuits and relays for cooperating with a tape controlled transmitter having only one set of contacts controlled by each element of a code combination so that said transmitter in combination with said relays and circuits responds to stored signals in the same manner as other transmitters having a plurality of sets of contacts controlled by each element of each stored code combination respond to stored signals.

Checking and indicating devices for detecting and indicating improper operation of the circuits or equipment by the attendants and subscribers served by the switching system.

Circuits and equipment so organized and designed so that spare equipment and circuits may be substituted readily for any of the regularly assigned circuits and equipment which develop trouble or which it is desired to remove from service for testing, adjusting and general maintenance such as cleaning, oiling, etc.

The means for fulfilling the foregoing objects and the practical embodiment of the features of this invention in a typical system will be fully and readily understood by reference to the following description when read with reference to the attached drawings which illustrate a typical comprehensive switching system. It is to be understood that the scope of the claims appended hereto is not limited, other than as recited in each claim, to any of the exact features or methods of circuit operation or equipment of the exemplary system shown and described.

Fig. 1 of the drawing shows the manner in which Figs. 2 through 7 are positioned adjacent each other to form an outline of the circuits and equipment of a typical system in accordance with this invention.

Figs. 2 to 7 when arranged as shown in Fig. 1 illustrate in a general way the various equipment and circuits and their manner of arrangement and cooperation to form the specific embodiment of this invention disclosed and described herein.

Fig. 8 shows the manner in which Figs. 5 to 7 and 9 to 90, inclusive, are arranged adjacent to each other to illustrate the details of the typical exemplary system shown in outline form in Figs. 2 through 7, inclusive.

Figs. 91 through 96, inclusive, show mechanical

details of the apparatus and equipment employed in the various circuits for controlling the transmission and switching apparatus employed in the typical embodiment of the invention disclosed herein.

General description

The general features of the system will now be described with reference to Figs. 2 through 7, inclusive, when arranged adjacent one another as shown in Fig. 1. Figs. 2, 3 and 4 show in schematic form, the typical circuits and apparatus which cooperate with one central exchange or switching center while Figs. 5, 6 and 7 show similar equipment and circuits which cooperate with a second switching center.

In order to facilitate the preparation and understanding of the disclosure and drawings the two switching centers, namely, the one shown in Figs. 2, 3 and 4 and the one shown in Figs. 5, 6 and 7 are shown to be substantially identical. It is to be understood, however, that these switching centers merely illustrate typical arrangements and that they need not be identical or the same. As will be understood by those skilled in the art each of these switching centers may be operated independently of the other center or they may be interconnected by one or more trunk circuits extending between them. Even in this case the two centers operate independently of each other except that they both may transmit to and receive from the other center over the trunk circuit. In these figures two party lines are shown terminating at each of the switching centers and a trunk circuit is shown extending between the two switching centers. These two party lines and the trunk circuit merely illustrate and show typical examples of the type of lines and equipment which may terminate at the switching centers. There may be any number of these party lines and trunks terminating at any one switching center and any number of stations, within the limits of the system and apparatus, may be served by a single party line. Furthermore, where traffic conditions warrant additional trunks may extend between the same switching centers. The systems are arranged to provide flexible arrangements whereby the number of party lines terminating at any switching center, the number of stations served by any party line and the number of trunks extending between the various switching centers may be readily determined by the traffic conditions, that is, the number of messages which originate at the various stations for transmission to others of the various stations. Furthermore, as these traffic conditions are changed the number of lines and number of stations served by any party line and the number of trunks may be changed at will. Additions and subtractions of lines and stations may also be made without altering the stations served by other party lines or the connection within the switching equipment proper other than those involved in the changes. In cases where there is sufficient message traffic to or from any particular station this station may be connected to the central switching center by a channel individual to that station. When any line or channel extends from the central switching station to only one outlying station there is no need for a secondary switching center and related circuits and equipment including a transmitter start circuit so this equipment will not be provided under these circumstances. Individual or "private" lines has not been shown because the equipment at the central station cooperates

with these lines in the same manner as described with reference to the party lines.

Referring now to the first switching center shown in Figs. 2, 3 and 4, which switching center is shown in greater details in Figs. 9 to 90, inclusive, as will be described hereinafter, Fig. 2 shows in block diagrammatic form, the stations and equipment connected to the respective party lines.

Two typical party lines are disclosed in Fig. 2. Line 210 is a typical full duplex party line extending to nine separate and distinct outlying subscriber's stations, all of which are served by the full duplex line 210.

Party line 260 is a half duplex line which similarly extends to nine outlying subscriber's stations. It is to be understood, of course, that the number of stations connected to any party line may be greater or less than nine and that it is not necessary to connect the same number of stations to the full duplex lines as are connected to the half duplex lines.

Considering now the full duplex party line 210 which comprises a transmission channel or path 212 for transmitting signaling impulses from the outlying subscriber's stations to the central switching station shown in Figs. 3 and 4 and a receiving channel 211 for transmitting signaling impulses from the central exchange to the outlying subscriber's stations.

The party line 210 has been shown in the drawing as two separate and distinct metallic transmission circuits. It is to be understood, however, that these lines or paths may include any of the usual types of switching systems suitable for the transmission of telegraph permutation code pulses. These two channels may form the two paths of a full duplex telegraph transmission system in which case both the impulses transmitted to and from the central office are transmitted over a single line conductor as is well understood in the art. These lines may also include telegraph channels of composite telephone and telegraph lines, channels of voice frequency carrier current, channels of high frequency carrier current, radio channels as well as time division multiplex channels and the method of transmission over these channels may be in accordance with any of the well-known transmission systems including pulses of current and no current, pulses of positive current and negative current, pulses of currents of different magnitudes, pulses of carrier current and no current, pulses of carrier currents of different frequencies, and pulses of current in some portions of the system may be represented by pulses of no current in other portions of the system as is well understood in the various types of telegraph transmitting systems. In addition, party line 210 as well as the two channels 211 and 212 may include any suitable types of open wire lines, cable circuits, suitable types of repeating and terminal equipment usually employed in the various types of systems including vacuum tube amplifiers, regenerator repeaters, bias control circuits and apparatus, level compensating equipment, and apparatus employed to interconnect various sections of different types of transmission. Consequently, the party line 210 may include one of the types of systems referred to above for a portion of its length and another type for other portions of its length. The sole requirement of the transmission system of the party line 210 being that it is capable of transmitting impulses in both directions simultaneously without interference be-

tween the impulses transmitted in the different directions and that the current conditions in the local or terminal loops extending to the central station and the subscribers' stations are maintained under the various signaling substantially as shown in the drawings. If this becomes impossible compensating changes must be made in the circuits at the stations affected as is well understood in the art.

Inasmuch as all of these various types of transmission systems are well known and operate in their usual manner when employed in combination with the systems of this invention, they have not been shown in detail, since to do so would needlessly complicate the disclosure without aiding or contributing to the understanding of the typical system embodying the features of this invention.

In general, the outlying subscribers' stations are provided with a receiving teletypewriter and a keyboard operated or controlled perforator indicated by the box 225 at station 216. As shown herein no provision has been made to provide a printed copy of the message as it is perforated. If it is desired to produce a printed copy of the message as it is perforated an additional printing device may be provided as is well understood by those skilled in the art. It should be pointed out that the party line 210 extends to nine outlying subscribers' stations 216 through 224, inclusive. Each of these subscribers' stations is shown to be provided with a receiving teletypewriter and keyboard perforator similar to that indicated at 225 at station 216. Each of these stations is shown also to include a transmitting distributor similar to that indicated at 235 at station 216 and control circuits and equipment 236 shown at station 216. The receiving teletypewriter is provided for receiving messages transmitted from the central exchange while the keyboard perforator and transmitting distributor and the control circuit are provided for transmitting messages from the subscriber's station to the central station.

While receiving apparatus and transmitting apparatus have been shown at each of the subscribers' stations, it will be readily understood by those skilled in the art that receiving only equipment may be provided at certain subscribers' stations while transmitting apparatus may be provided at other subscribers' stations without providing receiving equipment thereat. Since the receiving equipment and the transmitting equipment operate substantially independently of each other, any person skilled in the art will readily understand that either the receiving equipment or the transmitting equipment may be omitted and that the other equipment functions remain substantially as described herein. Typical apparatus suitable for use in combination with the circuits of the system described herein for receiving messages and perforating tape and transmitting signals in accordance therewith are described in detail in United States Patents 1,965,572; granted to Burcky et al. on July 10, 1934; 1,965,602, granted to Lake on July 10, 1934; and 1,969,891, granted to Lake et al. on August 14, 1934. The disclosures of these patents are hereby incorporated herein by reference. It is to be understood that the connections to the equipment disclosed in these patents including the controlling circuits, are connected as shown herein and not as shown in those patents. However, the structure of the equipment and its manner of operation in the system disclosed herein is sub-

stantially the same as described in the above-identified patents.

The receiving and transmitting equipment at each of the subscribers' stations is controlled from a secondary switching center or a control selector which may be located in the immediate vicinity of the outlying subscribers' stations or may be located at the same station together with the receiving and transmitting apparatus referred to above. In the drawings the secondary switching centers have been shown located at a different place from the subscriber's station to clearly indicate that it is possible to locate this switching equipment at a different position from the subscriber's station. However, it will be readily understood by a person skilled in the art that the transmission lines extending between the control equipment and the subscriber's station may be reduced to local circuits within the subscriber's station without altering the manner of operation of the circuits or equipment.

This control equipment comprises a monitoring selector connected to the receiving channel 211 of party line 210 which selector is provided with numerous contacts which are selectively actuated in response to various signals transmitted over the party line. These contacts are then employed to control the switching apparatus for connecting the receiving equipment at the associated subscribers' stations with the receiving channel 211 of the party line 210 and for connecting the transmitting equipment to the transmitting channel 212 of party line 210 and permitting it to operate to transmit signals thereover.

A manner in which this monitoring selector equipment causes the various contacts to close in response to signals transmitted over the receiving channel 211 of party line 210 is described in greater detail in United States Patent 2,112,234, granted to Beattie et al. on March 29, 1938, and Patent 2,120,235, granted to Beattie et al. on June 14, 1938, the disclosures of which patents are hereby made a part of this disclosure as if fully included herein. The structure of the monitoring selector equipment and mechanism employed in this invention is substantially the same as that disclosed in the above-identified patents to Beattie and operates in substantially the same manner. However, it is to be understood that the switching circuits controlled by the contacts of this equipment are in accordance with the description herein and not as shown in said above-identified patents.

The switching and controlling circuits including the selector circuit referred to above may be individual to each of the subscriber's stations served by a given party line or it may be common to a plurality of the stations served by a party line. In case the individual stations served by a party line are rather remotely separated one from another a switching and controlling equipment will be provided individual to each of the stations either at the stations or in the same general locality as the station. In case two or more of the subscribers' stations served by a given party line are located in the same general locality a single switching and controlling circuit including a selector circuit and mechanism may be employed to control the equipment at all of the subscribers' stations in the same general locality served by a given party line. It is to be understood that certain of the lines may have a switching and controlling circuit individual to each of the stations connected thereto while other lines

may have some stations having an individual switching and controlling circuit individual thereto and other stations of the same party line may be served by a common switching and controlling circuit.

In order to facilitate the description and reference to these switching and controlling circuits they are sometimes called secondary switching centers of the party line.

Thus, for example, in Fig. 2 party line 210 is shown provided with three secondary switching centers or switching and controlling circuits 213, 214 and 215. The switching and controlling circuit comprising the secondary switching center 215 is shown controlling the transmitting and receiving equipment at stations 216, 217 and 218, secondary switching center 214 is individual to the subscriber's station 219, while secondary switching center 213 of the party line 210 controls the transmitting and receiving equipment at stations 220, 221, 222, 223 and 224.

It should be noted that the subscriber's station 219 includes in addition to the receiving teletypewriter and the transmitting equipment an additional receiver or recorder which, in the embodiment shown in this invention, is a reperforator. This reperforator may be of any suitable type such as the type disclosed and described in detail here, or the type disclosed in United States Patent 2,042,788, granted to Krum on June 2, 1936, the disclosure of which patent is hereby made a part of this disclosure as if fully included herein.

Reperforators are generally not provided at the subscribers' stations in addition to the usual printing telegraph receiver. However, in case other circuits terminate at any of the subscribers' stations which other circuits are not connected to the switching center, it is frequently desirable to transmit messages received over one of the systems or circuits terminating thereat over another one of the circuits or systems. In order to facilitate such an exchange of messages between the systems, messages received at this station from the switching equipment are directed to the reperforating device 229 which may be of the type that both prints the message and punches the tape in accordance therewith so that the operator or attendant at the subscriber's station may take the punched tape and insert it in a transmitter connected to another circuit for which the message is intended. This eliminates the necessity for the message to be retransmitted by an operator from a keyboard and thus materially saves the operator's or subscriber's time.

The receiving equipment at each of the subscribers' stations is assigned a particular address code so that messages preceded by these codes will be transmitted to the particular receiving equipment. The typical codes are shown in Fig. 2 for the receiving equipment associated with the party line 210. Thus, the receiving equipment at station 216 has been assigned the code AA, the receiving equipment at station 217AB, at station 218AC, at station 220AE, at station 221AF, at station 222AG, at station 223BX and at station 224BY.

The receiving equipment at station 219 which is provided for receiving messages intended for station 219 has been assigned the code or address characters BD while the reperforating equipment has been assigned two different addresses comprising the characters BJ and BK. Thus, any time a message is addressed to BJ or BK it will be received by the printing reperforator or record-

ing equipment 229. The object of causing the single reperforating device 229 to receive messages having two different addresses is to facilitate the addition of these additional stations to the system without requiring their code address to be changed. In case additional independent circuits terminate at this station additional codes may be assigned to the receiving equipment at this station so that these additional stations may be added to the system without changing their code address. In addition when the address codes are repeated, as they frequently are, the operator can readily determine for which of the independent circuits terminating at this station the message is intended.

It is to be understood that additional receiving or recording devices such as 229 shown at station 219 may be provided at any of the other stations.

In addition to assigning addresses or address codes to the receiving equipment at each of the stations connected to the party line 210 a code is assigned to each transmitter connectable thereto to enable this transmitter to be controlled from the central switching station in the manner to be described hereinafter. Thus, the transmitter at station 215 is assigned code A, the transmitter at station 217 is assigned the code E, at station 218 the code I, at station 220 the transmitter is assigned the code P and at station 221 code Q. At station 222 the transmitting equipment is assigned the code or letter S, while at stations 223 and 224 the transmitting equipment is assigned the codes U and W, respectively.

At station 219 the transmitting equipment is assigned two codes L and Y. This equipment is assigned two codes to enable it to transmit twice as often as the other transmitting equipment connected to the party line if it is so desired because it will be generally necessary for this equipment to transmit messages which originate at station 219 as well as the messages which originate elsewhere and are received at station 219 over the other circuits terminating at this station which are independent of the switching system of this invention. Consequently, a larger number of messages will normally be handled by the transmitting equipment at this station than the transmitting equipment at other stations so that it is given more opportunities to transmit the message material. However, this equipment need not be given more opportunity to transmit nor need it be assigned more than one code character if the number of messages for transmission therefrom is not any greater than that available for transmission from the other subscribers' stations.

In case the traffic from this station is sufficiently great so that two code characters or two turns will not be sufficient to handle all of the traffic, additional characters may be assigned to this station or the transmitting equipment thereat may be given additional turns of transmission as the traffic condition warrants.

The transmitters at the other stations may be similarly assigned more than one code character so that they may be given more than one opportunity to transmit as compared with one opportunity for the other stations of the system. Thus, it is quite possible to allow some stations two or three or more opportunities to transmit, while other stations are given only one opportunity to transmit during each cycle of operations as will be described hereinafter.

It is not necessary that each of the transmitters be assigned a different code for each turn or

opportunity to transmit but this is a convenient way so it has been so shown in the system described herein.

The features of the full duplex party line disclosed herein but not claimed which are believed to be novel are claimed in the copending application of J. A. Krecek and C. R. Walker, Serial No. 408,604, filed August 28, 1941, now Patent No. 2,366,733 granted January 9, 1945. Features of the full duplex line disclosed in said application but not disclosed herein may be included in any or all of the full duplex party line termination at the respective switching centers.

The half duplex line 260 extends to a number of stations 266 through 274, inclusive. Each of the stations of the half duplex line provides equipment similar to the equipment of the stations served by the full duplex line 210. The half duplex line 260 is shown in Figs. 2 and 3 as comprising two transmission channels, one for transmitting the signals from the central station to the subscribers' stations and a second for transmitting signals from the subscribers' stations to the central station. A channel 261 for transmitting the signals from the central station to the subscribers' stations is called a "receiving channel" herein, while the other channel for transmitting impulses from the stations to the central exchange is called a "transmitting channel" herein.

While the party line 260 is shown as two separate lines herein for simplicity, it is to be understood that this is a half duplex line over which signals may be transmitted in either direction but in only one direction at a time. It is to be further understood that this line can include any of the well known types of communication channels listed above with reference to full duplex line 210.

The equipment at each of the subscribers' stations is controlled from secondary switching systems in the same manner as described above with reference to the full duplex line and the equipment at these secondary switching points is substantially the same as the equipment at the secondary switching points of the full duplex line 210 except that where it is desired to provide a home copy of any messages transmitted from any of the stations another repeater is employed at the respective secondary center for repeating the signals transmitted from that station to the receiving apparatus at that station. As shown in Fig. 2 the secondary switching center 265 controls three subscribers' stations, while switching center 264 is individual to the subscriber's station 269. The secondary switching center 263 controls the subscribers' stations 270 to 274, inclusive. It is noted that the arrangement of the lines of the secondary switching center and the subscribers' stations connected to the full duplex line 210 and the half duplex line 260 are substantially the same. It is quite apparent to those skilled in the art that any suitable arrangement of the stations of the secondary switching centers and transmission paths may be provided to fulfill the traffic requirements. It is also understood that the two lines shown in Fig. 2 are representative of typical lines and in the usual system one or more lines of each type will usually be provided. However, since this constitutes merely duplication of the equipment and disclosure without adding materially to the understanding thereof, only two typical lines have been shown.

As in the case of the full duplex line 210 the stations served by the half duplex line and the equipment thereat are assigned various address

codes. For example, the receiving apparatus at station 266 is assigned the code CA, at station 267BB and at station 268CC, at station 269, DD, receiving equipment at stations 270, 271, 272, 273 and 274 are assigned the respective codes CE, CF, CG, CJ and CK.

Likewise the transmitting equipment at the respective stations are assigned the codes A, E, I, L, P, Q, S, U and W to enable them to be properly controlled by signals transmitted over the party line 260. It is noted that each of the receiving devices is assigned a two-letter code which is individual to that station. However, there is no requirement that the stations connected to any given party line be assigned codes having identical first characters. Neither is there any limitation of requiring first characters to be individual to a given line. For example, stations BD and BX and BY are all connected to the receiving channel party line 210, while station BB is connected to the party line 260. It should also be noted that the stations connected to any given secondary switching center need not be assigned even the same first code. For example, the receiving equipment controlled by the secondary switching center 265 is controlled by the code CA, BB and CC. There is, however, one limitation upon the codes which may be assigned to receiving equipment served by any party line and that is that the same second code cannot be assigned to two different receiving devices served by a given party line. The reason for this limitation will appear hereinafter. For example, none of the codes listed above having receiving devices connected to the party line 210 have the same second character. Neither do any of the codes or addresses assigned to the receiving devices of the half duplex line have the same second character. However, it is to be noted that the receiving equipment connected to different lines may be assigned addresses terminating in the same code. For example, the second code assigned to the receiving equipment 225 connected to party line 210 is the letter A. Likewise the second code assigned to the receiving equipment at station 266 connected to party line 260 is the letter A. The first code of the address assigned to the different stations is different, being A and C, but it should be noted that the second letter is the same in both addresses.

The same codes may be assigned to the respective transmitters controlled or served by the different party lines. For example, the letter A is assigned to the transmitter 235 and its control circuits which are served by party line 210, while the letter A is also assigned to the transmitting equipment at station 266 which is served by party line 260. The above party lines which are provided with receiving equipment associated with these lines will also be assigned the same letters in the order listed above or in any other order.

The terminal equipment for these lines of the central station is shown in Fig. 3 and Fig. 4 shows other circuits and equipment at the central station. Considering first the terminal equipment of the full duplex party line 210 a transmitting channel 212 terminates in an incoming line circuit indicated generally by reference character 322. This incoming line circuit controls a reperforator 326 and a receiving teletypewriter 323. The incoming line circuit recognizes certain addresses preceding messages and causes messages intended for the central switching station to be recorded on the receiving only printing teletype-

writer 323. This arrangement insures prompt delivery of these messages and reduce the number of messages transmitted through the switching equipment and thus in addition to insuring the delivery of messages to the central switching center more promptly also reduces the congestion of and delay of messages transmitted through the switching equipment and the total quantity thereof. A transmitter 325 is combined with a reperforator 326 to form a combined unit 324. Mechanical details of this combined unit are shown in Figs. 91 to 96, inclusive, and will be described in greater detail hereinafter. At this point it is sufficient to say that this combined unit is so arranged that the reperforator 326 will punch a tape in accordance with the signals received and at the same time print the corresponding character upon the tape but displaced from the punchings representing the character by a certain number of character spaces. The tape transmitter is then controlled by the punched tape and is so arranged that it will transmit the last character punched in the tape before coming to rest. Transmitter 325 is connected to a director circuit 327 which together with the transmitter scans the address portion of the message and then controls the switching equipment through the sequence circuit 480 to operate the select magnet 328 and one of the hold magnets 490 to select a path for the transmission of the following message.

As shown in Fig. 3 the receiving channel of the full duplex line is provided with two reperforators and two transmitters controlled by tape perforated by them. These units 314 and 315 are similar to the unit 324. Each of the reperforators 318 and 319 are connected to an independent switching path through the switching equipment and may simultaneously receive messages from the other transmitters of the system. Details of a typical combined printing reperforator and storage transmitter capable of transmitting the last impulse stored in the tape are shown in Figs. 91 through 96. In addition, we have been informed and believe that a more complete disclosure of a mechanism, suitable for use in combination with the typical system disclosed herein is found in Patent No. 2,348,214 to E. A. Gubisch, dated May 9, 1944. See also British Patent 562,551, accepted July 6, 1944, to Gubisch.

The switching system employed in the typical embodiment of this invention and described herein makes use of a switch having a plurality of groups of contacts arranged in a coordinate arrangement. Switches of this type are frequently called "cross-bar switches" and are arranged so that any contacts may be selected and actuated by actuating magnets representing coordinates of the group of contacts to be operated. For example, the usual arrangement is to provide the contacts in rows and columns and select any set of contacts by operating a select magnet which is common to a row of contacts to be operated and a hold magnet which is common to a column or vertical row of contacts to be operated. The circuits are so arranged that the closing and opening of the contacts of this switch do not initiate or interrupt the flow of current through any of the contacts at the cross point of the horizontal row and vertical column. This arrangement greatly reduces the wear of the contacts at the cross point.

Details of the coordinate or cross-bar switch have not been shown in full herein because switches of this type are well known in the prior art and the switch or switches incorporated in

this invention operate in their usual or customary manner. A detailed description of the mechanical and electrical features of a typical switch suitable for use in combination with this invention reference is found in United States Patent 2,021,329, granted to Reynolds on November 19, 1935, and is hereby incorporated herein by reference.

While the system disclosed in Figs. 3 and 4 as well as in Figs. 9 through 90, inclusive, employs a single cross-bar switch, it is to be understood that both the rows and columns of a switch may be extended by providing additional switches if the traffic conditions warrant. Thus, to extend the columns or vertical rows of contacts and thus provide more horizontal rows of contacts an additional switch will be positioned above or below the switch disclosed in the drawings herein and the vertical magnets of both switches for any given column will be operated at substantially the same time either from a common circuit or one magnet would be operated by the operation of the other magnet. Similarly, if it was desired to extend the horizontal rows of contacts and provide a greater number of columns additional switches would be positioned either to the right or left of the switches disclosed in the drawings and the select magnet or horizontal magnets of the respective switches operated one by the other or from the same circuit. It will also be apparent to those skilled in the art that both the rows and columns may be extended to provide additional columns and horizontal rows by positioning switches above or below and to the right or left of the switch shown in the drawing if there are sufficient lines or paths required to warrant the additional switches.

The transmitting portions 316 and 317 of the respective instruments 314 and 315 are associated with the outgoing or receiving channel 211 of the party line 210. The two sets of control relays and equipment 311 and 313 are also associated with this channel as is the equipment common to the two devices 314 and 315. In addition the transmitter start circuit 310 is also connected to the receiving channel 211 of the party line 210.

One purpose of providing two instruments 314 and 315 for each of the outgoing channels is to prevent or reduce the delay in transmission of messages through the switching equipment as will be explained hereinafter.

The terminal equipment for the party line 260 is similar to the terminal equipment for the full duplex line 210 except in the case of the half duplex line 260 only a single storage repeater 334 comprising a reperforator 338 and transmitter 336 has been provided. The reason only a single storage repeater is provided for half duplex lines is that generally traffic on half duplex lines will be much less than over full duplex lines. Consequently, one storage repeater should prove sufficient to handle all the traffic directed to this line. If it is discovered that one storage repeater is insufficient for any of the half duplex lines, it is within the scope of this invention to provide two storage repeaters of the outgoing half duplex lines. However, in case one machine is insufficient for a half duplex line the traffic conditions will probably necessitate or at least warrant the installation of a full duplex line instead of a half duplex line. Consequently, only a single storage repeater is shown provided for the half duplex line.

The speed of transmission from the first storage repeater to the second one may be at any de-

sirable speed, being independent of the speed of transmission of the lines. In addition the speed of transmission over the various lines of the system may be different and the equipment at the central station arranged to receive from and transmit to the various lines at their respective speeds of transmission and transmit from the first storage repeater to the second storage repeater at still a different speed or at either of the other speeds. Good service with a fully loaded system requires a speed of transmission from one storage repeater to another at a speed at least as high or higher than the highest speed of transmission lines terminating at the repeater or switching point.

The second switching center which is shown in Figs. 5, 6 and 7 is illustrated as comprising a full duplex line and a half duplex line similar to the full duplex line 210 and the half duplex line 260 shown in Fig. 2. These lines are shown in Fig. 5 and are substantially the same as the lines shown in Fig. 2 except that the receiving equipment at each of the stations of the party lines are assigned different address codes. Thus, the receiving equipments at the stations connected to the full duplex party line 510 are assigned respective codes JA, JB, JC, KD, KJ, KK, JE, JF, JG, KX and KY, while the receiving equipment at the stations of the party line 560 are assigned respective codes LA KB, LC, ND, LE, LF, LG, LJ and LK. It should be noted that the transmitting equipment at these stations is assigned the same codes as assigned to the transmitting equipment of the stations connected to the party lines 210 and 260. While it is not necessary to assign the same codes to the transmitting apparatus assigned to different lines it may be desirable to so do, so that the transmitter starts circuits for all the lines may be wired substantially the same.

In addition to a full duplex and half duplex line terminating at each of these switching centers a trunk is shown terminated at each switching center and extended to the other switching center. The trunk circuit 290 comprises two transmission paths, one for transmitting signals from the first switching center to the second switching center and the second for transmitting signals from the second switching center to the first switching center. These transmission circuits may be the two channels of a full duplex line of a cable line or of an open-wire line or they may be any of the other types of transmission systems referred to above with reference to the full duplex line 210 including voice frequency carrier current channels, high frequency carrier current channels, radio channels, time division multiplex channels and may include the various types of apparatus and equipment and repeaters including regenerative repeaters usually employed in channels of the various types. It may also include the terminal equipment for these channels for converting signals suitable for transmission over one type of channel into signals suitable for transmission over an other type of channel. In other words, these channels may be made up of a number of links of channels of the various types as is well understood by those skilled in the art. An essential requirement is that the trunk circuit 290 be capable of simultaneously transmitting telegraph signaling impulses in both directions over the circuit.

Another requirement of these channels as well as the other channels of party lines or private lines, if such are included, is that when current flows in the portion of the channel extending to

one of the stations it will flow in the corresponding portion of the channel at the central exchange and generally flow in the corresponding portion of the channel extending to all of the other stations of the system.

The terminal equipment for the trunk circuit is similar to terminal equipment of the full duplex line except that no transmitter start circuit is provided. No transmitter start circuit is provided because the only transmitters connected to the incoming channel are the transmitters at the distant switching center and they are arranged to alternately transmit any message material supplied to them. Consequently, no transmitter start circuit is required for the trunk circuit at either end. As will be readily appreciated by those skilled in the art, equipment for receiving incoming messages will be connected to one of the channels at one of the central offices and equipment for transmitting impulses thereover will be connected to the other terminal of the same channel at the distant central office. In other words the outgoing terminal equipment at one office will be connected over one channel of the trunk to the incoming equipment at the other office.

The first characters of the address code combinations assigned to receiving apparatus served by party lines terminating at any office are generally restricted to that office, that is, the first characters A, B, C and D of the address code assigned to the receiving equipment at stations served by the first switching center are not assigned as the first character of any of the codes of the addresses assigned to the receiving equipment of the subscriber's station served by the second switching system. Similarly, the letters J, K, L and N assigned as first characters of the address codes of the receiving equipment at the stations served by the second switching system are not assigned as first codes of any of the addresses of the receiving equipment served by the first switching center. Consequently, all messages having address codes beginning with J, L, L and N transmitted from any of the stations of the first switching system will be transmitted over the trunk circuit to the second switching system and thence to the proper receiving equipment connected to party lines 510 or 560. Similarly, any messages preceded by address codes beginning with the letters A, B, C or D originating in the stations connected to the second switching system will be transmitted over the trunk 290 to the first switching system and thence to the proper stations served thereby.

In addition to the party lines and trunks terminating at each switching center message originating equipment is provided to enable the originating station to transmit messages selectively to any or all of the stations of the system by properly addressing the messages in the same manner as they are addressed by the outlying subscriber and delivered as described hereinafter. The originating equipment as shown in Fig. 4 comprises a keyboard perforator 411 and a transmitting distributor 412 controlled by the tape perforated by the keyboard perforator. Monitoring printer 410 is provided and arranged so that it may monitor the message as it is perforated in the tape or it may monitor the signals transmitted by the transmitting distributor 412. The perforating equipment as well as the transmitting distributor and monitoring printer are similar to the devices located at the subscribers' stations as described above. With re-

spect to the mechanical construction of this equipment reference is made to the same patents as referred to above with reference to the equipment at the subscribers' stations. The patents referred to and made a part of this disclosure show typical equipment suitable for use herein but other equipment may be employed equally well so long as it is capable of perforating the tape and transmitting signals in accordance therewith and recording received signals. Again, it is to be emphasized that while the patents referred to above show the mechanical details and manner of operation of the equipment, the equipment is to be connected in the circuits as described herein and not in the manner disclosed in the above-identified patents.

A group of control relays 413 is associated with each of the transmitting distributors and the director circuit 414 for controlling the select magnet 415 and the hold magnets 490 of the cross-bar switch to enable the transmitting distributor 412 to be connected to the outgoing line circuits and transmit the message signals to the outgoing line circuits of any of the lines terminating at the switching center. The originating equipment may be considered as a transmitting only station local to the central switching equipment.

In addition to the above equipment intercept positions and circuits are shown in Fig. 4. One intercept circuit is designated "willful" intercept circuit and indicated by reference 424. This circuit is arranged to receive messages which are properly addressed and transmitted through the switching equipment but which for some reason it is desired to intercept and prevent from being transmitted immediately to their respective stations of address. This is convenient in case certain stations are idle during certain hours or days when other stations are not idle because it may be undesirable to require an attendant to be present at those hours or upon those days at idle stations. Similarly, in case of trouble conditions arising at any station, it may be desirable to route the messages to the intercept position until the trouble is cleared and thus prevent them from being lost or interfering with the operation of the system or the transmission of messages of other stations not in trouble.

Inasmuch as messages directed to the willful intercept circuit are properly addressed they may be retransmitted through the system without any further attention by the operator. To facilitate this, transmitter 422 is associated with reperforator 421 of a storage device 420 of the willful intercept circuit. By properly operating the keys associated with this transmitter the operator or attendant at the central switching station may cause the messages sent to the willful intercept circuit to be automatically again routed through the equipment to their stations of address at a later time when an attendant will be present at the station of address or when trouble conditions have been corrected. In order to facilitate the routing of the messages through the switching equipment a director circuit 423 is associated with transmitter 422 and causes this transmitter to be connected to the proper outgoing line circuits for the transmission of the messages thereto.

A second intercept circuit 427, sometimes called a "miscellaneous" intercept circuit, is also provided. Only a receiving printing reperforator 426 together with a tape receptacle 425 is provided for this miscellaneous intercept circuit.

The switching equipment is arranged so that messages improperly addressed or messages in

which the address has been mutilated or messages for which the switching equipment has improperly responded are directed to the miscellaneous intercept circuit. Thus, if messages are preceded by code combinations which are not assigned to any receiving device they will be routed to the miscellaneous intercept circuit. Inasmuch as messages are usually faulty as received in the miscellaneous intercept circuit or position, they will, therefore, require the attention of an operator to correct them so that little would be accomplished by providing automatic transmission means for automatically transmitting the intercepted messages further through the system. If the operator can correct the messages they then can be transmitted from the originating station either by operation of the keyboard perforator 411 or by inserting the perforated tape, after correction, in the transmitting distributor 412.

In addition to the foregoing circuits a sequence circuit 480 is provided at the switching center which will permit any of the director circuits at this station to establish connections through the cross-bar switch under control of stored signals. However, the sequence circuit is arranged so that only one director at a time may establish a connection through the switch. This prevents any false connections due to two or more directors attempting to establish connections simultaneously. After a connection is once established, however, the connection is maintained so long as the message is being transmitted from the transmitter associated with the director to an outgoing line circuit. During this entire time during which the message is transmitted over a connection once established the sequence circuit will permit other directors to establish other connections one at a time without interference. The manner of operation of this circuit will be described hereinafter.

In addition to the foregoing equipment a control board is provided having start keys and intercept keys and numerous lights or other signals useful in observing the operation of the system. The start keys are represented at 390 in Fig. 3 and the intercept keys at 391. The lights and signals have not been represented in this figure but are shown in various figures showing the details of the system as will be described hereinafter.

Indicating and alarm circuits are provided to indicate the improper operation of the system and to prevent the loss of messages and to prevent the direction of messages to equipment which is not functioning properly. If transmission over incoming lines pauses for longer than a predetermined interval of time the transmitter start circuit will automatically be started into operation and initiate transmission from another transmitter.

If a connection is not established to an idle line within a predetermined interval of time, a trouble condition will be indicated to attract the attention of an attendant. These trouble conditions generally require some response on the part of the attendant to cancel the indication and restore the system to its operative condition after the particular trouble is noted and corrected.

The recording instruments are provided with alarm circuits which cooperate with the receiving and switching circuits and indicate a trouble condition when the recording instruments are connected to a transmission path or when signals are directed to the respective recording instruments and these instruments do not respond. Briefly, these trouble indicating circuits and

equipment comprise a time delay relay or other delay apparatus the operation of which is initiated by the connection of the receiving device to a transmission path or by the reception of the signals. If the receiving device does not respond to these signals within a predetermined interval of time a trouble condition is indicated. If, however, the recording instrument does respond within its time interval the time indicating device is restored to normal without indicating any trouble condition.

When a trouble condition is indicated the recording device is generally maintained busy, thus preventing the direction of messages to this equipment so long as the trouble condition is present.

In addition, indicating devices are provided to indicate when the supply of unperforated tape or stationery individual to each of the recording devices is reduced below a predetermined minimum quantity to enable the attendants to have sufficient time to replenish the supply before any messages are lost due to the absence of storing or recording tape in the receiving devices. In addition the recording devices are maintained busy so long as the supply of used stationery remains below a predetermined minimum quantity in the machines. Consequently, additional messages will not be directed to the machines at this time.

Certain of the machines are arranged to prevent or interrupt the transmission of messages to them when they do not properly respond to received impulses. The trouble indicating circuits are arranged to maintain these machines busy under these circumstances and thus prevent other messages from being directed to them and mutilated or lost.

Typical method of operation of the system

In operating systems of this general class or type it is necessary for the subscribers to perforate the tape in a particular manner especially at the beginning and end of each message. It is also desirable for the subscriber to perforate special signals prior to the message signals and the addresses thereof when transmission is first started and after a number of messages have been perforated in the tape. In order to aid the subscriber in properly perforating the various addresses and other control signals in the tape various routines or operating procedures are usually specified.

It is to be understood that depending upon the requirements and traffic conditions various types of operating procedure may be established in accordance with the requirements to be satisfied.

A typical operating procedure will be described for the system shown in the drawings together with certain departures therefrom as will be indicated. It is to be understood, however, that the system may be operated in other manners and that the suggested departures from the suggested manner of operation are not inclusive because many other operating procedures and departures from the manner of operating the system discussed hereinafter may be employed to meet special conditions which may be encountered.

While it is not necessary, it is desirable to have the subscriber perforate a number of letters signals in the tape to provide sufficient tape so that it may be properly inserted in the transmitters and so that it will be properly advanced through and control the transmitters. Following the letters signals it is desirable for the subscriber to perforate a disconnect or end of message signal in

the tape which in the specific embodiment of the invention disclosed herein is a figures signal followed by an H signal and a letters signal. It is not absolutely necessary that the subscriber perforate these signals in the tape. However it is desirable for him to do so because this will insure that the equipment will be in proper condition to receive the following address and message signals. Following the H signal the subscriber may perforate one or more letters signals to provide sufficient time for the apparatus to function properly at the central switching station. Letter signals may be inserted at various times by the subscriber to provide sufficient time following or between various directing or control signals to insure that the equipment will respond properly and will fully establish the necessary circuits so that none of the following message signals will be mutilated or lost. Following these letters signals the subscriber will perforate two characters in the tape which are assigned to the station for which the message is intended. These two character signals are sometimes called directing codes and at other times address signals. Following the address signals the subscriber will generally transmit a letters signal and the carriage return, line feed signal and another letters signal after which the subscriber generally will transmit the message. In order to facilitate the checking of the system and messages, the address of the station to which the message is directed as well as the sender's address is generally included as a portion of the message. If it is desirable the two address codes may be repeated and under certain circumstances, as pointed out hereinafter, the second code may be useful if the first one becomes lost or mutilated.

Following these signals perforated in the tape the subscriber will perforate the message. The subscriber may assign a number to each message and perforate it in the tape immediately following the address or at any other time he may so choose. Following the message the subscriber will perforate another disconnect signal in the tape, i. e., a figures signal immediately followed by the signal representing the letter H. Following the figures and H signals the subscriber may perforate one or more letters signals and then the address code or another station to which it is desired to transmit a second message and the above-outlined procedure repeated. At the end of the last message available for transmission at a given time from a subscriber station the subscriber will generally perforate a figures signal followed by an H signal in the tape and these signals will then be followed by a letters signal and a second H signal. The letters signal and the second H signal are employed to condition certain circuits at the central switching station as will be described hereinafter.

Assuming now that station 216 has a message which it desires to transmit to station 269, the subscriber at station 216 will first perforate several letters signals in the tape after which the subscriber will perforate a figures signal followed by an H signal and then a letters code combination. After this the subscriber perforates the letters DD in the tape followed by a letters code combination, a carriage return, line feed, and another letters signal. After these signals are transmitted the subscriber will transmit the full address of station 269 together with the address of station 216 and the number of the message transmitted from station 216 to station 269. Thereafter the subscriber will perforate the tape

in accordance with the contents of the message. Following the message the subscriber will perforate a figures signal followed by an H signal and then perhaps several letters signals. If the next message available for transmission from the subscriber station is intended for the central switching station the subscriber will then perforate the code GZ in the tape which will cause the equipment to direct the message to the central switching station as will be described hereinafter. Following the GZ signals, the subscriber will perforate a letters signal and then a carriage return, line feed and a second letters signal. After these signals are perforated in the tape the subscriber will perforate the tape in accordance with the message to be transmitted to the central switching center. Following the message a figures code combination followed by an H code combination and one or more letters code combinations will be perforated in the tape by the subscriber.

Assume now that it is desired to transmit a third message from station 216 to station 520 shown in Fig. 5. In this case the subscriber will then perforate several letters signals in the tape following which the subscriber perforates the code JE in the tape and thereafter letters signals, carriage return, line feed and a second letters signal following which the message is perforated in the tape. At the end of the message the subscriber will again perforate a figures signal followed by an H signal.

Assume now that the subscriber has a fourth message which he desires to transmit both to the central switching station and the recording apparatus 229 at station 219 for further transmission over other systems. In this case the subscriber will first perforate a G signal in the tape followed by an H signal and then a letters signal. Following this signal the subscriber will perforate a B signal followed by a K signal in the tape. Thereafter the subscriber will perforate a letters signal, a carriage return, line feed and a second letters signal in the tape. Following the message thereafter perforated in the tape, the subscriber will perforate an end of message signal comprising a figures signal followed by an H signal and then a letters signal. Assume now that no further message material is available for transmission at this particular time from the subscriber's station. Under these circumstances, the subscriber will then perforate a letters signal followed by an H signal and then perhaps several letters signals to properly advance the tape through the transmitter. Thereafter the subscriber will generally tear the tape from the perforating apparatus controlled by the keyboard and insert the tape in the transmitter 235 for transmitting the messages to the respective stations of address.

Of course the subscribers at the other stations will perforate the tape in accordance with the messages to be transmitted from their respective stations to the other stations of the system in a manner similar to that described with reference to the subscriber at station 216.

The messages assumed above have been selected as representative in order to describe the manner in which the system operates in transmitting typical messages from one subscriber to another or from one station to another. It will be readily understood that various other combinations and destinations of messages may be transmitted by the subscriber at station 216. For example, it is possible for this subscriber to cause any message to be received at the central switching sta-

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tion as well as at any of the other subscriber stations connected to any switching center in the system.

After the subscriber has inserted the perforated tape in the transmitter 235 the subscriber is free to direct his attention to any other subject-matter he desires. The only time required of the subscriber is the time required to perforate the tape in accordance with the message and insert the perforated tape in the transmitter. Thereafter the messages are transmitted through the switching equipment automatically to the station of address of each of the messages without further attention by the subscriber or the attendant at the subscriber station.

The manner in which each individual message is transmitted through the system will now be described generally with reference to the central switching equipment. At the central switching station it is necessary for the operator to actuate a start key illustrated in box 390 for each station of each of the party lines until a station has been found which has message material for transmission after which another key for each line may be operated to an automatic position and thereafter the equipment will automatically control the circuits as described hereinafter. The reason for requiring an operator to manually operate certain keys until a station has been found having message material for transmission is that it serves as a check of the system each day when the system is first put into service. If the central station equipment or the transmission lines or the subscriber stations are not in condition for transmission and reception or if there is some trouble therein, it will be impossible for the operator at the central switching station to receive any messages from the station. Consequently, her attention will be immediately directed to the fact that some trouble condition exists and she can take steps to have it corrected.

As pointed out herein a start key at the central switching station is provided with each of the transmitters connected to any of the party lines terminating at the switching center. Each of the lines is also provided with an emergency stop key and a key designated manual in one position and automatic in another position. The operator will operate this last key to its manual position and then operate one of the keys for starting one of the transmitters of each party line. Under the conditions assumed in which message material has been inserted in transmitter 235 at station 216, assume that the operator will operate the start key for starting the transmitter 235 at station 216. The operation of this key is located within the box 390 and will initiate the operation of a start circuit 310 and cause it to progress through one cycle of operation; during this cycle of operation of the start circuit it will cause various signals to be transmitted over the receiving channel 211 of the party line 210. The signals transmitted will comprise first a pause of approximately seven-tenths of a second followed by a blank code combination. The blank code combination will in turn be followed by a second pause or marking impulse of predetermined duration. Following the second pause a line feed signal will be transmitted and this in turn followed by a pause and then the letter A signal. After the letter A signal, a further pause will be transmitted and then the transmitter start circuit will pause in its operation.

The switching and control circuits including the selector circuits at the secondary switching

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centers 213, 214 and 215 all respond to these signals transmitted by the transmitter start circuit 310. However only the selector circuit at station 215 will cause the switching equipment thereof to connect transmitter 235 to the transmitting channel 212 of line 210 and to initiate the operation of this transmitter. The switching and control equipment included at 213 and 214 in responding to the signals transmitted by the transmitter start circuit will not cause any of the transmitting equipment controlled from these secondary switching centers to become operative or to be connected to the transmitting channel of party line 210 extending to the central switching station.

Thereafter the signals transmitted by the transmitter 235 will be transmitted to the central switching exchange over path 212 of the party line 210. At the central switching station the printing reperforator 326 will respond to the various signals transmitted over the line by the transmitter 235. The subscriber in inserting the tape in the transmitter 235 will generally insert it so that at least one letters signal will be transmitted preceding the figures signal and the H signal. This signal will be recorded by the printing reperforator 326 as will be the figures signal and the H signal. The printing reperforator will control the incoming line circuit 322 but generally none of the switching circuits therein will be in condition to fully respond to the figures signal and H signal. If the circuits of this equipment are not in their normal condition, these signals will restore them to their normal position. Following the first figures signals and H signal and the following letters signal which is recorded by the printing reperforator 326 in tape 339, the directing signals DD will be transmitted and recorded by the printing reperforator 326. Inasmuch as these signals will direct the message through the switching equipment to other lines, the incoming line circuit is rendered non-responsive to further signals received over the incoming transmission path of party line 210. The message signals will thereafter be recorded by the printing reperforator 326 in tape 339 both by printing on this tape and punching the tape in accordance with the received signals. Following the first message under the conditions assumed above a figures signal followed by an H signal and a letters signal or code combination will be transmitted to and received by the printing reperforator 326 which will record these signals in the tape 339 and in addition these signals will cause the switching equipment of the incoming line circuit 322 to become effective and respond to predetermined signals received over the incoming channel of party line 210. Under the assumed conditions the next characters transmitted to the printing reperforator 326 will be the signals GZ. When these signals are received by the printing reperforator they will cause switching circuits in the incoming line circuit 322 to be completed which circuits will cause the receiving teletypewriter 323 to be connected to the incoming channel of party line 210 and cause the printing reperforator 326 to be disconnected therefrom so that the following message which is intended for the central switching station will be recorded by the receiving-only device 323.

In the embodiment of this invention shown herein the receiving-only device 323 will cause the message intended for the central switching station to be printed. While the receiving apparatus for recording the messages at the various

stations of address has been shown as page printing apparatus it is to be understood that any suitable type of recording receiver may be employed. However, inasmuch as page printing equipment is generally preferred in systems of this type, this type of equipment has been shown in the drawing and the various circuits and signals transmitted are suitable for operating printing telegraph equipment of this type.

At the end of the message intended for the central switching station a figures signal followed by an H signal and then a letters signal will be transmitted by the transmitter 235 because these signals were perforated in the tape inserted in this transmitter by the subscriber as described above. When these signals are received by the receiving teletypewriter 323 at the central switching station it will cause certain circuits of the incoming line circuit 322 to function and disconnect the receiving-only teletypewriter 323 from the incoming receiving channel 212 of the party line 210 and cause the printing reperforator 326 to be reconnected to this line. In addition the figures signal followed by the H signal when received by the receiving-only teletypewriter 323 will condition the switching circuits of the incoming line 322 so that they will respond to succeeding signals received over the receiving channel 212.

Following the second figures, H, and letters signals the next significant signals transmitted by the transmitter 235 will be the code directing characters JE followed by the message intended for station 520.

The incoming line circuit 322 and the printing reperforator 326 will respond to these signals in substantially the same manner as if responding to the directing of signals DD described above and will cause the address signals JE as well as the following message to be recorded in tape 339. At the end of this message a figures signal followed by an H signal and a letters signal is again received from the transmitter 235. These signals will condition switching circuits in the incoming line circuit 322 to be responsive to further signals received over the party line 210. Under the assumed conditions where the fourth message transmitted by transmitter 235 is intended both for the central switching station and for the recording apparatus 229 at station 219 the subscriber first perforated GH in the tape followed by letters and then by BK.

When the control signals GH are received by the printing reperforator 326, it will cause switching circuit of the incoming line circuit 322 to function to connect the receiving-only teletypewriter 323 to the incoming channel of the party line 210 and at the same time cause these circuits to maintain the connection between the printing reperforator 326 and the incoming channel of the party line. The reception of these signals by the printing reperforator 326 also renders the switching circuits of the incoming line 322 non-responsive to further signals received over the incoming channel 212 of the party line 210. Thereafter the message is printed by the receiving-only teletypewriter and it is also recorded in tape 339 by the printing reperforator 326. At the end of this message the figures signal followed by the H signal will be received both by the receiving-only teletypewriter 323 and the printing reperforator 326. The reception of these signals by this equipment will cause the receiving-only teletypewriter to be disconnected from the incoming channel 212 and will cause the

switching circuits of the incoming line circuit 322 to become responsive to further signals transmitted to it. The next signals to be transmitted to this incoming line circuit under the assumed conditions will be the letters signal followed by an H signal. When these signals are received by the printing reperforator 326 they will cause the incoming line circuit 322 to indicate that the transmission from the subscriber station 219 has been completed.

If the operator at the central station has in the meantime operated a key associated with party line 210 to the automatic position, the reception of the letters signal followed by the H signal at the end of any message will initiate the operation of the transmitter start circuit 310 and cause it to progress through one or more cycles of operation.

During this next cycle of operation of the transmitter start circuit it will transmit signals over the receiving channel 211 of the party line 210 to test the transmitter 238 for the presence of storage material available for transmission and, if a tape has been inserted in this transmitter, the signals will cause the operation of this transmitter to start whereupon the operation of the circuits at the central switching station will be as described above. The reception of the signals from the transmitter 238 will control switching circuits in the incoming line circuit 322 and prevent further operation of the automatic transmitter start circuit 310 as well as cause the signals to be recorded either by the printing reperforator 326 or the receiving-only teletypewriter 323 or both as described above.

If, however, there is no storage material available for transmission by transmitter 238, i. e., if no perforated tape has been inserted therein no signals will be transmitted by this transmitter. Consequently, no signals will be received to actuate switching circuits in the incoming line circuit 322.

Under these circumstances, at the end of a predetermined time interval the operation of the transmitter start circuit 310 will again be initiated and during this cycle of operation signals will be transmitted to test and start the transmitter 239 at station 218. If message material is available for transmission by transmitter 239, the above cycle of operation will be completed and each of the transmitters connected to the party line 210 will be given an opportunity to transmit in turn if they have storage signals available for transmission. After the transmission from each of the transmitters all of the other transmitters will be given an opportunity to transmit before the transmitter which has just been transmitted is given a second opportunity to transmit. If none of the other stations connected to the line have message material available for transmission the last station to transmit will be given another opportunity to transmit and if it still has message material for transmission this material will be transmitted after which the above cycle of operation is repeated. If the last station to transmit does not have material available for transmission when it is tested after all of the other stations have been given an opportunity to transmit and no message material is available for transmission from any of the stations on the line, the operation of the automatic transmitter start circuit 310 will be interrupted for a predetermined period of time of the order of from five to ten minutes after which the operation of this circuit will be again initiated to test each of the stations

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on the line for message material for transmission to the central switching station.

As indicated above, each of the transmitters connected to the line will generally be given an opportunity to transmit in turn but none of them will be given a second opportunity to transmit until each of the other transmitters has had an opportunity to transmit. Under certain circumstances it may be desirable to give some one or more of the transmitters more than one opportunity to transmit for each opportunity given to the other of the transmitters to transmit. In case certain stations originate a large number of messages, it may be desirable to enable the transmitters at these stations to transmit oftener than the other transmitters. This may be accomplished in a number of ways. However, in accordance with the specific arrangement shown in the drawing the transmitter at station 219 is given two opportunities to transmit at different intervals of time for every opportunity granted the other transmitters on the system. This transmitter may be given even more opportunities to transmit and other transmitters may likewise be provided with additional opportunities to transmit during each complete series of operations of the transmitter start circuit.

Return now to the first, third and fourth messages recorded in the tape 339. When the first message was recorded in this tape the transmitting portion of the equipment 324 will become operative and scan the tape. The letters signals together with the figures signals and the H signals will be discarded by the transmitter. The two D signals will be scanned and will control the director circuit 327 in such a manner that will operate the selector magnet 328 and the hold magnet associated with the outgoing line connected to the half duplex party line 260. The operation of these magnets by the director 327 in cooperation with the sequence circuit 480 will establish a transmission path from the transmitter 325 to the printing reperforator 338 of the outgoing line circuit of the half duplex party line 260. Thereafter the message will be transmitted from the transmitter 325 to the reperforator 338. However, in this case since the message is being transmitted to a line local to this switching station, that is, a line terminating at this switching station the first D of the address will not be transmitted to or recorded by the printing reperforator 338. However the second D of the code combination together with the entire message and the figures signal followed by the H signal and the letters signal at the end thereof will be recorded by the printing reperforator 338. At the end of the message the figures signal and H signal and the letters when it is transmitted by the transmitter 325 will actuate the director circuit 327 in such a manner that the transmitter path between the transmitter 325 and the reperforator 338 will be interrupted and the various circuits restored to their original or normal condition.

The letters signals and also the G signal followed by the Z signal recorded in tape 339 between the first and third messages will be discarded by the transmitter 325. When the J signal reaches the transmitting point of the transmitter 325, the transmitter 325 will scan this signal and the following E signal and cause the directors 327 to establish a transmission path through the crossbar switch to the outgoing line circuit of the trunk 290. Thereafter the message will be transmitted over this path from the

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transmitter 325 to one or the other of the reperforators of the outgoing line circuit connected to the outgoing channel 291 of party line 290. At the end of this message a figures signal followed by the H signal and the letters signal will cause the operative path between these devices to be interrupted and the circuits restored to their original condition. The letters signals recorded in tape 339 between the third and fourth messages will be discarded by the transmitter 325 as will be the G signal followed by the H signal. When the B signal arrives at the control point of the transmitter 325 it will scan this character and the next one and together with the director 327 will cause a transmission path between transmitter 325 and one of the reperforators 313 or 319 of the outgoing line circuit of the party line 210 to be established. Thereafter the message will be transmitted over this path and at the end thereof the figures signal followed by the H signal and the letters signal will interrupt this path and return the circuits to their original condition. The letters signal and the H signal following the last message will be discarded by the transmitter.

If no further signals are received from the incoming path of the party line 210 by this time, the transmitter 325 will stop because it will have sensed the last signal recorded in tape 339 and since no further tape is available it is necessary to stop a transmitter at this time.

Considering now the first message which was recorded by reperforator 338 in tape 340, as soon as the first character of this message which will be the letter D of the directing code is stored in tape 340 certain relay circuits and other circuits of the transmitter 336 will be completed indicating that a message is awaiting transmission over the half duplex line 260.

The transmitter start circuit 330 associated with the half duplex line 260 operates in substantially the same manner as the start circuit associated with the outgoing line 310 and causes the various transmitters connected to the party line 260 to transmit in rotation when they have message material available for transmission. In addition, the transmitter 336 is controlled by the start circuit in a manner somewhat similar to the manner in which the other transmitters of this party line are controlled and started. In other words, the transmitter 336 must wait its turn for transmission over the half duplex line 260. The reason for this requirement is that the transmission circuits of line 260 are arranged to operate so that they will transmit messages only in one direction at a time. Consequently, if some one of the transmitters is transmitting when the first message is stored in tape 340 transmitter 336 must wait its turn before it can transmit this message over the party line.

When the transmitter 336 is given a turn to transmit over party line 260, it will transmit the message preceded by the letter D signal over the party line. The intermediate or secondary switching equipment at all of the stations, that is, equipment shown in boxes 263, 264, and 265 will all respond to the letter D signal of the message. The equipment at the secondary control centers 263 and 265 in responding to this signal renders the switching equipment non-responsive to further signals transmitted over the half duplex party line 260 without connecting any of the transmitters or receivers to the party line and without starting any of the transmitters into operation.

However when the letter D signal is received by the switching equipment designated 264 which may be at station 265 or may be located a short distance therefrom the switching equipment 264 will cause the receiving teletypewriter to be connected to the half duplex party line. The letter D signal when it is received by the switching equipment 264 will also render the switching circuits thereof non-responsive to succeeding signals transmitted over the party line 260. Thereafter the message will be transmitted by the transmitter 336 over the party line 260 to the receiving equipment at station 269. The receiving equipment at station 269 will respond to the message signals and record them at station 269. At the end of the message the figures signal followed by an H signal will be transmitted over the party line 260 to the receiving equipment at station 269.

While the switching circuits at the secondary switching stations 263, 264, and 265 are rendered non-responsive to signals transmitted over the half duplex party line after the letter D signal, a selector device at these stations receives all the signals transmitted over this party line and will respond to the end of message signal comprising a figures signal followed by the H signal when it is transmitted at the end of the message being transmitted to the receiving equipment located at station 269 and the control selector of the switching equipment 264 will cause certain circuits to respond thereto and interrupt the connection between the receiving equipment at station 269 and the half duplex line 260. In addition to interrupting the connection between the receiving equipment at station 269 and party line 260, the equipment at the secondary switching center 264 will be rendered responsive to further signals transmitted over the half duplex party line 260. In addition the selector and switching circuits at the other secondary switching centers 263 and 265 connected to the party line 260 will be rendered responsive to further signals transmitted over this party line in response to the reception of the end of message signal transmitted thereover to the receiving equipment at station 269.

The relay equipment 331 associated with the transmitter 336 may respond to the end of message signal transmitted thereby if a predetermined period of time has elapsed from the beginning of transmission from the transmitter 336 to the time the end of message signal is transmitted thereby. If this predetermined interval of time has not elapsed and another message is waiting transmission by the transmitter 336, this message will be transmitted thereby.

If this interval of time has elapsed prior to the transmission of the figures signal followed by the H signal circuits will be completed for stopping transmission from the transmitter 336 and initiating the operation of the transmitter start circuit 330 to provide an opportunity for enabling another transmitter to transmit message signals over the half duplex line 260 independently of whether or not any further messages are stored in tape 240 at this time.

It will be recalled that the third message was stored by one of the reperforators associated with the outgoing line circuit of the trunk 290. If no messages are being transmitted over trunk 290 or the transmission path 291 thereof at the time the first directing signal is recorded by the reperforator, the associated transmitter will control relay circuits in such a manner that this transmitter will be operatively associated with

channel 291 and start to transmit the message over this line. In this case the message is transmitted to the trunk circuits extending to other switching stations so the entire address will be transmitted preceding the message, that is, both the J and the E signals will be transmitted to and recorded in the reperforator associated with the outgoing line circuit of the trunk 290. Thereafter when the message is transmitted by the associated transmitter over trunk 290 both of these address codes will be transmitted preceding the message and the usual disconnect signal comprising a figures signal followed by an H signal will be transmitted following the message. Address signals together with the message signals will be received by the reperforator 672 and recorded in tape 695. As soon as the first character of the address portion is recorded in tape 695, the associated transmitter 676 will sense this code combination and the following one and together with the associated director circuit will establish a connection between this transmitter and the outgoing line circuit of the line extending to station 520. The circuits at the second switching center shown in Figs. 6 and 7 will thereafter respond to the signal stored in tape 695 and cause the message to be transmitted to and recorded by the receiving equipment at station 520 in the same manner as messages are transmitted to and recorded by the receiving equipment at the respective station connected to the party line as described below.

Considering now the fourth message transmitted from station 216 which was recorded by either reperforator 318 or 319, this message will be recorded by either one or the other of these reperforators depending upon whether or not the other one is busy and upon which one became idle first if they both were previously busy. Assume for example that the message will be recorded by the reperforator 318. As soon as the first signal received by the reperforator 318 is recorded in the tape, transmitter 316 will initiate the operation of certain relay control circuits for establishing an operative connection between the transmitter 316 and the receiving channel 211 of party line 210.

In this case the message is intended for the receiving apparatus 229 at station 219 which has been assigned an address of BK. Inasmuch as station 219 is connected to party line 210 terminating at the first switching center the director equipment 327 and transmitter 325 will cause the first code character, namely the letter B, to be discarded so that it will not be received by and recorded by the reperforator 318. However, the letter K will be received and recorded by this reperforator. When this letter is received and recorded in the tape, the transmitter 316 will complete circuits indicating that it has message material for transmission as pointed out above. If the outgoing channel 211 is not busy at that time circuits will be completed for establishing an operative connection between transmitter 316 and the outgoing channel whereupon transmitter 316 will transmit the message together with the second portion of the address signal, namely the letter K, over the channel.

If the channel is busy transmitter 316 will merely complete circuits indicating that it has message material for transmission, and at the end of the message then in progress of being transmitted from the channel by transmitter 317, transmitter 316 will be given an opportunity to transmit its message, assuming of course that no

messages prior to the message in question are recorded in the tape between the reperforator 318 and the transmitter 316. If a number of messages are recorded in the tape between this transmitter and reperforator, then these messages will be transmitted prior to the transmission of the message in question. If messages are also perforated in the tape between transmitter 317 and reperforator 319 then the transmitters 316 and 317 alternately transmit one message at a time over the outgoing channel. First transmitter 317 will complete the transmission of the message then in the progress of transmission, then transmitter 316 will transmit a message and then transmitter 317 another message and so on.

When the letter K preceding the message in question is transmitted over the receiving channel 211 of party line 210 the secondary switching equipment at all of the centers respond to this character. At the secondary switching centers 213 and 215 the selecting equipment responds and renders the switching circuits thereat non-responsive to further signals transmitted over the channel. At the control point 214 the selector equipment responds and causes the switching equipment to extend a communication path between the recording device 229 and the receiving channel of party line 210. Thereafter the message will be transmitted to and recorded by printing reperforator 229. The end of message signal following this message will cause the connection between the printing reperforator 229 and the receiving channel of party line 210 to be interrupted and the switching equipment at all of the secondary switching centers or control points 213, 214, and 215 to be rendered responsive to further signals transmitted over the receiving channel 211 of the party line 210. In addition the figures and H signal at the end of this message when transmitted by the transmitter 316 will cause certain contacts to close and stop the transmitter 316 from transmitting and permit transmission from transmitter 317 if additional material is available for transmission by this transmitter.

If at any time during the transmission of the message by transmitter 316 the transmission from some one of the transmitters connected to line 210 should terminate and the transmitter start circuit 310 be initiated the transmitter start circuit will first stop transmitter 316 from transmitting and then interrupt the operative connection between transmitter 316 and its associated distributor. Thereafter during the cycle of operation of the transmitter start circuit, the transmitter circuit will control the distributor associated with the transmitter 316 and cause the transmitter start signals to be transmitted thereover to start the transmission from another transmitter connected to party line 210. In addition the first code combination transmitted by the transmitter start circuit will be a blank signal as described above. When this blank signal is received by the control equipment 214 it causes the operative connection between the recording apparatus and the party line 210 to be interrupted so that succeeding transmitter start signals transmitted from the receiving channel of party line 210 will not be recorded by the printing reperforator 229. Consequently, these signals will not be added to the message which was interrupted. At the completion of the operation of the transmitter start circuit, the operative connection between the receiving recorder 229 and party line 210 will be restored and then the connection between the transmitter 316 and the

receiving channel 211 will also be restored and the operation of transmitter 316 resumed whereupon the remainder of the message will be transmitted to the receiving recorder 229 without any characters or signals being added to or subtracted from the message nor will any of the message signals be mutilated or changed.

The circuits at the central switching station are so arranged that if a subscriber inadvertently addresses a message to some address which has not been assigned to any station, the equipment will automatically route the message to a miscellaneous intercept position 427 which will cause the message to be recorded by the receiving reperforator 426 and the tape stored in a tape receptacle 425. The operator at the central exchange can then examine the tape and if possible correct it and cause the message to be retransmitted to the proper station or take such further action as may appear to be desirable.

Under certain circumstances, it may also be desirable to intercept certain messages at the control station and send them to the special storage or repeating device for later transmission to the station of address. A feature of this type is very useful in case a telegraph system extends over a large territory or territories such as through a number of States of the United States wherein certain days may be holidays in some States and not in others. If certain of the receiving stations are located in States having holidays on a particular day, it may be desirable to intercept the messages for these stations on these days and transmit them to the stations at a later date. In addition the hours of business may not coincide or be the same at all of the stations so that at certain times of the day it may be desirable to intercept the messages for certain stations and during other periods of the day intercept messages for other stations for later transmission to the respective stations. Inasmuch as the party lines themselves may extend across a number of States, it is highly desirable that the intercept be arranged upon a station basis rather than upon party line basis. Often it is desirable that the intercepting equipment be arranged so that messages for any station on a party line may be intercepted while the messages for the other stations connected to that line may be transmitted to them in their normal manner. Another use of the intercept position and equipment arises when certain equipment at various stations becomes unoperative or out of adjustment or when a portion of the line fails. In order to care for these various conditions an intercept circuit 424 is provided. In addition a number of intercept keys 391 are provided at the central switching system. A key is provided for each of the stations of address, the lines from which terminate at the central switching station in question. Then when it is desired to intercept messages intended for any of these stations the corresponding intercept key will be operated. All messages thereafter directed to the switching equipment which will be addressed to the station in question will be routed by the switching equipment to the special intercept circuit 424 and to the storage repeater 420 comprising a reperforator 421 and a tape control transmitter 422. The tape control transmitter 422 is provided with a director circuit 423 so that upon the proper operation of certain control keys, not shown in Figs. 2, 3 or 4 but shown in certain of the Figs. 9 to 90, the intercepted messages will be automatically transmitted to their stations of address.

The operation of the originating equipment of the control station is somewhat similar to the operation of the transmitter and associated directors associated with the incoming line circuits of the various party lines. In this case an operator operates the keyboard and causes the tape to be perforated in accordance with the address and message to be transmitted thereto. The tape is then passed through a transmitting distributor which together with certain control relays and a director circuit establishes a communication path between the transmitter and the proper outgoing line circuit for the transmission of the message thereto, after which the message is transmitted and at the end thereof an end of message signal causes the transmission path to be interrupted and the stations returned to their previous condition. Thereafter the message is transmitted to the station of address as described above.

Messages incoming over the trunk line 290 to the central switching equipment shown in Figs. 3 and 4 are transmitted through the equipment substantially in the same manner as other messages incoming from party lines as described above.

Briefly, the storage repeaters employed herein comprise a receiving and recording portion which is responsive to received permutation code signals and causes a tape to be punched in accordance with these signals and also causes the characters represented by these signals to be recorded in printed form upon the tape. The tape then passes through a transmitting portion which is controlled by the punches in the tape. The transmitting device is also controlled by the supply of perforated tape and is so designed it will sense and transmit the last signal stored in the tape. The tape transmitter is also provided with power driven means for controlling a large number of contacts in accordance with each element of a code combination representing a character or symbol stored in the tape. The contacts recorded by each element of each recorded combination are then employed to control circuits in response to certain predetermined characters or code combinations stored in the tape which pass through the transmitter.

The invention may be arranged to cooperate with other types of storage repeaters in which other types of storage media are employed as will be readily appreciated by those skilled in the art. The specific storage repeater shown therein is intended merely to illustrate features of a typical type of storage repeater suitable for use in combination with the circuits and other elements of this invention. Numerous features and details of such a typical storage repeater are shown in Figs. 91 through 96 inclusive, and will be described more fully hereinafter. A similar storage repeater is disclosed in detail in the above-identified patent to Gubisch.

The manner in which the circuits and apparatus are constructed and function to accomplish the above-described operations as well as providing numerous other features and modes of operation may be more fully understood by reference to the detailed circuits of typical elements of a system embodying this invention as disclosed in Figs. 9 through 90, inclusive, and Figs. 91 through 96, inclusive, which show details of a mechanism of suitable typical storage repeaters.

Initial condition of the system

Figs. 9 through 90 when arranged as shown in Fig. 8 show the circuit details of typical circuits

and equipment which cooperate to form the elements of a typical system in accordance with this invention. When power is first applied to the system when it is installed or the first thing in the morning if it is shut during the night the relays and equipment will assume the positions shown in Figs. 9 through 90. It is to be understood that suitable driving motors are provided for the various devices and that these are all started into operation by connecting them to a suitable source of power. Numerous motors and sources of power have been shown in the drawings. However, numerous other devices employ motors which motors are not shown in the drawing because it is well understood by those skilled in the art that such devices are commonly employed with these devices and that such motors will be supplied with these devices. For example, the receiving teletypewriters shown at each of the outlying subscribers' stations require a driving motor to drive them so that they will properly respond to receive the signals. In some cases the motor which drives the transmitter and operates the perforator shown thereat is also employed to operate the receiving teletypewriter. This arrangement is shown in certain of the above-identified patents showing details of suitable equipment for use in the subscriber's station. However, it is not necessary that the same motor be employed to drive all of the equipment at the subscriber's station. Instead one or more motors may be provided individual to the transmitting equipment and either motor or motors provided for the receiving equipment. In addition the control selectors at the intermediate points such as illustrated by the boxes 1001, 1101 and 1301 are also provided with motors which motors are connected to sources of power and continuously energized. Similar receiving and transmitting equipment at the central exchange is provided with driving motors for driving the various pieces of apparatus and most of these motors are illustrated in the drawing, it being understood that they are all connected to sources of power and continuously operating so that the equipment is at all times ready to respond to received signals and capable of transmitting and retransmitting the signals with a minimum delay.

The relays and other equipment at the subscribers' stations as well as the secondary or intermediate switching centers all remain in the condition shown in the drawing when power is applied and until the signals are transmitted over the system for energizing the circuits as will be described hereinafter. Relay 977 at the secondary switching center 215 is maintained in the position shown in the drawing due to current flowing through the upper winding of this relay in a circuit extending from battery through this winding to ground through the lower break contacts of key 991 and the left-hand break contacts of relay 978. Current also flows through the lower winding of relay 977 in an obvious circuit and is in the direction which tends to move the armature of relay 977 to its right-hand position. However, the effect of the current flowing through the upper winding of this relay predominates so its armature is maintained in the position shown in the Fig. 9. The armatures of relays 1177 and 1277 are similarly maintained in the position shown in the drawing. It should be noted that all of the line relays controlling the selector equipment at each of the secondary switching centers as well as the repeater relays thereat are operated to and remain in their marking positions

when power is applied to the lines due to the fact that the marking condition on potentials are applied to the lines at each of the subscribers' stations and the central office until signals are transmitted over the system.

In addition a few of the relays at the central exchange are operated and are normally maintained in the operated condition when power is applied to the system. For example, relay 1501 shown in Fig. 15 is operated and a circuit extending from battery through the winding of relay 1501 over conductor 1517 to ground through the upper break contacts of the skip keys 1441 through 1450 in parallel. It is to be understood that a skip key similar to 1441 is provided with each of the stations served by a particular party line in question. In the drawing only four keys are shown, it being understood that additional intermediate keys are provided between the keys actually shown as will be readily understood by persons skilled in the art. Similarly relay 1601 is operated in a circuit from battery through its winding to lead 1612 which extends through Figs. 15 and 14 to ground through the brush arm 1401 which is resting on the first contact in its normal position. The brush arms 1401 through 1406 inclusive are associated with one rotary stepping selector which are controlled by the magnet 1407. Switches of this type are well known and understood by persons skilled in the art. Further details of a typical switch of this type suitable for use in these circuits are disclosed in United States Patents 1,472,465, granted to Forsberg et al. on October 30, 1923, and 1,533,188, granted to Hargan on April 14, 1925, the disclosures of which patents are hereby made a part of this disclosure as if fully included herein.

The selector switch comprising brush arms 1401 through 1406 inclusive is provided with circuit arrangements for causing it to be returned to its initial position as shown in Fig. 14 when power is applied to the system if it is left in any other position. These circuits will be described hereinafter.

The selector comprising the brush arms 1408 through 1413, inclusive and the stepping magnet 1414 comprises a stepping switch similar to the switch comprising brush arms 1401 through 1406. The brush arms 1408 through 1413, however, are not returned to their initial position as shown in the drawing but will remain in the position to which they are last actuated unless changed in a manner to be described hereinafter. The third selector switch comprising brush arms 1415 and 1416 together with the stepping magnet 1417 is similar to the other two selector switches shown in Fig. 14. In this case the brush arms 1415 and 1416 are arranged so that they will remain in the position to which they were last operated until they are again operated to some new position. In other words, they are not returned to their initial or starting position as are the brush arms 1401 to 1406.

In addition relay 2708 is normally maintained operated in a circuit extending from battery through its winding and the upper inner break contacts of relay 2709 to ground through the break contacts 2845. Relay 2712 is maintained operated in a circuit from battery through its winding to ground through the upper break contacts of relay 2713. Relay 2714 is also maintained operated in a circuit from battery through its windings and operated contacts of relay 2712 to ground.

Relay 1817 maintained operated in a circuit extending from battery through its winding to

ground through the lower break contacts of relay 1812. Similarly, relay 1826 is maintained operated, the circuit extending from battery through the lower break contacts of relay 1821.

Relay 2124 is normally maintained operated in the circuit extending from battery through its winding to ground through the lower break contacts of relay 2112. Similarly, relay 2127 is maintained operated in a circuit extending from battery through its winding to ground through the upper break contacts of relay 2118.

Relay 2124 maintains a circuit for holding relay 2122 operated. Likewise relay 2127 maintains a circuit for holding relay 2125 operated.

In addition the circuits of the transmitter shown in Fig. 28 are arranged to operate and advance the sensing head 2806 causing the characters stored in the tape 2805 to be either discarded or transmitted until the last character stored in the tape 2805 has been sensed and transmitted or discarded whereupon the contacts 2821 are opened and further operation of the transmitting equipment stopped. The detailed description of the circuits and operation of the discarding and transmission of characters recorded in tape 2805 is given herein. Likewise the sensing heads 1907 and 2007 in the transmitters shown in Figs. 19 and 20 are advanced until they have sensed the last signal recorded in the respective tapes 1930 and 2030 and the respective contacts 1921 and 2021 open thus stopping further operation of these devices. The circuits causing the advance of these sensing heads in the transmission of the storage signals under control of these transmitters are described in detail hereinafter.

The relays corresponding to relays 977, 1177 and 1277 of the switching senders party line 260 are likewise maintained in their left-hand positions due to currents flowing through their windings similar to those described above with reference to relays 977, 1177 and 1277. Similarly, the brush arms 4001 to 4006 inclusive are restored to their No. 1 position in a manner similar to the manner in which the brush arms 1401 through 1406 are restored to their No. 1 position when power is first applied to the system and at other times as described above. Relay 4431 is maintained operated with an obvious circuit from battery through its windings to ground through the upper break contacts of relay 4412. Likewise, relays 4624 and 4622 are maintained operated in currents flowing through their windings in obvious circuits. As in the case of transmitting devices associated with party line 210 transmitting devices shown in Figs. 45 and 53 are arranged to scan a transmitter and discard or transmit the signals recorded in their respective tapes until the last character recorded has been transmitted or discarded. A number of relays in Fig. 52 are shown to be normally operated. These relays are maintained operated by current flowing through their windings in obvious circuits and are similar to the corresponding relays of Fig. 27 which are normally shown operated as described above.

The corresponding relays associated with the trunk circuit 290 are similarly maintained operated or in the positions described above with reference to the relays of the line circuits 210 and 260. These relays include among others relays 6117, 6126, 6422, 6424, 6425, 6427, 6608, 6612, 6614 and 6625. Likewise the transmitting apparatus senses and transmits or discards all of the characters recorded in the respective tapes until the

last character stored has been sensed and transmitted or discarded whereupon the operation of these transmitters stopped.

Relay 7520 of the originating station equipment is normally maintained operated in a circuit extending from battery through its upper winding to ground through second back armature from the bottom of relay 7519. Likewise relay 7616 is maintained operated in a circuit extending from battery through its windings to ground through contacts of relay 7615. In addition the corresponding relays of the intercept position shown in Figs. 82 through 88, inclusive are likewise normally maintained operated in circuits similar to those described above with reference to the other directors and transmitters.

In addition relays 9010 and 9011 of the sequence circuit shown in Fig. 90 are normally maintained operated in a circuit extending from battery through the winding of relay 9011 to the left-hand outer break contacts of relays 9021 through 9025, inclusive, the right-hand outer break contacts of relays 9021 through 9025 inclusive to ground through the winding of relay 9010. These relays in remaining operated continually test the continuity of the circuit of the break contacts of relays 9021 to 9025 and if these relays remain released for a long period of time they cause an alarm to be sounded as will be described hereinafter. Relay 9012 is maintained operated due to current flowing to the output circuit of tube 9020. The current is maintained flowing through the tube circuit due to the potential supplied to the grid so long as relays 9010 and 9011 are operated.

The current is also maintained flowing through the selector magnets of all the receiving instruments of the system including the receiving devices at the subscriber's station and monitoring selectors at the intermediate stations and all of the recording equipment at the central switching station. Current is maintained flowing through these magnets in order to maintain the respective equipment in their idle condition ready for the reception of signals when circuits are established to them as will be described hereinafter.

Subscriber perforates tape

The attendant at the subscribers' stations will perforate tape in accordance with the messages to be transmitted as described above. In addition they will perforate address or directing characters or codes preceding the message and end of message codes following each message. In order to accomplish this a subscriber or attendant will operate the keyboard perforator in accordance with the address codes of the message and the message signals. Normally the subscribers will be instructed to first perforate the end of message code at the head end of each piece of tape when they start to perforate. In addition letters signals, that is, code combinations in which all of the significant impulses are marking, are generally perforated in the tape between the address portion of the message and the message proper in order to allow sufficient time for switching circuits to properly function. It is to be understood that as many letters signals may be perforated between end of the various portions of the directing codes as well as between these signals and the message proper and between message as may be necessary or desirable to insure proper operation of the various circuits and apparatus. At the end of a group of messages the subscriber will be instructed to perforate a spe-

cial group of signals indicating that there is no further message material available for transmission from that station at that time. Thereafter, the subscriber generally will remove the perforated tape from the keyboard operated perforator and insert it in his transmitter. Each of the subscribers will thus perforate the tape in accordance with the address codes and message codes together with the other directing and switching codes and insert the perforated tape in the transmitter after which they are free to perforate other messages in the code as well as collect messages for transmission and distribute messages received by the receiving equipment.

For purposes of illustration assume that the subscriber at the station 216 shown in Figs. 2 and 23 perforates a series of messages and directing signals in this tape as described above in which a group of letters signals are first perforated in the tape, then an end of message signal comprising a figure signal followed by an H signal and a letters signal, then one or more letters signals followed by the address code letters DD followed by carriage return, line feed and another letters signal. Following these signals the subscriber will perforate the characters corresponding to the message intended for station 269. At the end of the message signals the subscriber will perforate a figure signal followed by an H signal and a letters signal. Thereafter they will perforate several letters signals and then the directing code or address signals GZ, which will direct the following message to the central switching center. Following the address signals GZ the subscriber will perforate letters signals and then a carriage return and line feed and a second letters signals in the tape. After these signals are perforated in the tape the subscriber will perforate the tape in accordance with the message to be transmitted to the central switching center. Following the second message, the subscriber will perforate a figures signals followed by an H signal and then several more letters signals.

Assuming now that it is desired to send a third message from station 216 to station 520. In this case the subscriber will then perforate the address code signals corresponding to characters J and E in the tape. Following these signals the subscriber will perforate letters signals, carriage return, line feed and second letters signal in the tape. Thereafter the subscriber will operate the keyboard in accordance with the message to be transmitted and cause the tape to be perforated in accordance with the message characters. At the end of this message the subscriber will perforate a figures signal followed by an H signal and several letters signals in the tape.

Assume the subscriber has a message which he desires to transmit both to the central switching station and the recording apparatus 220 at station 219 for further transmission over other systems. In order to properly transmit the messages to both of these stations the subscriber will first perforate a G signal followed by an H signal in the tape. Following these signals the subscriber may or may not perforate a letters signal in the tape and then the subscriber will perforate an address code BK in the tape. Following these address codes the subscriber will perforate a letters signal, carriage return, line feed and a second letters signal in the tape. Thereafter the subscriber will perforate the tape in accordance with the message signals to be transmitted. In many cases it will be desirable for

the subscriber to include as part of the text of each message the addresses of both the station of origin and the station of destination as well as serial number or other identification of the message. Such information aids in checking the operation of the system and errors to be found and remedied with a minimum of time and effort. Following these message signals the subscriber will perforate the figure signal followed by an H signal. There are no further messages for transmission at this time. A subscriber will then perforate a letters signal followed by an H signal and then a number of letters signals to insure that the tape will feed out of the keyboard perforator and properly feed through the transmitter. Thereafter the operator or attendant at this subscriber's station will gear the tape or detach it from the keyboard perforator and insert it in the transmitter.

It is to be understood that the subscriber in perforating the address codes, message codes, end of message codes and other directing signals in the tape merely operates the keys of the keyboard perforator to cause corresponding punches or perforations to be made in the tape representing the various characters and code combinations employed. It is to be understood that the various signals perforated in the tape following the address codes may be varied, for example, the address code may be repeated immediately following the letters signals following the first perforation of the address code. In addition the carriage return and line feed signals may be omitted and other signals substituted therefor. In addition it is usually an advantage for a subscriber to immediately follow the carriage return and line feed signals by a more complete address of the station or destination of the message as well as the address at the sending station and the number of the message transmitted between these respective stations.

No apparatus has been shown at the subscribers' stations for securing a printed copy of the address and message signals either as they are perforated or as they are transmitted. If it is desired to secure a copy of these signals at either of these times additional recording instruments will be provided for this purpose as is understood by those skilled in the art. For example the additional recorders, where required or desired, may be arranged similar to the one shown at the central switching station and described in greater detail hereinafter.

The other subscribers of course will similarly perforate the tape and insert it in their transmitters for transmission over the system, however at present for the purpose of illustration the procedure and operation of the system in transmitting the messages from station 216 will be described in detail, it being understood that the messages will be transmitted from the other stations in a similar manner.

Starting transmission from a subscriber's station

After power has been applied to the system an operator at the central switching station will first restore the automatic key 1419 to its unoperated or manual position if it had been operated to its automatic position. The operator will then operate one of the start keys 1431 through 1440. One of these keys is provided for each of the stations connected to the party line in question, in this case one key is provided for each of the stations connected to the party line 210.

Under the assumed conditions wherein the op-

erator wishes to start transmission from the station 216 and the transmitter at this station is assigned the letter A, the operator at the central station will operate key 1431 and hold it operated until the lamp 1421 lights as will be described hereinafter. Upon the operation of key 1431 a circuit is completed for the operation of relay 1503 from ground through the inner upper operated contacts of relay 1501 over lead 1513, the upper break contacts of relay 1510, the lower operated contacts of relay 1501, the second armature from the top and break contact of relay 1508, the operated contacts of the start key 1431 and the break contacts of the skip key 1441 through the break contacts of another skip key as, for example, 1444 and the break contacts of the associated start key 1434 through the A1 bank of the A selector switch and brush 1411 through the break contacts of the A stepping magnet 1414 to battery through the lower winding of relay 1503. As shown in the drawing, brush 1411 is resting upon the first terminal, that is, the terminal connected to the start key 1431. However, assuming that this brush is not resting upon this terminal a circuit will be completed through whatever terminal it is resting upon and the associated skip and start keys causing relay 1503 to operate as described above. Operation of relay 1503 completes an obvious circuit for operating relay 1512 which relay in turn connects an additional ground from the next to the bottom contacts of relay 1501 through the operated contacts of relay 1512 through the two sets of upper break contacts of relay 1508 through the start key 1431 and thence through the skip key and start key contacts and the bank contacts of the A1 bank and brush 1411 to the lower winding of relay 1503.

The operation of relay 1503 also completes a circuit for the operation of the stepping magnet 1414 of the A selector switch from battery through the winding of magnet 1414 to ground through the lower operated contacts of relay 1503. Magnet 1414 operates and interrupts the operating circuit of relay 1503 through its lower winding whereupon this relay releases and in turn interrupts the operating circuit of magnet 1414. Magnet 1414 thereupon releases and causes the associated brush arms 1408 through 1413 to advance one step. When the brush arm 1411 makes contact with the next terminal it will again complete the above described circuit for the operation of relay 1503 which relay in turn again causes magnet 1414 to operate and interrupt the operating circuit of relay 1503 and the subsequent release of relay 1503 again permits magnet 1414 to release and advance the brush arms another step.

The above cycles of operation are repeated until brush arm 1411 comes in contact with the terminal of the A1 bank to which no ground is connected through the corresponding start key. In other words, it comes to rest upon the terminal associated with the operated start key whereupon relay 1503 will not reoperate.

The brush arm 1412 of the A stepping switch is stepped simultaneously with the brush arm 1411 and connects ground to the lights corresponding to the terminals with which the brush arms of this switch are in contact. Consequently, the respective lights will light and the operator upon operating the start key 1431 will observe which of the lights 1421 through 1430 is lighted and will hold key 1431 operated until the A stepping switch steps to the terminal to which the key 1431 is connected whereupon the light 1421 lights and indi-

cates to the operator that she has held this key depressed sufficiently long.

The operation of the start key also completes circuits for causing the stepping magnet 1417 of the B stepping switch to operate and release in a manner similar to the operation of the stepping magnet 1414 of the A stepping switch. Circuits for the operation of the B selector magnet 1417 at this time may be traced as follows. A circuit is first completed for the operation of the stepping magnet 1417 from battery through the winding of this magnet and the lower break contacts of relay 1509 and the center set of lower break contacts of relay 1506 to ground through the brush arm 1415 and the contact bank of the B1 selector upon which this brush arm happens to be resting. The ground is connected to all of the contacts of the B1 bank except the one connected to the start key 1431 which has been operated. It is noted that the contacts of the B1 bank are connected in multiple or parallel with the contacts of the A1 bank of the A selector switch. Consequently, ground is connected to both of these banks from the same source. Namely, through the break contacts of all of the unoperated start keys and skip keys and through the operated contacts of the operated start key 1431, through the upper break contacts of relay 1508 and the lower break contacts of relay 1501, upper break contacts of relay 1510 to ground through the upper inner operated contacts of relay 1601. The operation of magnet 1417 in the above described circuit removes the short circuit from around the lower winding of relay 1509. Relay 1509 will then operate and interrupt the operating circuit of the stepping magnet 1417 allowing magnet 1417 to release. The release of magnet 1417 causes the brush arms 1415 and 1416 to step or advance one terminal. The release of magnet 1417 reestablishes the short circuit around the lower winding of relay 1509 and thus causes this relay to release. If ground is connected to the next terminal of the B1 bank a circuit will be reestablished for reoperating the stepping magnet 1417, which magnet will reoperate and remove the short circuit from around the lower winding of relay 1509 and permit this relay to operate. The operation of relay 1509 will interrupt the operating circuit of magnet 1417 and thus permit this magnet to release. The release of this stepping magnet advances the brush arms 1415 and 1416 one step as described above. The above cycles of operation will then be repeated until the brush arm 1415 is stepped to the same position as the brush arm 1411 of the A stepping switch. If the brush arm 1412 arrives at the position assigned to the operated start key 1431 first, a circuit will be completed for maintaining relay 1509 operated when brush arm 1416 reaches this terminal. This circuit may be traced from battery through the upper winding of relay 1509 and the brush arm 1416, through the contacts of the B2 bank and the contacts of the A2 bank to ground through brush arm 1412. This circuit will maintain relay 1509 operated as long as the A selector is in this position. In other words this circuit insures that the B stepping switch and brush arms will not leave a particular position until the A selector has advanced from this particular position because the stepping circuit of the stepping magnet 1417 is open at the lower contacts of relay 1509.

In addition if brush arm 1415 comes to rest upon a terminal of the B1 bank to which no ground is connected before the brushes of the A stepping switch reach the corresponding termi-

nal, a circuit will not be completed for the operation of the magnet 1417 even though relay 1509 is released. Consequently, both the A stepping switch and the B stepping switch will step to a position where their brushes make contact with wires extending to the operated start key. When the brushes of the A stepping switch stop on the corresponding terminal relay 1509 will be operated due to current flowing through its upper winding in the circuit traced above.

The operation of any one of the start keys, for example, the start key 1431 also completes a circuit for the operation of relay 1602 from battery through its winding and upper break contacts, the upper break contacts of relay 1606, the third armature from the top and break contact of relay 1508, the break contacts of the skip key 1441, the operated key contacts of the start key 1431, the upper break contacts of relay 1508, lower operated contacts of relay 1501 and the upper break contacts of relay 1510 to ground through the upper inner operated contacts of relay 1601.

Relay 1602 in operating completes a circuit for maintaining itself operated from battery through its winding and upper operated contacts to ground through lower break contacts of relay 1608 and the lower outer break contacts of relay 1506.

The operation of relay 1602 completes a circuit for the operation of relay 1701 from battery through the winding of relay 1701 to ground through the lower operated contacts of relay 1602. The operation of relay 1701 serves to interrupt the operation of any transmitter which may be transmitting to the receiving channel of the party line 210. However, since neither of the transmitters is transmitting to this channel at this time operation of relay 1701 performs no useful function.

When power is applied to the system the filament of vacuum tube 1610 is lighted and a negative bias is applied between the grid and filament so that insufficient anode current flows through this tube to operate relay 1603. The negative bias applied to the grid of the tube is obtained from resistance 1614 in a well known manner. At this time ground is also connected to both the left-hand and right-hand terminals of condenser 1611. The grid of vacuum tube 1610 is connected through a high resistance 1615 to the right-hand terminal of condenser 1611. Consequently, the potential of the right-hand terminal of condenser 1611 will control the potential of the grid of vacuum tube 1610. Prior to the operation of relay 1602 ground is connected to the right-hand terminal of condenser 1611 through the break contact and third armature from the bottom of relay 1602 and the upper break contacts of relay 1607.

However, when relay 1602 operates as described above this ground is disconnected from the right-hand terminal of condenser 1611 whereupon the right-hand terminal of this condenser starts to charge to a positive potential through the high resistances 1451 and 1453 in parallel. The time constant of these resistances and condenser 1611 together with the potential of battery 1616, the bias of tube 1610 and the constants of this tube are such that it requires approximately seven-tenths of a second for the potential of the right-hand terminal of condenser 1611 to become sufficiently positive to overcome the bias of tube 1610 to permit sufficient anode current to flow through tube 1610 to cause relay 1603 to operate.

At the end of this seven-tenths of a second interval however sufficient charge is acquired by the

right-hand terminal of condenser 1611 to cause relay 1603 to operate. Relay 1603 in operating completes a circuit for the operation of relay 1502. Relay 1502 in operating completes an additional locking circuit for maintaining relay 1601 operated from battery through the winding and lower operated contacts of relay 1601 to ground through the second set of operated contacts from the top of relay 1502. Relay 1502 in operating also completes a circuit for the operation of relay 1823 from battery through the winding of relay 1823, the upper outer break contacts of relay 1709, the second armature from the bottom and operated contact of relay 1602 to ground through the inner upper operated contacts of relay 1502.

Relay 1823 in operating completes a circuit for maintaining itself operated from battery through its winding, the upper outer break contacts of relay 1709, the second armature from the bottom and front contact of relay 1602, the second armature from the top and break contacts of relay 1709 to ground through the lowermost operated contacts of relay 1823. The operation of relay 1823 prepares a circuit for the lighting of lamp 1705 from battery through lamp 1705, contacts of relay 1704 to ground through the second armature from the top and front contact of relay 1823. Lamp 1705 will then light and later flicker as signals are transmitted to the receiving channel of party line 210 as described hereinafter. The operation of relay 1823 also removes the short circuit from around the transmitting contacts 1 through 5 and the stop contact of the distributor shown in Fig. 20 comprising cams 1 through 5 and mounted on shaft 2051. In addition the operation of relay 1823 connects the transmitting contacts controlled by cams 1 through 5 to the set of leads 1 through 5 designated 1828, which extend through Figs. 17, 16, and 15 to relay contacts and terminal of the B and C selector switches as will be described hereinafter.

The operation of relay 1502 also completes a circuit for the operation of the stepping magnet 1407 of the C stepping switch shown in Fig. 14 from battery through the winding of magnet 1407, the lower break contacts of relay 1604 to ground through the lower inner operated contacts of relay 1502. Relay 1604 does not operate at this time because ground is connected to both terminals of its upper operating winding from the lower inner operated contacts of relay 1502 and the break contacts of the stepping magnet 1407. Stepping magnet 1407 in operating interrupts the short circuit around the upper winding of relay 1604 to permit this relay to operate. The circuit for operation of this relay may be traced from ground through the inner lower operated contacts of relay 1502, the upper winding of relay 1604 to battery through resistance 1418. Relay 1604 in operating completes a circuit for maintaining itself operated from battery through its lower winding and lower inner operated contacts to ground through the lower break contacts of relay 1511 and the lower inner operated contacts of relay 1502. Relay 1604 in operating also interrupts the operating circuit of the stepping magnet 1407 and thus permits this magnet to release. The release of magnet 1407 causes the brush arms 1401 through 1406 to advance from their No. 1 position to the No. 2 position where they make contact with the No. 2 terminal of the corresponding banks C1 through C6.

The operation of relay 1604 also reconnects ground to the right-hand terminal of condenser 1611. This circuit may be traced from the right-

hand terminal of condenser 1611 through the upper operated contacts of relay 1604 to ground through the center lower armature and operated contacts of relay 1502. Condenser 1611 is discharged in this circuit and the potential of the grid of tube 1610 restored to ground potential. With the grid of tube 1610 at ground potential the bias of tube 1610 due to resistances 1614 causes anode current flowing through the tube to be interrupted and relay 1603 to release. Release of relay 1603 interrupts the operated circuit of relay 1502 which relay thereupon releases.

The release of relay 1502 and the advance of brush arm 1401 from its No. 1 position to its No. 2 position interrupts the locking and operating circuits of relay 1601. The release of relay 1601 removes ground from the control circuits extending through the start key so that any accidental or inadvertent operation of any of the other start keys at this time will not interfere with the operation of the circuit as described herein.

The release of relay 1502 interrupts the locking circuit of relay 1604 which permits this relay to release. The release of relay 1502 also removes the ground connected to the right-hand terminal of condenser 1611. The right-hand terminal of condenser 1611 thereupon again starts to be charged in a positive direction through resistances 1451 and 1453 in parallel.

In the meantime however the release of relay 1502 completes a circuit for the operation of the distributor release magnet 2047 from battery through the winding of magnet 2047 over lead 2026 which extends through Figs. 18 and 17 through the upper inner break contacts of relay 1709 and the second armature from the top and front contact of relay 1602, through the break contacts of relay 1505, the second terminal of bank C4 and brush 1403 to ground through the break contact and second armature from the bottom of relay 1502. The operation of magnet 2047 in this circuit will attract its armature 2013 and permit the clutch members 2024 to engage and drive shaft 2051 for one revolution through gears 2012 driven by motor 2001.

The manner in which magnet 2047 releases the clutch 2024 and the manner in which the shaft 2051 rotates will be described in greater detail hereinafter with reference to Figs. 91 through 96. During this rotation of the shaft 2051 the cams 1 through 5 close the corresponding contacts in sequence one after the other as is well understood. In addition shortly after the beginning of the revolution of shaft 2051 cam 2049 will cause contacts 2050 to close and complete a circuit for the operation of relay 1505 from battery through the winding of relay 1505, the upper outer operated contacts of relay 1602, the third armature from the bottom and back contact of relay 1709 to ground through the operated contacts 2050. The operation of relay 1505 interrupts the operating circuit of magnet 2047 and permits this magnet to release. In addition relay 1505 in operating completes a circuit for maintaining itself operated from battery through its winding and operated contacts to ground through the second contact of bank C4 and brush 1403 to ground through the lower inner break contacts of relay 1502.

The release of magnet 2047 insures that its armature 2013 will cause the clutch members 2024 to disengage at the end of the revolution of shaft 2051.

During the rotation of shaft 2051 as described above the contacts controlled by cams 1 through

5 will connect conductors 1 through 5 to the transmitting channel of the party line 210 in rotation one after another. At this time, however, these conductors are connected through conductors 1828 as described above to relay contacts and banks of the stepping switches A and C. At this time all five leads are open so that in addition to a spacing start pulse being transmitted all five of the selecting pulses will also be spacing. In other words the distributor comprising shaft 2051 and cam controlled contacts will transmit a blank signal over the receiving channel of party line 210 during this first revolution. At the end of this revolution the shaft will come to rest because magnet 2047 is now released as described above. Thereafter the circuits are maintained in the conditions described until the right-hand terminal of condenser 1611 has again been charged to a sufficiently positive potential to cause relay 1603 to be reoperated.

The operation of relay 1603 again completes a circuit for the operation of relay 1502 by completing the circuit traced above. The reoperation of relay 1502 interrupts the locking circuit of relay 1505 and permits this relay to release. The reoperation of relay 1502 again completes a locking circuit for maintaining relay 1601 operated and again completes a circuit for operating relay 1823. However, relay 1823 has been maintained operated since it was first operated so that in completing this circuit no function is performed. The operation of relay 1502 again completes a circuit operating the stepping magnet 1407 of the C stepping switch. Relay 1604 however does not operate at this time because its upper winding is short-circuited as described above. Magnet 1407 in operating removes the short circuit from around the upper winding of relay 1604 as described above and permits this relay to operate. The operation of relay 1604 at this time again completes a circuit for maintaining itself operated under control of relay 1502. Relay 1604 in operating also interrupts the operating circuit of magnet 1407 and permits this magnet to release and advance the brush arms 1401 through 1406 to the third terminal of their associated banks. The operation of relay 1604 again connects ground to the right-hand terminal of condenser 1611 which in turn causes relay 1603 to release and interrupt the operating circuit of relay 1502 as described above. The release of relay 1502 interrupts the locking circuit of relay 1604 and permits this relay to release. Release of relay 1502 also interrupts the ground connected to the righthand terminal of condenser 1611 whereupon this condenser again starts to charge through resistances 1451 and 1453 connected in parallel and resistance 1614. In the meantime, however, that is during the seven-tenths of a second interval during which time condenser 1611 is charging the release of relay 1502 completes a circuit for again operating magnet 2047 as described above.

Release magnet 2047 in reoperating again permits the distributor shaft 2051 to make a second revolution. Near the beginning of this revolution contacts 2050 are again closed and complete a circuit for operating relay 1505 as described above. The operation of relay 1505 interrupts the operating circuit of magnet 2047 and permits this magnet to release so that its armature will cause the clutch members 2024 to become disengaged at the end of this second revolution.

During the second revolution the cams 1 through 5 cause the corresponding contacts to be

again closed in sequence after a start signal has been transmitted over the receiving channel in the usual manner. This time the number 2 conductor of the group of conductors 1828 is completed from the number 2 cam controlled contacts, brush arm 1406, and the third contact of the C5 bank to the transmission circuit of the receiving channel of the party line 210. Consequently, a marking impulse is transmitted during the second impulse interval of the second code combination transmitted to the receiving channel of party 210. The other conductors 1, 3, 4 and 5 are open at this time so spacing impulses will be transmitted during these intervals. In other words, a line feed combination will be transmitted by the equipment during the second revolution of the distributor shaft 2051.

Then the distributor shaft 2051 comes to rest at the end of its second revolution and the circuits then remain in the condition described until the end of the third seven-tenths of a second interval at which time the right-hand terminal of condenser 1611 has been charged to a sufficiently positive potential to permit sufficient anode current to flow through tube 1610 to cause relay 1603 to operate. Operation of relay 1603 again causes relay 1502 to reoperate. The operation of relay 1502 interrupts the locking circuit of relay 1505 and permits this relay to again release. Relay 1502 in operating again completes a circuit for the operation of the stepping magnet 1407. The operation of the stepping magnet 1407 removes the short circuit from around the upper winding of relay 1604 and permits this relay to operate. The operation of relay 1604 at this time again completes a circuit for maintaining itself operated under control of relay 1502 and interrupts the operating circuit of the stepping magnet 1407 thus permitting this magnet to release and advance the brush arms 1401 through 1406 to the fourth terminal of their respective banks. The operation of relay 1604 again connects ground to the right-hand terminal of condenser 1611 and causes this condenser to become discharged whereupon the anode current of vacuum tube 1610 is reduced below the release value of relay 1603 thus causing relay 1603 to release. The release of relay 1603 again interrupts the operating circuit of relay 1502 and permits this relay to release. The release of relay 1502 interrupts the locking circuit of relay 1604 and permits this relay to release. The release of relay 1502 also removes the ground from the right-hand terminal of condenser 1611. Thereafter condenser 1611 starts to charge this time through high resistances 1451 and 1452 in parallel. The time constants of the circuit including condenser 1611, vacuum tube 1610, resistances 1614 and 1452 and 1451 are such that it requires approximately one and nine-tenths seconds for the condenser 1611 to receive sufficient charge to cause relay 1603 to be again operated.

In the meantime, however, release of relay 1502 again completes a circuit for the operation of the distributor magnet 2047, which magnet in reoperating permits the distributor shaft 2051 to make a third revolution. Near the beginning of this third revolution contacts 2050 will again be closed and complete a circuit for the operation of relay 1505 which relay operates and interrupts the circuit of the distributor magnet 2047 and permits this magnet to release so that its armature will engage the clutch members 2024 and cause them to be disengaged at the end of the third revolution of the cam barrel or shaft 2051.

During the third revolution of the distributor shaft 2051 the conductors 1 through 5 are again connected to the transmitting channel one after the other in sequence by means of the distributor contacts. In addition these contacts are extended to the group of conductors 1828 and these conductors extend through the banks of the A and C stepping switches so that a code combination which usually represents the letter A, in the usual permutation code employed in printing telegraph systems, will be transmitted to the receiving channel of the party line 210. In other words, the conductors 1 and 2 are connected through the brushes and banks of the stepping switches A and C to the transmitting channel while conductors 3, 4 and 5 of the group of conductors 1828 are not so connected. The circuit for conductor 1 may be traced through the brush arm 1413 which will be in its number 1 position at this time because the start key 1431 is operated and this brush arm advanced to the number 1 terminal of the A1 bank. The circuit then extends through the number 1 terminal of bank A3, through the lower outer break contacts of relay 1510 and the number 4 terminal of C6 bank and brush 1405 to the receiving channel of party line 210. Similarly the circuit of the number 2 conductor extends through brush 1406 and the number 4 terminal of bank C5 of the C stepping switch through the second armature from the bottom and back contact of relay 1510, the brush 1410 and the number 1 terminal of bank A4 of the A stepping switch and the lower outer break contacts of relay 1510, the number 4 terminal of bank C6 and brush 1405 to the transmitting channel of party line 210. The other terminals 3, 4 and 5 are open at this time. Number 4 conductor is open at the lower unoperated contacts of relay 1510, the number 3 conductor is open at the first terminal of bank A5 and the number 5 conductor is open at the first terminal of bank A6. Consequently, during the third revolution of the distributor shaft 2051 the letter A signal will be transmitted over the receiving channel of party line 210. At the end of this revolution, the distributor shaft 2051 will come to rest with the stop contacts 2050 closed after which the circuits remain in the condition described until the end of the one and nine-tenths second interval as described above.

Turning now to the signals transmitted over the receiving channel of the party line 210, the response of the switching equipment to the signals transmitted as set forth above will now be described and thereafter the further operation of the circuits at the central station will be described since they respond differently when material is available for transmission and when no material is available for transmission from the station from which it is attempted to start transmission.

As set forth above, a blank signal or code combination is transmitted after a pause in transmission of about 0.7 second. When this signal is transmitted over the receiving channel the party line 210, the line relays 1303, 1103 and 1003 all respond thereto and repeat it to the respective selector control magnets 1302, 1102 and 1002. The repeating relays 1383, 1384, 1385, 1183 and 1083 and 1084 also respond to this blank signal as well as to all of the other signals transmitted over the receiving channel of the party line 210. However, inasmuch as the contacts of these last-mentioned repeating relays are not operatively associated with any of the stations or equipment the response of these relays at this time under

the assumed conditions is without significance. The selector magnets 1302, 1102 and 1002 cause the selector mechanisms controlled thereby to momentarily close the blank contacts in response to reception of the blank signal. These contacts are designated 1327, 1127 and 1027, respectively. The manner in which these contacts are closed in response to the reception of a blank signal is described in the above-identified patents to Beattie and need not be repeated here. Closure of these contacts at the various intermediate switching centers causes the circuits thereat to respond and prepare switching circuits for response to succeeding signals. For example, closure of contacts 1027 complete a circuit for the operation of relay 947 from ground through the operated contacts 1027, the winding of relay 947 and the lower winding of relay 946 to battery. Current flowing through this above-described circuit causes relay 946 to remain in the positions shown and causes relay 947 to be operated.

The selector mechanisms in addition to momentarily closing the blank contacts 1327, 1127 and 1027 in response to the reception of a blank code combination or signal also close the universal contacts 1326, 1126 and 1026 a short interval of time after the blank contacts are closed. Thereafter these mechanisms will cause the universal contacts to open prior to the opening of the blank contacts 1027. In other words, these mechanisms are so arranged that the universal contacts close after any of the other contacts which may be operated in response to the reception of any particular code combination close and open before any of these contacts open following the completion of the response of the selector mechanism to the reception of any code combination.

The operation of relay 947 completes a circuit for operating relay 978. Relay 978 in operating in turn completes a circuit for maintaining itself operated from battery through its winding, the left-hand break contacts of relay 979, the right-hand inner operated contacts of relay 978 to ground through the break contacts of key 976. The operation of relay 978 also completes a circuit from ground through the momentarily closed universal contacts 1026 through the right-hand contacts of relay 978 to battery to the upper winding of relay 946. The current flowing through the upper winding of relay 946 is in such a direction as to tend to cause the armature of this relay to move to the left-hand position. However, this current is so adjusted that its effect upon the armature of relay 946 is overcome by the effect of the current flowing through the lower winding of its relay. Consequently, the armature of relay 946 remains in the position shown in the drawing. As pointed out above the universal contacts open prior to the opening of the blank contacts so that even at this time relay 946 will be maintained in its right-hand position.

Relays 1147, 1178 and 1146 at the control point 214 for station 219 respond in a similar manner to the transmission of the blank signal. In addition corresponding relays 1247, 1278 and 1246 at the control point or station 213 will also respond in this manner to the reception of the blank code combination transmitted from the central switching station.

Upon the opening of the blank contacts 1027 relay 947 will release and interrupt a circuit through the upper winding of relay 977. However, the current does not immediately cease flowing through the upper winding of this relay because condenser 990 starts to charge. Charging

current of condenser 990 is sufficient to cause relay 977 to remain in the position shown for approximately one-half second. At the end of this time the charging current of condenser 990 flowing through the upper winding of relay 997 will fall to such a value that it will no longer be sufficient to maintain relay 977 in the position shown in the drawing. At this time current flowing through the lower winding of this relay will cause its armature to move to its right-hand position.

The operation of relay 977 at this time completes an obvious circuit for the operation of relay 980. Relay 980 in operating completes an obvious circuit for the operation of relay 1081. Relay 980 in operating also removes ground from the right-hand terminal of condenser 972 and thus permits this terminal of condenser 972 to start to charge to a positive potential through high resistance 973.

The operation of relay 1081 at this time completes a circuit for the operation of relay 1004 from ground through the right-hand outer operated contacts of relay 1081 to battery through the winding of relay 1004. The operation of relay 1004 at this time disconnects the contacts of the selector mechanism 1001 from the switching circuits and contacts associated with the receiving apparatus at stations controlled by the secondary switching center 214. Consequently, this switching equipment will not be selectively controlled by the succeeding code combinations transmitted over the receiving channel 211 of party line 210.

In addition the operation of relay 1081 completes the filament circuit tube 970. Relay 971 does not operate at this time because the constants of tube 970 together with the bias supplied between the grid and filament by resistances 974 and 975 together with the time constants of condenser 972 and high resistance 973 are such that it requires approximately two seconds for the right-hand terminal of condenser 972 to receive a sufficient positive charge to cause sufficient current to flow through tube 970 to operate relay 971.

Relay 1081 in operating also extends the circuit of relay 942 to contacts 1022 of the control selector 1001. The corresponding relays 1177, 1180, 1181 and vacuum tube 1170 and associated circuits at the control point 214 and also corresponding relays 1277, 1280, 1382 and vacuum tube 1270 and associated circuits at the control point 213 all respond in substantially the same manner after the transmission of the blank signal.

It will be recalled that approximately seven-tenths of a second after the beginning of the transmission of the blank signal by the equipment of the central exchange this equipment will initiate the operation of the transmission of a line feed code combination. When this signal is received by the selector mechanisms 1301, 1101 and 1001 they will cause the corresponding contacts 1322, 1122 and 1022 to momentarily close.

The momentary closure of contacts 1022 completes a circuit for the operation of relay 942 from ground through closed contacts 1022, the left-hand inner operated contacts of relay 1081, winding of relay 942 to battery through the lower winding of relay 946. A short interval of time later the universal contacts will close and complete the circuit as described above through the upper winding of relay 946. However, since the circuit is also completed through the lower winding of this relay its armature will remain in the position shown in the drawing.

The operation of relay 942 again connects

ground to the right-hand terminal of condenser 972 and discharges this condenser and thus interrupts the operation of the timing circuit comprising this condenser, high resistance 973, vacuum tube 970 and relay 971. Relay 942 in operating also completes an obvious circuit for the operation of relay 905.

Relay 905 in operating completes a circuit for maintaining itself operated from battery through its winding and right-hand inner operated contacts to ground through the inner operated contacts of relay 980. The operation of relay 905 in addition activates the relays 940, 931 and 941 by extending their circuits to control contacts in the selector mechanism 1001.

The corresponding relays 1142 and 1105 respond in a similar manner as do relays 1242 and 1205 at the secondary control point 213 in response to the reception of the line feed code combination transmitted over this system.

At the end of the response of the selector mechanism 1001 to the reception of the line feed code combination the contacts 1022 will again open and permit relay 942 to release. The release of relay 942 at this time disconnects ground from the right-hand terminal of condenser 972 and again permits this terminal to start to charge a positive potential. However, it requires approximately two seconds for the potential of this terminal of condenser 972 to become sufficiently positive to permit sufficient current to flow through the anode circuit of tube 970 to operate relay 971.

The corresponding condensers at the other control points 214 and 213 similarly start to charge. However, before the end of the two seconds the letter A code combination will be transmitted as set forth above. In fact, this code combination will be transmitted approximately seven-tenths of a second after the start of the transmission of the line feed.

Upon reception of the letter A signal contacts 1010 of the selector 1001 will be momentarily closed. The momentary closure of these contacts completes a circuit for the operation of relay 940 from ground through the closed contacts 1010, the left-hand outer operated contacts of relay 905, right-hand winding of relay 940 to battery through the lower winding of relay 946. A short interval of time later the circuit through the universal contacts and the outer right-hand contacts of relay 978 to battery through the winding of relay 946 is completed. However, since current flows through the lower winding of relay 946 at this time the armature of this relay will remain in the position shown in the drawing. Relay 940 in operating completes a circuit for maintaining itself operated from battery through the left-hand break contacts of key 976, the left-hand winding and inner operated contacts of relay 940 over lead 2312 and winding of relay 2313 to ground through closed contacts 2315. If tape 2310 has been inserted in the transmitter at station 216 contacts 2315 will be closed. If no tape has been inserted in the transmitter these contacts will be opened so that relay 940 will not lock operated in the circuit described above.

The operation of relay 940 completes an obvious circuit for lighting lamp 960. In addition the operation of relay 940 extends the transmission channel 212 of party line 210 to the transmitter at station 216 and thus prepares the transmission circuit from the transmitter station 216. Assuming that tape has been inserted in the transmitter at this station and that contacts 2315 are closed as a result thereof, relay 2313 will operate and

complete a local circuit for the operation of the start magnet 2314 and permit the brush arm 2319 to rotate and transmit the telegraph signals recorded in tape 2310 over the transmission channel of the party line 210.

At the other switching points 214 and 213 the control circuits operate in a somewhat different manner in response to the reception of the code representing the letter A. For example, the selector 1301 will cause contacts 1310 to be momentarily closed in response to the reception of the A signal transmitted from the central switching station. However, contacts 1310 are not connected to any of the switching circuits at this time because relay 1304 is operated as described above. Consequently, when the universal contacts 1326 close a short interval of time after contacts 1310 are closed relay 1246 will be operated to its left-hand position. However, the circuit through the left-hand contacts of relay 1246 is open at this time due to the operation of relay 1205. When the universal contact 1326 reopens relay 1246 will be operated to the position shown in the drawing by means of a spring which engages the armature of this relay.

The circuits at the other switching center 214 respond to the A signal transmitted from the central switching center in substantially the same manner as equipment at the control point 213. At the end of the two-second interval the right-hand terminal of condenser 972 will be charged to a sufficiently positive potential to cause tube 790 to pass sufficient current to operate relay 791. The two-second interval provides ample time for the operation of all the relays and related circuits as described above. At the end of this time relay 971 will operate and complete a circuit for the operation of relay 979 from battery through the winding of relay 979 to ground through the operated contacts of relay 971. The operation of relay 979 completes a circuit for maintaining itself operated from battery through its winding and left-hand operated contacts to ground through the right-hand inner operated contacts of relay 978 and the break contacts of key 976. Relay 979 in operating interrupts the locking circuit of relay 978 and thus permits this relay to release. The release of relay 978 connects ground to the upper winding of relay 977 and thus causes the armature of this relay to move to its left-hand position. The operation of relay 977 to its left-hand position interrupts the operating circuit of relay 980 and relay 980 in releasing in turn interrupts the operating circuit of relay 1081. The release of relay 978 as described above also interrupts the locking circuit of relay 979 and permits this relay to release. The release of relay 1081 interrupts the operating circuit of relay 1004 and thus permits this relay to release. The release of relay 980 interrupts the locking circuit of relay 905 and permits this relay to release. The release of relay 905 disconnects the operating windings of relays 940, 930 and 941 from the contacts of the selector 1001 so that the above relays and switching circuits associated with them will no longer be actuated in response to the reception of signals transmitted over the receiving channel 211 of party line 210 unless they are preceded by the exact sequence and conditions such as described above. It should be noted that relay 940 will remain operated so long as its locking circuit is not interrupted.

The circuits at the other control points 214 and 213 are returned to their original condition at the end of the two-second time interval in the

same manner as described above with reference to the circuits at the control point 215. However, it should be noted that none of the transmitters controlled from the other control points are connected to the transmission channel and that none of them are started into operation.

It sometimes happens that party lines are subject to interfering currents which take the form of an open line condition of indeterminate small intervals of time. The equipment at the secondary switching centers and particularly selector equipment 1001, 1101 and 1301 respond to these short opens in much the same manner as they respond to blank signals. In other words, the blank contacts controlled by these selectors are closed one or more times. It is therefore desirable to provide some protection against these interference conditions so some manner of distinguishing blank signals transmitted from the center switching station by the transmitter start circuit from the interfering currents is required. In case the interfering currents are blank signals they will usually be followed immediately by another signal or else the line feed character will not follow within the predetermined time interval.

If another signal immediately follows the blank signal within some predetermined minimum time interval, as for example, 0.5 of a second, and prior to the operation of relay 977, the universal contacts 1026 will close in response thereto. If the signal following the blank signal is other than another blank signal or a figure signal the closure of the corresponding contacts will be ineffective because the circuits of all these other contacts are open at this time. If the following signal is another blank signal contacts 1027 will momentarily close and complete a circuit for the operation of relay 947 as described above which relay in operating will again discharge condenser 990 and maintain relay 977 in the position shown in the drawing. At the end of this blank signal, condenser 990 will again start to charge as described above.

If a figure signal is received relay 1045 will operate as described hereinafter. However, assuming that some other signal is received during the 0.5 releasing time of relay 977 the closure of the universal contacts 1026 completes a circuit from battery through the upper winding of relay 946 and the right-hand outer operated contacts of relay 978 to ground through the universal contacts 1026. Inasmuch as the circuit through the lower winding of this relay will not be completed at this time relay 946 will momentarily operate to its left-hand position and complete a circuit for the operation of relay 979 from battery through the winding of relay 979 and the right-hand outer break contact of relay 905 to ground through the left-hand contact and armature of relay 946. The operation of relay 979 interrupts the locking circuit of relay 978 and thus permits this relay to release. The release of relay 978 again discharges condenser 990 and maintains relay 977 in the position shown in the drawing. The release of relay 978 also permits relay 979 to release when the universal contacts 1026 open thereby restoring the circuit to its previous condition and cancelling the effect of and in response to the previous blank or extraneous current.

If no signals are received during this time interval relay 977 will operate as described above and prepare circuits for the operation of relay

942 in response to the reception of a "line-feed" signal.

The operation of relay 977 also completes a circuit for the operation of relay 980 as described above. The operation of relay 980 completes a circuit for the operation of relays 1031 and 1032 which relays in operating together with the operation of relay 980 initiate the operation of time delay circuit comprising tube 970 and condenser 972 and relating charging resistances. If the line-feed signal is not received during the time delay period of this timing circuit relay 971 will operate at the end thereof and complete a circuit for the operation of relay 979 which relay in operating will interrupt the locking circuit of relay 978 which relay will release and in turn cause the release of relays 977, 980, 1031 and 1032 and thus cancel the effect of the response to the blank or extraneous signal. As described hereinbefore if the line-feed signal is received within this time interval, relay 942 will operate and recycle the time delay circuit comprising tube 970, condenser 972 and resistances 973, 974 and 975. If the final selecting character is not received during the reception of the time delay interval of this timing arrangement relay 971 will operate at the end thereof and complete a circuit for the operation of relay 979 which relay will cancel the effect of the previous operation of the circuits in response to the transmitter start pattern received by the transmitting equipment. Whether or not this last signal is received and whether or not it operates any of the switching relays at the particular switching center, relay 971 will operate at the end of the second delay interval of tube 970 and cancel the effects of the start pattern received as described hereinbefore.

The switching and control circuits at the other secondary switching centers respond to interfering currents in substantially the same manner as described above with reference to Figs. 9 and 10.

Thus, it is apparent that any material departure from the start pattern will cause the response thereto to be cancelled so that the switching circuits are not materially interfered with even by extraneous currents unless they comprise a sequence of impulses practically identical in sequence and timing with the control currents or signaling impulses.

Returning now to the central office relay 2701 is connected to the transmitting channel 212 of party line 210 and will follow the signals transmitted by the transmitter at station 216 under the conditions assumed and described above. Relay 2701 repeats the received signals to the selector magnet 2803 of receiving device 2802. In addition relay 2701 repeats the signals to relay 2702. Relay 2702 in responding to the first spacing impulse, which will be the first start impulse of the first code combination transmitted over the transmitting channel 212 of party line 210, will cause its armature to move to its right-hand or spacing position where a circuit is completed from battery through the lower winding of relay 2702, through the upper break contacts of relay 2715 and the lower break contacts of relay 2718 to ground through the right-hand contact and armature of relay 2702. The current flowing in this path tends to maintain relay 2702 operated. In addition the operation of the armature of relay 2702 to its right-hand position completes an obvious circuit for the operation of relay 2713 and for lighting lamp 2830. Lamp 2830 in lighting

indicates that signals are being received from party line 210.

The operation of relay 2713 completes a circuit for the operation of relay 2718 from battery through the winding of relay 2718, the lower inner break contacts of relay 2715 to ground through the lower operated contacts of relay 2713. The operation of relay 2718 at this time completes a circuit for maintaining itself operated from battery through its winding and lower inner break contacts of relay 2715 to ground through the lower operated contacts of relay 2718. The operation of relay 2718 interrupts the current flowing through the lower winding of relay 2702. Thereafter relay 2702 will follow signals repeated by relay 2701. Each time relay 2702 is operated to its right-hand position it completes a circuit for maintaining the relay 2713 operated. In addition every time relay 2702 is operated to its left-hand position it completes a circuit for maintaining relay 2725 operated. The release characteristics of relays 2725 and 2713 are retarded so that these relays will be maintained operated during the normal transmission of signals over the system.

The operation of relay 2718 interrupts the circuit through the end of transmission lamp 2831 and thus indicates that some transmitter is connected to the transmitting channel of party line 210. In addition relay 2702 in operating to its right-hand or spacing position completes a circuit for lighting busy lamp 2830. When relay 2702 is operated to its left-hand position it interrupts the circuit of this lamp. Consequently when relay 2702 follows the succeeding signals received over transmitting channel of party line 210 busy lamp 2830 will flash in response to the signals received over the party line and thus indicate to the operator or attendant that signals are being received over this channel. Relay 2718 in operating also completes a circuit for energizing the filament of tube 2727. However, tube 2727 does not permit sufficient anode current to flow to operate relay 2706. Tube 2727 is effectively biased beyond its cut-off by means of resistances 2730 and by ground connected to the upper terminal of condenser 2728 and thus to the grid of this tube.

The operation of relay 2718 also connects ground to lead 2736 which extends through Figs. 14 and 15 to the contacts of relay 1507. Returning to the operation of the transmitter start circuit it will be recalled that the A signal had been transmitted and that condenser 1611 was being charged up during a 1.9 second timing interval. At the end of this time interval relay 1603 operates and completes a circuit for the operation of relay 1502. Relay 1502 in operating completes a circuit for the operation of stepping magnet 1407. The stepping magnet 1407 thereupon operates and removes a shunt from around the upper winding of relay 1604 which relay 1604 then operates and interrupts the operating circuit of a stepping magnet 1407. The stepping magnet 1407 then releases and causes the brush arms 1401 to 1406, inclusive, to advance one step to the No. 5 position, that is, to the position at which they may contact with the No. 5 terminals of the respective banks C1 to C6. When brush arm 1401 makes contact with its No. 5 terminal a circuit is completed for the operation of relay 1507 from battery through the winding of relay 1507 to ground through the No. 5 terminal of the C2 bank and brush 1401 of C stepping switch.

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The operation of relay 1604 completes a circuit for maintaining itself operated under control of relay 1502. In addition relay 1604 in operating connects ground to the right-hand terminal of condenser 1611 as described above and thus discharges condenser 1611 and blocks tube 1610 thus interrupting the current flowing through relay 1603. Relay 1603 thereupon releases and interrupts the operating circuit of relay 1502. The release of relay 1502 interrupts the locking circuit of relay 1604 and thus permits this relay to release. The release of relay 1502 disconnects ground from the right-hand terminal of condenser 1611. Thereafter condenser 1611 again starts to charge through resistances 1451 and 1453. The values of these resistances and the other constants of the tube 1610 and its associated circuits are such that it requires approximately seven-tenths of a second for the condenser to be charged to a sufficient value to unblock tube 1610 and cause relay 1603 to operate. By the end of this last-mentioned seven-tenths second timing interval the switching circuits at the outlying control point and the transmitter and associated circuits at the subscriber's station will have had ample time to start transmission over the transmitting channel 212 of party line 210. In addition these time intervals provide ample time for the operation of the circuits at the central switching station for causing relay 2718 to operate if a tape had been previously inserted in the transmitter at the outlying subscriber's station circuit so that if no signals are received prior to the end of this last seven-tenths second interval relay 1603 will operate at the end thereof and complete a circuit for the operation of relay 1502. Relay 1502 will thereupon operate and complete a circuit for the operation of the stepping magnet 1407. The operation of the stepping magnet 1407 interrupts the shunt from around the upper winding relay 1604 and this permits this relay to operate. The operation of the relay 1604 then completes a circuit for maintaining itself operated under control of relay 1502 and interrupts the operating circuit of the stepping magnet 1407. Magnet 1407 thereupon releases and advances the brush arms 1401 through 1406 one step to their No. 6 terminals. The operation of relay 1604 in addition again connects ground to the right-hand terminal of condenser 1611 discharging this condenser which in turn causes relay 1603 to release and interrupt the operating circuit of relay 1502. Relay 1502 releases and interrupts the locking circuit of relay 1604 thus interrupting all of these relays to their normal condition.

When brush arm 1401 is stepped to its No. 6 terminal a circuit is completed for the operation of relay 1608 from battery through the winding of relay 1608 and lower break contacts of relay 1606, the No. 6 terminal of C2 bank and brush 1401 of the C stepping switch to ground. Relay 1608 in operating interrupts the locking circuit of relay 1602 and permits this relay to release. Relay 1602 in releasing interrupts the operating circuit of relay 1701 which relay releases but under the assumed conditions performs no useful function at this time. If a message had been in the process of being transmitted when relay 1701 was operated, the release of relay 1701 would permit the transmission of the interrupted message to be resumed. The release of relay 1602 connects ground to the right-hand terminal of condenser 1611 and thus prevents condenser 1611 from being further charged at this time. The release of relay 1602 also interrupts the locking circuit of

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relay 1823 thus permitting this relay to release and restoring the circuits through its contacts to their normal condition.

The advance of the C stepping switch to the No. 6 position completes a circuit for the operation of relay 1511 from battery through the winding of relay 1511, the lower inner break contacts of relay 1506, the lower outer break contacts of relay 1502 to ground through the No. 6 terminal of the C1 bank and the brush arm 1402 through the lower break contacts of relay 1607. Relay 1511 in operating completes a circuit for the operation of the stepping magnet 1407 of the C selector switch from battery through the winding of magnet 1407, the lower break contacts of relay 1604, the lower operating contacts of relay 1511, brush arm 1402, No. 6 terminal of the C1 bank to ground through the lower break contacts of relay 1607 of the C stepping switch. Magnet 1407 in operating removes a short circuit from around the upper winding of relay 1604 thus permitting this relay to operate. The operating circuit for relay 1604 may be traced from battery through resistance 1418, the upper winding of relay 1604, the lower operated contacts of relay 1511, brush arm 1402 and No. 6 terminal of the C1 bank of the stepping switch C to ground through the break contact of relay 1607. The operation of relay 1604 interrupts the operating circuit of the stepping magnet 1407 and thus permits this magnet to release and step the C switch to the next terminal. The release of the magnet 1407 short circuits the upper winding of relay 1604 and causes this relay to release.

The release of relay 1604 reestablishes a circuit through the stepping magnet 1407 which will operate and remove the short circuit from around the upper winding of relay 1604 whereupon this relay will reoperate and interrupt the operating circuit of magnet 1407 and thus advance the C selector switch another step. The above cycle of operations is repeated until the brush arms of the C stepping switch are restored to their No. 1 position at which time no ground will be connected to the brush arm 1402 through C1 bank since the No. 1 terminals of this bank are not connected. During the time the C stepping switch is in its Nos. 7 and 8 positions or steps through these positions, the circuit for maintaining relay 1511 operated and for operating magnet 1407 and relay 1604 extends from brush 1402 and contacts Nos. 7 and 8 of the C1 bank to ground through the upper inner break contacts of relay 1607. During the time this switch is in its Nos. 9, 10 and N positions the above circuits extend to the ground connected to the respective contacts of the C1 bank.

Thus if no tape had been inserted in the transmitter at station 216 the C stepping switch at the central station or exchange would be restored to its No. 1 position ready for operation should the operator attempt to start the transmitter at another station.

However, under the assumed conditions the operator has inserted a tape in the transmitter at station 216. Consequently this transmitter will start to transmit the signals and transmit them to the central exchange so that relay 2718 will be operated before the end of the seven-tenths second interval during which the brushes of the C stepping switch are in contact with the No. 5 terminals of the respective banks. When relay 2718 operates prior to the end of this last seven-tenths second time interval a circuit is completed for the operation of relay 1506 from bat-

tery through the winding of relay 1506, the operated contacts of relay 1507 over conductor 2736 extending through Figs. 14 and 27 to ground through the upper outer operating contacts of relay 2718.

Relay 1506 in operating interrupts the locking circuit of relay 1602 and thus permits this relay to release. The release of relay 1602 interrupts the operating circuits of relays 1701 and 1823 as described above. The release of relay 1602 also connects ground to the right-hand terminal of condenser 1611 and thus prevents this condenser being charged to positive potential at the time. Consequently, it is impossible for relay 1603 to reoperate at this time.

The operation of relay 1506 completes an obvious circuit for the operation of relay 1609. The operation of relay 1609 at this time permits the use of the automatic key 1419 as will be described hereinafter.

The transmitter start circuit shown on Figs. 14, 15 and 16 thereafter remains in a condition described so long as a message is being received from the outlying station. During this time the end of transmission lamp 2831 is extinguished and the busy lamp 2830 flashes indicating that messages are being received from the transmitting channel party line 210. The end of transmission lamp 2831 and the busy lamp 2830 may be located on a control board in some central position or any other convenient place to indicate to the operators or attendants at the central control and switching station the conditions of the various channels terminating thereat.

Transmission from the subscriber's station to the central switching station

Transmission will now proceed from the transmitter 235 at station 216 in accordance with the perforations in the tape 2310. Signals transmitted from the subscriber's station will be transmitted over the line 2311 to the intermediate switching center shown in Figs. 9 and 10 and thence over the transmitting channel 212 of party line 210 to the incoming line circuit and receiving equipment at the central exchange. As pointed out above, the first spacing signal which will be the first start signal will cause relay 2702 to operate its armature to its right-hand position where a circuit is completed for the operation of relay 2713 which relay in turn completes a circuit for the operation of relay 2718 for controlling the transmitter start circuit as described above.

Under the assumed conditions several letters signals will generally be transmitted from the subscriber's station. When the letters signals are received at the central switching station, relay 2701 will respond to them and repeat them to the control or selector magnet 2803 of the recording device 2802. The circuit from relay 2701 to the control magnet 2803 extends from the armature of relay 2701 through the lower inner break contacts of relay 2704 to the winding of control magnet 2803. The control magnet 2803 will respond to the letters signals repeated to it and will cause contacts 2841 to momentarily close in response to each letters signal. The momentary closure of contacts 2801 at this time and under the assumed conditions completes a circuit through the upper winding of relay 2724 from battery through this winding, the lower break contacts of relay 2711, the upper break contacts of relay 2723, resistance 2733 to ground through the momentarily operated contacts 2841. Current

flowing in this circuit causes the armature of relay 2724 to be maintained in the position shown in the drawing. It should be noted that prior to the operation of contacts 2841, relay 2724 is maintained in the position shown in the drawing by current flowing from battery through its upper winding to ground through high resistance 2731. After the closure of contacts 2841, the current flowing through the upper winding of this relay is increased. A short interval of time after contacts 2841 close the universal contacts 2846 close and complete a circuit from battery through the lower winding of relay 2724 resistance 2732, the upper break contacts of relay 2709 to ground through the closed contacts 2846. Current flowing in this circuit through the lower winding of relay 2724 tends to move the armature of this relay to its right-hand position. However, resistance 2732 in series therewith limits the current so that the current flowing through the lower winding of relay 2724 is insufficient to overcome the effect of the increased current flowing through the upper winding of this relay during the time contacts 2841 are closed. Consequently, relay 2724 remains in the position shown at this time. Contacts 2846 then reopen a short interval of time before contacts 2841 reopen near the end of the response of the receiving device 2802 to the letters signal received by the control magnet 2803. Consequently relay 2724 remains in the position shown. Thereafter the receiving device 2802 responds in a similar manner to the reception of each letters signal received from the subscriber's station.

Following the letters signal the subscriber will usually perforate a figures signal followed by an H signal in the tape. These will then be transmitted over the transmitting channel of party line 210 to the central switching station. Relay 2701 responds to these signals and repeats them to the control magnet 2803. Control magnet 2803 in responding to the figures signal causes contacts 2842 to momentarily close and complete a circuit for the operation of relay 2720 from battery through the upper winding of relay 2724, the upper winding of relay 2720, the lower break contacts of relay 2710 to ground through the momentarily closed contacts 2842. A short interval of time later the universal contacts 2846 will close and complete a circuit described above through the lower winding of relay 2724. However, current flowing through the upper winding of this relay will maintain its armature in the position shown in the drawing.

The operation of relay 2720 completes a circuit for maintaining itself operated from battery through its lower winding, lower inner break contacts of relay 2719, the lower operated contacts of relay 2720 to ground through the left-hand contact and armature of relay 2724. The operation of relay 2720 also extends the circuit of the upper winding of relay 2719 to contacts 2844.

Following the figures signal the selector magnet 2803 will respond to the H signal and cause contacts 2844 to be momentarily closed. The momentary closure of contacts 2844 at this time completes a circuit for the operation of relay 2719 from battery through the upper winding of relay 2724 and the upper winding of relay 2719, the upper operated contacts of relay 2720, the upper break contacts of relay 2710 to ground through the operated contacts 2844. Universal contacts 2846 close a short interval of time after contacts 2844 and open a short interval of time before these contacts open. The closure of contacts 2846

completes a circuit through the lower winding of relay 2724. However, the current flowing through this lower winding is insufficient to operate the armature of this relay to the right-hand position while the increased current is flowing through its upper winding as described above, consequently, relay 2724 will remain in the position shown in Fig. 27.

In operating relay 2719 completes a circuit for maintaining itself operated under control of contacts 2844 from battery through the upper winding of relay 2724, the upper winding of relay 2719 and upper operated contacts of relay 2719, the upper break contacts of relay 2710 to ground through the operated contacts 2844. This insures that both relays 2724 and 2719 will remain in the positions described as long as contacts 2844 remain closed. Operation of relay 2719 also completes a circuit for maintaining itself operated under control of relays 2720 and 2724. These locking circuits may be traced from battery through the lower winding of relay 2719 to its lowermost operated contact to ground through the upper operated contacts of relay 2720 and also from battery through the winding of relay 2719 through its lower inner operated contacts and the lower operated contacts of relay 2720 to ground through the left-hand contact and armature of relay 2724.

These circuits insure that relay 2719 will remain operated as long as both relay 2720 remains operated and relay 2724 remains in the position shown in the drawing.

The operation of relay 2719 interrupts the locking circuit of relay 2720 and thus permits this relay to release. Thereafter when contacts 2844 open relay 2719 will release and the associated circuits restored to their initial condition. The object of transmitting the figures signal followed by an H signal and a letters signal is to cause relays 2720 and 2719 to operate and in turn release any of the other control relays which may have been operated due to some trouble condition or improper operation of the circuits. The manner in which these relays will release the control relays will be described hereinafter.

Following the H signal the subscriber will normally perforate another letters signal in the tape and this will be transmitted to the exchange and repeated to the control magnet 2803. This magnet in responding to the letters signal will cause contacts 2841 to operate and complete a circuit through the upper winding of relay 2724 for maintaining relay 2724 in the position shown in the drawing as described above.

Under the assumed conditions the subscriber will perforate the letters DD in the tape. These signals will be transmitted to the central exchange and repeated to the control magnet 2803. The control magnet in responding to the first of these signals will cause only the universal contacts 2845 and 2846 to be operated. The operation of contacts 2845 are for indicating trouble conditions or actuating alarms described hereinafter. The operation of contacts 2846 completes a circuit through the lower winding of relay 2724 as described above. However, at this time no circuit will be completed through the upper winding of this relay except a circuit through resistance 2731. Under these circumstances current flowing through the lower winding of relay 2724 is sufficient to overcome the effect of current flowing through the upper winding of this relay and causes the armature to be operated to its right-hand position. Relay 2724 operates to its right-

hand position and completes a circuit for the operation of relay 2723 from battery through the winding of relay 2723 to ground through the right-hand contact and armature of relay 2724. The operation of relay 2723 completes a circuit for maintaining itself operated from battery through its winding and the lower break contacts of relay 2719 and the upper operated contacts of relay 2723 to ground through the break contact and center lower armature of relay 2715.

The operation of relay 2723 deactivates the other switching relays by interrupting the circuit extending from the upper winding of relay 2724 to the windings of relays 2710, 2704 and 2721 and thus renders these relays non-responsive to the reception of certain predetermined signals by magnet 2803. Thereafter the second letter D signal together with the following letters signals, carriage return and line feed signals or a repeated code signal or both these groups of signals will be transmitted from the subscriber's station to the central switching station and repeated to the control magnet 2803. The control magnet 2803 will respond to these signals and cause them to be recorded by the recording instrument 2802 on and/or in tape 2805.

Fig. 91 shows numerous details of a typical recording instrument designated generally 2802 in Fig. 28 and suitable for use in the specific embodiment of this invention described herein.

The selector magnet 9103 corresponds to the selector magnet 2803 and serves to control the selecting and recording equipment.

The control magnet 9103 will release in response to the reception of a start impulse and cause the cam barrel indicated generally at 9120 to release, as is well understood by those skilled in the art, and to be rotated by means of friction clutch 9126. The manner in which the release of the cam drum 9120 is effected and driven through the friction clutch 9126 through gears 2171 by a motor not shown is well understood by those skilled in the art and described in U. S. Patent 1,745,633 granted to S. Morton et al., February 4, 1930, the disclosure of which patent is hereby made a part of this disclosure as if fully included herein. Thereafter magnet 9103 controls the extension 9112 of its armature and causes the sword members 9115 to be positioned either to its marking or spacing position depending upon whether the control magnet 9103 is positioned in its marking or spacing position at the time. It is to be understood that five sword members 9115 are provided and controlled by five cams and levers similar to cam 9123 and lever 9124. The sword members 9115 then position the T levers 9119 and they in turn position the code bars 9118. These code bars are provided with notches in their front surfaces and are such that the notches will line up before some one of the pull-bars 9131 for each of the positions of the five code bars 9118. The operation of a selector mechanism of this type is described in greater detail in U. S. Patents 1,937,376, granted November 28, 1933, to Zenner; 2,203,300, granted June 4, 1940, to Hanke; and 2,228,716, granted January 14, 1941, to Zenner, the disclosures of which patents are hereby made a part of this disclosure as if fully included herein.

Near the end of the revolution of the cam drum 9120, the cam will cause latch 9125 to be tripped and cause the cams 9127 and 9132 to be driven through suitable notches by the motor through gears 2171. The rotation of cam 9127 will permit the follower 9128 to raise rod 9129. The rod 9129 in raising raises printing bail 9130. When

the printing bail 9130 rises it will engage the selected pull-bar 9131 and cause this to be raised. When one of the pull-bars is selected and later raised by the printing bail, the contacts associated with it, such as contacts 9141, will be activated or operated. Contacts 9141 correspond to contacts 2841 shown in Fig. 28. These particular contacts are closed in response to the selection of the letters pull-bar in response to the reception of the letters code combination by the selecting magnet 9103. Similarly, the other contacts are controlled in a like manner when their particular pull-bars are selected in response to the reception of the corresponding code combination. These contacts are shown in Fig. 91 and also in Fig. 28.

Pull-bar 9131 when it is raised operates the type bar associated with it, as described in the above-identified patent to Morton et al. and causes the corresponding character to be printed on tape 9105.

When the printing bail 9130 starts to rise it will permit the locking member 9176 to lock the code bars 9118 as is well understood and described in the above-identified patent to Morton et al. In addition the locking member 9176 in moving to the right as shown in Fig. 91 and locking code bars 9118 releases the bell cranks 9146 and permits them to bear against the ends of the code bars 9118 if the code bars are moved to their marking positions. If these code bars are operated to their spacing positions, however, the bell cranks 9146 will not rest against their ends but will rotate in a clockwise direction. It is to be understood that there is one bell crank 9146 for each of the code bars. Then by means of levers 9149, 9162 and 9198 the settings of the five code bars 9118 are transmitted to the interponents 9166. These interponents are therefore also positioned in accordance with the impulses of the code combinations received by the selecting magnet 9103. It is to be understood that there is one interponent 9166 for each significant pulse of each code combination.

The rotation of cam 9132 causes follower 9133 and the linkage members including 9134, 9177, and 9137 to raise the interponents 9166. The interponents which are in their marking positions will engage punch pins and cause them to be raised and perforate tape 9105 in the punch box 9167. The operation of this equipment is well understood by those skilled in the art and need not be further described in detail herein. In the particular mechanism shown in Fig. 91 the feed holes are perforated in the tape by means of a separate punch block 9135 through the linkage members 9139, 9138, 9177 and 9134 so that a hole is perforated in the tape for each code combination perforated in the tape. However, the feed perforations are perforated in the tape at a position considerably in advance of the position wherein the code combinations are perforated in the tape. In addition, the characters are printed on the tape in advance of the position where the code perforations are punched in the tape. This relationship between the positions at which the various perforations and characters are recorded on the tape have been arranged to permit the transmitting operation of the equipment to be adjacent the position where the code combinations are punched in the tape so that the last code combination perforated in the tape may be transmitted by the transmitter as will be described hereinafter.

It is thus apparent that the receiving equipment shown in Fig. 91 performs three functions

in response to the reception of at least a plurality of code combinations received by the control magnet 9103. These functions are: one, printing the corresponding character on the tape; two, perforating the tape in accordance with the elements of the code combination received; and three, selectively closing one or more of a plurality of contacts or switches.

The tape punched or perforated by this mechanism need not have the punches or perforations fully punched out of the tape. Instead the perforations may be only a part of a circle or three sides of a square or two sides of a triangle, etc., so that the entire surface of the tape is available for printing characters thereupon. This manner of perforating a punching tape permits the printed characters to be readily read and at the same time this permits an automatic transmitter to automatically transmit the signals in accordance with the perforations in the tape without requiring an operator to operate a keyboard or any other instrument to retransmit the recorded signals.

Returning now to the transmission signals from the subscriber's station to the central exchange, at the end of the first message the subscriber will transmit an end of message signal which in the specific embodiment enclosed herein is a figures signal followed by an H code combination and then a letters code combination. When the figures code combination is received by the selector magnet 2803, it will cause the corresponding code combination to be perforated in the tape 2805. If a symbol has been assigned to this code combination, this symbol will also be printed on the tape 2805. In addition magnet 2803 in responding to the figures signal will cause contacts 2842 to momentarily close and complete a circuit for the operation of relay 2720 as described above. A figures signal may also be transmitted during the message at which time it will be followed by some signal other than an H signal. If any signal other than an H signal follows the figures signal relay 2724 will operate in response thereto due to the operation of the universal contacts 2846 and interrupt the locking circuit of relay 2720 thus releasing this relay and canceling the effect of the figure signal upon the switching circuits at the central exchange. However, at the end of a message an H signal will immediately follow the figures signal. Under these circumstances relay 2724 will be maintained in the position shown in the drawing by current flowing through the upper winding of relay 2724 in response to a momentary closure of contacts 2844. In addition, the closure of contacts 2844 completes a circuit for the operation of relay 2719 as described above. The operation of relay 2719 in addition to completing circuits for maintaining itself operated as described above will interrupt the locking circuit of relay 2723 and thus permit this deactivating relay to release. The release of relay 2723 will recondition relays 2710, 2704, 2721 and 2709 for response to succeeding signals received from the subscriber's station. Following the H signal one or more letters signals will generally be transmitted to the central switching station. The equipment at this point will respond to these signals as described above by recording them in the tape 2805 and causing contacts 2841 to be momentarily closed in response to the reception of each of the letters signals.

Following the letters signals, the next directing code will be transmitted from the subscriber's station. Under the assumed conditions where the second message is intended for the

central switching station the code letters GZ will be transmitted from the subscriber's station. Magnet 2803 will respond to the G code combination and cause the character G to be printed upon tape 2805 and also cause the tape to be punched or perforated in accordance with the corresponding code impulse. In addition, magnet 2803 will cause the receiving device 2802 to momentarily close contacts 2840. Momentary closure of contacts 2840 at this time completes a circuit for the operation of relay 2710 and for maintaining relay 2724 in the position shown in the drawing. This circuit may be traced from battery through the upper winding of relay 2724, the lower break contacts of relay 2711, the upper break contacts of relay 2723, the winding of relay 2710 and the upper inner break contacts of relay 2711 to ground through the momentarily operated contacts 2840. Relay 2710 in operating partially prepares the circuit for the operation of relay 2711 and extends switching circuits to relays 2704 and 2721. When the contacts 2840 open, near the end of the response of the receiving device 2803 to the reception of a G code combination, a short circuit is removed from around the winding of relay 2711 thus permitting this relay to operate in series with a locking circuit of relay 2710. This operating and locking circuit may be traced from one ground through the lower operated contacts of relay 2710, winding of relay 2711, winding of relay 2710, the upper break contact of relay 2723, the lower break contact of relay 2711 to battery through the upper winding of relay 2724. The operation of relay 2711 completes a circuit for locking itself operated in series with relay 2710 by substituting battery connected to its lower operated contacts for the battery connected through the upper winding of relay 2724.

Following the G signal a Z signal will be transmitted from a subscriber's station. Relay 2803 in responding to this signal will cause the letter Z to be printed on the tape 2805 and cause the tape to be perforated in accordance with the elements of the code combination representing this character. In addition the selector magnet 2803 in responding to the Z signal will cause a receiving device 2802 to momentarily close contacts 2843.

The momentary closure of contacts 2843 completes a circuit for the operation of relay 2704 and for maintaining the armature of relay 2724 in the position shown in the drawing. This circuit may be traced from battery through the upper winding of relay 2724 through the lower inner operated contacts of relay 2711, resistance 2735, upper winding of relay 2734, upper inner operated contacts of relay 2710 to ground through the operated contacts 2843.

The operation of relay 2734 completes a circuit for maintaining itself operated and for operating relay 2709 and relay 2723. These circuits may be traced from battery through the lower winding of relay 2734 and from battery through the winding of relay 2709, through the lower operated contacts and armature of relay 2704 and from battery through the winding of relay 2723 to ground through the lower break contacts of relay 2719, the lower center set of operated contacts of relay 2704 and the lower back contact and center lower armature of relay 2715. Relay 2723 operated and interrupts the operating and locking circuits of relays 2710 and 2711 as described above. In addition the operation of relay 2709 at this time transfers the alarm leads from the universal contacts 2845 and 2846 of the re-

ceiving device 2802 to the universal contacts 2837 and 2838 of a receiving only teletypewriter 2866.

The operation of relay 2704 as described above interrupts the connection between the armature of relay 2701 and the selecting magnet 2803 and connects battery to the lower terminal of this magnet for maintaining the magnet operated and the receiving device 2802 at rest. The circuit for maintaining magnet 2803 operated may be traced from ground through the winding of magnet 2803, the lower inner operated contacts of relay 2704, break contacts of relay 2705 to battery. The operation of relay 2704 also interrupts the circuit from magnet 2839 to battery and connects the winding of this magnet to the armature of relay 2701. This circuit may be traced from ground through the winding of magnet 2839 and the upper operated contacts of relay 2704 to the armature of relay 2701.

Thereafter the signals transmitted from the subscriber's station will be relayed to magnet 2839 instead of magnet 2803. Consequently, the receiving only teletypewriter 2866 located at the central switching station will record the following message.

The receiving only teletypewriter 2866 may be of any suitable type such as disclosed in the above-identified Patent 1,745,633, granted to Morton et al. or may be a page printing receiving instrument such as described in U. S. Patent 1,904,164, granted to Morton et al. on April 18, 1933, the disclosure of which patent is hereby made a part of this disclosure as if fully included herein.

The machine is provided with several sets of contacts. As shown in the drawing contacts 2835 are closed by the mechanism in response to the reception of an H code combination. The mechanism closes these contacts in addition to printing or recording the letter H. Similarly contacts 2836 are momentarily closed in response to the reception of a figures code combination. The machine responds otherwise to the reception of a figures signal in the same manner as described in the above-identified patent. That is, it causes the platen to be shifted to its upper case position. The machine is also provided with universal contacts 2838 and 2837 which are momentarily actuated once for each code combination. These universal contacts may be controlled by the printing bail similar to the universal contacts of the mechanism 2802 or in any other suitable manner.

At the end of the message transmitted to the central switching station a figures signal followed by an H signal will be transmitted from the subscriber's station. The momentary closure of contacts 2836 completes a circuit for the operation of relay 2720 which relay completes a circuit for maintaining itself operated as described and extends the operating circuit of relay 2719 to contacts 2835. The operating circuit of relay 2720 may be traced from battery through the upper winding of relay 2724, resistance 2734, the upper winding of relay 2720 and the lower break contacts of relay 2710 to ground through the operated contacts 2836. Following the figures signal an H signal will be transmitted which will complete a circuit for operating relay 2719 due to the momentary operation of contacts 2835. The operation of relay 2719 at this time interrupts the locking circuit of relays 2704 and 2723 as well as the operating circuit of relay 2709 thus permitting these relays to release and restore the circuits associated with the receiving channel of

party line 210 to their initial condition except that relay 2718 remains operated. The release of relay 2704 interrupts the circuit between the printing magnet 2839 and the armature of relay 2701 and connects battery to the winding 2839 and removes battery from the winding of the selector magnet 2803 and extends its circuit and the armature of relay 2701 so that the receiving only teletypewriter 2866 will not respond to further signals transmitted from the subscriber station to the central station. Instead, magnet 2803 will respond to the succeeding signals received from the party line.

Following the H signal one or more letters signals will be transmitted over the transmitting channel to the central exchange where the equipment will respond as described above. That is, magnet 2803 responds to these signals and completes circuits for maintaining relay 2724 in the position shown.

Assuming that the third message transmitted is intended for station 520 which is assigned the address code JE, these letters will be received at the central switching station. Magnet 2803 responds to them and causes the receiving device 2802 to record them upon tape 2805 and perforate the tape in accordance with the code combinations representing them and in addition to cause the universal contacts to close and relays 2724 and 2723 to operate as described above and render the contacts 2840 and 2843 ineffective. At the end of this message the figures signal followed by the H signal will again cause relays 2720 and 2719 to operate and release relay 2723.

Assuming now that a fourth message is transmitted to the central switching station and that this fourth message is intended both for the central switching station and for the recording apparatus 229 at station 219 which is assigned an address code of BK. This message will be preceded by the address codes GH letters BK. When the letter G signal is received by the selector magnet 2803 it will cause the receiving instrument 2802 to momentarily close contacts 2840 in addition to recording this signal in tape 2805 and printing the letter G upon the tape. Momentary closure of contacts 2840 completes the circuit traced above for operating relay 2710 while maintaining relay 2724 in the position shown. When contacts 2840 open relay 2711 will be operated as described above and complete circuits for maintaining itself and relay 2710 operated. The operation of relay 2711 extends the circuits of relays 2704 and 2721 to contacts 2843 and 2844. If the following signal is any signal other than a Z or an H signal, relay 2724 will operate and cause relay 2723 to operate and release relays 2710 and 2711. In addition the operation of relay 2723 will interrupt the operating and locking circuits of relays 2710 and 2711 and thus render contacts 2840, 2843 and 2844 ineffective to further control the operation of the system. If, as assumed, the signal immediately following the G signal is an H signal, contacts 2844 will be momentarily closed and complete a circuit for the operation of relay 2721 from battery through the upper winding of relay 2724, the lower inner operated contacts of relay 2711, resistance 2735, upper winding of relay 2721, upper outer operated contacts of relay 2710 to ground through the momentarily operated contacts 2844. Relay 2721 in operating completes a circuit for operating relay 2723 and for maintaining itself operated from battery through its winding and outer operated contacts and also from battery through the winding of relay 2723, through the lower break contacts of relay 2719, 75

the center set of operated contacts of relay 2721 to ground through the center set of lower break contacts of relay 2715.

Relay 2723 operates and interrupts the operating and locking circuits of relays 2710 and 2711 which relays release and render contacts 2840, 2843 and 2844 ineffective so that if they are operated during the transmission of the message they will not cause any of the relays to operate or alter any of the connections or established circuits. The operation of relay 2721 in addition interrupts the circuit from the winding of magnet 2839 to battery and connects the winding of this magnet to the armature of relay 2701. This circuit may be traced from magnet 2839 through the inner operated contacts of relay 2721 to the armature of relay 2701. Thereafter both magnets 2803 and 2839 respond to all of the signals received from the transmitting channel of party line 210. Consequently the message will be recorded both by the receiving only teletypewriter 2866 and by the printing reperforator 2802.

At any time during the transmission of the message the letter H signal may be received by both or either of the receiving instruments 2866 or 2802. Unless the H is preceded by the figures signal the contacts 2844 and 2835 which close in response to the reception of each H signal received by devices 2802 and 2866 are ineffective to control any circuits because relay 2720 is not operated. Similarly the figures signal may be transmitted at any time during the transmission of the message. When the figures signal is received by devices 2866 or 2802 or both of them it will cause relay 2720 to operate and lock operated under control of relays 2719 and 2724. If the immediately succeeding signal is other than an H signal, relay 2724 will be operated to its right-hand position where it interrupts the locking circuit of relay 2720 and permits this relay to release and cancel the effect of the previous figures signal. Only in case the figures signal is immediately followed by an H signal will relay 2719 be operated and release the various switching relays which have been locked operated as described above.

At the end of the message intended for both the switching station and the receiving equipment 229, a figures signal followed by an H signal will be transmitted from the subscriber's station. The receiving apparatus 2802 and 2866 will respond to these signals and cause relays 2720 and 2719 to be operated. The operation of relay 2719 interrupts the locking circuits of relays 2721 and 2723 and permits these relays to release.

If no further messages are available for transmission from the subscriber's station at this time the subscriber will have perforated a letters signal following the H signal in the tape and then a second H signal. It may not be essential to perforate the letters signal between the two H signals but such a letter signal will provide ample time for the operation of the switching circuits as described above and for this reason it is desirable to transmit this signal between the two H signals.

The receiving device 2802 will respond to the letters signal and cause contacts 2841 to momentarily close which causes relay 2724 to remain in the position shown in the drawing. The H signal following the letters signal will cause contacts 2844 to be momentarily operated and complete a circuit for the operation of relay 2715 from battery through the upper winding of relay 2724, resistance 2734, upper winding of relay 2715, the lower break contacts of relay 2723, the upper

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break contacts of relay 2719 which it will be recalled releases when the H contacts 2844 opened after the reception of the first H signal, the upper break contacts of relay 2710 to ground through the momentarily closed contacts 2844.

Relay 2715 in operating interrupts the locking circuit of relay 2718 and permits this relay to release. Relay 2715 in operating also connects ground to the right-hand terminal of the lower winding of relay 2720 and thus reduces the current flowing through the lower winding of this circuit to zero had this relay been locked operated due to current flowing through its lower winding.

Relay 2715 in operating completes a circuit for maintaining itself operated under control of relay 2713 from battery through its lower winding and lower inner operated contacts to ground through the lower operated contacts of relay 2713. Relay 2713 is a slow-release relay and requires a short interval of time to release. If additional signals are immediately received they will in all probability be due to stray currents or interference and will cause relay 2713 to remain operated and hold relay 2715 operated. So long as relay 2715 is operated it is impossible to reoperate relay 2718 and indicate to the transmitter start circuit that additional signals are received over the incoming channel of the party line.

The release of relay 2718 interrupts the operating circuit of relay 1506 and permits this relay to release. Release of relay 1506 at this time completes a circuit for the operation of relay 1511 from battery through the winding of relay 1511, lower inner break contacts of relay 1506, lower outer break contacts of relay 1502, brush arm 1402, the No. 5 terminal of the C1 bank of the C stepping switch to ground through the lower inner break contact of relay 1602. The operation of relay 1511 at this time completes a circuit for the operation of the stepping magnet 1407 from battery through the winding of this magnet, the break contacts of relay 1604, the lower operated contacts of relay 1511, the brush arm 1402 and the No. 5 terminal of the C1 bank of the C stepping switch to ground through the break contacts of relay 1602. Magnet 1407 operates and removes the short circuit from around the upper winding of relay 1604 and permits this relay to operate. The operation of relay 1604 interrupts the operated circuit of the stepping magnet 1407 and permits this magnet to release. Stepping magnet 1407 in releasing advances the brush arms 1401 through 1406 one step. Relay 1511 is maintained operated when the C stepping switch is in positions 6 through 10 inclusive when relay 1607 is released in a circuit extending from battery through the winding of relay 1511, lower inner break contacts of relay 1506, lower outer break contacts of relay 1502, brush arm 1402 and terminals 6 through 10 (also 17 through 21) of the C1 bank to ground through the lower outer break contacts of relay 1607. In addition magnet 1407 in releasing again short-circuits the upper winding of relay 1604 and causes this relay to release. Release of relay 1604 again completes the circuit of magnet 1407 and causes the magnet to reoperate in a circuit from battery through the winding of magnet 1407, the break contacts of relay 1604, lower operated contacts of relay 1511, brush arm 1402 and the No. 6 terminal of the C1 bank to ground through the break contacts of relay 1607 and the above cycle repeated until brush arm 1402 again rests in its No. 1 or No. 12 position where the above circuit for the operation of re-

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lay 1511 and magnet 1407 is interrupted. It is to be understood that the connections to the terminals of the banks of all of the stepping switches are repeated, that is, the connections to the terminals 1 through 10 are the same as the connections to terminals 12 through 22. In other words, all of these switches have two normal positions in the No. 1 position and in the No. 12 position. This reduces the wear on the switches in case it is only required to transmit different codes for starting ten different stations. If it is desired, the bank of these switches may be wired so that the brush arms will make a complete half revolution in response to each cycle of operation of the transmitter start circuit. When the brush arms 1401 through 1406 arrive in their No. 1 position (or the No. 12 position), the transmitter start circuit will be in condition to initiate another series of transmitter start signals for starting another transmitter connected to the system. As described herein it has generally been assumed that the C stepping switch is an eleven position switch because it operates as if it were such a switch when connected as shown in the drawing. It may be connected so as to provide as many positions as may be desired as is well understood by those skilled in the art.

In addition the release of relay 2718 as described above completes an obvious circuit for lighting an end of transmission light 2831, which light indicates to the operator or attendant that station 216 has completed the transmission of all the message material available for transmission from the station which has been transmitting.

It is to be noted that lamp 1421 has remained lighted all the time during the transmission from station 216 and continues to remain lighted until the operator operates some other start key for initiating the operation of the transmitter start circuit. The operator may do this at any time after lamp 2831 lights whereupon at the operation of the transmitter start circuit the equipment at the subscriber's station and the equipment associated with the transmission channel of the party line will operate in substantially the same manner as described above except that in general a different third code combination will be transmitted by the transmitter start circuit for testing the transmitter at a different subscriber station where the presence of message material ready for transmission in addition to the messages from that station will in general be directed to different stations and therefore preceded by different directing codes. However, the circuits respond in the same manner as described above with these minor exceptions which will be readily understood by those skilled in the art.

Automatic operation of the transmitter start circuit

At any time after the start of transmission from station 216 the operator can operate the automatic key 1419 to its automatic position. Key 1419 is arranged so that it will remain in either its manual or automatic position after it has been operated to that position. In other words, after key 1419 has been operated to its automatic position, it will remain in that position until manually restored by the operator.

If the transmission is still in progress from the subscriber's station at the time when the automatic key 1419 is operated to its automatic position the circuits will continue to function as described above. The operation of the key 1419

at this time will not cause the operation or release of any relays or change the manner of operation of the circuits as described above. However, when transmission ceases from station 216 as described above and the C stepping switch is returned to its No. 1 (or No. 12 position) a circuit is completed for the operation of relay 1601 from ground through brush arm 1401 and the No. 1 terminal of the C2 bank of the C stepping switch to battery through the winding of relay 1601. With both relay 1601 and key 1419 operated a circuit is completed for the operation of relay 1508 from battery to the winding of relay 1508, the upper operated contacts of relays 1600 and 1601, the lower inner break contacts of relay 1510 and the upper inner operated contacts of relay 1501 to ground through the operated contacts of the automatic key 1419. Relay 1508 in operating completes a circuit for maintaining itself operated from battery through its winding and lower inner operated contacts, lower break contacts of relay 1510 and the upper inner operated contacts of relay 1501 to ground through the operated contacts of key 1419.

The operation of relay 1508 interrupts control circuits extending to the start keys 1431 through 1440 so that if an operator should inadvertently operate any of these keys during the time the automatic key is set in its automatic position the inadvertent operation of the start keys will not in any way interfere with the automatic operation of the start circuit or with the signals transmitted thereby.

The operation of relay 1508 in addition completes a circuit for the operation of relay 1602 from battery through the winding and upper break contacts of relay 1602, the upper break contacts of relay 1606, the upper operated contact and second armature from the top of relay 1508, the lower outer operated contacts of relay 1501, upper break contacts of relay 1510 and the upper inner operated contacts of relay 1601 to ground.

Relay 1602 in operating at this time completes two separate circuits for maintaining itself operated. One of these circuits extends from battery through the winding and upper inner operated contacts of relay 1602 through the lower break contacts of relay 1608 to ground through the lower outer break contacts of relay 1506. The other locking circuit extends from battery through the winding and inner upper contacts of relay 1602, the lower inner break contacts of relay 1607, the second armature from the bottom and front contact of relay 1508 to ground through the lower outer break contacts of relay 1506.

The operation of relay 1602 completes a circuit for the operation of relay 1701 as described above. The operation of relay 1701 will interrupt the transmission over the receiving channel of party line 210 if any is in progress at this time.

The operation of relay 1602 also removes ground from the right-hand terminal of condenser 1611 and permits this condenser to start to charge. As described above with the C stepping switch in its No. 1 position it requires approximately seven-tenths of a second before condenser 1611 is charged sufficiently positive to cause tube 1610 to initiate a discharge current to operate relay 1603. When relay 1603 operates at the end of this time interval it completes a circuit for the operation of relay 1502. Relay 1502 in operating completes a circuit for the operation of relay 1503 from battery through the upper winding of relay 1503, the lower outer operated

contacts of relay 1508, the upper outer operated contacts of relay 1502 to ground through the No. 1 contact of the C2 bank and brush 1401 of the C stepping switch. Relay 1503 in operating completes a circuit for the operation of the stepping magnet 1414 which magnet thereupon operates. The operation of this magnet, however, does not advance the brush arms 1408 through 1413.

The operation of relay 1502 also completes a circuit for maintaining relay 1601 operated.

The operation of relay 1502 also completes a circuit for the operation of either relay 1814 or 1823 dependent upon whether or not relay 1709 is operated or released. As described above, relay 1709 was assumed to be released. Consequently, the operation of relay 1502 at this time causes relay 1823 to operate. Operation of relay 1823 at this time completes a circuit for maintaining itself operated under control of relay 1602 and transfers the leads from the distributor contacts controlled by shaft 2051 from the transmitter contacts and connects them to relay contacts and contacts of the banks of the A and C stepping switches of the transmitter start circuit.

The operation of relay 1502 completes a circuit for the operation of the stepping magnet 1407 which magnet operates and removes a short-circuit from around the upper winding of relay 1604 and permits this relay to operate. The operation of relay 1604 completes a circuit for maintaining itself operated under control of relays 1502 and 1511. The operation of relay 1604 interrupts the operating circuit of stepping magnet 1407 and permits this magnet to release. Magnet 1407 in releasing advances the brush arms 1401 through 1406 to the No. 2 position so that they make contacts with the No. 2 position of their respective banks.

The operation of relay 1604 connects ground to the right-hand terminal of condenser 1611 and discharges this condenser which causes relay 1603 to release and interrupt the operating circuit of relay 1502. Relay 1502 in releasing interrupts the locking circuit of relay 1601 and permits this relay to release. The release of relay 1502 at this time completes a circuit for the operation of magnet 2047 which magnet operates and releases the distributor shaft 2051 for rotation through one revolution. Near the beginning of this revolution, contacts 2050 close and complete a circuit for operating relay 1505 which relay in operating interrupts the operating circuit of magnet 2047 and completes a circuit for maintaining itself operated under control of relay 1502.

During the first rotation of the distributor shaft 2051 none of the leads 1 through 5 connected to the contacts controlled thereby are connected through the relays and stepping switches of the transmitter start circuit shown in Figs. 14, 15 and 16 so that a blank signal will be transmitted as described above.

When brush arm 1401 leaves the No. 1 terminal of the C2 bank and relay 1502 releases, the operating circuit of relay 1503 is interrupted, so this relay releases. The release of relay 1503 interrupts the operating circuit of the stepping magnet 1414 and thus permits this magnet to release and advance the brushes 1408 through 1413, inclusive, of the A stepping switch to their No. 2 position.

When brush arm 1412 advances from the No. 1 terminal of the A2 bank to the No. 2 terminal of the A2 bank it interrupts the locking circuit of relay 1509 which extends through the upper winding of this relay and permits this relay to

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release. The release of this relay does not re-establish a stepping circuit for magnet 1417 at this time. Consequently, magnet 1417 is not actuated and brush arms 1415 and 1416 remain in their No. 1 position.

The release of relay 1509 completes a circuit for the operation of relay 1605 from battery to the winding of relay 1605, the lower break contacts of relay 1514, the upper break contacts of relays 1506 and 1511, the fourth armature from the bottom and front contact of relay 1508 and the upper break contacts of relay 1509 to ground. Relay 1605 in operating completes a circuit for maintaining itself operated from battery through its winding, the lower break contact of relay 1514 and the upper break contacts of relays 1506 and 1511, the fourth armature from the bottom and front contact of relay 1508 to ground through the upper operated contacts of relay 1605.

The release of relay 1502 as described above also interrupts the locking circuit of relay 1604 and permits this relay to release. The release of relay 1502 disconnects ground from the right-hand terminal of condenser 1611. Approximately seven-tenths of a second later relay 1603 again operates and completes a circuit for the operation of relay 1502 which relay reoperates, interrupts locking circuit of relay 1505 and completes a circuit for the operation of the stepping magnet 1407. Operation of this magnet permits relay 1604 to again operate and lock under control of relay 1502. Operation of relay 1604 interrupts the operating circuit of magnet 1407 which relay releases and advances the brush arms 1401 through 1406 to their No. 3 position. The operation of relay 1604 also connects ground to the right-hand terminal of condenser 1611 which in turn causes relay 1603 to release and interrupt the operating circuit of relay 1502. Relay 1502 in releasing again completes a circuit for the operation of magnet 2047 which magnet again releases shaft 2051 for a second revolution during which revolution the code combination representing the line feed function is transmitted. Near the beginning of this revolution contacts 2050 are again closed and complete a circuit for the operation of relay 1505 which relay locks operated under control of relay 1502 and interrupts the operating circuit of magnet 2047, thus permitting this magnet to release and stop the distributor shaft 2051 at the end of the second revolution. Release of relay 1502 interrupts the operating circuit of relay 1604 and permits this relay to release. The release of relay 1502 again removes ground from the right-hand terminal of condenser 1611 which again starts to charge. At the end of approximately seven-tenths of a second relay 1603 will again be operated and the above cycle of operation repeated. During this cycle of operations, however, the circuit connections to the contacts controlled by the distributor shaft 2051 extend through the C and A stepping switch banks so that a code combination representing the letter E is transmitted and the C selector switch advanced to its No. 4 position. As described above, the C selector switch will remain in its No. 4 position for approximately one and seven-tenths seconds at the end of which time the C selector is advanced to its No. 5 position where an obvious circuit is completed for the operation of relay 1507.

If the transmission is started from the transmitter at station 217 in response to the transmission of the blank code combination the seven-tenths pause and the line feed code combination,

another seven-tenths pause and the E code combination, relay 2718 will operate as described above and complete a circuit for the operation of relay 1506. The operation of relay 1506 at this time interrupts the locking circuit of relay 1602. The release of relay 1602 at this time interrupts the operating circuit of relay 1701 and the locking circuit of relay 1823, thus permitting these relays to release and permit transmission from the transmitter shown in Figs. 19 or 20 to be resumed over the receiving channel of party line 210. The release of 1602 also connects ground to the righthand terminal of condenser 1611 thus prevents this condenser from further charging and operating relay 1603. Consequently, relay 1603 does not operate nor does relay 1502.

The operation of relay 1506 at this time completes a circuit for the operation of the stepping magnet 1417 from battery through winding of magnet 1417 and the lower break contact of relay 1509 to ground through the center lower armature and operated contact of relay 1506. The operation of magnet 1417 removes a short-circuit from around the lower winding of relay 1509 and permits this relay to operate. The operation of relay 1509 interrupts the operating circuit of magnet 1417 and permits this magnet to release and advance the brush arms 1416 and 1415 to a No. 2 position. When brush arm 1416 makes contact with the No. 2 terminal of bank B2 the locking circuit of relay 1509 is completed through the upper winding of relay 1509 which holds relay 1509 operated. Under these circumstances, the B stepping switch is in the same position as the A stepping switch. The operation of relay 1506 also interrupts the locking circuit of relay 1605 and permits this relay to release.

Thereafter the transmitter start circuit remains in the condition described as long as messages are transmitted from the transmitter at station 217. At the end of the transmission of all the messages available for transmission from station 217 a letters signal followed by an H signal will be transmitted after the transmission of the letter signal followed by an H signal at the end of the last message. When these signals are received at the central switching station they will cause relay 2718 to release as described above and interrupt the operating circuit of relay 1506. The release of relay 1506 at this time completes a circuit for the operation of relay 1511 from battery to the winding of relay 1511, lower inner break contacts of relay 1506, the lower outer break contacts of relay 1502, the brush arm 1402, No. 5 contact of the C1 bank to ground through the lower outer break contact of relay 1607. Relay 1511 in operating completes a circuit for operating the stepping magnet 1407 and in turn relay 1604 as described above so that the brush arms 1401 through 1406 are restored to their No. 1 position. Thereafter the circuit will operate as described above and cause signals to be transmitted for starting the next station. The above cycles of operation are thereafter repeated and transmission started from each of the stations connected to the system in turn so long as each of these stations has message material to transmit.

The connections to the banks of the A and C stepping switches are such that the last code combination during each complete cycle of operation of the transmitter start circuit is changed due to the stepping of the A switch. In the exemplary embodiment shown the connections are

such that during the first cycle of operation of the transmitter start circuit the letter A code combination will be the last code combination transmitted. During the second cycle of operation the last code combination transmitted will be the one representing the letter E. During the subsequent cycles I, L, P, Q, S, U, W and Y are transmitted.

It is to be understood that any other suitable letters may be transmitted as the last code combination of the signals transmitted by the transmitter start circuit. These last code combinations as described above are the ones which select the particular transmitter or station connected to the party line for transmission. Thus, under the conditions shown in the drawing, the transmitter at station 216 is assigned the letter A, at 217 the letter E, at 218 the letter I, etc. Thus the transmitter start circuit will transmit first a group of code combinations for starting a transmitter at station 216. After transmission from this transmitter is completed, the transmitter start circuit transmits a group of signals the last code combination of which is the code combination representing the letter E which will cause the transmitter at station 217 to transmit.

When the transmission is completed from station 217 the operation of the transmitter start circuit will again be initiated and during this cycle of operation it will transmit the letter I code as the final code combination which will select the transmitter at station 218. The operation will continue in this manner until all of the transmitters have been given an opportunity to transmit the message material available for transmission by them. Thereafter the transmitter start circuit will again send out code combinations in which the last code represents the letter A signal and give the transmitter at station 216 a second opportunity to transmit.

At station 219 the transmitter has been assigned two letters L and Y. Consequently, when the transmitter start circuit transmits the L code as the final code combination, the transmitter at this station will be given an opportunity to transmit, and transmit all the messages it has available for transmission at this time. Thereafter at a later time the transmitter start circuit will transmit the code representing Y as a final combination during this cycle of operations and again the transmitter at station 219 will be given an opportunity to transmit. In other words, the transmitter at station 219 is given two opportunities to transmit while the transmitters at the other stations of party line 210 are given only one opportunity to transmit.

As shown in the specific embodiment in this invention, the connections at the secondary switching center 214 are such that it responds to both the letters L and Y and causes the transmitter at station 219 to be started into operation. It will be readily understood by those skilled in the art that any of the stations such as station 219 may be started a number of times oftener than other stations by changing the connections in the transmitter start circuit so that it will send, say, the letter L as a final code combination when the A stepping switch is in more than one position, thus causing the transmitter assigned this letter to start oftener than the other transmitters.

The transmitters at any of the stations may be given more than merely two opportunities to transmit to one opportunity of all the other transmitters. The connections either at the secondary control point or at the contacts of the A stepping

switch banks or both may be so arranged that any of the transmitters at any of the stations may be given as many opportunities to transmit as desired relative to the opportunities provided for the other transmitters to transmit. In addition, the order of transmission from the respective stations may be controlled in any desired manner and in addition, the order in which the transmitter at any station may transmit its various numbers of turns with respect to the transmission from other transmitters may be readily adjusted by changing these connections as required by traffic conditions or for any other reason.

Assuming now that when the transmitter start circuit sends out the blank signal followed by a pause, then the line feed signal followed by a second pause, then the letter E signal as described above in detail after the operator has operated the automatic key 1419 to its automatic position. Assume further that there is no perforated tape inserted in the transmitter at the station 217 available for transmission. Under these circumstances no signals will be received at the central switching station so relay 2718 will not operate and will not have been operated by the end of the seven-tenths of a second interval during which the C selector remains in the No. 5 position. Consequently, relay 1506 will not operate at this time and relay 1602 will not release. At the end of this seven-tenths of a second interval relay 1603 will be operated and complete a circuit for the operation of relay 1502. Relay 1502 will operate and complete a circuit for operating stepping magnet 1407. Magnet 1407 in operating permits relay 1604 to operate and interrupt the operating circuit of magnet 1407. Relay 1604 in operating also completes a circuit for maintaining itself operated under control of relay 1502. The operation of relay 1604 also connects ground to the right-hand terminal of condenser 1611 and causes relay 1603 to release and in turn release relay 1502. When the magnet 1407 releases due to the operation of relay 1604 it will advance the brushes 1401 through 1406 to the No. 6 position. In the No. 6 position a circuit is completed from ground through brush arm 1401 and the No. 6 terminal of the C2 bank for the operation of relay 1608. The operation of relay 1608 interrupts one of the locking circuits of relay 1602. Relay 1602, however, remains operated at this time due to current flowing through the other of its locking circuits. Relay 1603 in operating also interrupts one of the locking circuits of relay 1508. This relay, however, remains operated due to current flowing in other locking circuits of this relay.

When the brush arm 1402 advances to the No. 6 position and makes contact with the No. 6 terminal of the C1 bank of the C stepping switch and relay 1502 releases, a circuit is completed for operating relay 1511 from battery through the winding of relay 1511, the lower inner operated contacts of relay 1506, the lower outer break contacts of relay 1502, brush arm 1402, the No. 6 terminal of the C1 bank to ground through the lower outer break contact of relay 1607. Relay 1511 in operating completes a circuit for operating the stepping magnet 1407 which magnet operates and permits relay 1604 to operate. Relay 1604 in operating interrupts the operating circuit of magnet 1407 and permits this magnet to release and advance the brush arms 1401 through 1406 to the No. 7 position. The release of magnet 1407 also short-circuits the upper winding of relay 1604 and causes this relay to release whereupon the circuit is reestablished through the winding of mag-

net 1407 and the No. 7 terminals of the C1 bank. The above cycle of operations is then repeated and the brush arms 1401 through 1406 returned to their No. 1 (or No. 12) position. When brush arm 1401 returns to its No. 1 position a circuit is completed from ground through this brush arm and the No. 1 contact of the C2 bank for operating relay 1501. Inasmuch as relays 1508 and 1602 have remained operated all during this time, the operation of relay 1601 performs no useful function at this time.

When relays 1604 and 1502 released after the C stepping switch stepped from the fifth to the sixth position, ground was disconnected from the right-hand terminal of condenser 1611. Consequently, this condenser starts to charge through the high resistance 1451. When the C stepping switch returns to its No. 1 position, resistance 1453 is connected in parallel with resistance 1451 so that the condenser 1611 will charge at a faster rate. When this condenser receives a sufficient charge relay 1603 will operate as described above and complete a circuit for the operation of relay 1502. Relay 1502 in operating completes a circuit for the operation of relay 1503 as described above. Relay 1503 then completes a circuit for operating magnet 1414. The operation of relay 1502 completes a circuit for the operation of a stepping magnet 1407 which magnet operates and permits relay 1604 to operate. Operation of relay 1604 interrupts the operating circuit of the stepping magnet 1407 and permits this magnet to release and advance the brush arms 1401 through 1406 to their No. 2 position. Relay 1604 in operating connects ground to the right-hand terminal of condenser 1611 and discharges it thus causing relay 1603 to release which in turn releases relay 1502. Release of relays 1502 and 1604 removes ground from the right-hand terminal of condenser 1611 and causes this condenser to again start to charge. When brush arm 1401 leaves contact with the No. 1 terminal of the C2 bank upon the release of magnet 1407, it interrupts a circuit through relay 1503 which relay releases and interrupts a circuit through the stepping magnet 1414 which magnet releases and advances the brush arms 1408 through 1413 to their No. 3 position. Thereafter, the cycle of operation of the circuits in Figs. 14, 15 and 16 is repeated substantially as described above. During this cycle of operation of these circuits a blank signal will be transmitted followed by a pause and this in turn followed by a line feed code combination and another pause. The third code combination transmitted during this cycle will be the one representing the letter I since the A stepping switch is in its third position. When this series of code combinations is transmitted over the receiving channel of party line 210, the selecting equipment at the secondary switching centers respond to them and at switching center 215 the transmitter 239 at station 218 will be connected to the transmitting channel. If there is any perforated tape in this transmitter available for transmission at this time signals in accordance with the perforations in the tape will be transmitted as described above. If signals are transmitted, relay 2718 will operate before the C stepping switch shown in Fig. 14 is advanced from its No. 5 position and stop the operation of the circuits in Figs. 14, 15 and 16.

Assuming now that there are no signals available for transmission from the transmitter 239 at station 218. Under these circumstances, relay 2718 will not operate and cause relay 1506 to op-

erate during the seven-tenths of a second time interval during which the C stepping switch remains in its No. 5 position. At the end of this time interval the C stepping switch will be stepped to its sixth position where a circuit is completed for operating relay 1511 as described above and the circuits again function and advance the C stepping switch to its No. 1 position. In this position, the stepping magnet 1414 is again operated and the C stepping switch advanced to its No. 2 position whereupon the brushes of the A stepping switch advanced one step and the cycle of operation of the transmitter start circuit repeated. At this time a blank signal will be transmitted followed by a pause of approximately seven-tenths of a second. Following this pause the line feed signal and another pause will be transmitted over the receiving channel of party line 210. At the end of the second pause of approximately seven-tenths of a second the letter L signal will be transmitted because the brushes of the A selector are now in their No. 4 position.

If no message material is available for transmission from station 219, relay 2718 will not operate to operate relay 1506 during the time the C stepping switch is in its No. 5 position. Consequently, the transmitter start circuits will continue to function and the C stepping switch returned to its No. 1 position after which another cycle of operation will be initiated. Thus the cycles of operation of the transmitter start circuit are repeated and for each cycle the A stepping selector is advanced one position. This will cause the final character of the code transmitted during the cycle to be changed so that another transmitter of the party line will be selected and given an opportunity to transmit.

Assume now that station 216 was the last station to transmit and that no message material is available for transmission from any of the other stations of the party line. When the brush arms of the A stepping switch return to the No. 1 position after having advanced through all of the other positions following the last transmission from station 216, a circuit will be completed for the operation of relay 1509 from battery through the upper winding of relay 1509, brush arm 1416 and the No. 1 terminal of bank B2, No. 1 terminal of the bank A2 to ground through the brush arm 1412. Relay 1509 in operating at this time completes a circuit for the operation of relay 1607 from battery through the winding of relay 1607, the lower operated contacts of relay 1605 to ground through the operated contacts of relay 1509. The circuits and the C stepping switch thereafter advance and the circuits operate as described above during which the C selector switch advances to its fifth position and a blank code combination followed by a pause and these in turn by a line feed combination and another pause and then the letter A signal is transmitted over the party line at 210. If there is still no perforated tape inserted in the transmitter at station 216 relay 2718 will not operate during the time the C stepping switch remains in its fifth position. At the end of this time interval, relay 1603 will be operated and in turn operate relay 1502. Relay 1502 operates and causes magnet 1407 to operate. This in turn permits relay 1604 to operate which relay in operating connects ground to the right-hand terminal of condenser 1611 and recycles this condenser timing arrangement. The operation of relay 1604 causes the magnet 1407 to release and advance the brush arms 1401 through 1406 to their No. 6 position.

At this time, however, relay 1607 is operated so that relay 1511 will not operate and immediately restore the C stepping switch to its No. 1 position. Instead, condenser 1611 will continue to charge through high resistance 1451. Condenser 1611 together with the vacuum tube 1610, resistances 1614 and the high resistance 1451 together with the potential of battery 1616 are such that under these circumstances it will require approximately two minutes for condenser 1611 to receive a sufficient high positive charge to permit sufficient anode current to flow through tube 1610 to cause relay 1603 to operate. At the end of this interval, relay 1603 will operate and cause relay 1502 to operate. Relay 1502 will cause the C stepping switch to advance to its No. 7 terminal.

If the receiving channel party line 210 is idle at this time, ground will be connected to the No. 7 terminal of the C1 bank of the C stepping switch in a circuit extending from the No. 7 terminal of the C1 bank through the cross-connection blocks 1460 and 1461 and lead 1462 extending through Figs. 15, 16 and 17 and the upper break contacts of relays 1810 and 1819. With ground connected to the No. 7 terminal, a circuit of the C1 bank circuit will be completed for operating relay 1511 and the stepping magnet 1407 as described hereinbefore and cause the brush arms 1401 though 1406 to advance to their No. 8 position whereupon similar circuits are again established and the switch advanced to the No. 9 position. In the No. 9 position ground is connected directly to the No. 9 terminal to the cross-connecting block 1416. Consequently, this switch will be advanced to its No. 10 position and thence to its normal position and finally to the No. 1 position whereupon the circuit will again start another cycle of operation during which all of the transmitters are tested for message material.

As described hereinafter, when the receiving channel of the party line is idle, relays 1810 and 1819 will be released. Consequently, only one timing interval approximately 2 minutes, in one embodiment of the invention, will elapse between the testing of all of the transmitters for storage material available for transmission.

However, if the control or receiving channel 211 of party line 210 is busy at the time brush arm 1402 advances to the No. 7 position either relay 1810 or 1819 will be operated and consequently, since one of these relays as well as relay 1607 is now operated under these conditions, ground will not be connected to the No. 7 terminal of the C1 bank. The timing arrangement comprising tube 1610 and condenser 1611 as described above, will, therefore, be recycled and at the end of a second delay period approximately 2 minutes will cause the stepping switch to advance to its No. 8 position. In the No. 8 position ground will not be connected to the No. 8 terminal of the C1 bank under the assumed conditions. Consequently the switch will remain in this position until advanced at the end of the third 2 minute interval by the operation of a time delay equipment comprising tube 1610, condenser 1611 and relay 1603 as described hereinbefore. As shown in the drawing, when the switch advances to its No. 9 position ground will be connected to the brush arm 1402 from the No. 9 terminal of the C1 bank. Consequently, the switch will advance through its No. 10 and normal position to the No. 1 position where the complete cycle of testing all of the transmitters will again be initiated.

Thus when the receiving channel of the party line is busy the transmitter start circuit will wait

for six minutes before initiating another cycle of operation. It will be quite apparent to those skilled in the art by altering the cross connections between blocks 1460 and 1461 and by properly connecting the contacts of the C1 bank of the stepping switch variation in these time intervals may be controlled in any desirable manner. Thus, for example, by connecting all of the contacts 7, 8, 9 and 10 to lead 1462, the circuits will respond by waiting two minutes when the receiving channel of the party line is busy and will wait ten minutes when it is busy. By connecting a lesser number of these terminals to lead 1462 the time interval during which the circuits pause when the receiving channel busy may be reduced. By connecting one or more of these terminals in parallel with terminal No. 7, the time of waiting between testing the transmitters may be increased under all conditions including the idle condition of the receiving channel.

If the receiving channel should become idle during the long waiting interval after the end of the first two minute interval, say for example at the end of the three minutes with the system connected as shown in the drawing, the release of relays 1810 and 1819 will connect ground to the No. 7 terminal of the C1 bank causing the advance of the C stepping switch to its No. 1 position as described above whereupon the operation of transmitter start circuit will again be initiated and cause each of the transmitters to be tested for message material available for transmission.

If any message material is available for transmission from any of these transmitters it will be transmitted and the brush arms of the B selector advanced to a position corresponding with the last station to transmit as described above. Thereafter the automatic operation of the start circuit will be again initiated and it will function to give each of the transmitters of the party line an opportunity to transmit. After each of the transmitters has been given an opportunity to transmit but no material is found available for transmission and after the last transmitter to transmit has been given a final opportunity to transmit, the transmitter start circuit will again wait ten minutes before another series of cycles of operation are initiated.

Skipping any transmitter

Provision has also been made for skipping any of the stations desired. In order to accomplish this a skip key, such as 1441 through 1450, has been provided. A skip key is provided for each of the stations served by the party line in question or in case certain of the stations are provided with more than one transmitter, a skip key may be provided for each transmitter. In case any transmitter is started by more than one code, a skip key may be provided for each code or for each position of the A stepping switch assigned to transmit codes for starting the station or transmitter in question. When any one of the skip keys is operated, the corresponding code which would start the transmitting apparatus assigned that final code will not be sent. Thus, assume that skip key 1449 has been operated. This indicates that it is desired to skip the transmitter started by the series of signals, the last significant one of which represents the letter W.

Under these circumstances when the C stepping switch returns to its No. 1 position after the transmission of the cycle in which the last sig-

nificant code combination of the transmitter start signals represented the letter U and after transmission has ceased from that station of transmitting apparatus, circuits will respond as described above, namely, relay 1601 operates and in turn completes a circuit for the operation of relay 1602 if this relay is released. Relay 1602 in operating, causes the transmitting distributors of the outgoing line circuit shown in Figs. 19 and 20, to be conditioned to cooperate with the transmitter start circuit, as described above, by interrupting any transmission from these distributors at this time. Relay 1602 in operating also initiates the operation of the timing circuit comprising condenser 1611 and tube 1610. At the end of approximately seven-tenths of a second relay 1603 will operate to complete a circuit for the operation of relay 1502 which relay operates and completes a circuit for the operation of relay 1503. Relay 1503 operates and causes the stepping magnet 1414 of the A stepping switch to operate.

In addition, the operation of relay 1502 completes a circuit for the operation of the stepping magnet 1407 which magnet in turn operates and permits relay 1604 to operate. The operation of relay 1604 interrupts the operating circuit of the stepping magnet 1407 and permits this magnet to release. The release of the stepping magnet 1407 advances brush arms 1401 through 1406 to their No. 2 position. When brush arm 1401 advances from its No. 1 position, it interrupts the circuit of relay 1503 and permits this relay to release. The release of relay 1503 at this time will interrupt the circuit of the stepping magnet 1414 and permit this magnet to release. The release of magnet 1414 causes the brush arms 1408 through 1413 to advance one step.

Under the assumed conditions the brush arms 1408 to 1413 were in their No. 8 position prior to the release of magnet 1414. Consequently, when magnet 1414 releases these brush arms will step to their No. 9 position. In the ninth position with key 1449 operated, a circuit is again completed for the operation of relay 1503 from battery through the lower winding of relay 1503, break contacts of stepping magnet 1414, brush arm 1411, the ninth contact of bank A1 of the A stepping switch, the upper break contacts of start key 1439, lower operated contacts of key 1449, the upper outer operated contacts of relay 1503 to ground through the No. 2 contact of the C2 bank and brush arm 1401 and the C stepping switch while this switch is in its No. 2 position as described. The operation of relay 1503 completes a circuit for the operation of the stepping magnet 1414 which magnet in operating interrupts circuit of relay 1503 and permits this relay to release. The release of relay 1503 interrupts the operating circuit of the stepping magnet 1414 which magnet will then release and advance brush arms 1408 through 1413 to their No. 10 position.

If the skip key 1450 is operated the above cycle of operation of the relay 1503 and stepping magnet 1414 will be repeated and the brush arms 1408 to 1413 advanced until they come to rest upon the terminal representing a station, the skip key of which has not been operated.

If the skip key, corresponding to the terminal upon which the brushes 1415 and 1416 of the B stepping switch are resting, is closed, a circuit will also be completed for advancing these brush arms when the C stepping switch advances to its No. 2 position.

When the C stepping switch advances to its

No. 2 position a circuit is completed from ground through the brush arms 1401 and the No. 2 terminal of the C2 bank, the upper operated contacts of relay 1503, the upper operated contacts of skip key corresponding to the terminal upon which brush arm 1415 is resting, the break contacts of the associated start key, contacts of the B1 bank and brush arm 1415 of the B stepping switch to battery through the upper break contacts and winding of relay 1514. A circuit also extends from the brush arm 1415 through the break contact and middle lower armature of relay 1506 and the lower break contacts of relay 1509 to battery through the winding of the stepping magnet 1417.

The operation of relay 1514 completes a circuit for maintaining itself operated under control of the brush arm 1401 as long as it is in its No. 2 position, and interrupts the operating and locking circuits of relay 1605 and thus permits this relay to release if it had previously operated.

The operation of magnet 1417 permits relay 1509 to operate which relay in turn interrupts the operating circuit of magnet 1417 and allows this magnet to release. The release of magnet 1417 advances the brush arms 1415 and 1416 one step. If a corresponding skip key is closed at this time, a similar circuit will be completed for reoperating stepping magnet 1417 and relay 1509 and the above cycle of operation of these relays repeated thus advancing the brush arms 1415 and 1416 until they come to rest upon the terminal of the corresponding skip key which is not operated.

Thus, the operation of a skip key causes the A stepping switch brush arms to advance past the corresponding terminal of this switch and causes the brush arms of the B stepping switch to step off the corresponding terminal if they are resting thereupon. This operation takes place during the time the C stepping switch is in its No. 2 position.

The advance of the brush arms of the C stepping switch from its No. 2 position will be as described above. Relay 1604 in operating connects ground to the right-hand terminal of condenser 1611 and thus recycles the timing circuit and tube 1610. In the meantime, however, the release of relay 1502 completes a circuit for the operation of magnet 2047 which magnet releases the distributor cam shaft 2051 via lead 2026 for rotation through one revolution. During this revolution relay 1505 is operated and a blank signal transmitted over the receiving channel of the party line 210.

Recycling of tube 1610 and condenser 1611 causes relay 1603 to release and in turn releases relay 1502. The release of relay 1502 permits the release of relay 1604. The release of these two relays removes ground from the right-hand terminal of condenser 1611 whereupon this condenser again starts to charge. Thereafter the circuits will operate as described above and the C stepping switch advanced from position No. 2 and through position No. 3 to position No. 4. When the C stepping switch advances to No. 4 position, it will cause a code combination to be transmitted which is determined by the position of the brush arms of the A stepping switch. Since the A stepping switch has been advanced from its No. 8 position to its No. 10 position, assuming that only one skip key 1449 has been operated, the final code combination will be a letter Y instead of the letter W. Consequently, the transmitter assigned the letter W will be skipped

at this time and will be skipped every time in a similar manner so long as the skip key 1449 remains operated.

If it is desired to manually control the starting of the transmitters at any time after the operation of the automatic key 1419, this key will be restored to its manual position. Restoring of key 1419 to its manual position will interrupt one of the locking circuits of relay 1508. However, relay 1508 is provided with two locking circuits. One under control of the automatic key 1419, relay 1510, and skip relay 1501 and the other under control of relays 1506, 1516 and 1608. Thus, if the automatic key is restored to its manual position during a time during which the transmitter control circuit shown in Figs. 14, 15 and 16 is engaged in transmitting a series of start signals relay 1508 will remain operated until either transmission is received from the transmitter represented by the series of start signals then in a progress of transmission or until relay 1608 is operated when the C stepping switch advances to its No. 6 position. Under these conditions, the operation of relay 1608 interrupts the second locking circuit of relay 1508 and permits this relay to release which in turn interrupts the locking circuit of relay 1602 and permits this relay to release. Thereafter the C stepping switch is advanced to its No. 1 position as described above whereupon the circuit is in condition for starting another transmitter under control of the manually operable start keys. Upon the operation of any of these keys the circuit will function to transmit the proper series of signals as described above and test and initiate transmission from the desired transmitter.

As shown in the drawing, each bank of the A stepping switch is provided with twenty-two terminals and the terminals of each bank are so wired that their switch is equivalent to a switch of ten terminals. Furthermore, as shown in the drawing, all ten of the code combinations determined by the ten independent positions of the stepping switch have all been assigned to transmitters of party line 210.

It will be readily appreciated by those skilled in the art that the A stepping switch may be provided with as many terminals in each bank as is desirable and that these terminals may be wired in any suitable manner to secure as many different starting codes as may be desired or as are available. It will also be understood by those skilled in the art that in case more terminals or codes are available than transmitters, or assigned to transmitters of the party line, the A stepping switch may be caused to automatically advance over these terminals by connecting ground directly to them in the same manner as the switch is caused to step over the normal or eleventh step. It should be noted that this terminal of the A1 bank is connected to ground as shown in the drawing in Fig. 14. Ground connected to this terminal will cause brush arms 1408 through 1413 to step off of this terminal in the same manner as described above if a skipping key had been thrown. In case more codes are provided than transmitters, ground will be connected to the extra terminals and the switches caused to automatically step off of them. The B stepping switch will similarly step its brushes 1415 and 1416 over these same terminals since ground would similarly be connected to them. This is also shown in Fig. 14 where ground is connected to the normal or eleventh terminal of the B1 bank and

causes the brush arm 1415 to automatically step off of this terminal as soon as it steps on to it.

Stopping transmission from subscriber's station

Provision has been made to permit the operator at the central switching station to stop the transmission from any subscriber's transmitter at any time. This enables the operator to stop transmission from any station and to manually start transmission from any other station in cases of trouble, emergency, emergency messages or urgent messages, or for any other reason. In order to accomplish this the operator must first restore the automatic key 1419 to its manual position. Since the only time necessary or desirable to stop transmission is during the time transmission is in progress from some subscriber's station, operator will restore this key to its manual position during the time messages are being transmitted from any one of the subscriber's stations. Consequently, the second locking circuit of relay 1508 is interrupted so that relay 1508 will release when the automatic key 1419 is restored to its manual position under these conditions.

The operator at the central switching station will then operate the emergency stop key 1420 which will complete a circuit for the operation of relay 1606 from battery through the winding of relay 1606, the upper inner operated contacts of relay 1506, the upper inner break contacts of relay 1508 to ground through the stop key 1420.

Relay 1606 in operating completes a circuit for maintaining itself operated from battery through its winding and upper inner operated contacts to ground through the upper break contacts of relay 1516. Operation of relay 1606 completes a circuit for the operation of relay 1510 from battery through the winding of relay 1510 to ground through the front contact and center upper armature of relay 1606. The operation of relay 1606 completes a circuit for the operation of relay 1602 from battery through the winding and upper break contacts of relay 1602 to ground through the upper outer operated contacts of relay 1606.

Relay 1510 in operating as described above, completes a circuit for maintaining relay 1602 operated from ground through the central upper armature and front contacts of relay 1606, the upper inner operated contacts of relay 1510 and the upper inner operated contacts of relay 1602 to battery through the winding of relay 1602.

The operation of relay 1606 completes a circuit for the operation of relay 2715 from battery through the lower winding of relay 2715, lead 2737 which extends from Fig. 27 through Figs. 14, 15 and 16 to ground through the lower outer operated contacts of relay 1606.

Relay 2715 in operating interrupts the locking circuit of relay 2723 and locking circuit of either relay 2704 or 2721 if either of these relays is operated. It will be recalled that relay 2723 is operated when signals are being received from the transmitting channel of party line at station 210, and that relay 2704 is also operated if the message being received is intended only for the central switching station. It will further be recalled that relay 2721 will be operated if the message being received is intended both for the central switching station and some other station. If the message is intended only for some other station, then relay 2723 only is operated. However, when relay 2715 is operated the locking circuit of any of these relays which may be operated is interrupted so that these relays thereupon release.

The operation of relay 2715 completes a circuit for maintaining itself operated under control of relay 2713 so that relay 2715 will not release until relay 2713 releases. Operation of relay 2715 also interrupts the operating circuit of relay 2718. It will be recalled that relay 2718 remains operated as long as signals are being received over the transmitting channel of party line 210. The release of relay 2718 removes ground from a lead 2736 which permits relay 1506 to release.

Inasmuch as signals continue to be received over the transmitting channel of party line 210 for a short interval of time, relay 2701 will repeat these signals to relay 2702 which relay will maintain relay 2713 operated and relay 2713 will maintain relay 2715 operated as described above. So long as relay 2715 is operated, relay 2718 will not be reoperated by the reception of these signals from the transmitting channel of party line 210. Consequently, relay 2718 will remain released.

The operation of relay 2715 connects ground to the right-hand terminal of the lower winding of relay 2720 and prevents this relay from locking in its operated position should one of the signals during this short interval of time be a figures signal.

The operation of relay 1602 as described above removes ground from the right-hand terminal of condenser 1611. At this time the C stepping switch will be in its fifth position because messages were being received at the central switching station at this time. With the C stepping switch in its No. 5 position it requires approximately seven-tenths of a second for the condenser 1611 to receive a sufficient charge to cause relay 1603 to operate, relay 1603 operates at the end of this time interval and completes a circuit for the operation of relay 1502. Relay 1502 in operating at this time completes a circuit for the operation of either relays 1814 or 1823 as described above. Under the assumed conditions, relay 1823 will operate. This relay in operating completes a circuit for maintaining itself operated and transfers the leads from the distributor shown in Fig. 20 from the transmitter of this figure to relay contacts and banks of the stepping switches as described above.

The operation of relay 1502 completes a circuit for the operation of magnet 1407 which magnet operates and permits relay 1604 to operate. The operation of relay 1604 interrupts the operating circuit of the stepping magnet 1407 which permits this magnet to release and advance the brush arms 1401 through 1406 to their No. 6 position. The operation of relays 1502 and 1604 completes a circuit for discharging condenser 1611 and thus causing relay 1603 to release and in turn release relay 1502. When the stepping magnet 1407 releases and advances brush arm 1402 to the No. 6 position, a circuit is completed for the operation of relay 1511 as described above from battery through the winding of relay 1511, the lower inner break contacts of relay 1506, the lower outer break contacts of relay 1502 to ground through brush arm 1402, the No. 6 terminal of the C1 bank and the lower outer break contacts of relay 1607. The operation of relay 1511 completes a circuit for the operation of magnet 1407 from ground through the lower outer break contacts of relay 1607, the No. 6 terminal of the C1 bank and brush arm 1402, lower operated contact of relay 1511, upper winding of relay 1604, lower break contacts of relay 1604 to battery through

the winding of magnet 1407. Magnet 1407 operates and permits relay 1604 to operate which relay interrupts the operating circuit of magnet 1407 and permits this magnet to release and advance brush arms 1401 through 1406. Thereafter, magnet 1407 and relay 1604 operate as described above and advance the brush arms 1401 through 1406 to the No. 1 position through positions No. 6 through 10 and N. When the brush arms arrive in their No. 8 position, a circuit is completed for the operation of relay 1516 from battery through the winding of relay 1516 to ground through the No. 8, No. 9 and No. 10 terminals of the C2 bank and brush arm 1401. Relay 1516 operates and interrupts the locking circuit of relay 1606 thus permitting this relay to release. Release of relay 1606 interrupts the operating circuit of relays 1510 and 1602. These relays, however, do not release at this time because they are maintained operated by current flowing in another locking circuit from ground through the lower outer break contacts of relay 1506, the lower break contacts of relay 1608 to battery through the upper inner operated contacts of relay 1602, also from the lower break contacts of relay 1608 to battery through the upper inner operated contacts and winding of relay 1510.

The C stepping switch does not stop or pause in positions No. 8, No. 9, No. 10 or No. 11, but steps through them due to the action of the stepping magnet 1407 and relay 1604 due to the operation of relay 1511 as described above. During the time this switch steps to these positions, relay 1516 operates as described above and permits relay 1606 to release.

When the C stepping switch arrives in its No. 1 position, it will pause until the timing circuit comprising condenser 1611, high resistances 1451 and 1453 and tube 1611 function to operate relay 1603. This requires approximately seven-tenths of a second. Thereafter, the circuits operate as described above and during which the C stepping switch advances to its No. 2 position and causes a blank signal to be transmitted over the receiving channel followed by a pause. Following these signals the switch advances to its No. 3 position and causes a line feed signal to be transmitted. Following the line feed signal another pause is transmitted and then the switch advances to its No. 4 position. In the No. 4 position of the C stepping switch, a code combination representing the letter R will be transmitted. This is due to the fact that relay 1510 is operated, the operation of which connects leads 1 through 5 of the cable 1228 so that the No. 2 lead and the No. 4 lead will be connected through to the transmission circuit and cause a marking impulse to be transmitted during these impulse intervals. During the other impulse intervals spacing impulses will be transmitted so that a code combination representing the letter R will be transmitted by a circuit. Thereafter, the C stepping switch will advance to its No. 5 position and await a reception of transmission.

However, the letter R code has not been assigned to any of the transmitters so that none of the transmitters of the party line will be started into operation by the reception of this code. As pointed out above, the transmission of the line feed code combination preceding the letter R code combination causes the transmitter to be disconnected from the transmitting channel and its operation stopped. Consequently, relay 2701 will not receive any further signals but will be maintained in its marking position and then in

turn will maintain relay 2702 in its marking position. When relay 2702 is maintained in its marking position, the circuit through relay 2713 will be interrupted sufficiently long to permit relay 2713 to release and in turn permit relay 2715 to be released. The release of relay 2715 then restores an incoming circuit to its initial or idle condition awaiting the reception of further signals transmitted from some transmitter connected to the transmitting channel of party line 210.

Inasmuch as no signals are transmitted at this time, relay 2713 will remain released so relay 1506 will not operate. Consequently, the C stepping switch will advance from its No. 5 position to its No. 6 position after a pause of approximately seven-tenths second in the No. 5 position. When the C stepping switch advances to its No. 6 position, a circuit is completed for the operation of relay 1603 which relay in operating interrupts the locking circuits of relays 1602 and 1510, thus permitting these relays to release. When the C stepping switch advances to its No. 6 position, a circuit will be completed for the operation of relay 1511 which will cause the C stepping switch to be advanced to its No. 1 position. Thereafter, the circuits are in condition for responding to the operation of any start key by the operator to cause the starting of any other transmitter or party line 210.

In this manner, the operator is enabled to stop the transmission from any of the stations of party line 210 and to initiate transmission from any other station at will.

In case all of the skip keys 1441 through 1450 associated with any given party line are simultaneously operated, relay 1501 will release. So long as any one of the skip keys is not operated relay 1501 will not release. Assuming now that all of the skip keys have been operated and that relay 1501 releases.

If the automatic key 1419 is operated to its automatic positions at this time, the release of relay 1501 interrupts one of the operating circuits of relay 1508. However, if the transmitting start circuits shown in Figs. 14, 15, and 16 are in the process of sending out a group of start signals, relay 1508 will not release because it will be maintained operated by current flowing through its second locking circuit as described above. If transmission is being received at the time of the release of relay 1501, the release of this relay will permit relay 1508 to release. If the last skip key is operated at a time when the C stepping switch is in one of its positions 2 through 5, or 13 through 16, relay 1508 will not immediately release. However, when the C stepping switch advances to its No. 6 or No. 17 position, relay 1508 will operate as described above and interrupt the second locking circuit of relay 1508 and thus permit this relay to release.

If the automatic key 1419 is in the manual position when the last skip is operated, the release of relay 1501 interrupts the operating circuit of the start relay 1602 thus preventing the start of a cycle of operation of the transmitting control circuit at the central station. If the automatic key 1419 is operated to its automatic position and in addition, if the C stepping switch should be in any position from 8 through 13 or 19 through 2 at the time a last skip key is thrown, when the stepping switch advances to its No. 3 position, a circuit will be completed for the operation of relay 1510 from ground through brush arm 1401 and the third terminal of the C2 bank,

the upper outer break contacts of relay 1501 to battery through the winding of relay 1510. The operation of relay 1510 at this time completes a circuit for maintaining itself operated under control of relay 1608. Operation of relay 1510 will cause the transmitting start circuit to transmit an R code during the time the stepping switch is in its No. 4 position as described above when relay 1510 was operated. When the final code transmitted by the transmitting control circuit is an R code, none of the transmitters are started and any transmitter which had been previously transmitting is stopped as described above. Consequently, no transmission will be received and the circuit will return to its original condition with the C2 stepping switch stopped in its No. 1 position. Thereafter, the circuit will respond as described above depending upon the manner in which the keys are actuated.

If one or more skip keys are released and the automatic key is still in its automatic position, automatic operation of the circuit will be resumed as described above. If the automatic key is restored to its manual position, then the operator at the central station can manually start any of the stations after its skip key has been restored to normal. It should be noted that should a start key be operated when the corresponding skip key is also operated, relay 1602 will not be operated because its operating circuit is open at the contacts of the operated skip key. Thus, even if the keys are improperly operated in this manner, the circuits will not transmit improper starting codes to cause improper operation of the control circuits.

Transmission of messages through the switching equipment

It will be recalled that the printing reperforator 2802 received the signals preceding the first message as well as messages 1, 3 and 4 transmitted from the outlying subscriber's station 216 as described above and caused tape 2805 to be perforated in accordance with these signals. In addition, receiving device 2802 in the embodiment of this invention, shown in the drawings, causes the corresponding characters to be printed upon tape 2805. As pointed out above, the transmitting head 2806 will normally be resting against the receiving device 2802 due to the operation of the circuits and apparatus. Consequently, contacts 2821 will be open prior to the reception of any message signals by the receiving device 2802. Upon the reception of the first signal and the perforation of tape 2805 in accordance therewith, the transmitting head 2806 of the transmitter will be moved to the right as shown in Fig. 23 and permit contacts 2821 to close. The closure of contacts 2821 will complete circuits for controlling the transmitting and switching equipment as will be described hereinafter.

Operation of the transmitting apparatus

Prior to describing the manner in which the various circuits cooperate with the transmitting apparatus, reference will be made to Figs. 91 through 96, inclusive, showing details of a typical transmitting apparatus suitable for use in combination with the switching circuits.

The transmitting apparatus comprises a transmitting head 9106 shown in Figs. 91, 92 and 93. This transmitting head is provided with a group of sensing pins carried by the levers 9175. A sensing pin and lever 9175 is provided for each of the elements of a code combination. Thus as

shown in the drawing 5 such levers and pins are provided, one for each of the elements of a five-unit code. In addition, a sixth pin and lever 9175 is provided. This sixth pin is arranged to engage the tape between the rows of perforations in the tape. The sixth pin is provided with a contact 9155 which is arranged to close when no tape is at the sensing position in the transmitting head 9106. Contacts 9155 will remain open so long as any tape is present in the sensing point, but will close and cause the circuits to operate as described hereinafter when the end of the tape passes beyond the sensing point of the transmitter. The transmitter head 9106 is arranged to pivot about an axis 9112 so that it can approach and come in contact with the receiving device adjacent the perforating portion or section thereof as clearly shown in Fig. 93. When the transmitting head rests in engagement with the perforating portion of the receiving device, it is capable of sensing the last code combination perforated in the tape.

As signals are received and perforated in the tape by the perforating apparatus and the tape advances therethrough, the transmitting head and assembly is rotated in a counterclockwise direction as about axis 9112 as viewed in Figs. 91, 92, 93 and 94. The transmitting head 2806 as viewed in Fig. 28, however, will be rotated in a clockwise direction by the reception and perforation of signals in tape 2805. The showing in Fig. 28 is a diagrammatic showing as will be readily understood by those skilled in the art to enable the operation of the system to be more readily understood.

As the transmitting head 9106 moves to the left, as shown in Figs. 91 through 94 inclusive, the lever 9168 will rotate in a counterclockwise direction and rest upon the tape between the transmitting head 9106 and the perforating portion of the receiving device. Lever 9168 will therefore push the tape down between these two portions of the apparatus and when the supply of perforated tape exceeds a predetermined quantity, the lever 9168 will engage the transmitting head 9106 and prevent its movement to the right until the supply of perforated tape between the perforator and transmitter becomes a predetermined minimum quantity, at which time the tape will lift lever 9168 out of engagement with the transmitting head 9106 and permit the transmitting head to move to the right and eventually come to rest against the receiving device after having first sensed the last code stored in the tape. When the transmitting head comes to rest against the receiving device, the extension 9174 of this assembly will depress pin 9173 and cause contacts 9121 to open. The opening of these contacts will stop the operation of the circuits and apparatus as will be described hereinafter, and thus prevent the tearing of the tape after the transmitting head has sensed the last character stored therein.

Connected to each one of the levers 9175 and associated sensing pins is a member 9107 provided with two extensions or prongs 9159 and 9160 as well as lug 9161 which cooperates with a cam mounted upon shaft 9153. Each of the corresponding members 9107 and 9175 is connected together by means of a pivot which is substantially on line with the axis 9112 so that the members 9175 may rotate with the assembly 9179 as described above under control of the supply of tape between the perforating position and the transmitting position and at the same time permit members 9107 to remain substantially sta-

tionary or to be actuated in accordance with perforations in the tape independently of the position of the assembly 9179. Shaft 9153 is controlled by means of a clutch magnet 9111 and armature 9113. When magnet 9111 is operated, the clutch engages shaft 9153 which is continuously rotating and causes the cams thereupon to make one or more revolutions. During the first portion of the revolution, the tape-advancing cams will cause the tape to be advanced one position through the transmitting head 9106. For a more detailed description of the manner in which the tape is advanced through the transmitting head, reference is made to the above-identified patent of Gubisch and also United States Patent 2,213,476, granted September 3, 1940, to Reiber, the disclosure of which patent is hereby made a part of this disclosure as if fully included herein. After the tape has been advanced by the tape-advancing mechanism, the cams 9181 through 9186 inclusive, will permit the corresponding lugs 9161 to move downward toward shaft 9153 and thus rotate members 9107 in a counterclockwise direction. Members 9107 in moving in a counterclockwise direction will cause the sensing levers 9175 to rise so that the sensing pins carried by the ends thereof will engage the tape. If the tape is perforated above any one of these levers, the pins will go through the perforation in the tape and allow lever 9175 to rise, whereas if the tape is not perforated, the lever 9175 will be restrained in substantially the same position as shown in the drawings. The levers 9175, the pins of which go through the perforations in the tape, will permit the members 9107 to rotate in a counterclockwise direction and thus assume the position in which the extension 9160 will be in line with the lower extension 9164 of the T levers 9108 whereas those members 9107 which are restrained in substantially the position shown in the drawing due to the fact that no perforation is present in the tape over their sensing pins will have the extension 9159 in line with the upper projection 9165 of the T levers 9108. Near the end of the revolution of shaft 9153 transfer lever 9156 will be rotated in a clockwise direction so that the T levers 9108 will engage and be rotated by either the upper or lower prong 9159 or 9160 of members 9107 depending upon whether or not the tape is perforated in the corresponding position. When the T levers rotate they cause the intermediate slide members 9110 to be moved either to their upper or lower positions. When no perforations are in the tape over the corresponding sensing pins, the slide member 9110 will be operated to its lower position whereas when perforations are in the tape over the corresponding sensing pin, the slide member 9110 will be operated to its upper position. Each slide member 9110 is provided with a projection 9158 which engages lever 9109. When the slide member is operated to its upper position, lever 9109 is rotated in a counterclockwise direction and causes contacts 9172 to be operated to their left-hand position whereas when the slide member 9110 is operated to its lower position it permits member 9109 to remain in or operated to the position shown in the drawing so that the contacts 9172 will be operated to their right-hand position.

In addition to the cams for controlling the members 9107 and for advancing the tape, two auxiliary cams are mounted upon shaft 9153 and rotated in unison with these other cams. These two auxiliary cams control two sets of contacts 9117 and 9116. Contacts 9117 and 9116 are em-

ployed to control the switching circuits as will be described hereinafter. Contacts 9117 are sometimes called the off-normal contacts, while contacts 9116 are sometimes called the distributor trip contacts. Fig. 95 shows the relative positions and shapes of the cams and followers of a typical machine suitable for operation in combination with this invention. It is to be understood that Fig. 95 is not intended to be a working drawing showing the exact contours of the cams. Fig. 95 is merely intended to show the cams and followers so that the relative times at which the various actions take place may be more readily understood.

The transmitting equipment is also provided with a second shaft 9151 which is provided with a number of cams shown in Fig. 96. These cams are similarly shown to illustrate the relative times at which various members of the equipment function. Cams 9191 through 9196 are provided with a bell crank follower 9157 which in turn controls the contacts 9150 in such a manner that contacts 1 through 5 close one after the other in succession. Cam 9196 controls a similar contact such that this contact is closed in the stop position. In addition to these cams, an auxiliary cam 9197 is provided which controls an auxiliary contact for controlling the switching circuits as will be described hereinafter. The shaft 9151 is continuously rotated from the same motor that rotates shaft 9153 and the cam drum carrying cams 9191 through 9197 is controlled through a clutch and a clutch magnet 9147 provided with the armature 9148. When magnet 9147 is energized, the clutch members are permitted to engage and rotate the cam drum with shaft 9151, whereas when magnet 9147 is released, clutch members are disengaged at the end of the revolution in progress and the cam stopped in the position shown in Fig. 96.

Provision is made for swinging the stop member 9158 in a clockwise direction to the dotted position shown in Fig. 93 so that tape may be readily inserted in the transmitting head 9106.

It is to be understood that the timing of the various elements is so arranged that a transmitter will transmit the last code combination stored in the tape. Thus, during a given cycle of operation, the tape is first advanced to a new sensing position in transmitting head 9106. If this is the last code combination stored in the tape, this advance in the transmitting head will bring it against the perforating portion of the receiving device as shown in Fig. 93 whereupon contacts 1921 will open. However, the release magnet 9111 had previously been operated to release shaft 9153 for rotation through one revolution before the transmitting assembly 9179 was rotated against the receiving device so that the cam barrel on shaft 9153 will continue rotation for one revolution. When the transmitting assembly 9179 is rotated against the perforating portion of the receiving device, contacts 9121 will open and interrupt the circuit of the release magnet 9111, thus preventing this magnet from releasing the cam drums mounted on shaft 9153 so long as transmitting head 9106 is against the perforating portion of the receiving instrument. After the tape has advanced one position, cams 9181 through 9186 will release the members 9107 and permit the sensing pins carried by levers 9175 to rise and sense the tape and position members 9107 in accordance with the perforations in the tape. Meantime one of the auxiliary cams has actuated the off-normal auxiliary contacts.

If members 9107 are positioned in accordance with the perforations in the tape, transfer cam 9187 will move the T levers 9165 to the right and position them in accordance with the setting of members 9107 and thus transfer the setting of members 9107 to the sliding members 9110. Members 9110 in turn set contacts 9172 in accordance with the perforations in the tape. At about this time the second auxiliary contacts or distributor trip contacts will be closed to energize the distributor magnet 9147 and permit cams 9191 through 9197 to rotate and transmit a code combination in accordance with the setting of contacts 9172 and thus in accordance with the perforations in the tape.

The circuit of the respective magnets 9111 and 9147 is controlled by additional circuits as will be described hereinafter. It should be understood that contacts 9172 remain in the position in which they are last set until reset in accordance with the perforations in the tape. Just before the cam barrel mounted on shaft 9153 comes to rest, lugs 9161 are raised by cams 9181 through 9186 and the sensing pins withdrawn from the tape, whereupon the cams come to rest and remain in this position until the transmitter control magnet 9111 is again operated. At this time the sets of contacts 9172 are positioned in accordance with the last perforations recorded in the tape and a short interval of time later when the cam drum carried by shaft 9151 comes to rest a code combination representing these signals will have been transmitted.

Discarding certain combinations

Returning now to the circuits which cooperate with the transmitting equipment shown in Figs. 91 through 96 inclusive, a similar equipment is represented in schematic form in Fig. 28. Here when the message is first received transmitting head 2806 will move to the right and permit contacts 2821 to close and complete a circuit for the operation of relay 3016 from battery through the winding of relay 3016 and its upper inner break contact, the lower inner break contacts of relay 3023, the lower inner break contacts of relay 2914, the center armature and lower break contact of relay 2913, the lower break contact of relay 2910 to ground through the closed contacts 2821. Contacts 2821 in closing also complete a circuit for operating relay 2915 from battery through the winding of relay 2915 to ground through the operated contacts 2821. Relay 2915 in operating completes an obvious circuit for operating relay 2916 and interrupts a special disconnecting circuit that will be described hereinafter.

Relay 3016 in operating completes a circuit for maintaining itself operated from battery through its winding and upper inner operated contacts to ground through the left-hand outer break contacts of relay 3110. Relay 3016 in operating completes a circuit for the operation of relay 3021 from battery through the winding of relay 3021, the upper outer break contacts of relay 2933 to ground through the lower center armature and front contact of relay 3016. Relay 3021 in operating partially conditions the circuits which will be described hereinafter.

The operation of relay 3016 completes a circuit for the operation of relay 2918 from battery through the winding of relay 2918, the upper outer break contacts of relay 2934 to ground through the front contact and center lower armature of relay 3016. Relay 2918 also partially conditions

and prepares certain circuits as will be described hereinafter.

Likewise, the operation of relay 3016 completes a circuit through the upper or biasing winding of relay 2919 which tends to maintain relay 2919 in the position shown in the drawing. The operation of relay 3016 also completes a circuit for the operation of the busy test relay 3017 from battery through the winding of relay 3017 and the upper break contacts of relay 3022 to ground through the front contact and center lower armature of relay 3016.

The operation of relay 3016 also completes a circuit for the operation of relay 3011 from battery through the winding of relay 3011, the upper outer break contacts of relay 2932, the lower break contacts of relay 3210, the lower break contacts of relay 3222 to ground through the front contact and center lower arm of relay 3016.

Relay 3016 in operating completes a circuit for the operation of the transmitter start magnet 2811 from battery through the winding of magnet 2811 over lead 2867 which extends through Figs. 29, 30, the center right-hand armature and break contact of relay 3110, the left-hand break contact of relay 3113, right-hand outer unoperated armature and break contact of relay 3112, left-hand break contact of relay 3115, the front contact and center upper arm of relay 3016, lower center armature and back contact of relay 2913, and lower break contact of relay 2910 to ground through the closed contacts 2821.

Magnet 2811 in operating releases the cam barrel 2853 or shaft 2853 for rotation through one revolution. At the beginning of this revolution the tape-advancing cams and apparatus causes tape 2805 to be advanced one position through the transmitting head 2806. Also near the beginning of this revolution of shaft 2853, cam 2819 will cause the off-normal auxiliary contacts 2817 to close. Contacts 2817 in closing complete a circuit for the operation of relay 3113 from battery through the winding of relay 3113, the upper outer operated contacts of relay 3016, the lower break contacts of relay 3013 to ground through the closed contacts 2817. Relay 3113 in operating completes a circuit for maintaining itself operated from battery through its winding and the upper outer operated contacts of relay 3016, through the right-hand operated contacts of relay 3113 to ground through the right-hand break contacts of relay 3115.

Relay 3113 in operating also interrupts the operating circuit of the transmitter clutch magnet 2811 and permits this magnet to release its armature 2813 so that the associated clutch will be disengaged at the end of the revolution of shaft 2853 and shaft 2853 stopped at the end of this revolution.

When tape 2805 has been advanced so that the next row of perforations is under the sensing pins of the transmitting head 2806, cams 1 through 5 and 2834 will permit the members 2807 to rotate in a clockwise direction as shown in Fig. 28. This will permit the sensing pins to sense the row of perforations in the tape and position members 2807 in accordance with the perforations in the tape. Inasmuch as tape is assumed to be present in the transmitting head, contacts 2855 will remain open because the sensing pin controlling them will engage the tape and be prevented from rising.

A short time after members 2807 have been positioned in accordance with the perforations in the tape, cam 2820 will rotate the levers 2856 in

a counterclockwise direction and move shaft 2822 to the left causing the T levers 2808 to engage the extensions 2859 or 2960 of members 2807 and position the sliding members 2810 in accordance with the perforations in the tape. By means of lugs 2858 the sliding members 2810 position the levers 2809 in accordance with the perforations in the tape and these levers in turn control the associated contacts. At about the time the contacts are positioned, cam 2818 will close contacts 2816. Contacts 2816 may close a short interval of time before members 2809 and associated contacts are finally positioned in accordance with the perforations in the tape. However, the contacts controlled by members 2809 are finally and fully positioned in accordance with the perforations in the tape before circuits through the contacts are completed because a number of things have to happen between the closing of contacts 2816 and the establishment of circuits through contacts controlled by members 2809.

Contacts 2816 in operating complete a circuit for the operation of the distributor magnet 2847 from battery through the winding of magnet 2847 to ground through the closed contacts 2816. The distributor magnet 2847 will therefore operate and attract its armature 2848 and release the distributor shaft 2851 for rotation through the revolution during which the cams 1 through 5 will close their associated contacts in sequence. However, at this time, circuits through these contacts are not fully established so that their closure is ineffective. Near the beginning of the revolution of the shaft 2851, cam 2849 will cause contacts 2850 to close.

Contacts 2850 in closing complete a circuit for the operation of relay 3112 from battery through the winding of relay 3112, the left-hand outer operated contacts of relay 3113, the upper break contacts of relay 3019 to ground over lead 2873 and through the closed contacts 2850.

A short interval of time later shaft 2853 will return to its initial starting position where it will be stopped by the released armature 2813 of the clutch magnet 2811. In addition, contacts 2817 and 2816 will be open. However, relay 3113 is locked operated independently of contacts 2817 as described above so that relay 3113 remains operated at this time. Contacts 2816 in opening interrupt the circuit of the distributor magnet 2847 and release this magnet so that its armature will engage the clutch at the end of the revolution of shaft 2851 and cause it to stop.

Meantime, however, the operation of relay 3112 partially prepares a circuit for the operation of the discard relay 3018.

Under the assumed conditions it will be recalled that the first signals transmitted from the subscriber's station were one or more letters signals followed by a figures and then an H signal. These signals were followed by additional letters signals after which the code combination DD was transmitted. All of these signals will be recorded in tape 2805. Consequently the first character sensed by the sensing fingers will be a letters signal which will permit members 2807 to be operated in a clockwise direction as viewed in Fig. 28. Consequently, the extensions 2860 will engage the lower projection of the T members 2808 and cause them to be rotated in a counterclockwise direction when cam 2820 causes the shaft 2822 to move to the left. Under these conditions the sliding members 2810 will be moved to their upper position where they will cause members 2809 to be rotated in a clockwise direction and operate the associ-

ated contacts. With these contacts all operated, a circuit is completed from ground through the right-hand operated contacts of each of the sets from 5 through 1 over lead 2868 through the right-hand inner break contacts of 3110 and the left-hand break contact and center left-hand armature of relay 3111, right-hand inner operated contacts of relay 3112, lower break contacts of relay 2931 to battery through the winding of discard relay 3018 thus energizing this relay. The operation of discard relay 3018 at this time completes a circuit for the operation of the reset relay 3115 from battery through the winding of relay 3115 to ground through the lower outer operated contacts of relay 3018. The operation of relay 3115 interrupts the locking circuit of relay 3113 and thus permits this relay to release. The release of relay 3113 interrupts the operating circuit of relay 3112 and permits this relay to release. The release of relay 3112 interrupts the operating circuit of the discard relay 3018. The release of relay 3018 interrupts the operating circuit of the reset relay 3115. The release of relays 3115, 3112 and 3113 again completes the circuit traced above for operating the transmitter clutch magnet 2811 which thereupon attracts its armature and releases shaft 2853 for rotation through a second revolution. During this second revolution contacts 2817 will again close and complete a circuit for the operation of relay 3113 as described above. During this second revolution contacts 2816 will also close and again complete a circuit for operating the distributor magnet 2847 which will permit shaft 2851 to rotate through a second revolution. During the second revolution of shaft 2853 the sensing fingers will sense a second code combination. If this code combination is a letters code, the above cycle of operations will be repeated. Thereafter, the cycle will again be repeated so long as letters signals perforated in the tape 2805 are over the sensing pins of the transmitting head 2806. Under the assumed conditions a figures signal is perforated in tape 2805. When the figures signal arrives over the sensing pins it will cause the contacts controlled by members 2809 to be set in accordance with the code combination representing the figures signal, namely, the first two and the fourth and fifth members 2810 will be operated to their upper position while the middle or third member 2810 will be operated to its lower position. Under these circumstances, a circuit is completed from ground through the right-hand operated contacts of a No. 5 set of contacts, the operated right-hand contacts of a No. 4 set, right-hand operated contacts of sets No. 1 and No. 2, and right-hand break contacts of a No. 3 set over lead 2870 through the left-hand inner break contacts of relay 3110, the break contact and center left armature of relay 3111, the right-hand inner operated contacts of relay 3112, lower break contacts of relay 2931 to battery through the winding of relay 3018 thus again operating this relay and causing the figures code combination to be discarded in a manner similar to that described above with reference to the letters signal.

In a similar manner circuits may be traced through the contacts controlled by members 2809 when they are positioned in accordance with the code combinations representing letters, figures, H or Z signals and the blank code combination, that is, a code combination in which all of the elements are of a spacing character, for causing these code combinations to be discarded or ignored by the transmitting equipment. If at any time dur-

ing the discarding of these signals the supply of perforated tape 2805 becomes exhausted, contacts 2821 will open after the equipment has started to sense the last character recorded in the tape. When contacts 2821 open they interrupt the operating circuit of magnet 2811 and thus prevent the reoperation of this magnet. Consequently the circuit will then remain in this condition until additional signals are received and recorded in tape 2805. If there is a supply of tape with any of the signals named above or recorded in it when power is first applied to the system, the circuit will operate as described above to discard all of these signals and eventually come to rest with transmitting head 2806 against the perforating portion of the receiving device 2802.

Then when more signals are received and recorded in tape 2805, contacts 2821 will reclose and again complete a circuit of magnet 2811 and cause the circuits to operate as described above.

Selecting a transmission path

When a code combination other than the combination representing the blank, letters, figures, H or Z signals arrive over the sensing pins and the sliding members 2810 positioned in accordance therewith, they will cause the associated contacts to be positioned in accordance with this code combination but no circuit will be completed through the sets of contacts controlled by member 2809 for the operation of the discard relay 3018. Consequently, this relay will not operate. Instead when contacts 2850 open near the end of the revolution of shaft 2851 they will complete a circuit for operating relay 3019 and maintaining relay 3112 operated from ground through the winding of relay 3019, the right-hand outer operated contacts of relay 3112, the left-hand outer operated contacts of relay 3113 to battery through the winding of relay 3112. The operation of relay 3019 completes a circuit for the operation of relay 3222 from battery through the winding of relay 3222 and over lead 3223 which extends through Fig. 31, the upper break contacts of relay 3014, the lower inner operated contacts of relay 3019, the upper inner break contacts of relay 2930, the upper outer break contacts of relay 2931, the lower inner break contacts of relay 3018, the right-hand armature and break contacts of relay 3111 to ground through the lower front contacts and center lower armature of relay 3016. Relay 3222 in operating completes a circuit for maintaining itself operated from battery through its winding over lead 3223, the upper break contacts of relay 3014, the lower outer operated contacts of relay 3222, the upper inner break contacts of relay 2930, the upper outer break contacts of relay 2931, the lower inner break contacts of relay 3018 and the right-hand armature and break contacts of relay 3111 to ground through the center set of lower operated contacts of relay 3016.

The operation of relay 3222 extends the circuits from the left-hand contacts controlled by members 2809 over leads 1 through 5 of the group of leads 2869 through Figs. 29, 30 and 31, the upper operated contacts of relay 3222 to the windings of the respective relays 3216, 3217, 3218, 3221, 3219 and 3220. These six relays are sometimes designated the "first fan" relays. In other words, these relays are employed to make a selection of one of a plurality of circuits in accordance with received signals as will be described hereinafter. Under the assumed conditions the first code combination was a letter D signal. The letter D sig-

nal is represented by a code combination in which the first and fourth impulses are marking. Consequently, the first and fourth set of contacts controlled by members 2809 will be operated to their right-hand positions, while the contacts controlled by the second, third and fifth members will be operated to their left-hand positions. Under these conditions relays 3216 and 319 will be operated while relays F2, 3, 6 and 5 will remain released. Relays F1 and F4 in operating complete a circuit for maintaining themselves operated from battery through their winding and upper inner operated contacts to lead 3224 through the upper break contacts of relay 3018 to ground through the lower outer break contacts of relay 3015.

The operation of relay 3222 completes a circuit for the operation of the reset relay 3115 from battery through the winding of relay 3115 to ground through the operated front contact and center lower armature of relay 3222 and the operated front contact and center lower armature of relay 3016. Relay 3115 in operating interrupts the locking circuit of relay 3113 and permits this relay to release. Relay 3113 in releasing interrupts the locking circuits of relay 3112 and 3019 and permits these relays to release.

The operation of relay 3222 interrupts the operating circuit of relay 3011 and permits this relay to release. Relay 3011 is somewhat slow in releasing so that it requires an appreciable time interval for this relay to release. The slow release time of relay 3011 is provided to insure that relays 3216 through 3221 have sufficient time to become fully operated and lock.

The operation of relay 3222 extends the circuit of relay 3022 to the sequence circuit and then to the line circuit shown in Fig. 90 from battery through the winding of relay 3022, high resistance 3026, the upper inner break contacts of relays 2914 and 2913, the upper outer operated contacts of relay 3222, the lower inner operated contacts of relay 3016 over lead 3225 which extends from Fig. 30 through Figs. 31, 32, 45, 57, 63, 71, 79, and 86 to Fig. 90.

If the sequence circuit shown in Fig. 90 is busy, relay 9016 will be operated as will be described hereinafter. Under these circumstances the circuits in Figs. 28, 29, 30, 31, 32, 33 and 34 remain in the above described condition until relay 9016 releases when the sequence circuit becomes idle. At this time lead 3225 is extended through the back contact and middle left-hand armature of relay 9016 to ground through the winding of relay 9023.

As pointed out above, relay 3017 is operated at this time so that high resistance 3026 is connected in series with the above described circuit extending from battery through the winding of relay 3022 to ground through the winding of relay 9023. This high resistance is of such a value as to permit the operation of relay 3022 but prevent the operation of relay 9023. Relay 3022 in operating transfers the circuit of relay 3017 from ground through the lower center armature and front contact of relay 3016, to ground through the lower operated contacts of relay 3011. As pointed out above, the circuit of relay 3011 is interrupted when relay 3222 operates. Relay 3011, however, is slow in releasing and does not immediately release. Upon the release of relay 3011 the circuit of relay 3017 is transferred to the apex of the selecting circuit through the first group of fan relays 3216 through 3221 inclusive. Under the conditions assumed, above relay 3017 will re-

main operated in this circuit and complete circuits for the operation of relays 3313 and 3025 from battery through the winding of relay 3017 through the operated contacts of relay 3022, the lower break contacts of relay 3011, the lower break contacts of relay 2934, the upper outer operated contacts of relay 3021, the lower inner break contacts of relay 2931 and lower outer break contacts of relay 2930, the lower break contacts of relay 3014 over lead 3027 which extends through Fig. 31 to the apex of the contacts of the fan relays 3216 through 3221, inclusive. It will be recalled that relays 3216 and 3219 are operated at this time due to the fact that the D signal was recorded in the tape 2805 and sensed by the transmitting head 2806. The other relays 3217, 3218, 3220 and 3221 are released at this time. Consequently, lead 3027 extends through the fourth armature from the top and break contact of relay 3220, fourth armature from the top and front contacts of relay 3219, third armature from the top and operated contacts of relay 3216, second armature from the bottom and back contacts of relay 3217, the break contacts of relay 3221 over the D lead through the cross connection blocks 3316 and 3317, winding of relay 3313, lead 3318 which extends through Figs. 32, 31 to ground through the winding of relay 3025.

The operation of relay 3025 completes a circuit for the operation of relay 3014 from battery through the winding of relay 3014 and the operated contacts of relay 3025 to ground through the front contacts and lower center armature of relay 3016. The operation of relay 3014 completes a circuit for maintaining relays 3025 and 3313 operated from battery through its lower outer operated contacts over lead 3027 extending through the contacts of relays 3216 through 3221, as described above, to ground through the windings of relays 3313 and 3025.

The sequence circuit shown in Fig. 90 must remain idle until relay 3014 operates and completes locking circuits of relays 3025 and 3313 as described above. Otherwise relay 3022 will release and interrupt the operating circuit of relays 3025 and 3313 prior to the establishment of their locking circuit. If this happens the circuit will then wait until the sequence circuit again becomes idle whereupon the above described circuits are reestablished and relay 3014 eventually operated and the locking circuits of relays 3025 and 3313 established. After relay 3014 has operated and completed locking circuits for relays 3313 and 3025 the sequence circuit may become busy and cause relay 3022 to release without interfering with or preventing the further operation of the circuits at this time as will now be described.

The operation of relay 3014, as described above, transfers the operating circuit of relay 3017 from the apex lead 3027, as described above, to ground through the lower inner armature of relay 3210 and back contact, thus maintaining relay 3017 operated. The circuit for maintaining relay 3017 operated at this time now extends from battery through the winding of relay 3017, the operated contacts of relay 3022 (assuming the sequence circuit remains idle), the lower break contacts of relay 3011, the lower break contacts of relay 2934, the upper outer operated contacts of relay 3021, the lower break contacts of relays 2931 and 2930, the lower inner operated contacts of relay 3014 to ground through the lower inner armature and back contact of relay 3210. If the sequence circuit should become busy at this time, relay 3022

will release and transfer the circuit of relay 3017 to ground through the front contact and center lower armature of relay 3016.

The operation of relay 3014 interrupts the locking circuit of relay 3222 and permits this relay to release. The release of relay 3222 reestablishes the circuit through the winding of relay 3011 from battery through the winding of relay 3011, the upper break contacts of relay 2932, the lower outer break contacts of relay 3210 and the lower inner break contacts of relay 3222 to ground through the lower operated contact and middle armature of relay 3016. Relay 3011 in operating transfers the winding of relay 3017 from ground through the lower inner break contacts of relay 3210 to ground through the lower operated contacts of relay 3011. The release of relay 3222 interrupts the circuit of relay 3022 extending to the relay 3023 of the sequence circuit and thus permits relay 3022 to release. Release of relay 3022 transfers the circuit of relay 3017 to ground through the front contact and middle lower armature of relay 3016. During this entire time, relay 3017 is maintained operated and if necessary it may be retarded to insure that it remains operated.

The release of relay 3222 disconnects the windings of relays 3216 through 3221 from the conductors 1 through 5 of the group or cable 2869 which extend to the contacts controlled by elements 2809 which elements are in turn controlled by the perforations in the tape. Consequently, the relays 3216 through 3221 will not be further affected by the operation or position of these groups of contacts at this time.

In addition, the release of relay 3222 interrupts the operating circuit of relay 3115 and permits this relay to release. The release of relay 3115 reestablishes the operating circuit of the transmitter clutch magnet 2811, as described above. The operation of the clutch magnet 2811 at this time releases the cam shaft or drum 2853 for rotation through a second revolution. Near the beginning of this second revolution contacts 2817 will close and complete a circuit for the operation of relay 3113 as described above. Relay 3113 in operating completes a circuit for maintaining itself operated under control of relays 3016 and 3115. The operation of relay 3113 in addition interrupts the operating circuit of the transmitter start magnet 2811 and thus permits this magnet to release its armature so that the shaft or cam barrel 2853 will come to rest at the end of the second revolution thereof.

During the first portion of the revolution of the shaft 2853, the tape 2805 is advanced one space through the transmitting head 2806. Thereafter members 2807 are released and the perforations in the tape sensed by means of the sensing pins which pins in turn control the setting of the members 2807 in accordance with the perforations in the tape over the pins at this time. A short interval of time thereafter the settings of members 2807 are transferred to the sliding members 2810 due to the action of the T levers 2808 and cam 2820 and lever 2856. This second code combination will again be the letter D, since the two D signals were recorded in tape 2805 at this time as the directing character or address portion of the first message directed to station 269. This means that the No. 1 and No. 4 elements 2809 will be operated to their marking or right-hand position, while the No. 2, No. 3 and No. 5 elements 2809 will be operated to their left-hand or spacing positions. At about

the time these elements are operated to their respective positions under control of the perforations in the tape 2805, contacts 2816 close and complete a circuit for the operation of the distributor start magnet 2847. The operation of this magnet releases the distributor cam shaft 2851 for rotation through a second revolution. As before, the contacts 1 through 5 controlled by this cam shaft are not connected to any transmitting circuit during this second rotation of shaft 2851. However, near the beginning of this second revolution, cam 2849 will cause contacts 2850 to close and complete a circuit for the operation of relay 3112, as described above. Relay 3112 in operating extends the circuit of the discard relay 3018 to the contacts controlled by members 2809, as described above. Since the second address code combination, that is, the code combination following the code combination representing the first letter D recorded in the tape, is not a discard code combination, that is, it is not a blank, a letters, H figures or a Z code combination, relay 3018 will not operate. If, however, this code combination had been one of these discard code combinations, relay 3018 could operate, as described above, and in operating would interrupt the locking circuit of relays 3216 and 3219 and permit these relays to release. The circuits would then be returned to the condition described above prior to the response to the first letter D signal stored in the tape. Thereafter the circuit would operate, as described above, during the discarding of code combinations stored in the tape.

Under the assumed conditions, however, relay 3018 does not operate. Consequently, relays 3112 and 3113 do not release during the closure of contacts 2850. Near the end of the second revolution of the shaft 2851, contacts 2850 will open and permit relay 3019 to operate in series with relay 3112 and maintain relay 3112 operated.

The operation of relay 3019 at this time completes a circuit for the operation of relay 3210 from battery through the winding of relay 3210, the upper operated contacts of relay 3014, the lower inner operated contacts of relay 3019, the upper inner break contacts of relay 2930, the upper outer break contacts of relay 2931, the lower break contacts of relay 3018, the third armature from the right and break contact of relay 3111 to ground through the front contact and center lower armature of relay 3016.

The operation of relay 3210 connects the windings of relays 3211 through 3215 to leads 1 through 5 of the group 2869 extending through Figs. 31, 30 and 29 to the contacts 1 through 5 controlled by members 2809 which members are positioned in accordance with the perforations in tape 2805. Under the assumed conditions, the first and fourth groups of these contacts will be operated to their marking position. Consequently, relays 3211 and 3214 will be operated from battery through their windings over conductors 1 and 4 of the group 2869 through the right-hand contacts of the No. 1 and No. 4 group controlled by members 2809 to ground through the break contacts and center upper armature of relay 3023.

Relay 3210 in operating again interrupts the operating circuit of relay 3011. This relay, however, does not immediately release because it is a slow-release relay. The operation of relay 3210 again extends the circuit of relay 3022 through the high resistance 3026 to the sequence circuit shown in Fig. 90 over lead 3225, as described above. If the sequence circuit is busy, relay 3016

will be operated and the circuits will remain in the above described condition until the sequence circuit becomes idle and relay 9016 releases. At this time, lead 3225 extends through the back contact and center left-hand armature of relay 9016 to ground through the winding of relay 9023. Due to the fact that high resistance 3026 is connected in this circuit, relay 9023 will not operate at this time but relay 3022 will operate.

The operation of relay 3022, the release of relay 3011, and the operation of relays 3210, 3211 and 3214 extend the circuit of the busy test relay 3017 to the busy test and control lead 3319 of the party line 260. If this party line is busy, that is, if neither reperforator individual thereto is available to receive the message, this lead will be grounded and maintain relay 3017 operated. This circuit may be traced from battery through the winding of relay 3017, the upper operated contacts of relay 3022, the lower break contacts of relay 3011, the lower break contacts of relay 2934, the upper outer operated contacts of relay 3021, the lower inner break contacts of relay 2931, the lower break contacts 2930, the lower inner operated contacts of relay 3014 over lead 3028 which extends through Fig. 31 through the lower inner operated contacts of relay 3210, the upper inner break contacts of relay 3215, front contact and third armature from the top of relay 3214, the lower outer operated contacts of relay 3211, the upper outer break contacts of relay 3212 and upper inner break contacts of relay 3213, the D lead through the center set of upper operated contacts of relay 3313 through the cross connection terminal blocks 3320 and 3321, break contacts of key 3314, lead 3319 to Fig. 46 to ground through contacts of relays 4610 or 4610 and 4611 if the circuit is busy as will be described hereinafter. If at any time during the time the outgoing line circuit of party line 260 is busy the sequence circuit also becomes busy. Relay 9016 thereof will operate and interrupt the operating circuit of relay 3022 thus transferring the winding of relay 3017 from the ground connected to lead 3319 by the outgoing line circuit of party line 260 to ground through the front contact and center lower armature of relay 3016. When the sequence circuit again becomes idle, the winding of relay 3017 is again transferred back to lead 3319 of the outgoing line circuit of party line 260. So long as this party line remains busy, relay 3017 will remain operated and the circuits remain in the condition described above.

When both the outgoing line circuit of the party line 260 shown in Figs. 46 and 45, and also the sequence circuit shown in Fig. 90, become idle, relay 3022 will become operated and relay 3017 will thereafter release.

Relay 3017 in releasing extends conductor 3225 to the winding of relay 2913. This path may be traced from conductor 3225 through the lower inner operated contacts of relay 3016, the lower center armature and front contact of relay 3210, the upper break contact of relay 3017, the lower outer break contact of relay 2914, lower inner break contact of relay 2913, the center lower armature and back contact of relay 2914 to battery through the winding of relay 2913. Relay 2913 is a marginal relay and will not operate due to the current flowing through its windings under these conditions provided the resistance of the relay 9023 is connected between conductor 3225 and ground. As will be readily appreciated by those skilled in the art, if a trouble or direct ground is connected to lead 3225, relay 3022 will

operate without waiting until the sequence circuit shown on Fig. 90 is idle and may cause improper operation of the switching circuits so that improper connections may be made and the proper transmission of messages interfered with. In an effort to prevent such improper operation of the circuits, lead 3225 is tested for direct ground at this time by relay 2913. If direct ground is connected to this lead due to some trouble condition, relay 2913 will operate and complete a circuit for maintaining itself operated from battery through its winding and center set lower break contacts of relay 2914 to ground through its lower inner operated contacts. Relay 2913 in operating interrupts the circuits from contacts 2821 thus preventing the further operation of the transmitting equipment shown in Fig. 28. Relay 2913 in operating also connects ground to lead 2936 to indicate trouble condition. When ground is connected to lead 2936 it will cause various lamps to function and if desired will cause certain bells to ring or gongs to sound. Thereafter the circuits remain in this condition until an attendant has an opportunity to determine the trouble and operate key 2834 which causes relay 2914 to operate and interrupt the locking circuit of relay 2913. Upon release of key 2834 relay 2914 will release as will be described hereinafter and permit the operation of the circuits to continue. Under the assumed condition, however, no trouble ground will be connected to the lead 3225 so that relay 2913 will not operate.

Relay 3017 in releasing short-circuits high resistance 3026 and increases the current flowing through the winding of relays 3022 and 9023 in the circuit described above so that relay 9023 will receive sufficient current to operate. Relay 9023 in operating completes a circuit for maintaining itself operated from ground through its winding and inner operated contacts, the right-hand inner break contacts of relays 9024 and 9025, the left-hand break contacts of relays 9025 and 9024, the left-hand operated contact of relay 9023 to battery through the winding of relay 3022 over lead 3225 which extends from Fig. 90 through Figs. 36, 79, 71, 63, 57, 45, 32 and 31 as described above.

The operation of relay 9023 interrupts the operating circuits of relays 9010 and 9011, thus permitting these relays to release. Relay 9010 is somewhat slow in releasing to permit sufficient time for relays 9021 through 9025 to have sufficient time to release in case more than one of them is operated as will be described hereinafter. Relay 9011 in releasing completes a circuit for operating relay 9017 which relay in turn in operating completes a circuit for the operation of relay 9016. Relay 9016 operates and interrupts the operating circuit of all the relays 9021 through 9025 thus preventing the operation of any of these relays and also preventing the operation of any of the relays corresponding to relay 3022 in the other switching circuits. Relays 3022 and 9023 however, do not release upon the operation of relay 9016 because they are maintained operated in a locking circuit as described above. The operation of relay 9016 together with the release of relay 9010 complete a circuit for the operation of relay 9018 from battery through the winding of relay 9018, the right-hand outer operated contacts of relay 9016 to ground through the left-hand break contacts of relay 9010.

The release of relays 9010 and 9011 interrupts the circuit from battery to the upper terminal of condenser 9026 whereupon this terminal starts to discharge through high resistance 9027. The

time constants of these circuits are such that sufficiently positive potential will be maintained on the grid of tube 9020 for a sufficiently long period of time to maintain relay 9012 operated which in turn maintains relay 9013 operated, during the time normally employed to establish connection through the system.

In case the connection is not established within some predetermined limit, as for example, three seconds, the positive charge or potential of the upper terminal of condenser 9026 falls to such a value that relay 9012 will release and in turn release relays 9013 and 9014. Relay 9013 in releasing will apply direct ground to lead 3225 from ground through the right-hand break contacts of relays 9013 and 9011, the left-hand break contacts of relays 9025 and 9024 and the left-hand operated contacts of relay 9023. The application of direct ground to lead 3225 at this time increases the current flowing over this lead sufficiently to cause relay 2913 to operate in a circuit extending from lead 3225 through the lower inner operated contacts of relay 3016, the center set of lower operated contacts of relay 3210, the upper break contacts of relay 3017, the lower center break contacts of relay 2914, the lower inner break contacts of relay 2913, the center set of lower break contacts of relay 2914 to battery through the winding of relay 2913.

In addition, relay 3022 is maintained operated due to the direct ground connected to lead 3225 in its operated circuit as described above.

The operation of relay 2913 at this time completes a circuit for maintaining itself operated from battery through its winding and the center set of lower break contacts of relay 2914 to ground through the lower inner operated contacts of relay 2913. The operation of relay 2913 interrupts the circuit of the transmitter start magnet 2811 and thus prevents this magnet from further operating to cause further selection or transmission. The operation of relay 2913, in addition, completes an obvious circuit for lighting lamp 2912, thus indicating a trouble condition in a particular circuit which failed to establish connection in the predetermined time interval.

The operation of relay 2913, in addition, connects ground to the alarm lead 2936 extending to the alarm circuit which causes a trouble indication to be indicated and attracts the attention of the attendants in any suitable way as described herein.

The operation of relay 2913 interrupts the circuits from battery through the winding of relay 3022 and also from battery through the winding of relay 2913 to the conductor 3225. The disconnection of these batteries through their respective windings from lead 3225, together with application of ground thereto by the release of relay 9013 causes relay 9023 to release, first, because its winding is short-circuited and, second, because the operating battery is removed therefrom. The release of relay 9023 interrupts the battery connected to lead 3226 which permits magnet 3401 to release and, in turn, release various relays of the director circuit, as described hereinafter.

The release of relay 9023 completes a circuit for the operation of relay 9011 from battery through the winding of relay 9011, the left-hand outer break contacts of relays 9021 through 9025 to ground through the right-hand break contacts of relays 9011 and 9013. The operation of relay 9011 removes the short circuit from around the winding of relay 9010 and permits this relay to operate in series with relay 9011 and thereby re-

store the sequence circuit of Fig. 90 to its address condition.

However, in case a trouble is due to an open circuit through the right-hand or left-hand break contacts of relays 9021 through 9025, the circuit will not be restored to its normal condition because relays 9010 and 9011 will not operate.

Thus the continuity of the circuit of relays 9010 and 9011 is continually checked or tested because if either of these relays or both of them remain released for more than the time delay period for discharging condenser 9026, a trouble condition will be registered to attract the attention of the attendant or maintenance force so that this trouble condition may be readily corrected. This is highly desirable because a trouble in these contacts will prevent the proper operation of the switching circuits and thus prevent the transmission of any messages through the system.

During the time relays 9010 and 9011 or either of them remain released, relay 9017 is maintained operated and holds relay 9016 operated thus maintaining the sequence circuit busy and preventing any of the director circuits from using it and attempting to establish a connection through the crossbar switch.

Returning now to the release of relay 9014, as described above, this relay in releasing completes an obvious circuit for the operation of relay 9015. Relay 9015 in operating completes an obvious circuit for lighting the lamp 8921 and the operation of the pilot relay 8922. In addition, the operation of relay 9015 completes a circuit for the operation of relay 8912 which causes the audible signal 8916 to operate as described hereinafter.

The operation of the key 8920 completes a circuit for the operation of relay 9019 which will remove ground from the operating circuit of relay 8912 and thus silences the audible signal as described hereinafter.

The attendant may restore the director circuits to their operated condition, after having first reset the tape in the sensing head 2806, if necessary, and remedied any other trouble condition, by momentary operation of key 2834 which causes relay 2914 to operate and interrupt the locking circuit of relay 2913. The release of relay 2913, together with the subsequent release of relay 2914 will permit the circuits to operate in a normal manner as described herein, assuming, of course, that the original trouble condition has been corrected and no further troubles encountered.

Returning now to the operation of the system under normal conditions, relay 9018 in operating completes a circuit for maintaining relay 9016 operated and also completes a circuit for the operation of the magnet 3401 from battery through the right-hand inner operated contacts of relays 9018 and 9016 and right-hand outer operated contacts of relay 9023 over lead 3226 which extends from Fig. 90 through Figs. 86, 79, 71, 63, 57, 45, 32, 33 and 34 to ground through the winding of magnet 3401.

Magnet 3401 is the horizontal or selecting magnet of the cross-bar switch and is associated with the directing circuits of the party line 210. The operation of this magnet conditions the horizontal row of contacts so that the particular group of these contacts will be actuated when one of the vertical magnets is operated as described hereinafter.

The operation of the horizontal magnet 3401 completes a circuit for the operation of relay 2934 from battery through the winding of relay 2934 and lead 2935 which extends from Fig. 29 through

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Figs. 30, 31, 32, 33 and 34 to ground through the operated contacts of magnet 3401.

Relay 2934 in operating interrupts the operating circuit of relay 2918. Relay 2918 is a slow release relay and does not immediately release.

The operation of relay 2934 transfers the circuit of lead 3319 from the winding of relay 3017 to the windings of relays 2919 and 2917. At this time this circuit may be traced from ground through the lower winding of relay 2919, winding of relay 2917, the middle set of upper break contacts of relay 2933, lower operated contacts of relay 2934, the upper operated contacts of relay 3021, the lower inner break contacts of relay 2931, the lower break contacts of relay 2930, the lower inner operated contacts of relay 3014, lead 3023 which extends through Fig. 31, the lower inner operated contacts of relay 3210, the upper inner break contacts of relay 3215, the front contact and third armature from the top of relay 3214, the lower outer operated contacts of relay 3211, the upper outer break contacts of relay 3212 and the upper inner break contacts of relay 3213, the center armature and front contact of relay 3313 through the contacts of key 3314, lead 3319, through the lower break contacts of relays 4610 and 4611 to battery through resistance 4640 and also to battery through the upper break contacts of relay 4614 and lead 4713 which extends through Figs. 47, 59, 65, 73, 81 and 88 to the vertical magnet 8842.

Relays 2919 and 2917 are connected in series with this circuit through all of the contacts described above to test first to make sure that the circuit is completed and second to make sure that the impedance to battery is not abnormally low or the potential of the battery abnormally high due, for example, to the fact that the windings of two or more hold magnets such as magnet 8842 are not crossed or connected together or connected to some other source of potential due to some trouble or improper operation of the circuits.

As will be readily appreciated by those skilled in the art, the selecting and busy test lead 3319 is of considerable importance and it is highly essential that its continuity be ascertained prior to transmitting signals because if the circuit is interrupted any place due to dirty contacts or broken wires or for any other reason the corresponding vertical magnet will not be operated and consequently a message will be lost. The resistances of the windings, relays 2919 and 2917 and the vertical magnet 8842 and the value of resistance 4640, as well as the adjustment of these relays are such that if the circuit is complete, magnet 8812 and relay 2919 will not operate whereas relay 2917 will operate. If the path is not completed and continuous, none of the relays will operate and if the circuits of two hold magnets, such as magnet 8842, are crossed or connected together to lead 3319, both relays 2919 and 2917 will operate but neither of the hold magnets 8842 or the other hold magnets connected in parallel therewith to lead 3319 will operate.

If two hold magnets are connected in parallel to lead 3319, relay 2919 will operate and complete a circuit for the operation of relay 2913 from battery through the winding of relay 2913, the center set of lower break contacts of relay 2914, the left-hand contact and armature of relay 2919 to ground through the upper operated contacts of relay 2934 and the center set of lower operated contacts of relay 3016. The operation of relay 2913 interrupts the operation of the selecting

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circuits by interrupting the circuit from contacts 2821 and thus prevents the further operation of the transmitting apparatus shown in Fig. 28. The operation of relay 2913 interrupts the circuit of relay 3022 and 9023 by interrupting the circuit traced above over lead 3225. The release of relay 9023 restores the circuits shown in Fig. 90 to their normal condition so they will be available for use in establishing other paths. The operation of relay 2913 also causes suitable lamps, alarms or other indicators to function to attract the attention of an attendant so that the cause of the trouble may be determined and eliminated after which the circuits will be restored to their proper operation conditions.

If the lead 3319 is open at any place neither relay 2919 nor relay 2917 will operate and under these conditions the message will be routed to the miscellaneous intercept equipment as will be described hereinafter.

Assuming that there are no trouble conditions present and that lead 3319 extends to the single vertical magnet 8842 and that the path is continuous, relay 2917 will operate and complete a circuit for the operation of relay 2933 from battery through the winding of relay 2933, the operated contacts of relay 2917, the right-hand contact and armature of relay 2919 and the upper operated contacts of relay 2934 to ground through the center lower operated contacts of relay 3016.

The operation of relay 2933 completes a circuit for maintaining itself operated from battery through its winding and second armature from the top and front contact, the upper operated contacts of relay 2934 to ground through the center set of lower operated contacts of relay 3016. The operation of relay 2933 interrupts the circuit through the winding of relay 3021 and permits this relay to release. Relay 3021 is slow in releasing, however, and does not immediately release.

Meantime, the operation of relay 2933 interrupts the circuit from lead 3319 through the winding of relays 2917 and 2919 thus permitting relay 2917 to release. In addition, the operation of relay 2933 connects direct ground to lead 3319 which causes the operation of the vertical hold magnet 8842 of the crossbar switch. The operation of this magnet at this time, during which time the horizontal magnet 3401 is operated, causes the group of contacts of the cross-bar switch 3471 through 3476 inclusive to close. The operation of the vertical magnet 8842 connects ground to lead 4715 which extends from Fig. 88 through Figs. 81, 73, 65, 59, and 47 through the lower break contacts of relay 4614 to battery through the winding of relay 4613. Relay 4613 is operated by current flowing in this circuit including its winding and in operating connects ground to lead 4716 extending from Fig. 46 to Fig. 47 to Fig. 34, the operated contacts 3474, lead 3416 through the right-hand outer break contacts of relay 3110, the lower operated contacts of relay 2933 to battery through the winding of relay 3111. Relay 3111 operates due to current flowing in this circuit through its winding.

The operation of relay 3111 completes a circuit for maintaining itself operated from battery through its winding and left-hand inner operated contacts, the right-hand outer break contacts of relay 3110, the right-hand outer operated contacts of relay 3111 over lead 3417 to ground through the operated contacts 3476. The operation of relay 3111 completes a circuit for

the operation of relay 4614 from battery through the winding of relay 4614, resistance 4628, lead 4714 which extends from Fig. 46 to Figs. 47 and 34, contacts 3472, lead 3414 which extends from Fig. 34 through Figs. 33 and 32 to ground through the winding of relay 3125 and the left-hand outer operated contacts of relay 3111. Relay 3125 is a manual relay and will not operate in series with resistance 4628. Relay 4614 however, does operate in this circuit in series with resistance 4628.

The operation of relay 4614 completes a circuit for holding the vertical selector magnet 8842 of the cross-bar switch operated from ground through the upper operated contacts of relay 4614 over lead 4713 which extends from Fig. 46 through Figs. 47, 59, 65, 73, 81, and 88 to battery through the winding of the vertical magnet 8842.

The operation of relay 4614 transfers the circuit through the winding of relay 4613 from lead 4715 extending to ground through the operated contacts of the hold magnet 8842 to lead 3319 in a circuit extending from battery through the winding of relay 4613 the lower operated contacts of relay 4614 and the upper operated contacts of relay 4613, the lower break contacts of relays 4611 and 4610 over lead 3319 which extends to ground through the upper inner operated contacts of relay 2933 as described above. Relay 4613 will be maintained operated by current flowing in the above circuit.

The operation of relay 3111 interrupts the operating circuit of relay 3210 and permits this relay to release. The release of relay 3210 disconnects the windings of relays 3211 through 3215 from the conductors of cable 2959 extending to the left-hand contacts of the contact groups 1 through 5 controlled by members 2809 and permits relays 3211 and 3214 to release. The release of relay 3210 reestablishes the operating circuit of relay 3011 and causes this relay to reoperate. The operation of relay 3011 causes relay 3017 to reoperate, which relay in turn removes the winding of relay 2913 from lead 3225 extending to the sequence circuit.

The release of relay 3210 interrupts the circuit extending from the winding of relay 3022 to the lead 3225 extending to the sequence circuit and permits relay 3022 to release. The release of relay 3210 in interrupting the circuit including lead 3225 also interrupts the locking circuit of relay 9023 of the sequence circuit. The release of relay 9023 reestablishes a circuit from battery through the winding of relay 9011 through the left-hand break contacts of relays 9021 through 9025, inclusive, and thence through the right-hand inner break contacts of relays 9025 through 9021 inclusive, to ground through the winding of relay 9010. Relays 9011 and 9010 operate in this circuit and in operating again connect positive battery to the upper terminal of condenser 9026. Under normal operating conditions this battery will be reconnected to the upper terminal of condenser 9026 before its potential has fallen sufficiently far to permit relay 9012 to release. Consequently, under normal operating conditions relay 9012 remains operated and maintains relay 9013 operated during the entire time that relays 9010 and 9011 have been released.

Relay 9010 in operating interrupts the operating circuit of relay 9018 and relay 9018 in releasing interrupts the locking circuit of relay 9016. The operation of relays 9010 and 9011 interrupts the operating circuit of relay 9017 thus permitting this relay to release. The release of relays 9017 and 9018 interrupts the operating and

locking circuits of relay 9016 and thus permits this relay to release and restore the sequence circuits shown in Fig. 90 to its idle condition.

The release of relay 9023 as described above interrupts the operating circuit of the horizontal selector magnet 3401 and permits this magnet to release. It should be noted, however, that contacts 3471 through 3476 do not release at this time because the cross-bar switch is so constructed that even though magnet 3401 releases, contacts 3471 through 3476 will be maintained closed or operated so long as the vertical hold magnet 8842 is maintained operated.

The release of magnet 3401 interrupts the operating circuit of relay 2934 and thus permits this relay to release. The release of relay 2934 interrupts the locking circuit of relay 2933 and thus permits this relay to release. The release of relay 2933 reestablishes the operating circuit of relay 3021 and causes this relay to reoperate if it had released by this time or causes this relay to remain operated if it had not as yet released.

The release of relay 2933 reestablishes the operating circuit through magnet 3021 and causes this relay to reoperate.

The release of relay 3210 together with the release of relays 3211 and 3214 as well as the release of relay 2933 interrupt the locking circuit of relay 4613 extending over lead 3319 as described above. Relay 4613 is slow in releasing so that it does not immediately release but provides sufficient time for the various relays to function as described above before relay 4613 finally releases. The release of relay 4613 connects the winding of relay 4612 through the lower break contacts of relay 4613 to conductor 4716 extending through Figs. 47 and 34 through contacts 3474 over lead 3416 extending through Figs. 33 and 32, the right-hand outer operated contacts of relay 3111 over lead 3417 which extends through Figs. 32 and 33 to ground through the operated contacts 3476. Relay 4612 operates due to current flowing through its winding in this circuit and completes a circuit for the operation of relay 4611. Relay 4611 in operating connects ground to lead 3319 through its lower outer operated contacts and the lower break contacts of relay 4610 thus making this outgoing line circuit of line 260 test busy should an attempt be made to transmit another message to it from some other transmitter associated with some other line or source of signal. Relay 4611 in operating completes a circuit for maintaining itself operated from battery through its winding and lower inner operated contacts over lead 4715 which extends from Fig. 46 through Figs. 47, 59, 65, 73, 81, and 88 to ground through the operated contacts of the vertical hold magnet 8842 of the cross-bar switch.

The operation of relay 4612 also removes ground from lead 4710 extending to the receiving magnet 4525 of the printing reperforator 4506 of the outgoing line circuit associated with line 260 thus conditioning this receiving equipment to respond to signals transmitted over conductor 4710 as will be described presently. The operation of relay 4612 interrupts the operating circuit of relay 4624. Relay 4624 is a slow release relay and does not immediately release.

The operation of relay 4612 also connects ground to lead 4711 extending from Fig. 46 through Figs. 47 and 34 through contacts 3473, lead 3411 extending through Figs. 33, 32 and 31 through the lower outer operated contacts of relay 3019 to battery through the winding of re-

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lay 3023. Relay 3023 operates due to current flowing through its winding over this circuit and completes a circuit for maintaining itself operated from battery through its upper inner operated contacts over lead 3411, contacts 3473 and lead 4711 to ground through the upper inner operated contacts of relay 4612.

The operation of relay 3023 completes a circuit for maintaining relay 4614 operated by connecting ground through its upper center armature and front contact and the winding relay 3125 to lead 3414 extending through Figs. 30, 31, 32 and 33, operated contacts 3472 and lead 4714 extending through Figs. 34, 47 and 46 to battery through resistance 4623 and the winding of relay 4614. The operation of relay 3023 also conditions the transmitting circuit for the transmitting distributor shown in Fig. 28 from ground through resistance 3029 over lead 3030 extending through Figs. 30 and 29 to the left-hand contacts of the groups 1 through 5 controlled by members 2809. The other transmission lead 2871 extends from the cam controlled distributor contacts shown in Fig. 28 through Figs. 29 and 30 and the upper outer operated contacts of relay 3023 over lead 3412 to Fig. 34. The operation of relay 3023 thus conditions the transmission circuit from a distributor of Fig. 28 for transmission through the link circuit of Fig. 34.

The operation of relay 3023 also completes a circuit for the operation of relay 3116 from battery through the winding of relay 3116, the right-hand outer break contacts of relay 3117, the front contact and lower center armature of relay 3023, the inner operated contacts of relay 3021 to ground through the lower front contact and center armature of relay 3016.

The operation of relay 3116 transfers leads 1 through 5 of cable 3120 from the corresponding leads 1 through 5 of cable 2869 extending to the tape controlled contacts 1 through 5 actuated by members 2809 to the lower outer contacts of relays 3216 through 3220, inclusive, and thence back to ground through resistance 3029. The operation of relay 3116 also disconnects lead 3410 from lead 3412 and connects ground to lead 3410 through the right-hand inner operated contacts of relay 3116 and the right-hand outer break contacts of relay 3119.

The operation of relay 3116 also completes a circuit for the operation of the distributor start magnet 2847 from battery through the winding of magnet 2847 over lead 2872 extending through Figs. 29, 30 and 31, the right-hand outer operated contacts of relay 3116, the upper break contacts of relay 3024 through the right-hand outer operated contacts of relay 3111 over lead 3417 extending through Figs. 32 and 33 to ground through the operated contacts 3476. The operation of the distributor start magnet 2847 releases the distributor cam shaft 2851 for rotation through one revolution. Near the beginning of this revolution a circuit will be completed for the operation of relay 3024 from battery through the winding of relay 3024, the left-hand break contact of relay 3117, the lower outer operated contacts of relay 3023, the upper operated contacts of relay 3019 to ground over lead 2873 and through the operated contacts 2850. Relay 3024 in operating interrupts the operating circuit of magnet 2847 and thus permits this magnet to release so that it will be in position to stop the cam shaft 2851 at the end of the revolution.

During this revolution of the cam shaft 2851 the first character of the directing code stored on re-

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lays 3216 through 3221 will be transmitted over lead 3412. Lead 3212 extending through contacts 3471 does not extend to the outgoing line circuit shown in Figs. 45 and 46 or to any other circuit. Consequently, these signals are not received by any receiving instrument. During this revolution of the cam shaft 2851 the transmitting circuit extending from the receiving magnet of the printing or control magnet 4525 of the printing perforator 4506 over lead 4710 extending through Figs. 46, 47 and 34 and contacts 3475 and lead 3410 is maintained in a marking position due to the ground connected to this lead through the right-hand inner operated contacts of relay 3116 and the right-hand outer break contacts of relay 3119. Near the end of this revolution of the cam shaft or barrel 2851, contacts 2850 will open and allow relay 3117 to operate and at the same time cause relay 3024 to remain operated in a circuit extending from battery through the winding and upper inner operated contacts of relay 3024 through the winding of relay 3117 to ground through the second armature from the right and front contact of relay 3111.

Relay 3117 in operating interrupts the operating circuit of relay 3116 and thus permits this relay to release. The release of relay 3116 disconnects ground from lead 3410 and connects leads 3410 and 3412 together, thus extending the transmission circuit from the magnet 4525 of receiving device 4506 to the contacts of the transmitting distributor shown in Fig. 28. The release of relay 3116 also reconnects leads 1 through 5 of cable 3120 to the corresponding leads of cable 2869.

Relay 3117 in operating again completes a circuit of the distributor release magnet 2847 from battery through the winding of magnet 2847, conductor 2872 extending through Figs. 29 and 30, the upper break contacts of relay 3015 to ground through the left-hand outer operated contacts of relay 3117. The operation of magnet 2847 will permit the transmitting cam shaft 2851 to rotate through another revolution. Near the beginning of this revolution contacts 2850 again close and connect ground to lead 2873 extending through Figs. 29 and 30, the upper operated contacts of relay 3019 and lower operated contacts of relay 3023 and the left-hand inner operated contacts of relay 3117, and the right-hand inner break contacts of relay 3118 to battery through the winding of relay 3015. The operation of relay 3015 interrupts the locking circuits of relays 3216 and 3219 which, it will be recalled, were operated due to the setting of transmitting contacts controlled by members 2809 in response to the first address or code directing character which in this case was the letter D. Release of relays 3216 and 3219 interrupts the operating circuits of relays 3025 and 3313 and thus permits these relays to release.

The release of relay 3025 interrupts the operating circuit of relay 3014 and thus permits this relay to release. The operation of relay 3015 interrupts the operating circuit of the distributor release magnet 2847 and thus allows this magnet to release so that it will be in condition to stop the cam barrel 2851 at the end of the revolution then in progress.

It will be recalled that the transmitting contacts controlled by members 2809 were positioned in accordance with the second code directing character by the operation of the transmitting equipment as described above. In other words, these contacts were set in the code positions representing the letter D which is the second call directing character. In addition, as pointed out

above, due to the release of relay 3116 the left-hand contacts of each of the groups are connected to the corresponding cam controlled contacts of the transmitting distributor. Consequently, during this revolution of the cam controlled distributor the letter D signal will be transmitted over lead 2871 through the upper operated contacts of relay 3023 over lead 3412, the inner right-hand break contacts of relay 3116, lead 3410 extending through Figs. 32 and 33, the operated contacts of relay 3475, conductor 4710 to the control magnet 4525 of the recording device 4506. This magnet will respond to these signals and cause the mechanism 4506 to record this letter D signal in and/or tape 4530.

In the embodiment of this invention as shown in the drawing and described herein, the recording device 4506 is similar to the recording device shown in Figs. 91 to 96 inclusive, and represented in Fig. 28. The main difference between these two devices being that all of the contacts of the recording device employed in Fig. 28 are not employed in the device shown in Fig. 45. It is to be understood, however, that these contacts may be provided in case it is desired to make these devices interchangeable. In this case, the additional contacts will not be connected when the device is used in combination with the circuits shown in Fig. 45. These contacts have not been shown in Fig. 45, since they would perform no useful function in the circuit arrangement shown in this figure.

Near the end of this revolution of the transmitting cam barrel 2851 after the entire code combination representing the letter D signal, under the assumed conditions, has been transmitted, contacts 2850 will open and permit relay 3118 to operate and at the same time maintain relay 3105 operated in a circuit extending from battery through the winding and center lower armature and front contact of relay 3015 and winding of relay 3118 to ground through the second armature from the right and front contact of relay 3111.

The operation of relay 3118 completes a circuit for the operation of relay 3114 from battery through the winding of relay 3114, the right-hand inner operated contacts of relay 3111 to ground through the right-hand outer operated contacts of relay 3118. Relay 3114 in operating completes an obvious circuit for the operation of relay 3110. Relay 3110 in operating completes a circuit for maintaining relay 3114 operated from battery through the winding of relay 3114, the upper break contacts of relay 3012 to ground through the left-hand outer operated contacts of relay 3110. Thus relay 3114 is maintained operated under control of relay 3012 and in turn maintains relay 3110 operated under control of relay 3012.

The operation of relay 3110 first connects ground to lead 3416 extending through Figs. 32, 33 and 34, operated contacts 3474, lead 4716 extending from Figs. 34 through Figs. 47 and 46 through the lower break contacts of relay 4613 to battery through the winding of relay 4612 and then interrupts the locking circuit of relay 3111 thus maintaining relay 4612 operated while permitting relay 3111 to release. The release of relay 3111 interrupts the locking circuits of relays 3015 and 3024, 3117 and 3118 and thus permits these relays to release.

The operation of relay 3110 interrupts the locking circuit of relay 3016 and permits this relay to release. The release of relay 3016 interrupts the operating or locking circuits of relays 3113, 3017,

3011, 3021 and 2913 and permits these relays to release. The release of relay 3114 interrupts the locking circuit of relays 3112 and 3019 and permits these relays to release.

5 The operation of relay 3110 completes a circuit for the operation of the transmitter start magnet 2811 from battery through the winding of magnet 2811 over lead 2887 extending through Figs. 28, 29, 30, the center right-hand armature and front contact of relay 3110, the lower break contacts of relay 3012, the upper break contact and center armature of relay 3016, the center lower armature and break contact of relay 2913, the lower break contact of relay 2910 to ground through the operated contacts 2821.

10 The operation of magnet 2811 at this time will release the transmitting shaft or cam barrel 2853 for rotation which will cause the tape 2805 to be advanced through the transmitting head 2806 and the next character will be sensed and transferred to the transmitting contacts controlled by members 2809. During the revolution of the cam barrel 2853, contacts 2816 will close and complete a circuit for the operation of release magnet 2847 at or about the time contacts controlled by members 2809 are fully positioned in accordance with the new code sensed by the sensing members of the transmitting end 2806. Thereafter this code combination will be transmitted over the above described transmission circuit to the control magnet 4525 where it will be recorded. Succeeding code combinations stored in the tape 2805 will be transmitted in a similar manner to the control magnet 4525 which will in turn cause these code combinations to be recorded in and printed upon tape 4530.

20 As described above, the operation of relay 4612 interrupts the operating circuit of relay 4624 and permits this relay to start to release. Relay 4624, however, is slow in releasing and does not immediately release and interrupt the operating circuit of relay 4622. The time-delay constants of relays 4624 and 4622 are such that ample time is provided for the establishment of a connection and the transmission of signals from the transmitter shown in Fig. 28 to the recording device 4506 shown in Fig. 45 under normal operating conditions of the system before these relays both release. Upon receiving the first code combination transmitted by the transmitter shown in Fig. 28 to the recording device 4506, which under the assumed conditions will be the D signal, recording device 4506 will cause the universal contacts 4541 and 4540 to be momentarily operated. Momentary operation of contact 4540 completes a circuit for the operation of relay 4623 from battery through the winding of relay 4623 and the upper inner operated contacts of relay 4612 to ground through the operated universal contacts 4540.

30 Relay 4623 in operating completes a circuit for maintaining itself operated under control of relay 4612 from battery through the winding of relay 4623 and the upper inner operated contacts of relay 4612 to ground through the upper operated contacts of relay 4623.

35 Relay 4623 in operating prepares a circuit for the operation of relay 4622 from battery through the winding of relay 4622 and the lower operated contacts of relay 4623 to ground through the break contacts 4540. As described herein, the universal contacts associated with the recording devices are arranged to be only momentarily operated in response to each code combination received by the recording devices. Consequently,

these contacts will be in their normal position for a considerable percentage of the time, which percentage of time will be sufficient to maintain the slow-release relay 4622 operated. Relays 4622 and 4623 will therefore remain operated until relay 4612 is released at the end of the message as described herein.

Assume now that some trouble condition exists which either prevents the transmitter shown in Fig. 28 from immediately transmitting signals to the recording device 4506 after relay 4612 has operated, or that the recording device does not respond to said signals due to open wires, motor trouble and other types of trouble conditions. Upon the release of relay 4624 under these circumstances the circuit of relay 4622 is interrupted, which relay starts to release. If no signals are received by the recording device 4506, or if it does not respond by actuating its universal contacts prior to the release of relay 4622, the release of relay 4622 will complete a circuit for the operation of relay 4610 from battery through the winding of relay 4610, the upper break contacts of relay 4622 to ground through the lower outer operated contacts of relay 4612.

The operation of relay 4610 completes a circuit for lighting the tape-out lamp 4533 which preferably is located on or near the machine cabinet supporting recording device 4506.

The operation of relay 4610, in addition, connects ground to lead 2738 extending to the alarm circuit shown in Fig. 89 where it will cause relay 8910 to operate and, in turn, light the tape-out pilot lamp 8911. This pilot lamp is preferably located on or near some control board or position of the system.

The release of relay 4622, in addition, short-circuits resistance 4628 which is connected in series with relay 4614 and lead 4714 which lead, under the assumed conditions, is connected through the closed contacts 3472 to lead 3414 which extends through the winding of relay 3125 to ground through the left-hand outer operated contacts of relay 3111. When resistance 4628 is short-circuited by the release of relay 4622 the current flowing through the winding of relay 3125 is sufficiently increased to cause this relay to operate. The operation of relay 3125 completes a circuit for the operation of relay 2913 from battery through the winding of relay 2913, the operated contacts of relay 3125 to ground through the right-hand operated contacts of relay 3110 which relay, under the assumed condition, operated after the transmission of the second D signal, as described above. The operation of relay 2913 interrupts the circuit of the transmitter start magnet 2811 and thus stops the operation of the transmitter shown in Fig. 28. The operation of relay 2913, in addition, completes a circuit for maintaining itself operated from battery through its winding, the center set of lower break contacts of relay 2914 to ground through the lower inner operated contacts of relay 2913.

The operation of relay 2913 completes an obvious circuit for lighting the sender or director lamp 2912 which indicates which of the directors or transmitters has been stopped. In addition, the operation of relay 2913 connects ground to lead 2936 which extends to the alarm circuit shown in Fig. 89 and causes an audible signal to sound when it is so desired. The operation of the signal and the lighting of the various lamps described indicate to the attendants, operators, and maintenance people that a trouble condition

exists which requires some attention on their part.

Upon observing the various indicators the attendants or service people may follow a number of different procedures. It may be desirable for them to first attempt to locate the trouble and correct it, if possible, before operating any of the keys or equipment to restore service. In case trouble occurs in the switching circuits or in the transmitter shown in Fig. 28 such a procedure would probably be the most desirable.

However, trouble will generally occur in the recording equipment 4506 and related circuits. Under these circumstances a different form of procedure is desirable and will generally be followed. The operator or attendant upon noting the signals referred to above will usually operate the make-busy key 4505 associated with the recording device 4506 which is in trouble. The operation of this key completes an obvious circuit for maintaining 4611 operated and thus prevents any further messages being directed to the recording device 4506. After operating key 4505 the attendant will then operate the director stop key 2833, which key in operating completes an obvious circuit for the operation of relay 2910. The operation of relay 2910 completes a circuit for maintaining lamp 2912 lighted and in addition maintains the circuit of the transmitter start magnet 2811 open and thus prevents further operation of this transmitter at this time.

The order in which the keys 2833 and 4505 are operated is not material. However, it is desirable that both of these keys be operated before any of the other keys are operated. After the operation of both of these keys, disconnect key 2832 may be operated. The operation of key 2832 at this time completes a circuit for the operation of relay 3119 from battery through the winding of relay 3119 and the upper inner operated contacts of relay 2910 to ground through the operated contacts of key 2832.

Relay 3119 in operating completes a circuit for maintaining itself operated and causes the automatic transmission of the disconnect pattern from the switching circuits to the recording device 4506 as described elsewhere herein when relay 3119 operates. Upon the completion of the transmission of this disconnect pattern the connection previously established from the transmitter of Fig. 28 to the recording device 4506 will be interrupted. The operator may then move the tape 2805 backward in the sensing head 2806 so that the directing characters will again be scanned or sensed upon the release of the director circuit. Thereafter the operator will restore key 2833 which releases relay 2910. In addition the operator will momentarily operate key 2834. The operation of key 2834 completes an obvious circuit for the operation of relay 2914. Relay 2914 in operating interrupts the locking circuit of relay 2913 and permits this relay to release. The subsequent release of key 2834 will permit relay 2914 to release and restore the director circuits to their operative condition whereupon directing characters in the tape 2805 will again be sensed and the connection again attempted to be established to a transmission path extending toward the proper line. If two or more paths extend to the proper line and the other one is not busy, the message will be routed to the idle path. Meantime the attendants or service force may be determining and correcting the trouble in the recording device which is maintained busy due to the operation of the busy key.

Under the assumed conditions where only one path extends to the desired line, the director circuit will test this path and find it busy so long as key 4505 is operated and will wait until the trouble has been corrected and key 4505 restored to its normal condition.

Of course there are many variations of both methods of procedure which may be followed in any particular case as, for example, if the same sender or director fails to transmit the message properly the second time an attempt is made, it would suggest that the trouble was in the switching circuits or the transmitter shown in Fig. 28 in which case the first method of operation referred to above or some variation thereof would be preferable in an effort to locate and correct the trouble.

Thus, at the beginning of each connection to recording device 4506 its operation is checked. If the device operates in response to received signals the circuit operates in a normal manner. However, if the device does not respond in a predetermined interval of time after a connection is established to it the operation of the circuits is stopped and trouble indicators actuate to attract the attention of the operator and maintenance force so that the cause of the trouble may readily be determined and corrected and the circuits thereafter restored to their proper condition.

Similar protective and testing circuits are provided for each of the other recording devices, such as 1906, 2006, 6206, 6306, 8206 and 8761.

In the case of the recording devices 8206 and 8761, the relay corresponding to relay 4624 has been omitted because, as described herein, when messages are transmitted to the intercept positions both directing characters are transmitted to the recording devices preceding the message. Consequently, the first signal will be transmitted to and recorded by these devices sooner than in the case of the devices 4506, 1906 and 2006 because the first directing character while transmitted from transmitter shown in Fig. 28 is not transmitted to these devices. Consequently, an additional delay period is necessary which delay period is furnished by the relays corresponding to relay 4624.

The recording devices 6206 and 6306 have been provided with respective relays 6424 and 6427 which correspond to relay 4624. In the case of the recording devices 6206 and 6306, these additional relays may not be absolutely necessary because these recording devices receive the entire address codes preceding the message as described herein. However, relays 6424 and 6427 provide an additional margin to allow ample time for signals to be sent to the recording devices 6206 and 6306 and for these devices to respond to them so that false trouble indications will not be registered.

During the transmission of the message the contacts controlled by members 2809 will be positioned in accordance with each of the code combinations recorded in the tape 2805 and transmitted to the recording device 4506. The text of the message will, of course, include the same characteristics as employed in the address or code directing portions of the message. These characters will be transmitted through the system without altering the circuits or connections which have been established.

In addition the message will include H signals, figures signals, Z signals, letters signals, but generally no blank signals. If, however, a blank signal is in some manner inserted or included in

the message it will cause no difficulty. The signals enumerated above will also be transmitted through the system from the transmitting device shown in Fig. 28 to the recording device 4506. The circuits will be completed from ground through the contacts controlled by the members 2809 in response to the signals enumerated above. However, the leads to which ground is applied by these specific code combinations are all open at this time except the lead to which the figures signal applies ground. Ground will be applied to this lead every time a figure signal appears in the text of the message and will complete a circuit for the operation of relay 3020 from battery through the upper winding of relay 3020, left-hand inner operated contacts of relay 3110 over lead 2870 to ground through the groups of contacts 1 through 5 controlled by members 2809 when positioned in accordance with the code combination representing the figures signals which is a marking first, second, fourth and fifth impulse and a spacing third impulse in the telegraph code usually employed in printing telegraph systems. However, so long as any signal other than an H signal follows the figures signal relay 3020 will release without causing any change in the circuits. Thereafter other signals may be transmitted through the system as before.

In case an H signal immediately follows the figures signal, relay 3013 will be operated. Relay 3020 in operating connects a resistance in parallel with its lower winding and thus causes this relay to be somewhat slow in releasing so that it will remain operated until some time during at least the first portion of the transmission of the next character. If this next character happens to be an H signal a circuit will be completed through the operated contacts of relay 3020 for the operation of relay 3013 from battery through the winding of relay 3013, lower inner operated contacts of relay 3020, the left-hand front contact and center armature of relay 3110 to ground through the sets of contacts 1 through 5 when positioned by members 2809 in accordance with the code combination representing the letter H which code combination comprises the spacing first, second and fourth impulse and the marking third and fifth impulse. The operation of relay 3013 completes a circuit for maintaining both itself and relay 3020 operated under control of relay 3110. These circuits may be traced from battery through the lower winding of relay 3020 and also from battery through the winding of relay 3013 and its lower inner operated contacts to ground through the left-hand outer operated contacts of relay 3110.

At this time the circuit through the transmitter start magnet 2811 is still completed from battery through the winding of this magnet over lead 2867 extending through Figs. 29 and 30 the center right-hand armature and operated contact of relay 3110, lower break contacts of relay 3012, the center set of upper break contacts of relay 3016, the lower center armature and back contact of relay 2913, the lower break contact of relay 2910 to ground through the closed contact 2821. It will be recalled the subscriber will generally perforate a letters signal in the tape following the H signal at the end of message signal. Consequently, contacts 2821 will be closed at this time because there will still be at least one letters code combination stored in tape 2805. If this code combination or some other combination has not been stored in tape 2805, the circuits will re-

main in a condition described herein until another code combination is stored in the tape.

Assume now another code combination which will generally be the letters code combination is stored in tape 2805. Under these conditions the circuit traced above will be completed for maintaining magnet 2811 operated which will release cam drums 2853 and cause the next character in the tape to be sensed, the contacts controlled by the members 2809 positioned in accordance with this code combination. Near the beginning of this revolution contacts 2817 will close and complete a circuit for the operation of relay 3012 from battery through the winding of relay 3012, the lower outer operated contacts of relay 3013 to ground through closed contacts 2817. The operation of relay 3012 completes a circuit for maintaining itself operated from battery through its winding and upper operated contacts to ground through the left-hand outer operated contacts of relay 3110.

The operation of relay 3012 in addition interrupts the operating circuit of magnet 2811 thus permitting this magnet to release and stop the cam shaft 2853 at the end of the revolution then in progress. The operation of relay 3012 also interrupts the locking circuit of relay 3114 and permits this relay to release.

Relay 3114, however, is slow in releasing and does not immediately release so that ample time is provided for transmission of this character which is letters character over the transmission path extending to the recording device 4506 thus insuring that this character is properly transmitted thereto. When relay 3114 releases at the end of this time interval it interrupts the operating circuit of relay 3110 and permits this relay to release. The release of relay 3110 interrupts the locking circuit of relays 3012, 3013 and 3020 and permits these relays to release.

In addition the release of relay 3110 removes ground from lead 3416 extending through Figs. 31, 32 and 33 operated contacts 3474 and lead 4716 extending from Fig. 34 through Figs. 47 and 46, the lower break contacts of relay 4613 to battery through the winding of relay 4612. Relay 3110 in removing ground from this path permits relay 4612 to release.

The release of relay 4612 connects ground to the transmission lead 4710 and thus completes a circuit for maintaining the control magnet 4525 operated so that the recording device 4506 will remain at rest in the idle condition. Relay 4612 in releasing interrupts the locking circuit of relay 4623 and permits this relay to release. The release of relay 4612 removes ground from lead 4711 extending through Figs. 47 and 34, contacts 3473, lead 3411 extending through Figs. 33, 32 to battery through the upper inner operated contacts and winding of relays 3023. Relay 3023 then releases and restores the transmission circuits extending from the transmitting distributor of Fig. 28 to their original or initial condition.

The release of relay 3023 in addition removes ground from lead 3414 extending through Figs. 31, 32, 33 and 34 operated contacts 3472, lead 4714 extending through the winding of relay 4614 to battery. This interrupts the current flowing through the winding of relay 4614 and permits this relay to release. The release of relay 4614 removes the ground from lead 4713 extending through Figs. 47, 59, 65, 73, 81, and 83 to battery through hold magnet 8842 and thus permits this magnet to release. The release of magnet 8842 causes contacts 3471 through 3476 to release and

restore the circuits to their initial condition. The release of magnet 8842 also removes ground from lead 4715 and interrupts the circuit of relay 4611 and permits this relay to release.

5 The circuits have now been restored in their initial condition after the first message recorded in tape 2805 has been transmitted by the equipment indicated in diagrammatic form in Fig. 28 to the recording equipment 4506 in Fig. 45. Consequently, this message now appears in tape 4530 and it is available for further transmission through the equipment in Fig. 45 to the station of address as will be described hereinafter.

15 *Discard of address or directing codes which have performed their functions*

It will be recalled that under the assumed conditions a second message was intended for the central switching center so that the subscriber transmitted a G signal followed by a Z signal after the one or more letters signals following the figures and H signals at the end of the first message. It will be further recalled that the G signal followed by the Z signal was recorded in tape 2805 but that thereafter the message was recorded by the receiving only device or teletypewriter 2866. It will be further recalled that the receiving only teletypewriter 2866 responded to the figures signal followed by the H signal at the end of the second message by causing itself to be disconnected from the transmitting channel party line 210 and causing the printing reperforator 2802 to be reconnected thereto so that the signals transmitted from the subscribers station after the figures and H signals and possibly after the following letters signal transmitted at the end of the second message will again be recorded in tape 2805. Under the assumed conditions the subscriber at station 216 then transmitted the address code JE indicating that the third message was intended for station 520 shown in Fig. 5.

Consequently all these signals were recorded in tape 2805 as well as the text of the third message as described above. Under these conditions contacts 2821 will not be opened after the letters signal following the figure and H signals transmitted at the end of the first message has been scanned. Under these circumstances the release of relay 3023 again completes the operating circuit of relay 3016 described above. Relay 3016 in operating completes a circuit for maintaining itself operated under control of relay 3110. The operation of relay 3016 in addition completes circuits for the operation of relays 3017, 3021, 2918 and 3011 and thus conditions the circuit to search for additional code directing characters comprising the address of the following message. In addition the operation of relay 3016 completes a circuit for the operation of magnet 2811 which magnet in turn operates and releases the cam drum 2853 for rotation through one revolution during which revolution the succeeding character is stored in tape 2805 as scanned by the transmitting head 2806. If this next code combination is one of the discard code combinations, namely, a blank, letters, figures, an H or a Z code combination it will be discarded as described above due to the operation of the discard relay 3018. Following the letters signals interposed between the H signal at the end of the first message and the first directing code combination of the address of the second message, the G signal, under the assumed conditions, will be recorded in tape 2805. When this signal is sensed the contacts controlled by members 2809 will be positioned in accordance with

this code combination which is in the usual printing telegraph code a spacing first and third impulse and a marking second, fourth and fifth impulses. Under these conditions since the G signal is not a discard signal relay 3018 will not operate.

Under these conditions when magnet 2811 is operated and releases the shaft 2853 for rotation contacts controlled by members 2809 will be positioned in accordance with the code representing the G signal.

Near the beginning of this revolution of the cam drum 2853, contacts 2817 will close and complete a circuit for the operation of relay 3113. Relay 3113 in operating completes a circuit for maintaining itself operated under control of relays 3115 and 3016. After the contacts of group 1 through 5 controlled by members 2809 have been positioned in accordance with the letter G signal, contacts 2816 will close and complete a circuit for the operation of magnet 2847 which magnet in operating will permit the cam drum 2851 to rotate through one revolution. Near the beginning of this revolution, contacts 2850 will close and complete a circuit for the operation of relay 3112. Inasmuch as the letter G signal is not one of the discard signals enumerated above, the discard relay 3018 will not operate at this time.

During this revolution of the cam shaft 2851 the letter G signal will be transmitted over conductor 2871. This conductor, however, does not extend to any receiving device at this time so this signal will not be recorded at this time by any other receiving instrument. Near the end of the revolution of the cam shaft 2851, contacts 2850 will open and permit relay 3019 to operate. The operation of relay 3019 at this time completes a circuit for the operation of relay 3222. Relay 3222 in operating completes a circuit for maintaining itself operated as described above and in addition completes a circuit for the operation of relay 3115. Relay 3115 in operating interrupts the locking circuit of relay 3113, thus permitting this relay to release. The release of relay 3113 interrupts the locking circuit of relays 3112 and 3019 and permits these relays to release.

Relay 3222 in operating also extends the circuits from the left-hand contacts of each group of contacts 1 through 5 controlled by members 2809 to the windings of relays 3216 through 3220, respectively, and also to the winding of relay 3221. Under the assumed conditions that a G signal was sensed, relays 3217, 3219 and 3220 will be operated and lock operated under the control of relays 3018 and 3015. Under the assumed conditions, however, the operation of these relays will not extend a circuit through them to any relays similar to relays 3310, 3311, 3312 or 3313 since no relay corresponding to these relays is provided for the letter G signal.

If address codes comprising the letter G signal followed by any other usable signal, except Z and H, were assigned to other stations connected to the system a relay corresponding to relays 3310 through 3313 will be provided for operation in response to the letter G signal in the same manner as relays 3310 through 3313 respond to the first code directing characters A, B, C and D.

It will also be apparent to those skilled in the art that each of the relays 3310 through 3313 is provided with contacts equal in number to the number of available second characters of address codes or equal in number to the number of characters or code combinations actually used for second address characters. As shown in the

drawing, relay 3310 is provided with twenty contacts. In actual practice, relays 3311, 3312 and 3313 will be similarly provided with at least twenty contacts. However, in order to save space and simplify the drawing so that it may be more readily understood, the entire group of twenty contacts has been shown only on relay 3310 while only the contacts necessary for the specific system illustrated in detail in the drawing have been shown in Fig. 33. In addition, only four relays 3310, 3311, 3312 and 3313 corresponding to four first code combinations of the address have been shown. It will readily be understood by those skilled in the art that in case it is desired to employ other message directing codes, additional relays corresponding to these relays will be provided and they will be provided with all of the contacts available or with as many as may be required in that particular instance. The code terminals which these relays provide will be left open in case the particular code combination is not employed for the direction of messages to a particular station or receiving apparatus.

Thus, under the assumed conditions, the code combination representing the letter G signal has not been assigned as a first directing code to any of the stations of the system other than the central switching station. Consequently, the G terminal on the cross connection block 3316 will not be connected to any relay corresponding to relays 3310 through 3313. Instead, this terminal will be open or disconnected at the terminal block 3316 so the operation of relays 3317, 3319 and 3320 will not extend the apex of this fan circuit from lead 3027 to any relay or to ground or any source of potential.

The operation of relay 3222 as described above interrupts the operating circuit of relay 3011 and permits this relay to release. Relay 3011, however, is slow in releasing and will not release until relays 3016 through 3021 have had ample time to be operated in accordance with the setting of the contacts of groups 1, 5 controlled by members 2809.

The operation of relay 3222 in addition extends the circuit of relay 3022 over lead 3225 extending through the winding of relay 9023 to ground when the sequence circuit shown in Fig. 90 is idle. If the sequence circuit is not idle at this time, relay 3022 will not operate until the sequence circuit becomes idle. When relay 3011 releases and relay 3022 operates the winding of relay 3017 is extended to the apex circuit 3027 of the selecting or fan relays 3216 through 3221. Under the assumed conditions wherein this circuit over the apex 3027 is incomplete, relay 3017 will release and short-circuit resistance 3026 which in turn increases the current flowing over lead 3225 sufficiently to cause relay 9023 to operate. The operation of relay 9023 completes a circuit for maintaining itself operated and interrupts the operating circuits of relays 9010 and 9011. Relay 9010 is slow in releasing, however, and does not immediately release. Relay 9011, however, releases and completes a circuit for the operation of relay 9017. Relay 9017 in turn operates and completes a circuit for the operation of relay 9016 which relay causes the sequence circuit to become busy and prevents any other of the director circuits from establishing a connection through the cross-bar switch at this time. After relays 9017 and 9016 have had ample time to operate and release all except the highest numbered relay of the group of relays 9021 through 9025, relay 9010 will release and complete a circuit for the operation

of relay 9018. Relay 9018 in operating will complete a circuit for maintaining relay 9016 operated and in addition complete a circuit for the operation of the selector magnet 3401 over lead 3226 as described above. The operation of the cross-bar horizontal magnet 3401 will complete a circuit for the operation of relay 2934 over lead 2935 as described above. The operation of relay 2934 interrupts the operating circuit of relay 2918 and permits this relay to release. Relay 2918, however, is slow in releasing so that it does not immediately release. The operation of relay 2934 transfers the apex lead 3027 from the winding of relay 3017 to the windings of relays 2917 and 2919 as described above. Under the assumed conditions that this apex lead is open neither relays 2917 nor 2919 will have operated by the time relay 2918 releases. Under these conditions the release of relay 2918 will complete a circuit for the operation of relay 2930 from battery through the winding of relay 2930, the upper inner break contacts of relay 2933, the lower break contacts of relays 2918 and 2917, the right-hand contacts and armature of relay 2919, the upper operated contacts of relay 2934 to ground through the front contact and center lower armature of relay 3016.

Relay 2930 in operating completes a circuit for maintaining itself operated from battery through its winding and upper inner operated contacts and upper outer break contacts of relay 2931, the lower inner break contacts of relay 3018, the third armature from the right and break contacts of relay 3111 to ground through the lower operated contact and lower middle armature of relay 3016. Relay 2930 in operating interrupts the operating and locking circuit of relay 3222 and permits this relay to release.

The release of relay 3222 reestablishes the operating circuit for relay 3011 and causes this relay to reoperate. The release of relay 3222 interrupts the circuit extending over lead 3225 between relays 3022 and 9023 and permits these relays to release. The release of relays 3022 and 3011 completes circuits for the operation of relay 3017 which relay reoperates at this time.

The release of relay 9023 again establishes the operating circuits for relays 9010 and 9011 which relays operate and in turn interrupt the operating circuit of relays 9017 and 9018 which relays in turn release and interrupt the locking circuit of relay 9016, thus permitting this relay to release and restore the sequence circuit shown in Fig. 90 to its idle condition.

The release of relay 9023 in addition interrupts the operating circuit of relay 3401 and permits this relay to release. The release of relay 3401 interrupts the operating circuit of relay 2934 and thus permits this relay to release. The release of relay 2934 again establishes the operating circuit for relay 2918 and causes this relay to reoperate.

The operation of relay 2918 at this time completes a circuit for the operation of relay 2932 from battery through its winding, the upper outer operated contacts of relay 2930, the upper operated contacts of relay 2918 to ground through the upper operated contacts of relay 3011 and the lower front contacts and second armature from the bottom of relay 3016. Relay 2932 in operating completes a circuit for maintaining itself operated from battery through its winding and the upper outer break contacts of relay 2930, the upper inner operated contacts of relay 2932 to ground through the lower operated contact and center bottom armature of relay 3016.

The operation of relay 2932 interrupts the operating circuit of relay 3011 and permits this relay to release.

In the meantime, the release of relay 3222 as described above interrupts the operating circuit of relay 3115 and permits this relay to release. The release of relay 3115 reestablishes the operating circuit of the transmitter release magnet 2811. Magnet 2811 in operating again releases the cam barrel 2853 for rotation through another revolution. During this revolution the directing code following the G signal will be sensed by the transmitting head 2806 and the contacts 1 through 5 controlled by members 2809 positioned in accordance with this signal. Under the assumed conditions, the signal or code combination following the G code combination will be a Z code combination. Near the beginning of the revolution of the cam shaft 2853, contacts 2817 will close and complete a circuit for the operation of relay 3113. At about the time contacts controlled by members 2809 are fully positioned in accordance with this Z code combination, contacts 2816 will close and complete a circuit for the operation of the distributor start magnet 2847. This magnet will operate and release the cam shaft 2851 for another revolution during which time the Z signal will be transmitted to lead 2871. This lead, however, is still not closed so that this signal will not be recorded by any other receiving apparatus at this time due to transmission over lead 2871. Near the beginning of this revolution of the cam shaft 2851, contacts 2850 will be closed and complete a circuit for the operation of relay 3112.

The letter Z signal now recorded upon the contacts positioned by members 2809 is one of the discard signals. Consequently, upon the operation of relay 3112 a circuit will be completed for the operation of relay 3018 as described above. Relay 3018 in operating at this time interrupts the locking circuit of relays 3217, 3219 and 3220 and thus allows these relays to release. The operating of relay 3018 at this time interrupts the locking circuit of relay 2930 and permits this relay to release. The release of relay 2930 interrupts the locking circuit of relay 2932 which relay in turn releases. The operation of relay 3018 in addition completes a circuit for the operation of relay 3115. Relay 3115 in operating interrupts a locking circuit of relay 3113 and permits this relay to release. The release of relay 3113 interrupts the operating circuit of relay 3112 and permits relay 3112 to release. The release of relay 3112 interrupts the operating circuit of relay 3013 and permits relay 3018 to release. Relay 3018 in releasing interrupts the operating circuit of relay 3115 and permits relay 3115 to release. The release of all these relays restores the circuit to its initial condition at which time a circuit through the transmitter clutch magnet 2811 is again completed and the search for directing characters again resumes. It is thus apparent that the address code GZ which was employed to direct a second message to the central switching station has been discarded by the switching equipment and a search started for additional code directing characters recorded in the tape 2805.

Transmission of a message to a trunk circuit

After the G and Z signals have been discarded from tape 2805 the circuits and equipment will function as described above under the heading discard and discard letters signals or other sig-

nals enumerated above until another message directing code is encountered in tape 2805. Under the assumed conditions, the next message directing code will be the letter J followed by the letter E. This code designates station 520 at the second switching center. Consequently it will be necessary to transmit this message over a trunk circuit 290 extending to the second switching center shown in Figs. 5, 6 and 7.

When the J signal arrives over the sensing pins of the transmitting head 2806, the sets of contacts 1 through 5 positioned by members 2809 will be positioned in accordance with the code representing the letter J signal namely the first, second and fourth sets of contacts will be positioned in their marking position while the third and fifth will be positioned in their spacing position. If the contacts are positioned in this manner, relay 3018 will not be operated as described above under the discard operation of the circuit. Instead near the beginning of the revolution of the cam shaft 2853 during which the letter J signal is sensed, contacts 2817 will close and complete a circuit for the operation of relay 3113. Relay 3113 in operating completes a circuit for maintaining itself operated under control of relays 3016 and 3115. After contacts controlled by members 2809 have been fully positioned in accordance with the letter J signal, contacts 2816 will close and complete a circuit for the operation of magnet 2847 which releases cam shaft 2851 for rotation through one revolution. During this revolution, a code combination representing the letter J will be transmitted over conductor 2871. This conductor, however, is not connected to any receiving device at this time so that the code combination transmitted thereover will be ineffective.

Near the beginning of the revolution of the cam shaft 2851, contacts 2850 will close and complete a circuit for the operation of relay 3112. As pointed out above, the letter J signal is not one of the discard signals enumerated above. Consequently, relay 3018 does not operate at this time.

Near the end of the revolution of cam shaft 2851 contacts 2850 will open and cause relay 3019 to operate in series with relay 3112 thus maintaining relay 3112 operated. The operation of relay 3019 at this time completes a circuit for the operation of relay 3222. Relay 3222 in operating completes a circuit for maintaining itself operated under control of relays 3014, 2930, 2931, 3018, 3111 and 3016 and in addition completes a circuit for the operation of relay 3115. Relay 3115 in operating interrupts the locking circuit of relay 3113 and permits this relay to release. The release of relay 3113 interrupts the locking circuits of relays 3112 and 3019 and permits these relays to release. Relay 3222 in operating also interrupts the operating circuit of relay 3011. Relay 3011, however, is slow in releasing and does not immediately release.

The operation of relay 3222 also extends the circuits of the windings of relays 3216 through 3221 to the sets of contacts 1 through 5 controlled by members 2809. Under the assumed conditions with the No. 1, 2 and 4 sets of contacts operated to their marking positions relays 3216, 3217 and 3219 will be operated and lock operated under control of relays 3018 and 3015 as described above. The operation of relays 3216, 3217 and 3219 completes a circuit from the apex conductor 3027 through the break contact and fourth armature from the top of relay 3220, a front contact and fourth armature from the top of relay 3219, a third armature from the top and front contact of

relay 3216, the lower inner operated contacts of relay 3217 and middle lower armature and break contact of relay 3218 over the J lead through a connecting terminal block 3316.

Inasmuch as the station to which the following message is directed can be reached only through a second switching center which is designated by a first code combination or letter J signal, the J lead will extend directly over lead 6419 to the outgoing line circuit of the trunk circuit 290.

The operation of relay 3222 also extends the circuit of relay 3022 from battery through its winding and high resistance 3026 over lead 3225 extending through Figs. 45, 57, 63, 71, 79 and 86 to ground through the winding of relay 9023 if the sequence circuit shown in Fig. 90 is idle. If the sequence shown in Fig. 90 is idle relay 3022 will operate but relay 9023 will not operate at this time due to the high resistance 3026 as described above. If the sequence circuit is busy relay 3022 will not operate until the sequence circuit becomes idle.

After the circuit apex conductor 3027 is fully established through the contacts of relays 3216 through 3221 to the conductor 6419, relay 3011 will release. When relay 3011 releases and relay 3022 operates, the circuit of the busy test relay 3017 will be extended over the apex conductor 3027 and lead 6419 to the outgoing line circuits of the trunk circuit 290 extending to the switching center shown in Figs. 5, 6 and 7. If both of the outgoing line circuits or transmission paths leading to this trunk circuit are busy ground will be connected to lead 6419 in a manner similar to the manner in which ground is connected to lead 2119 when both the outgoing line circuits of the party line 210 are busy as will be described hereinafter.

If ground is connected to the lead 6419, the busy test relay 3017 will remain operated until one or the other of the outgoing line circuits of trunk 290 become idle. Assuming that neither of these outgoing line circuits are busy and that they are in the condition shown in the drawing ground will not be connected to lead 6419 so that the busy test relay 3017 will release.

The release of busy test relay 3017 connects the winding of relay 2913 to the circuit of lead 3225 to test for trouble ground. If a trouble ground is connected to this lead, the operation of the circuits will be stopped and indicators actuated to indicate the trouble conditions. Assuming that no trouble ground is encountered upon the release of relay, the release of this relay short circuits high resistance 3026 and increases the current flowing on conductor 3225 so that relay 9023 will operate. The operation of this relay interrupts the circuits of relays 9010 and 9011 and permits relay 9011 to release which in turn completes a circuit for the operation of relay 9017. Relay 9017 in operating completes a circuit for the operation of relay 9016. Relay 9016 interrupts the operating circuits for all the relays from 9021 through 9025 and thus makes the sequence circuit shown in Fig. 90 busy. Relay 9023 does not release due to the fact that it is locked operated at this time as described above. A short time later relay 9010 will release and complete a circuit for the operation of relay 9018. Relay 9018 in operating completes a circuit over conductor 3226 extending from Fig. 90 to Figs. 86, 79, 71, 63, 57, 45, 32, 33 and 34 for the operation of magnet 3401. The operation of the cross-bar horizontal or selective magnet 3401 con-

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ditions the contacts controlled thereby for actuation in response to the operation of some one of the hold magnets as will be described herein-after. The operation of relay 3401 in addition completes a circuit for the operation of relay 2934. Relay 2934 in operating interrupts the operating circuit of relay 2918. Relay 2918, however, does not immediately release because it is a slow to release relay. The operation of relay 2934 transfers the circuit of the apex conductor 3027 and lead 6419 to the windings of relays 2917 and 2919. Assuming that only a single vertical magnet is connected to the lead at this time, relay 2919 will not operate and the vertical magnet 8843 will not operate. The operation of relay 2917 at this time completes a circuit for the operation of relay 2933 before relay 2918 releases. The operation of relay 2933 interrupts the operating circuit of relay 3021. This relay, however, does not immediately release but remains operated for an appreciable interval of time. Relay 2933 in operating also completes a circuit for maintaining itself operated under control of relay 2934.

The operation of relay 2933 connects direct ground to the apex lead 3027 which in turn is connected to lead 6419 through the contacts of relays 3216 through 3320, inclusive. When direct ground is thus applied to lead 6419 either the vertical or hold magnet 8843 or 8844 will be operated. With the circuits in the conditions shown in Fig. 64 the hold magnet 8843 will be operated in a circuit extending from lead 6419 through the lower break contacts of relay 6410 and the lower outer break contacts of relay 6411, the upper break contacts of relay 6415 and the upper break contacts of relay 6414, lead 6513 which extends through Figs. 65, 73, 81 and 88 to battery through the winding of the vertical magnet 8843.

The operation of magnet 8843 closes the contacts 3481 through 3486 inclusive, and in addition completes a circuit for the operation of relay 6413 from battery through the winding of relay 6413, lower break contacts of relay 6414, lead 6515 which extends through Figs. 65, 73, 81 and 88 to ground through the operated contacts of magnet 8843.

The operation of relay 6413 completes a circuit for the operation of relay 3111 from battery through the winding of relay 3111, the lower operated contacts of relay 2933, the right-hand outer break contacts of relay 3110, lead 3416 which extends through Figs. 32 and 33, the operated contacts 3484, lead 6516 which extends through Figs. 34, 47, 59, 65 to ground through the lower operated contacts of relay 6413.

Relay 3111 in operating completes a circuit for maintaining itself operated from battery through its winding and left-hand inner operated contacts, the right-hand outer break contacts of relay 3110, the right-hand outer operated contacts of relay 3111, lead 3417 extending through Figs. 32, 33 and 34 to ground through the operated contacts 3486 of the cross-bar switch.

The operation of relay 3111 as described above connects ground through the winding of relay 3125 to lead 3414 extending through Figs. 32 and 33, contacts 3482 and lead 6514 extending from Fig. 34 through Figs. 47, 59 and 65 to battery through resistance 6428 and the winding of relay 6414. Relay 3125 will not operate in this circuit in series with resistance 6428, but relay 6414 will operate in this circuit. The operation of relay 6414 in this circuit connects ground to lead 6513 extending to battery through the winding of the hold magnet 8843, thus maintaining the hold

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magnet 8843 operated. The operation of relay 6414 in addition transfers the winding of relay 6413 from lead 6515 and thus from ground through the operated contacts of the hold magnet 8843 to lead 6419 which in turn extends to ground through the operated contacts of relay 2933.

The operation of relay 3111 also interrupts the locking circuit of relay 3222 and permits this relay to release. The release of relay 3222 completes a circuit for the operation of relay 3011 and causes this relay to be operated. The reoperation of relay 3011 again completes a circuit for the operation of relay 3017 which relay in turn operates and disconnects the winding of relay 2913 from the test lead 3225.

The release of relay 3222 interrupts the operating circuit of relay 3115 and permits this relay to release. The release of relay 3115 reestablishes the operating circuit of magnet 2811 and releases the cam shaft 2853 for another revolution. During this revolution the sensing members on the transmitting head 2806 will sense the next code combination which, under the assumed conditions, will be the letter E. This code combination will be transferred to members 2809 which in turn sets the contacts 1 through 5 in accordance with this code combination.

The release of relay 3222 as described above interrupts a circuit extending from the winding of relay 3022 over lead 3225 to ground through the winding of relay 9023, thus permitting both relays 3022 and 9023 to release. The release of relay 3022 merely transfers the winding of relay 3017 to ground through the center set of lower operated contacts of relay 3016.

The release of relay 9023 reestablishes the operating circuit through relays 9010 and 9011. The reoperation of these relays interrupts the operating circuits of relays 9017 and 9018 which relays release and interrupt the operating and locking circuits of relay 9016, thus restoring the sequence circuit shown in Fig. 90 to its original condition.

The release of relay 9023 as well as the release of relays 9016 and 9018 interrupt the circuit extending over lead 3226 through the winding of horizontal magnet 3401. The release of this magnet does not cause the contacts 3481 through 3486 to release at this time since they are maintained operated by the operated hold magnet 8843. The release of the horizontal magnet 3401 interrupts the operating circuit of relay 2934 and thus permits this relay to release.

The release of relay 2934 completes the operation of a circuit of relay 2918 and interrupts the locking circuit of relay 2933. The release of relay 2933 removes the ground connected to lead 6419 which extends through the contacts of this relay to ground through the operated contacts of relay 2933 over the circuit traced above. The release of relay 2933 again completes a circuit through the winding of relay 3021 for reoperating or holding this relay operated.

The interruption of the locking circuit of relay 6413 permits this relay to release. The release of relay 6413 completes a circuit for the operation of relay 6412 from battery through the winding of relay 6412, the lower break contacts of relay 6413, lead 6516 extending through Figs. 65, 59, 47 and 34, the operated contacts 3484, lead 3416 which extends through Figs. 33 and 34, the right-hand outer operated contacts of relay 3111, lead 3417 extending through Figs. 32 and 33 to ground through the operated contacts 3486.

Relay 6412 in operating removes ground connected to conductor 6512 extending to the con-

trol magnet 6325 of the recording device 6306 and thus conditions this magnet for the reception of the signals to be transmitted thereto as will be described.

The operation of relay 6412 in addition completes a circuit for the operation of relay 6415 which relay in turn operates and locks operated under control of relays 6417, 6416 and 6418.

The operation of relay 6412 in addition completes a circuit for the operation of relay 6411. Relay 6411 in operating completes a circuit for maintaining itself operated over lead 6515 under control of the vertical magnet 8843. The operation of relay 6411 transfers lead 6419 to the vertical magnet 8844 so that if a call is now directed to the trunk circuit 290 the hold magnet 8344 will operate and connect the receiving instrument 6206 to the transmitter having a second message for transmission of the trunk 290.

The operation of relay 6412 in addition connects ground to lead 6511 extending through Figs. 65, 59, 47, and 34, operated contacts 3483, conductor 3411 extending through Figs. 33, 32 and 31 to the contacts of relay 3019.

Returning now to the operation of the transmitting equipment shown in Fig. 28, it will be recalled that magnet 2811 was operated in response to the release of relay 3115 which in turn released the cam shaft 2853 for rotation through one revolution. During this revolution the contacts controlled by members 2809 were set under control of the second code directing character which was the letter E. Near the beginning of this revolution contacts 2817 close and complete a circuit for the operation of relay 3113. After the contacts 2809 have been positioned in accordance with the second code directing character, contacts 2816 will close and complete a circuit for the operation of magnet 2847 which magnet will operate and release the distributor cam drum 2851 for rotation through one revolution. During this revolution the letter E signal will be transmitted over conductor 2871. This lead, however, is open to contacts of relay 3023 so these signals are not transmitted to any other receiving instruments.

Near the beginning of this revolution of the cam drum 2851, contacts 2850 will close and complete a circuit for the operation of relay 3112. Near the end of the revolution of the cam drum 2851, contacts 2850 will open and will permit relay 3019 to operate in series with relay 3112. Contacts 2850, however, do not open until the entire code combination representing the letter E signal has been transmitted to lead 2871, so that relay 3019 does not operate until after this entire code combination has been transmitted over lead 2871.

The operation of relay 3019 extends a circuit of conductor 3411 through the lower operated contacts of relay 3019 to battery through the winding of relay 3023 and thus completes a circuit for the operation of this relay. The operation of relay 3023 completes a circuit for maintaining itself operated from battery through winding and upper inner operated contacts, over conductor 3411 to ground through the operated contacts 3483 and conductor 6511 and the upper operated contacts of relay 6412.

The operation of relay 3023 extends the transmission circuit from conductor 2871 to conductor 3412 and in addition conditions the conductor 3930 for transmission. The operation of relay 3023 in addition connects ground to conductor 3414 for maintaining relay 6414 operated independently of relay 3111. The operation of relay

3023 completes a circuit for the operation of relay 3116 which relay in turn transfers the leads 1 through 5 extending to the transmitter distributor contacts from the contacts controlled by members 2809 to contacts controlled by relays 3216 through 3220. Relay 3116 in addition interrupts the connection between conductors 3410 and 3412 and connects ground to conductor 3110.

The operation of relay 3116 also completes a circuit for the operation of the transmitting distributor release magnet 2847. The operation of this magnet releases the distributor cam shaft 2851 for one revolution. Near the beginning of this revolution contacts 2850 close and complete a circuit for the operation of relay 3024. The operation of relay 3024 interrupts the operating circuit of magnet 2847 and permits this magnet to release so that it will be in condition to stop the cam drum 2851 at the end of this revolution.

During this revolution of the cam drum 2851 the contacts controlled thereby are connected to contacts of relays 3216 through 3220 so that a code combination in accordance with the condition of these relays will be transmitted over conductor 2871 at this time. It will be recalled that relays 3216 through 3220 have been operated in accordance with the letter J signal, namely, relays 3216, 3217 and 3219 have been operated. Consequently, marking impulses will be transmitted during the first, second and fourth impulse periods while spacing impulses will be transmitted during the third and fifth intervals of the code, assuming that the usual printing telegraph code is employed.

As pointed out above, lead 2871 is connected to conductor 3412 through the contacts of relay 3023 at this time. Consequently, this code combination will be transmitted over lead 3412 through the operated contacts 3481 and over lead 6512 to the control magnet 6325 to the recording device 6306. In this case it should be noted that the first code combination will be recorded by this device because its control magnet is connected to lead 6512 and not 6510 as was the case of the control magnet 4525 described above.

In other words, when the message is transmitted to a local line terminated at the central exchange, the first code combination of the directing signals or address of the message is not transmitted whereas when the message is transmitted over a trunk to another switching center, the first code combination of the address codes is transmitted to the outgoing line circuit for later transmission over the trunk circuit.

Near the end of this revolution of the cam drum 2851, after the complete code combination representing the letter J signal has been fully transmitted, contacts 2850 will open and permit relay 3117 to operate in series with relay 3024. Operation of relay 3117 interrupts the circuit of relay 3116 and permits this relay to release. The release of relay 3116 connects the sets of contacts controlled by members 2809 to the contacts of the transmitting distributor controlled by the cams of cam drum 2851.

The operation of relay 3117 in addition again completes a circuit for the operation of the transmitting distributor release magnet 2847 which magnet in operating again releases the transmitting cam shaft 2851 for rotation through another revolution. Near the beginning of this revolution contacts 2850 close and complete a circuit for the operation of relay 3015. Relay 3015 in operating interrupts the locking circuit of relays

3216 through 3221. Since relays 3216, 3217 and 3219 have previously operated, these relays will release at this time.

During this revolution of the cam shaft 2351 a code combination representing the letter E signal will be transmitted since, it will be recalled that, the contacts controlled by members 2809 were previously positioned in accordance with the code representing the letter E signal due to the fact that the letter E signal was perforated in tape 2805 following the letter J signal. This code combination is likewise transmitted to a control magnet of recording device 6306.

Near the end of the revolution of the transmitting cam shaft 2351 after the code combination representing the letter E signal has been transmitted, contacts 2850 will open and permit relay 3118 to operate in series with relay 3015. Relay 3118 in operating completes a circuit for the operation of relay 3114. Relay 3114 in turn completes a circuit for the operation of relay 3110. Relay 3110 in operating completes a circuit for maintaining relay 3114 operated under control of relay 3012. Relay 3110 in operating interrupts the locking circuit of relay 3016 and permits this relay to release. The release of relay 3016 in turn causes relays 3021, 2918, 3017, 3011, 3019, 3112 and 3113 to release.

The operation of relay 3110 in addition interrupts the operating circuit of relay 3111 and permits this relay to release and at the same time completes a circuit for maintaining relay 3012 operated. The release of relay 3111 interrupts a locking circuit of relays 3117, 3118, 3024 and 3015 and permits these relays to release.

The operation of relay 3110 as described above in addition completes a circuit for the operation of the transmitter start magnet 2811 and causes this magnet to operate and release the transmitter shaft 2853 for rotation. During the rotation of this shaft it will advance the tape since the next combination causes the contacts controlled by members 2809 to be positioned in accordance with this next code combination and finally to operate the distributor trip magnet 2847 and cause this combination to be transmitted to the control magnet 6325. In this manner the text of the message including all of the signals following the E signal are transmitted by the transmitting equipment shown in Fig. 28 under control of the perforated tape 2805 to the receiving equipment 6306 of the first outgoing line circuit associated with trunk 290.

Emergency disconnect

If the supply of perforated tape 2805 becomes exhausted, that is, if the last character received and recorded in tape 2805 has been scanned by the transmitting head 2806 and transmitted by the transmitting equipment shown in Fig. 28, contacts 2821 will open and interrupt the circuit of release magnet 2811, thus causing the equipment to come to rest and wait until an additional supply of perforated tape is available for transmission.

Such a condition may arise if the supply of perforated tape at the outlying subscriber's station becomes exhausted without passing out of the transmitter or if the tape of the transmitter becomes stuck in some manner, or if a subscriber inadvertently fails to perforate a disconnect signal in the tape, or for other reasons too numerous to mention. If the trouble is promptly corrected so that additional signals will be received and perforated in tape 2805, contacts 2821 will

reclose and reestablish the operating circuit of the release magnet 2811, whereupon the transmission of the message signals by the transmitting equipment shown in Fig. 28 will be resumed.

However, should the pause in transmission be longer than some predetermined time interval, as for example, approximately 30 seconds, the equipment in Fig. 27 will function in the following manner to initiate the operation of the transmitter start circuit as described above when the transmission signal is received, that is, when the figures signal and a second H signal is received.

When no signals are received by the incoming line, that is, the transmitting channel party line 210 remains in its marking condition, relays 2701 and 2702 will have their armatures maintained in their marking positions. With the armature of relay 2702 in its marking position the operating circuit of relay 2713 is interrupted, assuming that a message had been previously in the process of transmission and that no disconnect signal followed the message, but assuming instead that the transmission from the outlying station merely ceases.

After a short interval of time relay 2713 will release and disconnect ground from the upper terminal of condenser 2728 and permit this condenser to charge through high resistance 2729 to the positive potential. The time constants of resistance 2729, condenser 2728 as well as the constants of the vacuum tube 2727 and resistance 2730 and the value of the potential applied to the circuits of tube 2727 are so related that it requires approximately 30 seconds for the upper terminal of condenser 2728 to be charged in a positive direction sufficiently to initiate a discharge current through tube 2727 sufficient to operate relay 2706 if no signals are received during this entire interval, relay 2706 will operate at the end thereof. If, however, signals are received during this interval, relay 2702 will be operated to a spacing position and cause the operation of relay 2713 which relay in operating will discharge the upper terminal of condenser 2728 by connecting ground to it and thus prevent the operation of relay 2706.

Assume, however, that no signals are received during this interval so that relay 2706 operates. The operation of relay 2706 completes an obvious circuit through the lower winding of relay 2715 for operating this relay. The operation of relay 2715 interrupts the locking circuit of relay 2718 and permits this relay to release. The operation of relay 2715 will cause the release of either relays 2704, 2709, 2721 or 2723, depending upon which of these relays was operated at the time. The release of relay 2718 initiates the operation of the automatic start circuit shown in Figs. 14, 15 and 16 and causes this circuit to send out signals for disconnecting the transmitter in trouble and for initiating the transmission from another station if the automatic key has been operated to its automatic position. If this key is in the manual position, the end of transmission lamp will light and indicate to the operator that transmission has ceased over the incoming channel or the transmitting channel of party line 210, as described above.

With the supply of perforated tape exhausted so that contacts 2821 are opened without a figures signal followed by an H signal having been received, the circuit of relay 2915 is interrupted. If relays 2704, 2721 and 2723 are released at this time or release, the operating circuit of relay 2916 is interrupted. After a short interval of time,

this relay will release and complete a circuit for the operation of emergency disconnect relay 3119 from battery, through the winding of relay 3119, the upper break contacts of relays 2916, 2915 and 3013 over lead 3411, which extends through Figs. 31, 32, 33 and 34, operated contacts 3483, lead 6511 which extends from Fig. 34 to Figs. 47, 59 and 65 to ground through the upper operated contacts of relay 6412.

Relay 3119 in operating completes a circuit for maintaining itself operated from battery through its winding and right-hand inner operated contacts to ground through the upper operated contacts of relay 6412 over leads 3411, operated contacts 3483 and lead 6511.

It is assumed that in the foregoing description of the operating path of relay 3119 the transmitting equipment was transmitting a message to the receiving equipment 6306 at the time the supply of perforated tape 2885 becomes exhausted and a thirty-second pause occurs in the transmission from the subscriber's station transmitting this message.

It will be readily appreciated by those skilled in the art that in case the pause occurs during the transmission of other messages the operating circuit for relay 3119 will extend over lead 3411 through other contacts of a crossbar switch and thence to ground through the operated contacts of relays similar to relay 6412.

The operation of relay 3119 completes an obvious circuit for the operation of relay 3116. Relay 3116 in operating transfers the contacts of the transmitting distributor from the left-hand contacts of group 1 through 5 of the transmitter shown in Fig. 28 and connects them through the operated contacts of relay 3119 to the contacts of relays 3117 and 3118.

The operation of relay 3116 completes a circuit for the operation of the distributor release magnet 2847, from battery, through the winding of this magnet, over lead 2872 which extends through Figs. 29, 30 and 31, through right-hand outer operated contacts of relay 3116, upper break contacts of relay 3024 to ground through the right-hand outer operated contacts of relay 3110. The operation of magnet 2847 will release the transmitting cam shaft 2851 for rotation through one revolution. Near the beginning of this revolution, contacts 2850 will close and complete a circuit for the operation of relay 3024, from battery, to the winding of this relay, the left-hand inner break contacts of relay 3117, the front contacts and second armature from the right of relay 3119, to ground, through the operated contacts 2850. Relay 3024 in operating interrupts the operating circuit of magnet 2847 traced above and thus releases this magnet so that it will cause the transmitting cam drum 2851 to come to rest at the end of this revolution.

During this revolution of the cam shaft 2851 a figures signal will be transmitted over the outgoing circuit which under the assumed conditions will be to the recording device 6306. As pointed out above the contacts controlled by the cam barrel 2851 extend to the contacts of relay 3117 through the contacts of relays 3116 and 3119. With relays 3116 and 3119 operated and relay 3117 released a path will be completed through contacts of these relays for leads 1, 2, 4 and 5 connected to the transmitting distributor consequently, marking impulses will be transmitted during these intervals. The No. 3 lead is not connected so that the third impulse will be spaces. In the usual printing telegraph code this

combination represents a figures signal. It is to be understood that any signal may be transmitted by appropriately connecting the leads 1 through 5 to the contacts of relay 3117. Near the end of the revolution of shaft 2851 after the figures signal has been completely transmitted, contacts 2850 will open and permit relay 3117 to operate in series with relay 3024.

Relay 3117 in operating alters the connections to the contacts controlled by the transmitting distributor shaft so that during the next revolution thereof a marking signal will be transmitted only during the third and fifth impulse intervals while the spacing impulse will be transmitted during the first, second, and fourth intervals, thus causing a code combination representing the letter H to be transmitted. The operation of relay 3117 also again completes the circuit of the release magnet 2847 and causes this magnet to operate and release the distributor shaft 2851 for rotation through another revolution. During this revolution the code combination representing the letter H will be transmitted.

Near the beginning of this revolution contacts 2850 close and complete a circuit for the operation of relay 3015. Relay 3015 in operating again interrupts the operating circuit of magnet 2847 and permits this magnet to release so that its armature will cause the cam barrel 2851 to come to rest at the end of this revolution.

Near the end of this revolution after the H signal has been transmitted contacts 2850 will open and permit relay 3118 to operate in series with relay 3015.

Relay 3118 in operating again alters the connections to the distributor contacts so that marking impulse will be transmitted during all five impulse intervals. In other words the code combination representing a letters signal will be transmitted during the next revolution of the cam barrel 2851.

The operation of relay 3118 again completes a circuit for the operation of the distributor start magnet 2847 from battery through its winding over lead 2872 which extends through Figs. 29 and 30, the lower break contacts of relay 3010, the center right-hand armature and front contact of relay 3118 through the right-hand inner operated contacts of relay 3119 over lead 3411, the operated contacts 3483, lead 6511 to ground through the upper operated contacts of relay 6412. Magnet 2847 in operating again releases the cam shaft 2851 for rotation through the third revolution during which time a letters signal is transmitted to the receiving device 6306 thus constituting a complete disconnect signal.

Near the beginning of this third revolution contacts 2850 will again close and complete a circuit for the operation of relay 3010 from battery through the winding of relay 3010, the left-hand inner operated contacts of relay 3119, right-hand inner operated contacts of relay 3118, the left-hand inner operated contacts of relay 3117, front contact and second armature from the right of relay 3119 over lead 2873 extending from Fig. 31 through Fig. 30 and 29 to ground through contacts 2850. Relay 3010 in operating again interrupts the circuit of magnet 2847 and permits this magnet to release so that its armature will cause the cam shaft 2851 to stop at the end of the revolution during which the letters signal is transmitted.

The operation of relay 3010 completes a circuit for maintaining itself operated from battery through its winding and lower operated contacts,

the right-hand center armature and front contact of relay 3118, and right-hand inner operated contacts of relay 3119 to ground over lead 3411 which extends through crossbar switch contacts 3483 and lead 6511 to ground through the upper operated contacts of relay 6412.

The operation of relay 3010 completes a circuit for the operation of relay 3012 from battery through the winding of relay 3012 to ground through the operated contacts of relay 3010. Relay 3012 in operating interrupts the locking circuit of relay 3114. Relay 3114 is slow releasing so that it remains operated until after the letters signal is fully transmitted by the distributor cam barrel 2851. Thereafter relay 3114 will release and interrupt the operating circuit of relay 3110. Relay 3110 will in turn release and interrupt the locking circuit of relay 6412 described above and permit this relay to release. The release of relay 6412 interrupts the locking circuit of relay 3023 as well as the locking circuits of relays 3010 and 3119 thus permitting all of these relays to release. The release of relay 3119 in turn permits relays 3117, 3118, 3015 and 3024 to release. The release of relay 6412 as described above connects ground to the transmission lead 6512 and thus maintains the receiving instrument 6306 in its idle or normal condition. The release of relay 3023 interrupts the locking circuit of relay 6414 and permits this relay to release. The release of relay 6414 interrupts the holding circuit of the hold magnet 8843 and permits this magnet to release which in turn causes contacts 3481 through 3486 inclusive to release and restore the crossbar contacts to their unoperated condition. The release of the hold magnet 8843 interrupts the locking circuit of relay 6411. The release of relay 6411 disconnects ground from the busy test circuit of this outgoing line circuit or channel.

The release of relay 3110 as described above interrupts the locking circuit of relay 3012 and permits this relay to release and restore the circuits to their original condition.

Thereafter when perforated tape becomes available contacts 2821 will again reclose and complete a circuit for the operation of the research relay 3016 after which the system will operate as described above and search for the next code directing character.

Under the assumed conditions where trouble arose at the subscriber's station, the next message may be preceded by message signals from the previous message and the disconnect signals followed by other letters signals and then the directing codes as described above with reference to transmission from station 216.

If transmission was resumed from the subscriber's station at about the time relay 2715 was operated as described above, there may be a few additional message signals perforated in tape 2805 before the transmitter start circuit has had an opportunity to function and stop the transmitter at station 216 and start a transmitter at some other station.

Under these circumstances the remaining portion of the message signals thus recorded in tape 2805 may appear to the director circuit to be part or all of the address code of a succeeding message since the previously established circuit over which the previous or interrupted message was transmitted has been interrupted.

Automatic direction of messages to miscellaneous intercept circuit

Assuming now that some additional signals

have thus been recorded in tape 2805, the transmitting equipment shown in Fig. 23 will sense this first signal and cause the relays 3216 through 3221 to be operated in accordance with this signal in the manner described above. Of course if the next signal is a disconnect signal the discard relay 3018 will operate instead of the relays 3216 to 3221.

Assume for example that the first character is not a discard character and is not a first address code assigned to any station receiving equipment of the system. Consequently, when magnet 2811 operates it will release shaft 2353 for rotation to scan this first letter. Assume that this letter was the letter U. The contacts controlled by members 2809 will therefore be positioned in accordance with the code combination representing the letter U. Near the beginning of the revolution of shaft 2853 contacts 2817 close and complete a circuit for the operation of relay 3113. When the contacts controlled by members 2809 have been fully positioned contacts 2816 will be operated to complete a circuit for operating magnet 2847 which magnet will operate and release the distributor shaft 2851 for rotation through one revolution. During this revolution the letter U signal will be transmitted over conductor 2871 but since this conductor is open at the contacts of relay 3023 this code combination will not be transmitted to any receiving apparatus. Near the beginning of this revolution of shaft 2851 contacts 2850 will close and complete a circuit for the operation of relay 3112. Inasmuch as the letter U signal is not one of the discarded signals relay 3018 will not operate at this time. Near the end of the revolution of shaft 2851 contacts 2850 will open and permit relay 3019 to operate in series with relay 3112. Relay 3019 completes a circuit for the operation of relay 3222. Relay 3222 in operating interrupts the operating circuit of relay 3011 and permits this relay to start to release. This relay is slow in releasing however so that it does not immediately release.

Relay 3222 in operating completes a circuit for the operation of relay 3115 which relay in operating interrupts the locking circuit of relay 3113 and permits this relay to release. Relay 3113 in turn interrupts the circuits through the windings of relays 3112 and 3019 and permits these relays to release.

The operation of relay 3222 in addition connects the left-hand contacts of the group of contacts 1 through 5 controlled by members 2809 to the windings of relays 3216 through 3221. The contacts 1 through 5 which are operated in response to the letter U signal will cause the corresponding relays 3216 through 3221 to operate and lock operated as described above. However, since the letter U has not been assigned as the first directing code to any receiving station or stations connected to the system, the apex conductor 3027 of the fan circuit through the contacts of relays 3216 through 3221 will not be completed through any relays corresponding to relays 3310 to 3313 and thence through relay 3025 to ground. Instead this lead will be open at the terminal block 3316.

The operation of relay 3222 also extends the circuit from the winding of relay 3022 over conductor 3225 to the sequence circuit of Fig. 90. When the sequence circuit becomes idle ground will be connected to this lead in the sequence circuit and cause the operation of relay 3022 but

not the operation of relay 9023 of the sequence circuit as described above.

Upon the operation of relay 3022 and the release of relay 3011 the winding of relay 3017 is connected to the apex of conductor 3027 extending through the contacts of the relays 3316 through 3221. Inasmuch as this lead is open at the terminal block 3316, relay 3017 will release and test the conductor 3225 for direct ground as described above.

The release of relay 3017 also short-circuits resistance 3026 and causes the sequence circuit to function first by causing relay 9023 to operate, which in turn permits relays 9011 and 9010 to release. Relay 9017 operates upon the release of relay 9011 and in turn causes the operation of relay 9016 which makes the sequence circuit busy. The release of relay 9010 then completes a circuit for the operation of relay 9018. Relay 9018 in operating connects battery to conductor 3226 and causes the operation of the crossbar selector and horizontal magnet 3401. The operation of this magnet conditions the corresponding row of contacts of the crossbar switch and completes a circuit for the operation of relay 2934. Relay 2934 in operating transfers the apex conductor 3027 from the winding of relay 3017 to the windings of relays 2917 and 2919.

The operation of relay 2934 also interrupts the operating circuit of relay 2918 and thus permits this relay to start to release. Under the assumed conditions the apex conductor will be open so that neither relay 2919 nor relay 2917 will operate. Consequently, when relay 2918 releases a circuit will be completed for the operation of relay 2930 as described above when the G and Z signals were discarded. The operation of relay 2930 interrupts the operating circuit of relay 3222 and in turn permits this relay to release.

The release of relay 3222 interrupts the circuit over conductor 3225 which will release the sequence circuit shown in Fig. 90 as described above and restore it to its original condition. The horizontal magnet 3401 will likewise be released and release relay 2934. Relay 2934 in releasing again completes a circuit for the operation of relay 2918. When the circuit of conductor 3225 is interrupted relay 3022 will also release and again complete a circuit for the operation of relay 3017.

The release of relay 3222 reestablishes the operating circuit of relay 3011. The reoperation of relay 3011 at this time completes a circuit for the operation of relay 2932 from battery through the winding of relay 2932, the upper outer operated contacts of relay 2930, the operated contacts of relay 2918, the operated contacts of relay 3011 to ground through the center set of lower operated contacts of relay 3016. Relay 2932 in operating completes a circuit for maintaining itself operated from battery through its winding, the upper outer operated contacts of relay 2930, the upper inner operated contacts of relay 2932 to ground through the center set of lower operated contacts of relay 3016. The operation of relay 2932 again interrupts the operating circuit of relay 3011 and permits this relay to start to release.

The operation of relays 2930 and 2932 also transfers the busy test conductor from the apex circuits to lead 8719 extending from Fig. 29 through Figs. 30, 31, 32, 33, 46, 58, 64, 72, 80, and 87 to the miscellaneous intercept circuit shown in Fig. 87.

The release of relay 3222 interrupts the operating circuit of relay 3115 and permits this relay to release and the release of relay 3115 will again

complete a circuit for the operation of the transmitter start magnet 2811. The operation of magnet 2811 releases the cam shaft 2853 for rotation through another revolution. During this second revolution the second code combination stored in tape 2805 will be scanned and contacts 1 through 5 controlled by members 2809 positioned in accordance with this code combination. Near the beginning of this revolution contacts 2817 will close and complete a circuit for the operation of relay 3113 which relay in operating completes a circuit for maintaining itself operated under control of relays 3115 and 3016 as described above. After the contacts controlled by members 2809 have been fully positioned in accordance with this next code combination the contacts 2816 will close and complete a circuit for the operation of the distributor magnet 2847. The operation of this magnet will release the distributor shaft 2851 for rotation through one revolution during which this code combination is transmitted over conductor 2871. This conductor is interrupted at this time however so this code combination is not transmitted to any receiving apparatus.

Near the beginning of this revolution of the distributor shaft 2851 contacts 2850 will close and complete a circuit for the operation of relay 3112. If this second code combination is a discard code combination relay 3018 will operate and the circuits and apparatus function as described above when the G and Z signals were discarded.

Assuming now that the second code combination is not one of those which are discarded. Consequently relay 3018 will not operate at this time. The operation of relay 3112 as described above completes a circuit from the winding of relay 3022 over conductor 3225 to the sequence circuit shown in Fig. 90. This circuit extends from battery through the winding of relay 3022, resistance 3026, the upper inner break contacts of relay 2914, the upper inner break contacts of relay 2913, the center right armature and front contact of relay 3112, the lower outer operated contact of relay 2932, lower inner operated contact of relay 3016 over lead 3225 which extends to ground through the winding of relay 9023 if the sequence circuit in Fig. 90 is idle. If the sequence circuit is not idle the circuits remain in the condition described except that near the end of the revolution of the cam shaft 2851 contacts 2850 will open and permit relay 3019 to operate in series with relay 3112. When the sequence circuit becomes idle relay 3022 will operate and connect the winding of relay 3017 to lead 8719. If the miscellaneous intercept circuit is idle relay 3017 will release and short-circuit resistance 3026.

More than one director circuit may attempt to simultaneously test busy lead 8719 to determine whether or not the miscellaneous intercept circuit is busy. More than one director circuit may test any of the other leads to determine if the particular outgoing line circuit is busy.

Assume for the moment that two director circuits simultaneously test the lead 8719 to determine whether or not the miscellaneous intercept circuit is busy. Of course, if the circuit is busy relay 3017 will remain operated and the relay corresponding to this relay in the other director testing this circuit will also remain operated. When the miscellaneous intercept circuit becomes idle ground will be removed from lead 8719 and relay 3017 will release. In addition the relays of the other directors testing the lead 8719 will also release. The release of these relays short-circuits resistance 3026 as well as the resistance of the

other directors corresponding to this resistance. When resistance 3026 is short-circuited relay 9023 will operate as described above assuming of course that the sequence circuit shown in Fig. 90 is idle. In a similar manner other of the relays 9021 through 9025 associated with the other directors testing the miscellaneous intercept circuit will also operate in similar circuit. However, only one of these relays, namely, the highest numbered one will lock operated because the locking circuit of the lower number relays is completed through break contacts of the higher number relays. For example, assume that both relays 9022 and 9023 are simultaneously operated when the sequence circuit shown in Fig. 90 becomes idle and the miscellaneous intercept circuit also becomes idle. Under these circumstances the operation of relay 9023 will interrupt the locking circuit of 9022 and prevent it from locking operated. However, the operation of relay 9023 in operating will complete a circuit for maintaining itself operated. The operation of these two relays interrupt the operating circuits of relays 9010 and 9011. Relay 9011 releases and completes a circuit for the operation of relay 9017, which relay in turn completes a circuit for the operation of relay 9016. Relay 9016 in operating interrupts the operating circuit of relays 9021 through 9025. Consequently only the one relay which is locked operated will remain operated and all of the others will release. Under the assumed conditions relay 9023 will remain operated and relay 9022 will release when relay 9016 operates. A short interval of time later after relays 9021 through 9025 have had ample time to release the slow release relay 9010 will finally release and complete a circuit for the operation of relay 9018. At this time only one of the relays 9021 through 9025, i. e., 9023 will be operated. Consequently, the operation of relay 9018 will complete a circuit to only one horizontal magnet which under the assumed conditions will be magnet 3401.

It will be readily understood by those skilled in the art that the sequence circuit shown in Fig. 90 may be arranged so that any director circuit or circuits may be given an opportunity to establish connections through the crossbar switch in any desired order. That is, the circuits may be arranged so that when calls are awaiting for connection to outgoing lines the director circuits and associated transmitters are given an opportunity to be connected to the proper outgoing line circuit in a definite sequence which is determined by the position in the sequence circuit of the relay assigned to that director. For example, as illustrated in the drawing, the director circuits shown in Fig. 71, that is, the director circuits of the trunk circuit are given the first turn. The director circuit of the originating station shown in Fig. 79 is given next turn. The party line 210 is given next turn while the half duplex line 260 is given next turn and the intercept circuit shown in Fig. 86 is given last turn. It will be readily understood by those skilled in the art that the connections of the leads between the director circuits and the windings and contacts of relays 9021 through 9025 may be arranged to provide any sort of sequence between the various director circuits.

It will also be apparent to those skilled in the art that a number of relays or directors is not limited to those shown in the drawing but may be extended to as many as may be necessary, it being understood that each director is provided with a relay similar to relays 9021 through 9025

all connected in the chain circuit so that only one of these relays will remain operated after the operation of relay 9016. Under these circumstances only one of the horizontal magnets will be operated and the director circuit associated therewith permitted to proceed with the establishment of a connection through the crossbar switch and the other director circuits upon the interruption of the circuit over the leads corresponding to lead 3225 cause the relay corresponding to relay 3022 to release and reoperate relay 3017 and remain in this condition until both the sequence circuit and the circuit to which the message is directed, or the intercept circuit, has, under the assumed conditions, again become idle.

Returning now to the operation of the director circuit shown in Figs. 28, 29, 30, 31, 32, and 33 and assuming that the miscellaneous intercept circuit is idle and that relay 9023 operates and locks operated. The horizontal magnet 3401 is then operated after relay 9018 operates. The operation of this magnet completes a circuit for the operation of relay 2934. Relay 2934 in operating interrupts the operating circuit of relay 2918 and permits this relay to start to release. The operation of relay 2934 also connects the windings of relays 2917 and 2918 to lead 8719 for the purpose of testing this lead to insure first that it is complete and second that it has not become crossed with some other lead. If two vertical magnets are connected to this lead both relays 2917 and 2919 will operate and the operation of relay 2919 stops the further operation of the system and causes indication of a trouble condition to appear before the attendant as described above. If only one vertical magnet is connected to this lead as will be the usual case, only relay 2917 will operate.

The operation of only relay 2917 at this time completes a circuit for the operation of relay 2933 from battery through the winding of relay 2933, operated contacts of relay 2917, the right-hand contact and armature of relay 2919 to ground through the upper operated contacts of relay 2934 and the center set of lower operated contacts of relay 3016.

Assume now that lead 8719 extends only to one vertical magnet which is magnet 8846. Under these circumstances relay 2917 will operate but relay 2919 will not. The operation of relay 2917 at this time completes a circuit for the operation of relay 2933. Relay 2933 in operating interrupts the operating circuit of relay 3021 and permits this relay to start to release. Relay 2933 in operating completes a circuit for maintaining itself operated under control of relay 2934.

Relay 2933 in operating connects direct ground to lead 8719 and thus to the circuit for the operation of the vertical magnet 8846 of the crossbar switch. The operation of magnet 8846 completes a circuit for the operation of relay 8753 from battery through the winding of relay 8753, the left-hand break contacts of relay 8754 to ground through the operated contacts of magnet 8846.

The operation of magnet 8846 at the time magnet 3401 is operated causes the crossbar contacts 3441 through 3446 to operate. That is, the simultaneous operation of these two magnets causes these contacts to close. The closure of contacts 3444 together with the operation of relay 8753 complete a circuit for the operation of relay 3111. The operating circuit of relay 3111 has been previously described with reference to other outgoing line circuits so it is not believed necessary to describe this operating circuit in detail. The opera-

tion of relay 3111 completes a circuit for maintaining itself operated under control of the cross-bar switch contacts 3446 and relay 3110. The operation of relay 3111 interrupts the locking circuit of relay 2930 and permits this delay to re-
 5 lease. The release of relay 2930 interrupts the locking circuit of relay 2932 and thus permits relay 3932 to release. The release of relay 2932 again completes the operating circuit of relay 3011 and thus causes this relay to operate. The
 10 release of relay 2932 interrupts the circuit extending from the winding of relay 3022 over lead 3225 to ground through the winding of relay 9023 in the sequence circuit. Thus both relays 3022 and
 15 9023 release. The release of relay 3022 again completes the operating circuit of relay 3017 and causes this relay to reoperate.

The release of relay 9023 causes the sequence circuit shown in Fig. 90 to be restored to its normal or idle condition as described above and
 20 interrupts the operating circuit of relay 3401. Relay 3401 in releasing causes relay 2934 to release and this relay in releasing again establishes the operating circuit of relay 2918 and inter-
 25 rupts the locking circuit of relay 2933 thus permitting this relay to release. The release of relay 2933 reestablishes the operating circuit of relay 3021 and causes this relay to reoperate.

The operation of relay 3111 as described above completes a circuit for the operation of relay
 30 8754. The operation of relay 8754 completes a circuit for maintaining the vertical magnet 8846 operated and thus maintaining contacts 3441 through 3446 closed. The operation of relay 8754 also transfers the winding of relay 8753 from
 35 ground through the operated contacts of the vertical magnet 8846 to ground connected to lead 8719 through the operated contacts of relay 2933. Upon the release of relay 2933 as described above the locking circuit of relay 8753 is interrupted
 40 so that this relay releases. The release of relay 8753 completes a circuit for the operation of relay 8752. Relay 8752 in operating removes ground from the left-hand winding terminal of the control magnet 8760 of the recording device
 45 8761 so that this magnet and recording device will then be in condition to receive messages from the transmitter shown in Fig. 28. The operation of relay 8752 completes a circuit for the operation of relay 8751. Relay 8751 operates and con-
 50 nects ground to lead 8719 thus maintaining the miscellaneous intercept circuit busy. Operation of relay 8752 also connects ground to alarm leads for indicating a trouble condition to the attend-
 55 ants because messages are directed to the intercept circuit only due to some trouble condition. The operation of relay 8752 also lights the busy lamp 8762 and indicates that the intercept circuit is busy.

Relay 8751 in operating completes a circuit for
 60 maintaining itself operated under control of the operated contacts of the vertical magnet 8746. The operation of relay 8752 also completes a circuit for the operation of start relay 3023. The operation of this relay extends the transmission
 65 path of lead 2871 to leads 3412 and 3410. Operation of the start relay 3023 also completes a circuit for maintaining itself operated under control of the crossbar contacts and operated con-
 70 tacts of relay 8752.

The operation of relay 3023 completes a circuit for the operation of relay 3116 which relay in
 75 turn connects ground to lead 3410 and disconnects this lead from lead 3412. The operation of relay 3116 also transfers the contacts of the

transmitting distributor shown in Fig. 28 from the contacts of the transmitter to contacts of re-
 80 lays 3216 through 3221. The operation of relay 3116 also completes a circuit for the operation of magnet 2847, which magnet in turn operates and releases the distributor shaft 2851 for rotation
 85 through one revolution. During this revolution the code combination representing the letter U signal, which caused relays 3216 through 3221 to be positioned in accordance therewith, will be
 90 transmitted over lead 3412. The transmission circuit over lead 3412 extends to the control magnet 8760 at this time, consequently, this character will be recorded by the recording device
 95 8761.

The recording device 8761 may be either a re-
 100 perforator or printing reperforator which causes the signals to be perforated or punched in the tape and also cause them to be printed thereupon. This recording device may be similar to those described with reference to Figs. 91 through
 96 in the drawing.

It will be readily appreciated by those skilled in the art, however, that the recording device 8761
 105 may be any suitable type of recording instrument, as for example the teletypewriter.

Near the beginning of the revolution of the distributor shaft 2851 contacts 2850 will close and complete a circuit for the operation of relay 3024
 110 which relay in operating interrupts the operating circuit of magnet 2847. Near the end of the revolution of the shaft 2851 contacts 2850 will open and permit relay 3117 to operate in series with relay 3024. Operation of relay 3117 again
 115 completes a circuit for the operation of distributor magnet 2847 which releases the distributor shaft 2851 for rotation through another revolution.

The operation of relay 3117 also interrupts the
 120 operating circuit of relay 3116 thus permitting this relay to release and restore the connection between the distributor contacts and the contacts controlled by members 2809. Consequently, during this revolution of the distributor shaft 2851
 125 a code combination in accordance with the character following the U signal will be transmitted to the control magnet 8760. Under these circumstances both of the code directing characters are transmitted to and recorded by the receiving
 130 recorder 8761 of the miscellaneous intercept circuit.

Near the beginning of this revolution of the distributor shaft 2851 contacts 2850 will close and complete a circuit for the operation of relay
 135 3015. Relay 3015 in operating interrupts the locking circuits of relays 3216 through 3221 and thus permits these relays to release. The operation of relay 3015 in addition interrupts the operating circuit of the distributor magnet 2847
 140 and permits this magnet to release. Near the end of the revolution of the distributor shaft 2851 contacts 2850 open and permit relay 3118 to operate in series with relay 3015. The operation of relay 3118 at this time completes a circuit for the operation of relay 3114, which relay
 145 in operating in turn completes a circuit for the operation of relay 3110. Relay 3110 in operating causes the remaining portion of the message stored in the tape 2805 to be transmitted to the recording device 8761. In addition the opera-
 150 tion of relay 3110 causes numerous relays to release in a director circuit as described above in a manner similar to the manner when a connection is established to any of the outgoing line
 155 circuits.

It is also possible that the first character of the remaining portion of the message the transmission of which was interrupted will be a character assigned as the first code of some station connected to the system. Assume for example that this character was the letter A. In this case the circuits will operate as described above when a connection was established to the outgoing line circuit of a local line. However, if the second character is one which is not assigned as the second character and one which is not discarded when the circuits will operate as described above except that upon the operation of relay 2934 in response to seizure and operation of the sequence circuit, relay 2917 will not operate because the circuit through this relay over the apex conductor 3028 will be open at the terminal block 3320. Consequently, relay 2917 will not operate. Instead relay 2930 will operate upon the release of relay 2918 a short interval of time later.

The operation of relay 2930 at this time interrupts the operating and locking circuit of relay 3210 and permits this relay to release. The release of relay 3210 interrupts the circuits from relay 3022 over lead 3225 extending through the winding of relay 9023 in the sequence circuit and thus causes both of these relays to release.

The release of relay 3022 causes relay 3017 to reoperate. The release of relay 9023 causes the sequence circuit to be restored to its idle or normal condition and causes the release of horizontal magnet 3401. The release of magnet 3401 causes relay 2934 to release. The release of relay 2934 causes relay 2918 to reoperate. The release of relay 3210 completes a circuit for the operation of relay 3011. The operation of relays 3011 and 2918 completes a circuit for the operation of relay 2932. The operation of relay 2932 causes lead 8719 to be tested for busy by establishing a connection to the sequence circuit. The sequence circuit must be idle for the test to be made as described above. Thereafter the connection is established to the miscellaneous intercept circuit shown in Fig. 87 in the same manner as described above and both the code directing characters which cause the message to be routed to intercept will be transmitted to the recording device 8761 as well as the following characters forming a portion at least of a message. At the end of these characters the figures and H signals followed by a letters signal, if received, will cause the established connection to be broken down and the circuits restored to their original condition in the same manner as described above with reference to the outgoing line circuits of party lines or truck circuits. If the transmitter in trouble is disconnected before the disconnect pattern is sent it will be necessary for the operator at the central switching center to interrupt the connection by operating the director stop key 2833 and then operate the disconnect key 2832 and then operate and restore key 2834. The operation of these keys in this manner causes the circuits to the intercept circuit to be interrupted in the manner described herein.

Returning now to the second message stored in the tape 2805 which was the third message transmitted from the subscriber's station 216 and assuming that this message is properly addressed and transmitted in its entirety to the recording device controlled by the selector magnet 6325 as described above. At the end of the message the figure signal will cause relay 3020 to operate. This relay is slow to release so that if the immediately

following signal is an H signal relay 3013 will be operated in response thereto. However, if some other signal is interposed between the figure signal and the H signal relay 3020 will release so that relay 3013 will not operate because its operating circuit extends through operated contacts of relay 3020 as described above.

At the end of the message the H signal always immediately follows the figure signal so that relay 3020 will be operated at this time. If the H signal does not immediately follow the figure signal due to some trouble condition the emergency disconnect circuits and apparatus including relay 3119 will operate and transmit a figure signal immediately followed by an H signal, as described above. Upon the transmission of the letters signal following the H signal relay 3012 will operate as described above and cause the various relays to release and disconnect the transmitter from the recording device 6306 associated with the trunk circuit 290.

The operation of relay 3012 interrupts the locking circuit of relay 3114. Relay 3114 is somewhat slow in releasing so that the connection is not interrupted until after the letters signal has fully transmitted. The operation and release of the various relays as described above in addition to interrupting the transmission path from the transmitter shown in Fig. 28 to the recording instrument 6306 shown in Fig. 63 also stop the operation of the transmitting equipment in Fig. 28.

If there are additional messages stored in tape 2805 as there will be under the assumed condition, upon the release of relay 3023 the circuit will be reestablished for the operation of relay 3016. The operation of relay 3016 then establishes the various circuits described above for causing the transmitting equipment shown in Fig. 28 to sense the succeeding groups of perforations or punches in tape 2805. As described above, the letter signals, figure signals, H signals, Z signals, and blank signals will be discarded in the manner described above. Consequently, the letters signal followed the H signal perforated in tape 2805 will be discarded.

In accordance with the signals assumed to have been transmitted from station 216 the letter G signal followed by the letter H signal will be recorded in tape 2805. Inasmuch as the letter H signal is one of the discard signals both the G and H signals will be discarded from tape 2805 in a manner similar to the manner in which the G signal and Z signal were discarded from the tape after the first message was transmitted as described above. The letter signals following the H signal will also be discarded following which the B signal followed by a K signal will be recorded in this tape. These signals will be sensed by the transmitting head 2806 and cause the circuits to function and cause the transmitting equipment in Fig. 28 to be connected to either the recording equipment 1906 shown in Fig. 19 or the recording equipment 2006 shown in Fig. 20. Under the conditions assumed with the circuits as shown in the drawings the message will be transmitted to the recording device 1906.

Automatic transmission to the willful intercept circuit

If it is desired to intercept any of the messages at the central switching station as, for example, if station 219 is not operative at the particular time due to some trouble condition thereat or due to the fact that it is located in a State or nation or district having a holiday at the time or having

different hours of business, it is possible to intercept this message by operating an appropriate intercept key at the central switching station. The intercept keys are shown in Fig. 33. These keys together with other keys, lamps, etc., are located on a control board at the central switching station and indicated in Fig. 3 at 391.

Generally, a key is provided for each of the individual stations of the system and by operating this key the circuits are so arranged that when a message is directed to this particular station it will be routed to the intercept position instead of being transmitted to the station. Where desirable, one intercept key may be provided for a plurality of stations or receiving devices. Inasmuch as the recording equipment 229 at station 219 has been assigned two address signals, namely, BJ and BK, it generally will be undesirable to intercept messages preceded by only one of the addresses and permit messages preceded by the other address to be transmitted to this station. The circuits as shown in Fig. 33 have, therefore, been provided with only one intercept key for these two address codes. Consequently, when this key 3322 is operated, messages preceded by the address codes BJ and BK will be routed to the intercept position.

It will be quite apparent to those skilled in the art that if it is desirable to intercept only those messages preceded by one of the address signals and not messages preceded by other address signals even though they will be recorded upon the same receiving instrument, that individual keys similar to key 3322 will be provided for each address code. If this is the case, then when one of the keys is operated, messages preceded by the address codes assigned to this key will be routed to the intercept position while messages preceded by the other address codes assigned to this machine will be transmitted thereto. As shown in Fig. 33, key 3315 is provided so that when this key is operated messages directed to any of the stations controlled by the secondary switching center 263 will all be directed to the willful intercept circuit. In addition, other intercept keys are provided which are individual to each of the stations served by this switching center so that it is possible to intercept messages for any of the individual stations and also to intercept messages for all of these stations by the operation of a single key instead of necessitating the operation of all of the individual keys. Thus, it will be quite apparent to those skilled in the art that suitable intercept keys may be provided for intercepting the messages for individual stations or for any desired group of these stations merely by changing the connections of these keys as shown by the typical examples referred to above and illustrated in Fig. 33.

The operation of any of the intercept keys transfers the busy test and control lead over which the hold magnets of the crossbar switch are operated from the outgoing line circuit of the line to which the particular station in question is connected to the corresponding test and control lead extending to the hold magnet associated with the willful intercept circuits.

Under the assumed conditions where it is desired to intercept the third message recorded in tape 2805, key 3322 is operated, the operation of this key transfers the BK lead from lead 2119 extending to the outgoing line circuit of the party line 210 and connects it to the lead 3323 extending to the line circuit shown in the upper half of Fig. 87 associated with the willful intercept cir-

uits. Consequently, when relay 3022 operates, after the transmitting head 2806 has sensed both the B and K code combinations and the sequence circuit is idle, it will connect the winding of relay 3017 to lead 3323 and test this lead for a busy condition instead of connecting the winding of relay 3017 to lead 2119 extending to the outgoing line circuit of party line 210. The circuit will then operate in substantially the same manner as described hereinbefore and cause a message to be transmitted to and recorded by the recording device 8206.

Of course, if key 3322 is operated after the hold magnet 8840 or 8841 has operated it will be ineffective to cause the particular message from being routed to the outgoing line circuit of party line 210 to be rerouted to the willful intercept circuits. Similarly, if this key is operated before the path extending to party line 210 is tested by the director circuit the message will be automatically routed to the willful intercept position circuit.

It is conceivable that this key might be operated just after the path of lead 2119 is tested and found to be idle but before the hold magnet could be operated. If this is the case and the intercept circuit is busy at this time, neither the hold magnet 8840 of the outgoing line circuit of party line 210 nor the hold magnet 8845 of the willful intercept circuit will operate. Of course, if the intercept circuit is busy the hold magnet 8845 will already have been operated without closing any of the contacts 3431 through 3436. Consequently, none of the cross-points associated with the selector magnet 3401 will be operated at this time. Relay 3111 will not operate under these conditions to intercept the circuit of relay 3210. Relay 3210 will, therefore, be unable to release and interrupt the circuit through the winding of relay 3022 extending over conductor 3225 to the sequence circuit shown in Fig. 90.

So long as relay 3111 remains released relay 3023 will not operate so that the circuits will remain in this condition until relay 3021 releases. It will be recalled that relay 2917 operates in response to a single hold magnet being connected to one of the test leads which will be lead 2119 under the assumed conditions. It is assumed above that this relay 2917 operates which in turn causes relay 2933 to operate. The operation of relay 2933 as described above connects ground to the circuit of a hold magnet extending over lead 2119 for the purpose of operating the hold magnet 8840 or 8845 if key 3322 is operated. However, under the assumed conditions key 3322 is operated just after relays 2917 and 2933 operate but before the hold magnet 8840 operates and the willful intercept circuit is busy so that ground will be connected to lead 3323 and not the hold magnet 8845. As described above, the operation of relay 2933 interrupts the operating circuit of the slow release relay 3021. This relay, however, does not immediately release but remains operated for a period of time longer than required for a connection to be established under normal operating conditions. However, when the key 3322 is operated at the instant assumed above, a connection will not be established by the time relay 3021 releases. Upon the release of relay 3021 under these circumstances the release of relay 3021 will complete a circuit for the operation of relay 3017.

It will be recalled that when the outgoing line circuit of the intercept circuit is busy relays 8714, 8712 and 8711 are maintained operated. The operation of relay 8711 connects ground to lead 3323

extending from Fig. 87 through Figs. 80, 72, 64, 58, 46 and 33, operated contacts of key 3322, BK lead, upper operated contacts of relay 3311, K lead through the contacts of relays 3211 through 3215 and the lower inner operated contacts of relay 3210 over the apex lead 3028 which extends through Fig. 31, the lower inner operated contacts of relay 3014, the lower break contacts of relay 2930, lower inner break contacts of relay 2931, upper break contacts of relay 3021, the lower break contacts of relay 3011 and operated contacts of relay 3022 to battery through the winding of relay 3017. Relay 3017 in operating at this time inserts high resistance 3026 in series with the lead 3225 extending to the sequence circuit thus causing relay 3023 to release and restore the sequence circuit to its idle condition. The release of the sequence circuit will cause the horizontal magnet 3401 to release which in turn releases relay 2934. The release of relay 2934 interrupts the locking circuit of relay 2933 and permits this relay to release. Release of relay 2933 reestablishes the operating circuit of relay 3021 and causes this relay to reoperate. The reoperation of relay 3021 at this time transfers the busy test lead described above from its back contacts through its front contacts and back contacts of relay 2934 to the winding of the busy test relay 3017. Thereafter, the circuit will remain in this condition until the intercept circuit becomes idle at which time relay 3017 will again release and thereafter the circuits will operate as described above during which the lead 3323 will be tested for the presence of a single holding magnet 3345 and circuits established to the intercept circuit in a manner similar to the manner in which a connection is established to other recording instruments.

If the intercept key had been operated and is released at the particular time in question the circuit will operate in the same manner as when this key is operated except that the message will be transmitted to the proper outgoing line circuit instead of to the willful intercept circuit.

Thus, even if the intercept key 3322 is operated or released just at this particular moment assumed or either before or after this particular moment the circuits will operate to direct a message either to the intercept circuit or to a line circuit only when these circuits are idle.

At the end of this message whether transmitted to the outgoing line circuit of party line 210 or to the willful intercept circuit a figure signal followed by the H signal and then a letters signal will cause the connection to be interrupted and the circuits restored to their initial condition. Thereafter, the circuits will function to discard the letter signals, the H signal and any additional letter signals recorded in the tape 2805. If no messages have been received in the meantime after the transmitting head 2806 has sensed the last signal recorded in tape 2805, contacts 2821 will be opened and interrupt the circuit of the release magnet 2811 and thus stop the operation of the transmitting and sensing equipment shown in Fig. 28.

Of course, if transmission has in the meantime started from some other station connected to the party line 210 either due to the operator having manually operated some one of the start keys or due to the automatic operation of the start circuit the additional messages recorded in tape 2805 will be sensed and directed to the proper line in accordance with the address signals received in a manner similar to the manner described above.

Originating messages at the switching center

As indicated above, provision has been made for the initiation of messages at the switching center. Details of this equipment and the related circuits are shown in Figs. 74 to 81, inclusive. As shown in Fig. 74, an originating instrument 7410 is provided with keyboard 7416. The operator or attendant may operate this keyboard which will cause a tape 7417 to be punched or perforated in accordance with the messages to be transmitted thereby. Typical apparatus for use in combination with the circuits at the central switching station for perforating tape and then transmitting signals in accordance therewith is described in detail in U. S. Patents 1,965,572, granted to Burcky et al. on July 10, 1934; 1,965,602, granted to Lake on July 10, 1934; and 1,969,891 granted to Lake et al. on August 14, 1934, the disclosures of which are hereby made a part of this disclosure as if fully included herein. This equipment, it is to be understood, is connected as shown in Fig. 74.

With key 7412 in the position shown and the keyboard-tape lever in its central position, the operation of the keys of the keyboard 7416 in addition to causing tape 7417 to be perforated in accordance with the messages to be transmitted also causes the transmitting contacts 7415 to transmit corresponding signals to the receiving magnet 7413 of a recording instrument. In this manner the operator is provided with a printed copy of the message as it is perforated in the tape 7417. This enables the operator to easily check the signals stored in the tape 7417 and to correct errors therein.

For the purpose of illustration, assume that it is desired to transmit a message from the central switching station to some one of the stations connected to line 210 as, for example, station 223. In addition, assume that it is desired to transmit a second message both to the second switching center as shown in Fig. 6 and also to station 521.

As before, the operator will first perforate a number of letters signals in tape 7417 followed by the disconnect pattern comprising a figure signal, an H signal and a letters signal. Following these signals the attendant will perforate the address code of the first message which, under the assumed conditions, will be BX. These code combinations will then be followed by a letters code combination, a carriage return, a line feed and another letters signal after which the operator will perforate the message intended for the station 223. Following the message the attendant will perforate another disconnect pattern in the tape and then after one or more letters signals will perforate the code for directing the following message both to the second switching center and to station 521. These codes comprise first the letter N signal followed by the letter H signal. These signals will then be followed by one or more letters signals after which the subscriber will perforate a K signal followed by a Y signal in the tape. Thereafter the attendant will perforate additional letters signals, a carriage return, a line feed and another letters signal in the tape following which she will operate keyboard 7416 in accordance with the message to be transmitted to both of these stations. At the end of the message another disconnect pattern will be perforated in tape 7417. Assuming now that there are no further messages for transmission from the central switching point, the attendant will perforate an additional number of letters

signals in the tape so that the entire message will be advanced out of the perforating mechanism after which she will tear the tape 7417 and insert the beginning thereof in the tape transmitter 7431 and close the starting switch 7420.

Upon the insertion of tape 7417 in transmitter 7431 and the closure of switch 7420 a circuit will be completed for the operation of relay 7510 from battery through the winding of relay 7510 to ground through switch 7420 and contacts 7418 and 7419. A circuit is also completed at this time for the operation of relay 7716 from battery through its winding and upper inner break contacts, lower inner break contacts of relay 7723, the lower inner break contacts of relay 7614, the center lower armature and break contact of relay 7613, lower break contact of relay 7610 to ground through switch 7420 and contacts 7419 and 7418.

As described above, with reference to relay 3016 the operation of relay 7716 completes a circuit for the operation of relay 7717 from battery through the winding of relay 7717 and the break contacts of relay 7722 to ground through the center set of lower operated contacts of relay 7716. The operation of relay 7716 also completes a circuit for the operation of relay 7711 from battery through the winding of relay 7711, the upper break contacts of relay 7632, lower outer break contacts of relay 7910, lower inner break contacts of relay 7922 to ground to the center set of lower operated contacts of relay 7716. The operation of relay 7716 also completes a circuit for the operation of relay 7618 from battery through the winding of relay 7618 and the upper break contacts of relay 7634 to ground through the center set of lower operated contacts of relay 7716. The operation of relay 7716 completes a circuit for the operation of relay 7721 from battery through its winding and the upper break contact of relay 7613 to ground through the center set of lower operated contacts of relay 7716. Operation of relay 7716 also completes a circuit for the operation of relay 7519 from battery through the winding of relay 7519 to ground through the upper outer operated contacts of relay 7716. It should be noted that relay 7520 was previously operated by current flowing through its upper winding in an obvious circuit, extending from battery through its upper winding and the lower break contact relay 7519. Upon the operation of relay 7519 the circuit through the upper winding of relay 7520 is interrupted and a circuit extending from battery through its lower winding and the lower operated contacts of relay 7519 is completed to ground through the auxiliary contacts 7421 of transmitter 7431.

The operation of relay 7519 transfers the armatures of the tape control contacts 1 through 5, inclusive, from conductors 7534 to the left-hand windings of relays 7521 through 7525, respectively.

The operation of relay 7716, as described above, completes a circuit for the operation of transmitter start magnet 7422 from battery through the winding of this magnet over lead 7432, extending through Figs. 75, 76 and 77, the center set of right-hand break contacts of relay 7810, the left-hand inner break contacts of relays 7813, 7812 and 7815, the third set of operated contacts from the top of relay 7716, the center set of lower break contacts of relay 7613, lower break contacts of relay 7610 to ground through switch 7420 and contacts 7419 and 7418.

The operation of magnet 7422 will release the

distributor shaft carrying brush arm 7425 for rotation through one revolution. Near the beginning of this revolution contacts 7421 will open and interrupt the circuit through the lower winding of relay 7520, as described above, and permit this relay to release. Release relay 7520 completes a circuit for the operation of relay 7813 from battery through the winding of relay 7813, the second set of operated contacts from the top of relay 7716 to lower break contacts of relay 7713 to ground through the inner break contacts of relay 7520. The operation of relay 7813 interrupts the circuit through the transmitter start magnet 7422 and permits the magnet to release so that it will stop the brush arm 7425 at the end of this first revolution. The operation of relay 7718, in addition, completes a circuit for the operation of relay 7812 from battery through the winding of relay 7812 and the left-hand outer operated contacts of relay 7813, the upper inner break contacts of relay 7719 to ground through the outer break contacts of relay 7520.

During the first revolution of brush arm 7425 the sensing fingers of the transmitter 7431 will rise and sense the row of perforations of tape 7417 over them. Contacts 1 through 5 will then be positioned in accordance with this row of perforations in the tape as is well understood by those skilled in the telegraph art. Contacts 1 through 5 are generally positioned before contacts 7421 open. The closure of contacts 1 through 5 in accordance with the perforations in the tape will complete obvious circuits for the operation of the corresponding relays 7521 through 7525. Under the assumed conditions wherein a letters signal is recorded on the tape, all five contacts will close and complete a circuit for the operation of all five relays 7521 through 7525. The operation of all five of these relays will complete a circuit for the operation of discard relay 7718 from battery through the winding of relay 7718, the lower break contacts of relay 7631, the right-hand inner operated contacts of relay 7812 and the center set of left-hand break contacts of relay 7811 through the right-hand inner break contacts of relay 7810 over lead 7820 which extends through Figs. 77, 76 and 75 through the left-hand outer operated contacts of relays 7523 and 7524, the left-hand inner operated contacts of relays 7525 and 7521 and left-hand outer operated contacts of relay 7522 to ground.

The operation of relay 7718 completes a circuit for the operation of relay 7815 from battery through the winding of relay 7815 to ground through the lower operated contacts of relay 7718. Operation of relay 7815 interrupts the locking circuit of relay 7813 extending from battery through the winding of relay 7813 through the second set of upper operated contacts of relay 7716 through the right-hand operated contacts of relay 7813 to ground through the right-hand break contacts of relay 7815. Relay 7813, however, does not release at this time because its operating circuit, traced above, has been maintained closed through the upper break contacts of relay 7520. Thereafter the circuits remain in this condition during the remainder of the revolution of the brush arm 7425. During this revolution the signals are transmitted over lead 7471. However, this lead is open at contacts of relay 7723 at this time so these signals are not transmitted to any receiving equipment.

Near the end of the revolution of the brush arm 7425 contacts 7421 will reclose and a short

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interval of time later the sensing fingers will be withdrawn from the tape and contacts 1 through 5 will return to the position as shown in the drawing. The closure of contacts 7421 complete locking circuits for maintaining relays 7521 through 7525 operated. In addition, closure of these contacts completes a circuit through the lower winding of relay 7520 for causing this relay to reoperate. The operation of relay 7520 interrupts the operating circuits of relays 7813 and 7812 and permits these relays to release. The release of relay 7812 interrupts the operating circuit of relay 7718 and permits this relay to release which relay, in turn, releases the reset relay 7815. Release of relay 7815, together with the release of relays 7813 and 7812 will again re-establish a circuit through the transmitter start magnet 7422 which magnet will reoperate and again release the brush arm 7425 for rotation through another revolution. Near the beginning of this revolution the sensing fingers will sense the next row of perforations in tape 7417 and position contacts 1 through 5 in accordance with the perforations in this row. The operation of these contacts will complete operating circuits for relays 7521 through 7525 as described above. A short interval of time later contacts 7421 will open and interrupt the locking circuits, relays 7521 through 7525 and permit those of this group of relays which are not maintained operated by contacts 1 through 5 which were previously operated to release. Thereafter, only those relays 7521 through 7525 will remain operated which have their operating circuits completed through operated contacts 1 through 5.

If the second character sense is again a letters signal the circuits will respond as described above. In addition, if this character is a blank signal or a letter Z signal, ground will be connected to lead 7820 due to the setting of relays 7521 through 7525 in accordance with these signals and the circuits will operate in the same manner as described above and cause all the letters signal, the blank signals and the Z signals stored in tape 7417 to be discarded.

Under the assumed conditions a figures signal will follow a number of letters signals.

When the figures signals arrive over the sensing fingers contacts 1 through 5 will be positioned in accordance with the code combination representing this signal and will cause relays 7521 through 7525 to be positioned in accordance with this code combination in the manner described above. However, when the contacts 1 through 5 are positioned in accordance with the figures signal, relay 7513 will be operated to its right-hand position.

The upper winding of relay 7513 is connected in a circuit from ground through resistances 7532 to the conductors 1, 2, 4 and 5 extending to contacts 1, 2, 4 and 5 of the transmitter. As long as any of these contacts are operated to their spacing positions current will flow through the upper winding of relay 7513 and maintain the armature of this relay in the position shown in the drawing. The lower winding of relay 7513 is connected in the circuit extending from battery through resistance 7531 to contact No. 3 of the transmitter 7431. As long as contact No. 3 is positioned in its marking position current will flow through the lower winding of relay 7513 in such a direction as to maintain the armature of this relay in the position shown in the drawing. However, when contacts 1, 2, 4 and 5 are positioned in their marking position ground will be

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connected to both winding terminals of the upper winding of relay 7513 and when the No. 3 contact remains in its spacing position at this time the battery is connected to both terminals of the lower winding of this relay. Consequently no current will flow through either winding and a biasing spring will operate the armature to its right-hand position where an obvious circuit is completed for the operation of relay 7516.

Relay 7516 in operating completes a circuit for the operation of relay 7718 which relay then responds as described above when letters signals, blank signals, or Z signals are scanned in the tape at this time. Consequently, this figures signal will also be discarded. The H signal following the figures signal will cause relay 7514 to operate in a manner similar to the manner in which relay 7513 operates in response to a figures signal. The operation of relay 7514 completes an obvious circuit for the operation of relay 7517. Relay 7517 again completes a circuit for the operation of the discard relay 7718 which relay operates and thereafter the circuit progresses as described above.

Following the H signal the circuits will discard the letters signals perforated tape 7417 as described above. Under the assumed conditions the address code combinations BX will be the next two signals recorded in tape 7417. When the letter B signal arrives over the sensing pins, contacts 1 through 5 will be positioned in accordance with this signal; namely, contacts 1, 4 and 5 will be operated to the marking positions and contacts 2 and 3 will remain in their spacing position. Consequently relays 7521, 7524 and 7525 will be operated. A short interval of time later contacts 7421 will open and permit relays 7522 and 7523 to release if they have been previously operated. In addition, contacts 7421 in opening interrupt the operating circuit of relay 7520 which relay releases and completes a circuit for the operation of relay 7813 as described above. Relay 7813 in operating interrupts the operating circuit of the transmitter start magnet 7422 and permits this magnet to release to stop the brush arm 7425 at the end of this revolution. The operation of relay 7813 also completes a circuit for the operation of relay 7812. Under these circumstances relay 7818 will not operate because the letter B signal is not one of the signals enumerated above which is discarded. Thereafter the circuits will remain in this condition during the remainder of the major portion of the revolution of brush arm 7425. Near the end of this revolution contacts 7421 will close, completing circuits for maintaining relays 7521, 7524 and 7525 operated and also completing a circuit for the operation of relay 7520. A short interval of time later the sensing pins will be withdrawn from the tape 7417 and the tape advanced one position where a new character, namely, the letter X signal will be above the sensing pins.

The operation of relay 7520 as described above permits relay 7719 to operate in a series with relay 7812 and maintain relay 7812 operated in a circuit extending from battery through the winding of relay 7812 through the left-hand outer operated contacts of relay 7813 and the right-hand outer operated contacts of relay 7812 to ground through the winding of relay 7719. The operation of relay 7719 completes a circuit for the operation of relay 7518 from battery through the winding of relay 7518 through the upper outer operated contacts of relay 7719, the upper outer break contacts of relay 7718, the left-hand outer

break contacts of relays 7817 and 7814 to ground. Relay 7518 completes a circuit for maintaining itself operated from battery through its winding and upper operated contacts to ground through the upper outer break contacts of relay 7718 and the right-hand outer break contacts of relays 7817 and 7814.

The operation of relay 7518 also completes a circuit for maintaining relay 7519 operated and, in addition, completes a circuit for operating the magnet 7423 of the tape transmitter 7431.

The operation of magnet 7423 attracts its armature which is interlinked with the feeding mechanism for advancing tape 7417 in such a manner that when magnet 7423 is operated tape will not be advanced in a normal manner but will remain in the same position, irrespective of the rotation of the brush arm 7425.

The manner in which the operation of magnet 7423 prevents the advance of the tape through the transmitter may be more fully understood by reference to Fig. 74, together with reference to United States Patent 2,055,567, granted to E. F. Watson, September 29, 1936, the disclosure of which is hereby made a part of this disclosure as if fully included herein. The patent to Watson shows in detail the general arrangement of the parts of a transmitter suitable for modification and, as modified, suitable for operation in combination with the circuits of this system. Cam 7475 is driven from shaft 7424 and rotates lever 7449 about pivot 7478. This lever in turn rotates member 7480 about pivot 7445 through the action of the extension 7447 which cooperates with a screw in the end of lever 7449. The member 7480 corresponds to the contact lever ball of the patent to Watson and causes the sensing pins to be released to sense the tape and controls the contacts 1 through 5. The member 7480 also actuates the bell crank 7457 for raising the feed pawl 7458. During the normal operation of the transmitter when the sensing pins are withdrawn from the tape after a code combination has been transmitted, the bell crank 7457 will be rotated in a counter-clockwise direction as viewed in Fig. 74 which causes the feed pawl 7458 to be moved downward and advance the feed ratchet 7463 one character space to bring another set of perforations over the sensing pins. This operation is repeated for each code combination transmitted as is well understood by those skilled in the art. A special extension 7450 is provided on the lower end of the feed pawl 7458 and cooperates with the armature 7451 of the magnet 7423. When magnet 7423 is operated it will attract its armature 7451, move it in a clockwise direction, when this armature will engage the extension 7450 of the feed pawl 7458. Consequently, when the feed pawl is lowered at the completion of the transmission of a code combination, the extension 7450 will engage the end of the armature 7451 and cause the feed pawl to be rotated in a clockwise direction away from the ratchet 7463. As a result, the ratchet will not be advanced and the same perforations will therefore remain over the sensing pins.

As long as magnet 7423 remains operated the tape will not be advanced due to the fact that the feed pawl 7458 will be prevented from engaging the feed ratchet 7463. Upon the release of magnet 7423 its armature 7451 will be moved to the left out of the path of the extension 7450, whereupon the feed pawl 7458 will engage the ratchet 7463 and advance the tape in a normal manner.

The operation of relay 7719 as described above completes a circuit for the operation of relay 7922 from battery through the winding of relay 7922, the upper break contacts of relay 7714, the lower inner operated contacts of relay 7719, the upper inner break contacts of relay 7630 and the upper outer break contacts of relay 7631, the lower inner break contacts of relay 7713 to ground through the third armature from the right and break contact of relay 7811, and the middle set of lower operated contacts of relay 7716.

The operation of relay 7922 connects the windings of the fan relays 7916 through 7921 to the right-hand outer contacts of relays 7521 through 7525. Inasmuch as relays 7521, 7524 and 7525 are operated at this time the corresponding relays 7916, 7919 and 7920 will be operated. These relays in operating complete a circuit for maintaining themselves operated under control of relays 7718 and 7715 in a manner similar to that described above with reference to the switching equipment associated with party line 210. The operation of relay 7922 in addition completes a circuit for the operation of the reset relay 7815 in a circuit from battery through the winding of relay 7815 and the center set of lower operated contacts of relay 7922 to ground through the center set of lower operated contacts of relay 7716. Relay 7815 in operating interrupts the locking circuit of relay 7813 which relay releases and in turn interrupts the locking circuits of relays 7812 and 7719 thus permitting these relays to release.

The operation of relays 7916, 7919 and 7920 complete a circuit from the apex lead 7727 through the contacts of relays 7919 through 7921, the B lead through the winding of relay 8011 to ground through the winding of relay 7725.

The operation of relay 7922 as described above extends a circuit from the winding of relay 7722 from battery through the winding of relay 7722, resistance 7726, the upper inner break contacts of relays 7614 and 7613, the upper outer operated contacts of relay 7922 and the lower inner operated contacts of relay 7716 over lead 7925 which extends from Fig. 77 through Figs. 78 and 79 and 86 to Fig. 90 and thence to ground through the fourth set of contacts from the left of relay 9016 to ground through the winding of relay 9024. The above circuit is completed only when relay 9016 is released and thus only when the sequence circuit shown in Fig. 90 is released. The high resistance 7726 connected in this circuit is of such a value that relay 7722 will operate but relay 9024 will not operate.

The operation of relay 7722 together with the release of relay 7711, which relay releases a short interval of time after its circuit is interrupted by the operation of relay 7922, extends a circuit from battery through the winding of relay 7717 over the apex conductor 7727 through the windings of relays 8011 and 7725 thus operating these relays.

It is assumed, of course, that the path through the apex conductor 7727 is complete and that there are no trouble conditions encountered. If the path is not complete due to some trouble condition such as broken wires or dirty contacts and the like, the circuit will operate in a manner similar to the manner described above with reference to the party line 210 and eventually cause the message to be directed to the miscellaneous intercept circuit.

Assuming now that no trouble conditions are encountered, the operation of relay 7725 completes a circuit for the operation of relay 7714

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from battery through the winding of relay 7714 and the operated contacts of relay 7725 to ground through the center set of lower operated contacts of relay 7716. The operation of relay 7714 completes a circuit for maintaining relays 8011 and 7725 operated from battery through its lower outer operated contacts over the apex conductor 7727, through the contacts of relays 7916 through 7920 to ground through the windings of relays 8011 and 7725.

The operation of relay 7714 interrupts the locking circuit of relay 7922 and permits this relay to release. The release of relay 7922 reestablishes the operating circuit of relay 7711 and causes this relay to reoperate. The release of relay 7922 also interrupts the operating circuit of relay 7722 which relay releases and completes a circuit for maintaining relay 7717 operated. The release of relay 7922 disconnects the windings of relays 7916 through 7921 from the right-hand outer armatures of relays 7521 through 7525.

The release of relay 7922 also interrupts the operating circuit of relay 7815 which relay releases and again completes a circuit for the operation of the transmitter start magnet 7422 which magnet will operate and release the transmitter shaft for rotation through another revolution. During this revolution the sensing pins will rise and sense the letter X code combination over them perforated in tape 7417. This occurs near the beginning of this revolution and causes contacts 1 through 5 to be positioned in accordance with the letter X. When these contacts are positioned they will cause corresponding relays 7521 through 7525 to be operated in accordance with the positions of contacts 1 through 5 and thus in accordance with the code combination representing the letter X. A short interval of time later, contacts 7421 will open and interrupt the locking circuit of relays 7521 through 7525 and thus permit the relays which were previously operated but not now operated under control of contacts 1 through 5 to release.

Under the assumed conditions with a teletype-writer code commonly used, the letter X signal is represented by marking first, third, fourth and fifth impulses. Consequently, relays 7521, 7523, 7524 and 7525 will be operated at this time and relay 7522 released.

When contacts 7421 open they also interrupt the operating circuit of relay 7520 and permit this relay to release. The release of relay 7520 again completes a circuit for the operation of relay 7813 which relay in turn completes a circuit for the operation of relay 7812. Relay 7813 in operating completes a circuit for maintaining itself operated under control of relays 7716 and 7815. Relay 7813 in operating also interrupts the operating circuit of the transmitter start magnet 7422 and permits this magnet to release and stop the brush arm 7425 at the end of the revolution during which the letter X signal is sensed.

Under the assumed conditions the second signal will be the letter X signal which is not a discard signal. Consequently, the discard relay 7718 will not be operated at this time. Thereafter the circuits remain in this condition until brush arm 7425 nears the end of this revolution at which time contacts 7421 are again closed and the locking circuits for relays 7521 through 7525 reestablished. A short interval of time after contacts 7421 reclose, contacts 1 through 5 controlled by perforations in the tape will be returned to the position shown in the drawing and the sensing fingers withdrawn from tape 7417. However,

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magnet 7423 is operated at this time so that the tape will not be advanced in the normal manner when the sensing fingers are withdrawn therefrom. Instead, the letter X signal will remain over the sensing fingers and be sensed a second time when these fingers are later released as will be described hereinafter.

The closure of contacts 7421 as described above reestablishes the operating circuit of relay 7520 and causes this relay to reoperate. The operation of relay 7520 at this time permits relay 7719 to operate in series with relay 7812. The operation of relay 7719 completes a circuit for the operation of relay 7910 from battery through the winding of relay 7910, the upper operated contacts of relay 7714, the lower inner operated contacts of relay 7719, the upper inner break contacts of relay 7630, the upper outer break contacts of relay 7631, the lower inner break contacts of relay 7718, and the third set of contacts from the right of relay 7811 to ground through the center set of lower operated contacts of relay 7716.

Relay 7910 in operating connects the windings of relays 7911 through 7915 to the right-hand outer armatures of relays 7521 through 7525. Under the assumed conditions in which relays 7921, 7923, 7924 and 7925 are operated, relays 7911, 7913, 7914 and 7915 will be operated. The operation of these relays will extend the apex conductor 7728 to the X lead and through the operated contacts of relay 8011 and then from Fig. 80 through Figs. 72, 64, 58, 46 and 33 through the contacts of the intercept key 3324 to conductor 2119 extending to the outgoing line circuits of party line 210.

It should be noted that the contacts of relay 8011 are connected in multiple with contacts of relays 8711, 7211, 5811 and 3311 and thence through the intercept key to conductor 2119 extending to the party line 210. The other contacts of the corresponding relays are also connected together as indicated in the drawing by the dot-dash lines 3422, 3423, 3424 and 3425, which represent a cable of all of these respective leads as is well understood by those skilled in the art.

Inasmuch as only one of the director circuits is permitted to establish connection at any one time, no interference between the various circuits is possible since only one of the relays having their contacts multiplied together can have circuits completed through their contacts at any one time due to the action of the sequence circuit as described hereinbefore.

The operation of relay 7910 as described above again interrupts the operating circuit of relay 7711 and permits this relay to start to release. The operation of relay 7910 in addition extends the winding of relay 7722 over lead 7925 to the sequence circuit shown in Fig. 90. When the sequence circuit is idle this lead will extend to ground and cause relay 7722 to operate.

The operation of relay 7722 together with the release of relay 7711 extends a circuit from the winding of relay 7717 over path through the apex conductor 7728 and lead 2119 and through the outgoing line circuit associated with party line 210 to battery through the winding of the hold magnet 8841 over conductor 2223.

The path from conductor 2119 to conductor 2223 may be traced through the outgoing line circuits over different paths depending upon the conditions of the outgoing line circuit. If we assume that the first message directed to party line 210 is still in the progress of being recorded by the recording instrument 1906 so that relays

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2111, 2112, 2114, and 2115 are operated, the path extends from conductor 2119 through the lower break contacts of relay 2110, the lower operated contacts of relay 2111, the upper break contacts of relay 2116 and the upper inner break contacts of relay 2117 and the upper break contacts of relay 2120 to conductor 2223.

If it is assumed that the previous message has been fully recorded by recording device 1906, relays 2111, 2112 and 2114 will be released but relay 2115 still operated, assuming no other messages have been directed to the party line 210 in the meantime. Under these conditions the path extends from conductor 2119 through the lower break contacts of relays 2110 and 2111 through the upper operated contacts of relay 2115 and the upper break contacts of relays 2116, 2117 and 2120 to conductor 2223.

If relay 2110 is operated due to the operation of the tape contacts 1915, a path will extend from conductor 2119 through the lower operated contacts of relay 2110 and the upper break contacts of relays 2116, 2117 and 2120 to conductor 2223.

If the recording instrument 2006 is idle at this time, the battery through the winding of the vertical magnet 8841 will be connected to conductor 2119 and thus to the right-hand winding terminal of relay 7717. Consequently, since battery is connected to both the terminals of this winding, relay 7717 will release. If both of the recording instruments 1906 and 2006 associated with party line 210 are busy, ground will be connected to lead 2119 and maintain relay 7717 operated. However, when both the sequence circuit is idle so that relay 7722 is operated and one of the recording instruments of party line 210 is idle, assuming the recording device 2006 is idle, relay 7717 will release and short-circuit resistance 7726. The release of relay 7717 also tests the conductor 7925 for a direct ground and if it is found to be grounded the operation of the circuits will be stopped and a trouble condition indicated as described above. Assuming that this conductor is not grounded when resistance 7726 is short-circuited, the current flowing over conductor 7925 is increased to such an extent that relay 9024 will operate and in turn interrupt the operating circuits of relays 9010 and 9011 as described above. These relays in turn cause relay 9017, 9016 and 9018 to operate. The operation of relay 9018 connects battery over conductor 7926 for the operation of the horizontal magnet 8101 which magnet conditions the crossbar switch and in addition completes a circuit for the operation of relay 7634.

The operation of relay 7634 interrupts the operating circuit of the slow release relay 7618 which relay starts to release. The operation of relay 7634 also transfers the circuit of the apex conductor 7728 from the winding of the busy test relay 7717 to the windings of relays 7617 and 7619. If two vertical magnets are connected to this lead due to trouble conditions, marginal relay 7619 will operate but if only one magnet is connected to the lead this relay will not operate. If the lead is open, relay 7617 will not operate during the release time of relay 7618 and the message will be directed to the miscellaneous intercept position as described hereinafter. However, if only one vertical magnet is connected to this lead and the lead is not open, relay 7617 will operate and complete a circuit for the operation of relay 7633. Relay 7633 in operating connects direct ground to a lead 7728 extending to the hold magnet 8841 and causes this magnet to operate. It should be

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noted that during the time relays 7617 and 7619 are connected to this lead the resistance of their windings is such that the hold magnet 8841 receives insufficient current to operate it.

The operation of the hold magnet 8841 completes a circuit for the operation of relay 2121. The operation of the vertical magnet 8841 also causes contacts 8161 through 8166 to be closed due to the fact that magnet 8101 is operated at the time magnet 8841 operates. The operation of contacts 8161 through 8166 together with the operation of relay 2121 complete a circuit for the operation of relay 7811. Relay 7811 in operating completes a circuit for maintaining itself operated under control of relay 7810 and the switch contacts 8166.

Relay 7811 in operating interrupts the operating circuit of relay 7910 and permits this relay to release. The release of relay 7910 interrupts the circuit over conductor 7925 extending to the sequence circuit shown in Fig. 90 and causes this circuit to be restored to its idle condition at which time ground is removed from conductor 7926 thus permitting the horizontal magnet 8101 to release. However, the switch contacts 8161 through 8166 do not release at this time due to the fact that the hold magnet 8841 maintains these contacts closed.

The release of the horizontal magnet 8101 interrupts the circuit of relay 7634 which relay releases and in turn releases relay 7633. The release of relay 7634 again establishes the operating circuit of relay 7618, which under normal conditions will be before relay 7618 has released, thus maintaining this relay operated. The release of relay 7633 again completes the operating circuit of relay 7721.

The operation of relay 7811 also completes a circuit for the operation of relay 2120 which relay operates and completes a circuit for maintaining the hold magnet 8841 operated. The operation of relay 2120 also connects the winding of relay 2121 to lead 2119 extending via lead 7728 to contacts of relay 7633. Consequently, when relay 7633 releases the circuit of relay 2121 is interrupted and this relay releases. The release of relay 2121 completes a circuit for the operation of relay 2118 which relay operates and removes ground from the winding of the selector magnet 2025 and thus conditions this magnet to receive signals. The operation of relay 2118 also completes an obvious circuit for the operation of relay 2117 which relay in turn locks operated under control of the vertical magnet 8841. The operation of relay 2118 also completes a circuit for the operation of the start relay 7723 which relay in turn locks operated under control of relay 2118 and switch contacts 8163. The operation of the start relay 7723 extends the transmission conductor 7471 to conductor 8112. The operation of relay 7723 also completes a circuit for maintaining relay 2120 operated. The operation of relays 7723 and 7721 completes a circuit for the operation of relay 7816.

The operation of relay 7816 connects segments 1 through 5 of the distributor 7431 to the lowermost armatures of relays 7916 through 7920. The operation of relay 7816 also disconnects conductor 8110 from conductor 8112 and connects ground to conductor 8110. The operation of relay 7816 also completes a circuit for the operation of the distributor start magnet 7422 from battery through the winding of start magnet 7422 over conductor 7432 which extends through Figs. 75, 76 and 77 through the right-hand outer oper-

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ated contacts of relay 7816, the upper break contacts of relay 7724 through the right-hand outer operated contacts of relay 7811 to ground over conductor 8117 through contacts 8166.

The operation of the start magnet 7422 will release the brush arm shaft 7424 for rotation through one revolution. During this revolution, brush arm 7425 will pass over segments 1 through 5. Since these segments are connected at this time to the contacts of relays 7916 through 7920, the code combination in accordance with the setting of these relays will be transmitted. Under assumed conditions these relays were operated in accordance with code combination representing the letter B signal, namely, relays 7916, 7919 and 7920, are operated. Consequently, a marking impulse will be transmitted during the first, fourth and fifth impulse intervals which code combination represents the letter B. This code combination is transmitted by distributor 7431 over conductor 7471 which is connected to conductor 8112. However, conductor 8110 is not connected to conductor 8112 at this time but instead is grounded. Inasmuch as the selector magnet 2025 of the recording instrument 2006 is connected to conductor 2220 which conductor is connected to conductor 8110 through the contacts 8165, the letter B signal will not be transmitted to this recording instrument. Had this message been directed to the trunk circuit or to the intercept position, the recording instrument would have been connected to conductor 8112 in which case the letter B signal would be transmitted to and recorded by the recording instrument associated therewith.

Near the beginning of this revolution the feeler pins will rise and again sense the letter X combination recorded in the tape and will position contact members 1 through 5 in accordance with this code combination. These contacts when so positioned will then maintain relays 7521, 7523, 7524 and 7525 operated but will not operate relay 7522. A short interval of time later contacts 7421 will open and interrupt the locking circuit of relays 7521 through 7525. However, these relays will be maintained in their previous position as described above. The opening of contacts 7421 also interrupts the operating circuit of relay 7520 which relay will release and complete a circuit for the operation of relay 7724 from battery through the winding of relay 7724, the inner left-hand break contacts of relay 7817, the lower outer operated contacts of relay 7723, the upper inner operated contacts of relay 7719 to ground through the upper outer break contacts of relay 7520. Relay 7724 in operating interrupts the circuit of the transmitter start magnet 7422 and permits this magnet to release its armature so that brush arms 7425 will come to rest at the end of this revolution. Near the end of this revolution contacts 7421 will again close and complete locking circuits for maintaining relays 7521 through 7525 in the positions described above wherein they are set in accordance with the letter X signal. A short interval of time later the sensing pins will be withdrawn from the tape and contacts 1 through 5 returned to the position shown in the drawing. At this time the magnet 7423 is still operated. Consequently, the tape is again not advanced but rather maintained in its previous position with the perforations representing the letter X above the sensing pins.

Upon the reclosure of contacts 7421 near the end of this revolution of the brush arm 7425 a circuit is again completed for the operation of

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relay 7520 which relay in operating permits relay 7817 to operate in series with relay 7724.

Relay 7817 in operating again completes a circuit for the operation of the transmitter start magnet 7422 from battery through the winding of magnet 7422 over conductor 7432 through the upper break contacts of relay 7715 to ground through the center set of left-hand operated contacts of relay 7817. The operation of relay 7817 interrupts the locking circuit of relay 7518 and permits this relay to release. The release of relay 7518 interrupts a circuit through magnet 7423 and allows this magnet to release and restore the tape advancing mechanism of distributor 7431 to its normal condition so that it will advance the tape 7417 in the normal manner.

The operation of relay 7817 interrupts the operating circuit of relay 7816 and thus permits this relay to release. The release of relay 7816 reconnects the transmission conductor 8110 to conductor 8112. Consequently, all the signals thereafter transmitted over conductor 7471 will be transmitted over conductors 8112 and 8110. The release of relay 7816 also reconnects the segments 1 through 5 of the distributor of the transmitter 7431 to the right-hand outer armatures of relays 7521 through 7525.

Upon the operation of the start magnet 7422 in response to the operation of relay 7817 as described above, brush arm 7425 will be again released for rotation through another revolution during which the letter X signal will be transmitted over conductor 7471, since relays 7521 through 7525 are positioned in accordance with this signal. It should be noted that near the beginning of this revolution the sensing pins will again sense the letter X signal stored in the tape and position contacts 1 through 5 in accordance with this signal combination. These members in turn will retain relays 7521 through 7525 in the positions described above and cause the letter X signal to be transmitted at this time.

This letter X signal as indicated above will be transmitted over conductor 7471 and both conductors 8112 and 8110. Since the selecting magnet 2025 of the recording instrument 2006 is connected to conductor 8810 as described above, it will receive this code combination and cause device 2006 to record this character or code combination.

Near the beginning of this revolution of brush arm 7425, contacts 7421 will again open and interrupt the locking circuits of relays 7521 through 7525. These relays are maintained in the position representing the letter X as described above. The opening of contacts 7421 at this time again interrupts the operating circuit of relay 7520 and permits this relay to release. The release of relay 7520 completes a circuit for the operation of relay 7715 from battery through the winding of relay 7715, the right-hand inner break contacts of relay 7818, the left-hand inner operated contacts of relay 7817, the lower outer operated contacts of relay 7723, the upper inner operated contacts of relay 7719 to ground through the outer break contacts of relay 7520. Relay 7715 in operating interrupts the locking circuit of relays 7916 through 7921, inclusive, and permits the release of these relays which were previously operated and locked, namely, relays 7916, 7919 and 7920 under the assumed conditions. The release of relays 7916 through 7920 interrupt the circuit through relays 7725 and 8011 and permit both of these relays to release. The release of relay 7725 interrupts the operating circuit of relay 7714 and

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permits this relay to release. Relay 7715 in operating interrupts the circuit of the start magnet 7422 of the transmitting distributor 7431 and permits this magnet to release and stop the brush arm 7425 at the end of the revolution during which the letter X signal is transmitted.

Near the end of the revolution during which the letter X signal is transmitted, contacts 7421 will reclose and complete a circuit for reoperating relay 7520 which relay in operating will permit relay 7818 to operate in series with relay 7715. The operation of relay 7818 at this time completes a circuit for the operation of relay 7814 which relay operates and in turn completes a circuit for the operation of relay 7810.

The operation of relay 7810 interrupts the locking circuit of relay 7716 and permits this relay to release. The release of relay 7716 interrupts the locking circuit of relay 7813 and permits this relay to release. The release of relay 7813 in turn releases relays 7812 and 7719. The release of relay 7716 also causes relays 7721, 7711, 7618 and 7519 to release.

The release of relay 7519 completes an obvious circuit for maintaining relay 7520 operated. Relay 7519 in releasing disconnects the operating windings of relays 7521 through 7525 from the contacts 1 through 5 of transmitter 7431 and connects these contacts to segments 1 through 5 of the distributor through break contacts of relay 7816. Consequently, during the succeeding revolution of the brush arm 7425 the distributor 7431 will be conditioned to transmit signals in accordance with the setting of contacts 1 through 5 of the transmitter 7431.

The operation of relay 7810 completes a circuit for maintaining relay 7814 operated under control of relay 7712. The operation of relay 7810 interrupts the locking circuit of relay 7811 and permits relay 7811 to release. Relay 7811 in releasing interrupts the locking circuits of relay 7724, 7715, 7817 and 7818 and permits these relays to release. The operation of relay 7810 also completes a circuit for maintaining relay 2118 operated.

In addition, the operation of relay 7810 and the release of relay 7716 reestablishes a circuit for operating the start magnet 7422 from battery through the winding of magnet 7422, lead 7432 through the center right-hand operated contacts of relay 7810 through the lower break contacts of relay 7712, the third set of break contacts from top of relay 7716, the lower center armature and break contacts of relay 7613, the lower break contact of relay 7610 to ground through switch 7420 and contacts 7419 and 7418.

Thereafter the transmitter 7431 will transmit signals in accordance with the perforations in tape 7417 representing the message. These signals will be transmitted to and recorded by the receiving instrument 2006. Under the assumed conditions these signals will comprise first a letters signal, then a carriage return, a line feed and a second letter signal after which the text of the message will generally be recorded in tape 7417 and all of these signals will be transmitted to the recording instrument associated with the line or channel over which it is desired to transmit the message.

The operation of relay 7810 also completes a circuit for the operation of relay 7511 from battery through the winding of relay 7511 to ground through the left-hand outer operated contacts of relay 7810. Relay 7511 in operating prepares a circuit from the transmitting conductor 7471 to

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the contacts of key 7412. Consequently, if key 7412 is operated at this time, the selector magnet 7413 will respond to the signals transmitted over conductor 7471 by transmitter 7431 and thus produce a copy of the signals as actually transmitted. By properly operating the tape-keyboard lever of the device 7410, it is still possible to operate the keys 7416 to perforate tape while the recording portion of this instrument is recording the signals transmitted over conductor 7471. In this case, however, it is impossible to produce a typed or printed copy of the message or signal as actually recorded in the tape because the receiving instrument is employed in recording the signal actually transmitted over conductor 7417.

If, however, key 7412 is not actuated and it is so desired the receiving instrument will record the signals under the control of the keyboard 7416 as they are recorded in tape 7417 irrespective of the signals transmitted over conductor 7471.

If at any time during the transmission of a message the tape 7417 passes out of the transmitter 7431, contacts 7419 will open. If these contacts open or the tape lever contacts 7418 which are controlled by the supply of perforated tape open or if the operator inadvertently opens key 7420 during the transmission of a message and before the disconnect pattern comprising a figure signal followed by an H letter and a letters signal is transmitted, relay 7510 will release. In addition, relay 7615 will also release. At this time, however, relay 7616 will remain operated and consequently relay 7819 will not operate so that the director circuit will not function at this time to cause a figure signal followed by an H signal and then a letter signal to be automatically transmitted. The opening of either one of the contacts 7418 or key 7419, or of switch key 7420 interrupts the circuit of the start magnet 7422 and then permits this magnet to release and stop the operation of the transmitter 7431.

The release of relay 7510 completes the circuit for the operation of relay 7512 from battery, through the winding of relay 7512, the lower operated contacts of relay 7511 to ground, through the lower break contacts of relay 7510.

The operation of relay 7512 completes the filament circuit of tube 7526. The operation of relay 7512 also removes ground from the right-hand terminal of condenser 7529, which is connected to the grid of tube 7526. Upon the removal of this ground, the right-hand terminal of condenser 7529 starts to charge to a positive potential through the high resistance 7528. The bias applied to tube 7526, together with the constants of the condenser charging circuit comprising condenser 7529 and high resistance 7528, are such that it requires an appreciable time for the right-hand terminal of condenser 7529 to be charged to a sufficiently high positive potential to initiate the flow of sufficient current in the anode circuit of tube 7526 to cause relay 7515 to operate. In typical embodiment of this invention these constants are so related that relay 7515 does not operate till approximately 30 seconds after relay 7512 operates. If one or more of the contacts 7418, 7419 or switch 7420 remain open during this entire period, relay 7515 will operate at the end thereof.

If, however, the attendant or operator notes the trouble before the end of this time, and corrects it either by reclosing switch 7420, inserting a new tape in the transmitter or providing an additional supply of tape 7417 before the end of this period relay 7510 will reoperate and interrupt the oper-

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ating circuit of relay 7512. Relay 7512 in releasing again connects ground to the right-hand terminal of condenser 7529 and completely discharges the condenser in a very short interval of time. Consequently if one of the above-enumerated contacts are again opened, the operation of the timing circuit is again initiated, at which time it will again require the same interval to cause the operation of relay 7515.

If relay 7512 remains operated for this entire interval relay 7515 will operate. The operation of relay 7515 completes a circuit for the operation of relay 7611. Relay 7611 in operating completes a circuit for the operation of the alarm relay 7613, which relay in turn completes a circuit for maintaining itself operated under control of the center set of lower break contacts of relay 7614.

The operation of relay 7613 completes an obvious circuit for lighting lamp 7612, indicating that the associated director circuit is tied up or in trouble and also connects ground to lead 2936 of an indicating device such as a bell or an alarm to attract the attention of the service man or attendant.

The operation of relay 7613 also interrupts the circuit of the start magnet 7422 so that the transmitter will not automatically restart should either one of the contacts 7418, 7419 or switch 7420 be reclosed thereafter.

It should be noted that the operation of relay 7613 does not cause the operation of the emergency disconnect relay 7819 to transmit a disconnect pattern.

The emergency disconnect pattern is not automatically transmitted at this time because the transmitter 7431 at which the trouble originates is located at the same station as the automatic switching equipment, so that the operator or attendant may readily determine the causes of trouble and have an opportunity to correct it at the transmitter 7431. However, if it is desired the operator or attendant may cause the automatic transmission of the disconnect pattern by, first, the operation of the transmission or director stop key 7429 and then the operation of disconnect key 7430. The operation of key 7429 causes relay 7610 to operate. The operation of relay 7610, together with the subsequent operation of key 7430 by the attendant will complete a circuit for the operation of the emergency disconnect relay 7819 from battery, through the winding of relay 7819, through the upper inner operated contacts of relay 7610 to ground, through the operated contacts of the disconnect key 7430.

The operation of relay 7819 causes the relays 7724, 7818, 7715, 7816, 7817 and 7710 to operate and cause a figure signal followed by an H signal and a letters signal to be automatically transmitted to the recording instrument connected to transmitter 7431 and then causes the transmission circuit between these two units to be interrupted and the recording instrument restored to its idle condition in a manner similar to the transmission of these signals from the director circuit associated with party line 210, as described above.

If there are no further signals available for transmission the circuits will function as described elsewhere herein.

If further signals of a previous message remain stored in the tape 7417 at this time, these signals will be routed to the miscellaneous intercept circuit in a manner similar to the operation of the director circuit associated with party line 210, as described above when the keys 7429 and 7430 are restored to the unoperated positions.

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If it is desired the remaining portion of the message signals stored in tape 7417 may be directed to the wilful intercept circuit instead of allowing them to be directed to the miscellaneous intercept circuit. In case it is desired to direct these signals to the wilful intercept machine instead of the miscellaneous intercept machine, key 7429 will be released and key 7428 immediately operated thereafter. Thereafter, key 7430 will be momentarily operated. Upon the subsequent release of key 7428 the remaining signals will be routed to the wilful intercept machine instead of the miscellaneous intercept machine.

Keys 7428 and 7429 are preferably part of a combined key unit which when operated in one direction will cause contacts 7429 to close and when operated in the other direction will cause contact 7428 to close. This arrangement prevents both keys from being simultaneously operated.

When key 7429 is released after the circuit extending from transmitter 7431 is interrupted relay 7610 will release. Assuming that there are additional signals stored in the tape 7417 so that both contacts 7418 and 7419 as well as the switch 7420 are closed, a circuit will be completed for the operation of relay 7716 as described above. The operation of relay 7716 completes circuits for causing the transmitter to scan the following code combinations recorded in tape 7417. The subsequent operation of key 7428 completes an obvious circuit for the operation of relay 7614. The operation of relay 7614 interrupts the operating circuit of relay 7716. This relay, however, once it is operated, locks operated under control of relay 7810. The operation of relay 7614 interrupts the circuit of the start magnet 7422 which magnet releases if it had been previously operated in response to the operation of relay 7716. Relay 7716 completes circuits for the operation of relays 7717, 7721, 7618, 7711 and 7519 as described above.

The subsequent operation of key 7430 completes a circuit for the operation of relay 7631 from battery through the winding of relay 7631 through the lower outer operated contacts of relay 7716 and the upper outer operated contacts of relay 7614 to ground through the operated contacts of key 7430. The operation of relay 7631 completes a circuit for maintaining itself operated from battery through its winding, the lower outer operated contacts of relay 7716, the upper outer operated contacts of relay 7631, the lower inner break contacts of relay 7718, the third armature from the right and break contact of relay 7811 to ground through the front contact of the second armature from the bottom of relay 7716. The operation of relay 7631 completes a circuit for the operation of relay 7632 from battery through the winding of relay 7632, the upper inner operated contacts of relay 7631, the upper outer operated contacts of relays 7618 and 7711 to ground through the center set of lower operated contacts of relay 7716. The operation of relay 7632 completes a circuit for maintaining itself operated from battery through its winding, the upper inner operated contacts of relays 7631 and 7632 to ground through the center set of the lower operated contacts of relay 7716. The operation of relay 7632 interrupts the operating circuit of relay 7711 which relay starts to release.

If the interval of time between the release of key 7429 and the operation of key 7428 is insufficient to cause the operation of start magnet 7422 the subsequent release of key 7428 will permit relay 7614 to release and complete a circuit for the operation of this start magnet. However, if suffi-

cient time elapses between the release and operation of this case so that magnet 7422 has sufficient time to operate then upon the release of key 7428 it will not reoperate.

The operation of magnet 7422 upon the release of key 7429 or the subsequent release of key 7428 will release the transmitter shaft 7424 for rotation through one revolution. During this revolution the character stored in tape 7417 over the sensing pins will be scanned and contacts 1 to 5 positioned in accordance with this character. The setting of contacts 1 to 5 is transferred to relays 7521 to 7525 as described above. Near the beginning of the revolution of the transmitter shaft 7424 the auxiliary contacts 7421 will open and interrupt the circuit through the lower winding of relay 7520 and permit this relay to release. The release of relay 7520 completes circuits for the operation of relays 7813 and 7812.

The operation of relay 7812 connects the winding of relay 7722 to lead 7925 extending to the sequence circuit. The circuit path may be traced from battery through the winding of relay 7722, high resistance 7726, the upper inner break contacts of relays 7614 and 7613, the third armature from the right and front contact of relay 7812, the lower inner operated contacts of relay 7716 to lead 7925 extending through Figs. 77, 78, 79, 86 and 90 to ground through the break contacts of relay 9016 and the winding of relay 9024. If the sequence circuit is idle at this time relay 7722 will operate but relay 9024 will not operate. If the sequence circuit is busy relay 7722 will not operate but will wait until this circuit becomes idle at which time relay 7722 will operate.

The operation of relay 7722 together with the release of relay 7711 connects the winding of the busy test relay 7717 to the control conductor 3323 of the local intercept circuit. The circuit extending from the winding of relay 7717 may be traced from battery through the winding of relay 7717, the operated contacts of relay 7722, the lower break contacts of relay 7711, the lower break contacts of relay 7634, the upper outer operated contacts of relay 7721, the lower inner operated contacts of relays 7631 and 7632 to conductor 3323 which extends from Fig. 76 through Figs. 77, 78, 79, 80, to Fig. 87. If the wilful intercept circuit is busy ground will be connected to conductor 3323 due to the fact that relay 8711 is operated when this circuit is busy. Under these conditions relay 7717 will remain operated. If the sequence circuit should again become busy relay 7722 will release and complete a holding circuit for maintaining relay 7717 operated. When both the wilful intercept circuit is idle and the sequence circuit not in use, relay 7717 will release because lead 3323 under these circumstances will extend from battery through the winding of relay 7717 and the operated contacts of relay 7722 over the circuit traced above through lead 3323, the right-hand outer break contacts of relays 8710, 8711, and 8714 to battery through the winding of the vertical magnet 8845. Since battery is connected to both terminals, relay 7717 under these circumstances, will release and short-circuit the high resistance 7726 whereupon the current flowing over conductor 7925 is increased sufficiently to cause relay 9024 to operate. Thereafter the circuits operate in substantially the same manner as described above and establish connections to a recording device 8206 and cause transmitter 7431 to be connected to the recording device 8206 of the wilful intercept circuit. Thereafter the remaining signals

stored in the tape 7417 will be transmitted to the wilful intercept recording device 8206. At the end of these signals the figures H signal will cause the transmission path between recording device 8206 and the transmitter 7431 to be interrupted and the circuits restored to their idle or normal condition.

While the operation of the circuit under these circumstances, which permit the operator to direct the message to the wilful intercept circuit by operating keys 7428 and 7430, have been described with particular reference to the originating station transmitter shown in Fig. 74 and its related circuits, similar keys are associated with each of the other lines and trunk circuits so that the operator may direct any message or portion thereof to the wilful intercept circuit in a manner described above with reference to transmitter 7431 of the originating station.

Assuming now that the text of the message is fully transmitted from transmitter 7431 to the recording device 2006, as described above, following the text of the message, the operator will now perforate a figures signal, an H signal and a letters signal in tape 7417. When the figures signal is sensed and contacts 1 to 5 positioned in accordance with this code combination the corresponding signaling impulses will be transmitted to and recorded by the recording instrument 2006. In addition, the armature of relay 7513 will be operated to its right-hand position in response to the positioning of contacts 1 to 5 in transmitter 7413 in accordance with the figures signal. The operation of relay 7513 completes an obvious circuit for the operation of relay 7516, which relay operates and completes a circuit for maintaining itself operated under control of contacts 7421. The operation of relay 7516 completes a circuit for the operation of relay 7720 from battery through the upper winding of relay 7720 the left-hand inner operated contacts of relay 7810 to ground through the upper operated contacts of relay 7516. Relay 7720 is a slow-to-release relay and will not immediately release upon the release of relays 7513 and 7516. Following the figure signal, transmitter 7431 will sense the H code combination stored in tape 7417 and cause corresponding signals to be transmitted to and recorded by the receiving device 2006. In addition, the armature of relay 7514 will be operated to its right-hand position in response to the position of contacts 1 to 5 in accordance with the H signal. The manner in which relays 7513 and 7514 respond to the positioning of contacts 1 to 5 in response to the figure code combination and the H code combination was described hereinbefore when the first figures signal and H signal preceding the message were disregarded.

The operation of relay 7514 at this time completes a circuit for maintaining itself operated under control of contacts 7421. The operation of this relay also completes a circuit for the operation of relay 7517. Relay 7517 in operating completes a circuit for the operation of relay 7713. Relay 7713 in operating completes a circuit for maintaining itself and relay 7720 operated under control of relay 7810. Following the transmission of the H signal, the sensing pins will be withdrawn from the tape and the contacts 1 through 5 restored to the position shown in the drawing, at which time the armature of relay 7514 will be returned to the position shown in the drawing. Relay 7517 does not release at this time because contacts 7421 close and complete the locking circuit of relay 7517 before relay 7514 releases.

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After the H signal is transmitted the brush arm 7425 will start to rotate through another revolution. The sensing fingers will sense the letters signal in the tape and then contacts 7421 will open and interrupt the locking circuit of relay 7517. The release of relay 7517 at this time completes a circuit for the operation of the release relay 7712 from battery, through the winding of relay 7712, the lower outer operated contacts of relay 7713, the upper break contacts of relay 7517 to ground, through the upper operated contacts of relay 7511. The operation of relay 7712 interrupts the operating circuit of the start magnet 7422 and permits this magnet to release and stop the brush arm 7425 after the figures signal has been fully transmitted.

The operation of relay 7712 interrupts the locking circuit of relay 7814. Relay 7814 is slow in releasing and does not release until after the letter signal has been fully transmitted to the receiving device 2006. Upon the release of relay 7814 the operating circuit of relay 7810 is interrupted which relay in turn releases. The release of relay 7810 causes the director circuit to be restored to its initial condition and causes transmitter 7431 to be disconnected from the recording device 2006. In addition the circuits associated with the cross-bar switch and the recording device 2006 are also restored to their initial or idle conditions.

The letters signals recorded in tape 7417 following the first letter signal will be discarded in the manner described above as will the other signals normally discarded. As assumed above, following these letters signals a directing or address code combination comprising the letters N and H will be recorded in tape 7417. When the N signal arrives over the sensing pins they will sense the corresponding code combination and position contacts 1 to 5 in accordance with it. Relays 7521 through 7525 will be positioned in accordance with the code combination representing this N signal and will cause the director circuit to test one of the outgoing line circuits of the trunk 290 extending to the second switching center since the N signal indicates that the following message is intended for some station reached through this second switching center. If both of the recording instruments associated with this trunk circuit are busy, the director circuit will wait until one or the other of them becomes idle, at which time it will sense the second character of the trace code which, under the assumed conditions, is a letter H signal. The letter H signal is a signal which is normally discarded but under the assumed conditions where the first code combination represents a station connected to another switching center, neither it nor the following H signal will be discarded. Instead, the connection will be established to the idle recording device of the trunk circuit and both the N signal and the H signal transmitted to and recorded by this device. The following letters signals and the second group of address code signals, namely, K, Y and then the following message will be transmitted to this recording device for later transmission over the trunk circuit 290.

As shown in Figs. 62, 63, 64 and 65, two recording instruments 6206 and 6306 are associated with the trunk circuit 290 in the manner similar to the manner in which the two recording instruments are associated with the party line at 210.

As in the case of the party line 210, messages directed to this trunk circuit are directed alternately to these two recording instruments if

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both of them are idle, or to whichever one of them may be idle at the particular moment if one is busy and the other idle, or to whichever one of them becomes idle first if both happen to be busy at the particular time when a message is awaiting transmission to the trunk circuit.

The manner in which the messages are alternated between these receiving devices may be best described with reference to Fig. 64. It is to be understood however, that messages are alternated between the receiving devices associated with the outgoing portion of party line 210 in substantially the same manner. It will be recalled that when the first message was directed to this trunk circuit relays 6411, 6412 and 6414 operate and remain operated during the entire time the message is being transmitted to the recording device 6306.

Upon the operation of relay 6412, relay 6415 operates and in operating completes a circuit for maintaining itself operated under control of relays 6416, 6417 and 6418.

The operation of relay 6415 shifts the connection of lead 6419 from the contacts of relays 6413 and 6414 associated with the first recording instrument 6306 to the contacts of relays 6416, 6417, 6421 and 6420 associated with the second recording device 6206. The next message then directed to the outgoing line circuit of trunk 290 will cause the relays 6417, 6418, 6420 and 6421 to operate and direct the message to the second recording device 6206. The operation of relay 6417 and 6418 interrupts the locking circuit of relay 6415 and permits this relay to release if relay 6412 is also released. The release of relay 6415 will then again transfer lead 6419 back to the contacts of relays 6413 and 6414 so that the next message will be directed to the first recording device 6306 of trunk 290.

Of course, if relay 6412 is still operated when relay 6418 or 6417 operates, relay 6415 will remain operated. Under these circumstances both the recording devices of the trunk 290 will be busy and ground will be connected to the test lead 6419 through the upper inner operated contacts of relay 6417, the upper break contacts of relay 6416, the lower outer operated contacts of relay 6411 and the lower break contacts of relay 6410. This ground causes the recording device of the trunk 290 to test busy and prevents any other messages being directed to the trunk circuit until one or the other of the recording devices become free. If the first recording instrument becomes free first relay 6415 will release so that the next message will be directed to the first recording instrument. If, however, the second recording instrument becomes free first, relays 6418 and 6417 will release to complete a locking circuit for maintaining relay 6415 operated. Consequently, the next message under these circumstances will be directed to the second recording device.

By alternating the messages between the two recording devices, the load upon these devices tends to be equalized so that the wear will be equally distributed between them and also so that the messages stored in both tapes will be transmitted with a minimum delay. In other words, the messages will be further transmitted with substantially the same dispatch.

The messages directed to stations connected to party line 210 are directed alternately to the recording devices 1906 and 2006 associated with party line 210 in substantially the same manner as described above, so that in this case the wear upon the apparatus is also equalized and the mes-

sages are transmitted through each of the devices with substantially equal dispatch.

In the case of the party line 260 only one recording device is provided and in this case all the messages directed to this party line are recorded by this instrument one after another in the order in which the circuits to this device are established.

Outgoing transmission

Returning now to the messages stored in tapes 1930, 2030, 4530, 6230 and 6330 as described above, the manner in which these messages are transmitted over the respective outgoing lines or trunks will now be described.

Considering first the outgoing channel of trunk circuit 290 and, for purposes of illustration, assume that the messages arrived at or were started to be stored in tapes 6230 and 6330 substantially simultaneously by the respective recording instruments 6206 and 6306. After the first character is stored in each of these tapes the respective contacts 6221 and 6321 will close.

It is assumed that these contacts are open due to the fact that the transmitting heads 6207 and 6307 have sensed the last character previously stored in these tapes and the system is idle and, consequently contacts 6221 and 6321 will be open until the first character of the next message is recorded in the tapes.

Under the assumed conditions, the first character recorded in tape 6330 will be the character J of the address code JE of station 520, while the first character recorded in tape 6230 will be the letter N of the address code NH assigned to the second switching station.

The closure of contacts 6221 completes a circuit for the operation of relay 6119 from battery through the winding of relay 6119, the second armature from top and break contact of relay 6017 to ground through the closed contacts 6221.

A similar circuit is completed upon the closure of contacts 6321 for the operation of relay 6110 from battery through the winding of relay 6110, the second armature from the top and break contact of relay 6010 over conductor 6014 which extends through Fig. 61 and in cable 6128 extending through Figs. 62 to 63 to ground through closed contacts 6321.

The operation of relay 6110 completes a circuit for the operation of relay 6113 from battery through the winding of relay 6113, the lower inner break contacts of relay 6007, the operated contacts of relay 6110, the lower break contacts of relay 6115 to ground through the lower break contacts of relays 6009 and 6002.

The operation of relay 6119 similarly completes a path for the operation of relay 6122 from battery through the winding of relay 6122, the upper break contacts of relay 6007, the operated contacts of relay 6119, lower break contacts of relay 6124 to ground through the upper break contacts of relays 6009 and 6003. Both relays 6113 and 6122 are operated by current flowing through their windings in the circuits traced above. The operation of either or both of these relays completes a circuit for the operation of relay 6007 from battery through the winding of relay 6007 to ground through the upper outer operated contacts of relays 6113 and 6122.

The operation of relay 6122 at least partially prepares a locking circuit for maintaining itself operated from battery through its winding and upper inner operated contacts through the upper break contacts of relay 6113 and the inner operated contacts of relay 6007 to ground through the

break contacts of relay 6002. The operation of relay 6113, however, interrupts this locking circuit through its upper inner break contacts and prepares a locking circuit for maintaining itself operated from battery through its winding and upper inner operated contacts to ground through the operated contacts of relay 6007 and the break contact of relay 6002.

The operation of relay 6007, as described above, first completes the above-described locking circuits through its second armature from the top and second armature from the bottom and front contacts. After these locking circuits are completed, further operation of relay 6007 interrupts the operating circuits of relays 6113 and 6122. Inasmuch as the locking circuit of relay 6122 is interrupted at the contacts of relay 6113, relay 6122 will release while relay 6113 will be maintained operated due to current flowing through its locking circuit upon the operation of relay 6007.

Upon the release of relay 6122 a circuit will be completed for operating the slow-operate relay 6006. Slow-operate relay 6006 will not operate until relay 6122 has had ample time to fully release. This relay cannot operate while both relays 6113 and 6122 are operated, but only when one of these relays is operated and the other one released. One of the relays 6113 or 6122 must be operated to first operate relay 6007 and then the other one of these two relays must be released to operate relay 6006.

The operation of relay 6006 completes a circuit for the operation of relay 6012 from battery through the winding of relay 6012 to ground through the lower operated contacts of relay 6113, the upper outer operated contacts of relay 6007 and the operated contacts of relay 6006. The operation of relay 6012 completes a circuit for maintaining itself operated from battery through its winding and third armature from the top and front contacts to ground through the operated contacts of relay 6117. It should be noted that relay 6117 is normally operated so that its contacts will be closed at this time for maintaining relay 6012 operated. The operation of relay 6012 completes a circuit for the operation of relay 6009 from battery through the winding of relay 6009, the upper outer break contacts of relays 6010 and 6017 to ground through the upper inner operated contacts of relay 6012. Relay 6009 in operating completes a circuit for maintaining itself operated from battery through its winding and upper break contacts of relays 6010 and 6017 to ground through the lower outer operated contacts of relay 6009 and the second break contacts from the top of relay 6013.

The operation of relay 6012 also completes a circuit for the operation of relay 6002 from battery through the winding of relay 6002 to ground through the center set of lower operated contacts of relay 6012. Relay 6002, in operating, completes a circuit for operating relay 6003. The operation of relay 6003 connects ground to the armature of relay 6004 which causes a lamp 6015 to flash or flicker when the signals are transmitted as will be described hereinafter. The operation of relays 6002 and 6003 interrupt the operating circuits of relays 6113 and 6122 so that neither of these relays can reoperate as long as relays 6002 and 6003 are operated. The operation of relay 6002, in addition, interrupts the locking circuit of relay 6113, thus permitting this relay to release and, in turn, releasing relays 6007 and 6006.

The operation of relay 6012 removes a short

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circuit from around the contacts of the transmitting distributor comprising the contacts controlled by cam shaft 6323 and thus conditions these contacts for the transmission of signals.

The operation of relay 6012 also completes a circuit for the operation of the transmitter clutch magnet 6311 from battery through the winding of magnet 6311, the lower break contacts of relay 6118, the upper break contacts of relay 6112 the second armature from the top and front contact of relay 6012, the second armature from the top and break contact of relay 6010 over lead 6014 to ground through contacts 6321.

The operation of magnet 6311 will release the transfer cam shaft or transmitter cam shaft 6353 for rotation. Rotation of this cam shaft will cause the characters stored in tape 6330 to be sensed and the contact members controlled by members 6309 positioned in accordance with the perforations or punches in tape 6330. After each code combination has been sensed and the contact members controlled by member 6309 positioned in accordance therewith, contacts 6316 will close and complete an obvious circuit for the operation of a distributor clutch magnet 6347. This magnet will release and cause corresponding signaling impulses to be transmitted over the transmitting channel of party line trunk circuit 290. Relay 6004 will follow these signals and cause lamp 6015 to flash or flicker so long as the signals are being transmitted. It will be recalled that both the J and E characters of the address code JE were recorded in tape 6330 following which a letters signal, a carriage return, and a line feed signal and additional letter signals were perforated in the tape, following which the text of the message is perforated in the tape. All of these signals are transmitted over the transmitting channel of the trunk circuit 290 to the distant switching center where the circuits and apparatus respond in substantially the same manner as the circuit and equipment at the first switching center in directing messages to stations of an address local thereto.

During the text of the message one or more figure signals may be transmitted to cause the receiving equipment to be operated to its upper case position. When the figure signal is sensed by the transmitting head 6307 and the contacts controlled by members 6309 positioned in accordance therewith, a circuit will be completed through the contacts controlled by member 6309 for the operation of relay 6111 from battery through the upper winding of relay 6111 to ground through the contacts controlled by members 6309 when they are positioned in accordance with the figures code combination. Relay 6111 is slow releasing and does not immediately release. If, however, the succeeding code combination stored in tape 6330 is not an H code combination, relay 6111 will release without any further action or effect upon the circuits.

At the end of the message a figures code combination followed by the H code combination will be perforated in the tape 6330 as described above. Under these circumstances the H code combination will immediately follow the figures code combination. The figures code combination will cause relay 6111 to operate as described above and the immediately following H code combination will complete a circuit for the operation of relay 6116 and for maintaining relay 6111 operated before relay 6111 releases. The circuit for maintaining relay 6111 operated may be traced from battery through the lower winding of relay 6111 and lower

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operated contacts of relay 6111, lower outer operated contacts of relay 6012 to ground through the contacts controlled by members 6309 when they are positioned in accordance with the letter H code combination.

The circuit for operating relay 6116 may be traced from battery through the winding of relay 6116, the upper and lower operated contacts of relay 6111 to ground through the lower operated contacts of relay 6012 and the contacts controlled by members 6309 when they are positioned in accordance with the code combination representing the letter H signal.

The operation of relay 6116 completes a circuit for maintaining both itself operated and relay 6111 operated under control of relay 6012 from battery through the winding of relay 6116 and the upper operated contacts of relay 6116 to ground through the lower inner operated contacts of relay 6112. Relay 6111 is maintained operated in a circuit from battery through the lower winding of relay 6111 and the upper operated contacts of relays 6111 and 6116 to ground through the lower inner operated contacts of relay 6012. It will be recalled that a letters signal is perforated in tape 6330 following the H signal. Then the letter signal is scanned by the sensing members in response to the continued rotation of shaft or cam barrel 6353. Near the beginning of this revolution during which the letters signal is scanned, the cam controlled contacts 6317 will close and complete a circuit for the operation of relay 6112 from battery through the winding of relay 6112 and the lower operated contacts of relay 6116 to ground through the operated contacts 6317. Relay 6112, in operating, completes a circuit for maintaining itself operated under control of relay 6012 from battery through the winding and upper operated contacts of relay 6112 to ground through the lower inner operated contacts of relay 6012. The operation of relay 6112 also interrupts the operating circuit of the clutch magnet 6311 of the transmitter shown in Fig. 63 and thus causes the transmitter cam drum 6353 to come to rest at the end of the revolution during which the letter signal was scanned.

The operation of relay 6112 also interrupts the circuit through the winding of relay 6117. Relay 6117, however, is a slow-release relay and will not immediately release. The releasing time of relay 6117 is sufficiently long to permit the entire letter signal to be fully transmitted over the transmitting channel of the trunk circuit 290 to the distant switching center. After sufficient time has elapsed to permit this signal to be fully transmitted, relay 6117 will release and interrupt the locking circuit of relay 6012. Relay 6012 will then release and interrupt the locking circuits of relays 6111, 6116 and 6112 and permit these relays to release. Release of relay 6012 will also short-circuit the transmitting distributing contacts controlled by cam shaft 6323 and thus prevent further transmission from these contacts at this time.

The release of relay 6012, in addition, interrupts the operating circuit of relay 6002. This relay is slow-releasing and does not immediately release. After relays 6111, 6112 and 6116 have had sufficient time to fully release, relay 6002 will release. If we assume that additional messages are still stored in tape 6330 relay 6119 will not release at this time. As assumed above, a message was waiting in tape 6230 for transmission. Upon the release of relay 6002 a circuit will be completed for the operation of relay 6122.

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However, at this time the circuit of relay 6113 extends to the break contact of relay 6003. The release of relay 6002 interrupts the operating circuit of relay 6003. However, relay 6003 is slow in releasing and does not release until relay 6122 has had ample time to operate and to cause relay 6007 to operate. The operation of relay 6007 interrupts the operating circuit of relay 6113 and completes a locking circuit for maintaining relay 6122 operated. Consequently, relay 6122 will operate and lock under control of relays 6007 and 6002 while relay 6113 will not. The circuit for the operation of relay 6122 now extends from battery through the winding of this relay, the upper break contacts of relay 6007, to the operated contacts of relay 6119, lower break contacts of relay 6124, through the lower operated contacts of relay 6009 to ground and break contacts of relay 6002. The circuit for the operation of relay 6113 now extends from battery through the winding of relay 6113 through the lower break contacts of relay 6007, the operated contacts of relay 6110 and the lower break contact of relay 6115 through the upper operated contacts of relay 6009 to the upper contact of relay 6003. Inasmuch as relay 6003 has not released, as described above, relay 6113 will not operate at this time.

The operation of relay 6122 completes a circuit for the operation of relay 6007 as described above, and relay 6007, in operating, first completes a locking circuit for maintaining relay 6122 operated, and then interrupts the operating circuits of both relays 6122 and 6113, thus preventing the operation of relay 6113 at this time. The operation of relay 6007, together with the fact that relay 6113 is released at this time, causes relay 6006 to operate and complete a circuit for the operation of relay 6013 from battery through the winding of relay 6013, lower operated contacts of relay 6122, the lower break contacts of relay 6113 to ground through the upper outer operated contacts of relay 6007 and the operated contacts of relay 6006. The operation of relay 6013 completes a circuit for maintaining itself operated under the control of the normally operated relay 6126 and, in addition, completes a circuit for reoperating relay 6002 which relay in turn reoperates and maintains relay 6003 operated. Relay 6002, in operating, also interrupts the locking circuit of relay 6122 and permits this relay to release, which relay, in releasing in turn interrupts the operating circuit of relay 6007 which relay releases and, in turn, releases relay 6006. The operation of relay 6013 interrupts the locking circuit of relay 6009 which relay thereupon releases. The operation of relay 6013 then removes the short circuit from around the transmitting distributor contacts controlled by cams of the cam shaft 6223 and thus conditions this transmitting distributor for transmission of signalling impulses. The operation of relay 6013 also completes a circuit for the operation of the clutch magnet 6211, which magnet will operate and release the distributor shaft 6253 for rotation.

The rotation of this shaft 6253 causes the punches or perforations in tape 6230 to be sensed and contacts controlled by members 6209 positioned in accordance therewith. At about this time a circuit is completed for the operation of the distributor clutch magnet 6247, which magnet releases and causes the corresponding signals to be transmitted over the transmitting channel of party line 290 to the distant switching center.

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Under the assumed conditions, the N signal followed by the H signal will be transmitted. Following these signals, the letters signal, a K signal, a Y signal and another letter signal will be transmitted in sequence over the outgoing line circuit. Following these signals, a carriage-return signal, a line-feed signal and another letter signal will be transmitted, following which the text of the message is transmitted to the distant switching center.

At the distant switching center the N signal, followed by the H signal will cause the equipment at that end of the trunk circuit to respond and be conditioned so that a copy of the message will be received at the distant switching center and also transmitted on to station 521 which is assigned the address code KY.

At the end of this message relay 6120 will be operated in response to the figure signal and relay 6125 in response to the H signal. The closure of contacts 6217 during the scanning of the following letters signal completes a circuit for the operation of relay 6121, which relay operates and locks under control of relay 6013. Relay 6121 also interrupts the operate circuit of relay 6126. Relay 6126 does not release, however, until the letters code combination is fully transmitted to the distant switching center. The operation of relay 6121, however, interrupts the circuit of the clutch magnet 6211 and stops the transmitter shaft 6253 at the end of the revolution during which the letters signal was scanned. The release of relay 6126 interrupts the locking circuit of relay 6013 which relay releases causing relays 6120, 6121 and 6125 to release. The release of relay 6121 causes relay 6126 to reoperate.

The release of relay 6013 interrupts the operating circuit of relay 6002. After sufficient time has elapsed to permit the above enumerated relays to fully release, relay 6002 will release.

If it is assumed that messages are still present in both tapes 6230 and 6330, both relays 6119 and 6110 will remain operated. Upon the release of relay 6002, a circuit will be completed for the operation of relay 6113. Inasmuch as relay 6009 is now released, the release of relay 6002 will complete a circuit for the operation of relay 6113. Thereafter the circuits will operate as described above and cause a message to be transmitted from tape 6330. Assume now that after the end of this message an additional message is recorded in tape 6330 but no further messages are recorded in tape 6230, under which circumstances contact 6221 will be open and relay 6119 released. At the end of the message in the progress of being transmitted from tape 6330, relays 6111, 6116 and 6112 will operate as described above and cause relay 6117 to release, which relay, in turn, releases relay 6012. Relay 6012 in releasing will interrupt the circuit of relay 6002. At this time relay 6009 is locked operated, as described above, so that the release of relay 6002 will partially prepare a circuit for the operation of relay 6122. However, since no messages are awaiting transmission from tape 6230, relay 6119 will be released and relay 6122 will not operate at this time.

As described above, the release of relay 6002 interrupts the operating circuit of relay 6003 and at the end of the delay period during which relay 6003 remains operated, this relay will release and complete a circuit for the operation of relay 6113 from battery through the winding of relay 6113, through the lower break contacts of relay 6007, the operated contacts of relay 6110 and the lower break contacts of relay 6115 to ground through

the upper operated contacts of relay 6009 and break contacts of relay 6003. Thereafter circuits will function as described above and cause the following message to be transmitted to the second switching center of trunk 290.

Thus, as long as messages are stored in both tapes 6230 and 6330 a message will be transmitted from one of the tapes and then a message from the other tape, and then a message from the first tape and so on. When messages are stored in one of the tapes these messages will be transmitted, one after the other until they are completely transmitted or until additional messages are stored in the other tape, at which time the messages again will be transmitted alternatively from the tapes until all the messages stored in both tapes have been fully transmitted over the trunk circuit 290.

The messages stored in tapes 1930 and 2030 are transmitted over the receiving channel party line 210 much in the same manner as the messages stored in tapes 6230 and 6330 were transmitted over the trunk circuit 290. In other words, as long as messages are recorded in both tapes 1930 and 2030, a message will first be transmitted from tape 1930 and then a message from tape 2030, then one from 1930 and so on, the messages being transmitted in alternation from these tapes. If messages from any tape are completely transmitted while messages are still stored in another one of the tapes, the stored messages will then be transmitted one right after the other from the tape in which they are stored.

The circuits for causing the transmission of the messages stored in tapes 1930 and 2030 operate and respond substantially the same as described below with respect to the transmission of the messages from tapes 6330 and 6230. These circuits are shown in detail in Figs. 17 and 18. The circuits shown in Figs. 17 and 18 include a number of relays not shown or described in Figs. 60 and 61. These relays relate to and cooperate with the transmission start circuit shown in Figs. 14, 15 and 16 and were described hereinbefore in connection with the operation of the start circuit. Inasmuch as no start circuit is required or would perform any useful function in cooperating with the trunk circuit disclosed herein, such a circuit has not been shown to be cooperating with the trunk circuit. Consequently the relays for interconnecting the start circuit of the message transmitter were not shown in Figs. 60 and 61 since they would perform no useful function there. Briefly, upon the storing of the first character of a message in either tape 1930 or 2030 the corresponding contacts 1921 or 2021 will be closed and complete circuits for the operation of the respective relays 1810 and 1819. These relays, in turn, complete circuits for the operation of the respective relays 1813 and 1822 assuming, of course, that neither of the transmitting distributors shown in Figs. 19 and 20 are employed for the transmission of transmitter start signals at the time the message is first recorded in tapes 1930 and 2030. If it should happen that messages were recorded in these tapes at this time, relays 1810 and 1819 will not operate until the distributors which are cooperating with the transmitter start circuit are released, at which time these relays will operate and complete circuits for the operation of relays 1813 and 1822. As described hereinbefore with respect to relays 6113 and 6122, if relay 1709 is released and both relays 1702 and 1703 are released, both relays 1813 and 1822 will operate. However, only relay 1813 will lock op-

erated upon the operation of relay 1707. Relay 1707 operates in response to the operation of either relay 1813 or 1822. The operation of relay 1707 will cause relay 1813 to lock operated and relay 1822 to release. The release of relay 1822 completes a circuit for the operation of relay 1706 which relay, in operating, in turn causes relay 1712 to operate and condition the circuits for causing the transmitter shown in Fig. 19 to transmit the message stored in tape 1930. At the end of the message relays 1811, 1816, and 1812 will operate in response to the figure signal followed by the H signal and stop the operation of the transmitter shown in Fig. 19. In addition, the operation of relay 1812 interrupts the circuit of relay 1817 and permits this relay to release after the final letters signal has been fully transmitted over the receiving channel of party line 210. Release of relay 1817 permits relay 1712 to release, which relay releases and in turn causes relays 1811, 1816, and 1812 to release and relay 1817 to reoperate. The release of relay 1712 interrupts the control circuits of the transmitter shown in Fig. 19 and stops its operation and, in addition, interrupts the operating circuit of relay 1702 which relay thereupon releases and completes a circuit for the operation of relay 1822. Thereafter relay 1822 operates and causes relay 1707 to operate and lock relay 1822 operated. Under these circumstances the operation of relay 1707 completes a circuit for the operation of relay 1706 which relay, in turn, causes relay 1713 to operate and condition the transmitting equipment shown in Fig. 20 for transmitting the message stored in tape 2030. At the end of this message relays 1820, 1825 and 1821 operate and relay 1826 releases which in turn releases relay 1713. The release of relay 1713 interrupts the control circuits of the transmitter shown in Fig. 20 and stops this transmitter. Thereafter the above cycle of operations is completed until all of the messages stored in either tapes 1920 and 2030 are fully transmitted.

The operation of these circuits has not been described in detail because the circuits are arranged in substantially the same manner and operate in substantially the same manner as the circuits shown in Figs. 62 and 63 and described in detail with reference to the trunk circuit 290, with the exception, as pointed out above, of the added relays required for cooperating with the transmitter start circuit. Inasmuch as the operation of these relays and associated circuits has also been described in detail with reference to the operation of the transmitter start circuit, it is not deemed necessary to repeat that description at this place.

It should be noted that when relay 1712 is released the transmitting contacts of the transmitting distributor shown in Fig. 19 are short-circuited and thus the transmitting equipment effectively disassociated with the receiving channel of the party line 210. Similarly when relay 1713 is released the contacts of the transmitting distributor shown in Fig. 20 are short-circuited. Consequently, this transmitter is also effectively disassociated from the receiving channel 211 of party line 210. However, upon the operation of these relays this transmitting equipment is operatively associated with this channel for transmission thereof.

It should be noted that the right-hand contacts of the group of contacts controlled by members 1909 are connected to the respective distributor

contacts through the break contacts of relay 1814 when relay 1814 is released, while the corresponding contacts of the transmitter shown in Fig. 20 are connected to the distributor of that figure when relay 1823 is released. As described hereinbefore, relays 1814 and 1823 are released, except during the operation of the transmitter start circuit described hereinbefore. Consequently, during the time these relays are released, signals will be transmitted in accordance with the setting of the contacts controlled by members 1909 and 2009 which setting is, in turn, controlled by the perforations in the respective tapes 1930 and 2030. Thus the signals are transmitted in accordance with the messages recorded in these tapes.

Considering now the signals as transmitted over the receiving channel 211 of party line 210, it will be recalled that the first code combination recorded in tape 1930 was the code combination representing the letter K which preceded a message intended for the recording equipment 229 at station 219. Each of the selecting equipments 1301, 1101 and 1001 responds to this code combination and causes contacts 1050, 1150 and 1350 to momentarily close in response thereto. The equipment for closing these contacts and the manner of operation in response to the reception of the letter K signal is described in detail in the patents to Beattie et al., referred to and incorporated hereinbefore, so that the operation of this equipment need not be repeated in detail.

The operation of contacts 1050 completes a circuit for the operation of relay 1029 from ground through the operated contacts 1050 and the break contacts of relay 1004 to battery through the winding of relay 1029. Relay 1029, in operating, completes a circuit for maintaining itself operated from battery through its winding and left-hand operated contacts, the left-hand inner break contacts of relay 1037 to ground through the right-hand operated contacts of relay 1029.

The operation of relay 1029 completes an obvious circuit for the operation of relay 1004. Relay 1004, in turn, interrupts the circuits from the selecting contacts controlled by the selecting equipment 1001 so that if any of these contacts happen to be operated by code combinations representing characters of the message, such operation will be ineffective to further control the switching circuits at the intermediate switching center shown in Figs. 10 and 11. It should be noted that none of the receiving equipment controlled by this intermediate switching equipment is operatively associated with the receiving channel 211 of party line 210.

Likewise, the operation of contacts 1350 completes a circuit for the operation of relay 1329 which relay locks operated under control of relay 1337 and completes a circuit for the operation of relay 1304. Relay 1304 in operating disconnects the selecting contacts from the switching circuits at the intermediate switching center shown in Fig. 13 without operatively associating any of the receiving equipment controlled thereby with the receiving channel of party line 210.

The momentary closure of contacts 1150 completes a circuit for the operation of relay 1133 which relay, in operating, completes a circuit for maintaining itself operated from battery through its winding and left-hand inner operated contacts, the left-hand inner break contacts of relay 1137 to ground through the right-hand inner operated contacts of relay 1133. Operation of relay 1133 also completes a circuit for the operation of relay 1104 which relay, in turn, in operating dis-

connects the selecting contacts controlled by selector 1101 from the control circuits so that these contacts may be operated during the transmission of a message without affecting the switching circuits.

The operation of relay 1133 also connects line 2421 to the contacts of the receiving and repeating relay 1183. Consequently, the line relay 2422 will respond to the succeeding signals transmitted over the receiving channel 211 of party line 210 and repeat these signals to the receiving or recording equipment 2424 which will receive and record the remaining portions of the message intended therefor. It should be noted that both the directing characters B and K which originally preceded the message have been absorbed in the switching equipment so that the message as recorded by the receiving equipment will not include these directing characters.

During the transmission of the message the selectors 1001, 1101 and 1301 receive and follow all of the signals transmitted over receiving channel 211 of party line 210. If at any time during the message the figure signal is transmitted, contacts 1025 of selector 1001, contacts 1125 of selector 1101 and contacts 1325 of selector 1301 will momentarily close and complete a circuit for the operation of the respective relays 1045, 1145 and 1345. The closure of any of the other contacts controlled by these selectors during the message will be ineffective to actuate any switching circuits, except the blank combination as described hereinbefore. The circuit for the operation of relay 1145 may be traced from ground through the momentarily operated contacts 1125, through the right-hand winding of relay 1145 to battery through the lower winding of relay 1146. A short interval of time later contacts 1126 will close and complete a circuit through the upper winding of relay 1146 which tends to move the armature of this relay to its left-hand position. However, the effect of the current flowing through the upper winding of relay 1146 is overcome by a stronger effect of a current going through the lower winding of the relay tending to maintain its armature in a position shown in the drawing. Consequently, this relay will remain in the position shown in the drawing at this time. Relay 1145, in operating, completes a circuit for maintaining itself operated from battery through its left-hand winding, the left-hand outer break contacts of relay 1137, and left-hand and right-hand upper operated contacts of relay 1145 to ground through the right-hand contact and armature of relay 1146.

If the succeeding signal is another figure signal, the circuits will remain substantially in the same condition as described above. If the succeeding signal is a blank signal, the circuits will operate as described hereinbefore for the conditioning and starting of transmission from one of the subscriber stations of the party line 210. If, however, the succeeding signal is any signal other than these signals or an H signal, the universal contact 1126 will momentarily close and complete a circuit through the upper winding of relay 1146. Since all the other contacts controlled by the selector are open at this time, no current will flow through the lower winding of relay 1146. Consequently the armature of this relay will move to its left-hand position where it interrupts the locking circuit of relay 1145.

At the end of the message the figure signal will be immediately followed by the letter H signal as described hereinbefore. The figure signal will

cause relay 1145 to operate and lock as described above, and the following H signal will cause relay 1137 to operate in a circuit extending from battery through the lower winding of relay 1146, the winding of relay 1137, the left-hand lower operated contacts of relay 1145 to ground through the momentarily closed contacts 1117. A very short interval of time after contacts 1117 close, contacts 1126 will close and complete a circuit through the upper winding of relay 1146. This relay has current flowing through the lower winding at this time so that its armature will be maintained at the position shown in the drawing.

Relay 1137, in operating, completes a circuit for maintaining itself operated under control of contacts 1117 and interrupts the locking circuit of relay 1145. Relay 1137, in operating, also completes a circuit for maintaining itself operated under control of relay 1133 from battery through the lower winding of relay 1146, the winding of relay 1137, the left-hand inner operated contacts of relay 1137 to ground through the right-hand inner operated contacts of relay 1133. The operation of relay 1137 also interrupts the locking circuit of relay 1133, which relay in turn releases. The release of relay 1133, together with the release of contacts 1117, cause relay 1137 to release. The release of relay 1133 also causes relay 1104 to release and restore the circuit at the switching center to its initial condition.

The switching circuits at the other switching centers of party line 210, respond to the figure signal immediately followed by an H signal in a similar manner. Thus relay 1045 operates in response to the figures signal and relay 1037 in response to the H signal. The operation of relay 1037 causes the release of relay 1029 and restores the circuit to its initial condition. The circuits shown in Fig. 13 are similarly restored to their initial condition. Thus, all of the switching centers are again in condition to respond to the next signal of the succeeding message transmitted over the receiving channel of party line 210. This next signal under normal operating conditions will be the second directing signal preceding the message and will cause the message to be directed to the desired receiving instrument. Under the assumed conditions this signal will be the letter X and cause the next message, which was the one transmitted from tape 2030, to be transmitted to the recording device 234 at station 224.

It may sometime happen that the first character transmitted over the receiving channel party line 210 is in some manner mutilated, perhaps due to interfering impulses operating upon the line. When this happens the character may be changed into some character not assigned as an address code of any of the stations on the line. Consequently, none of the selecting contacts for controlling the receiving equipment will be actuated and, therefore, none of the receiving instruments at any of the stations will be connected to the receiving channel and the following message will therefore be lost. In a well designed system this condition occurs infrequently, still it is desirable to provide means for preventing the losing of even these occasional messages. In order to prevent the loss of these messages, an additional relay is provided at each of the switching centers which relay is controlled by the carriage return signal normally transmitted after the letter signal following the address. The added relay is designated 1048 in Fig. 10, 1148 in Fig. 11, and 1348 in Fig. 13. In case none of the other contacts assigned to address codes connected to

a particular line are operated prior to the transmission of the carriage return signal, none of the relays and, in particular, none of the respective relays 1004, 1104 and 1304 will operate. When the carriage return signal is therefore received and the respective contacts 1028, 1128 and 1328 momentarily close in response thereto, relays 1048, 1148 and 1348 will operate. These relays, in operating, complete a circuit for maintaining themselves operated under control of the respective relays 1037, 1137 and 1337. Relay 1048 completes circuits for the operation of relays 1030, 1031 and 1032. Relay 1148 completes circuits for the operation of relays 1134 and 1133. Relay 1338 completes circuits for the operation of relays 1334, 1335, 1336, 1343 and 1344. All these relays lock operated and connect the receiving equipment at the respective stations to the receiving channel of the party line. Thus, when the first directing character is mutilated or changed so that it does not represent the address code of any stations served by the party line, relays 1048, 1148 and 1348 operate in response to the following carriage return signal and cause the entire message to be recorded by all of the receiving equipments served by the party line. Normally the message will be intended for some one of the stations and since the message will be delivered to that station it will not be lost. In addition, the subscribers or attendants at the various stations can generally tell from the text of the message whether the message is intended for that station or some other station. This is particularly true in the case where the code address of both the sending and receiving stations are transmitted as part of the message.

In case the message is not intended for any station of the line, some one station may be assigned the duty of returning the message to the central switching station where suitable disposition thereof may be made.

By adapting this operating procedure and providing the additional circuits described above, even the messages which on rare occasions are improperly switched or mutilated are not lost but are transmitted to all of the stations of a party line, one of which the message generally is intended for. Consequently, little or no delay is encountered even under these circumstances. If the message is not intended for any of the stations on the line, it still is not lost since it will be returned to the central switching station where the message may be corrected, if possible, and transmitted to its proper station of address with a minimum of delay.

As shown in Figs. 10, 11 and 13, circuits are provided from the contacts of the respective relays 1048, 1148 and 1348 for causing receiving equipment at all of the stations of the party line to be connected to the receiving channel. This is accomplished by means of the conductors or straps 1075, 1175 and 1375. As shown in the drawing, one of these conductors or straps is provided for each station or printing equipment served by the party line.

At times it may not be desirable to transmit these mutilated or changed address signals to all of the stations of the party line. It may be desirable to transmit them only to certain of the stations, or perhaps to only one station. Such an arrangement may be easily provided by omitting the straps or conductors 1075, 1175 and 1375 from the stations to which it is not desired to send such messages. Then when relays 1048, 1148 and 1348 operate the relays controlling these stations

will not operate and receiving equipment thereat will accordingly not be connected to the receiving channel of the party line. It should be noted that once the respective relays 1004, 1104 and 1304 operate in response to the reception of an address code assigned to that line the operating circuit of relays 1048, 1148 and 1348 is interrupted so that these relays will not operate under these circumstances.

There are also other methods of preventing messages, the first character of which is mutilated when transmitted over the receiving line, from becoming lost. It will be recalled that if the address characters preceding a message are so mutilated that they do not represent an address assigned to some one station of the system, the messages will be routed to the miscellaneous intercept position at the center switching station where the operator or attendant can determine the trouble and, if possible, correct the address and transmit it to the proper station or destination. If, however, trouble arises in the outgoing line circuit or upon the receiving channel of the party line, some provision, such as described above, is desirable to prevent the message from becoming lost. In case only a relatively small number of stations are served by the system it is possible to so operate the system in another manner that messages preceded by a false first character when transmitted over the receiving channel of the party line will not become lost.

In some cases the number of stations connected to the entire switching system and the number of stations connected to any one line is such that it is not necessary to assign the same address characters as the first and last characters of the address codes. In other words, if the letter A is used for the first character of any address code it will not be used as the second address character of any address code. Similarly, if the letter E is the second character of any address code, it is not assigned as the first character of any address code. When the address codes are so chosen it is possible to repeat the entire address code right after the letters signal following the first address code. In this case the second address code will form a part of the message in the same manner that the carriage return, line feed and letter signals described above form a portion of the message. The line feed, carriage return and letter signals may also be transmitted following the second or repeated address codes.

Then when the message is finally transmitted over the receiving channel of the proper party line and assuming that the first character transmitted, which will be the second character of the first address code, as described above is mutilated or lost so that the receiving equipment at none of the stations will be connected to the party line, when the first character of the repeated address code is transmitted over the system none of the selecting contacts of the control selectors of the party line will be closed and, consequently, this character will be lost or discarded.

However, when the second character of the repeated address is transmitted over the receiving channel of the party line, the proper contacts controlled by the switching selectors will be closed and cause the proper receiving instrument to be associated with the receiving channel of the party line in question. Thus, by a judicious choice of the address codes assigned to the stations of a party line and perhaps to the stations of the entire system where there are sufficient

codes available it is possible to provide a second opportunity for the proper operation of the system and direction of a message to the desired station.

Attention is also directed to the fact that at certain of the secondary switching centers the same contacts controlled by the selector equipments are employed both to control or initiate the operation of the transmitting equipment at stations controlled thereby and also to control the switching circuits controlling the receiving equipment at the respective stations. Thus in Fig. 10 contact 1010 is employed to both start the transmitting equipment at station 216 and also cause the receiving equipment 2324 to be connected to the receiving channel of the party line depending upon the signals preceding the letter A signal which actuates contacts 1010. If a disconnect signal preceded the letter A signal without a blank signal intervening, a momentary closure of contacts 1010 will cause the receiving equipment 2324 to be connected to the receiving channel 211 of party line 210. If, however, the A signal is preceded by a blank signal and then the remaining portion of the transmitter start pattern, momentary closure of contacts 1010 will cause the transmitting equipment at station 216 to be started into operation. Similarly, the letter E signal when receiving at the secondary switching center may cause either the transmitting equipment at station 217 to be started into operation or it may deactivate the switching equipment at this station without connecting any of the receiving equipment to the party line. This signal, however, when received by the selector equipment 1301 under the latter conditions will cause the receiving equipment at station 220 to be connected to the receiving channel of the party line.

Half duplex party line

Returning now to the message stored in tape 4530, as described above, and addressed to station 269 and shown in detail in Fig. 49, the transmission of this message to this station will now be described. It will be recalled that this message was preceded by a letter D signal which was the second address code assigned to the receiving equipment at station 269. Upon the storing of the first character of this message which is the last D signal in tape 4530, contacts 4521 will close and complete a circuit for the operation of relay 4322 from battery through the winding and lower inner break contacts of relay 4322, the lower break contacts of relay 4309 and the right-hand outer break contacts of relay 4434 to ground through the operated contacts 4521. Relay 4322, in operating, completes a circuit for maintaining itself operated under control of relay 4309 from battery through the winding and lower inner operated contacts of relay 4322 to ground through the upper break contacts of relay 4309.

Thereafter the circuits shown in Figs. 45, 44 and 43 remain in this condition until operation of the transmitting equipment shown in Fig. 45 is permitted by the transmitter start circuit.

The operation of the transmitter start circuit shown in Figs. 40, 41 and 42 is substantially the same as described above with reference to the transmitter start circuit of party line 210 shown in Figs. 14, 15 and 16. It will be recalled that the operator at the central switching station may initiate the operation of any of the transmitters of the party line by operating the key or button associated with or designating that particular sta-

tion which will cause a start pattern to be transmitted for initiating the operation of the transmitter at that station, providing it is supplied with tape perforated in accordance with the address and message to be transmitted. It will also be recalled that upon the operation of a special key to an automatic position the operation can cause the circuit to automatically test each of the transmitters served by the party line for message material and cause them to transmit the stored message material in rotation. In the latter case, each transmitter is given one or more turns or opportunities to transmit in a regular order and if none of the transmitters is supplied with message material, then after the last transmitter to transmit has been again tested the transmitter start circuit will pause or rest for a predetermined interval of time, after which all the transmitters will again be tested for presence of the stored message material available for transmission. In addition, the operator at the central station may stop the transmission from any of the transmitters at the outlying stations in a manner similar to the manner of stopping transmission from the stations connected to party line 210. As shown in the drawing, the variable time delay feature described above with reference to the full duplex line has not been incorporated into the half duplex line control circuits. Instead a single delay interval is provided which is cancelled or terminated if a message is directed to the half duplex line at the central office.

As described herein, when a message is awaiting transmission over the half duplex line relay 4322 is operated. The operation of this relay connects ground to the No. 6 terminal of the C1 bank of the C stepping switch and causes this switch to advance at once before the end of the pause. The advance of the C stepping switch at this time will initiate the operation of the transmitter start circuit for testing the transmitters for message material.

After the relay 4322 operates, as described above, the circuits will remain in the position described until either the operator at the central switching station manually starts the transmission from the transmitting equipment shown in Fig. 45 by manually operating the key 4040, or by the automatic operation of this circuit assigning a time for the operation of the transmitter shown in Fig. 45 during its regular turn or rotation during the automatic operation of the transmitter start circuit.

In either case, when brush arm 4012 comes to rest upon the terminal or terminals assigned to the transmitting equipment shown in Fig. 45 and relay 4216 releases during the operation of the transmitter start circuit as described above, a circuit will be completed for the operation of relay 4432 from battery through the winding of relay 4432 through the lower break contacts of relay 4216 over conductor 4055 extending through Figs. 42, 41 and 40 to ground through the contact of the A2 bank of the A stepping switch and brush arm 4012 thereof.

As shown in the drawing, this conductor 4055 is connected to the No. 10 terminal of the A2 bank as well as the No. 21 terminal thereof. Consequently, when brush arm 4012 steps on to this terminal the above-described circuit will be completed for the operation of relay 4432. The operation of relay 4432 removes the short circuit from around the transmitting distributor of contacts and thus conditions the distributor for operation so that when this distributor is released, as will

be described hereinafter, it will cause signals stored in tape 4530 to be transmitted over the party line 260.

The operation of relay 4432 also initiates the operating of the timing circuit, comprising tube 4436, condensers 4438, 4439 and 4442 as well as resistances 4437, 4444 and 4443 and relay 4324. Relay 4432, in operating, energizes the filament circuit of vacuum tube 4436 through its lower outer operated contacts and by means of the operation of its lower armature reverses the connections to condenser 4439 so that the charge upon this condenser will start to reverse through high resistance 4444. If keys 4440 and 4441 are in the position shown in the drawing, the charge on condenser 4438 will also start to reverse through the high resistance 4444. If key 4441 is operated the charge on condenser 4442 will also be reversed through this high resistance. Thus by appropriate operation of keys 4440 and 4441 the capacity of the condenser may be altered so as to change the time constants of these condensers to secure the desired time interval. This time interval is determined by the constant of tube 4436, resistances 4437 and 4443, as well as the time constants of the high resistance 4444 and the capacity of condensers 4438, 4439 and 4442. The operation of this timing circuit is set forth in greater detail in Patent No. 2,327,791 to A. L. Hopper, dated August 24, 1943, the disclosure of which is hereby made a part hereof as if fully included herein. In the usual case, constants of this time circuit are such that it requires from two to ten minutes after the operation of relay 4432 for the subsequent operation of relay 4324.

Returning now to the operation of transmitter start circuit, it will be recalled that during the operation of this circuit after brush arm 4012 comes to rest on the terminal representing the transmitter which it is desired to test or attempt to start, a transmitter start pattern will be transmitted over the system. In case the brush arm 4012 is resting upon the No. 10 terminal, as assumed above, the final character of the transmitter start pattern will be the letter Y which in this case, that is, in the case of the party line 260 shown in Figs. 35 through 39 and 48 through 51, inclusive, is not assigned to any of the transmitters which are controlled or served by this party line. Consequently, the secondary switching centers in responding to this transmitter start signal pattern will not cause any of the transmitters controlled by them to be started into operation. Instead, the circuits will be restored to their previous condition as described above.

As described above, upon the completion of the transmission of the start pattern, brush arm 4001 which corresponds to brush arm 1401, will be advanced to its No. 5 position where it will complete a circuit for the operation of relay 4107. It will be recalled that relay 4107, in operating, completes a circuit for determining if the transmitter tested and attempted to be started actually starts. These circuits were described in detail above with reference to relay 1507. However, in the case of the testing of transmitters shown in Fig. 45 when brush arm 4001 advances to its No. 5 position a circuit will be completed for the operation of relay 4413 from battery through the winding of relay 4413, the lower outer operated contacts of relay 4322, lower outer operated contacts of relay 4432, the upper break contacts and second armature from the top or relay 4110 to ground through the No. 5 terminal of the C2 back and brush arm 4001.

The operation of relay 4413 completes a circuit for the operation of relay 4106 from battery through the winding of relay 4106, the operated contacts of relay 4107 to ground through the upper operated contacts of relay 4413. The operation of relay 4106 causes the transmitter start circuit to suspend operations, as described above with reference to relay 1506.

The operation of relay 4413 completes a circuit for the operation of the transmitter start magnet 4511 from battery through the winding of magnet 4511, through the lower break contacts of relay 4418, the lower break contact on second armature from the bottom of relay 4302, lower break contacts of relay 4412 and 4433, the lower inner operated contacts of relay 4413, the lower break contacts of relay 4309, the right-hand break contacts of relay 4434 to ground through the closed contacts 4521.

The operation of magnet 4511 at this time will release the transmitter for operation and cause the letter D signal followed by the message signals recorded in tape 4530 to be transmitted over the party line 260. During the transmission of this message, figure signals may be transmitted to cause the receiving teletypewriter to move its platen to the upper case position. When a figure signal is transmitted ground will be connected to lead 4534 through the contacts controlled by members 4509 which are positioned in accordance with the figure signal perforated in tape 4530 in the manner described above. When ground is connected to lead 4534 a circuit is completed for the operation of relay 4326 from battery through the upper winding of this relay to ground connected to lead 4534. Relay 4326 is somewhat slow in releasing and will remain operated until the next character is scanned and perhaps partially transmitted. If the next character following the figure signal is not an H signal relay 4326 will release without causing any further change in the circuits. If, however, the signal immediately following the figure signal recorded in tape 4530 is an H signal, a circuit will be completed for maintaining relay 4326 operated and for operating relay 4323. When an H signal is perforated in tape 4530 and members 4509 positioned in accordance therewith, ground will be connected through the contacts controlled by members 4509 to lead 4535. When the H signal immediately follows a figures signal a circuit extends from ground through the contacts controlled by members, when positioned by the H signal, over lead 4535, through the lower inner operated contacts of relays 4431 and 4326 to battery through the winding of relay 4326 for maintaining relay 4326 operated. This circuit also extends from ground over lead 4535 through the operated contacts of relays 4431 and 4326, the lower and upper operated contacts of relay 4326, and the lower outer break contacts of relay 4302 to battery through the winding of relay 4323.

Relay 4323, in operating, completes a circuit for maintaining itself and relay 4326 operated from battery through the winding of relay 4323, the lower outer break contacts of relay 4302, the upper operated contacts of relay 4323, the upper outer break contacts of relay 4302, and the upper operated contacts of relay 4322 to ground. Relay 4322 is locked operated at this time under control of relay 4309 as described above. After the figure signal is fully transmitted the transmitter shown in Fig. 45 will sense the following letters signal. Near the beginning of this revolution of the transmitter shaft 4553 the auxiliary contacts

4517 close and complete a circuit for the operation of relay 4412 from battery through the winding of relay 4412, the lower operated contacts of relay 4323 to ground through the closed contacts 4517. Relay 4412, in operating, interrupts the circuit of the transmitter clutch magnet 4511, thus permitting this magnet to release and stop the transmitter in Fig. 45 after the letters signal following the H signal has been fully transmitted.

The operation of relay 4412, in addition, completes a circuit for the operation of relay 4320, assuming that another message has been stored in tape 4530. If another message has not been stored in tape 4530 or if the end of the time period of the charging of the condenser 4439 has elapsed by this time, relay 4320 will not be operated. Assume for purposes of illustration that there is a message stored in tape 4530 and that the time delay interval of the tube 4436 and related circuits has not fully expired so that relay 4320 will operate at this time.

The operation of relay 4412, in addition, interrupts the operating circuit of relay 4431. Relay 4431 is a low-release relay and does not immediately release. The releasing time of relay 4431 is made sufficiently long to insure that the letters signal following the figures signal and an H signal at the end of the first message stored in tape 4530 will be fully transmitted. At the end of this interval of time, relay 4431 will release and complete a circuit for the operation of relay 4302 from battery through the winding of relay 4302, the operated contacts of relay 4320 to ground, through the lower break contacts of relay 4431.

Relay 4302, in operating, completes a circuit for maintaining itself operated from battery through its winding and lower inner operated contacts to ground through the lower break contacts of relay 4431. Relay 4302, in operating, interrupts the locking circuits of relays 4326, 4323, 4320 and 4412, thus permitting these relays to release. The release of relay 4412 reestablishes the operating circuit of relay 4431 and causes this relay to reoperate. The reoperation of relay 4431 interrupts the locking circuit of relay 4302 which relay then releases and again completes a circuit, traced above, for the operation of the transmitter start magnet 4511 which operates and permits the transmitter shown in Fig. 45 to transmit the next message stored in tape 4530 over the party line 260.

Assume that during the time this message is being transmitted that relay 4324 is operated due to the fact that the condensers 4439, 4438 and 4442 which are connected to the grid of tube 4436 due to the setting of keys 4440 and 4441, have received a sufficient charge to cause the upper terminals to reach the potential required to initiate the flow of sufficient anode current through tube 4436 to cause the operation of relay 4324. Relay 4324, in operating, completes a circuit for the operation of relay 4321. Thereafter the circuits remain in the condition described until the end of this message.

At the end of the message the figures signal will cause relay 4326 to operate, as described above, and the immediately following H signal will cause relay 4323 to operate. During the sensing of the following letters signal recorded in tape 4530 a circuit will again be completed for the operation of relay 4412. Relay 4412, in operating, completes a circuit for maintaining itself operated from battery through its winding and upper in-

ner operated contacts through the upper outer break contacts of relay 4302 to ground through the upper operated contacts of relay 4322. The operation of relay 4412 interrupts the circuit of magnet 4511 and causes this magnet to release and stop the transmitter shown in Fig. 45 after the letter signal has been fully transmitted.

The operation of relay 4412 at this time, however, does not complete a circuit for the operation of relay 4320 because the operating circuit of this relay is open at the upper operated contacts of relay 4321. Relay 4412, in operating, again interrupts the operating circuit of relay 4431. After the letter signal is fully transmitted relay 4431 will again release. This time, however, since relay 4320 is released, the release of relay 4412 completes a circuit for the operation of relay 4309 from battery through the winding of relay 4309, the upper inner break contacts of relay 4302, the break contacts of relay 4320 to ground through the lower break contacts of relay 4431.

Relay 4309, in operating, completes a circuit for maintaining itself operated under control of relay 4432 from battery through the winding and lower operated contacts of relay 4309 to ground through the upper outer operated contacts of relay 4432. The operation of relay 4309, in addition, interrupts both the locking circuit and the operating circuit of relay 4322 and thus permits this relay to release.

The release of relay 4322 interrupts the locking circuit of relays 4326, 4323, 4412 and 4413, thus permitting these relays to release. The release of relay 4412 again reestablishes the operating circuit of relay 4431. The reoperation of relay 4431 interrupts the operating circuit of relay 4309. This relay does not release at this time because its locking circuit is maintained through the contacts of relay 4432, as described above. The release of relay 4413, in addition, interrupts the circuit of relay 4106.

The release of relay 4106 then causes the transmitter start circuit to either return to its normal condition or to cause it to start to test another transmitter, depending upon whether the automatic key is in its manual or automatic position. In either event, when the C stepping switch returns to its number 1 position a circuit will be completed for the operation of relay 4216, which relay, in operating, will interrupt the operating circuit of relay 4432. The release of relay 4432 restores the timing circuit comprising tube 4436 and associated equipment to its original condition and, in addition, discharges and charges condensers 4439, 4438 and 4442 in the reversed direction if they are connected to the grid of tube 4436. The release of relay 4432 also interrupts the locking circuit of relay 4309 and restores this relay to its original condition whereupon the circuit will remain in this condition until the transmitter start circuit again causes or permits the transmitter shown in Fig. 45 to send the succeeding messages stored in tape 4530.

When the transmitter start circuit again permits the operation of the transmitter shown in Fig. 45, the circuits will respond substantially as described above for the transmission of messages stored in tape 4530. Assume that the transmitting circuits have been established, as described above, and that only a single message is stored in tape 4530. At the end of this message a figures signal followed by an H signal and the H signal in turn followed by a letters signal will be recorded in tape 4530. Upon the transmission of the figures signal, relay 4326 will be operated and

upon the sensing of the following H signal, relay 4323 will operate. During the sensing of the succeeding letters signal relay 4412 will operate, as described above. However, at about the time relay 4412 operates or prior thereto, contacts 4521 will open due to the fact that the transmitting head of the transmitter shown in Fig. 45 has advanced to its last position where it is sensing the last character stored in tape 4530. It will be recalled that following the transmission of a letter signal at the end of every message the transmitting circuits to the recording instrument 4506 are interrupted and the recording instrument maintained in its idle or rest position. Therefore the letters signal following the final message will be the last character recorded in tape 4530. When the contacts 4521 therefore open during the cycle of operations of the transmitter during which this letter signal is sensed, they will interrupt the circuit of the start magnet 4511 and thus stop the transmitter shown in Fig. 45 after the letter signal has been fully transmitted.

The operation of relay 4412 again will not cause relay 4320 to operate because its operating circuit will be open at the open contacts 4521. The operation of relay 4412, as described above, will again interrupt the operating circuit of relay 4431. The release of the slow-release relay 4431, after the letters signal has been fully transmitted, will again complete a circuit for the operation of the disconnect relay 4309, which relay will operate and cause the transmitter shown in Fig. 45 to be disassociated from the transmitting channel and will also either initiate the operation of the automatic transmitter start circuit or indicate the end of transmission to the operator at the central switching center.

When additional messages are recorded in tape 4530 the circuits and apparatus will respond as described above.

The signals as transmitted over the receiving channel of the party line 260 cause the switching equipment associated therewith to connect the proper receiving instrument to the receiving channel in the same manner as described above with reference to party line 210.

In addition, the feature for preventing messages from being lost, as described with reference to party line 210, may also be employed as will be well understood by those skilled in the art. This feature, however, has not been disclosed with reference to party line 260. Instead a broadcast feature has been disclosed wherein any subscriber may cause a message to be transmitted to any predetermined group of the receiving devices or stations served by party line 260. To accomplish this in the specific embodiment shown in the drawing the message must be preceded by the address codes AP. These address codes will cause the message to be directed through the central switching equipment as described above with reference to other codes and eventually be transmitted over the receiving channel of party line 260. The letter A signal will be absorbed in the switching equipment at the central switching station as described herein so that the message will be preceded by the letter P when transmitted over the receiving channel of party line 290. When this signal is received by the selectors 3601, 3701 and 3901 they will cause contacts 3660, 3760 and 3960 to momentarily close in response thereto and complete circuits for the operation of relays 3648, 3748 and 3948. The operation of these relays will cause the operation of the switching relays for connecting the desired receiving in-

struments. As shown in the drawing, straps 3675, 3775 and 3975 are provided for all the switching relays so that all of the receiving devices served by party line 260 will be connected thereto and simultaneously receive the message which is preceded by the address code AP.

If it is desired to have this message received by less than all of the stations, the straps designated 3675, 3775 and 3975 will be omitted so that the corresponding relays which control the omitted stations will not operate. It will be perfectly evident to anyone skilled in the art that as many different subgroups may be provided as desired by merely providing a special relay at the secondary switching centers involved which will operate in response to the particular code designating any particular subgroup. It will also be evident to those skilled in the art that a similar group of relays may be provided which will respond to the carriage return signal, as described with reference to party line 210, and thus prevent messages from being lost.

It will also be evident to those skilled in the art that the broadcast feature as herein described with reference to party line 260 may be applied equally well to party line 210 or any other party line of the system so that messages may be broadcast to any group or all of the stations connected to party line 260.

Inasmuch as party line 260 is operated on a half duplex basis, that is, the transmission can take place in only one direction and from only one station at a time, it is sometimes desirable to provide circuit arrangements for permitting messages transmitted from any station to be recorded upon the receiving equipment at that station as a home copy. Circuits and apparatus for accomplishing this manner of operation may be provided at any of the switching centers for any of the stations controlled thereby. As shown in the drawings, provision has been made so that the receiving equipment at stations 266, 267, 268, 269, 270, 271 and 273 will receive copies of messages transmitted therefrom upon their receiving machines. This is accomplished by providing the respective repeating relays 3690, 3691, 3692, 3790, 3990, 3991 and 3993. These relays having a winding connected in series with the transmitting circuits from the respective stations and have their contacts connected in series with the transmitting circuits extending to the respective stations. Thus, when a message is transmitted from any one of these stations the corresponding repeating relay referred to above will follow the signals and repeat them to the transmitting circuit extending to the receiving equipment to that station and thus producing a copy of the transmitted message as it was actually transmitted. This equipment of course may be provided for all of the stations or it may be omitted for any desired station. It has been omitted from the equipment provided for stations 272 and 274 by way of example.

Transmission of messages from intercept positions

Considering now the messages directed to the intercept miscellaneous positions, as described above, and recorded by the recording device 8761 it will be recalled that it will generally be necessary for the operator to correct these messages or deal with them in some other manner since they are improperly addressed or since some trouble condition exists in the switching system which should be remedied.

With respect to the messages routed to the willful intercept machines the situation is somewhat different. When messages are routed to the local intercept machine due to the fact that some station is shut down that particular time or day, messages are capable of being automatically transmitted through the system at some later time. When the messages are routed to any particular willful intercept machine for any reason the operator at the central switching station will generally operate the director hold key 8234 which will cause an obvious circuit for the operation of relay 8314. The operation of this relay will not interfere with the transmission of any message then in progress of transmission through the director circuit. However, the operation of this relay will prevent the transmission of any subsequent messages from the transmitter shown in Fig. 82 as will be described herein-after. If, of course, messages are stored in any given intercept machine intended for a number of stations some of which later become available or operative for receiving the messages and others do not become operative or attended, the operator may release the director hold key 8234 after having restored the intercept keys associated with the stations which are ready and capable of receiving the messages. In this case the messages directed to this station will be transmitted through the equipment to them, while the messages stored in tape 8230 which are directed to other stations, the intercept keys of which remain operated because the stations are not in condition to receive the messages will be redirected to the willful intercept recording device 8206.

It will, of course, be appreciated by those skilled in the art that any number of willful or intercept positions may be provided and a key assigned to each station for each willful intercept circuit provided. In this manner it is possible to separate messages for different stations in the different intercept circuits by operating the keys assigned to said stations in such a manner as to direct messages addressed to one station to one of the intercept circuits and operating other keys assigned to the other stations so as to direct these messages addressed to other stations to other of the intercept circuits. In this manner the messages directed to the various stations may be separated so that it will not be necessary to cause many of them to be redirected to the intercept position when a plurality of intercept positions are provided.

It is also possible to operate the system in such a way that one or more of the intercept positions may be operated as an overflow circuit. If some line becomes heavily overloaded at some particular time so that other messages are delayed due to the fact that the two recording devices individual to the overloaded line for receiving messages for later transmission over this line are incapable of handling all of the traffic, it is possible to divert a portion of the traffic to one or more intercept circuits thus expanding the number of recording devices which may receive messages intended for the heavily overloaded lines and in this manner release other messages for transmission over other circuits to the stations for which they are intended. Even under these circumstances it will be desired to operate the direct or hold keys 8234 to prevent the automatic transmission of any of these messages during the heavily overloaded period. However, after the peak of the traffic for a particular line has passed so that the two recording instru-

ments assigned to this line are capable of handling all of the messages the intercept keys will be restored to normal and the hold key 8234 also restored to normal. Under these circumstances the messages intended for the overloaded line and stored in tape 8230 will be directed to the recording devices associated therewith. Inasmuch as the intercept positions are assigned the positions at the end of the sequence circuit shown in Fig. 90 so long as any other director or transmitter has messages directed to the overloaded line they will be able to transmit them to the recording instrument associated with that line when any of the recording instruments associated with the line are idle. Thus the transmission of subsequent messages will not be materially delayed. However, as soon as no further messages are awaiting transmission to the outgoing line circuit in question then the messages stored in tape 8230 will be automatically directed to these outgoing line circuits so long as no other messages are directed thereto from some other line. In this manner it is possible to provide an emergency arrangement for handling messages for a heavily overloaded line during any peak loads which may arise.

The transmission of the messages from the tape 8230 to the outgoing line circuits is substantially the same as described above with reference to the transmission of messages stored in tape 2805 and consequently need not be repeated here.

Miscellaneous features

Various manual control keys have been provided to enable the operator and attendants to properly control the circuits. For example, each of the transmitting devices is provided with a key which will stop all transmission therefrom and prevent further transmission as long as the key is operated. Another key is provided which, when operated, does not interfere with the transmission of a message then in progress but which will prevent the transmission of any additional messages by the transmitting equipment.

Thus key 2833, when operated, will cause relay 2910 to operate as described herein and interrupt all transmission from the transmitter shown in Fig. 28. Similarly, key 2834, when operated, completes an obvious circuit for the operation of relay 2914. The operation of this relay does not prevent the transmission of a message in progress of being transmitted at the time this relay is operated. It does, however, prevent the reoperation of relay 3016 at the end of the message in progress and being transmitted. Consequently, it will prevent the direction of a further message through the system. If relay 3016 had previously operated prior to the operation of relay 2914, the operation of relay 2914 will interrupt the circuit of lead 3225 and thus prevent the establishment of any connection through the crossbar system because the sequence circuit of Fig. 90 cannot be seized so that the horizontal magnet 3401 cannot be operated. Consequently, it will be impossible to establish a connection for the transmission through the system of the following message recorded in tape 2805. However, under these circumstances, with both relay 2914 and relay 3016 operated, the circuits will function to discard the group of characters referred to above and advance tape until the first code directing character is sensed at which time the operation of the circuits will stop until key 2833 is released.

An additional key 2832 is provided and when

this key is operated at the time key 2833 is operated relay 3119 will be operated, as described herein, and cause an emergency disconnect pattern to be transmitted thus interrupting any previously established connection through the system.

If key 2832 is operated when key 2834 is operated, a circuit will be completed for the operation of relay 2931 and thus direct the following message to a willful intercept position irrespective of the address code preceding this message.

In this manner the operator or attendants are able to interrupt any connection and cause the appropriate disconnect pattern to be transmitted automatically for disconnecting the circuits previously established in the outgoing line circuits as well as at the secondary switching centers controlling the equipment at the subscribers' stations. In addition, the attendant may prevent the further transmission of signals and direct any desired messages to an intercept position in case it is desired to relieve congestion or for any other reason.

A number of trouble indicators have been provided to indicate trouble conditions and to attract attention of the attendant or operator. For example, if the incoming line of the transmission channel of any of the party lines or trunk circuits become open an indication will be registered to indicate that a line has become open. For example, assume that the transmitting channel of party line 210 is inadvertently opened due to some trouble. The armature of relay 2701 will then move to its left-hand position and cause the armature of relay 2702 to move to its right-hand position. With the armature of relay 2702 in its right-hand position the circuit for the operation of the slow-release relay 2725 is interrupted. Relay 2725 is sufficiently slow in releasing to remain operated during the time the armature of relay 2702 is in its spacing or right-hand position during the normal reception of signals. However, when the line becomes open due to some trouble condition the armature of relay 2702 will remain in its right-hand position sufficiently long to permit relay 2725 to release. The release of relay 2725 completes an obvious circuit for the operation of a relay 2716. Relay 2716 in operating completes a circuit for maintaining itself operated from battery through its winding and center set of upper operated contacts to ground through the upper break contacts of relay 2726. The operation of relay 2716 in addition completes an obvious circuit for lighting the line trouble lamp 2828 and thus indicating to the attendant that the incoming line is open. The operation of relay 2716 also connects ground to lead 2738 through the upper inner break contacts of relay 2726. Lead 2738 extends to the alarm circuit as shown in Fig. 89, where it causes relay 8910 to operate and complete a circuit for lighting lamp 8911. The operation of relay 8910 completes a circuit for the operation of relay 8912 assuming the "on-off" switch shown at the left of Figure 89 is in the closed position as shown thereon, which relay in turn sets into operation the circuit comprising tube 8913 together with the timing condenser 8914 and high resistance 8915 which eventually causes the operation of an audible indicating device 8916 due to the operation of relays 8917, 8918 and 8919. The time constants of this circuit and the operation times of the various relays involved are such that the indicating device 8916 is operated at predetermined intervals generally of a relatively short duration.

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shown in Fig. 19 until key 1914 is restored to its normal position. A stop key 1932 is also provided which key when operated will cause the transmitter shown in Fig. 19 to stop transmission if it is transmitting at the time and will prevent it from transmitting at any later time until this key is restored. The operation of key 1932 completes a circuit for the operation of relay 1710 which relay operates and stops the transmission then in progress from this transmitter and prevents any further transmission until key 1932 is restored to its unoperated position.

If the transmitter stop key 1932 is operated at the time during which the transmitter start circuit has control of the transmitting distributor, relay 1701 will be operated due to the operation of the transmitter start circuit, as described above. The operation of key 1932 at this time will not cause the operation of relay 1710 because the operating circuit of this relay is interrupted at the upper outer operated contacts of relay 1701. Instead, the operation of key 1932 completes a circuit from battery through the upper winding of relay 1709 and the center set of lower break contacts of relay 1710 to ground through the operated contacts of key 1932 for the operation of relay 1708. The operation of relay 1708 connects ground to lead 2736 for indicating a busy condition or transmission condition at the transmitter start circuit.

When ground is applied to lead 2736, transmitter start circuit stops with the C stepping switch in its No. 5 position and causes relay 1701 to release. The release of relay 1701 will then complete the operating circuit of relay 1710 which relay then operates and locks operated under control of key 1932. The operation of relay 1710 interrupts the operating circuit of relay 1708 and permits this relay to release and remove the busy ground from the start circuit whereupon the operation of transmitter start circuit will be resumed. However, under these circumstances the transmitter start circuit will seize the distributor of Fig. 20 instead of the distributor of Fig. 19 due to the fact that relay 1710 in operating interrupts the locking circuit of relay 1708. It will be recalled that relay 1709 must be operated for the transmitter start circuit to seize the distributor of Fig. 19. With relay 1709 released the transmitter start circuit seizes the distributor shown in Fig. 20 as described above.

It should be noted that should the transmitter stop key 2032 be operated instead of 1932, the operation of relay 1711 will complete a circuit for the operation of relay 1709 and thus cause the transmitter start circuit to invariably seize the distributor shown in Fig. 19 instead of the distributor of Fig. 20 as long as this key is operated.

The operation of the transmitter start key and the operation of relay 1709, as described above, also prevents any further messages from being transmitted by the respective distributors over the outgoing channel of the party line and, in addition, permits the other one of the pair to transmit continuously all available messages for that line.

If both keys 1932 and 2032 are operated, both relays 1710 and 1711 will be operated and connect ground to the busy lead 2736 of the transmitter start circuit and thus prevent further operation of the transmitter start circuit. If, however, the transmitter start circuit is in operation and relay 1701 operated at the time the last one of these keys is operated, relay 1708 will operate as described above and stop the operation of the trans-

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mitter start circuit during the testing period. Thus the operation of the transmitter start circuit is not interrupted or interfered with so long as it is in the process of transmitting a start pattern. However, as soon as the particular start pattern in progress of transmission has been completed the operation of the transmitter start circuit will be interrupted irrespective of whether or not the corresponding transmitter at the outlying station has started transmission.

The operation of key 1941 or 2041 during the time the corresponding relay 1710 or 1711 is operated causes the operation of the corresponding relay 1812 or 1821 which in turn interrupts the locking circuits of the corresponding relays 1712 or 1713. It will be recalled that one or the other of these relays is operated during the time the corresponding transmitter is connected at the outgoing channel. The release of these relays disconnects the corresponding transmitter from the outgoing channel and permits the other transmitter to seize the channel as described hereinbefore. Thus the operation of the transmission stop key stops the operation of the transmitter and disconnects it from the outgoing channel after which the other transmitter may seize the channel and transmit thereover.

The operation of the transmitter hold key 1914 or 2014, however, merely causes the operation of corresponding relay 1815 or 1824. The operation of these relays merely prevents the corresponding transmitter from seizing the outgoing line or channel of the party line and does not in any way prevent the transmitter start circuit from using the associated distributors or interfere with any message in the progress of transmission at the time these keys are operated.

It will be apparent to those skilled in the art that the various keys and signals may be located at suitable and convenient places or positions and may be duplicated at more than one position. It is desirable to have certain of the lamps and other indicators individual to each of the machines or located adjacent to the machines to indicate which ones of the machines or circuits need attention. It is also desirable to locate a number of the signals and control keys and equipment adjacent each of the machines so that while the operator or attendant is working with the particular machine he may properly control it by making it busy and by preventing its seizure and causing it to operate to facilitate adjustment and the threading of paper through the machine.

It is also desirable to locate other of the signals and control keys and switches at some central control point or panel. Thus it will generally be desirable to provide numerous trouble indicators from the alarm circuit as well as various control keys on a control panel. The transmitter start keys and skip keys, together with other control keys, may be more advantageously located on the control panel. Certain of the keys and lamps may be duplicated and located both on the control panel and also on the cabinets or equipment adjacent the particular circuits or machines in trouble.

Suitable control keys and lamps and other indicators are provided at the secondary switching centers. A key similar to key 976 is provided in each of these secondary switching centers. The operation of these keys disconnects all the transmitting and receiving equipment controlled from the secondary switching center from the party line to enable the maintenance force at these places to more readily test the equipment and

circuits and to prevent interference with the operation of the other stations on the party line in case some trouble is encountered in the locking circuit extending from the secondary switching center to the subscribers station.

The foregoing miscellaneous features have been described with reference more particularly to party line 210. Similar provisions are made for operation equipment associated with the other party lines, the trunk circuits and the originating and intercept positions at the central switching center. Because all of these circuits operate in a similar manner their description has not been repeated.

What is claimed is:

1. In a telegraph system, a plurality of stations each assigned a different address code comprising a plurality of permutation codes, transmission paths extending between said stations, switching apparatus located at certain of said stations controlled by all of the permutation codes of each address code preceding each message for directing the respective messages over paths toward their stations of address, and switching equipment nearer the respective stations of address controlled by only a portion of said address codes for directing said messages to their respective stations of address.

2. In a telegraph system, a plurality of stations each assigned a different address of a plurality of permutation code combinations, a plurality of switching stations, a plurality of transmission paths interconnecting said stations, selective switching apparatus controlled by all of the address code combinations preceding each message for directing the message through switching apparatus at one of said switching stations toward the respective stations of address and control apparatus for controlling said switching apparatus at a subsequent switching station in accordance with the latter portion only of said address codes.

3. In a telegraph system, a plurality of stations each assigned an address, a primary switching center, a secondary switching center, transmission paths extending between said stations, control apparatus for automatically directing messages including an address portion through said primary switching center in response to the entire address portion thereof toward the respective stations of address, and control equipment for automatically directing the messages through the secondary switching centers under control of only a part of the address portion of the messages.

4. In a telegraph system, a plurality of primary switching centers, a plurality of secondary switching centers, interconnecting transmission paths extending between said centers, transmitting instrumentalities for transmitting telegraph messages including an address portion to said primary switching centers, control equipment at said primary switching centers for directing messages to other primary switching centers under control of only a part of the address portion of each message, other control circuits, for directing messages to said secondary switching centers under control of the entire address portion of each message, and control equipment at said secondary switching centers for directing the messages under control of only a part of the address portion.

5. In a telegraph system, a plurality of switching points, a plurality of stations each assigned a different address code comprising a plurality of permutation codes, transmission equipment for transmitting messages preceded by address codes from one of said stations to the station of ad-

dress through successive switching points, switching apparatus located at certain of said stations controlled by all of the permutation codes of each address code preceding each message for directing the respective messages over paths extending to succeeding switching points toward their stations of address, and switching equipment located at said succeeding switching point controlled by only a portion of said address codes for directing said messages to their respective stations of address.

6. In a telegraph system, a plurality of stations each assigned a different address of the same number of permutation code combinations, a plurality of switching stations, selective switching apparatus located at one of said switching stations controlled by all of the address code combinations preceding each message for directing the message to a succeeding switching equipment toward the respective stations, and control apparatus for controlling said succeeding switching apparatus in accordance with the latter portion only of said address codes.

7. In a telegraph system, a primary switching center, a secondary switching center, transmission equipment for transmitting messages successively through said primary and secondary switching centers, control apparatus for automatically directing messages including an address portion through said primary switching center in response to the entire address portions thereof, and control equipment for automatically directing the messages through the secondary switching centers under control of only a final part of said same address portion of the messages.

8. In a telegraph system, a plurality of primary switching centers, a plurality of secondary switching centers, interconnecting transmission paths extending between said switching centers, transmitting instrumentalities for transmitting telegraph messages including an address portion to said primary switching centers, control equipment at said primary switching centers for directing messages to other primary switching centers under control of only the first part of the address portion of each message, other control circuits for directing messages to said secondary switching center under control of the entire address portion of each message, and control equipment at said secondary switching centers for directing the messages under control of only a final part of the address portion.

9. In a telegraph system, a plurality of telegraph stations each assigned an address code of a plurality of permutation codes, a main switching station, a plurality of party lines extending to a plurality of said stations, switching equipment controlled by the entire address code for automatically directing messages to said party lines in accordance with the address codes of the stations connected thereto, other switching apparatus controlled by only the last portion of the address code for automatically routing each message to its station of address only.

10. In a telegraph system, a channel of transmission having associated therewith a plurality of message receiving devices, directing apparatus controlled conjointly by and in accordance with a plurality of successive code combinations for selectively directing a message preceded by said code combinations to said channel, and selective apparatus controlled by and in accordance with less than all of said same successive code combinations for causing reception of said message at one of said devices selectively.

In order to suppress the indicating device key 8920 is operated. The operation of this key completes a circuit for the operation of relay 8921 which relay operates and interrupts the circuit to the start relay 8912 of the timing circuit controlling the audible signal. The operation of key 8920 also applies ground to lead 2739 which extends to Fig. 27 and thence through the upper operated contacts of relay 2716 to battery through the winding of relay 2726. The operation of relay 2726 completes a circuit for maintaining itself operated under control of relay 2726 and then interrupts the locking circuit of relay 2716. The release of relay 2716 then causes relay 2726 to release and restore the circuit to its original condition, assuming, of course, that the trouble condition has been cured and that the line was closed when key 8920 is operated.

A somewhat similar alarm circuit is provided to indicate trouble in either the receiving reperforator or the receiving only recording instrument depending upon which one of them is connected to the transmitting channel of the party line. So long as no signals are received over the transmission channel of party line 210, relay 2701 will remain in its marking position and will cause relay 2702 to also remain in its marking position where a circuit is completed for the operation of relay 2725 as described above. So long as the armature of relay 2702 remains in its left-hand or marking position the circuit of a slow-release relay 2713 is interrupted so that this relay will release and complete an obvious circuit for the operation of relay 2712. Relay 2712 in turn will operate and in operating complete an obvious circuit for the operation of relay 2714. Relay 2714 in operating maintains its contacts open.

However, when signals are received relay 2702 will follow these signals and complete a circuit through its spacing or right-hand contact from ground and through its armature and right-hand contacts to battery through the winding of relay 2713. Relay 2713 operates and interrupts the obvious circuit referred to above through the winding of relay 2712 and relay 2712 starts to release. Upon the release of relay 2712 relay 2714 starts to release. If the receiving recorder connected to the circuit does not respond by the time relays 2712 and 2714 release, ground will be connected to the upper winding terminal of relay 2717 and operate this relay. Relay 2717 in operating completes an obvious circuit for lighting the machine or motor trouble lamp 2829 and also completes a circuit extending over lead 2733 for operating the alarm circuits as described above with reference to the open line alarm.

If, however, the receiving instrument responds to the received signal it will cause the universal contacts 2845 to be momentarily operated. The operation of these contacts will complete a circuit for the operation of relay 2707 from battery through the winding of relay 2707 and the operated contacts of relay 2708 and the lower break contacts of relay 2709 to ground through the operated contacts 2845, assuming that the recording instrument 2802 is connected to the transmitting channel of party line 210. If the receiving only instrument 2866 is connected then contacts 2838 will close and relay 2709 will be operated. Consequently, relay 2707 will operate and complete a circuit for the operation of relay 2712 which relay in turn causes relay 2714 to operate or remain operated and removes ground from lead 2733 extending to the alarm circuits. The alarm is silenced in the same manner as that

described above. It should be noted that the universal contacts 2845 alternately close the break and make contacts so that both relays 2708 and 2707 remain operated during the reception of signal impulses by the recording device 2802. Thus, so long as the mechanism properly responds to the received signals so that it causes universal contacts 2845 to momentarily close one during the reception of each code combination, the alarm will not be actuated. In other words, the alarm is only actuated when signals are being received by relays 2701 and 2702 and neither contacts 2845 nor contacts 2838 are actuated to indicate that the mechanism is responding to receive signals.

A contact mechanism is also provided for co-operating with the supply reel of unperforated tape to indicate when the supply of paper tape for recording received signals becomes low. If the size of the supply reel is reduced below a predetermined minimum, contacts 2815 will close and complete a circuit for the operation of relay 2722 which relay will complete a circuit for maintaining itself operated under control of key 2826. The operation of relay 2722 also completes a circuit for lighting the tape out lamp 2827 and also for connecting ground to trouble lead 2738 extending to the alarm circuit. The operation of the alarm circuit will then be as described above. The attendant or operator upon noting that the supply of tape is low will change the reel and thread the tape through the mechanism. In order to accomplish this a special lever is provided on the recording instrument 2802 to cause this instrument to automatically perforate a number of letters and combinations in the tape so long as this lever is held operated. This lever has not been shown in the drawing since its operation is well known in the prior art. For a more detailed description of the operation of a reperforating mechanism employing such a lever reference is made to United States Patents 2,005,748, granted June 25, 1935, to Larson and 2,042,788, granted June 2, 1936, to Krum the disclosure of which patents are hereby made part of this disclosure as if fully included herein. The operator by pressing this lever is able to cause sufficient tape to be advanced through the recording mechanism so that she is able to thread the end of it through the recording instrument and out of the machine where she can attach it to the end of the previous tape.

During the time the operator is threading the machine it is desirable that none of the messages be lost or mutilated. Consequently, contacts 2815 are adjusted to close before the supply of unperforated tape is completely utilized so that generally there will be enough tape remaining on the reel after the contacts close to cause the reception and recording of the message then in the process of being received. At the end of this message the operator will generally operate key 2824 which causes relay 2703 to operate and direct all succeeding messages to the receiving only instrument 2866 at the central exchange. Messages intended for other stations may then be retransmitted from the local transmission position at the central switching station in the same manner as directed above for traffic originating at this station.

When it becomes necessary or desirable to change the stationery of the receiving only recording instrument 2866, key 2825 will generally be operated which causes all messages to be directed to the reperforator 2802 so that these mes-

sages will not be lost during the time a new supply of paper is inserted in machine 2866.

After threading a new tape through the recording instrument 2802 the operator will generally staple the end of this tape to the end of the old tape and in addition will tear the tape so that the sixth pin which controls contacts 2855 will close when a staple approaches the transmitting head 2806. This transmitting head is so constructed that the staple is incapable of passing through the head so that it will not harm the mechanism thereof. Consequently, when the staple is advanced to the transmitting head it will prevent the advance of the tape and as a result the feed holes will be torn and the tape stopped so it is highly desirable to appraise the operator of the approach of this staple to this position so that she may immediately thread the new tape through the transmitting head 2806. In order to accomplish this the tape is generally torn as described above so that contacts 2855 will close at this time. The closure of contacts 2855 will complete a circuit for the operation of the tape relay 2911 which relay operates and completes a circuit for the operation of the alarm relay 2913 which relay operates and stops the transmission from the transmitter shown in Fig. 28 and causes an alarm indication to be registered as described above. Thereupon the operator will properly thread the new tape through the transmitting head 2806 and then operate key 2826 to release the alarm relay 2722 as described above. The operation of relay 2911 as described above also completes a circuit for the operation of relay 2722 which relay again operates and actuates the indicators referred to above. It should be noted that the operator will also have to momentarily operate key 2826 again to release relay 2722 as described above.

The storage repeating instruments shown in Figs. 19 and 20 are similarly provided with keys to enable the operator to properly control these devices.

In addition contacts 1915 are controlled by the supply of perforated tape for recording signals directed to this instrument. When these contacts close they complete a circuit for the operation of relay 2110 provided the device is not busy receiving a message. However, the device will normally be busy receiving a message at this time. Consequently, relay 2110 will not immediately operate but will operate only after the message in the process of being recorded by instrument 1906 has been fully received.

The operation of relay 2110 after the recording instrument has completed the transmission of the message in the progress of transmission at the time contacts 1915 close, causes the recording instrument 1906 to test busy and direct all messages intended for the party line 210 to the recording instrument 2006. Relay 2110 in operating completes a circuit for maintaining itself operated under control of relay 2111. The operation of relay 2110 also applies ground to the alarm or trouble lead 2738 and thus attracts the operator's attention to the fact that the supply of tape is low. The operator or attendant will then operate the busy key 1905 which completes an obvious circuit for the operation of relay 2111 which relay in operating interrupts the locking circuit of relay 2110 so that this relay will release when contacts 1915 are opened after a new supply of storage material has been inserted. The operation of relay 2111 also causes any messages di-

rected to party line 210 to be directed to the recording instrument 2006.

The recording instruments 1906 and 2006 are provided with a lever similar to the one described above with reference to the recording device 2802 to cause the mechanism to automatically perforate letter signals in the tape to advance the end of the tape through the mechanism. Under these conditions the operator will normally permit the transmitter associated therewith to completely transmit the message through the transmitting head. The operator will then thread the new tape through this portion of the mechanism and operate key 1931 which completes an obvious circuit for the operation of magnet 1911. The operation of magnet 1911 at this time causes the letters signals to be advanced through the transmitting head and thus discard it until the transmitting head has sensed the last character recorded in the tape at which time contacts 1921 open and interrupt the circuit of magnet 1911. Thereafter the operator will release key 1931 and then key 1905 which restores the circuits and equipment to their idle condition so that they will be available for the reception of the next message directed to party line 210.

Key 1941 is provided for the operation of relay 1812. The operation of relay 1812 causes the transmitting portion of the repeating device shown in Fig. 19 to be disconnected from the receiving channel of party line 210 and thus permit the transmitter shown in Fig. 20 to transmit over this channel.

The transmitting head 1907 is provided with a sixth pin which controls contacts 1955. So long as perforated tape is in the transmitting head 1907 contacts 1955 will remain open. If, however, the tape between the recording instrument 1906 and the transmitting head 1907 becomes torn or for any other reason the tape passes out of the transmitting head, contacts 1955 will close and complete a circuit for the operation of relay 1818. Relay 1818 in operating completes a circuit for maintaining itself operated under control of relay 1815. Relay 1818 in operating completes an obvious circuit for operating the tape out lamp 1933 and thus indicating a trouble condition. The operation of relay 1818 also connects ground to trouble lead 2738 extending to the alarm circuit shown in Fig. 89 which circuit then operates as described above. After the operator has again inserted a tape in the transmitting head she will momentarily operate key 1914 which key completes a circuit for the operation of relay 1815. Relay 1815 in operating interrupts a locking circuit of relay 1818. Thereafter when the operator releases key 1914 relay 1815 will release and restore the circuit to its idle condition after which it will be available for use in conveying messages.

Key 1914 may also be operated to cause the transmitting portion of the storage repeater shown in Fig. 19 to stop operation at the end of the message then in the process of transmission. When key 1914 is operated relay 1815 will be operated and relay 1815 in operating interrupts the operating circuit of relay 1813. Consequently, this relay cannot operate to cause the transmitter shown in Fig. 19 to resume operations at the end of the transmission of the next message transmitted from the transmitter shown in Fig. 20. In other words, the operation of key 1914 will permit the message in the process of being transmitted at the time this key is operated to be completely transmitted after which no further messages will be transmitted from the transmitter

11. In a telegraph system, a channel of transmission having associated therewith a plurality of message receiving devices, directing apparatus controlled conjointly by and in accordance with a plurality of successive code combinations for selectively directing messages preceded by said code combinations to said channel, there being a number of different sets of successive code combinations capable of directing messages to said channel having different codes in any position in the succession for directing the messages to said channel, and selective apparatus controlled by and in accordance with a code or codes of the same set as controlled by the direction of the message to said channel independently of other codes of the set for causing reception of the message at one of said devices selectively.

12. In a telegraph system, a record controlled telegraph transmitter for transmitting message signals preceded by address signals, a plurality of telegraph transmission circuits, switching equipment for extending a transmission circuit from said transmitter to said plurality of telegraph circuits including equipment for causing the transmission of all of said address signals and message signals over predetermined ones of said paths and for transmitting only a portion of the address signals over other of said transmission paths.

13. In a telegraph system comprising a permutation code telegraph transmitter for transmitting message signals preceded by a plurality of directing codes, two transmission circuits extending from said transmitter, switching equipment for causing all of the directing codes and the succeeding message codes to be transmitted over one of said transmission circuits, other switching equipment for causing only a portion of said directing codes followed by all of said message codes to be transmitted over the other of said transmission circuits, a plurality of transmission paths leading from said transmitter and control apparatus responsive to said directing codes for selectively extending one or the other of said transmission circuits to one of said plurality of transmission paths.

14. In a telegraph system, a perforated tape controlled permutation code telegraph transmitter for transmitting message codes preceded by address codes, a plurality of telegraph stations each assigned an address code, telegraph transmission paths extending to said stations, switching equipment for causing the transmission of message codes preceded by only a portion of the address codes selectively to said stations under control of the entire address code preceding each message.

15. In a telegraph system, permutation code transmitter for transmitting message codes preceded by address codes, a plurality of telegraph stations each assigned an individual address code, switching equipment for selectively directing messages and transmitting the message together with only a portion of the address codes over lines extending to said stations in accordance with the entire address codes, an intercept circuit and switching equipment for directing messages preceded by unassigned codes to said intercept circuit and transmitting the entire code preceding the messages and the following message to said intercept circuit.

16. In a telegraph system, a telegraph switching station, a plurality of local telegraph lines terminating thereat, a plurality of trunk circuits terminating thereat, a telegraph transmitter for

transmitting message signals preceded by a plurality of address signals, control apparatus for causing the transmission of only a portion of said address codes over said local lines and other control equipment for causing the transmission of all of said address codes over said trunk lines.

17. In a telegraph system, a telegraph transmitter for transmitting message codes preceded by a plurality of service codes, a plurality of groups of telegraph transmission paths for different types of service, switching and control equipment for transmitting the entire service codes over certain of said groups of paths, other switching and control equipment for transmitting only a portion of said service codes over other of said groups of paths.

18. In a telegraph system, a record controlled telegraph transmitter for transmitting message signals preceded by address signals, a plurality of telegraph transmission circuits, switching equipment controlled by said address signals for extending a transmission circuit from said transmitter to any one of said plurality of telegraph circuits including equipment for causing the transmission of all of said address signals and message signals over predetermined ones of said paths and for transmitting only a portion of the address signals over other of said transmission paths.

19. In a telegraph system comprising a permutation code telegraph transmitter for transmitting message signals preceded by a plurality of directing codes, two transmission leads extending from said transmitter, switching equipment for selectively transmitting all of the directing codes and the succeeding message codes over certain of said transmission leads, other switching equipment for transmitting only the last portion of said directing codes followed by all of said message codes over the other of said transmission circuits, a plurality of transmission paths leading from said transmitter and control apparatus responsive to said directing codes for selectively extending one or the other of said transmission leads to one of said plurality of transmission paths.

20. In a telegraph system, a perforated tape controlled permutation code telegraph transmitter for transmitting message codes preceded by address codes, a plurality of telegraph stations each assigned an address code, telegraph transmission paths extending to said stations, switching equipment for causing the transmission of message codes preceded by only the last portion of the address codes to the respective stations of address selectively under control of the entire address code preceding each message.

21. In a telegraph system, a record controlled permutation code transmitter for transmitting message codes preceded by address codes, a plurality of telegraph stations each assigned an individual address code, switching equipment for selectively directing messages and transmitting the message together with only a portion of the address codes over lines extending to said stations in accordance with the entire address codes, an intercept circuit and switching equipment for directing messages preceded by unassigned codes to said intercept circuit and transmitting the entire code preceding the messages and the following message to said intercept circuit.

22. In a telegraph system, a telegraph switching station, a plurality of local telegraph lines terminating thereat and extending to local stations, a plurality of trunk circuits terminating

thereat and extending to other switching stations, a record controlled telegraph transmitter for transmitting recorded message signals preceded by a plurality of recorded address signals, control apparatus for causing the transmission of only a portion of said recorded address codes over said local lines and other control equipment for transmitting all of said recorded address codes over said trunk lines.

23. In a telegraph system, a telegraph transmitter for transmitting message codes preceded by a plurality of service codes, a plurality of groups of telegraph transmission paths for different destinations, switching and control equipment for transmitting the entire address codes over certain of said groups of paths, other switching control equipment for transmitting only a portion of said service signals over circuits of other of said groups of paths.

24. In a system for automatically directing messages, a message transmitter controlled by a storage means having stored therein message signals preceded by address signals, a plurality of paths of transmission to which the address signals may direct the message in combination with means operable incident to the direction of the message to one of said paths for transmitting the directing code combination or combinations over the path and other means operable incident to the direction of a message to another path for dropping a directing code combination or combinations and not further transmitting it or them.

25. In a telegraph system for automatically directing messages, a message transmitter controlled by a storage means having stored therein message signals preceded by address signals, a plurality of message directing points, apparatus at one of said points operable incident to the direction of a message therethrough for transmitting the entire address code preceding the respective messages, and apparatus at another of said points operable incident to the direction of the same message therethrough to drop a portion of the address code and prevent its further transmission.

26. In a system for automatically directing messages, a message transmitter controlled by a storage means having stored therein message signals preceded by address signals, a plurality of paths of transmission to which the address signals may direct the message in combination with apparatus operable incident to the direction of the message to any of a plurality of said paths for transmitting all the address code combination or combinations over the path and other apparatus operable incident to the direction of the message to another plurality of said paths for dropping a portion of said address codes and preventing the further transmission of said dropped portion.

27. The method of selectively directing messages over a plurality of paths which comprises selectively directing a message from one point over a path to another point in accordance with a plurality of code combinations and thereafter directing the same message selectively over another path at the other point under the control of a portion only of the same code combinations.

28. A telegraph system comprising a central office, a plurality of lines radiating from said office, a plurality of sending devices transmissively associable with each of said lines, a plurality of receiving devices receptively associable with each of said lines, means for providing each of said sending devices with stored transmissible

material in the form of code combinations designating one of said receiving devices followed by message code combinations to be received by the designated receiving device, means at said central office for causing each of said transmitting devices to initiate transmission of message forming groups of such stored combinations at intervals over its associated line, means at the central office controllable by and in accordance with a plurality of directing code combinations of each message group operating coadjuvantly to direct each message group of said code combinations to a particular one of said lines, and means associated with each said line operable under the control of one of said code combinations to selectively cause receptive association of one of said receiving devices with said line and recording of said message by said receiving device.

29. In a telegraph system, a record controlled permutation code transmitter, a record for controlling the same, a plurality of telegraph transmission paths, switching apparatus for connecting said transmitter to said transmission paths, and automatic control apparatus responsive to the permutative character of two permutation code signals of said record for controlling said switching apparatus to make one switching operation only for connecting said transmitter to one of said paths.

30. In a telegraph system, a storage telegraph transmitter, apparatus for supplying stored telegraph signals to said transmitter, a plurality of telegraph transmission paths leading away from said transmitter, switching apparatus for connecting said transmitter to said paths, and directing equipment for permutatively combining the elements of two stored signal groups and selecting one of said paths in accordance with the combined elements of the two stored signal groups.

31. In a telegraph system, a storage medium, a telegraph transmitter for transmitting telegraph signals under control of said storage medium, switching equipment controlled by said storage medium comprising apparatus for sensing one signal stored in said medium and additional apparatus for sensing the immediately succeeding signal stored in said medium, a single stage of switching circuits selectively controlled in accordance with the combined permutative character of said two signals.

32. In a telegraph system, a record medium for storing permutation code groups of telegraph signaling conditions, switching apparatus controlled by said record medium comprising means for sensing the permutation groups of conditions recorded by said medium, a first plurality of permutation elements, means for positioning said elements in accordance with a group of telegraph signaling conditions recorded by said medium, a second group of permutation elements, apparatus for positioning said second group of permutation elements in accordance with the immediately following group of telegraph signaling conditions stored by said medium, apparatus responsive to the combined permutative setting of all of said permutative elements for the selection of one of a plurality of telegraph transmission circuits.

33. In a telegraph system, a tape-controlled transmitter, a first group of fan relays, a second group of fan relays, apparatus responsive to signals perforated in said tape for setting said first group of fan relays in accordance with one set of perforations in said tape, apparatus for positioning said second group of fan relays in ac-

cordance with the immediately following set of perforations in said tape, and selecting circuits controlled by the simultaneous positioning of both of said groups of fan relays.

34. In a telegraph system, a tape-controlled transmitter for transmitting permutation code groups of signaling impulses, a group of transmission circuits potentially greater than the total number of possible permutations of a single code group of impulses, and apparatus responsive to the permutative character of a plurality of said permutative groups of impulses for selecting in one selective operation one of said plurality of transmission paths.

35. In a telegraph system, a plurality of telegraph stations each assigned two-letter address codes, a central switching station, lines extending from said switching station to said stations, at least one of which lines extends to a plurality of said telegraph stations independently of the codes assigned said stations, switching apparatus for directing messages to said lines in accordance with address codes of stations connected to their respective lines.

36. In a telegraph system, a record controlled permutation code transmitter, a plurality of telegraph transmission paths, one set of switching apparatus for connecting said transmitter to said transmission paths, and control apparatus responsive to a plurality of successive permutation code signals of said record for controlling said one set of switching apparatus for performing the entire operation of connecting said transmitter to one of said paths in a single switch operation.

37. In a telegraph system, a storage telegraph transmitter, apparatus for supplying stored telegraph signals to said transmitter, a plurality of telegraph transmission paths leading away from said transmitter, switching apparatus for automatically and selectively connecting said transmitter to said paths, and directing equipment for selecting in a single selective operation one of said paths permutatively in accordance with the elements of a plurality of successive stored signal groups.

38. In a telegraph system, a storage medium, a telegraph transmitter for transmitting telegraph signals under control of said storage medium, switching equipment controlled by said storage medium comprising apparatus conditioned by one sensed group of permutation code signal elements stored in said medium and additional apparatus conditioned by the immediately succeeding sensed group of permutation code signal elements stored in said medium, switching circuits selectively controlled by the conditioned apparatus in accordance with the combined permutative character of said two groups of permutation code signal elements.

39. In a telegraph system, a record medium for storing permutation code groups of telegraph signaling conditions, switching apparatus controlled by said record medium comprising means for sensing the permutation groups of conditions recorded by said medium, a first plurality of permutation elements, means for positioning said elements in accordance with a group of telegraph signaling conditions recorded by said medium, a second group of permutation elements, apparatus for positioning said second group of permutation elements in accordance with the immediately following group of telegraph signaling conditions stored by said medium, apparatus responsive to the combined permutative setting of all of said

permutative elements for controlling a single selective operation for the selection of one of a plurality of telegraph transmission circuits.

40. In a telegraph system, a tape-controlled transmitter, a first group of fan relays, a second group of fan relays, apparatus responsive to signals perforated in said tape for setting said first group of fan relays in accordance with one group of perforations in said tape, apparatus for positioning said second group of fan relays in accordance with another group of perforations in said tape, switching circuits controlled by the simultaneous positioning of both of said groups of fan relays for executing a single selective operation in accordance with perforations in said tape.

41. In a telegraph system, a main switching station, a telegraph transmitter, a plurality of local lines terminating at said switching station, a plurality of trunk lines terminating at said switching station, switching apparatus located at said switching station responsive to a predetermined single group of permutation code elements for selectively connecting said transmitter to any one of said plurality of trunk circuits, other switching apparatus responsive to a combined permutative character of a plurality of permutation code groups for selectively connecting said transmitter to one of said local circuits terminating at said station.

42. In a telegraph system, a tape-controlled transmitter for transmitting permutation code groups of signaling impulses, a group of transmission circuits potentially greater than the total number of possible permutations of a single code group of impulses, and switching apparatus for permutatively combining the elements of a plurality of said permutation groups of impulses and selecting any one of said plurality of transmission paths in accordance with the permutative character of said combined groups of impulses.

43. In a telegraph system, a plurality of telegraph stations each assigned different two-letter address codes, a switching station, a plurality of lines extending from said switching station to said telegraph stations, switching apparatus for directing messages to said lines in accordance with address codes of stations connected to their respective lines and additional switching apparatus connected to said lines for directing messages to the respective stations of address connected to said lines in accordance with one one-letter code of said two-letter codes.

44. A permutation code selecting arrangement comprising apparatus for storing permutation code signals, a sensing mechanism for determining the character of said stored signals, a first group of switching devices controlled by said sensing equipment, a second group of switching devices also controlled by said sensing mechanism, operative connections between said storing apparatus and said sensing mechanism and said switching devices for simultaneously positioning said first group of switching devices in accordance with one set of stored permutation code groups and simultaneously positioning the second set of switching devices in accordance with a second stored permutation code group and switching apparatus controlled by the combined positioning of said switching devices for selecting one of a plurality of telegraph transmission paths.

45. In a telegraph system, a tape-controlled transmitter, a first group of fan relays, a second group of fan relays, apparatus responsive to signals perforated in said tape for simultaneously setting said first group of fan relays in accord-

ance with one set of perforations in said tape, other apparatus for simultaneously positioning said second group of fan relays in accordance with a succeeding set of perforations in said tape, and switching circuits controlled by the simultaneous positions of both of said groups of fan relays for performing a single selective operation under control of groups of perforations in said tape.

46. In a telegraph system, a telegraph transmitter controlled by stored permutation code signals, a plurality of telegraph transmission channels, a sensing mechanism for determining the character of said stored signals, a first group of switching devices controlled by said sensing equipment, a second group of switching devices also controlled by said sensing mechanism, operative connections between said storing apparatus, said sensing mechanism and said switching devices for simultaneously positioning said first group of switching devices in accordance with one set of stored permutation code groups and simultaneously positioning the second set of switching devices in accordance with the second group of stored permutation code, and a single stage of switching apparatus controlled by the combined positioning of said switching devices for selectively extending one of a plurality of telegraph transmission paths to said transmitter.

47. In a telegraph system, a record controlled telegraph transmitter for transmitting stored telegraph permutation code signals comprising a mechanism for scanning said record, a plurality of switching devices, apparatus for positioning said switching devices under control said sensing mechanism, apparatus responsive to the positioning of said switching devices for initiating the operation of sensing mechanism to scan a succeeding stored signal, a second plurality of switching devices, apparatus for positioning said second plurality of switching devices under control of said scanning mechanism, and a single stage of selecting circuits controlled by all of said switching devices for selectively establishing a transmission channel away from said transmitter.

48. A system for selecting, by means of permutation codes recorded in a medium, elements for determining a path under the conjoint operation of two codes which comprise means for sensing one code and selectively storing said code, means for sensing a subsequent code, and means conjointly operable under control of said codes for selectively determining one out of a plurality of paths in a single selective operation.

49. In a telegraph system, a tape-controlled transmitter for transmitting permutation code groups of signaling impulses, a group of transmission circuits potentially greater in number than the total number of possible permutations of a single code group of impulses, a single stage of selecting apparatus for selecting any one of said transmission circuits, control apparatus for partially conditioning said selecting apparatus in accordance with one group of stored permutation code signaling impulses, and other control apparatus for further conditioning said selecting apparatus in accordance with a succeeding permutation code group of signaling impulses.

50. In a telegraph system, a receiving reperforator instrument for recording received telegraph signals in a flexible medium, apparatus for sensing the recorded signals including the last signal recorded, instrumentalities for transmitting signals under control of said sensing apparatus,

control equipment for stopping said sensing apparatus upon the sensing of the last signal recorded in said medium, and other control apparatus for stopping said transmitting instrumentalities upon transmitting signaling impulses in accordance with signals including the last signal recorded in said medium.

51. In a telegraph system, telegraph transmitting apparatus controlled by signals, a recorder for recording said signals in a storage medium, apparatus for determining the signals recorded in said medium, an advancing mechanism for advancing said determining apparatus with respect to said recorder for determining the last signal recorded in said storage medium, apparatus controlled by the presence of unsensed signals recorded in said medium for initiating the operation of said advancing mechanism, telegraph transmitting apparatus, and circuits controlled by said determining apparatus for selectively establishing transmission paths away from said transmitting apparatus.

52. In a telegraph system, a plurality of telegraph transmission paths, telegraph transmitting apparatus controlled by telegraph signals stored in a recording medium, a recording mechanism for so recording signals, apparatus for sensing the signals recorded in said medium, mechanism for advancing said sensing mechanism relative to said recording medium to enable the last signal stored in said recording medium to be sensed, a telegraph distributing mechanism, a transfer mechanism for controlling said distributing mechanism in accordance with said sensing apparatus, and switching circuits controlled by said sensing apparatus for selectively connecting said distributor to one of said transmission paths.

53. In a telegraph system, a telegraph transmitter controlled by signals stored in a recording medium, said medium having unit zones each for the recording of a signal code, a recorder for recording signal codes one after another in said zones, switching circuits controlled by signal codes stored in said medium, and instrumentalities for causing said transmitter to scan a plurality of signal codes including the signal code stored in the last unit zone of said medium to pass said recorder and means controlling the switching circuits in accordance therewith.

54. In a telegraph system, a device for transmitting telegraph signals in accordance with signals stored in a recording medium comprising means for sensing the signals stored in said medium, a plurality of contacts, a mechanical transfer mechanism for controlling said sensing medium and transferring the signals recorded in said medium to said plurality of contacts, and circuits interconnecting said contacts for controlling the operation of said transmitting apparatus in accordance with predetermined signals recorded in said medium.

55. Telegraph transmitting apparatus for transmitting telegraph signaling impulses in accordance with permutation code signals stored in said recording medium, a sensing element for each element of said permutation code, a plurality of contacts for each element of said permutation code, transfer mechanism for positioning all of the contacts in accordance with the respective elements of the permutation code, and circuits controlled by said contacts when they are positioned in accordance with predetermined permutation code signals for discarding said signals.

56. In a telegraph system, a telegraph transmitter controlled by a punched tape, apparatus

for sensing the punches in said tape and a mechanism responsive to sensing the last signal punched in said tape for suspending the operation of said transmitting apparatus, and other circuits responsive to predetermined combinations of punches recorded in said tape for interrupting the transmission circuit from said transmitter when said predetermined combinations of punches are sensed.

57. In a telegraph system, a telegraph transmitter controlled by stored telegraph signals capable of sending and transmitting the last stored signal comprising apparatus for sensing stored signals, instrumentalities for causing said sensing apparatus to sense stored signals in the order in which they are stored including the last stored signal, a plurality of contacts, a mechanically actuated transfer mechanism for transferring the setting of said sensing apparatus to said contacts, transmitting apparatus controlled by said contacts, a plurality of telegraph transmission paths, switching apparatus controlled by the setting of said contacts for selecting one of said transmission paths, a distributing mechanism connected to said contacts, and apparatus for initiating the operation of said distributing mechanism for the transmission of telegraph signals in accordance with the setting of said contacts.

58. In combination, a telegraph code signal recording mechanism, a telegraph signal transmitting mechanism, means movable with respect to said mechanisms having zones for the recording of successive signal codes, one code for each successive zone, said means serving to convey recorded signal codes from said recording mechanism to said transmitting mechanism, means for advancing said movable means with respect to said transmitting mechanism for controlling said transmitting mechanism at times in accordance with the signal code recorded in the last zone passed through said recording mechanism, and switching circuits selectively controlled by said transmitting mechanism for the automatic transmission of signals from said transmitting mechanism to one of a plurality of transmission paths.

59. In a telegraph system, telegraph transmitting apparatus for transmitting signaling impulses in accordance with the stored signals comprising devices for sensing the elements of the stored signals, a plurality of contacts for each element of a code group of stored signals, control mechanism for initiating the operation of said sensing devices for causing them to successively sense each code group of stored signals including the last signal stored, transfer apparatus for positioning each set of said plurality of contacts in accordance with the respective elements of stored signals, distributing apparatus for transmitting signaling impulses in accordance with the setting of said contacts, apparatus for initiating the operation of said distributing mechanism under control of said transfer mechanism, and other circuits for initiating the operation of said distributing apparatus independently of the operation of said transfer mechanism.

60. In a telegraph system, a tape-controlled permutation code transmitter comprising tape sensing members, apparatus to advance said members with respect to the tape until the last signal recorded in the tape has been sensed, a plurality of circuit controlling members for each element of a permutation code, a mechanically driven mechanism for positioning said circuit

controlling members under control of said sensing members, and connections to said contacts for altering a circuit in response to a predetermined permutation code.

61. In a telegraph system, a storage medium for recording each element of a plurality of groups of permutation code groups of signaling impulses, a sensing member for each element of the permutation code group of impulses, a plurality of contact members for each element of a permutation code group of signaling impulses, a mechanically driven transfer mechanism for transferring the setting of each of said sensing members to the corresponding set of contacts, and circuit connections to said contacts for altering a circuit each time said contacts are set in accordance with a single predetermined particular code combination.

62. In a telegraph system, a recording instrument for recording telegraph signals in a flexible medium, apparatus for sensing the last signal recorded in said medium, instrumentalities for transmitting signals under control of said sensing apparatus, control equipment for stopping said sensing apparatus upon the sensing of the last signal recorded in said medium, and other control apparatus for stopping said sensing apparatus upon the sensing of predetermined recorded signals.

63. In a telegraph system, a recording device for recording telegraph signaling impulses in a storage medium, sensing devices for sensing the signals recorded in said storage medium, a plurality of contacts, a mechanically driven transfer mechanism for positioning said contacts under control of said sensing devices, a telegraph transmitting apparatus, and control circuits for connecting said transmitting apparatus to said contacts positioned by said transfer mechanism for the transmission of signaling impulses in accordance with the signals recorded in said storage medium, and switching circuits controlled by said contacts for automatically connecting said transmitting apparatus to a transmission path.

64. In a telegraph system, a plurality of telegraph transmission paths, telegraph transmitting apparatus controlled by telegraph signals stored in a recording medium, cyclically operable apparatus for sensing the signals stored in said medium, mechanism for advancing said sensing mechanism relative to said storage medium to enable the last signal stored in said recording medium to be sensed, a cyclically operable telegraph distributing mechanism, a transfer mechanism for controlling said distributing mechanism in accordance with said sensing apparatus, circuits for initiating a cycle of operation of said distributing mechanism during each cycle of operation of said sensing apparatus, and other circuits for initiating the operation of said distributing apparatus independently of said sensing apparatus.

65. Telegraph transmitting apparatus for transmitting telegraph signaling impulses in accordance with permutation code signals stored in a recording medium, a sensing element for each element of said permutation code, a plurality of contacts for each element of said permutation code, mechanical transfer mechanism for positioning all of the contacts in accordance with the respective elements of the permutation code, and means including circuits controlled by said contacts when they are positioned in accordance with the predetermined permutation code signals for discarding groups of said signals.

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66. In a telegraph system, a telegraph transmitter controlled by a tape punched in accordance with stored signals, apparatus for sensing the punches in said tape, a mechanism responsive to sensing the last signal punched in said tape for suspending the operation of said transmitting apparatus, and other circuits responsive to predetermined signals punched in said tape for establishing a transmission circuit from said transmitter incidental to the sensing of said predetermined signals.

67. In a telegraph system, a telegraph transmitter controlled by stored telegraph signals capable of sensing and transmitting the last stored signal comprising signal sensing apparatus, instrumentalities for causing said sensing apparatus to sense stored signals in the order in which they are stored, a plurality of contacts, a mechanically driven transfer mechanism for transferring the setting of said sensing apparatus to said contacts, transmitting apparatus controlled by said contacts, a plurality of telegraph transmission paths, switching apparatus controlled by the setting of said contacts for selecting one of said transmission paths, a distributing mechanism connected to said contacts, and apparatus for connecting said distributing mechanism to said selected path and thereafter initiating the operation of said distributing mechanism for the transmission of the stored signals.

68. In combination, an advanceable medium for recording signals, a telegraph signal recording mechanism for impressing upon said medium a record of signals, a telegraph signal transmitting mechanism, means for supplying recordings of signals recorded by said recording mechanism to said transmitting mechanism, apparatus including sensing means for controlling said transmitting mechanism in accordance with signals, means capable of advancing said sensing means relative to said recording means to sense the last signal recorded in the medium by said recording mechanism, and switching circuits selectively controlled by said transmitting mechanism for the automatic transmission of signals from said transmitting mechanism selectively to one of a plurality of transmission paths in accordance with said recorded signals.

69. In a telegraph system, telegraph transmitting apparatus for transmitting signaling impulses in accordance with the stored signals comprising devices for sensing the elements of the stored signals, a plurality of contacts for each element of a code group of stored signals, control mechanism for initiating the operation of said sensing devices for causing them to successively sense each code group of stored signals, a mechanically operated transfer mechanism for positioning each set of said plurality of contacts in accordance with the respective elements of stored signals, and a distributor for transmitting signaling impulses in accordance with the setting of said contacts.

70. In a telegraph system, a storage medium for recording each element of a plurality of groups of permutation code groups of signaling impulses, a sensing member for each element of a permutation code group of impulses, a plurality of contact members for each element of the permutation code group of signaling impulses, a mechanically operated transfer mechanism for transferring the setting of each of said sensing members to the corresponding set of contacts, and circuit connections to said contacts for controlling a circuit in response to the positioning of said

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contacts in response to predetermined groups of codes stored in a predetermined order in said medium.

71. In a telegraph system, a storage medium for recording each element of a plurality of groups of permutation code groups of signaling impulses, a sensing member for each element of a permutation code group of impulses, a plurality of contact members for each element of the permutation code group of signaling impulses, an operative mechanical connection between said contacts and said sensing members for positioning said contacts in accordance with code groups of stored signal impulses, and circuits controlled by said contacts in response to the positioning of said contacts in accordance with successive predetermined code combinations.

72. Means for directing messages having at the head end of each message a plurality of code combinations for directing the message over a selected one of a plurality of paths comprising a storage medium in which the directing combinations are stored, a plurality of sensing pins for sensing the individual elements of each code combination, a plurality of sets of contacts associated with and selectively conditioned mechanically by each sensing pin, and means controlled by said contacts for selecting one of said paths.

73. Means for directing messages having at the head end of each message a plurality of code combinations for directing each message comprising a storage medium in which the directing combinations are stored, a plurality of sensing pins for sensing the individual elements of each code combination, a plurality of sets of contacts associated with and selectively conditioned mechanically by each sensing pin, and selective apparatus controllable by and in accordance with said sets of contacts for establishing a path for further transmission of each message.

74. Means for directing messages having at the head end of each message a plurality of code combinations for directing the message comprising a storage medium in which the directing combinations are stored, a plurality of sensing pins for sensing the individual elements of each code combination, a plurality of sets of contacts associated with and selectively conditioned mechanically by each sensing pin, selective apparatus controllable by and in accordance with the sets of contacts for establishing a path for further transmission of a message, and means controllable by and in accordance with the sensing pins under the control of stored combinations for transmitting a message over the selective path.

75. A system of telegraphy including a storage medium for groups of message code combinations accompanied by a plurality of directing code combinations for each message group, each code combination comprising n elements having m conditions, means for deriving from said storage medium and storing independently of the storage medium a plurality of said directing code combinations, means for selecting a path of transmission under the conjoint and simultaneous control of said derived code combinations according to the permuted nature thereof, and means for impressing upon the path of transmission electric conditions permuted according to the message code combinations, m and n being positive integers.

76. Means for directing messages having at the head end of each message a plurality of directing code combinations selectively designating a path for transmission of the message comprising a

medium in which the designating code combinations are stored, means for advancing said medium past a sensing point, code sensing elements, one for each element of the code at said sensing point, secondary storage means, means for transferring a directing code combination from said medium to said secondary storage means incident to advance of said code combination past said sensing point and the sensing thereof, and means for selecting said path under the conjoint control of the permuted secondary storage means in conjunction with a code combination at said sensing point.

77. A directing system for messages preceded by a plurality of code combinations adapted to determine selectively paths for transmission of the messages comprising n selectable elements designed to be conditioned in m manners by one of said code combinations, and p other selectable elements adapted to be set in q manners by another of said code combinations, means for setting all said elements and maintaining the settings simultaneously during a given period of time, means selectively determining said path in accordance with the settings of said elements and the settings of said other elements acting coadjuvantly, and means for transmitting the messages over the paths thus determined, m , n , p and q being positive integers.

78. In a system for directing messages under control of code combinations, mechanical storage means for code combinations, sensing means for the code combinations, contacts selectively settable in accordance with the sensing means, means operable during the time a code combination remains set upon said contacts for first performing a switching operation selectively in accordance with said setting of said contacts, and means thereafter transmitting the same code combination selectively in accordance with the setting of said contacts.

79. A telegraph system comprising a plurality of stations, a control station, a telegraph transmission path extending to all of said stations, a telegraph transmitter at each of said stations, a control circuit at said control station for testing at intervals the transmitters at each of said plurality of stations for message material one at a time in rotation, and apparatus controlled by a busy condition at the control station for varying the intervals of the testing of said other transmitters.

80. In a telegraph system, a plurality of tape-controlled transmitters, a telegraph transmission path extendable to all of said transmitters, switching equipment located near said transmitters, a control station including transmission equipment, transmitter start apparatus located at said control station for controlling said switching equipment for testing each of said transmitters at intervals one at a time and in rotation for message material available for transmission and causing said transmitters to start transmitting when message material is found available for transmission, and apparatus controlled by the busy condition of transmitting equipment at the control station for varying the intervals of testing said tape-controlled transmitters.

81. In a telegraph system, a plurality of tape-controlled transmitters for transmitting over a common transmission channel, testing apparatus for testing said transmitters one at a time and in rotation for the presence of message material available for transmission, and control equipment for stopping the operation of said testing appa-

ratus after the last transmitter to transmit has been tested without finding any message material available for transmission.

82. In a telegraph system, a plurality of tape-controlled transmitters for transmitting over a common transmission channel, testing apparatus for testing said transmitters one at a time and in rotation for the presence of message material available for transmission, control equipment for stopping the operation of said testing apparatus after the last transmitter to transmit has been tested without finding any message material available for transmission, and time delay apparatus for initiating the operation of said testing equipment after a predetermined interval of time.

83. A telegraph system comprising a plurality of tape-controlled transmitters, a common transmission channel connectable to each of said transmitters one at a time and in rotation, switching equipment located near said transmitters for controlling the operation of said transmitters, a control station connected to said transmission channel, a transmission channel for controlling said switching equipment in accordance with permutation code signals, a transmitter start circuit at said control station for transmitting a series of transmitter start patterns over said transmission channel for testing each of said transmitters in rotation for the stored material available for transmission and apparatus for interrupting the operation of said transmitter start circuit after a complete series of transmitter start patterns including the pattern assigned to the last transmitter to transmit have been transmitted.

84. A telegraph system comprising a plurality of tape-controlled transmitters, a common transmission channel connectable to each of said transmitters one at a time and in rotation, switching equipment located near said transmitters for controlling the operation of said transmitters, a control station connected to said transmission channel, a transmission channel, a transmitter start circuit at said control station for transmitting a series of transmitter start patterns over said transmission channel for testing each of said transmitters in rotation for stored material available for transmission, apparatus for interrupting the operation of said transmitter start circuit after it has transmitted the start pattern which started transmission from the last transmitter to start, and time delay apparatus for again initiating the operation of said transmitter start circuit at the end of a predetermined interval of time.

85. A telegraph system comprising a plurality of tape-controlled transmitters, a common transmission channel connectable to each of said transmitters one at a time and in rotation, switching equipment located near said transmitters for controlling the operation of said transmitters, a control station connected to said transmission channel, a control channel for transmitting permutation code signals for controlling said switching equipment, a transmitter start circuit at said control station for transmitting a series of transmitter start patterns over said transmission channel for testing each of said transmitters one at a time and in rotation for the stored material available for transmission, apparatus for interrupting the operation of said transmitter start circuit after a complete series of transmitter start patterns ending with the pattern for testing the last transmitter to start, time delay apparatus for again initiating the operation of said transmitter start circuit at the end of a prede-

terminated interval of time, and other equipment responsive to the busy condition of said control channel for varying said predetermined interval of time.

86. An automatic transmitting arrangement for transmitting a predetermined series of signal patterns each constituting a plurality of permutation code signals for starting a plurality of tape-controlled transmitters comprising a first stepping switch for causing the transmission of a complete pattern during each cycle of said switch, a second stepping switch for controlling the character of at least one of the permutation signals of each pattern, control circuits for advancing said second switch one step for each cycle of operation of said first switch, apparatus responsive to the operation of any one of said transmitters for stopping the operation of said transmitting equipment, and apparatus responsive to the stopping of said transmitter for again initiating the operation of said transmitting arrangement.

87. An automatic transmitting arrangement for transmitting a predetermined series of signal patterns each constituting a plurality of permutation code signals for starting a plurality of tape-controlled transmitters comprising a first stepping switch for causing the transmission of a complete pattern during each cycle of said switch, a second stepping switch for controlling the character of at least one of the permutation signals of each pattern transmitted, control circuits for advancing said second switch one step for each cycle of operation of said first switch, apparatus responsive to the operation of any one of said transmitters for stopping the operation of said transmitting equipment, apparatus responsive to the stopping of said transmitter for again initiating the operation of said transmitting arrangement, a third stepping switch responsive to the operation of each of said transmitters for indicating the transmitter which transmitted last, circuits controlled conjointly by said three switches for interrupting the operation of said transmitting arrangement after complete series of start patterns has been transmitted without causing the third switch to advance.

88. An automatic transmitting arrangement for transmitting a series of signal patterns each comprising a plurality of permutation code signals and pauses between said permutation code signals, a stepping switch for causing the transmission of a complete pattern during each cycle of operation thereof, a second stepping switch for controlling the character of one of the permutation codes and control circuits for advancing said second switch one step for each cycle of operation of said first switch for changing said one permutation code combination in accordance with a predetermined pattern, and apparatus for causing said transmission arrangement to omit the transmission of any desired one of the signal patterns.

89. A telegraph system, a plurality of tape-controlled transmitters for transmission over a common transmission channel, a control circuit for testing said transmitters one at a time for the presence of stored message material available for transmission one at a time and in rotation, and apparatus for preventing said control circuit from testing any one or more of said transmitters during any one or more cycles of operation of said control apparatus.

90. A telegraph system comprising a plurality of telegraph transmitters controlled by stored signals for transmitting over a common telegraph

channel, an automatic control circuit for transmitting a plurality of transmitter start patterns in rotation for testing each of said transmitters one at a time for the presence of stored message material available for transmission, a conditionable control element or elements for selectively preventing the transmission of any one or more of said start patterns during the time said element or elements remain conditioned.

91. A telegraph system comprising a plurality of stations, a control station, a telegraph transmission path extending to all of said stations, a telegraph transmitter at each of said stations, a control circuit at said control station for testing at intervals the transmitters at each of said plurality of stations for message material one at a time in rotation, a transmitter located at said control station, and apparatus controlled by an idle condition of said transmitter located at the control station for increasing the frequency of the testing of said other transmitters.

92. In a telegraph system a plurality of tape-controlled transmitters, a telegraph transmission path extendable to all of said transmitters, switching equipment located near said transmitters, a control station remote from at least one of said transmitters, transmitter start apparatus located at said control station for controlling said switching equipment for testing each of said transmitters at intervals one at a time and in rotation for message material available for transmission, instrumentalities responsive to the presence of message material available for transmission for initiating the operation of said transmitters to start transmitting and apparatus controlled by the busy condition of transmitting equipment at the control station for varying the intervals of testing said tape-controlled transmitters.

93. In a telegraph system a plurality of tape-controlled transmitters for transmitting over a common transmission channel, testing apparatus for testing said transmitters one at a time and in rotation for the presence of message material available for transmission, control equipment responsive to cessation of the transmission over said channel to initiate the operation of said testing apparatus, apparatus for stopping the operation of said testing apparatus after the last transmitter to transmit has been tested without finding any message material available for transmission.

94. In a telegraph system, a plurality of tape-controlled transmitters for transmitting over a common transmission channel, testing apparatus for testing said transmitters one at a time and in rotation for the presence of message material available for transmission, control equipment responsive to the cessation of transmission over said common channel for initiating the operation of said testing apparatus, instrumentalities for stopping the operation of said testing apparatus after the last transmitter to transmit has been tested without finding any message material available for transmission, time delay apparatus for initiating the operation of said testing equipment after a predetermined interval of time.

95. A telegraph system comprising a plurality of tape-controlled transmitters, a common transmission channel connectable to each of said transmitters one at a time and in rotation, switching equipment located near said transmitters for controlling the operation of said transmitters, a control station connected to said transmission channel, a transmission channel for controlling said switching equipment in accordance with

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permutation code signals, a transmitter start circuit at said control station for transmitting different transmitter start patterns over said control channel for each of said transmitters for testing each of each transmitters in rotation for the stored material available for transmission, and apparatus for interrupting the operation of said transmitter start circuit after it has transmitted the transmitter start pattern for testing the last transmitter to transmit.

96. A telegraph system comprising a plurality of tape-controlled transmitters, a common transmission channel connectable to each of said transmitters one at a time and in rotation, switching equipment located near said transmitters for controlling the operation of said transmitters, a control station connected to said transmission channel, a control channel for transmitting permutation code signals for controlling said switching equipment, a transmitter start circuit at said control station for transmitting a series of transmitter start patterns over said transmission channel for testing each of said transmitters in rotation for the stored material available for transmission and apparatus for interrupting the operation of said transmitter start circuit after it has transmitted a complete series of transmitter start patterns ending with the pattern for testing the last transmitter to start, time delay apparatus for again initiating the operation of said transmitter start circuit at the end of a predetermined interval of time.

97. A telegraph system comprising a plurality of tape-controlled transmitters, a common transmission channel connectable to each of said transmitters one at a time and in rotation, switching equipment located near said transmitters for controlling the operation of said transmitters, a control station connected to said transmission channel, a transmission channel extending to said switching equipment, a transmitter start circuit at said control station for transmitting a series of transmitter start patterns over said transmission channel for testing each of said transmitters in rotation for the stored material available for transmission and apparatus for interrupting the operation of said transmitter start circuit after transmission of the start pattern which caused the last previously operating transmitter to start, time delay apparatus for again initiating the operation of said transmitter start circuit at the end of a predetermined interval of time, other equipment responsive to an idle condition of said control channel for decreasing said predetermined interval of time.

98. An automatic transmitting arrangement for transmitting a predetermined series of signal patterns each constituting a plurality of permutation code signals for starting a plurality of tape-controlled transmitters comprising a first stepping switch for causing the transmission of a complete pattern during each cycle of said switch, a second stepping switch for controlling the character of at least one of the permutation signals of each pattern, transmitter controlled circuits therefor for advancing said second switch one step for each cycle of operation of said first switch, and additional control circuits for causing said second switch to automatically step through predetermined positions without causing a corresponding permutation code combination to be transmitted.

99. An automatic transmitting arrangement for transmitting a predetermined series of signal patterns each constituting a plurality of permu-

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tation code signals for starting a plurality of tape-controlled transmitters comprising a first stepping switch for causing the transmission of a complete pattern during each cycle of said switch, a second stepping switch for controlling the character of at least one of the permutation signals for each pattern in a transmitter, control circuits therefor for advancing said second switch one step for each cycle of operation of said first switch, a third stepping switch responsive to the operation of each of said transmitters for indicating the transmitter which transmitted last, circuits jointly controlled by said three switches for interrupting the operation of said transmitting arrangement after a complete series of start patterns has been transmitted without causing the third switch to advance.

100. An automatic transmitting arrangement for transmitting a series of signal patterns each comprising a plurality of permutation code signals interspersed with pauses of predetermined duration, a stepping switch for causing the transmission of a complete pattern during each cycle of operation thereof, a second stepping switch for controlling the character of one of the permutation codes and control circuits for advancing said second switch one step for each cycle of operation of said first switch for changing said one permutation code combination in accordance with a predetermined pattern, manually control apparatus for causing said transmission arrangement to omit the transmission of any desired one of the signal patterns.

101. A telegraph system, a plurality of geographically separated tape-controlled transmitters for transmission over a transmission channel common to said transmitters, a control circuit for testing said transmitters one at a time for the presence of stored message material available for transmission one at a time and in rotation, and manually controlled apparatus for selectively preventing said control apparatus from testing any specified one or more of said transmitters.

102. A telegraph system comprising a plurality of storage controlled transmitters for transmitting over a common telegraph channel, an automatic control circuit for transmitting a plurality of transmitter start patterns in rotation for testing each of said transmitters one at a time for the presence of stored message material available for transmission, and manually controlled skip circuits for skipping the testing of one of said transmitters.

103. In a telegraph system comprising a plurality of tape-controlled transmitters, a common channel connectable to each of said transmitters one at a time and in rotation, a control circuit for transmitting a transmitter start pattern for each transmitter connectable to said common transmission channel comprising a first stepping switch for transmitting a complete pattern during each cycle of operation thereof, and a second stepping switch for indicating the one of said transmitters which started to transmit last.

104. In a telegraph system comprising a plurality of tape-controlled transmitters, a common channel connectable to each of said transmitters one at a time and in rotation, a control circuit for transmitting a transmitter start pattern for each transmitter connectable to said common transmission channel comprising a first rotary switch for controlling the transmission of a complete pattern during each cycle of operation thereof and a second stepping switch for indicating the one of said transmitters which started to

transmit last, apparatus responsive to the operation of any of said transmitters for stepping said second switch to a position corresponding to the respective transmitter, a third stepping switch for varying said pattern in a predetermined manner for starting each of said mentioned transmitters in rotation.

105. In a telegraph system a plurality of tape-controlled telegraph transmitters each assigned an individual starting pattern, a telegraph transmission path extendable to all of said transmitters, a transmitter start circuit for transmitting in rotation the transmitter start patterns assigned to each of said transmitters comprising a rotary stepping switch, apparatus for causing said switch to advance one step during each start pattern for changing a part thereof, and manually controlled apparatus for positioning said switch.

106. In a telegraph system, a telegraph transmission channel, a plurality of record-controlled telegraph transmitters for transmitting over said channel, a control circuit for initiating the operation of each of said transmitters in accordance with a predetermined program, said control circuit including means for initiating the operation of at least one of said transmitters oftener during each of said programs than the operation of other of said transmitters is initiated during each program.

107. In a telegraph system, a telegraph transmission channel, a plurality of record-controlled transmitters for transmitting over said channel, control apparatus for each of said transmitters responsive to predetermined start patterns for establishing connections between said transmitters and said control apparatus and for causing the operation of one of said transmitters to be initiated by a greater number of start patterns than the other of said transmitters, and a transmitter start circuit for transmitting each of the transmitter start patterns assigned to said transmitters one at a time and in rotation.

108. In a telegraph system, a telegraph transmission path, a plurality of storage telegraph transmitters for transmission over said path each of which is assigned a different transmitter start pattern, an automatic telegraph transmission system for automatically transmitting a series of said transmitter start patterns in which at least one of said patterns is transmitted more often than another one of said start patterns.

109. In a telegraph system, an automatic transmitting arrangement for transmitting a predetermined series of similar signaling patterns comprising permutation code signaling impulses interspersed with prolonged signaling conditions of predetermined duration comprising a stepping switch for controlling the character of each of the permutation code groups transmitted when said switch is resting in certain of its positions, time-controlled apparatus for advancing said switch from one position to the next, and other circuits for advancing said switch through predetermined steps thereof independently of said timing circuit.

110. In a telegraph system comprising a plurality of tape-controlled transmitters, a common channel connectable to each of said transmitters one at a time and in rotation, a control circuit for transmitting a transmitter start pattern for each transmitter connectable to said common transmission channel comprising a stepping switch having a position for each of a plurality of said transmitters for indicating the one of said transmitters which started to transmit last, and apparatus responsive to the operation of said

transmitters for causing said switch to move to the position assigned to the respective transmitters.

111. In a telegraph system comprising a plurality of tape-controlled transmitters, a common channel connectable to each of said transmitters one at a time and in rotation, a control circuit for transmitting a transmitter start pattern for each transmitter connectable to said common transmission channel comprising a first rotary switch for causing the transmission of a complete pattern during each cycle of operation thereof, a second stepping switch for indicating the one of said transmitters which started to transmit last, a third stepping switch for varying the character of a portion of said pattern and manually operated switches for positioning said last switch to cause the transmission of any one of said patterns.

112. In a telegraph system a plurality of tape-controlled telegraph transmitters each assigned an individual starting pattern, telegraph transmission path extendable to all of said transmitters, a transmitter start circuit for transmitting in rotation the transmitter start pattern assigned to each of said transmitters for permitting each of said transmitters to transmit one at a time and in rotation, and equipment responsive to the presence of material available for transmission from one of said transmitters for initiating the operation of said transmitter start circuit.

113. In a telegraph system a telegraph transmission channel, a plurality of record-controlled telegraph transmitters for transmitting over said channel, a control circuit for initiating the operation of each of said transmitters in accordance with a predetermined and repeated program in which the operation of one of said transmitters is initiated a plurality of times during said program.

114. In a telegraph system, a telegraph transmission channel, a plurality of record-controlled transmitters for transmitting over said channel, control apparatus for each of said transmitters responsive to predetermined start patterns for establishing connections between said transmitters and said control apparatus, additional circuits for establishing a connection between one of said transmitters and said control apparatus in response to a plurality of different start patterns, a transmitter start circuit for transmitting each of the transmitter start patterns assigned to said transmitters one at a time and in rotation.

115. In a telegraph system, a telegraph transmission path, a plurality of storage telegraph transmitters for transmission over said path each of which is assigned a different transmitter start pattern, an automatic telegraph transmitting system for automatically and repeatedly transmitting a series of said transmitter start patterns over said path in which one of said patterns is transmitted a plurality of times during each of said series.

116. In a telegraph system, an automatic transmitting arrangement for transmitting a predetermined series of similar signaling patterns comprising permutation code signaling impulses interspersed with prolonged signaling conditions of predetermined duration comprising a stepping switch for controlling the character of portions of said patterns transmitted when said switch is resting in certain of its positions, time-controlled apparatus for advancing said switch from one position to the next, other circuits and apparatus responsive to the operation of said transmitters

for preventing the operation of said time-controlled apparatus.

117. In a telegraph system, a channel of transmission, a plurality of transmitters associable therewith for transmission thereover, means for storing message material to control transmission from each of said transmitters, transmitter start means for assigning periods of transmission in succession to said transmitters, said start means functioning upon termination of transmission from one transmitter to test each transmitter for stored material in sequence until the last to transmit has been tested and found void of stored material, timing means effective thereafter to delay further testing for a predetermined time, and means operable by supply of material to the storage means of one of said transmitters to cut short said time and initiate transmission.

118. In a telegraph system, a tape-controlled transmitter, a plurality of telegraph channels each provided with a single lead extending toward said transmitter, transmission paths extending from said transmitter toward said channels, switching equipment operated under control of said transmitter for selecting one of said leads in accordance with stored signals, testing equipment for testing a busy condition of said lead, and other testing equipment for testing the continuity of said lead and initiating a connection between said transmitter and a path extending toward the selected channel.

119. In a telegraph system a switching station, a plurality of telegraph channels leading from said station, a plurality of telegraph paths within said station leading to one of said channels, a telegraph transmitter, switching equipment located in said station for extending one of said paths to said transmitter, and a single lead individual to said channel for indicating an idle condition of any one said plurality of paths and controlling the extension of said idle path to said transmitter.

120. In a telegraph system, a switching equipment comprising a plurality of telegraph transmitters, a plurality of telegraph channels leading away from said equipment each provided with a plurality of paths through said switching equipment, control apparatus for controlling said switching equipment in accordance with permutation code signals available for transmission from said transmitters, a single lead individual to each of said channels extending to said switching equipment, apparatus for testing for a busy condition of said lead, other apparatus for testing the continuity of said lead, and still other apparatus for indicating cross connections between said lead and other leads, and apparatus controlled by said testing equipment for initiating over said lead the extension of one of said paths to one of said transmitters.

121. In a telegraph system comprising a plurality of telegraph transmission channels, a plurality of paths leading to a plurality of said paths and a plurality of transmitters, a switching equipment for extending said paths to said transmitters, a single lead individual to each of said channels for initiating the extension of one of said paths to one of said transmitters, apparatus for testing the continuity of said lead through said switching equipment, an intercept position, and additional control equipment responsive to an open condition of said lead for connecting said one transmitter to said intercept circuit.

122. In a telegraph system, a plurality of telegraph transmitters, a telegraph channel, a plurality of telegraph paths leading to said channel,

switching equipment for extending said paths to said transmitters, a single lead individual to said channel extending through said switching equipment and apparatus for associating said lead with each said paths leading to said channel one at a time for controlling the extension of the path associated therewith to one of said transmitters.

123. In a telegraph system, switching apparatus responsive to stored permutation code signals for selecting one of a plurality of control leads, instrumentalities for testing a busy condition of said lead, other testing apparatus controlled by said busy testing instrumentalities for testing the continuity and impedance of said lead and the potential applied thereto.

124. In a telegraph system, switching apparatus responsive to stored permutation code signals for selecting one of a plurality of control leads, instrumentalities for testing the busy condition of said lead, other testing apparatus controlled by said busy testing instrumentalities for testing the continuity and impedance of said lead and the potential applied thereto, and apparatus responsive to all of said testing equipment for initiating a switching operation over said lead.

125. In a telegraph system, switching apparatus responsive to stored permutation code signals for selecting one of a plurality of control leads, instrumentalities for testing a busy condition of said lead, other testing apparatus controlled by said busy testing instrumentalities for testing the continuity and impedance of said lead and the potential applied thereto, time-delay apparatus and control equipment initiated thereby to again test the busy condition of said lead after a predetermined interval of time, and apparatus responsive to the operation of said switching apparatus for preventing said retest.

126. In a telegraph system a telegraph transmitter controlled by permutation code groups of telegraph signaling impulses, switching apparatus responsive to a first permutation code group of said stored signaling impulses for selecting one of a plurality of secondary selection paths, apparatus for testing the continuity of said path, advance means for advancing said transmitter under control of said continuity testing apparatus, a second group of switching devices responsive to a succeeding permutation code group of stored impulses for selecting in accordance with the combined permutative character of said first and succeeding permutation code groups one of a plurality of switching circuits of a potentially greater number than the maximum number of permutations of a single permutation code group, and apparatus for testing the continuity of said finally selected switching circuit.

127. In a telegraph system, a plurality of telegraph channels, a plurality of paths leading to a plurality of said channels, a plurality of sources of telegraph signals, switching equipment for selectively extending said paths to said sources, a single lead individual to each of said channels for controlling the extension of said paths to said sources, an intercept circuit, and manually controlled keys connected to said leads for automatically causing said sources to be connected to said intercept circuit instead of to paths leading to said channel.

128. In a telegraph system, a plurality of telegraph stations each assigned an address code, a central station, telegraph transmission channels extending from said central station to said plurality of stations, at least one of said lines extending to more than one of said stations, switch-

ing equipment provided with a code point for each of said address codes, and circuits for connecting the code points of stations connected to any given line together and to circuits controlling paths leading to said channel.

129. In a telegraph system, switching apparatus responsive to stored permutation code signals for selecting one of a plurality of control paths, instrumentalities for applying a test condition to said path, and apparatus for selecting another path in response to the absence of a predetermined minimum current flowing over said selected path during a predetermined portion of the application of said test condition to the selected path.

130. In a telegraph system, an intercept circuit, a tape-controlled transmitter, a plurality of telegraph channels each provided with a single lead extending toward said transmitter, selective switching equipment controlled by said transmitter for selecting one of said leads in accordance with stored signals, testing equipment for testing a busy condition of said lead, and other testing equipment for testing the continuity of said lead and automatically establishing a connection between said transmitter and said intercept circuit when said selected lead is open.

131. In a telegraph system, a switching station, a plurality of telegraph channels leading from said station, a plurality of telegraph paths within said station leading to one of said channels, a telegraph transmitter, switching equipment located in said station for extending one of said paths to said transmitter, and a single lead individual to said channel for indicating a busy condition of all of said plurality of paths and preventing the extension of any of said paths to said transmitter.

132. In a telegraph system, a switching equipment comprising a plurality of telegraph transmitters, a plurality of telegraph channels leading away from said equipment each provided with a plurality of paths through said switching equipment, control apparatus for controlling said switching equipment in accordance with permutation code signals available for transmission from said transmitter, a single lead individual to each of said channels extending to said switching equipment, apparatus for delaying the operation of said switching equipment in response to a busy condition of said lead, other apparatus for testing the continuity of said lead, and still other apparatus responsive to cross connections between said lead and other leads for preventing the extension of said paths to said transmitters.

133. In a telegraph system, comprising a plurality of telegraph transmission channels, a plurality of paths leading to a plurality of said channels and a plurality of transmitters, a switching equipment for extending said paths to said transmitters, a single lead individual to each of said channels for initiating the extension of one of said paths to one of said transmitters, apparatus for testing the impedance of said lead through said switching equipment, an intercept position, and additional control equipment responsive to an abnormally high impedance of said lead for connecting said one transmitter to said intercept circuit.

134. In a telegraph system, a plurality of telegraph transmitters, a telegraph channel, a plurality of telegraph paths leading to said channel, switching equipment for extending said paths to said transmitters, a lead individual to said channel extending through said switching equipment and apparatus for associating said lead with said

paths leading to said channel one at a time and in rotation for controlling the extension of the path associated therewith to one of said transmitters.

135. In a telegraph system, switching apparatus responsive to stored permutation code signals for selecting one of a plurality of control leads, instrumentalities for testing a busy condition of said lead, apparatus controlled by said busy testing instrumentalities for initiating the operation of said switching apparatus, time-delay apparatus and control equipment initiated thereby to again test the busy condition of said lead after a predetermined interval of time and apparatus responsive to the operation of said switching apparatus for preventing said retest.

136. In a telegraph system, a telegraph transmitter controlled by permutation code groups of telegraph signaling impulses, switching apparatus responsive to the first permutation code group of said stored signaling impulses for selecting one of a plurality of secondary switching circuits, apparatus for testing the continuity of said circuit, advance means for advancing said transmitter under control of said continuity testing apparatus, a second switching apparatus responsive to a succeeding permutation code group of stored impulses, and circuits and equipment controlled by the combined condition of all of said switching apparatus for selecting in a single selective operation in accordance with the combined permutative characters of said first and succeeding permutation code groups one of a plurality of switching circuits larger in number than the maximum number of said plurality of secondary switching circuits and apparatus for testing the continuity of said finally selected switching circuit.

137. In a telegraph system, a plurality of telegraph channels, a plurality of paths leading to a plurality of said channels, a plurality of sources of telegraph signals, switching equipment for selectively extending said paths to said sources, a single lead individual to each of said channels for controlling the extension of said paths to said sources, an intercept circuit, a single lead individual to said intercept circuit for controlling the extension of a transmission path to said intercept circuit, manually controlled keys for transferring connections from said lead individual to said channels to said lead individual to said intercept circuit.

138. In a telegraph system, a plurality of telegraph stations each assigned an address code, a central station, telegraph transmission channels extending from said central station to said plurality of stations, at least one of said lines extending to more than one of said stations, a single control lead individual to each of said channels for controlling the transmission of messages to said channels, switching equipment provided with a code point for each of said address codes and circuits for connecting the code points of stations connected to any given line to said single lead individual to the given line, an intercept circuit, a single control lead therefor and a switch for connecting any code point to said control lead for said intercept circuit.

139. In a telegraph system, switching equipment responsive to stored permutation code signals for selecting one of a plurality of control leads, instrumentalities for applying a test condition to said lead, apparatus responsive to a current which exceeds a predetermined value for stopping the operation of the switching equipment and operating an indicating device.

140. In a telegraph system, a channel of transmission having associated therewith a plurality of receiving devices, means for impressing upon said channel messages each normally preceded by duplicated address codes signifying one of said stations, means operable to condition for reception of each message the station designated by the address code assigned thereto, means whereby none of said stations are conditioned by an erroneous initial address code not assigned to any of said stations, and means whereby, after none of said stations are conditioned by the erroneous address code, a following correct address code conditions the designated station for reception of the following message.

141. In a telegraph system, a channel of transmission having associated therewith a plurality of receiving devices, means for supplying messages preceded by a set of two duplicated directing code combinations directing apparatus controlled normally by and in accordance with the two first of said code combinations for selectively directing a message preceded by said codes to said channel, and selective apparatus controlled by and in accordance with one of said code combinations designating one device for causing reception of said message at said one of said devices, in combination with means whereby if said one code combination of the first two is erroneous and designates no one of said devices, a correct code combination of the second two will correctly cause reception of said message at a designated station.

142. In a telegraph system, a channel of transmission having associated therewith a plurality of receiving devices, means for impressing upon said channel messages each normally preceded by a duplicated address code signifying one of said stations, means operable to condition for reception of each message the station designated by the address code assigned thereto, means preventing conditioning of all of said stations by an erroneous initial address code not assigned to any of said stations, and means whereby after said preventing means have functioned the following correct address code conditions the designated station for reception of the following message.

143. A system of message transmission comprising sources of messages, an outgoing channel of transmission for certain of said messages, two storage devices individual to said outgoing channel of transmission for storing messages directed to said outgoing channel only, means for storing said messages in one or the other of said storage devices, and means causing consecutive messages to be stored in rotation in said storage devices.

144. A system of message transmission comprising sources of messages, an outgoing channel of transmission for certain of said messages, a plurality of storage devices individual to said outgoing channel of transmission for storing messages directed to said outgoing channel only, means for storing said messages in one or another of said storage devices, and means causing consecutive messages to be stored in rotation in said storage devices.

145. A system of message transmission comprising various sources of messages each normally accompanied by directing codes, an outgoing channel of transmission to which the codes direct certain of said messages, two storage devices individual to said outgoing channel of transmission for storing messages directed to said outgoing channel only, means for storing said messages in one or the other of said storage devices, and

means causing consecutive messages to be stored in rotation in idle ones of said storage devices.

146. A system of message transmission comprising a source of messages each normally accompanied by directing codes, an outgoing channel of transmission to which the codes direct certain of said messages, a plurality of storage devices individual to said outgoing channel of transmission for storing messages directed to said outgoing line only, means for storing said messages in one or another of said storage devices, and means causing consecutive messages to be stored in rotation in idle ones of said storage devices.

147. In a system for relaying messages through or out of an office, comprising devices of original storage for messages to be selectively directed to telegraph channels outgoing from said office, said outgoing channels each being provided with a plurality of storage devices individual thereto, and means including intraoffice channels for selectively transmitting messages from said devices of original storage to said storage devices individual to said outgoing channels whereby a plurality of such messages directed to a single outgoing channel may be simultaneously so transmitted independently of the availability at the time of said transmission of the outgoing channel for transmitting any of said messages, together with automatically operable means for equalizing the intraoffice transmission of messages to the several storage devices individual to an outgoing channel of transmission, said means comprising means for routing successive messages directed to an outgoing channel to idle ones of its storage devices in succession.

148. In a telegraph system, a record controlled permutation code transmitter, a record for controlling the same, a plurality of telegraph transmission paths, switching apparatus for connecting said transmitter to said transmission paths, and automatic control apparatus responsive to the permutative character of two permutation code signals of said record for controlling said switching apparatus to make one switching operation only for connecting said transmitter to one of said paths, in combination with another transmission path and intercept control means whereby messages directed to a selected one or more of said transmission paths may be automatically routed to said other path.

149. In a telegraph system, a record controlled permutation code transmitter, a record suppliable with message and directing codes for controlling the same, a plurality of telegraph transmission paths, switching apparatus for connecting said transmitter to said transmission paths, and automatic control apparatus responsive to the permutative character of two permutation code signals of said record for controlling said switching apparatus to make one switching operation only for connecting said transmitter to one of said paths, in combination with a plurality of stations associated with one of said transmission paths, an interceptive transmission path, and intercept control means whereby messages directed to a selected station or stations on said one transmission path may be alternatively routed to said interceptive transmission path.

150. In a telegraph system, a tape-controlled transmitter for transmitting permutation code groups of signaling impulses, transmission channels potentially greater than the total number of possible permutations of a single code group of impulses, and apparatus responsive to the permutative character of a plurality of said permuta-

tive groups of impulses for selecting in one selective operation one of said plurality of transmission channels, in combination with an intercept transmission path, and intercept means whereby a message directed by any selected ones of a plurality of said permutative groups of impulses may be selectively directed to said intercept transmission path.

151. In a telegraph system, a record controlled permutation code transmitter, a record suppliable with message and directing codes for controlling the same, a plurality of telegraph transmission paths, switching apparatus for connecting said transmitter to said transmission paths, and automatic control apparatus responsive to the permutative character of two permutation code signals of said record for controlling said switching apparatus to make one switching operation only for connecting said transmitter to one of said paths, in combination with a plurality of stations associated with one of said transmission paths, an interceptive transmission path, and intercept control means whereby messages directed to a selected station or stations on said one transmission path may be alternatively routed to said interceptive transmission path and messages for other stations on said path or paths are routed to their respective stations without interception.

152. In a telegraph system, a storage controlled transmitter for transmitting permutation code groups of signaling impulses, messages originating transmitters operable to supply permutation code groups to the storage thereof, transmission channels potentially greater than the total number of possible permutations of a single code group of impulses, and apparatus responsive to the permutative character of a plurality of said permutative groups of impulses for selecting in one selective operation one of said plurality of transmission channels, in combination with an intercept transmission path, and intercept means whereby a message directed by any combination or selected combinations less than all of the said plurality of permutative groups of impulses may be selectively directed to said intercept transmission path without disturbing the selection of said one transmission channel by the remainder of said plurality of permutative groups.

153. In a telegraph system, a plurality of stations each comprising a storage controlled telegraph message transmitter, means at one station for controlling the initiation of transmission from another station, said means comprising a transmitter start signal storage device, a distributor at said controlling station transmissively associated with the message controlled storage device and the transmitter start signal storage device thereat.

154. In a telegraph system, a telegraph transmission channel, a plurality of message transmitters, a distributor individual to each of said transmitters, control circuits for causing said message transmitters to transmit messages to said channel one at a time, an additional transmitter for transmitting service signals, control apparatus for interrupting the operation of any of said message transmitters and connecting said additional transmitter to the distributor individual to the interrupted transmitter for transmitting service signals over said channel.

155. In a telegraph system, a telegraph transmission channel, a plurality of message transmitters, a distributor individual to each of said transmitters, control circuits for causing said message transmitters to transmit messages to said chan-

nel one at a time, an additional transmitter for transmitting service signals, control apparatus for connecting said additional transmitter to the distributor of the last message transmitter to transmit and causing service signals to be transmitted through said distributor to said channel.

156. A telegraph system comprising a line extending from a control office to a plurality of way stations, a storage controlled transmitter at the control office for transmitting over said line messages directed to one or another of the way stations, means at the way stations for selectively receiving messages directed thereto, transmitting means at each way station for transmitting messages toward the control station, receiving means at the control station for recording said messages, means at the control station for intermittently sending selective signals to the way stations to start the transmitters thereat one at a time, additional means at the control station operative to interrupt outgoing message transmission from the message transmitter thereat to allow said control signals to be sent, means for resuming message signals after the sending of said control signals and a distributor at said control station common to said message transmitter and said control signal transmitter.

157. A system comprising a control station, one or more outlying stations, a system of transmission conductors extending from the control station to the outlying stations and designed for transmitting only one way at a time, automatic storage controlled transmitters at each station including the control station, and means at said control station assigning periods of starting transmission from each of said transmitters including the transmitter at the central station onto said system of conductors in sequence.

158. A system comprising a control station, one or more outlying stations, a system of transmission conductors extending from the control station to the outlying stations and organized for transmitting only one way at a time, automatic storage controlled transmitters at each station including the control station, and means at said control station assigning periods of starting transmission from each of said transmitters including the transmitter at the central station onto said system of conductors in sequence in combination with transmitter start means operative upon the cessation of transmission from any transmitter to initiate transmission from the next transmitter in sequence which is provided with stored transmissible material.

159. A system comprising a control station, one or more outlying stations, a system of transmission conductors extending from the control station to the outlying stations and organized for transmitting only one way at a time, automatic storage controlled transmitters at each station including the control station, means at said control station assigning periods of starting transmission from each of said transmitters including the transmitter at the control station over said system of conductors in sequence in combination with transmitter start means operative upon cessation of transmission from any transmitter to test the other transmitters in sequence for stored transmissible material and to initiate transmission from the next in sequence having such material.

160. A system comprising a control station, one or more outlying stations, a system of transmission conductors extending from the control station to the outlying stations and capable of trans-

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mitting only one way at a time, automatic storage controlled transmitters at each station including the control station, means at said control station assigning periods of starting, in sequence, transmission by each of said transmitters including the transmitter at the central station onto said system of conductors, and means for causing reexamination for transmissible material in sequence back to the station which last transmitted before initiating a temporary idle condition.

161. In a telegraph system, a control station, one or more outlying stations, a system of transmission conductors extending from the control station to the outlying stations, automatic storage controlled transmitters at each of said stations, apparatus at said control station for assigning periods of starting each of said transmitters one at a time and in rotation, apparatus for stopping the operation of said apparatus for assigning periods of starting after it has assigned a period to each of said transmitters without any of said transmitters starting to transmit, and apparatus responsive to the presence of message material available from one of said transmitters to initiate the operation of said apparatus for assigning starting periods.

162. A system comprising a control station, one or more outlying stations, a system of transmission conductors extending from the control station to the outlying stations and designed for transmitting only one way at a time, storage controlled transmitters at each station including the control station, and means at said control station assigning periods of starting transmission from each of said transmitters including the transmitter at the central station onto said system of conductors in sequence, and apparatus for arresting the operation of said assigning means after a starting time has been assigned to each of said stations without starting any of the transmitters located thereat.

163. A system comprising a control station, one or more outlying stations, a system of transmission conductors extending from the control station to the outlying stations and organized for transmitting only one way at a time, automatic storage controlled transmitters at each station including the control station, and means at said control station assigning periods of starting transmission from each of said transmitters including the transmitter at the central station onto said system of conductors in sequence in combination with transmitter start means operative upon the cessation of said transmission from any transmitter to initiate the operation of said means for assigning starting transmission from said transmitters.

164. A system comprising a control station, one or more outlying stations, a system of transmission conductors extending from the control station to the outlying stations and organized for transmitting only one way at a time, automatic storage control transmitters at each station including the control station, means at said control station assigning periods of starting transmission from each of said transmitters including the transmitter at the control station over said system of conductors in sequence in combination with transmitter start means operative upon cessation of transmission from any transmitter to test the other transmitters in sequence for stored transmissible material and rest after testing all in sequence including the last which transmitted.

165. A system comprising a control station, one or more outlying stations, a system of transmis-

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sion conductors extending from the control station to the outlying stations and capable of transmitting only one way at a time, automatic storage controlled transmitters at each station including the control station, means at said control station assigning periods of starting transmission from each of said transmitters including the transmitter at the central station onto said system of conductors in sequence, and means for causing a temporary idle condition upon finding no transmissible material in any transmitter.

166. A telegraph system comprising a plurality of telegraph stations, a telegraph transmission system extending to said stations and capable of transmitting only one way at a time, storage controlled transmitters at each of said stations connectable to said transmission system, apparatus at one of said stations for testing said transmitters one at a time and in rotation for storage material available for transmission, and means at one of said stations responsive to the presence of storage material available for transmission for initiating the operation of said apparatus for testing said transmitters for the presence of storage material available for transmission.

167. In a telegraph system, storage controlled transmitter means, storage means to store signals to control said transmitter means, switching apparatus responsive to signals stored by said storage means for selectively establishing a path leading from said transmitter means, other apparatus responsive to a predetermined pattern of signals stored by said means for interrupting said path, and equipment for transmitting said pattern independently of signals stored by said storage means.

168. In a telegraph system, a storage repeater, switching apparatus controlled by said storage repeater for establishing a transmission path away from said repeater, control devices responsive to a predetermined signal pattern for interrupting said path, and instrumentalities responsive to a pause in signals occurring between said establishment of said path and the interruption thereof which exceeds a predetermined interval for automatically transmitting said signal pattern.

169. In a telegraph system, a channel from a signal originating transmitter to a central office, a storing device at said office for storing in storage means signals arriving over said channel, a transmitter controlled by and in accordance with signals in said storage means for seizing a path selectively under direction of said storage means for transmission of stored signals thereover, means for sending disconnect codes for disconnecting said seized path under control of appropriate signals stored in said storage means, and other means operable by a cessation of signals arriving over said channel for sending disconnect codes over said seized path, said other means originating said disconnect codes independently of the presence of disconnect codes in said storage means.

170. In a telegraph system, a channel from a signal originating transmitter to a central office, a storing device at said office for storing in storage means signals arriving over said channel, a transmitter controlled by and in accordance with signals in said storage means for seizing a path selectively under direction of said storage means for transmission of stored signals thereover, and other means operable by a predeterminedly long cessation of signals arriving over said channel for sending disconnect codes over said seized path,

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said other means originating said disconnect codes independently of the presence of disconnect codes in said storage means.

171. In a telegraph system, a channel from a signal originating transmitter to a central office, a storing device at said office for storing in storage means signals arriving over said path, a transmitter controlled by and in accordance with signals in said storage means for seizing a path extending to a storage device associable with an outgoing line selectively under direction of said storage means for transmission of storage signals thereover, means operable in response to storage of signals in said last-named storage device for associating a transmitter controlled thereby with said outgoing line, other means operable by a predeterminedly long cessation of signals arriving over said channel for sending disconnect codes over said seized path, said other means originating said disconnect codes independently of the presence of disconnect codes in said first-named storage means, and means controlled by said disconnect codes for disassociating said last-named transmitter from said outgoing line.

172. In a telegraph system, a channel from a signal originating transmitter to a central office, a storing device at said office for storing in storage means signals arriving over said channel, a transmitter controlled by and in accordance with signals in said storage means for seizing a path selectively under direction of said storage means for transmission of stored signals thereover, and other means operable by a predeterminedly long cessation of signals arriving over said channel for sending disconnect codes over said seized path, said other means originating said disconnect codes independently of the presence of disconnect codes in said storage means in combination with other means operable by a predeterminedly long cessation of signals arriving over said channel for sending a code pattern to said signal originating transmitter, and selective means controlled by said pattern to decondition said originating transmitter for transmission over said channel.

173. In a telegraph system, a channel from a signal originating transmitter to a central office, a storing device at said office for storing in storage means signals arriving over said channel, a transmitter controlled by and in accordance with signals in said storage means for seizing a path selectively under direction of said storage means for transmission of stored signals thereover, and other means operable by a predeterminedly long cessation of signals arriving over said channel for sending disconnect codes over said seized path in combination with other means operable by a predeterminedly long cessation of signals arriving over said channel for sending a code pattern to said signal originating transmitter, and selective means controlled by said pattern to decondition said originating transmitter for transmission over said channel.

174. In a telegraph system, a channel from a signal originating transmitter to a central office, a storing device at said office for storing in storage means signals arriving over said channel, a transmitter controlled by and in accordance with signals in said storage means for seizing a path selectively under direction of said storage means for transmission of stored signals thereover, other means operable by a predeterminedly long cessation of signals arriving over said channel for sending disconnect codes over said seized path in combination with other means operable by a

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predeterminedly long cessation of signals arriving over said channel for sending a code pattern to said signal originating transmitter, selective means controlled by said pattern to decondition said originating transmitter for transmission over said channel, and a common timing means for both of said other means.

175. Apparatus for utilizing code combinations stored in recorded form in successive order which comprises instrumentalities controlled by the elements of a code at a sensing position, transfer and storage mechanism for storing a combination which has passed the sensing position, means for making a selection under the conjoint control of a combination in the storage mechanism and another combination remaining at the sensing position.

176. A system having a first storage means for simultaneously storing many code combinations and second storage means for storing one code combination derived from the first storage by sensing mechanism at a sensing point, and means for making a selection under the coadjutant selective control of a code combination stored in said second storage means and a code combination of said first storage means remaining at said sensing point.

177. The method of utilizing a code combination stored in a record for performing a selective switching operation and also controlling further transmission which comprises deriving a code combination from the record incident to sensing that combination of the record, temporarily storing the code combination separately from the record, controlling the selective switching operation under control of the code combination, and thereafter controlling the transmission of pulses over an outgoing path in accordance with the code combination as stored independently of the record.

178. In a telegraph system, a record of codes, a code transmitter suppliable with codes of said record to be transmitted, sensing means for sensing codes of said record, storage means separate from the record for storing a code sensed by said sensing means, means for establishing a path selectively under control of the code as stored in said storage means, and means for transmitting currents representing the code over said path under control of said storage means independently of storage in the record.

179. In a telegraph system, a record of codes, a code transmitter suppliable with codes of said transmitter to be transmitted, sensing means for sensing codes of said record, storage means separate from the record for storing a code sensed by said sensing means, means for establishing a path selectively under control of the code as stored in said storage means, and means for transmitting currents representing the code over said path under control of said storage means independently of storage in the record, and means actuated by other codes of said record for disestablishing said path.

180. In a telegraph system, a recorder for recording signals on a flexible web, a source of supply of said flexible web, selective means for seizing the recorder for storage of signals, means having an available condition permitting seizure of the recorder and an unavailable condition preventing seizure of the recorder, and means operable by an available supply of web less than a given amount for conditioning said means to the unavailable condition.

181. In combination, a message storing device

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comprising a flexible web and instruments for storing in said web, in a form suitable for actuating a retransmitter, code combinations, a supply source for said web, means conditionable to prevent initiation of storage of code combinations in said web, and means effective by a supply of web below a predetermined limited amount to so condition said means.

182. In combination, a reperforator for perforating message codes in an elongated web, means controlled by incoming line signals constituting a message address for seizing said reperforator for initiating storage of a message thereby, a supply source for said web, and means controlled by a predetermined minimum amount of web in said supply source to prevent seizure of said reperforator for initiation of storage of a message.

183. In a telegraph system, a recorder for recording signals on a flexible web, a source of supply of said flexible web, a plurality of paths connectable to said recorder to supply signals thereto for record, selective means for seizing the recorder when idler for connection to one of said paths for recording of signals, actuable means for causing said recorder to test busy when connected to one path to prevent double connection of the recorder to two paths simultaneously, and means operable by an available supply of web less than a given amount for actuating means to maintain a busy test condition established by connection of said recorder to one path after release therefrom.

184. In combination, a reperforator for perforating message codes in an elongated web, selective instrumentalities controlled by signals constituting a message address for seizing said reperforator and initiating storage of a message thereby, a supply source for said web, and means controlled by a predetermined minimum amount of web in said supply source to prevent seizure of said reperforator for initiation of storage of a message, said means maintaining continued seizure of said reperforator for continued storage of a message whose storage has already been initiated.

185. In a telegraph system, a receiving device in combination with a time delay device, apparatus responsive to the transmission of signals to said receiving device independently of the response of the receiving device to initiate the operation of said time delay device, indicating apparatus responsive to the operation of said time delay device at the end of the delay period thereof, and instrumentalities responsive to the operation of said receiving device in response to the signals transmitted thereto for preventing the operation of said indicating device.

186. In a telegraph system, a permutation code receiving instrument, a universal contact actuated thereby incident to the response of said instrument to each permutation code group of impulses, an indicating device, apparatus responsive to the transmission of signals to said instrument independently of the response of the receiving device to said signals for initiating the operation of said indicating device, and means responsive to the operation of said universal contact for preventing the operation of said indicating device.

187. In a telegraph system, a receiving device, switching apparatus for establishing a transmission path to said device, indicating apparatus, means operative incident to the establishing of a path to said device for initiating the operation

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of said indicating apparatus, and apparatus responsive to the operation of said receiving device for preventing the complete operation of said indicating apparatus.

188. In a telegraph system, a receiving instrument in combination with a time delay device, apparatus operative incident to the transmission of signals to said receiving instrument to initiate the operation of said timing device, and other apparatus operative incident to the operation of said receiving instrument in response to the signals to arrest the operation of said timing device.

189. In a telegraph switching system, a receiver, a make-busy circuit therefor, apparatus operative incident to the establishing of a connection to said receiver for starting a train of events leading to the application of a busy condition to said make-busy circuit, and means operative incident to the operation of said receiving device in performing its receiving function to interrupt said train of events.

190. In a telegraph system, a telegraph receiver, a make-busy circuit therefor, switching circuits for establishing a transmission path to said receiver, apparatus for applying and automatically maintaining a busy condition to said make-busy circuit, and devices for preventing the application of said busy condition to said make busy circuit incident to the operation of said receiver.

191. In a telegraph system, a telegraph transmitter, a telegraph receiver, a transmission path extendable between said transmitter and receiver, apparatus for starting the operation of circuits and apparatus leading to the eventual stopping of said transmitter and operative incident to the extension of said path to said transmitter and said receiver, and means responsive to the operation of said receiving device incidental to its receiving function for preventing the stopping of said transmitter.

192. In a telegraph system, a telegraph transmitter, a telegraph receiver, a telegraph transmission channel extendable between said transmitter and said receiver, circuits and apparatus operative incident to the extension of said path between said transmitter and said receiver for starting the operation of said transmitter, time delay apparatus for stopping the operation of said transmitter also operative incident to said extension of said path, and means responsive to the receiving operation of said receiver for preventing the stopping of said transmitter.

193. In a telegraph system, a tape-controlled telegraph transmitter, a telegraph receiving device, switching apparatus for establishing a transmission path from said transmitter to said receiver, apparatus operative incident to the establishment of said path for starting said transmitter, a make-busy means for said transmitter, circuits and apparatus operative a short time interval after the establishment of said path for stopping said transmitter and applying a busy condition to said make-busy circuit, and equipment operative incident to the operation of said receiving device for preventing the operation of said last-mentioned circuits and apparatus.

194. In a telegraph system, a plurality of telegraph transmitters, a plurality of telegraph receivers, transmission channels extendable between said transmitters and said receivers, make-busy circuits for each of said receivers, switching devices and circuits for extending transmission channels between said transmitters and receivers, apparatus for applying a busy condition to the

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respective make-busy circuit of the particular receiver a short interval of time after the extension of said path, and means controlled by the operation of the respective receiver for preventing the complete operation of said last-mentioned apparatus.

195. A system for the selective direction of messages under the control of two code combinations acting coadjuvantly comprising a transmitter having mechanical storage means for storing one code while sensing another, another transmitter having electrical storage means for storing one code while sensing another, and means including selective directing equipment operable under the control of either of said transmitters to make identical selections by identical sequences of selecting codes.

196. In a telegraph system, a telegraph transmitter, the first plurality of telegraph transmission paths extending from said transmitter, a second plurality of telegraph transmission paths extending from said transmitter, a single stage of selecting equipment for selectively extending transmission paths from said transmitter to one of said transmission paths, apparatus for controlling said single stage of selecting equipment in accordance with a single permutation code for selectively establishing a path to one of said first plurality of transmission paths, and other apparatus for controlling said single stage of selective equipment in accordance with a plurality of permutation codes for selectively establishing a path to one of said second plurality of transmission paths.

197. A telegraph system comprising a storage controlled telegraph transmitter, a first plurality of telegraph channels, a second plurality of telegraph channels, a single stage of selective switching apparatus, control equipment responsive to a single stored permutation code group for establishing a transmission path through said selective switching apparatus from said transmitter to one of said first plurality telegraph channels, and other control equipment responsive to a plurality of stored permutation code groups for selectively establishing a transmission path through said selective switching apparatus to one of said second plurality of telegraph channels.

198. In a selective switching system, a single stage of selecting apparatus included therein, control equipment therefor for selectively controlling said single stage of switching apparatus in accordance with a single predetermined code group of signals, and other control apparatus for controlling said single stage of switching apparatus in accordance with the combined characteristics of a plurality of permutation code groups of signals taken together.

199. In a telegraph system, a record controlled telegraph transmitter, a first plurality of telegraph transmission channels, a second plurality of telegraph transmission channels, switching equipment for establishing transmission paths from said transmitter to said channels selectively, apparatus controlled by predetermined permutation code groups for selectively establishing a path from said transmitter to one of said first plurality transmission paths, and other apparatus responsive to the combined permutational character of a plural number of other predetermined permutation codes for selectively establishing a path from said transmitter to one of said second plurality of transmission channels.

200. In a selective switching system, a single stage of switching apparatus, means responsive to

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the combined permutative character of a plurality of permutation code combinations for selectively controlling said single stage of switching apparatus, and equipment responsive to the permutative character of a different number of permutation code combinations for also controlling said single stage of switching apparatus.

201. In a telegraph system, a record controlled transmitter, a plurality of transmission paths potentially greater in number than a number of possible permutations from a single permutation code group extending from said transmitter, and selective switching apparatus responsive to the combined permutative character of a plurality of codes for selecting a single one of said plurality of telegraph channels in a single selective operation.

202. In a telegraph system, a record controlled telegraph transmitter, a plurality of telegraph transmission channels, a plurality of telegraph transmission paths extending toward each of a plurality of said channels, a lead individual to each of said channels, selective switching apparatus controlled by stored permutation code signals for selecting one of said leads individual to each of said channels, testing equipment for testing the condition of all of the paths leading toward the selected channel to which said lead is individual, and other switching circuits for thereafter extending an idle one of said transmission paths to said transmitter.

203. In a telegraph system, a source of permutation code signals, a plurality of telegraph transmission channels, a switching and testing lead individual to each of said channels, selective switching apparatus, a plurality of telegraph transmission paths extending from said source through said switching apparatus to each of a plurality of said telegraph channels, selective equipment responsive to permutation code signals for selecting one of said leads individual to one of said channels and testing equipment for thereafter testing the busy condition of said paths to said selected channel, and control equipment operated incident to the selecting and testing for extending an additional transmission path through said switching equipment between said transmitter and said selected channel.

204. In a telegraph switching system, an outgoing telegraph transmission channel, a plurality of transmission paths leading to said channel, switching apparatus for preselecting idle ones of said paths in rotation, a single lead individual to said channel, apparatus for extending said lead to said preselected path, and apparatus controlled over said lead for establishing a transmission circuit over said preselected path.

205. A telegraph system, which when duly energized by application of suitable power sources, comprising a plurality of storage means each capable of storing, simultaneously with the others, a succession of codes comprising message forming groups with associated codes of address for each message; transmission means automatically and successively, without interference, initiated into operation and automatically controlled by said stored successions of codes; a plurality of receiving stations; selective means actuated selectively by stored codes of address, representing individual recorders, for directing messages with which said codes are associated to said individual recorders; and means actuated selectively by stored codes of address, representing groups of recorders, for directing messages to the represented groups.

206. A telegraph system including a plurality

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of channels of communication and a plurality of stored media supplied simultaneously or successively with a succession of codes comprising message forming groups and associated codes of address for the messages thus formed, said system comprising automatic directing means to selectively direct certain of said messages and transmit them simultaneously or successively over two or more of said channels, a plurality of stations of address in said system, means controlled by codes of address individual to said stations of address to direct messages thereto, and means controlled by other codes of address common to certain of said stations of address for directing other messages thereto, each message being routed according to its associated codes of address.

207. In a telegraph system, a plurality of stations each assigned an address code, a primary switching center, a secondary switching center, transmission paths extending between said stations, control apparatus for automatically directing messages including an address portion through said primary switching center in response to the entire address portion thereof toward said secondary switching center, and control equipment for automatically directing said messages through the respective secondary switching center under control of only a part of said same address portion originally accompanying the message.

208. In a telegraph system, a plurality of tape-controlled transmitters, a telegraph transmission path extendable to all said transmitters, switching equipment located near said transmitters, a control station remote from at least one of said transmitters, transmitter start apparatus located at said control station for controlling said switching equipment for testing each of said transmitters one at a time and in rotation for message material available for transmission, instrumentalities responsive to the testing of all of said transmitters without finding message material available for transmission for stopping the operation of said transmitter start apparatus, time delay apparatus for restarting the operation of said transmitter start apparatus, and equipment responsive to a

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busy condition at said control station for varying the time delay interval of said delay apparatus.

209. In combination, a first transmitting device, a second transmitting device, a distributor common to said devices and operatively associated therewith, means to initiate transmission under the control of one of said devices, and means to defer transmission from the other of said devices pending completion of transmission from said one of said devices.

210. In combination, a first means adapted to transmit a variable message, a second means adapted to transmit an invariable message, a distributor common to both said means and operatively associated thereto, means to initiate transmission under the control of said second means, and means controlled by said second means to defer transmission from said first means pending completion of transmission from said second means.

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Certificate of Correction

Patent No. 2,430,447.

November 11, 1947.

DAVID E. BRANSON ET AL.

It is hereby certified that error appears in the printed specification, of the above numbered patent requiring correction as follows: Column 242, strike out lines 3 to 10, inclusive, comprising all of claim 209, and insert instead the following—

209. In a telegraph switching system, a receiving instrument, a make-busy circuit therefor, a time delay device, apparatus operative incident to establishing a path to said receiving instrument for initiating the operation of said time delay device, an operative connection between said make-busy circuit and said time delay device for applying a busy condition to said make-busy circuit upon the complete operation of said time delay device at the end of the delay period thereof, and equipment operative incident to the operation of said receiving device for preventing the application of said busy condition to said make-busy circuit.

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of August, A. D. 1948.

[SEAL]

THOMAS F. MURPHY,

Assistant Commissioner of Patents.