Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 1

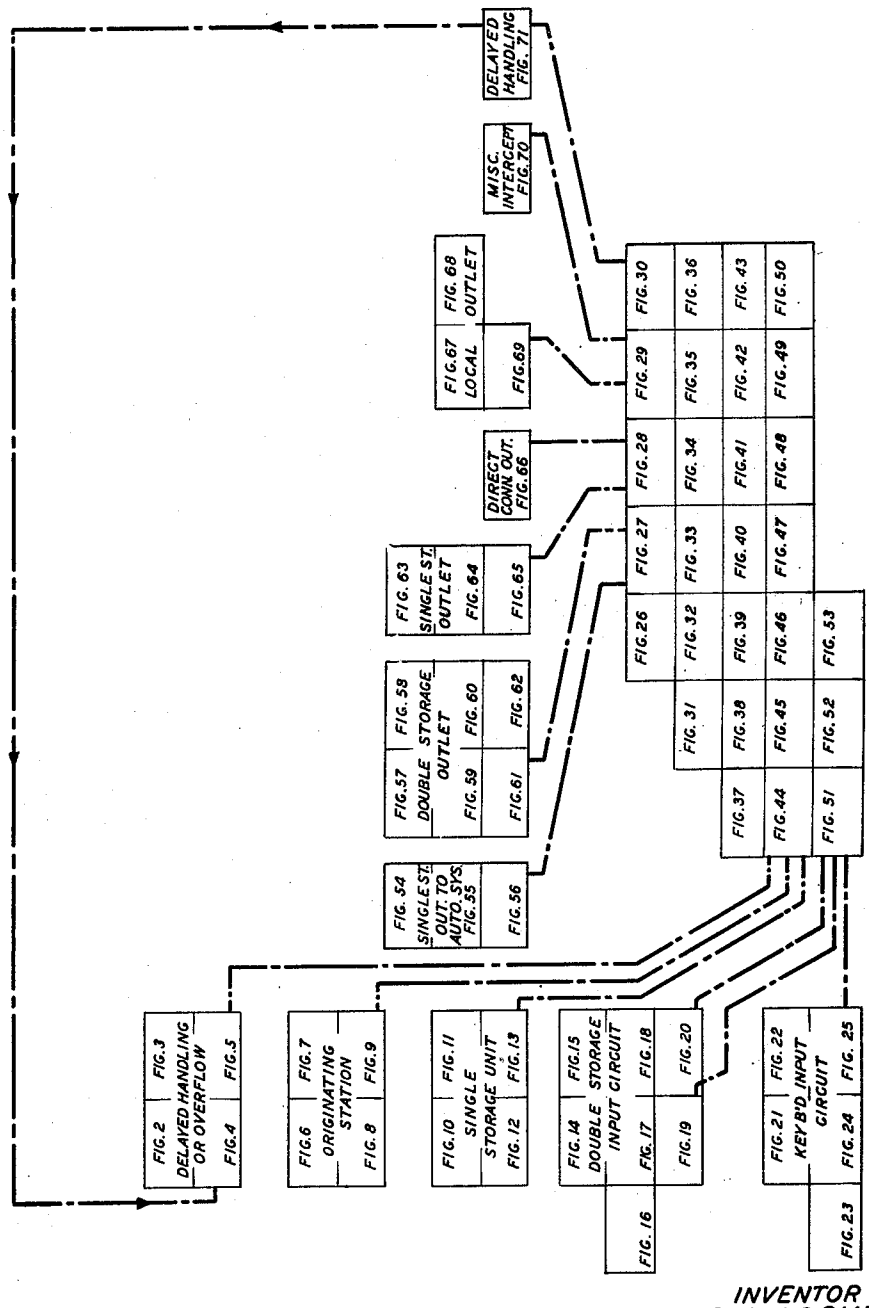

FIG. 1

INVENTOR
G. A. LOCKE
BY R. C. Lerry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 2

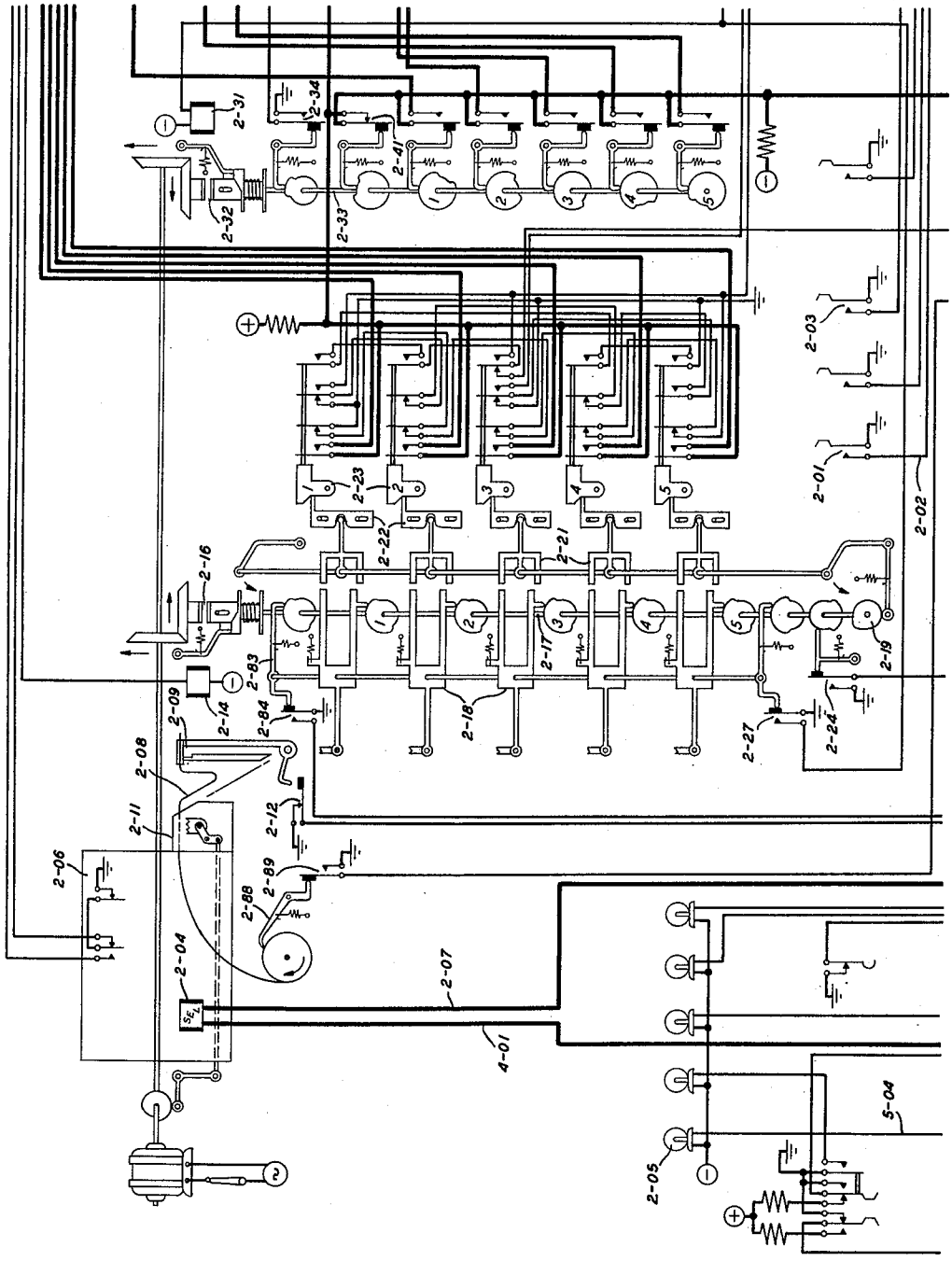

FIG. 2

INVENTOR
G. A. LOCKE
BY
R. C. Leroy
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 3

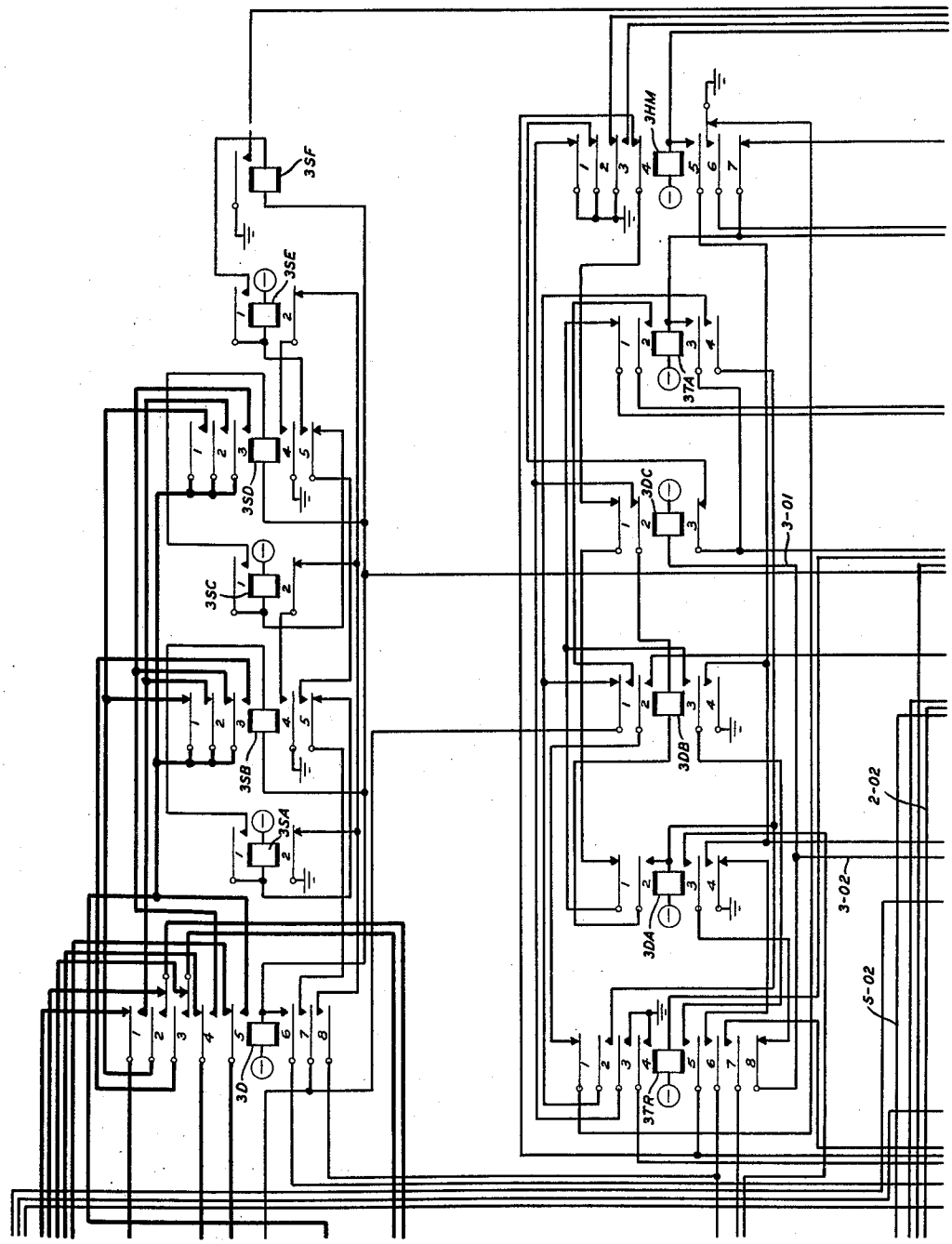

FIG. 3

INVENTOR
G. A. LOCKE

BY R. C. Terry

ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 4

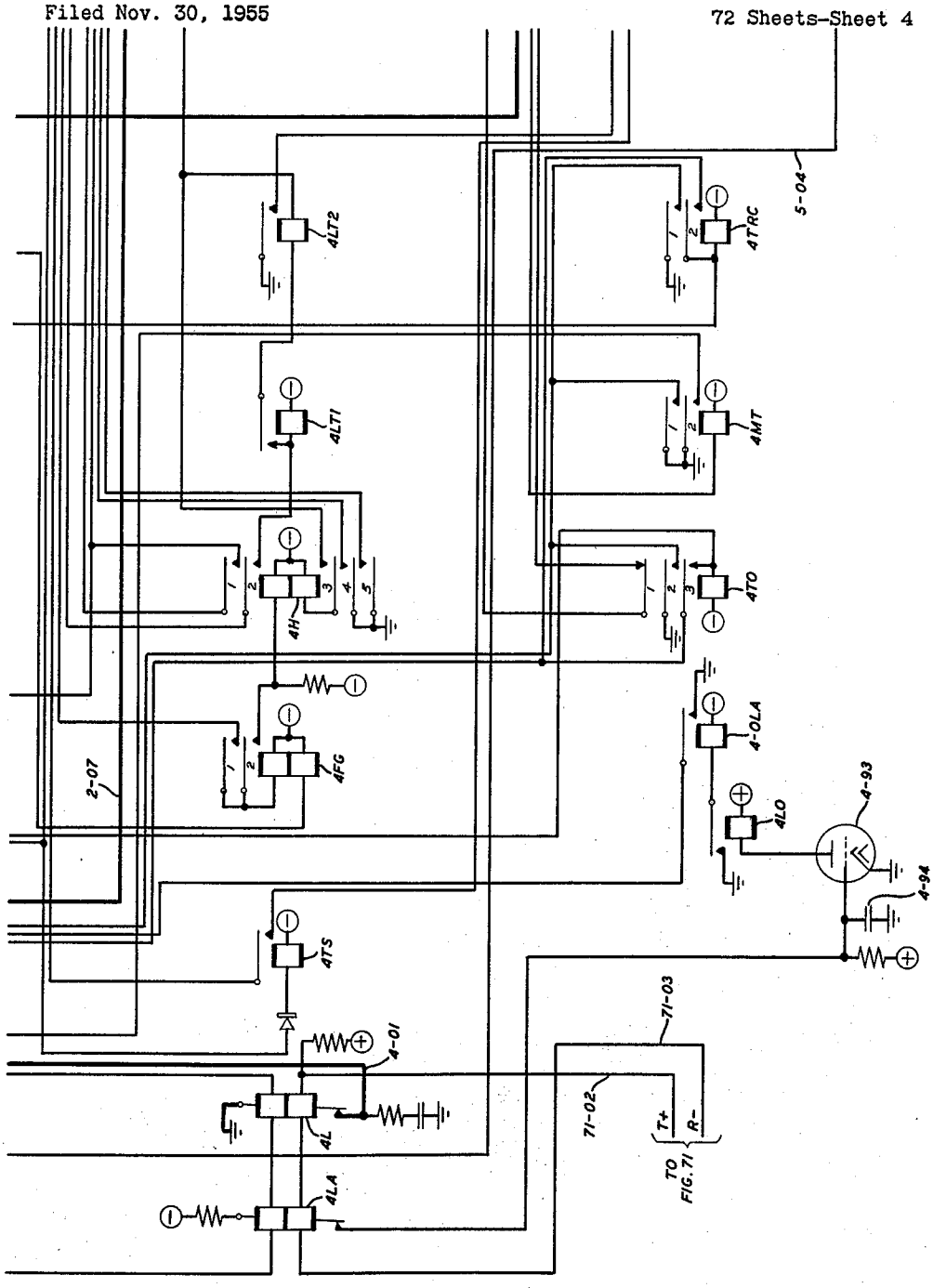

FIG. 4

INVENTOR
G. A. LOCKE

BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 5

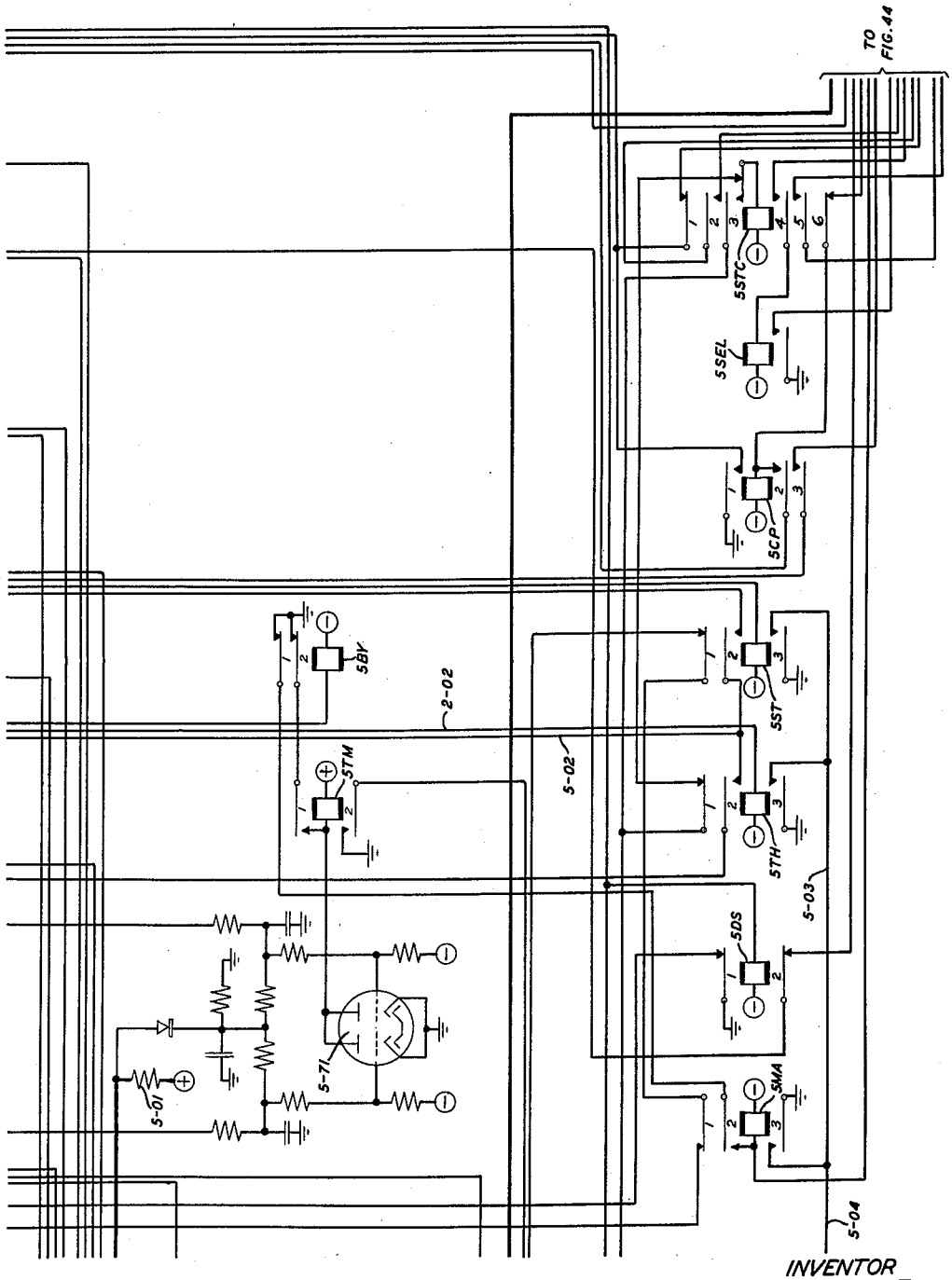

FIG. 5

INVENTOR
G. A. LOCKE

BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 6

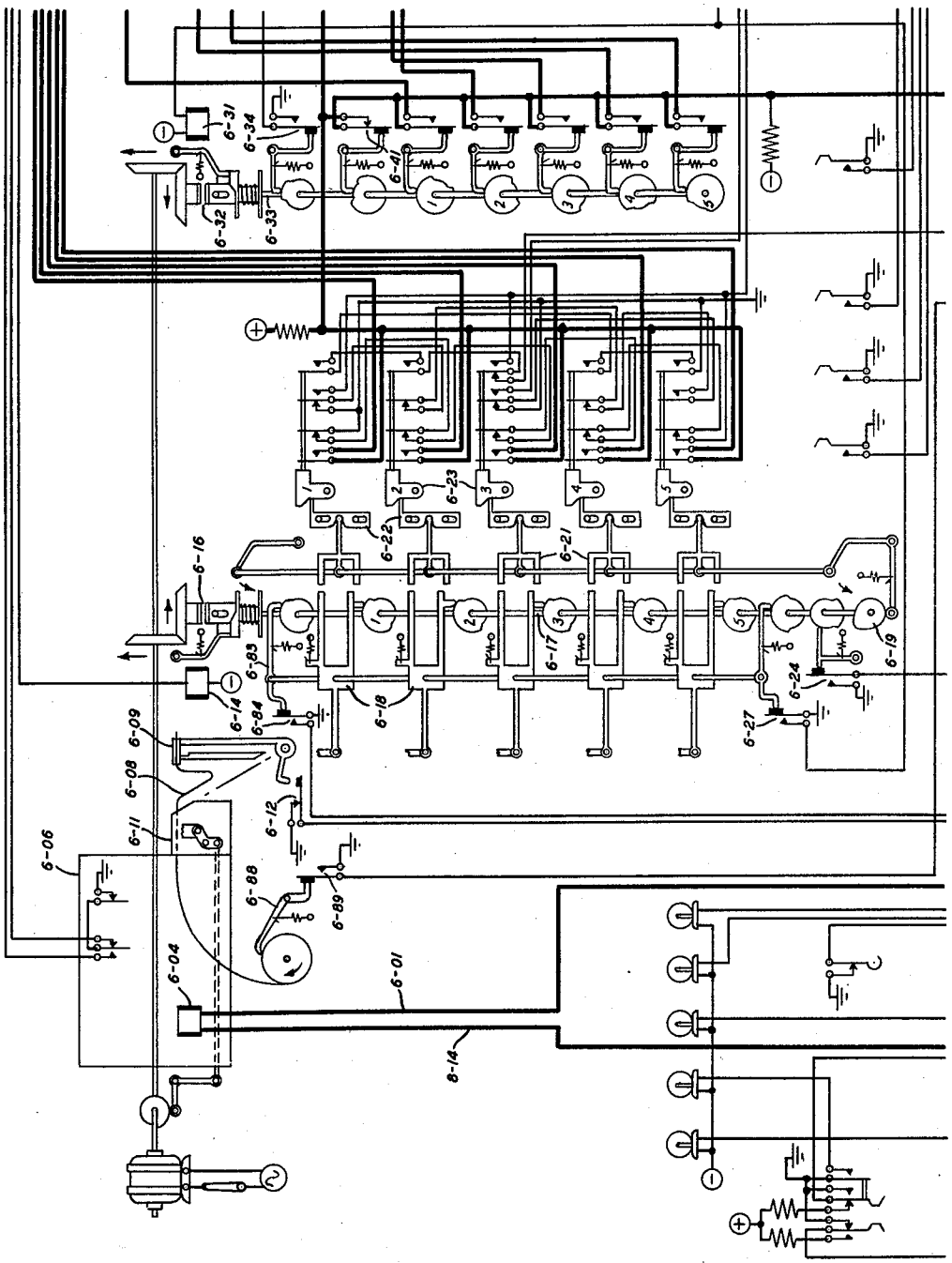

FIG. 6

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 7

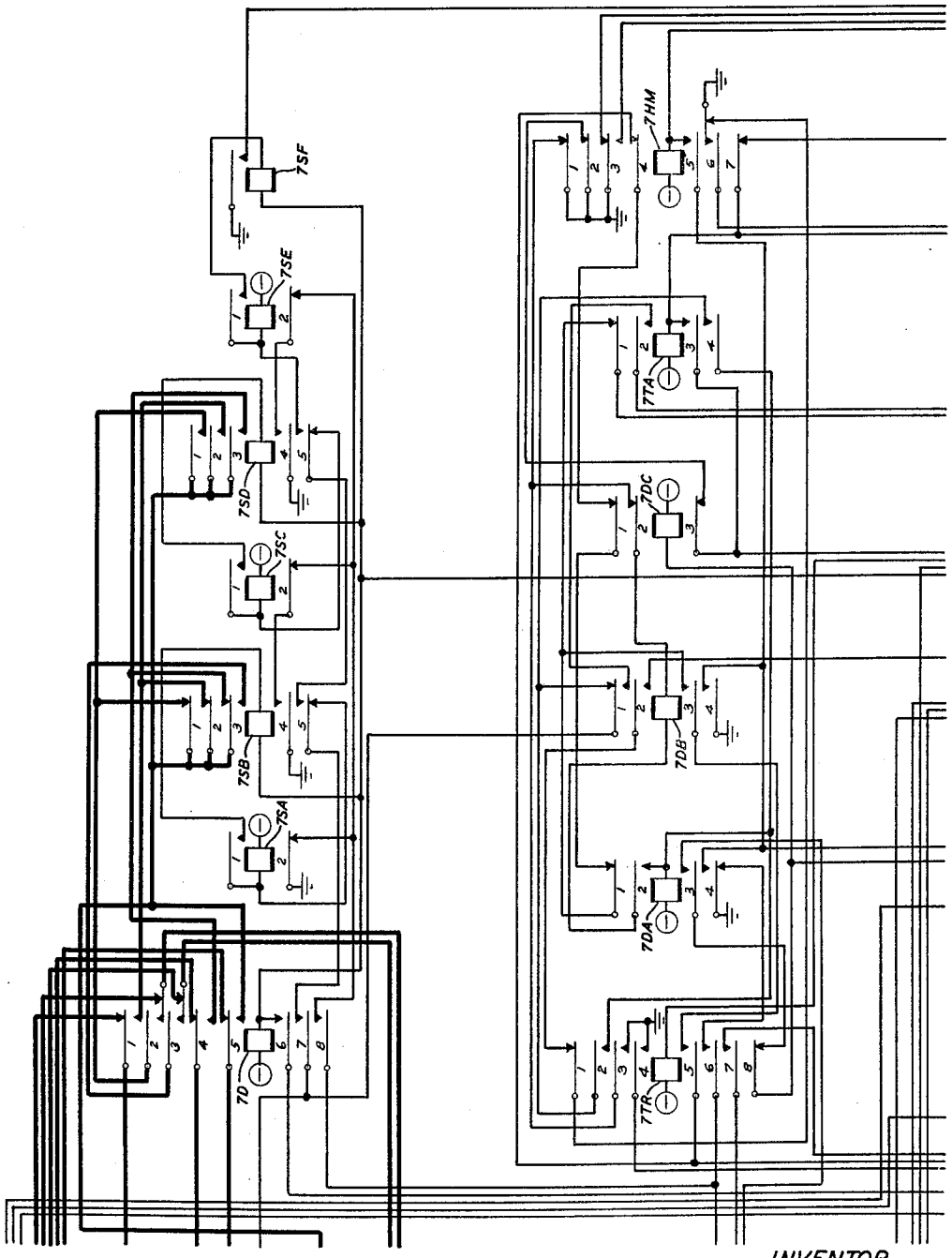

FIG. 7

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 8

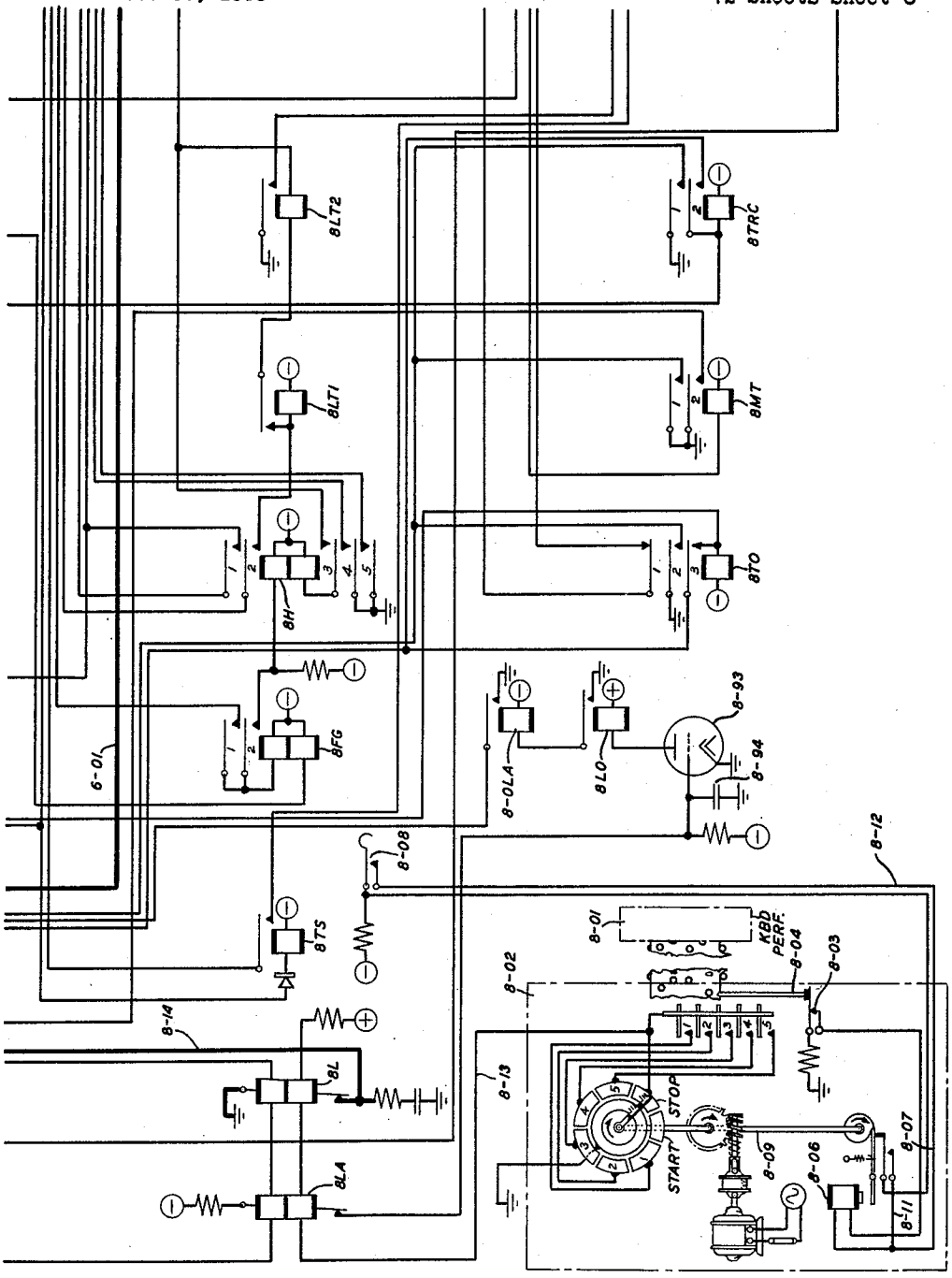

FIG. 8

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 9

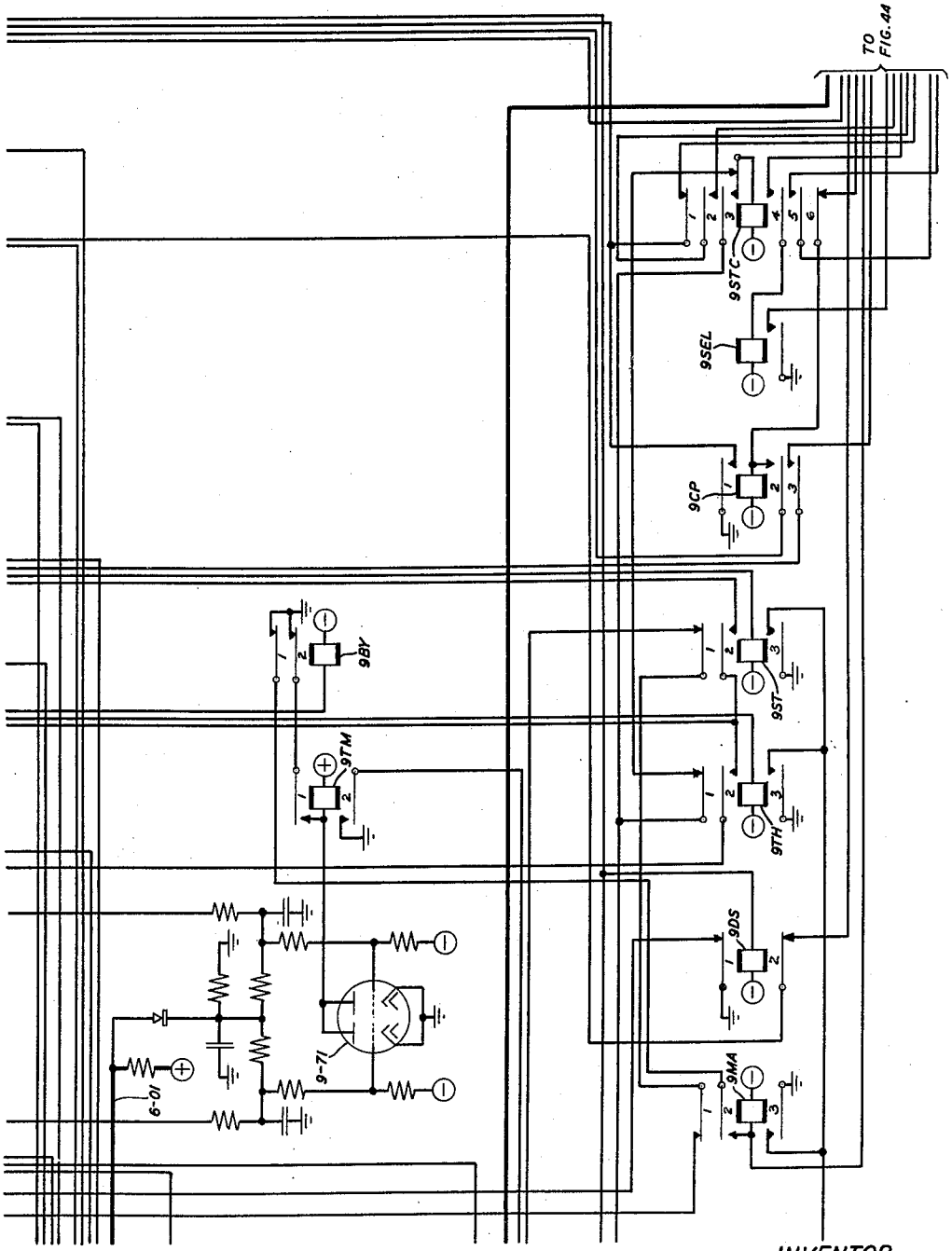

FIG. 9

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 10

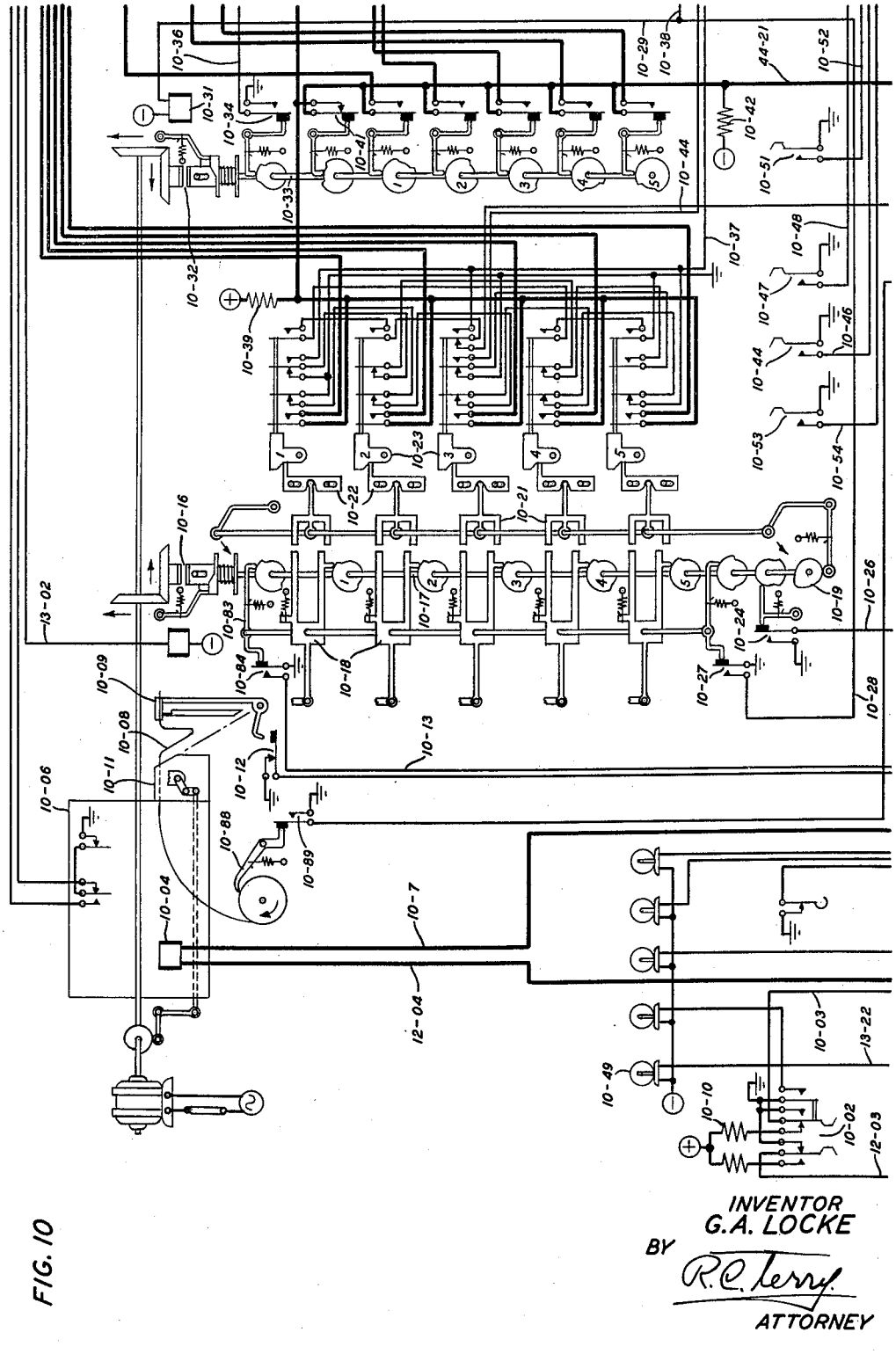

FIG. 10

INVENTOR
G.A. LOCKE
BY
R.C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 11

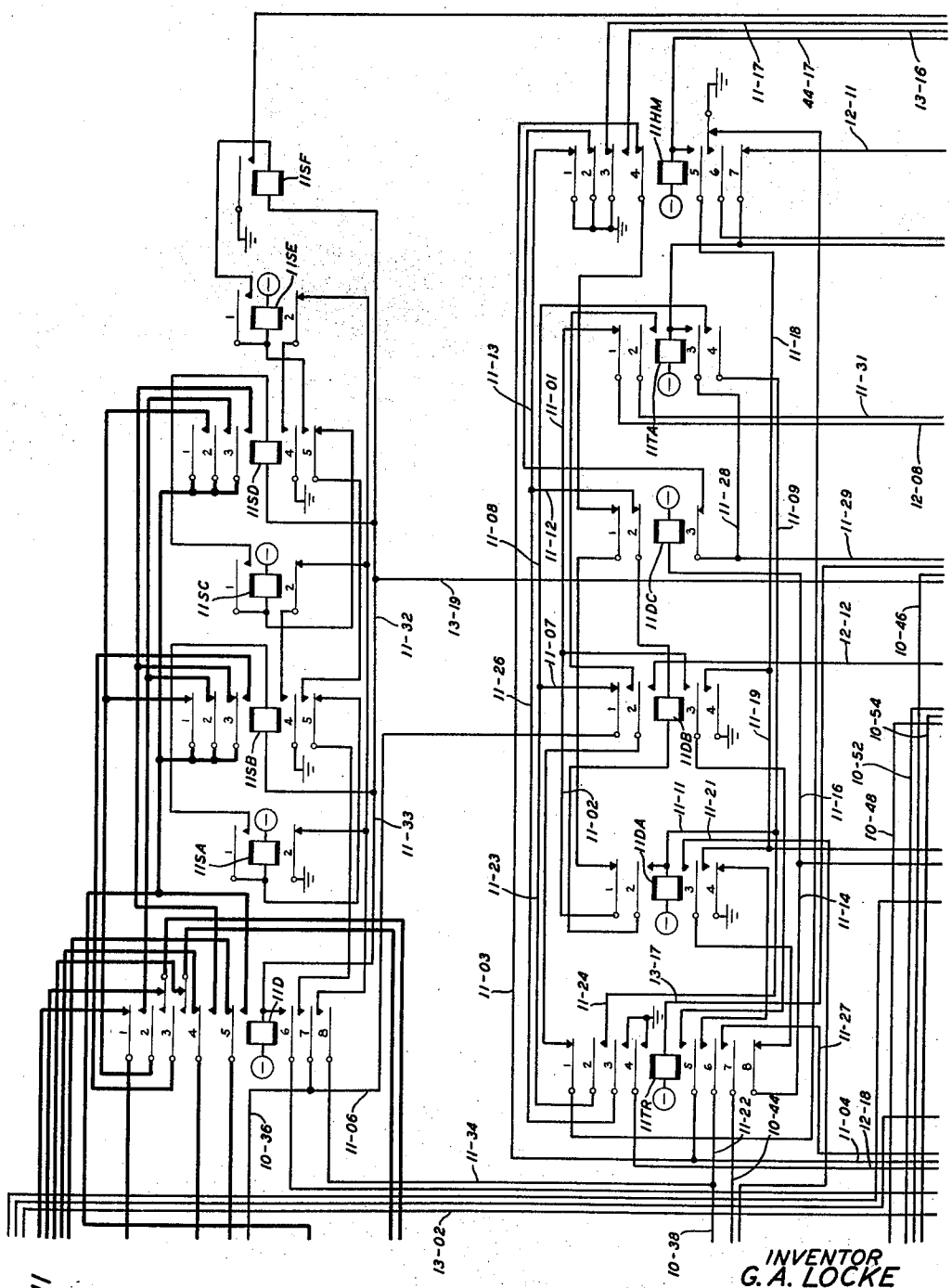

FIG. 11

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 12

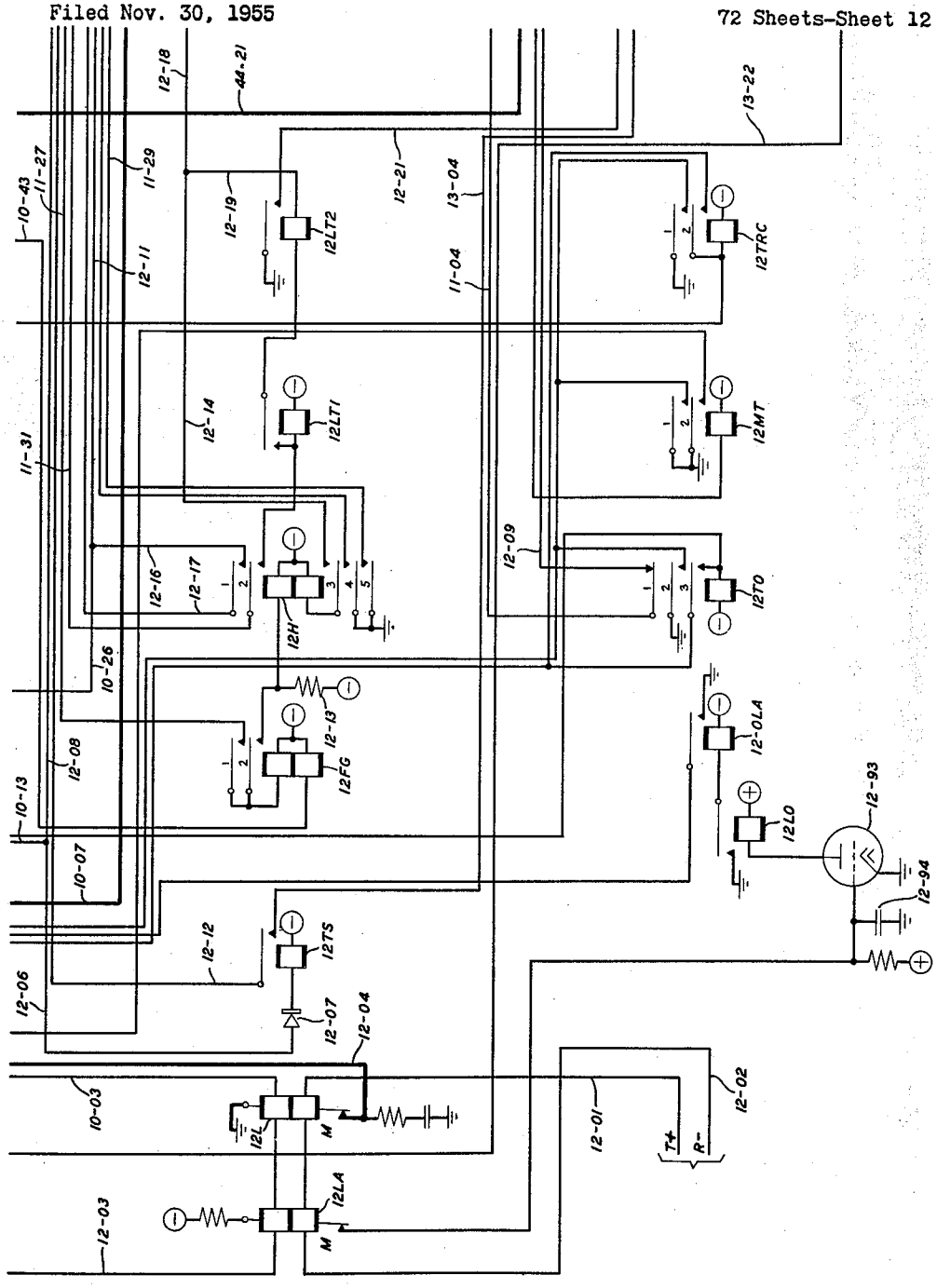

FIG. 12

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 13

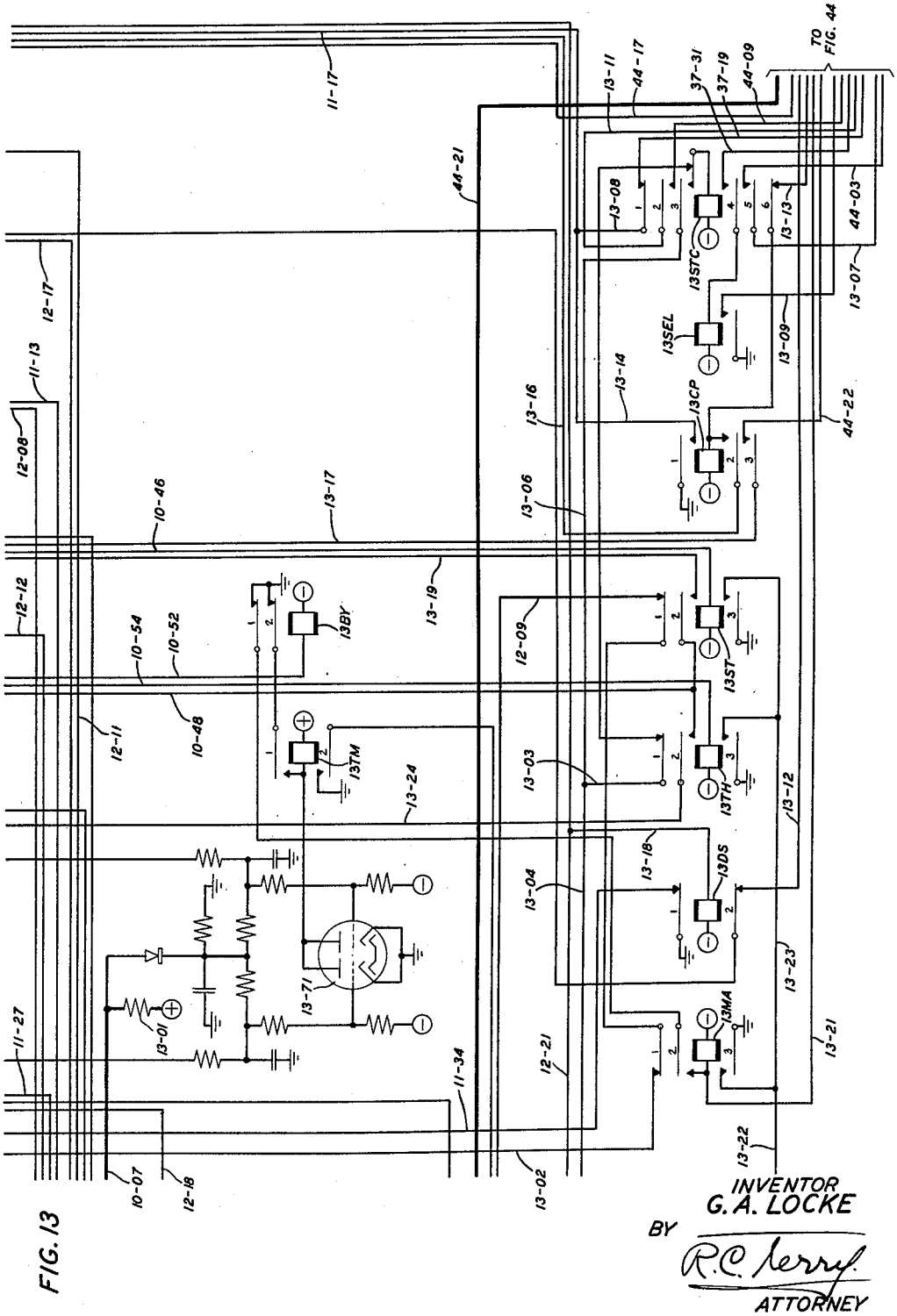

FIG. 13

INVENTOR
G. A. LOCKE

BY R. C. Terry

ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 14

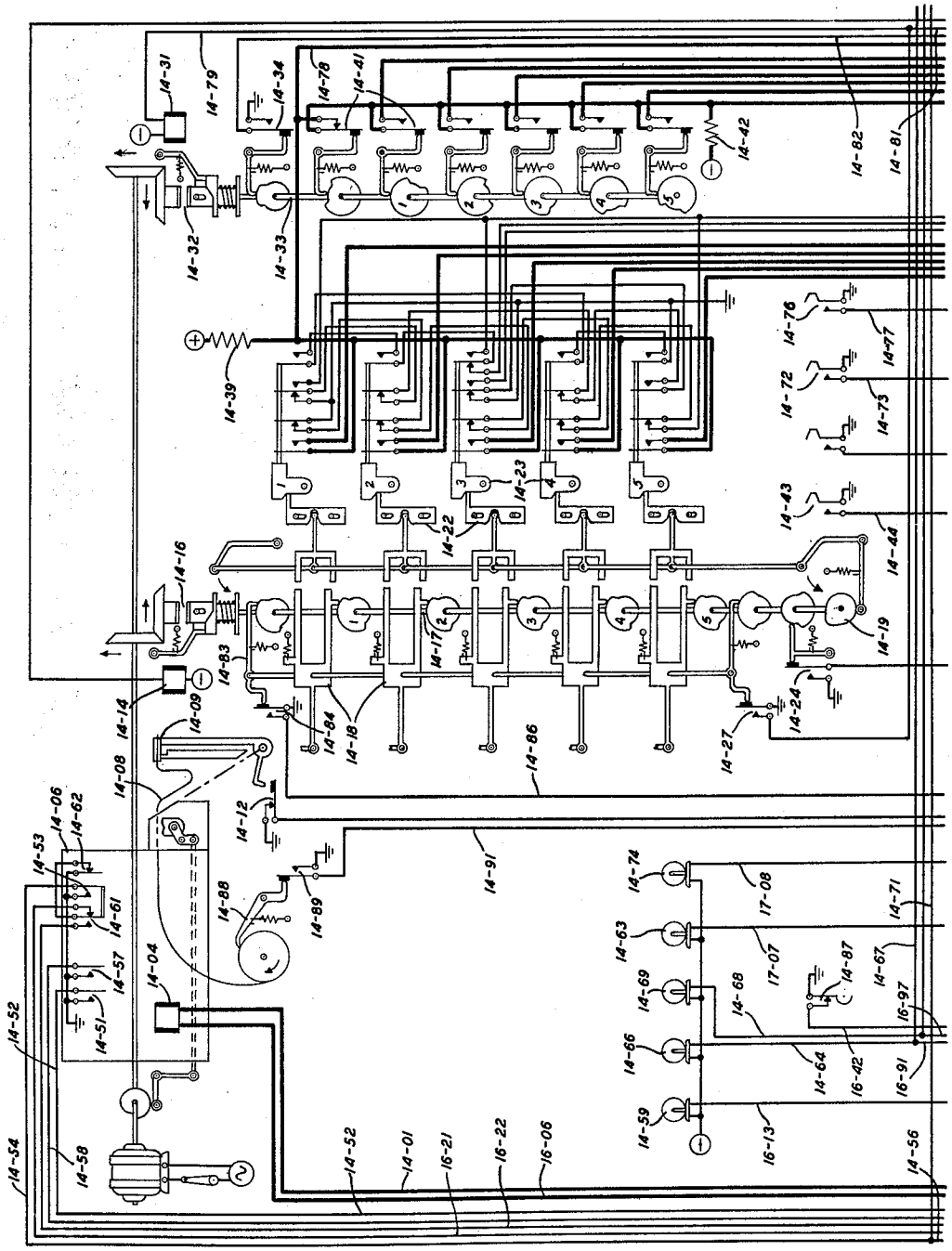

FIG. 14

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 15

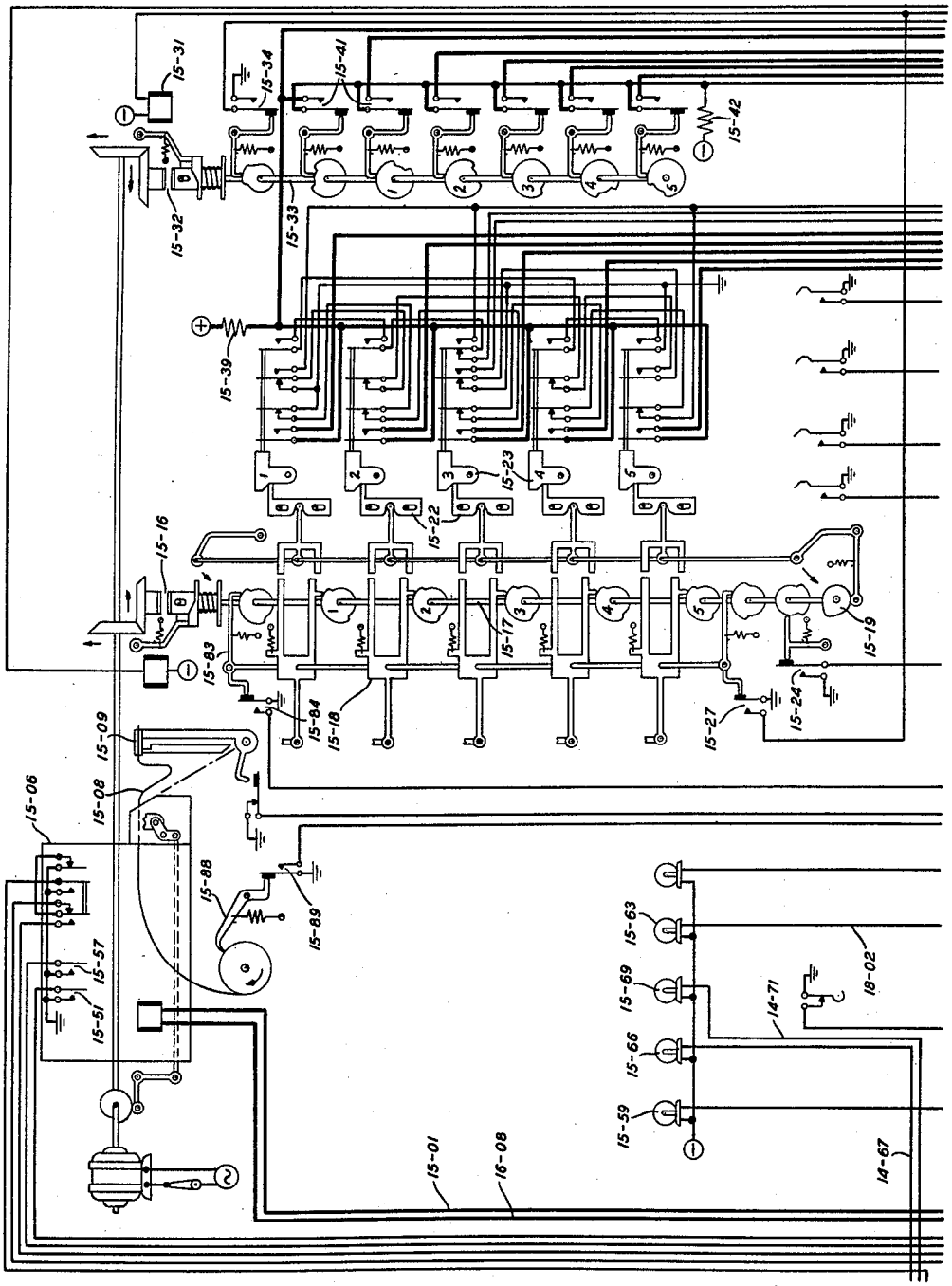

FIG. 15

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 16

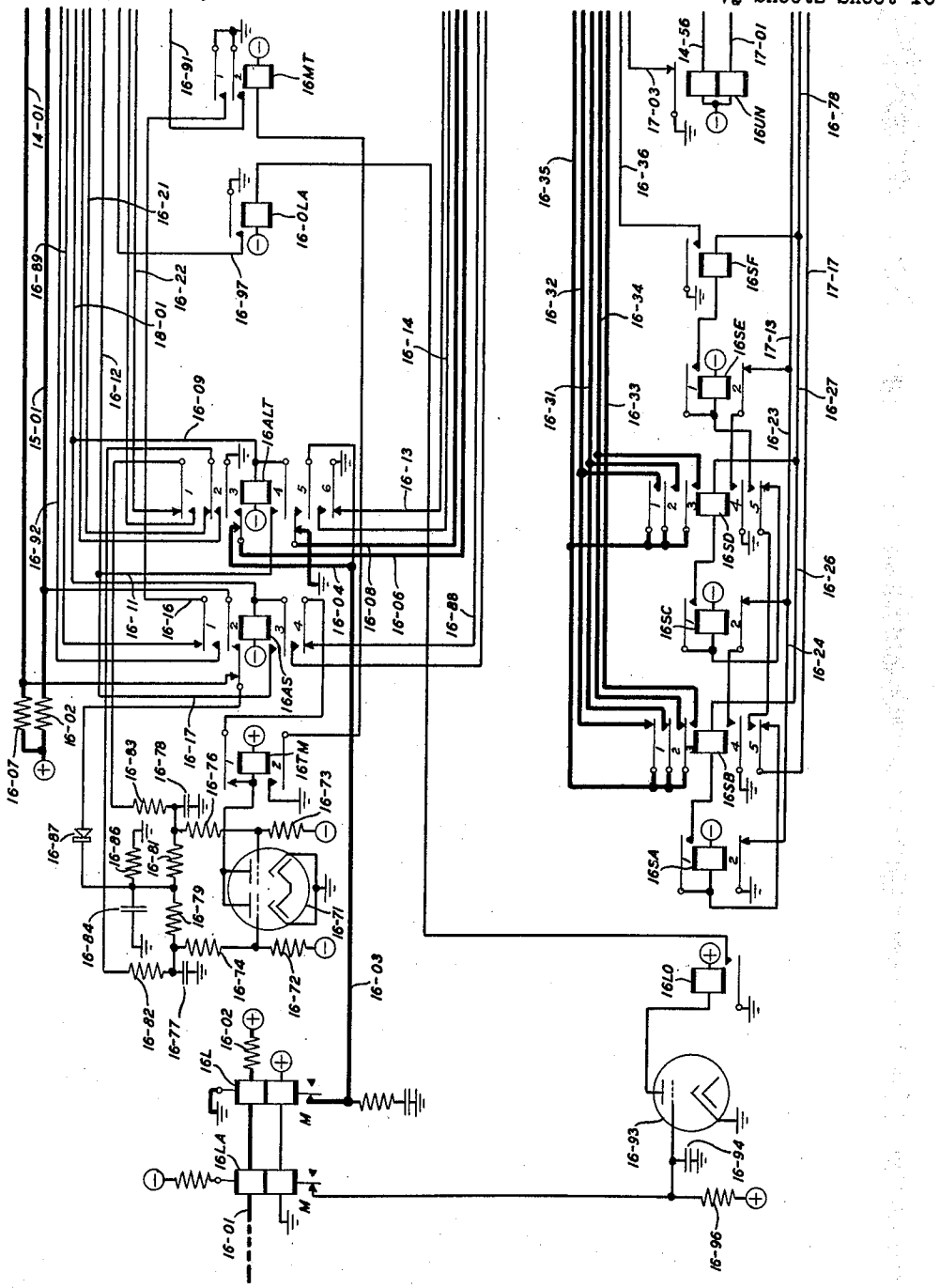

FIG. 16

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 17

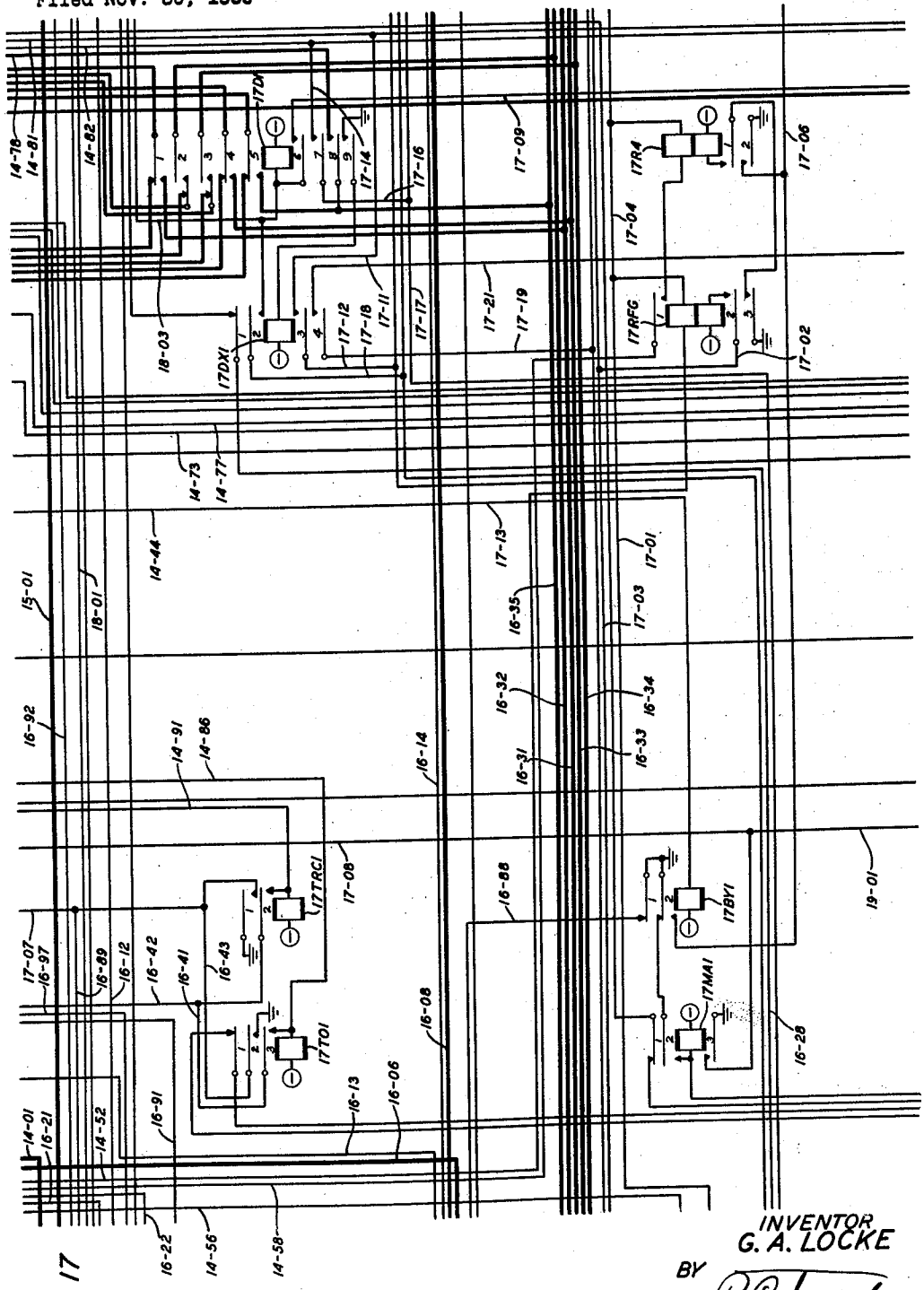

FIG. 17

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 18

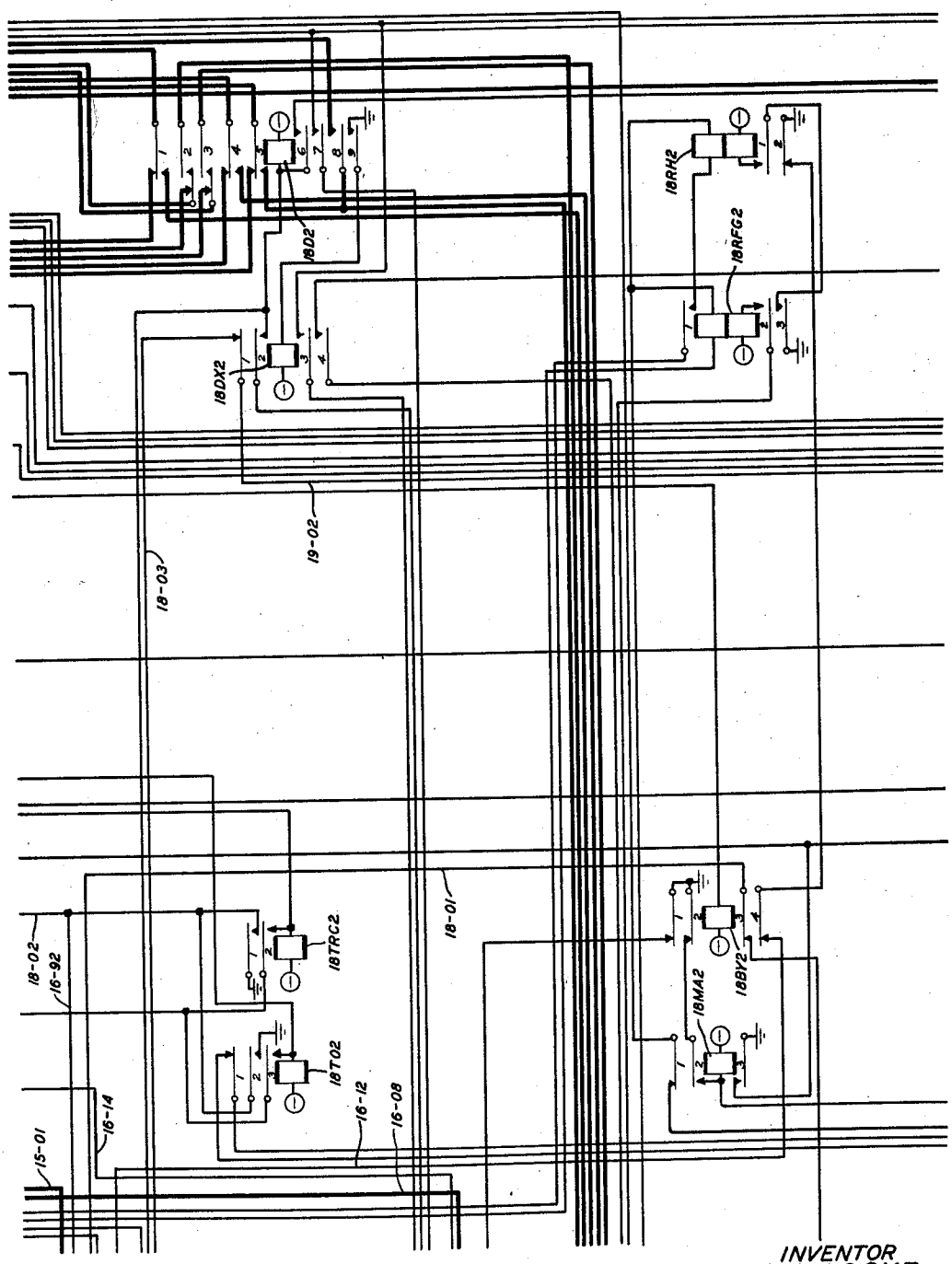

FIG. 18

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 19

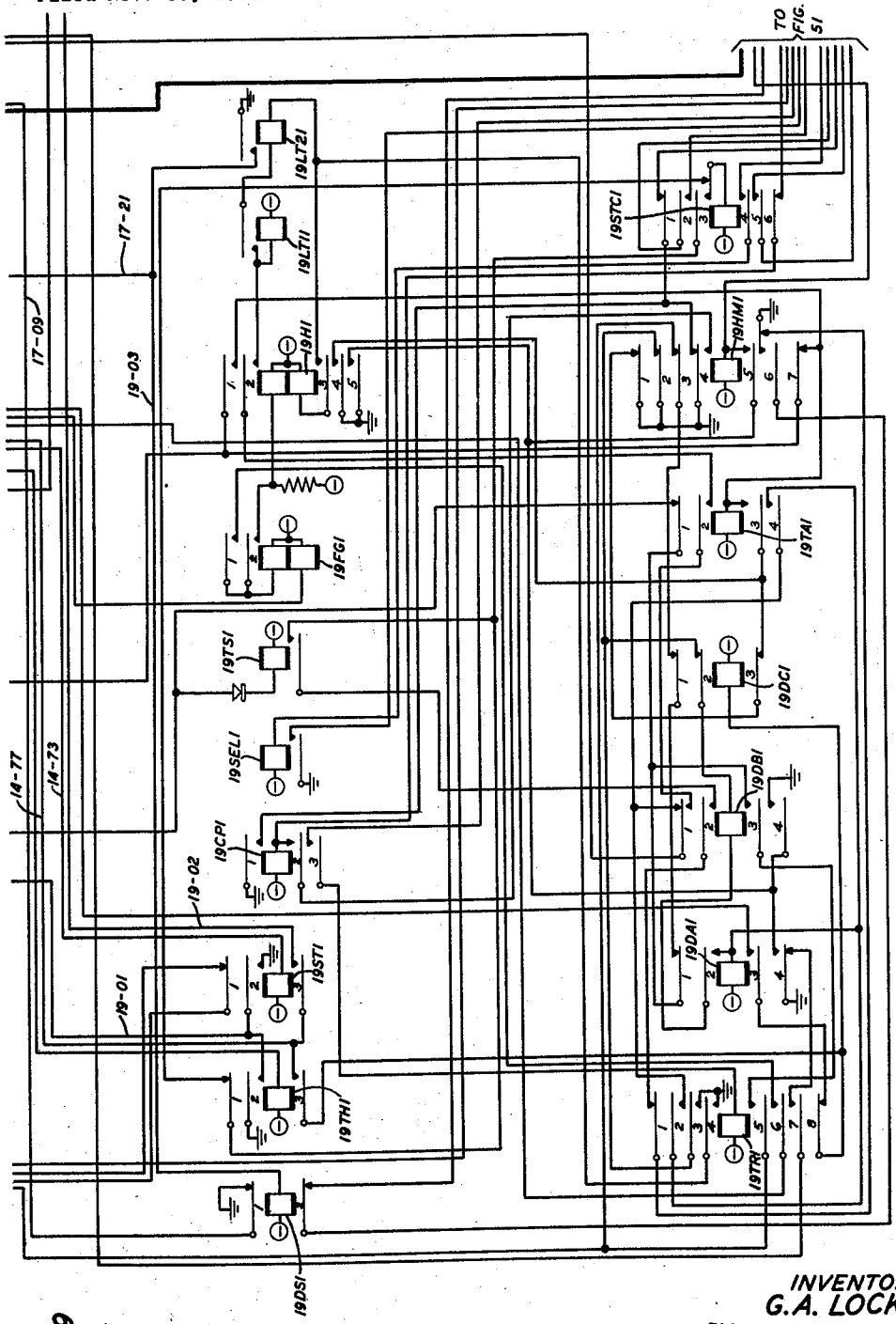

FIG. 19

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 20

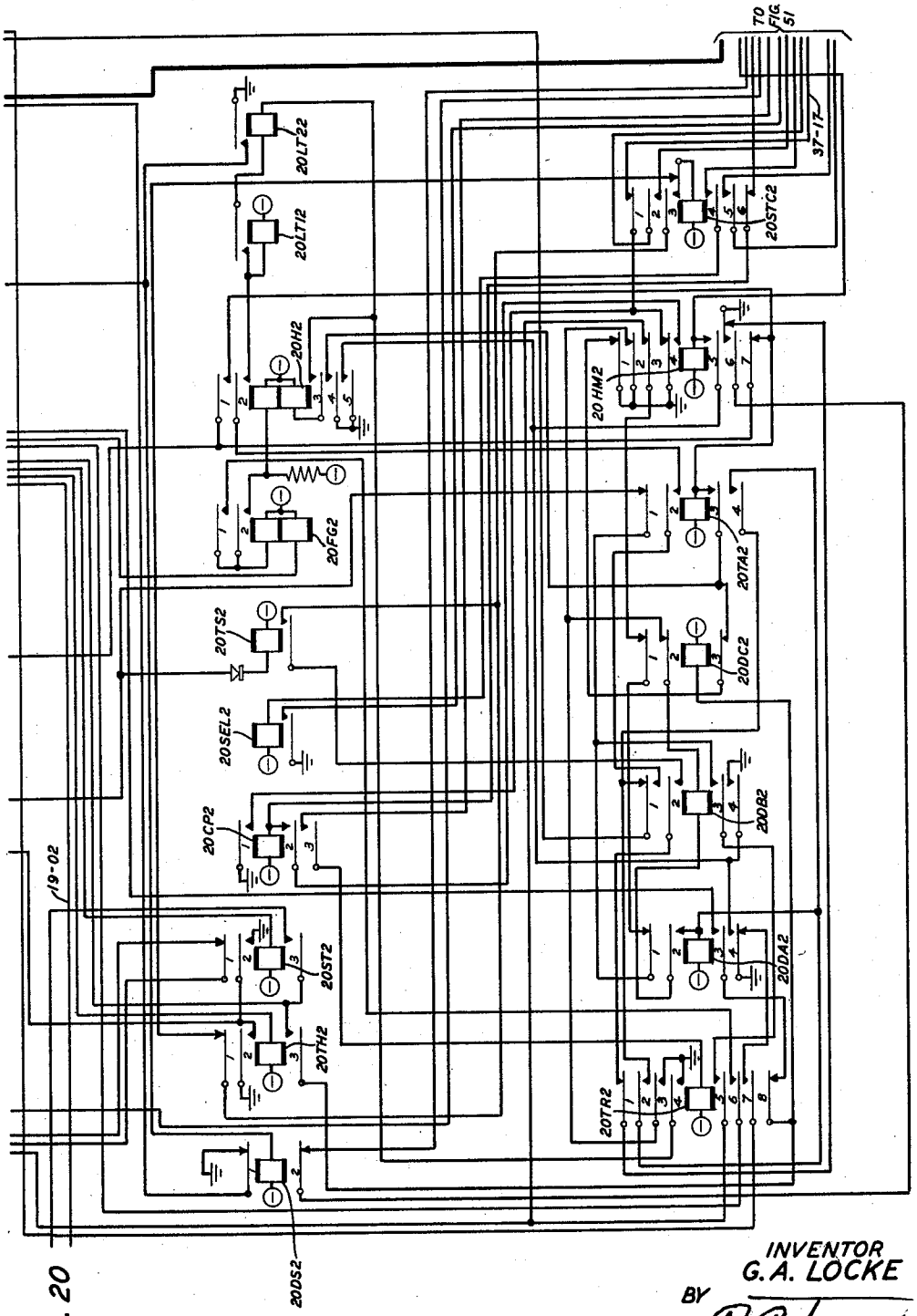

FIG. 20

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 21

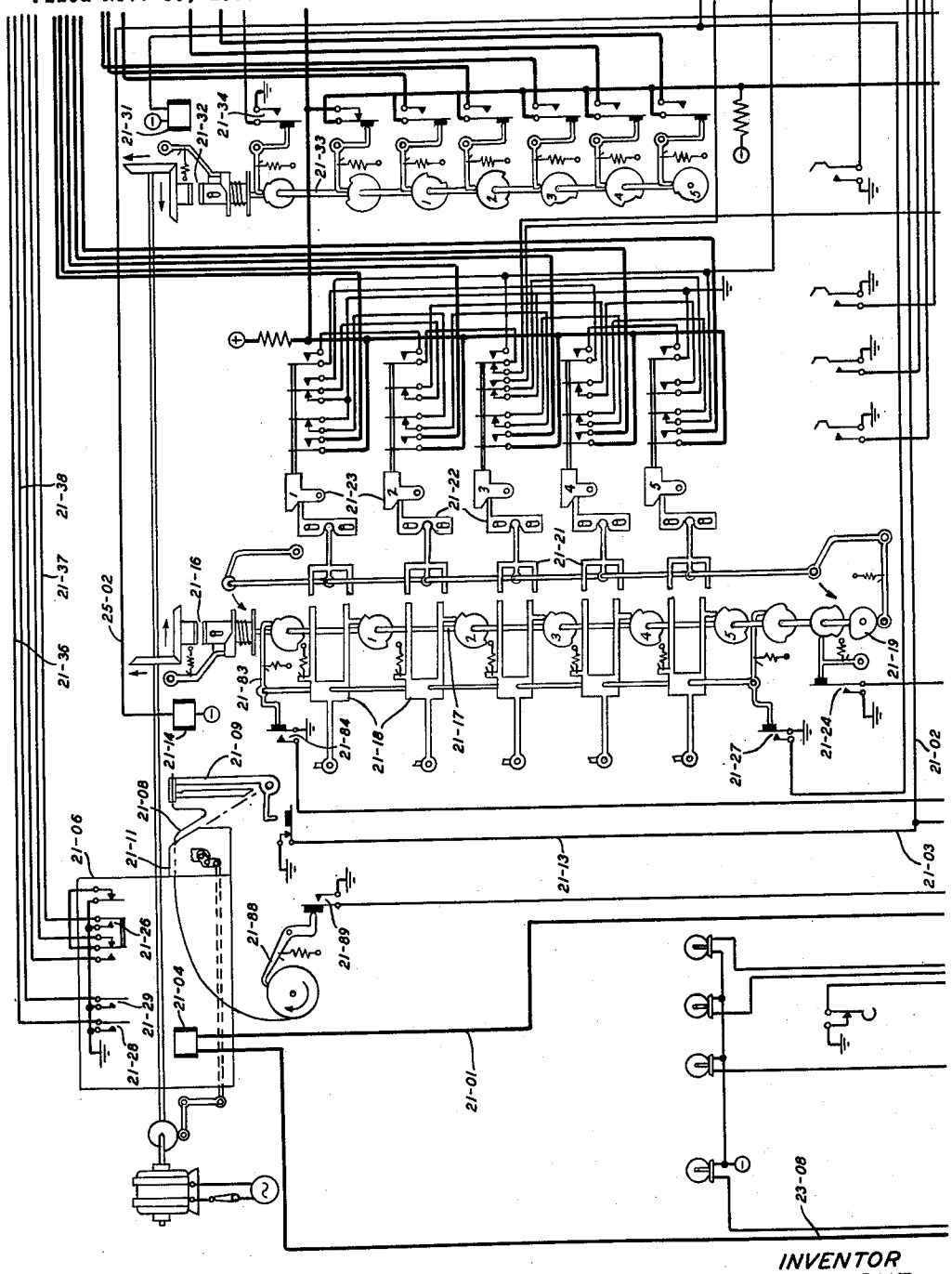

FIG. 21

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 22

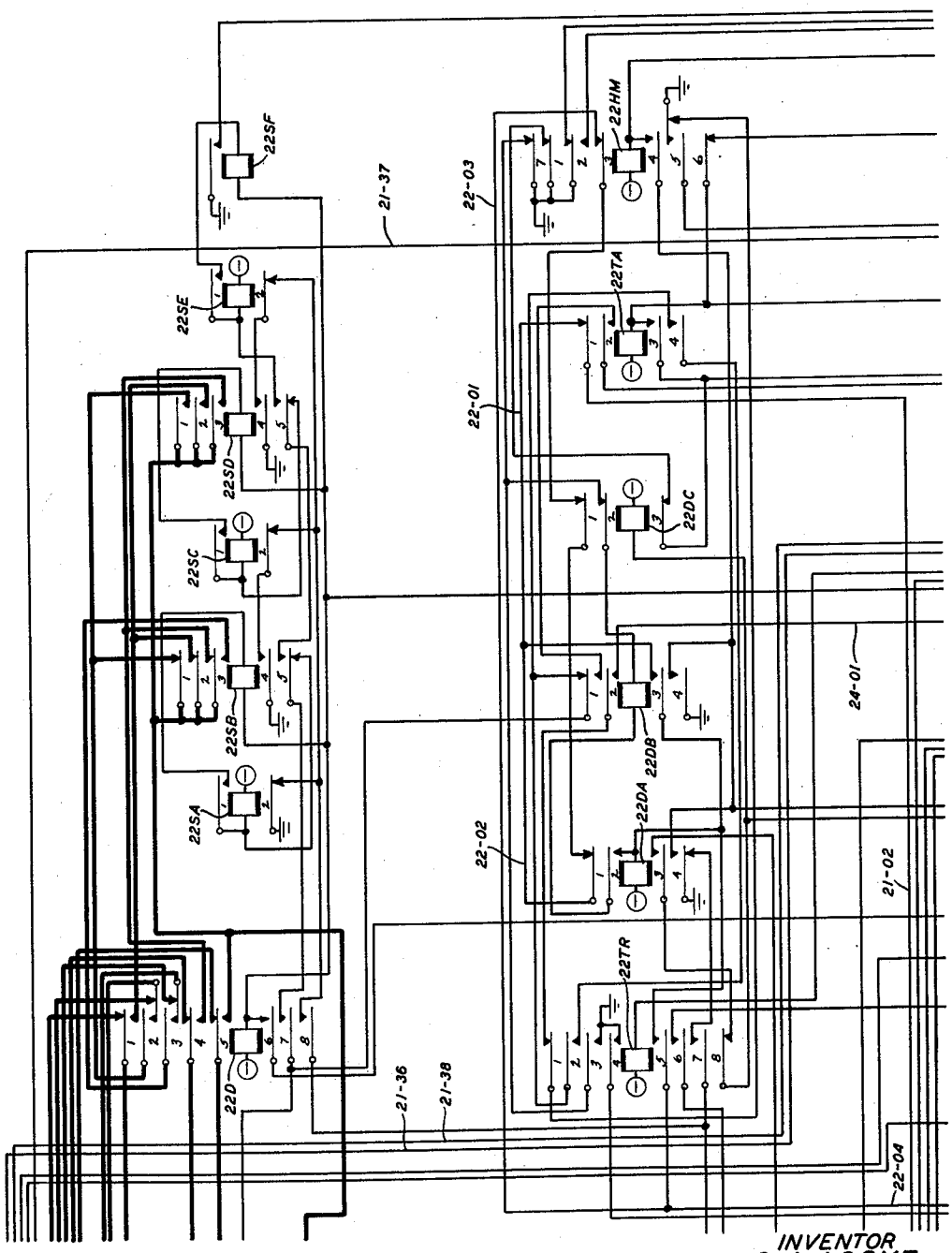

FIG. 22

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 23

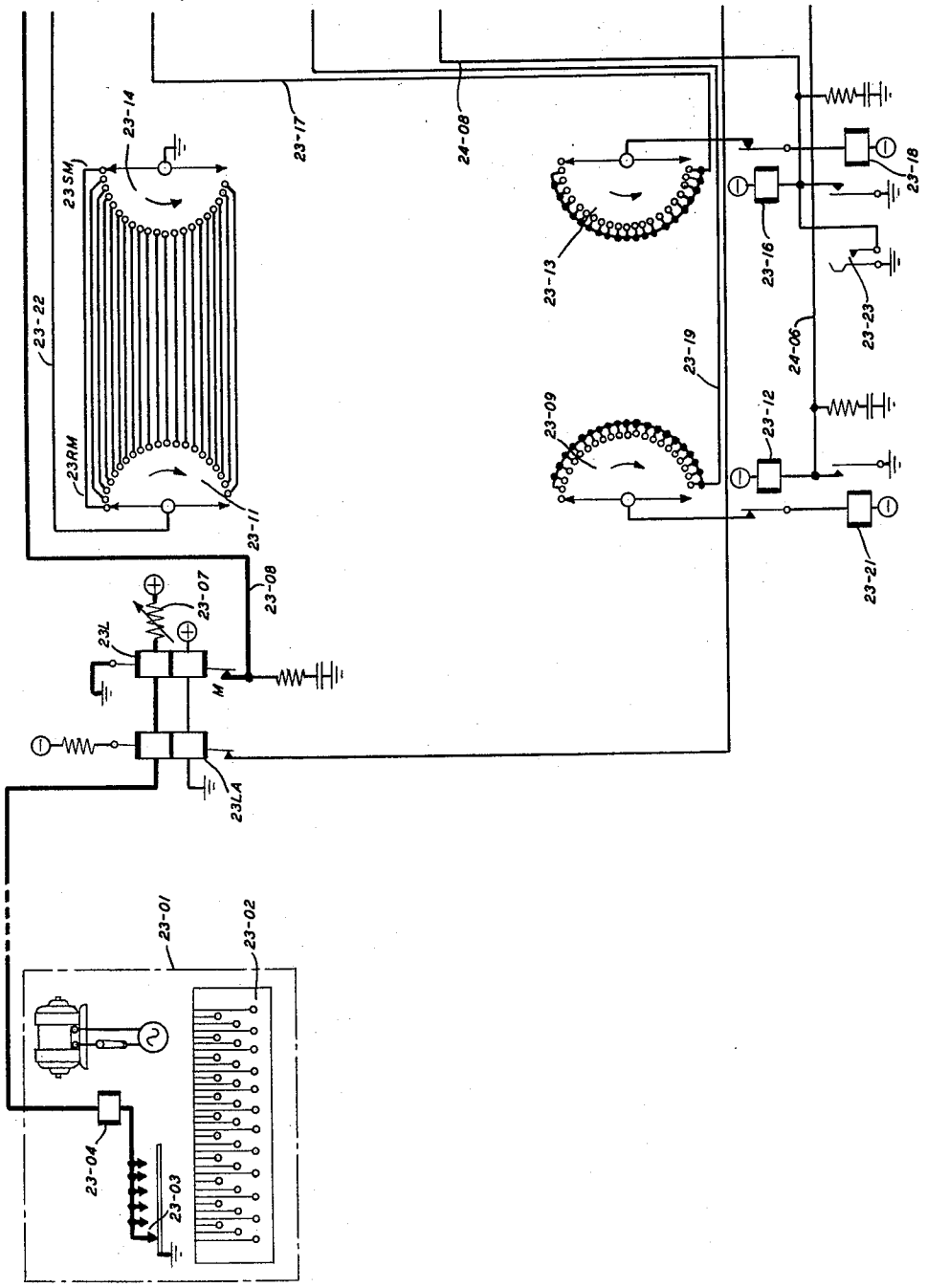

FIG. 23

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 24

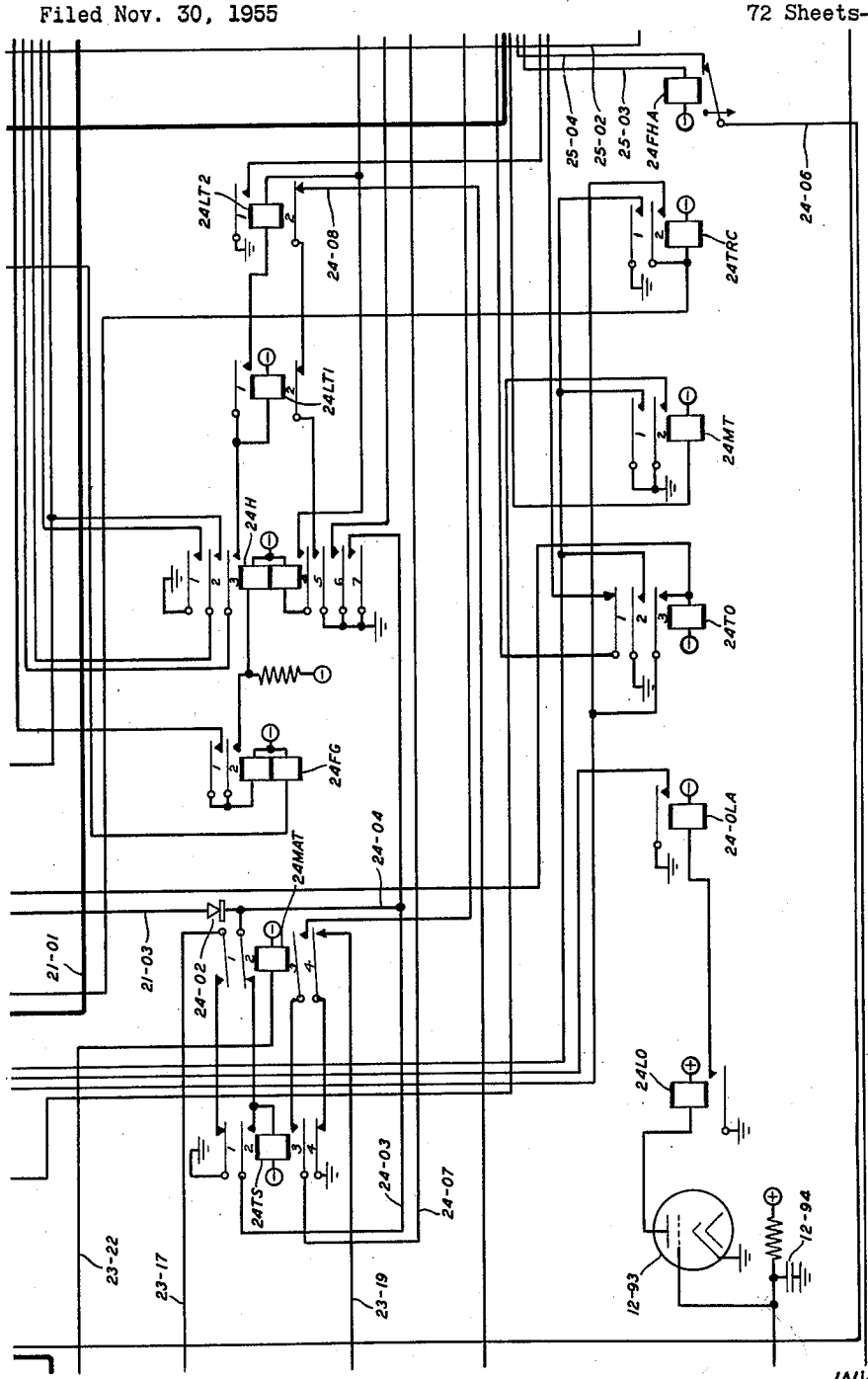

FIG. 24

INVENTOR
G. A. LOCKE

BY

R. C. Terry

ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 25

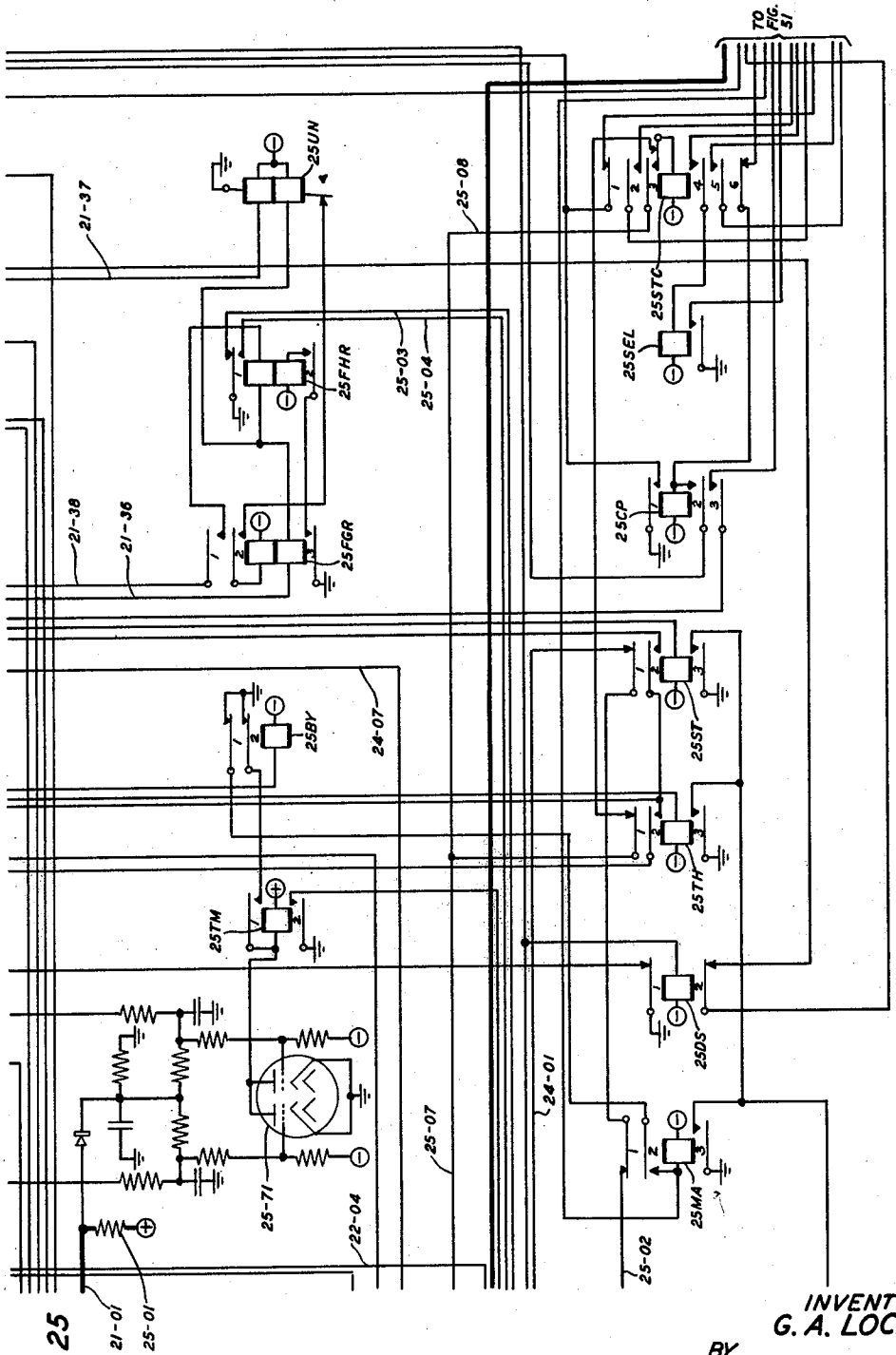

FIG. 25

INVENTOR
G. A. LOCKE
BY
R. C. Leroy
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 26

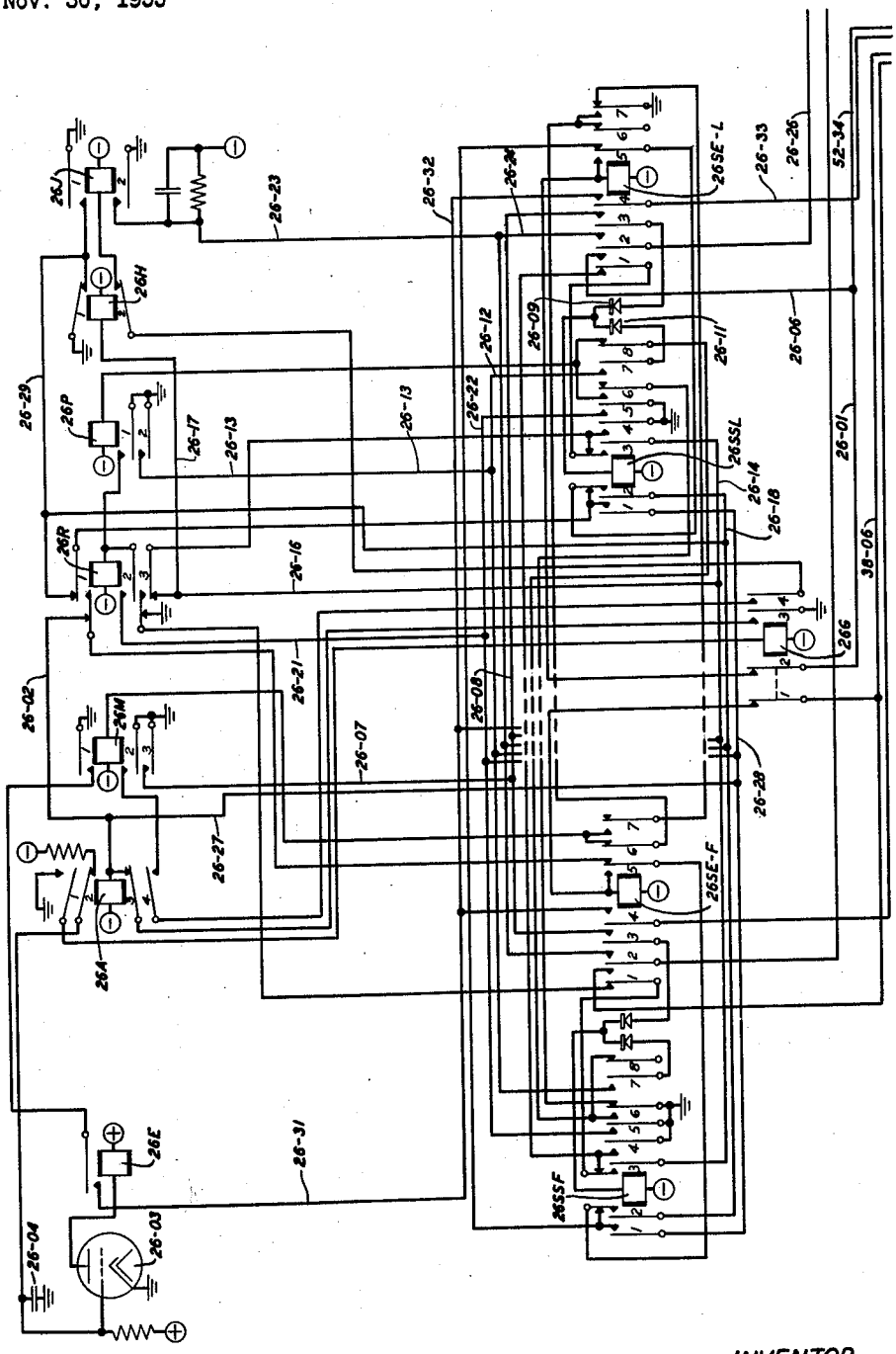

FIG. 26

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 27

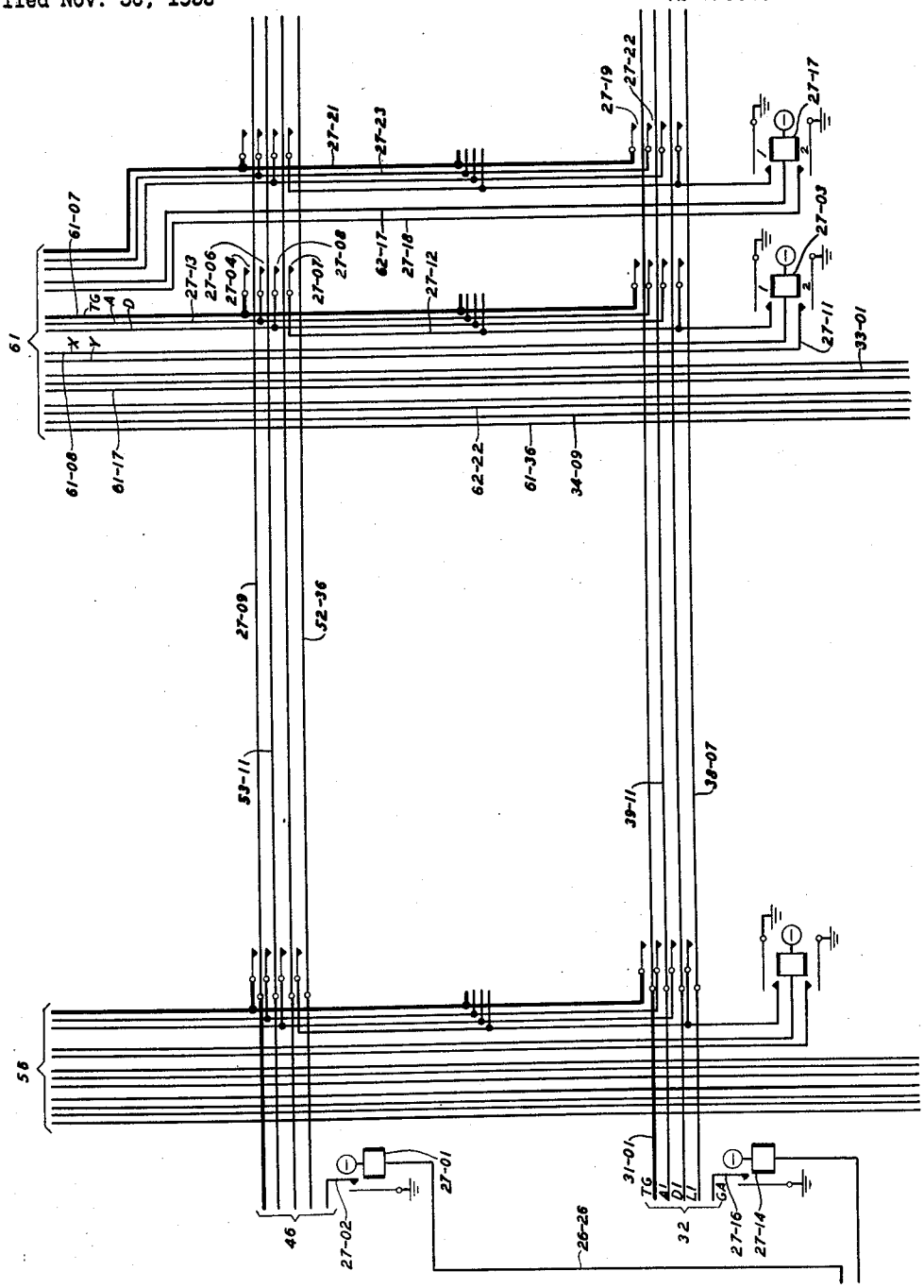

FIG. 27

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 28

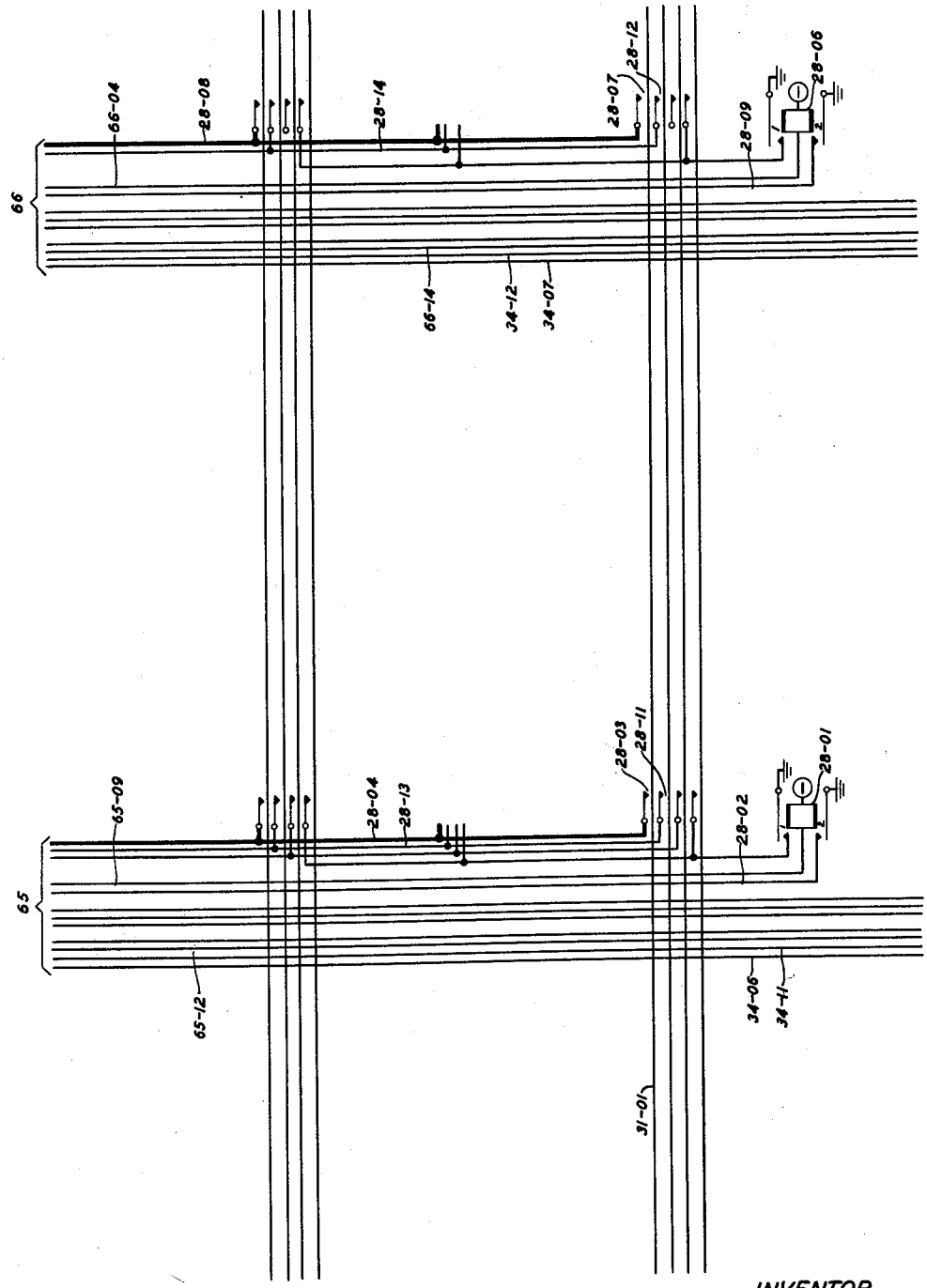

FIG. 28

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 29

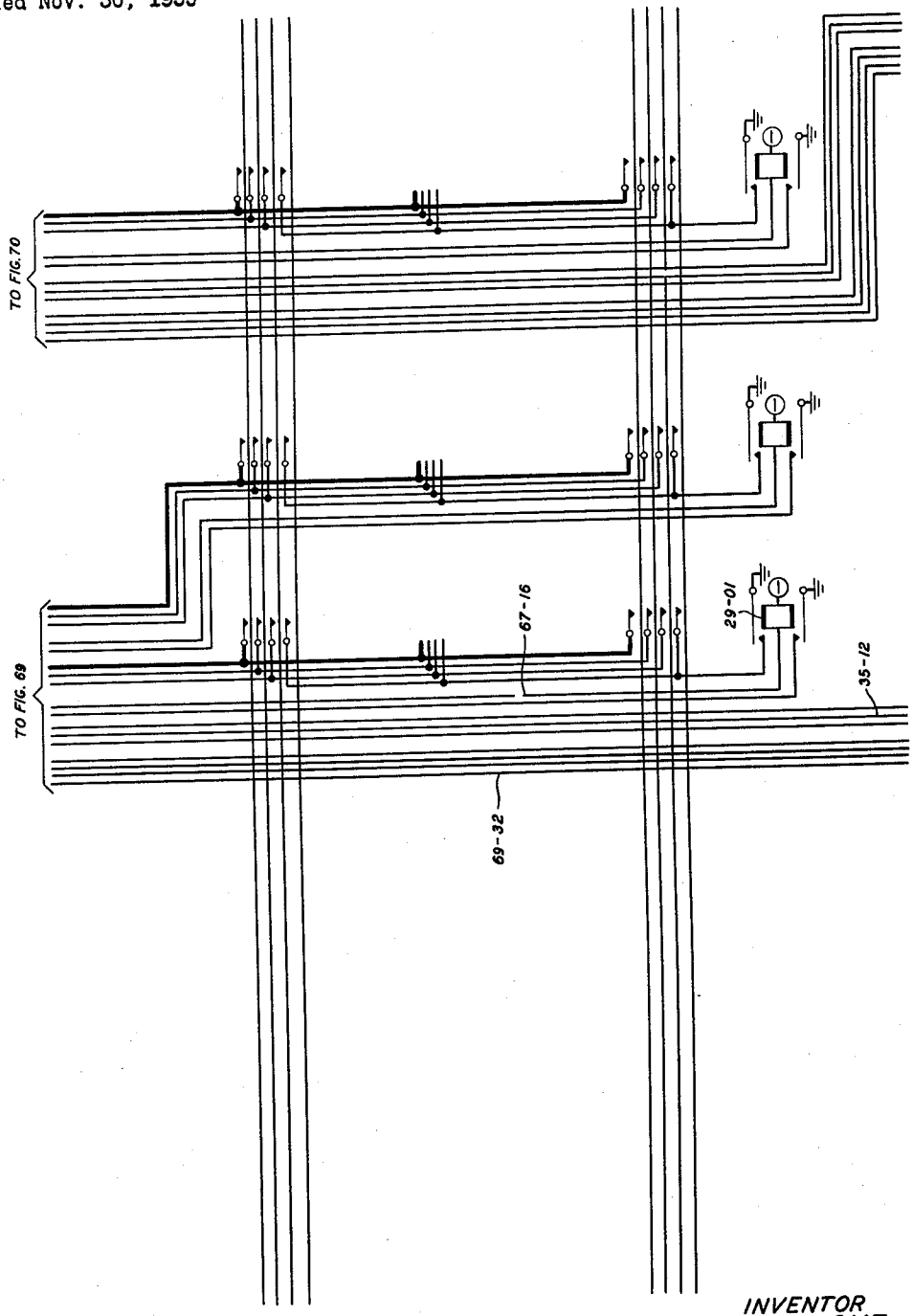

FIG. 29

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 30

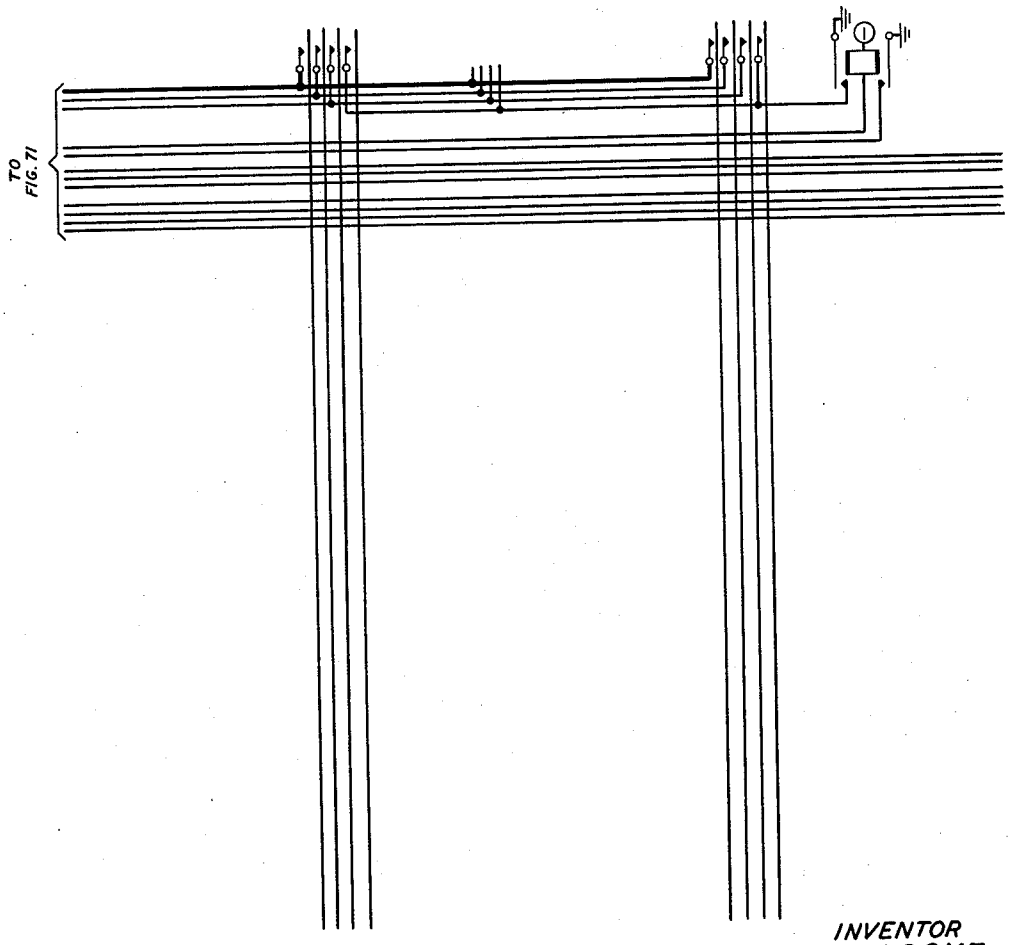

FIG. 30

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

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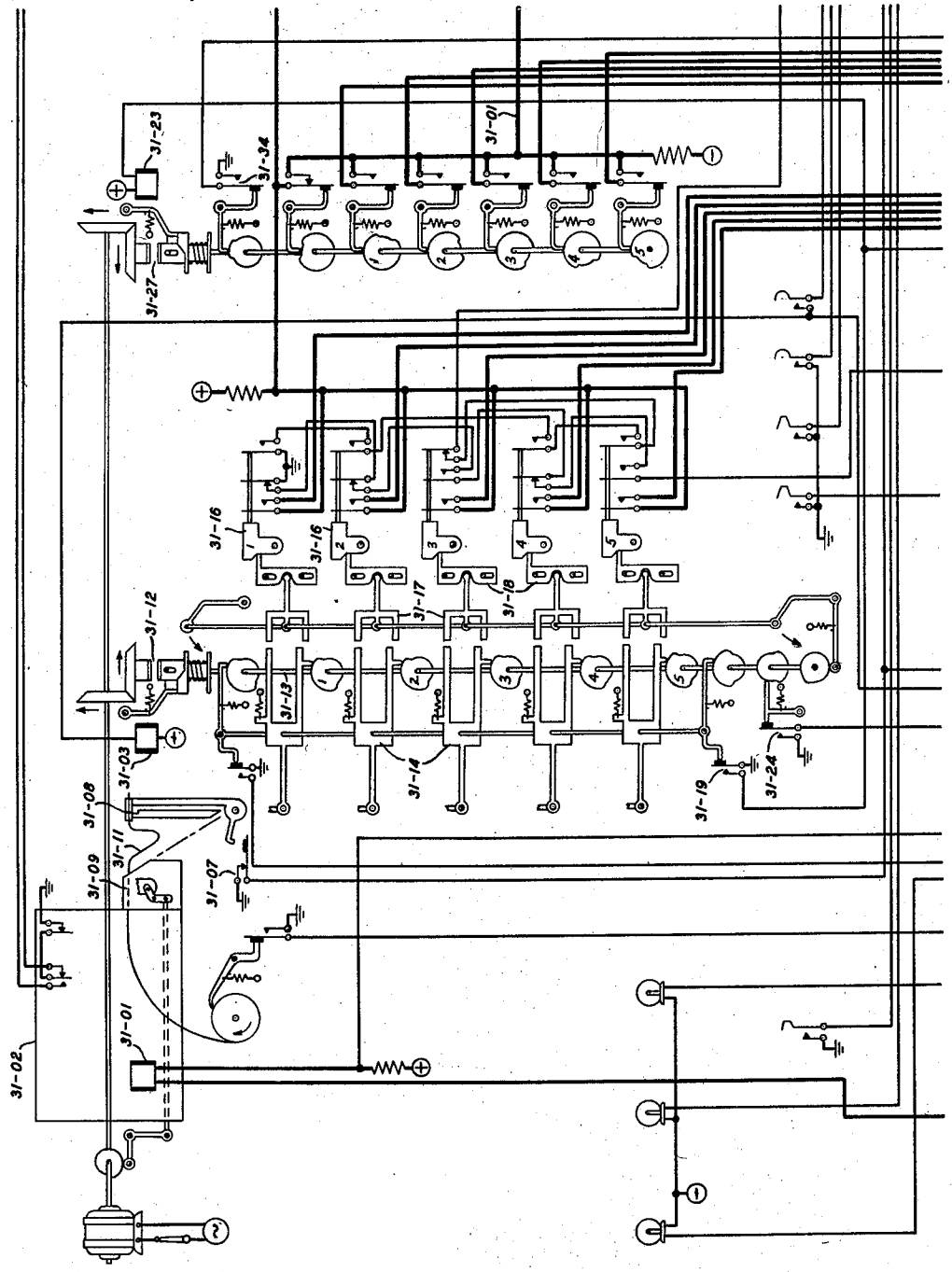


FIG. 31

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 32

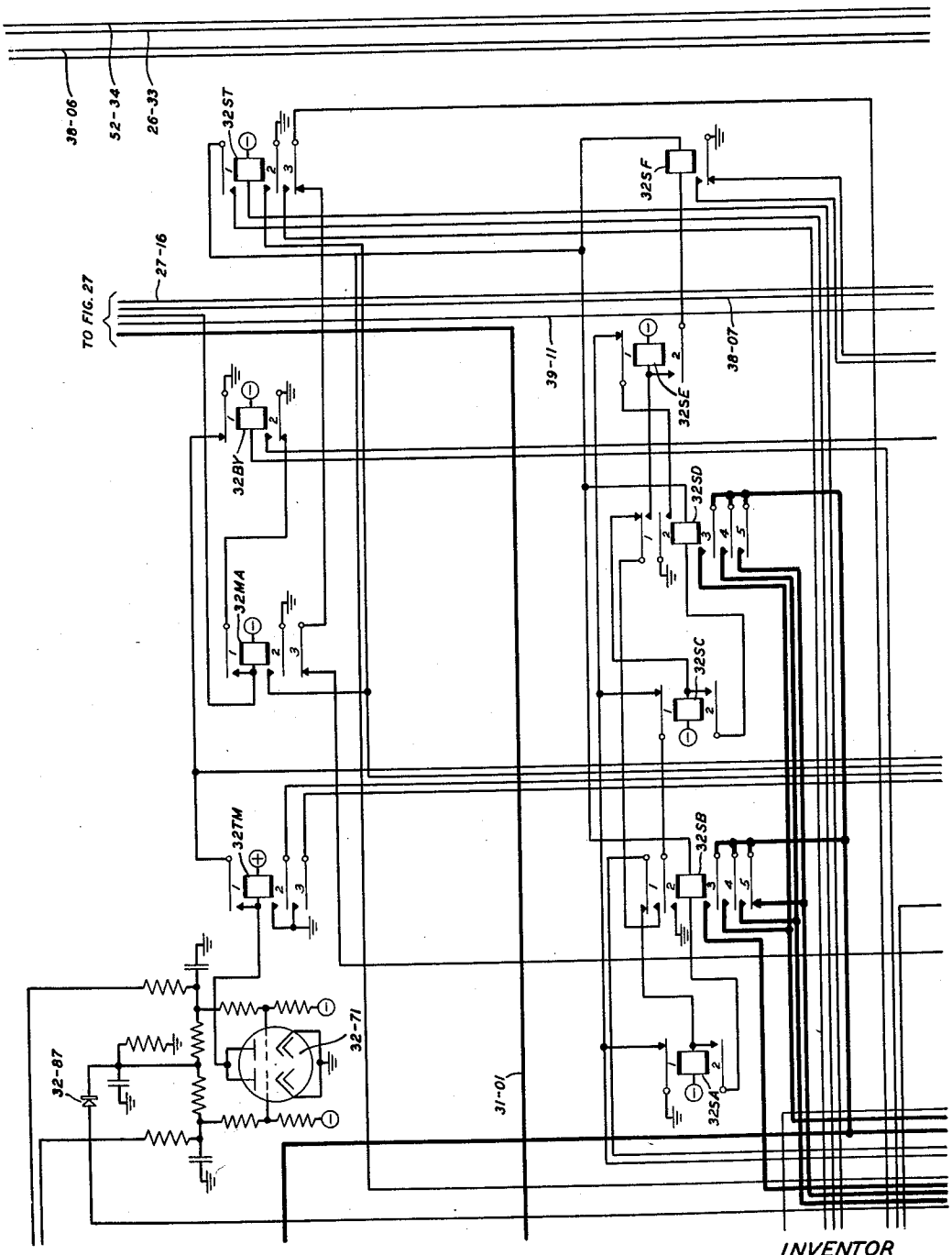


FIG. 32

INVENTOR
G. A. LOCKE
BY
R. C. Kerry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 33

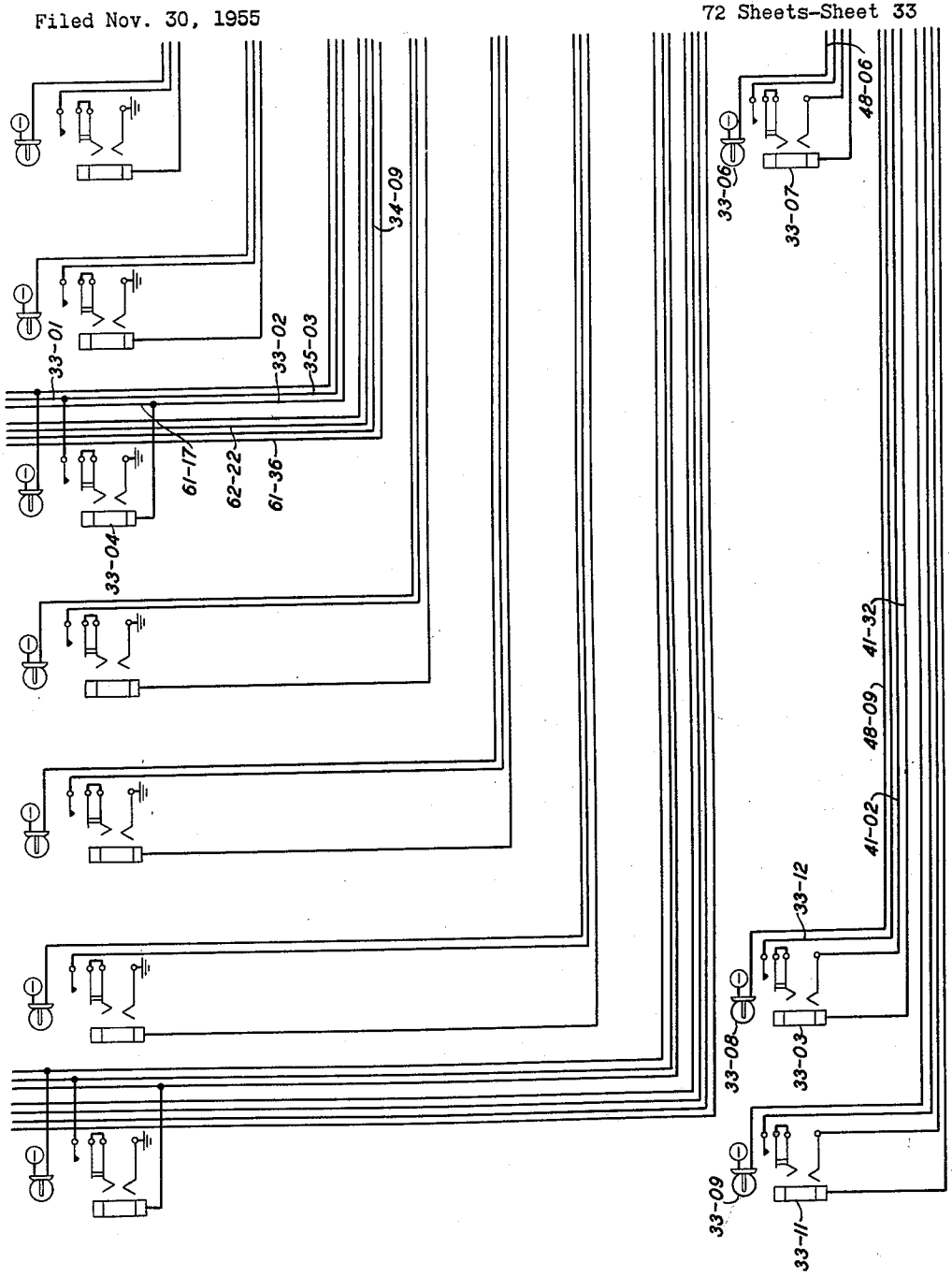


FIG. 33

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 34

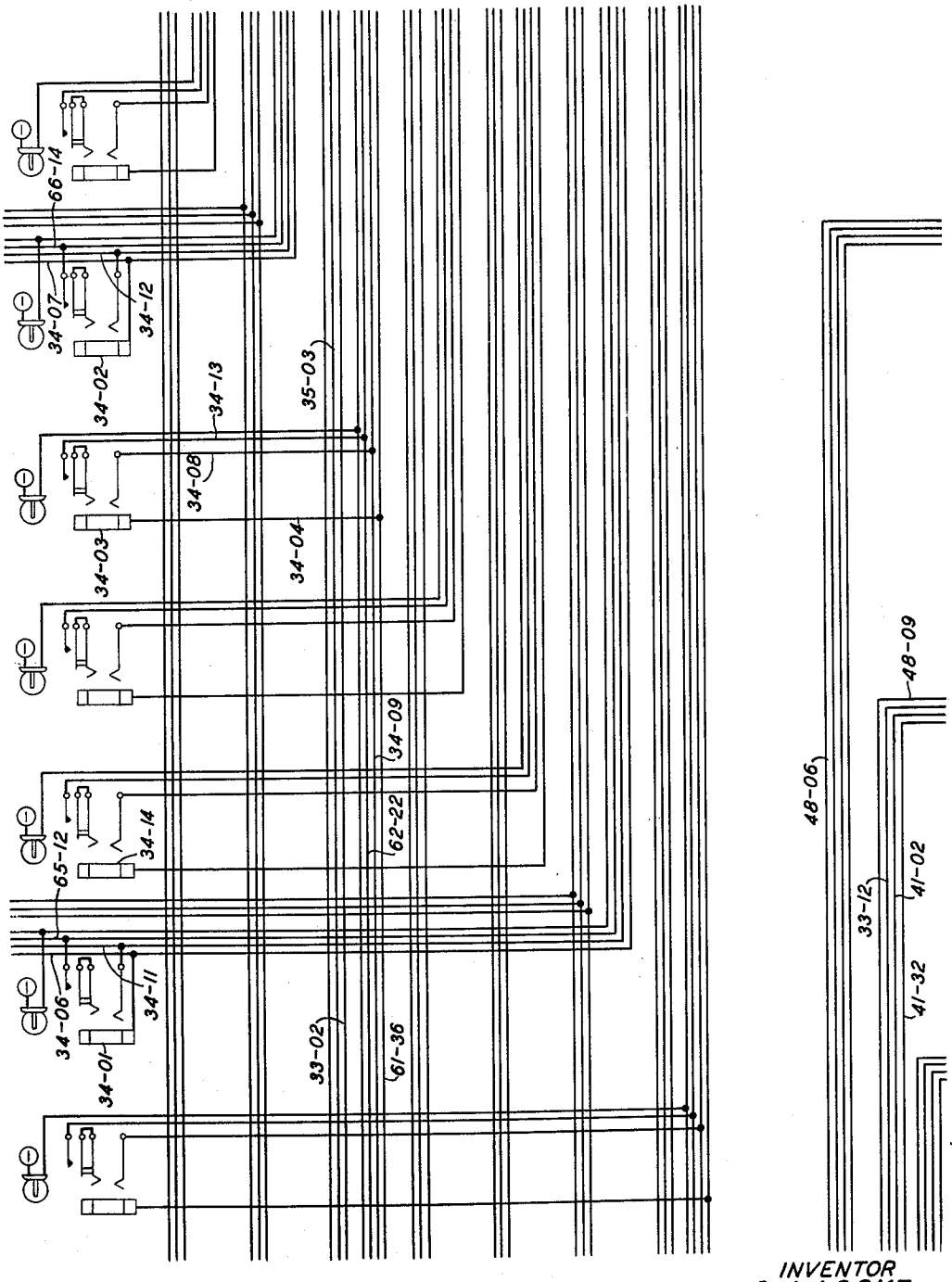


FIG. 34

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 35

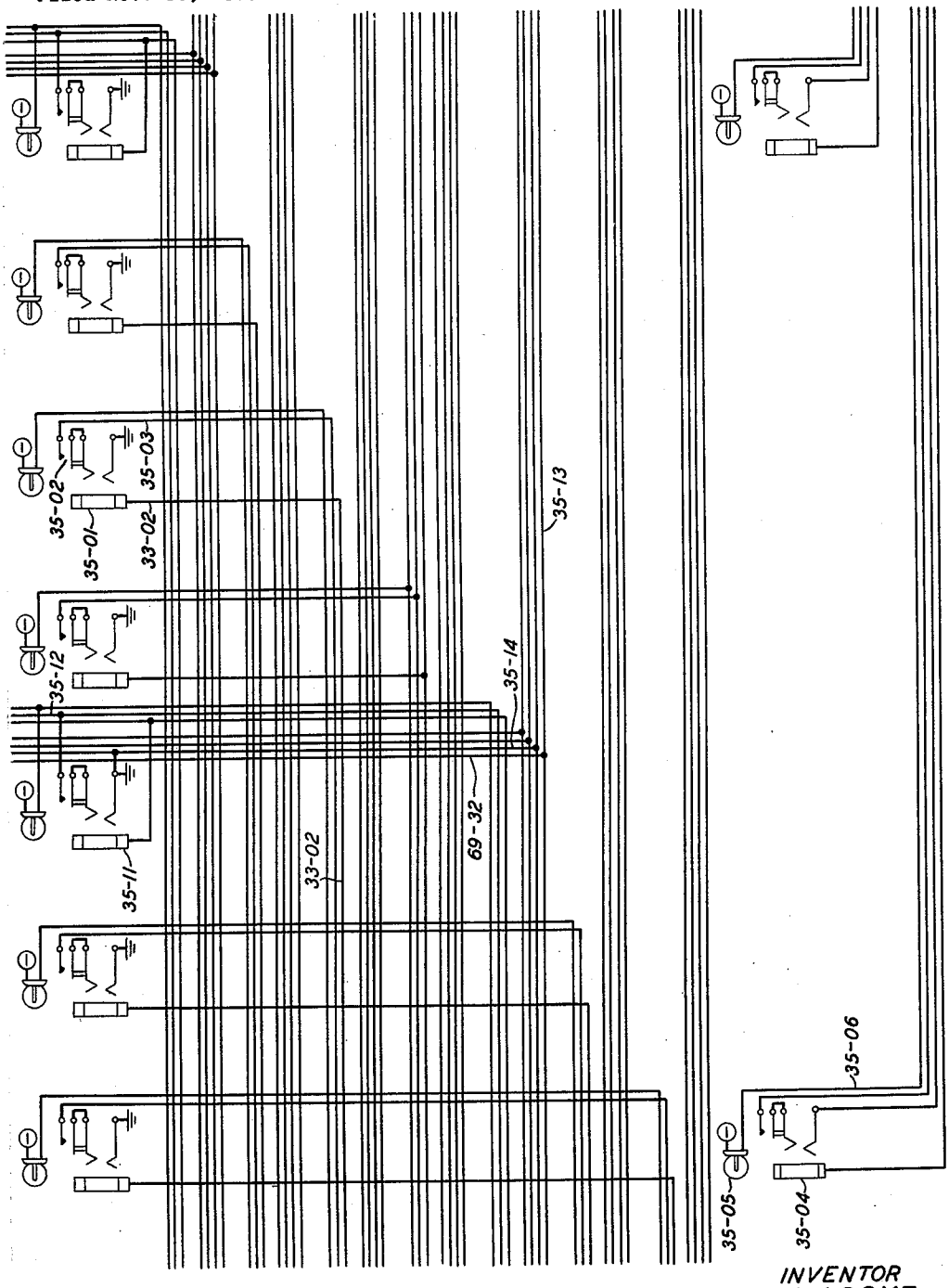


FIG. 35

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 36

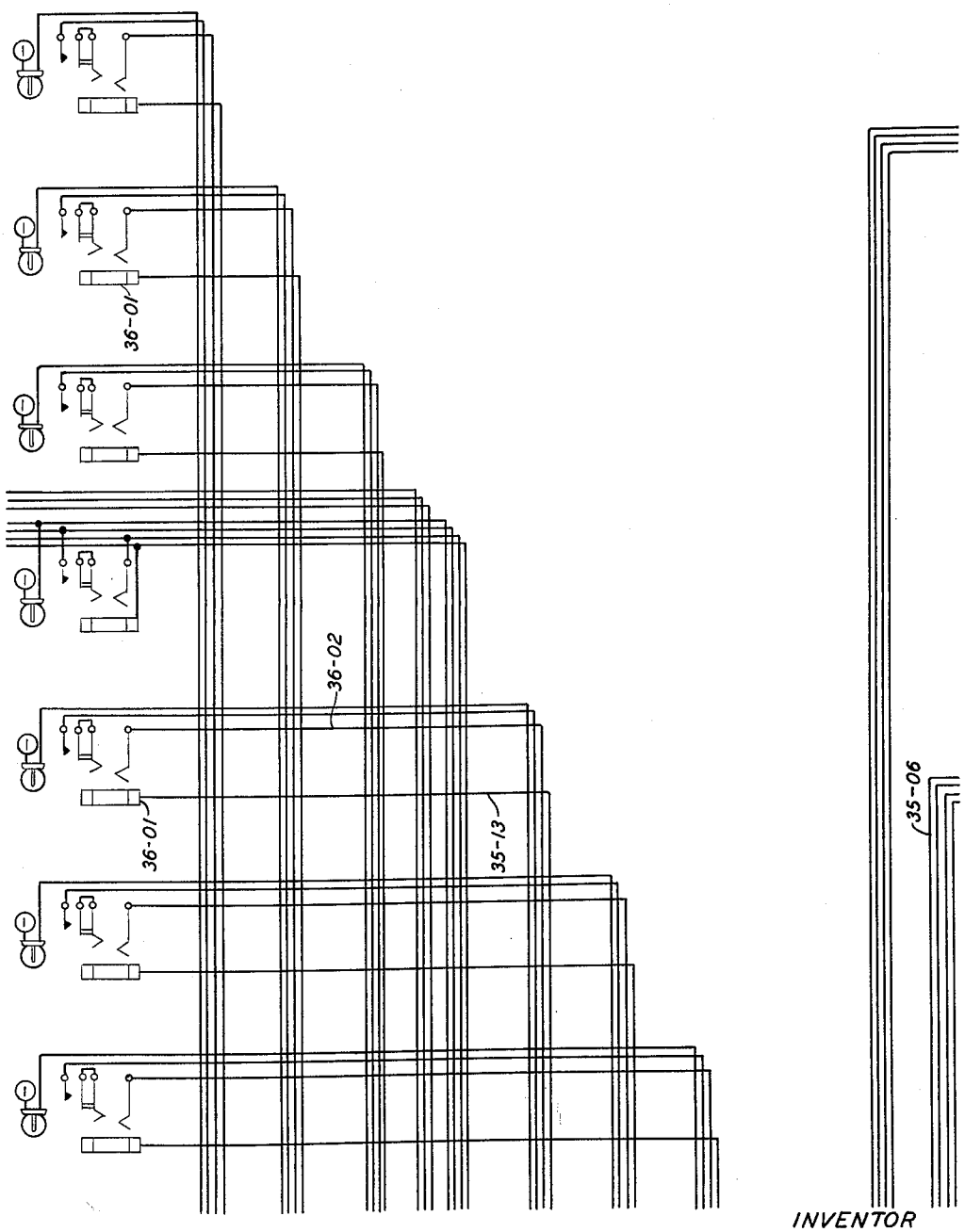


FIG. 36

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 37

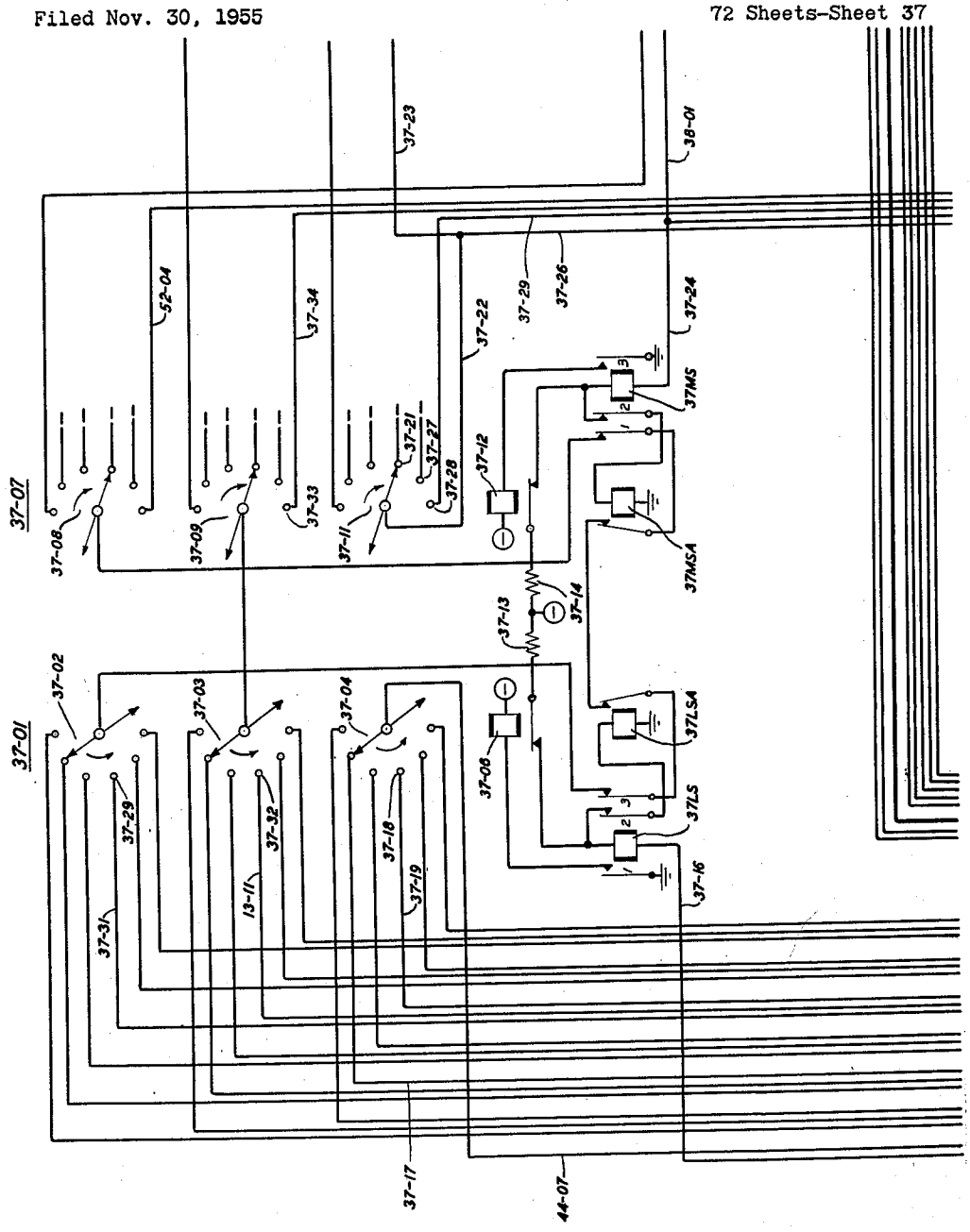


FIG. 37

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 38

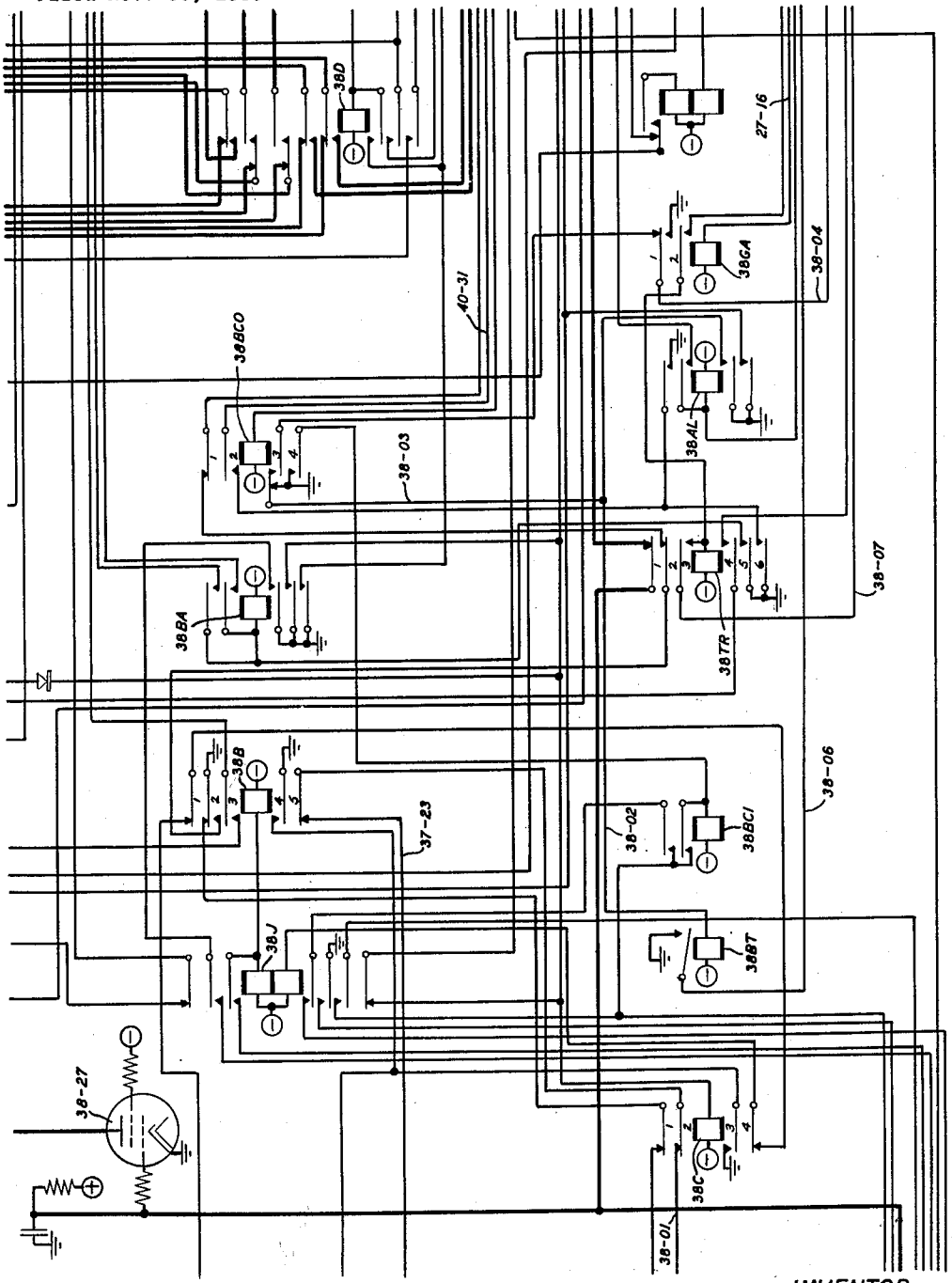


FIG. 38

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 39

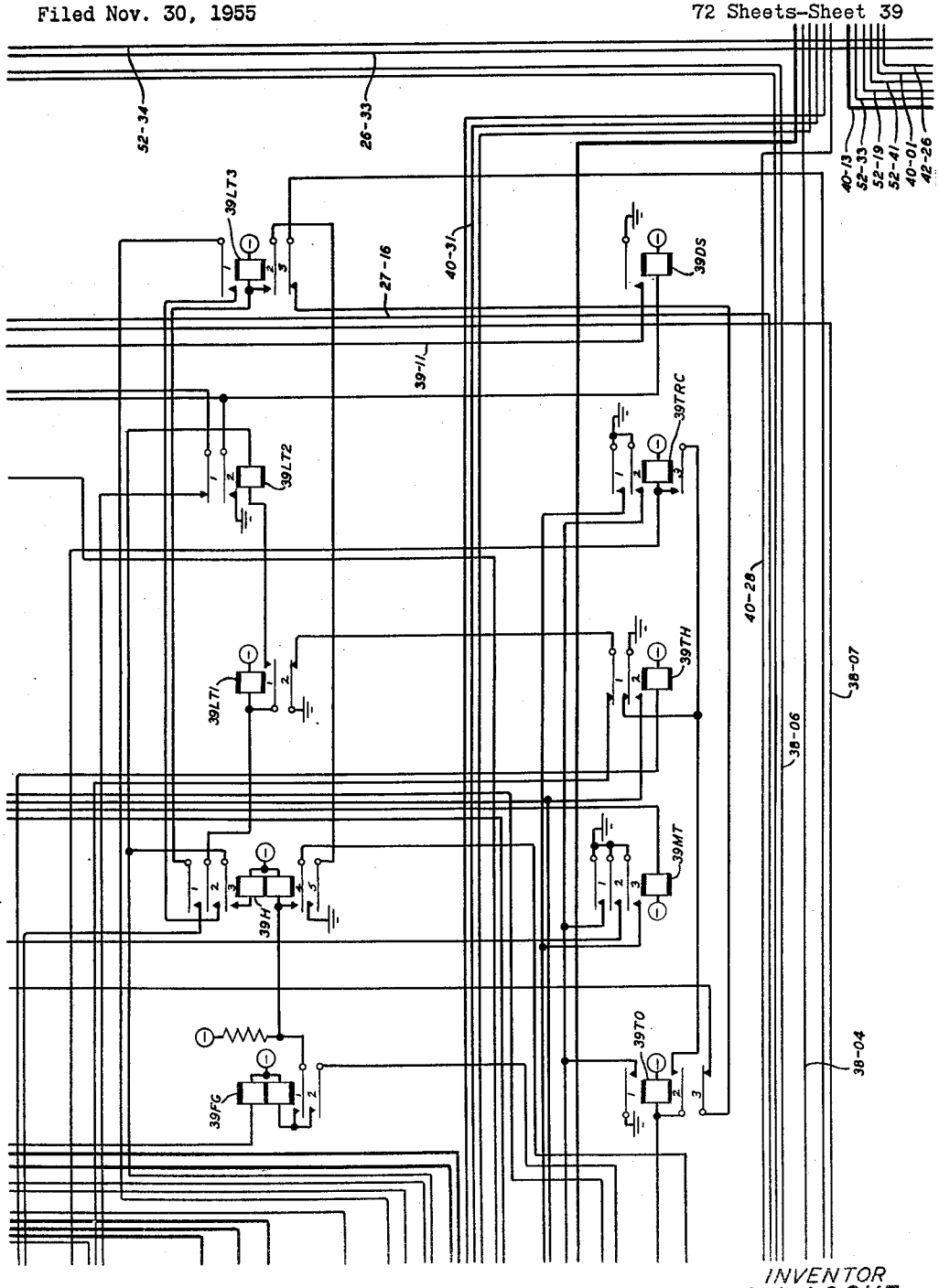


FIG. 39

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 40

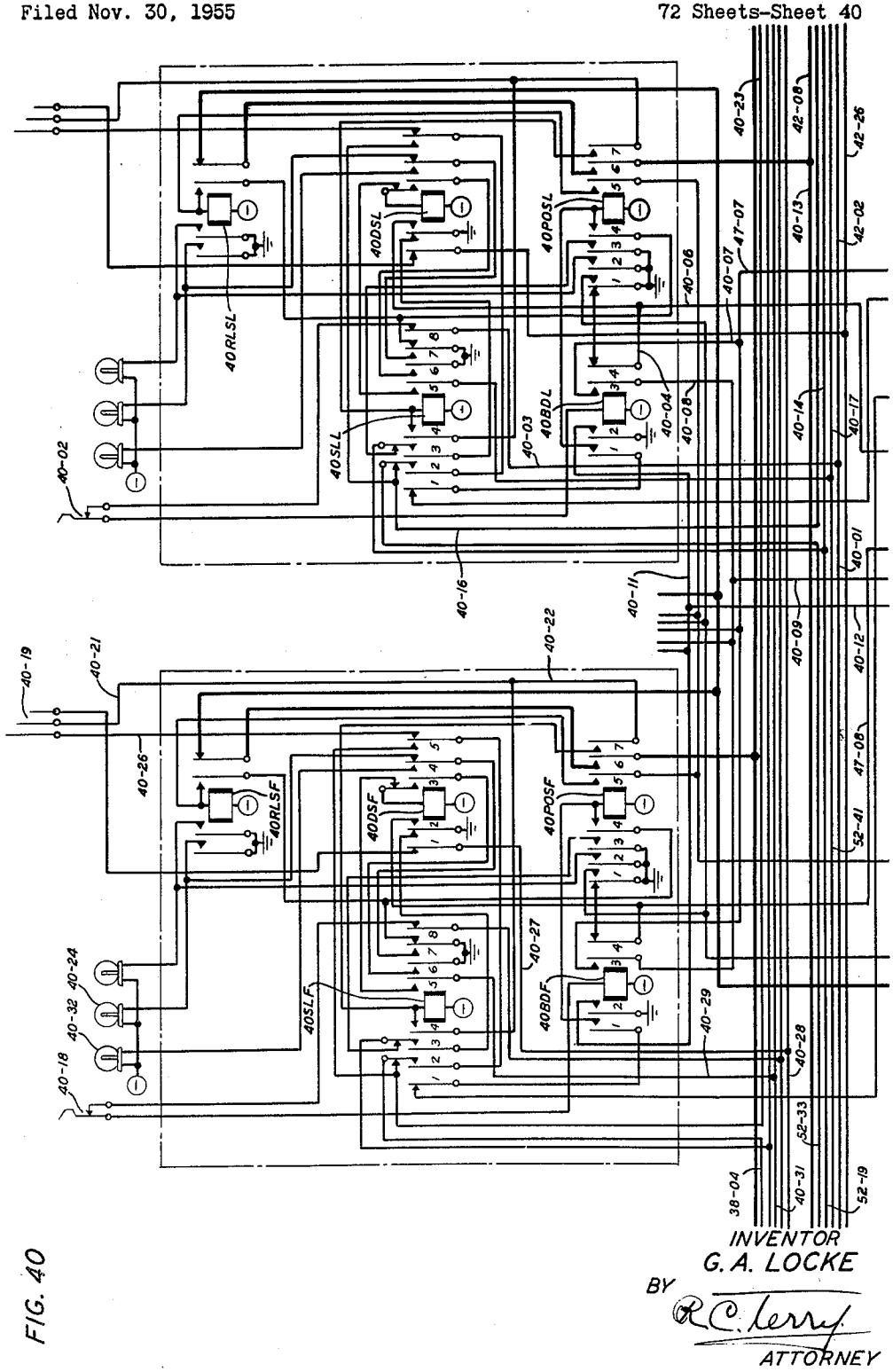


FIG. 40

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 41

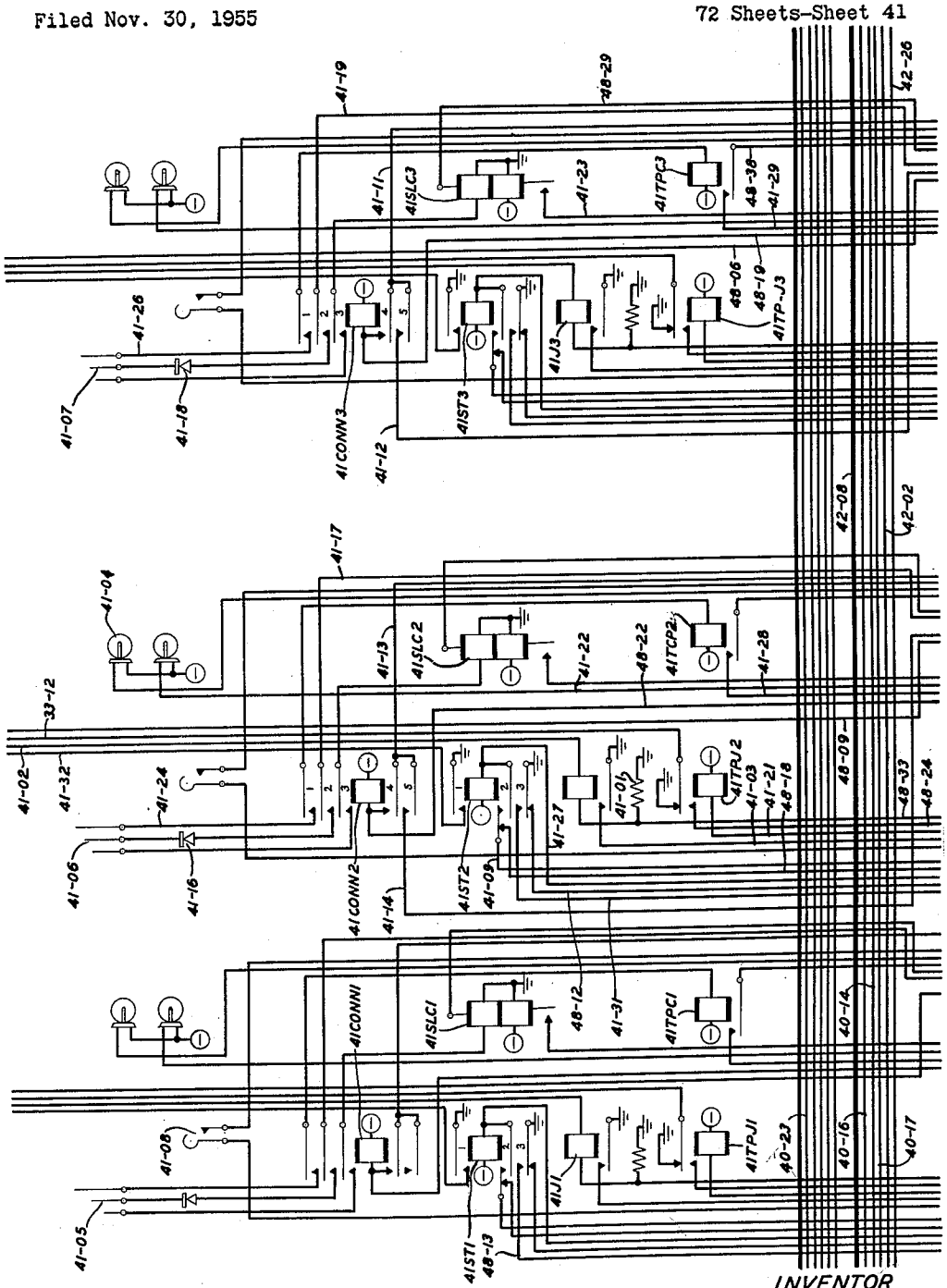


FIG. 41

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 42

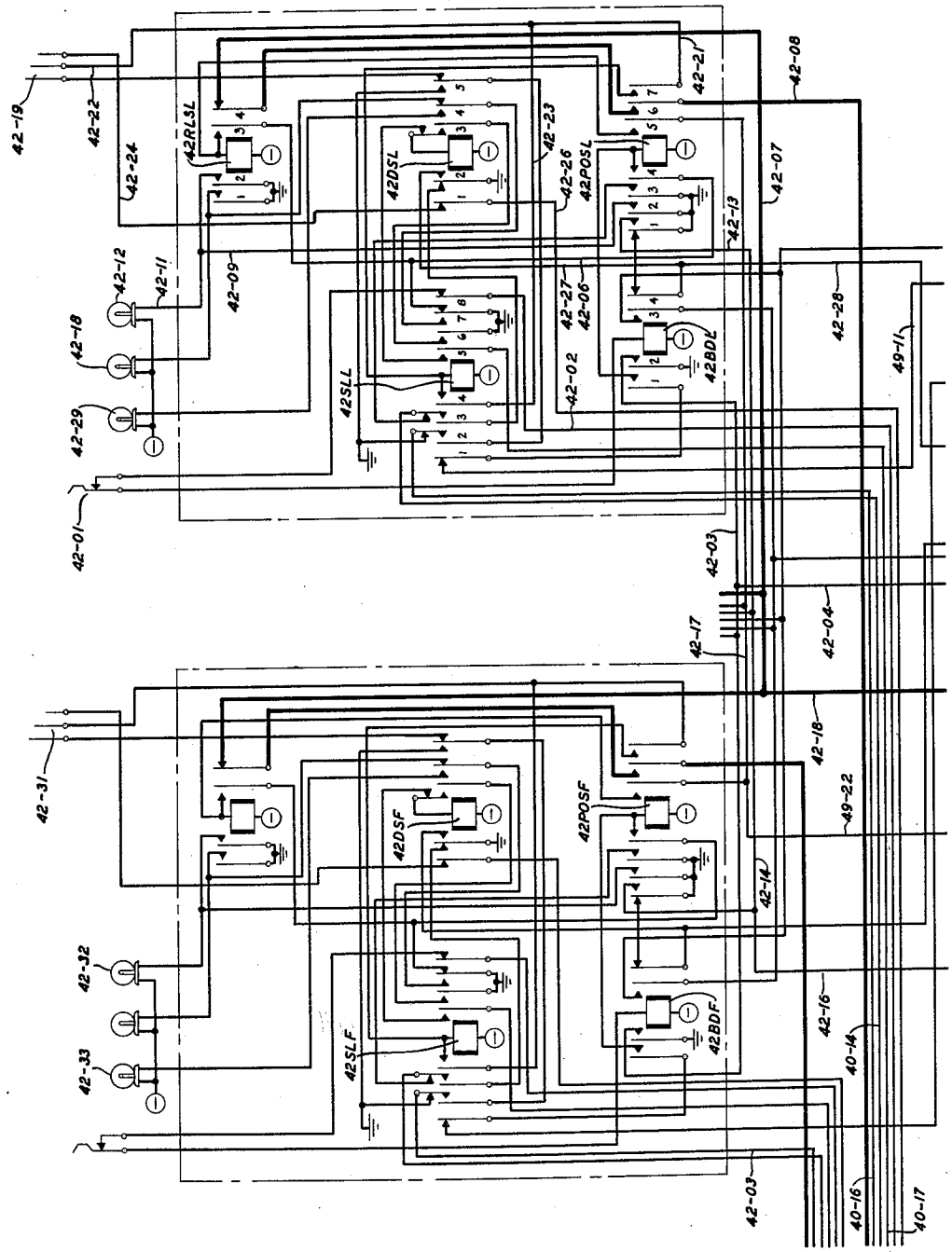


FIG. 42

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 43

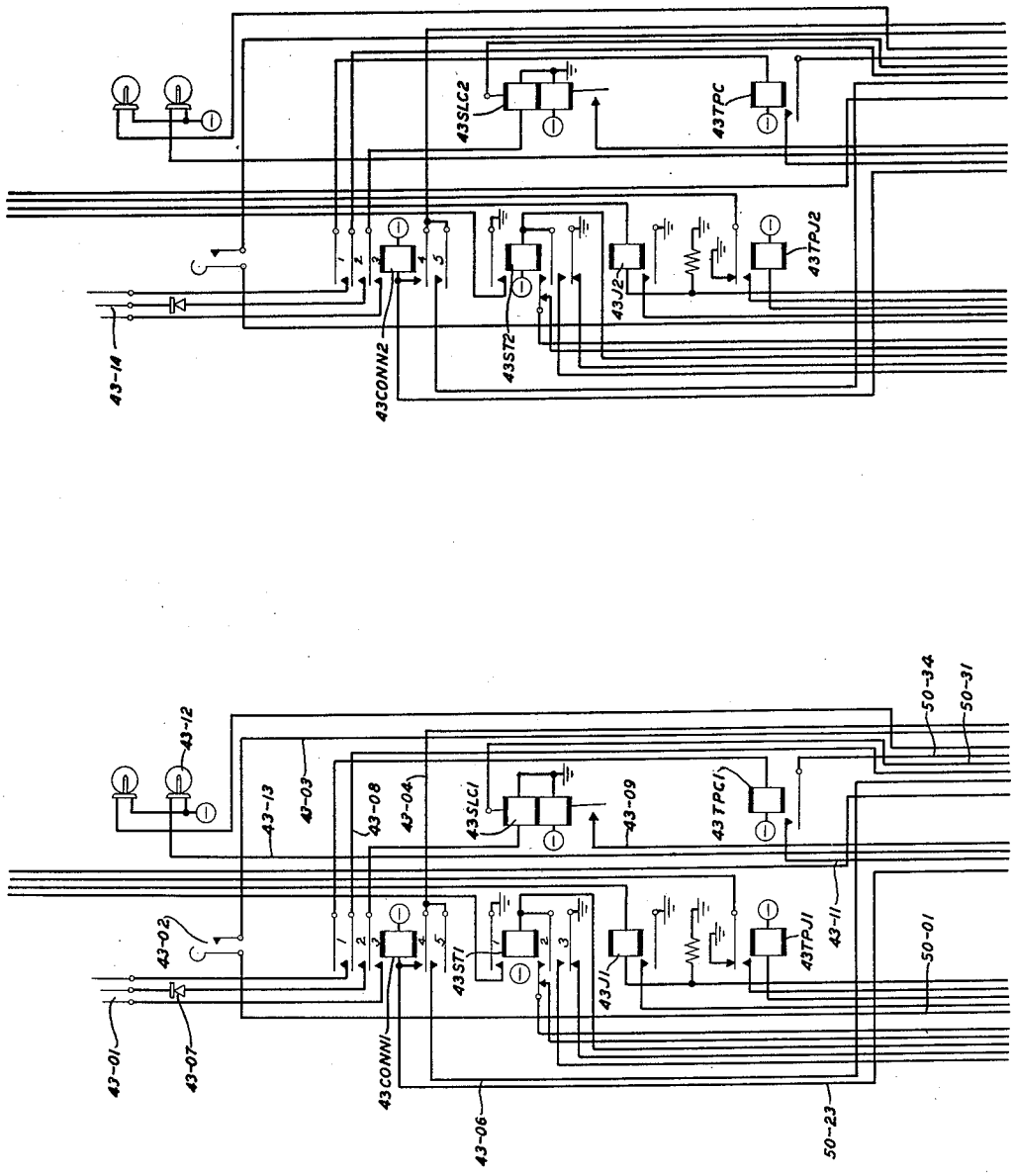


FIG. 43

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 44

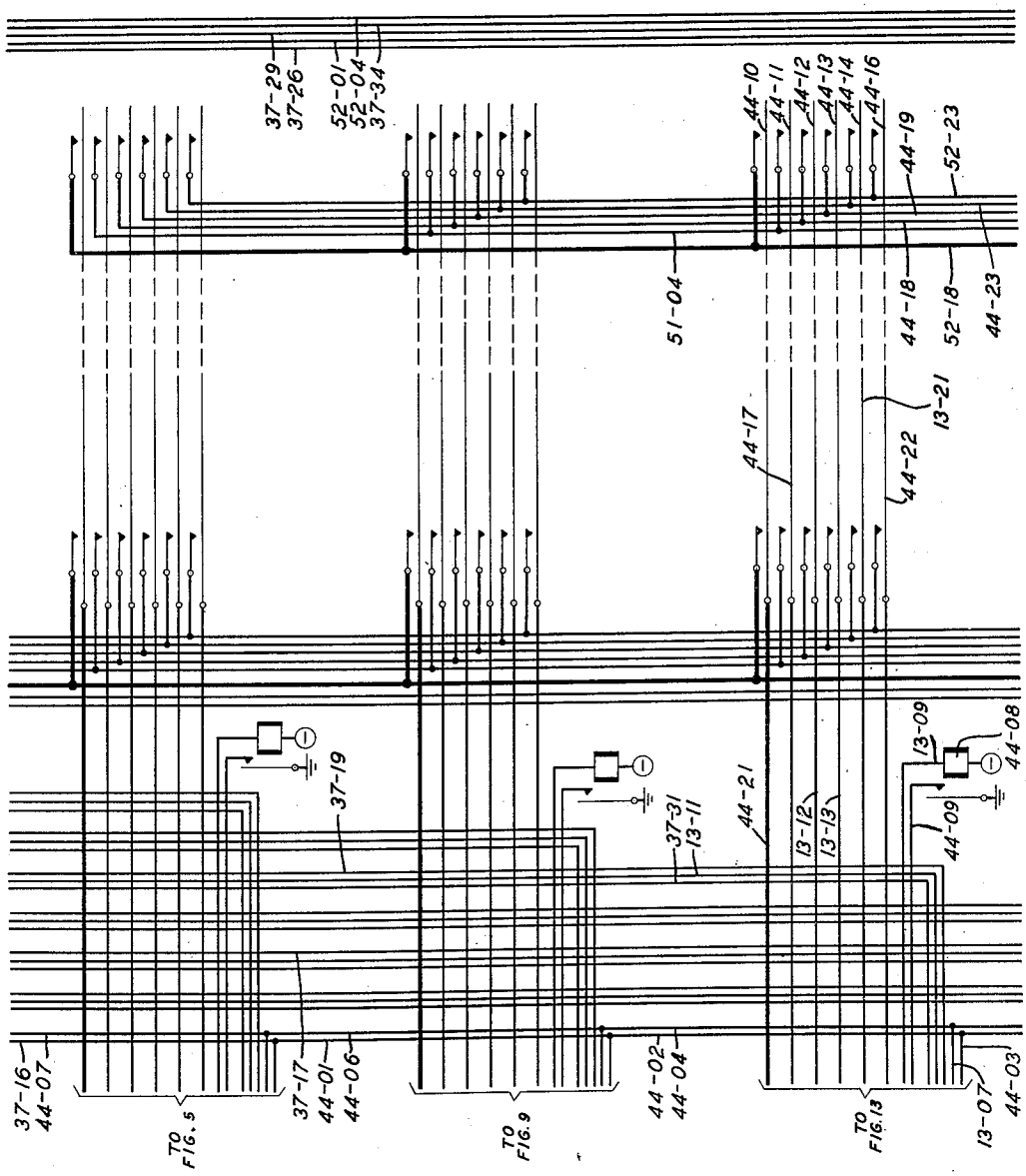


FIG. 44

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 45

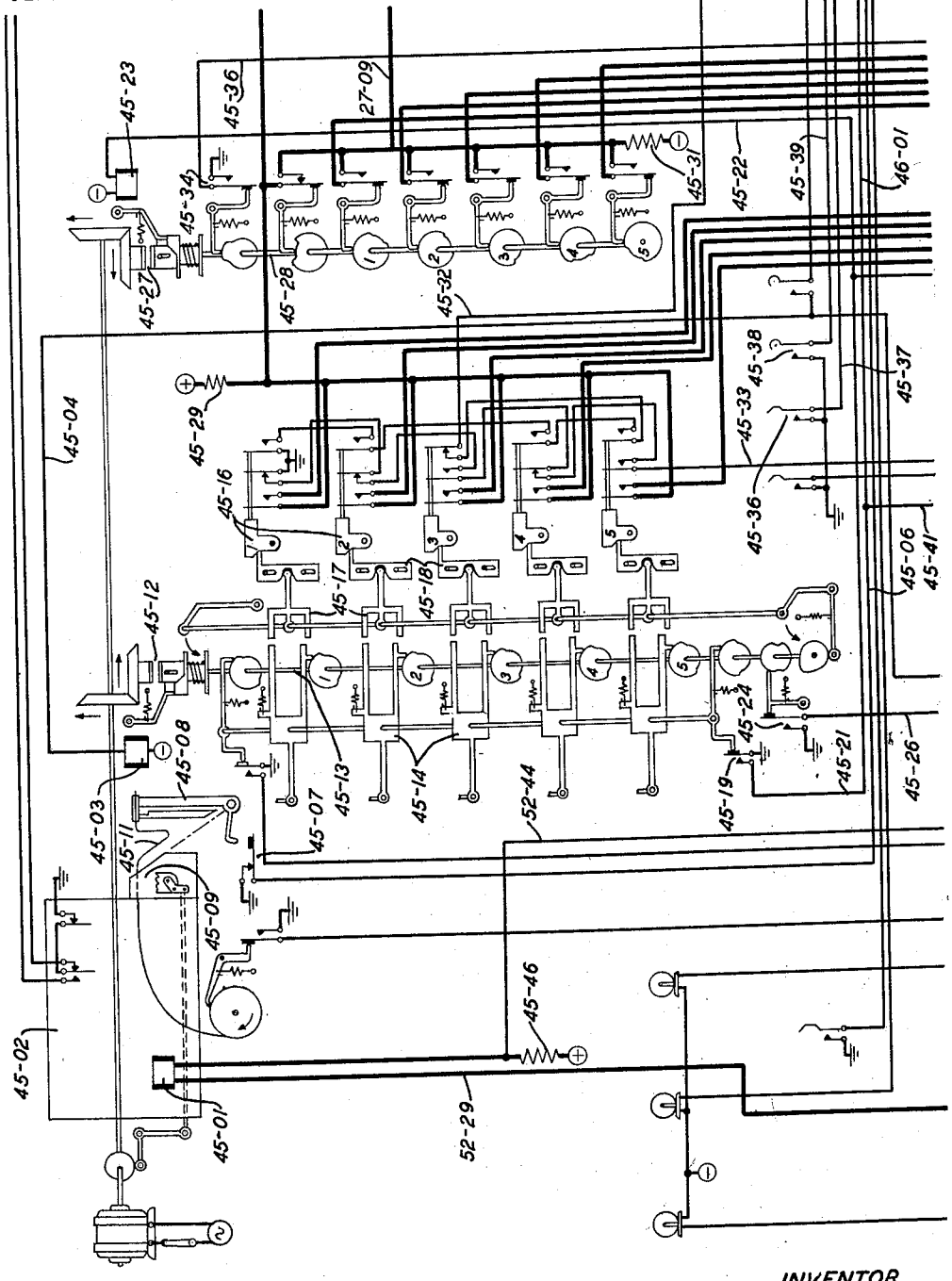


FIG. 45

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 46

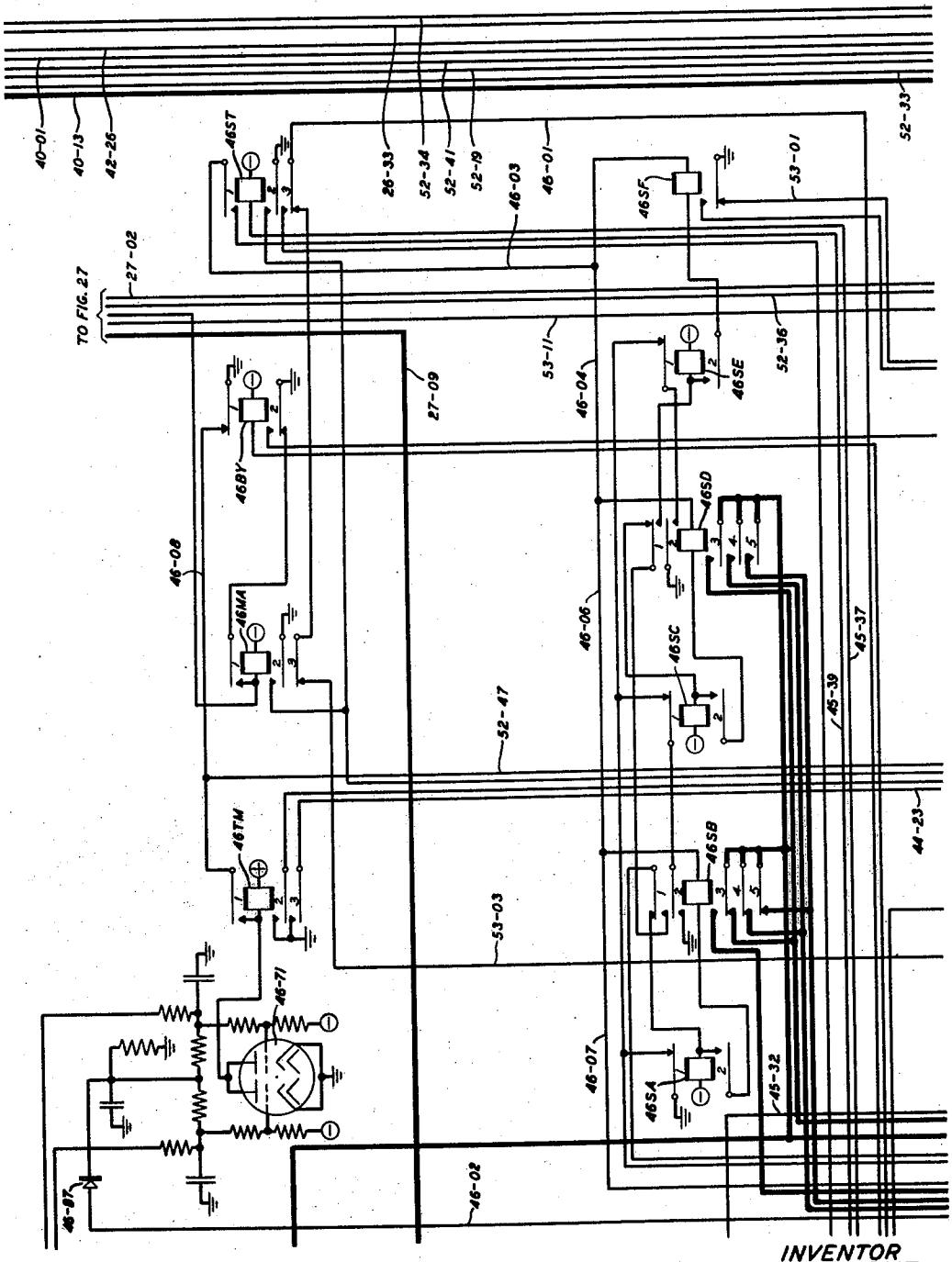


FIG. 46

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 47

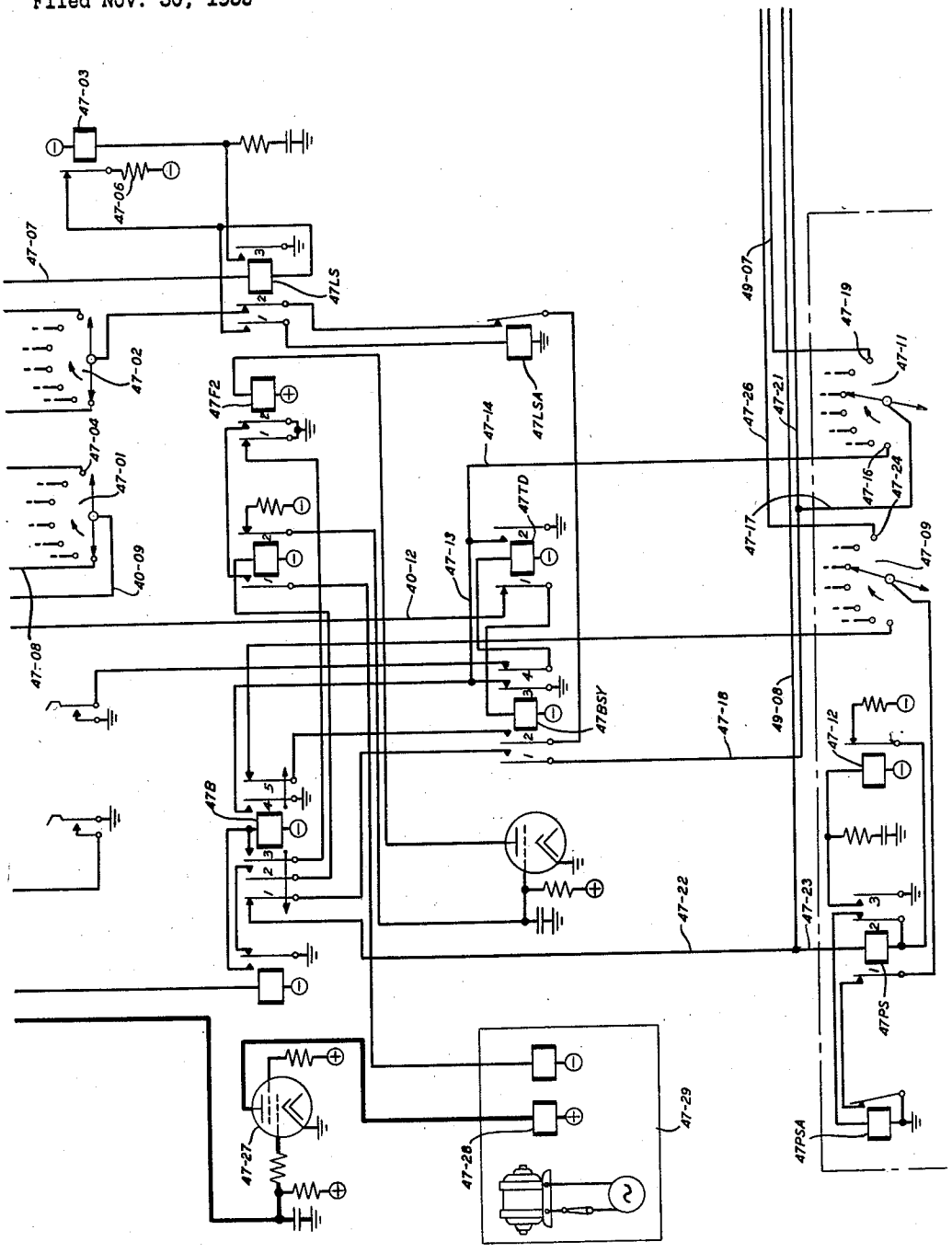


FIG. 47

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 48

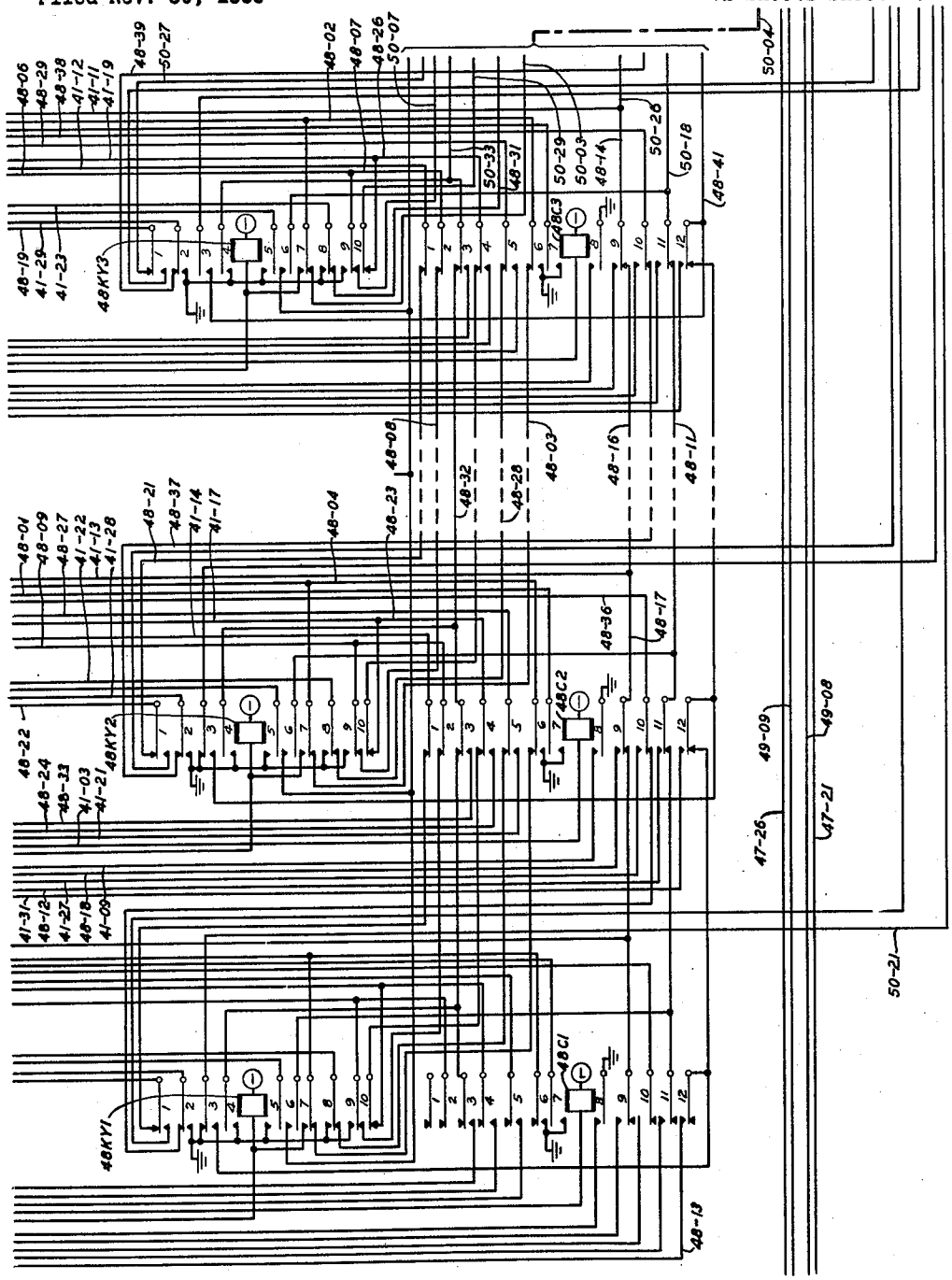


FIG. 48

INVENTOR
G. A. LOCKE
BY R. C. Leng.
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 49

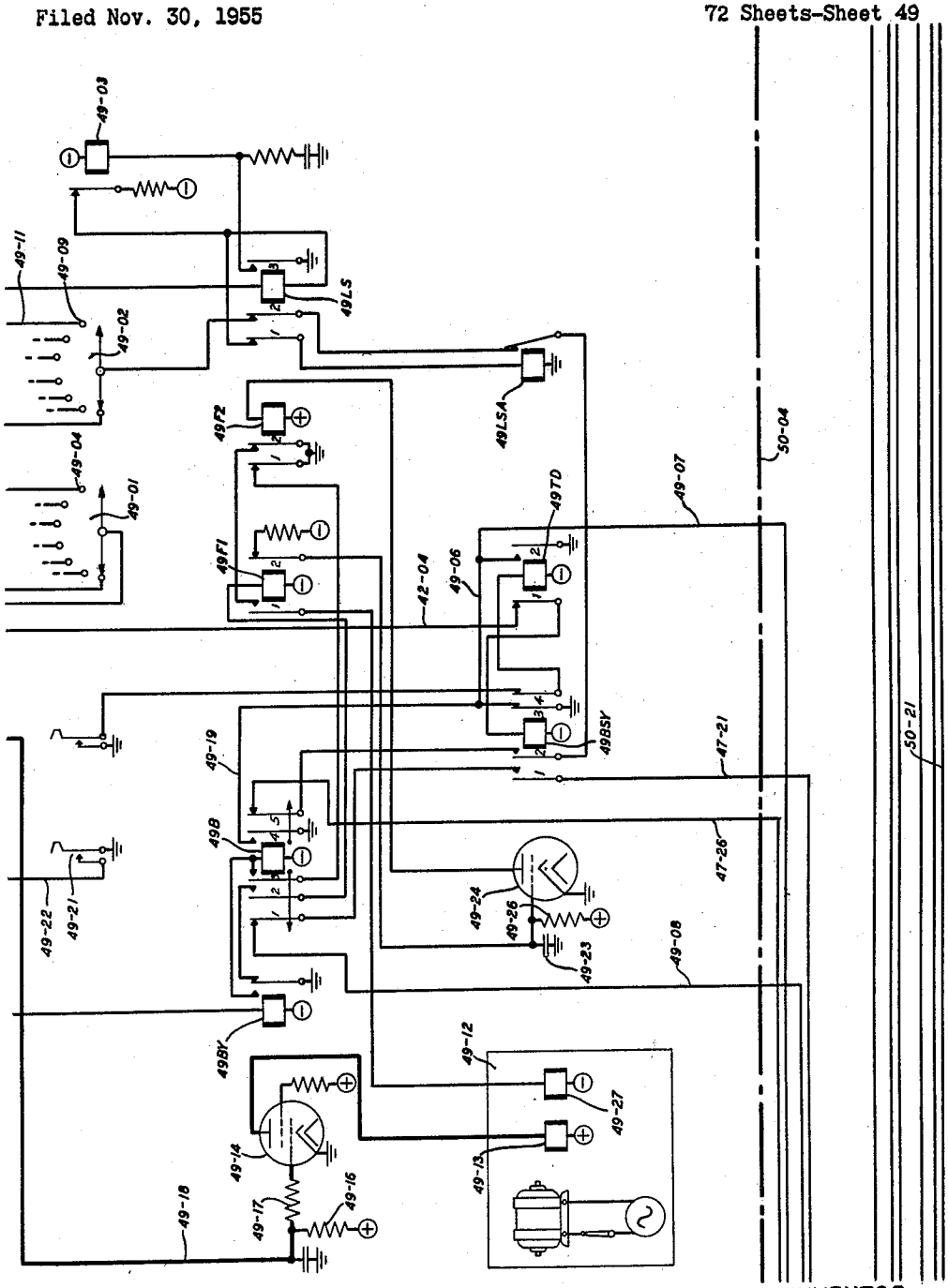


FIG. 49

INVENTOR
G. A. LOCKE
BY R. C. Kerr
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 50

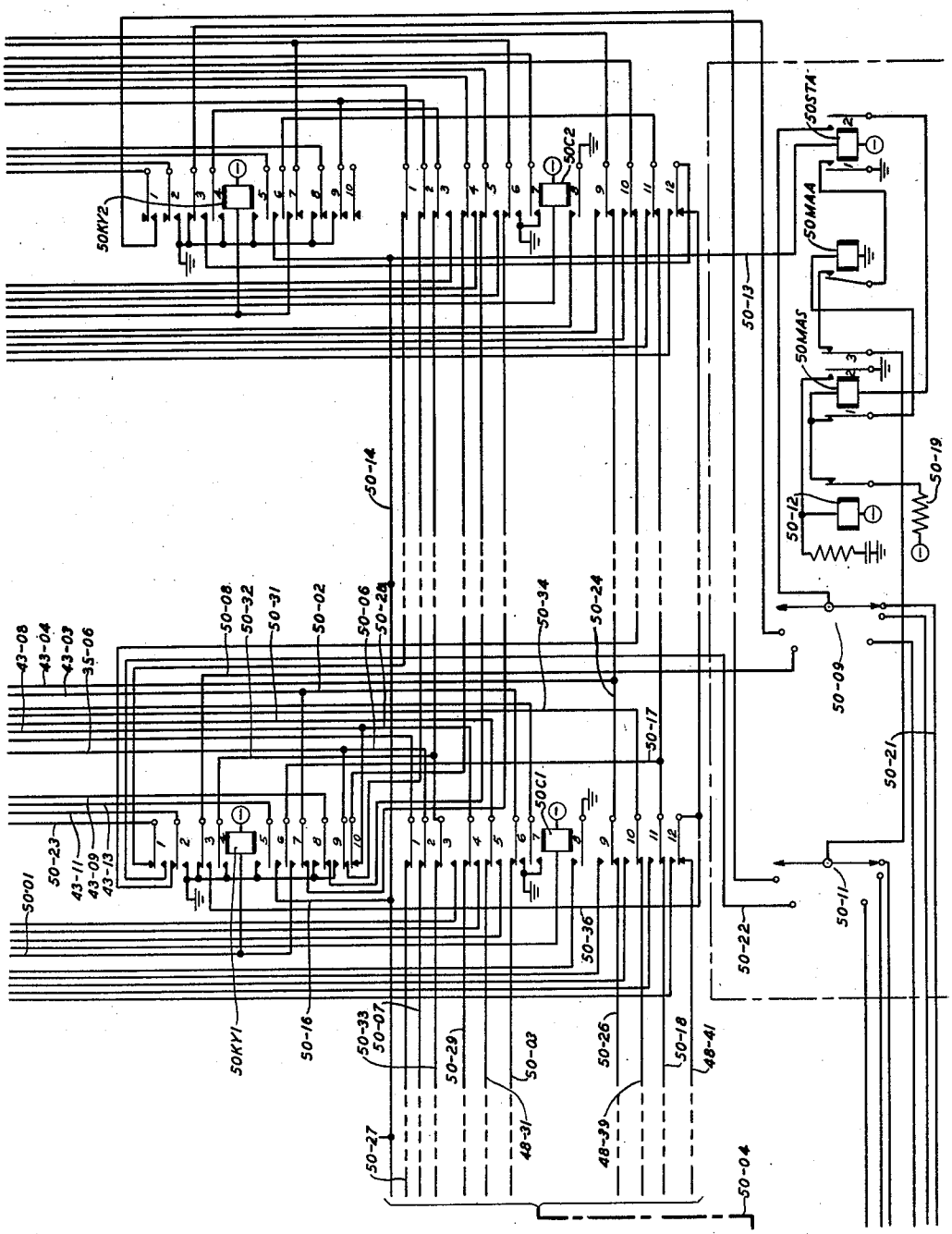


FIG. 50

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 51

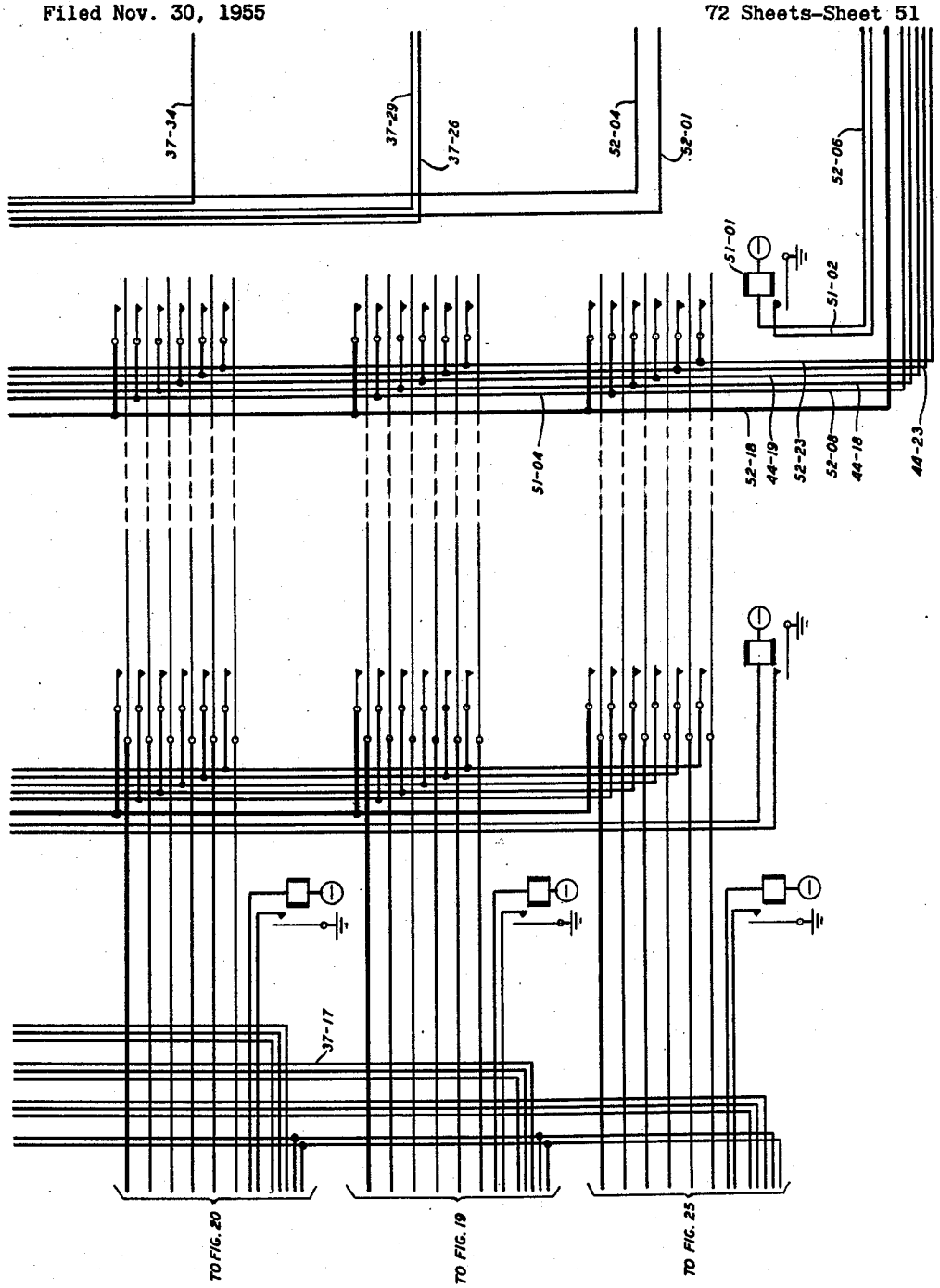


FIG. 51

INVENTOR
G. A. LOCKE
BY R. C. Leng.
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 52

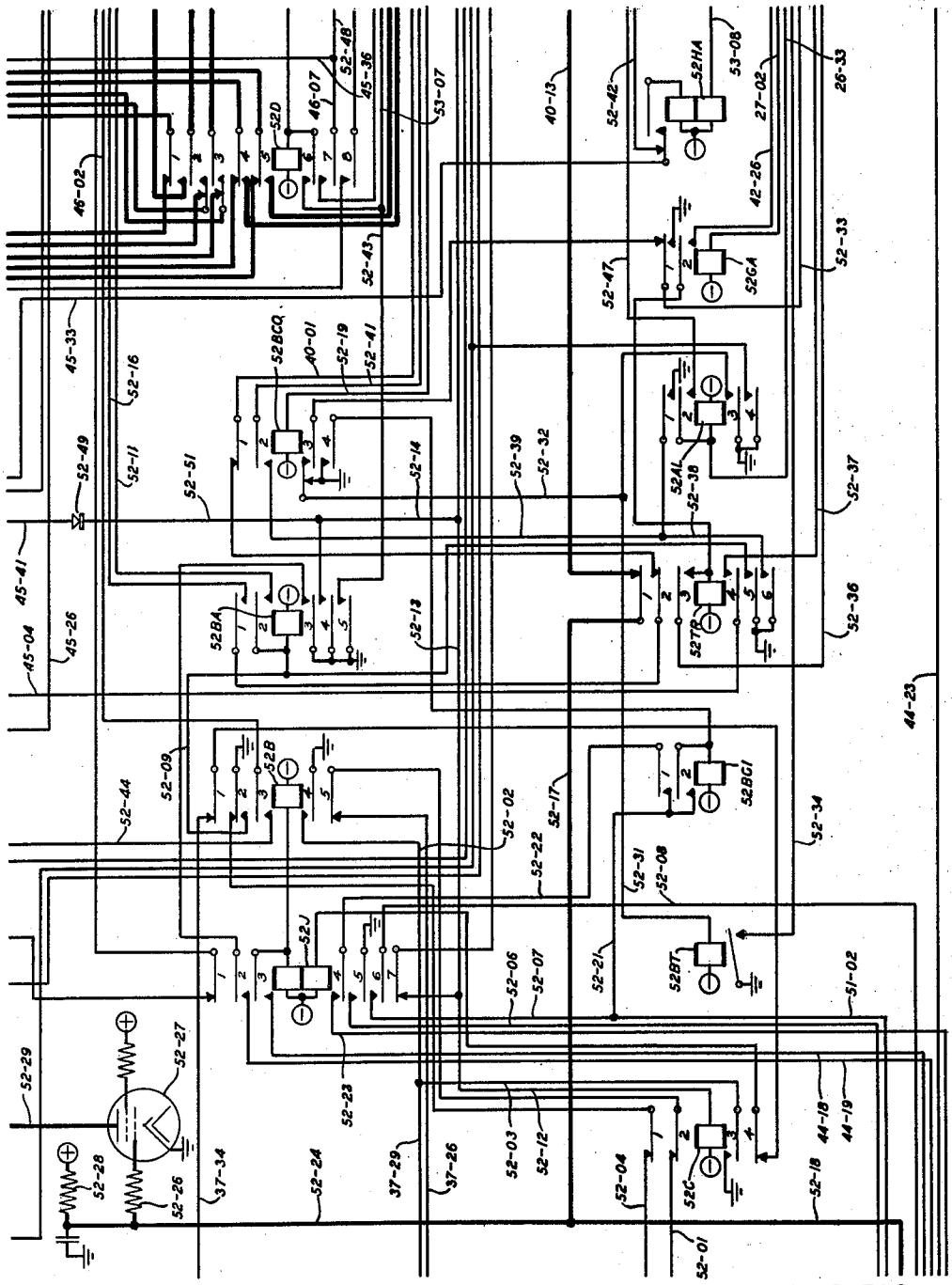


FIG. 52

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 53

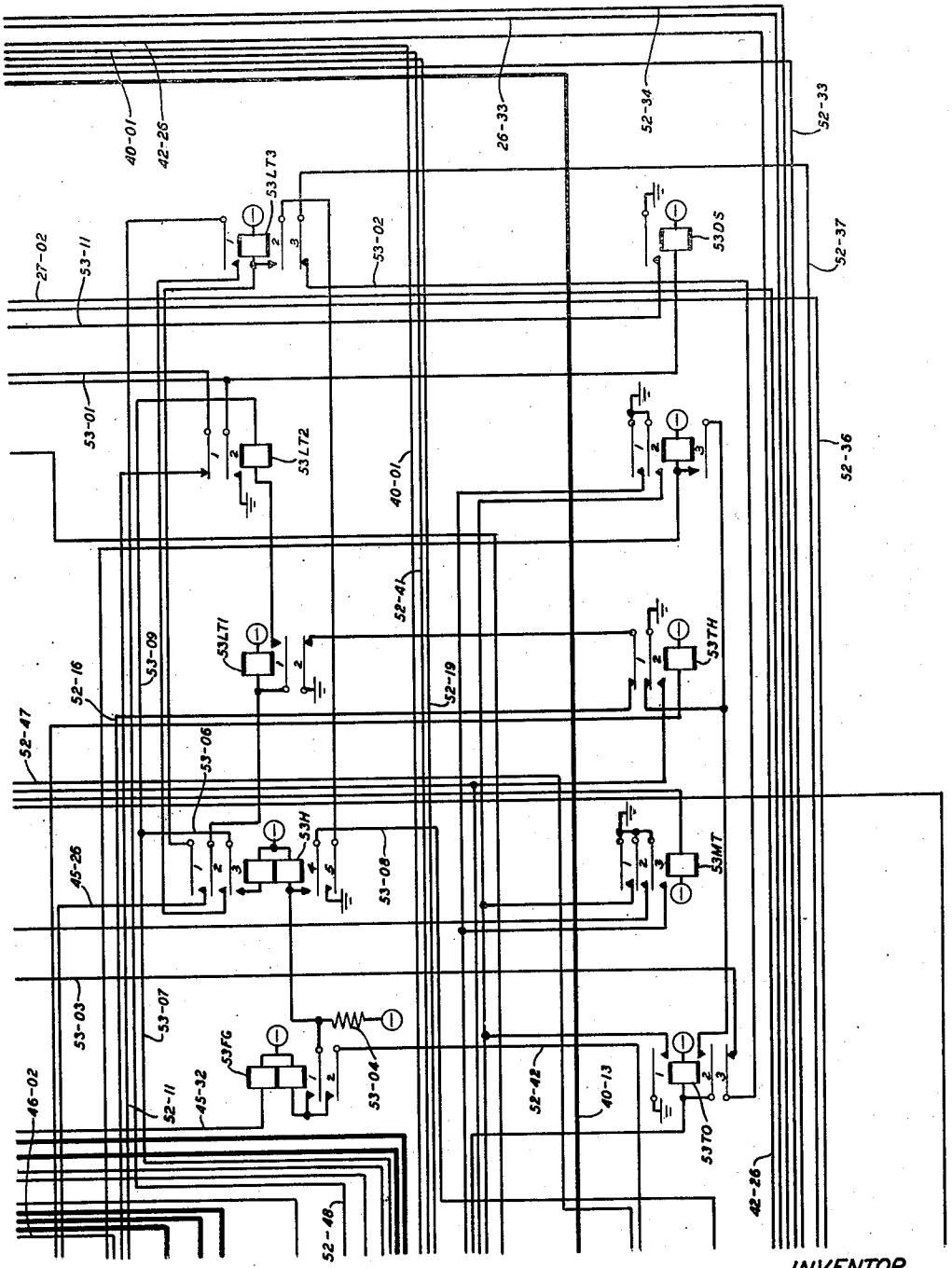


FIG. 53

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 54

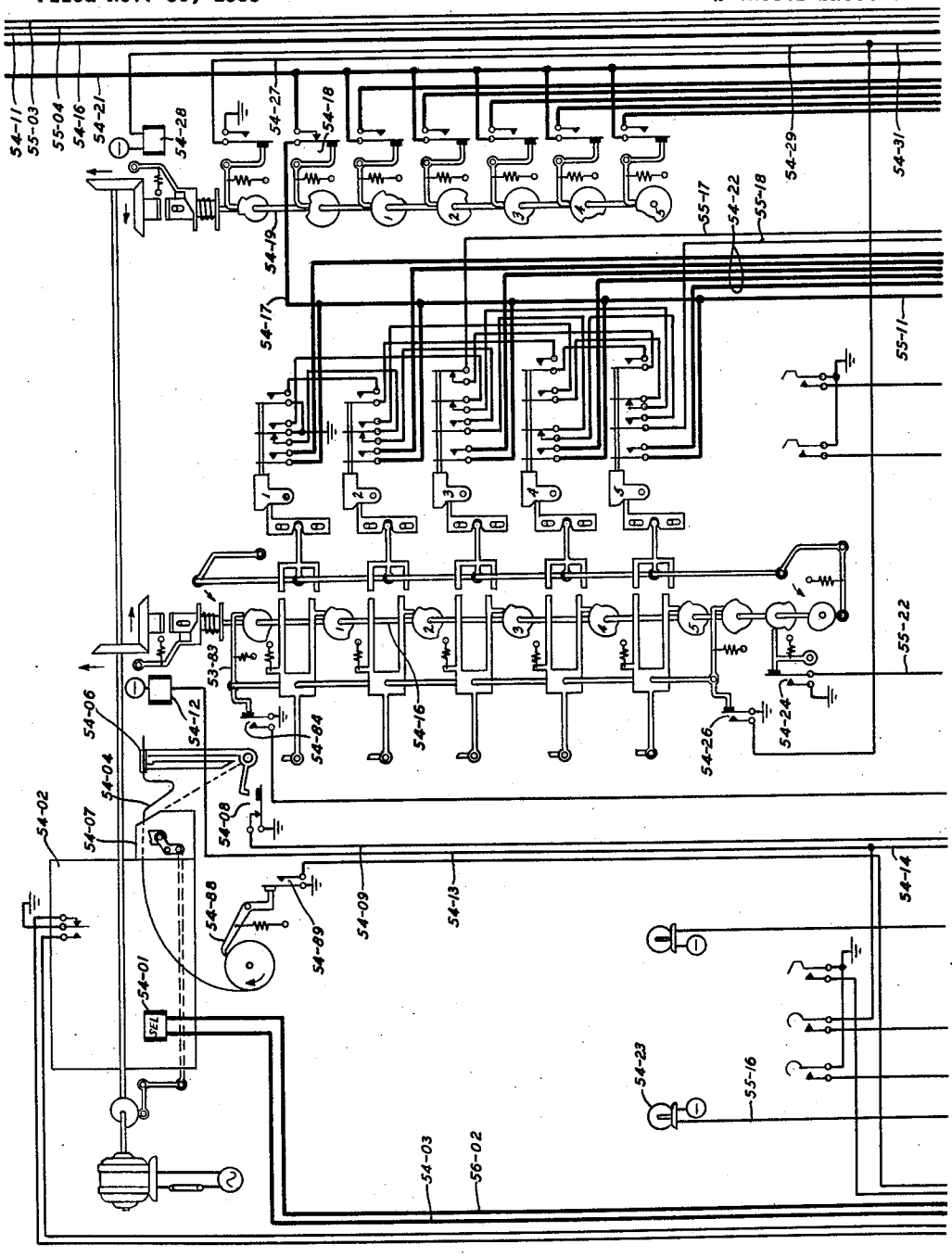


FIG. 54

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 55

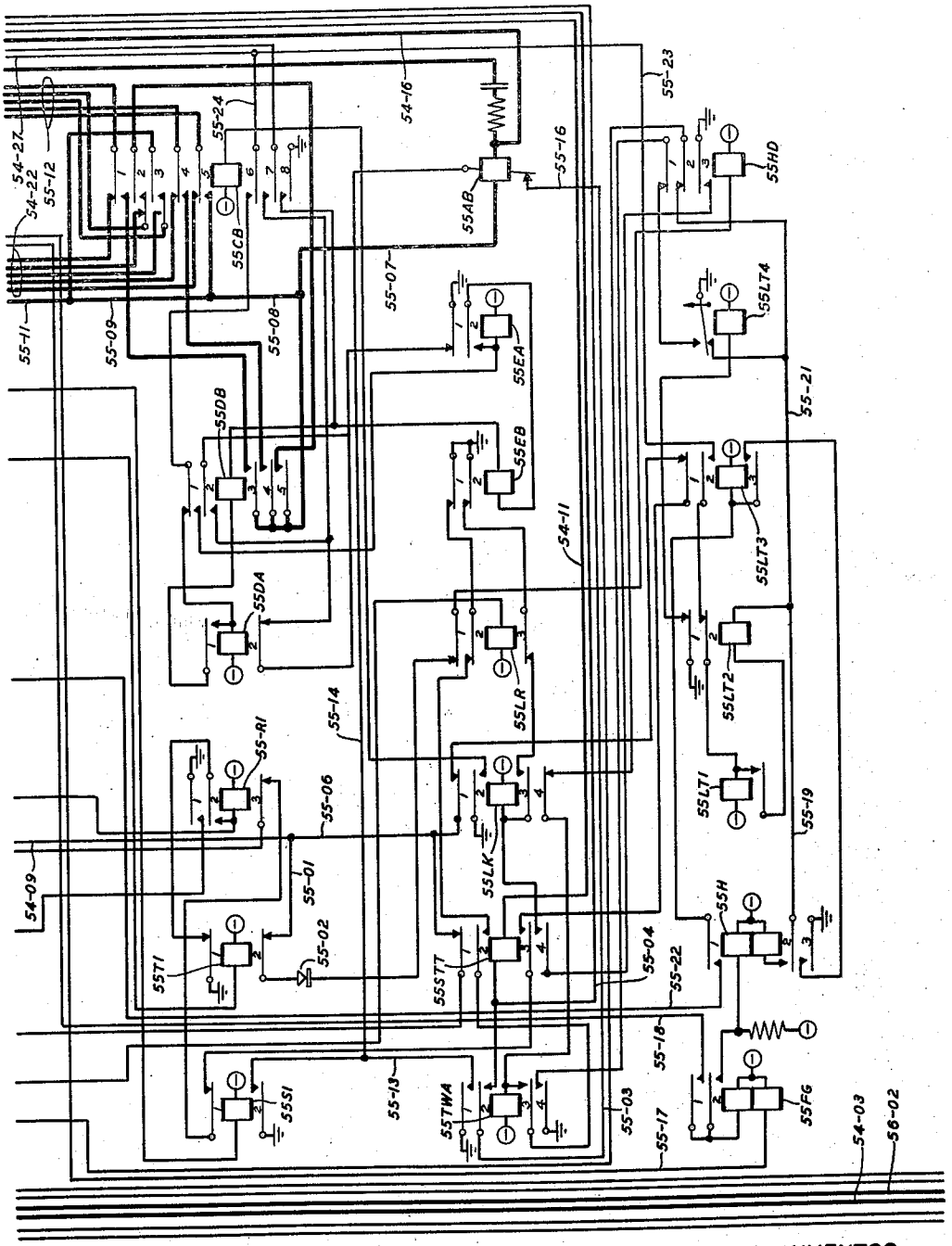


FIG. 55

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 56

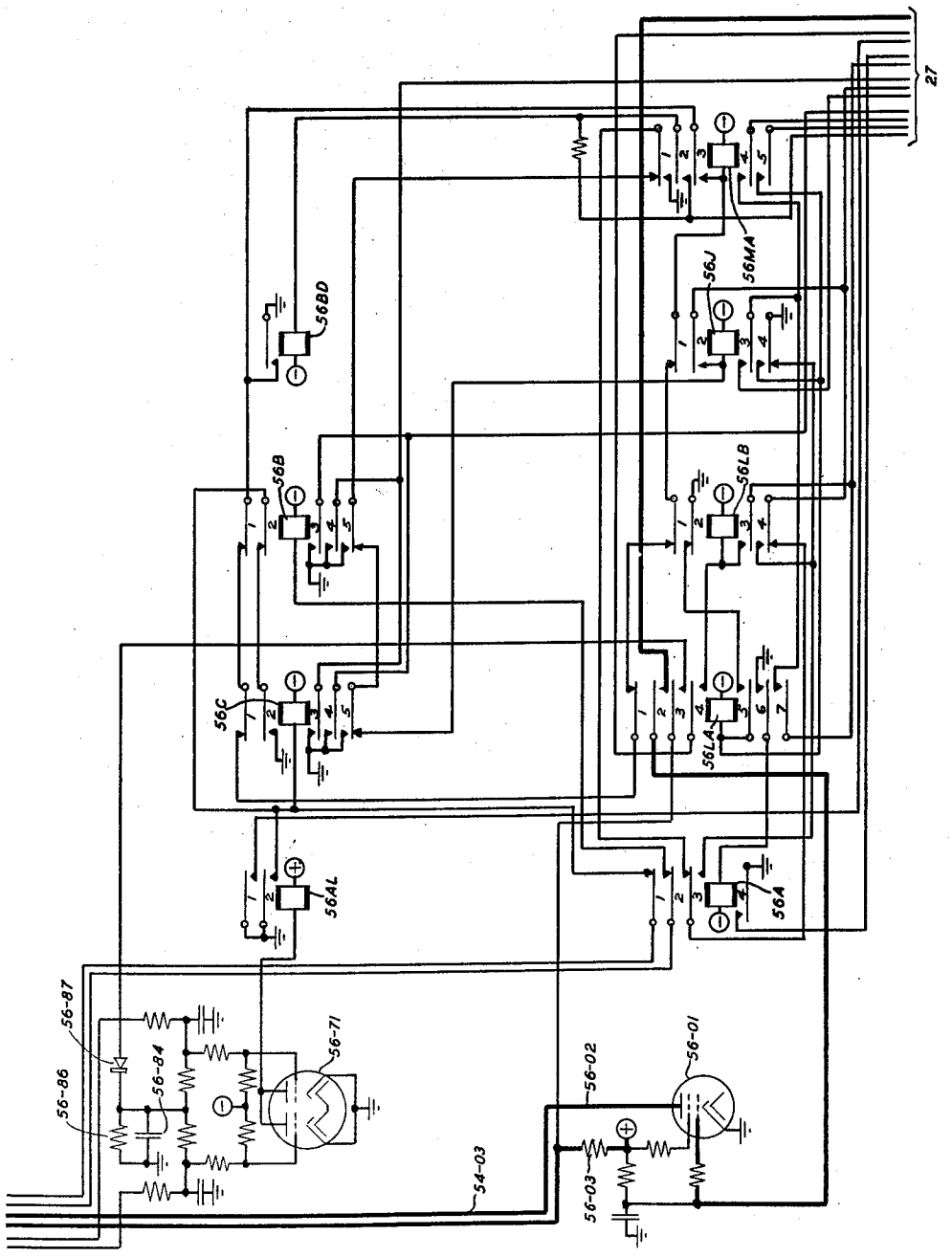


FIG. 56

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 57

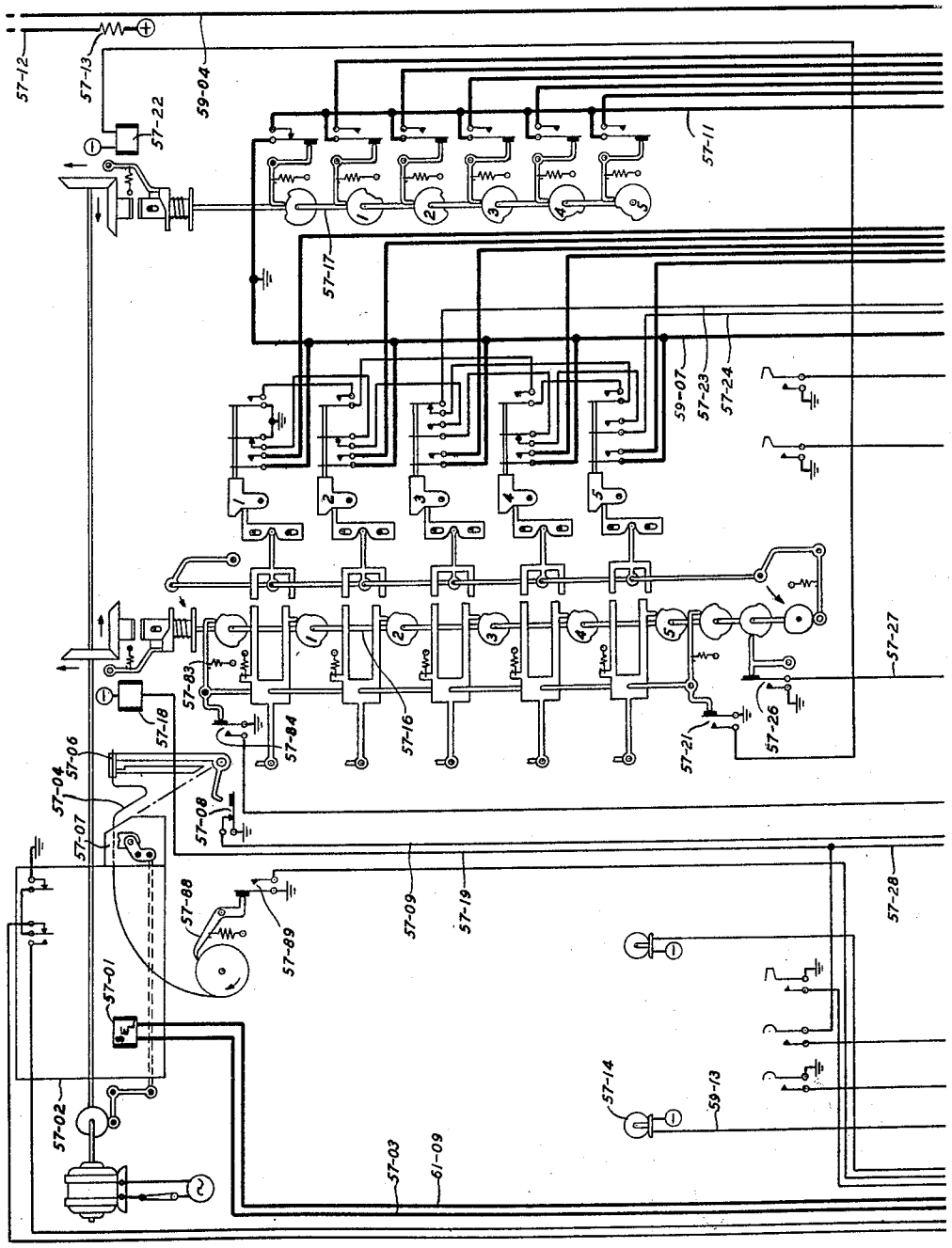


FIG. 57

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 58

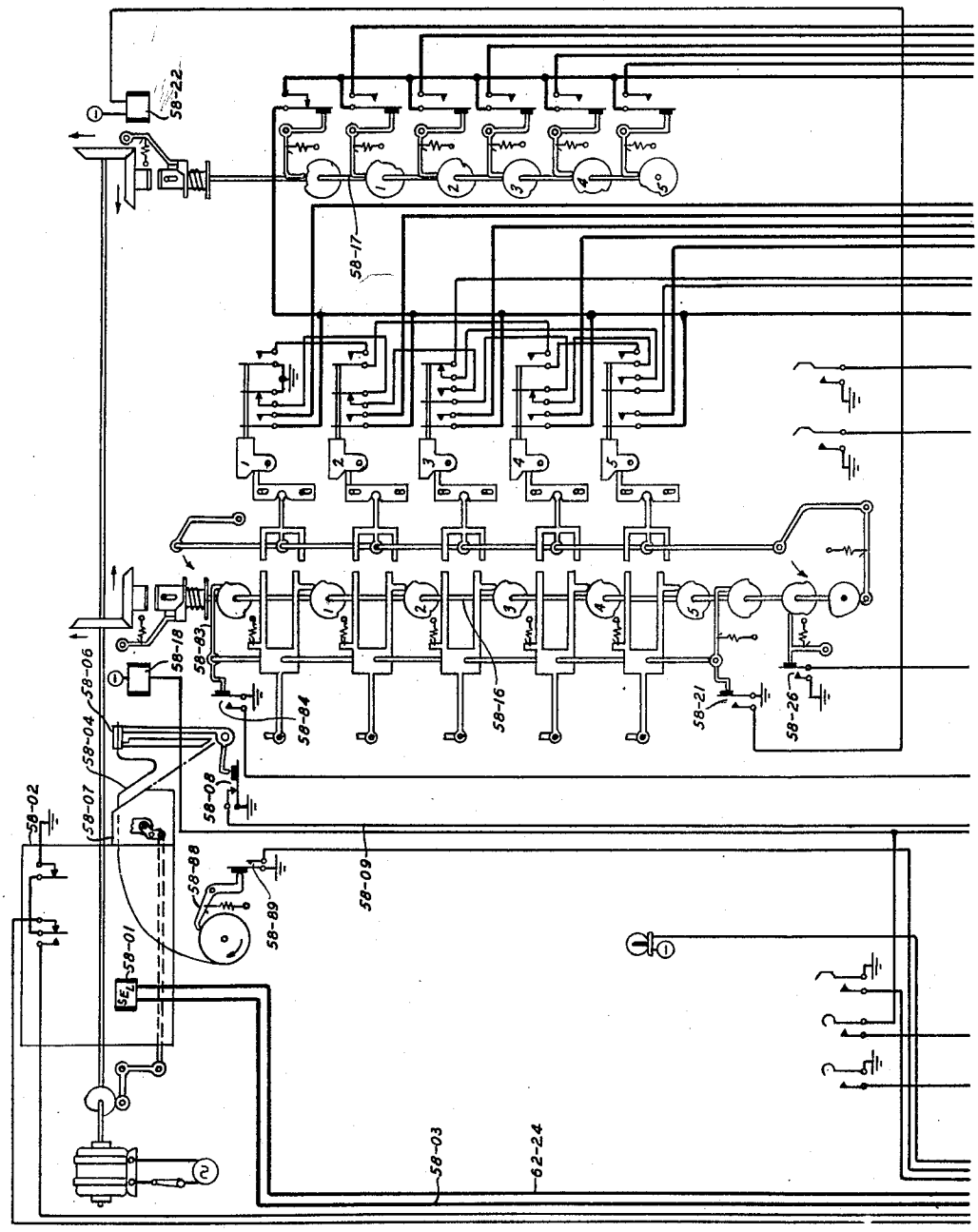
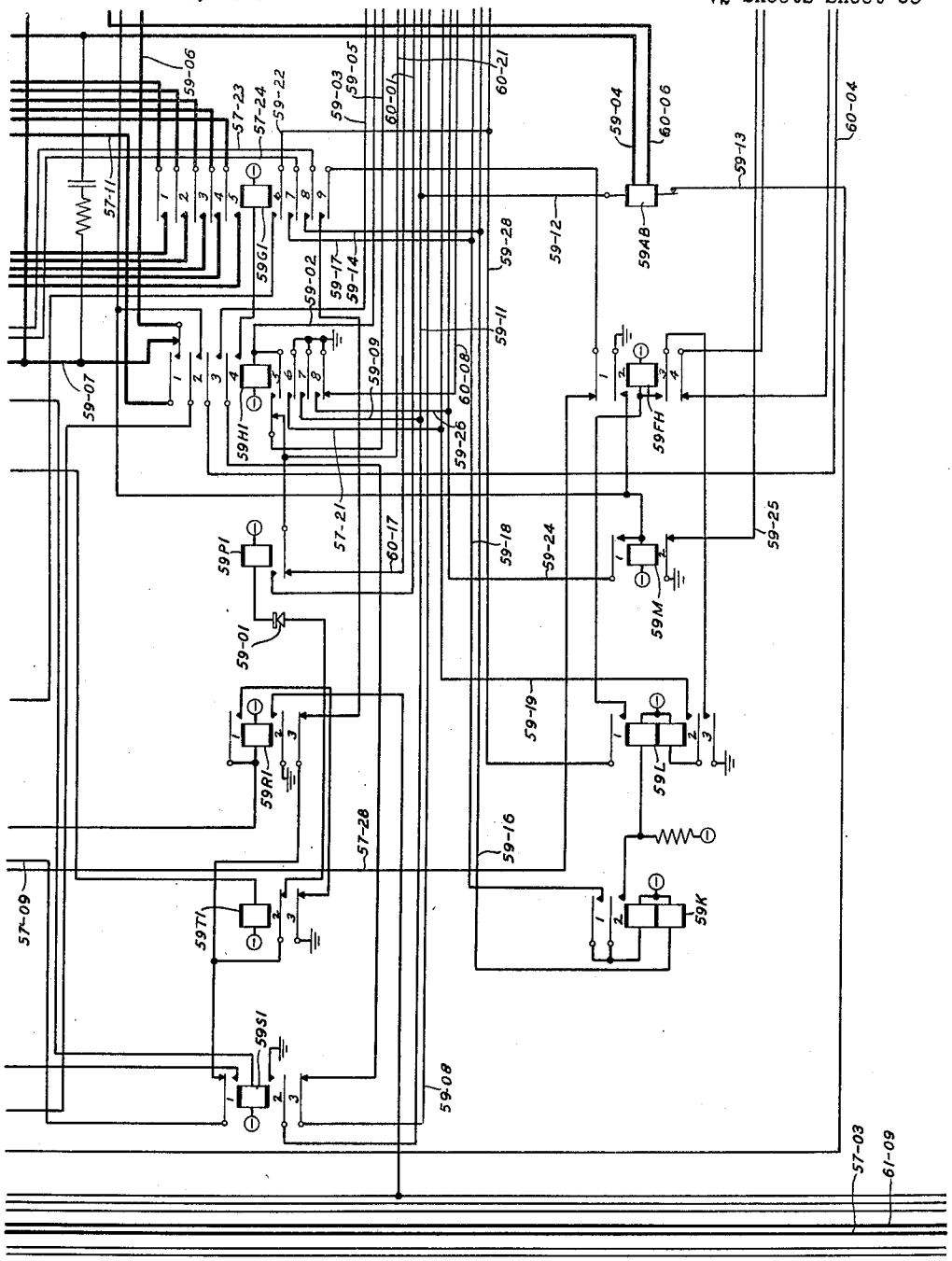


FIG. 58

INVENTOR
G. A. LOCKE
BY R. C. Leary
ATTORNEY

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 59



F/G. 59

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 60

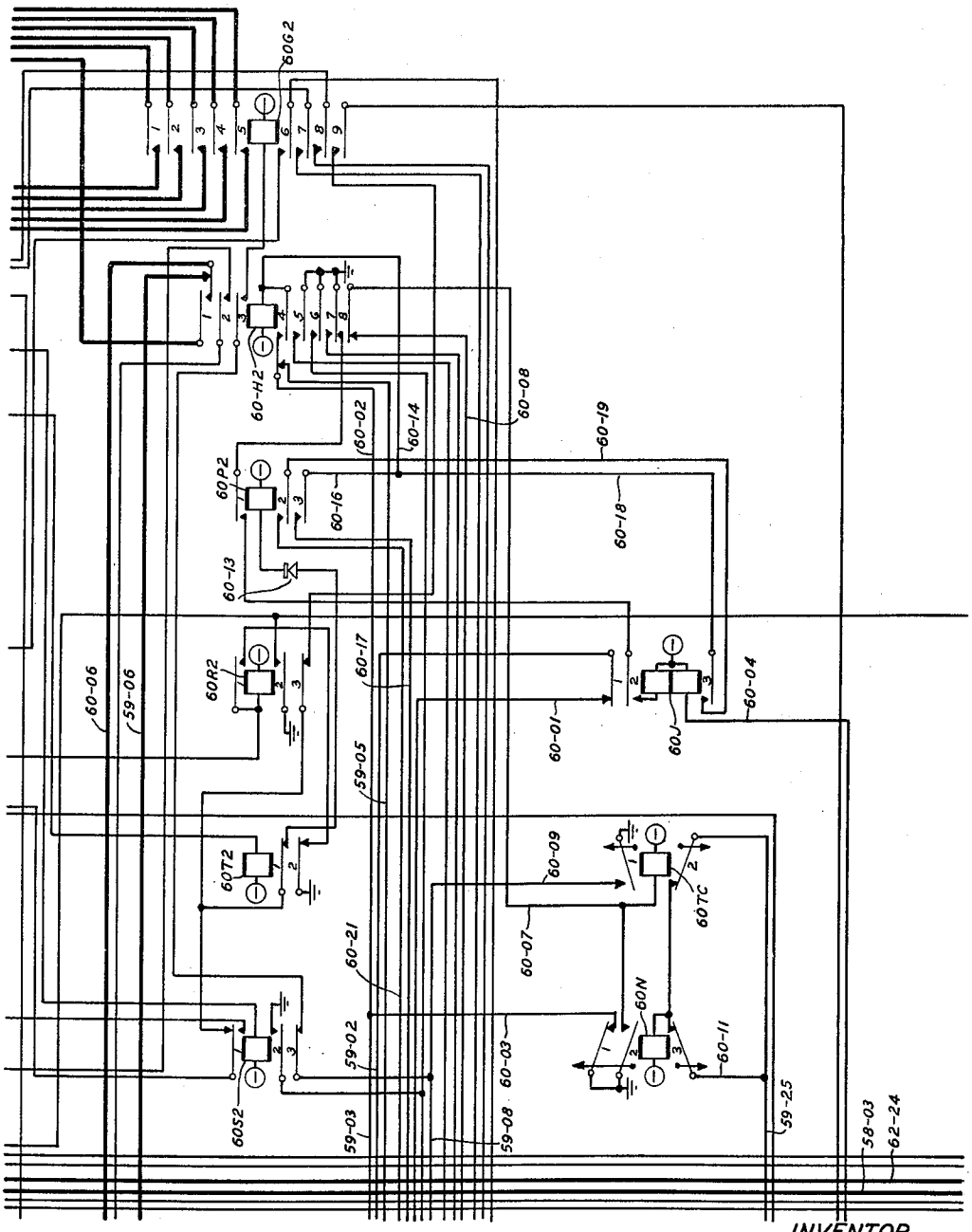


FIG. 60

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 61

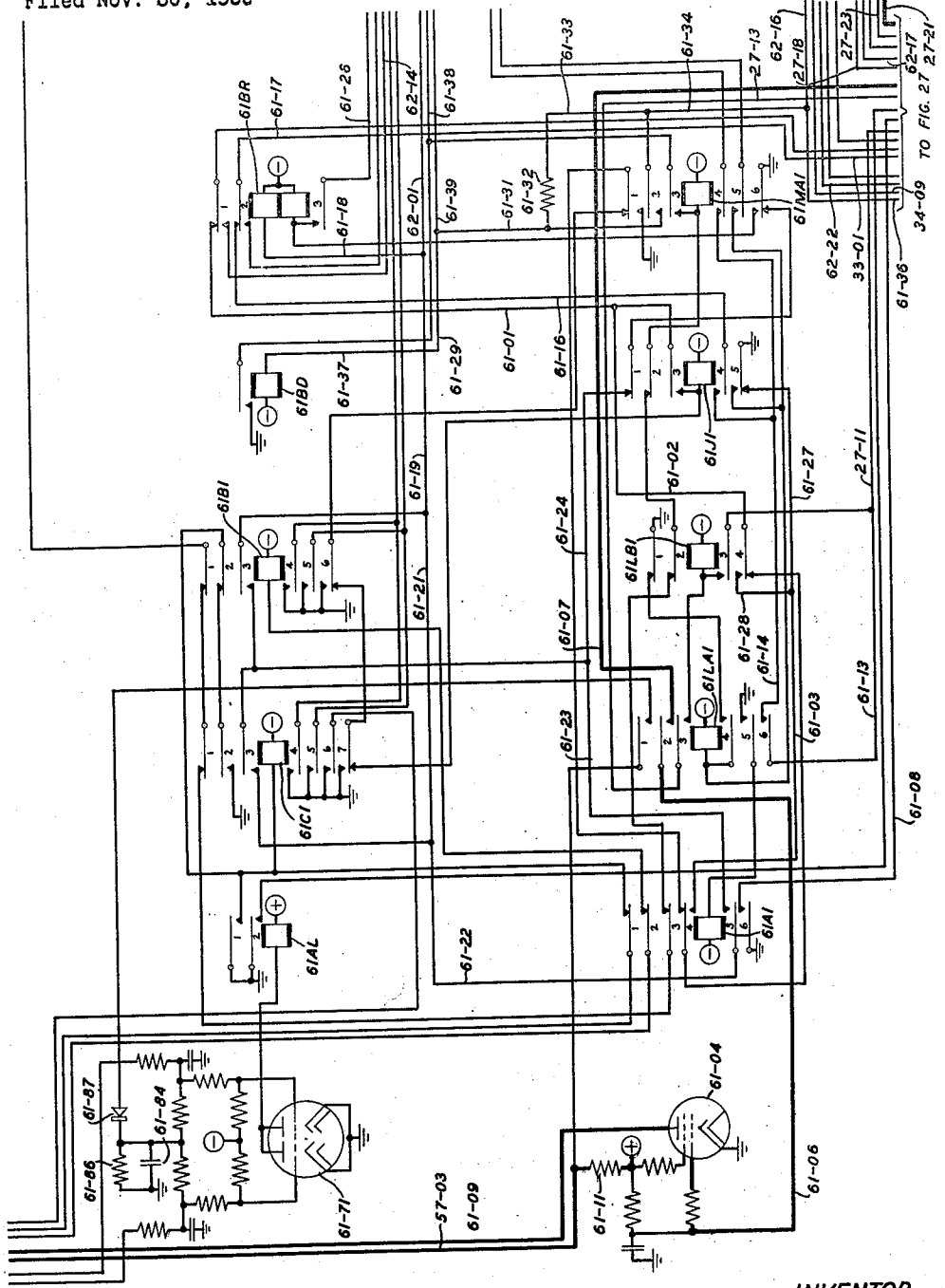


FIG. 61

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 62

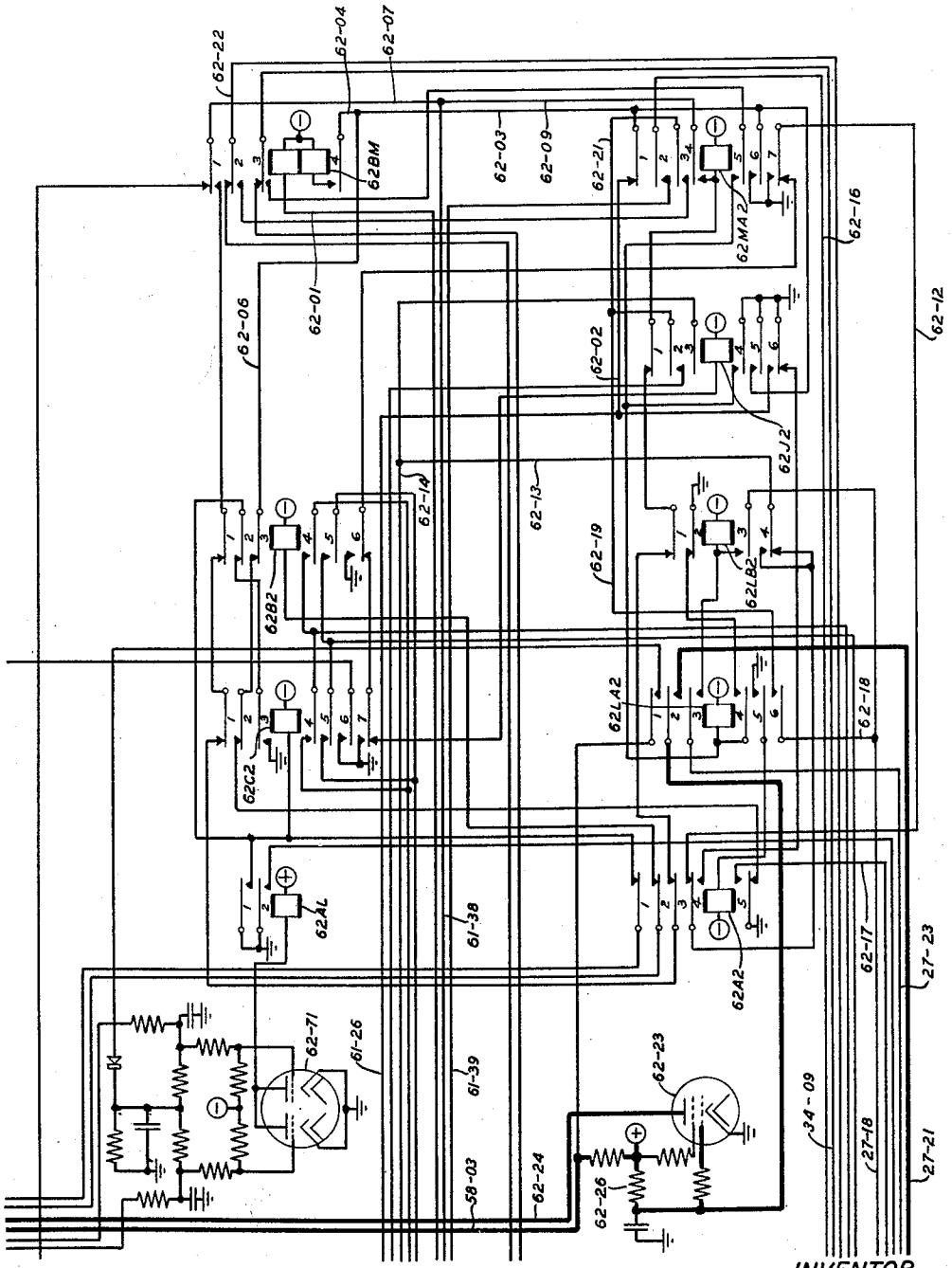


FIG. 62

INVENTOR
G. A. LOCKE
BY
R. C. Leary
ATTORNEY

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 63

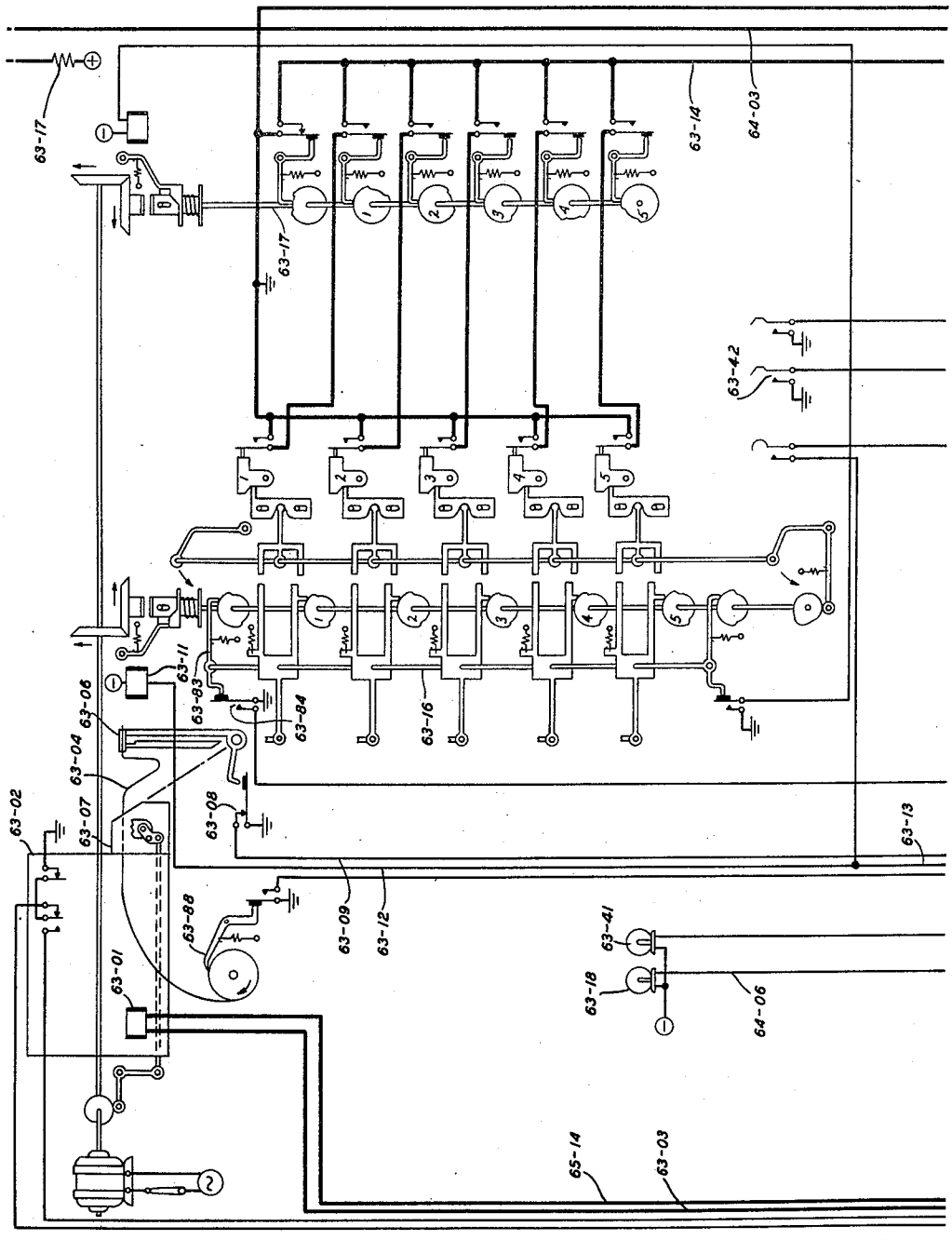


FIG. 63

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 64

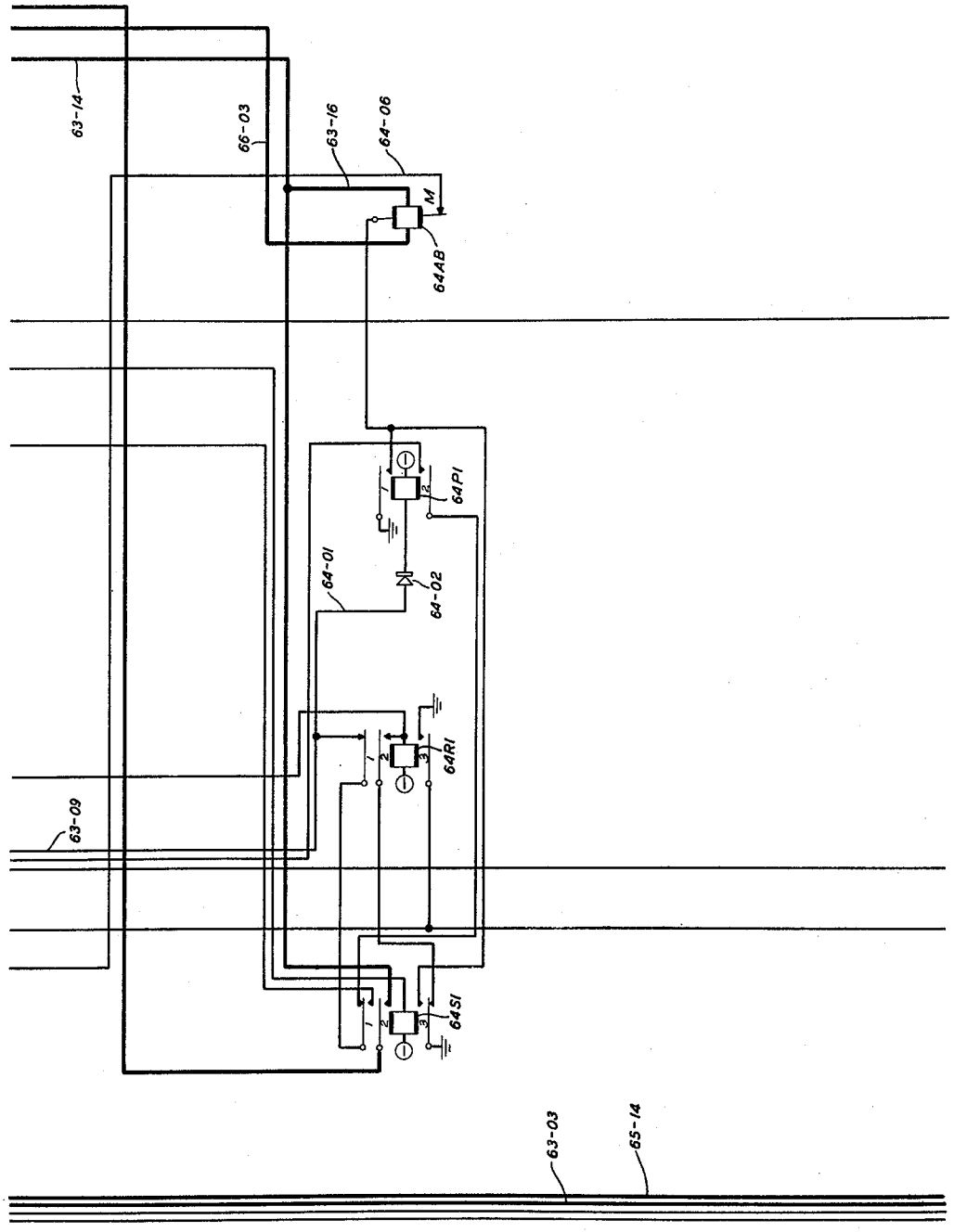


FIG. 64

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 65

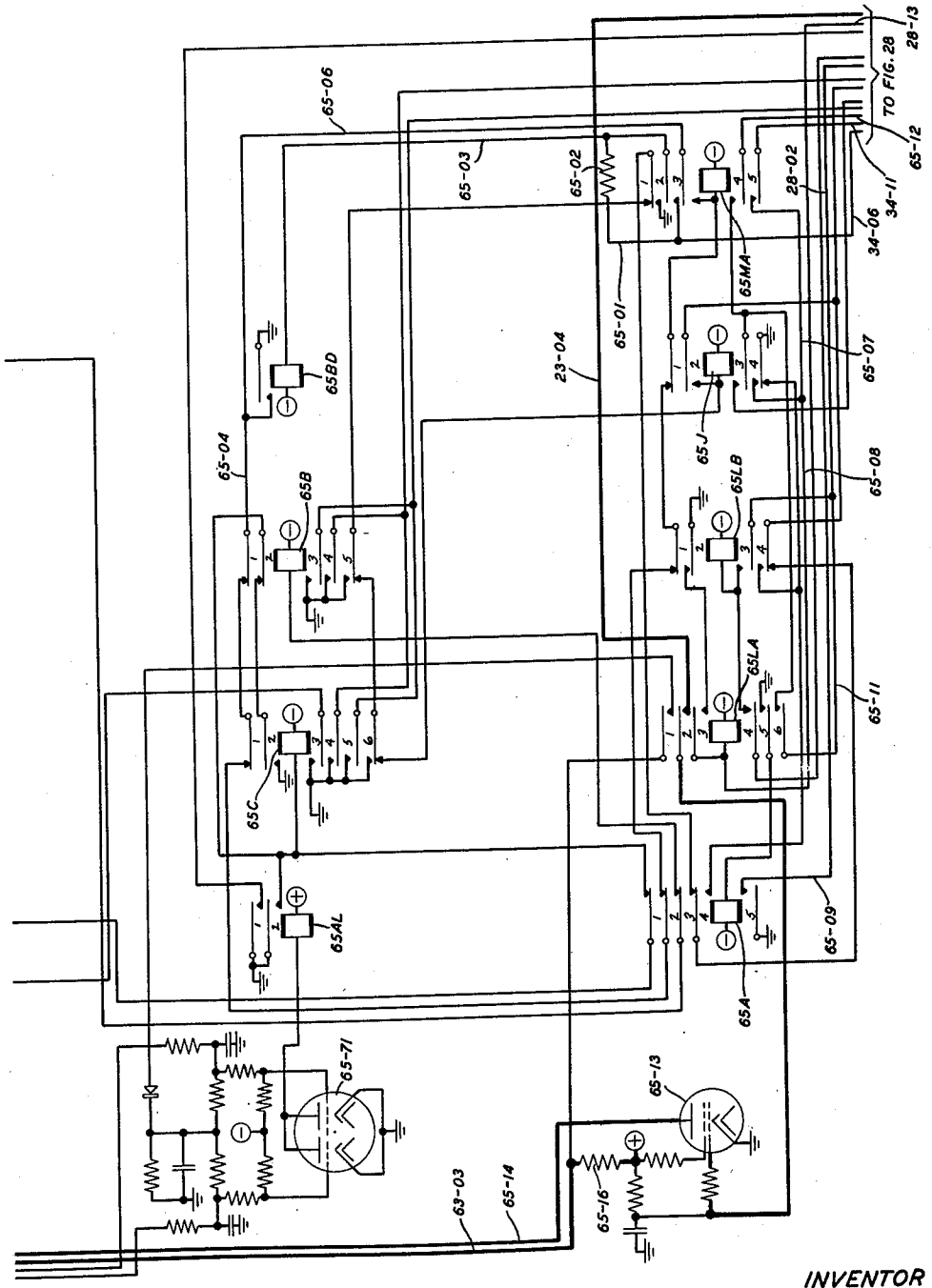


FIG. 65

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 66

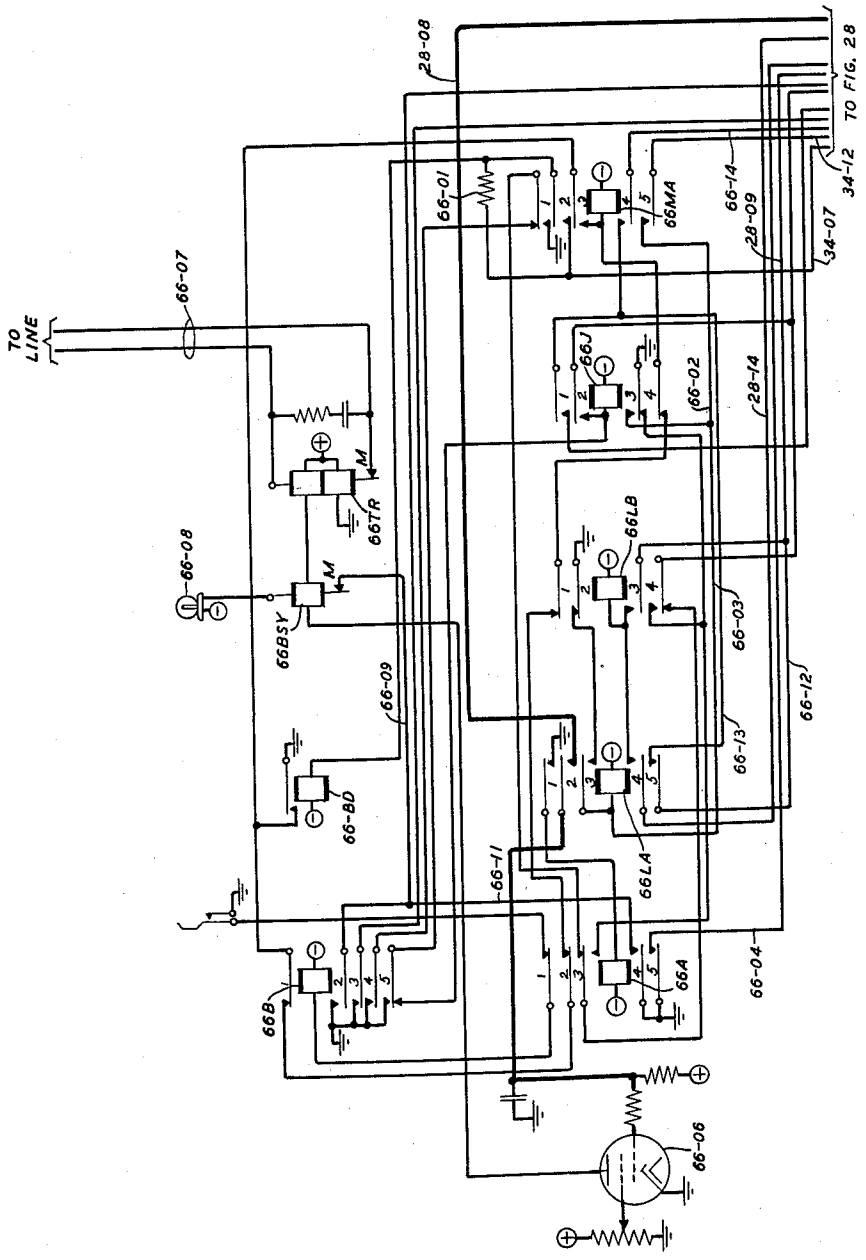


FIG. 66

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 67

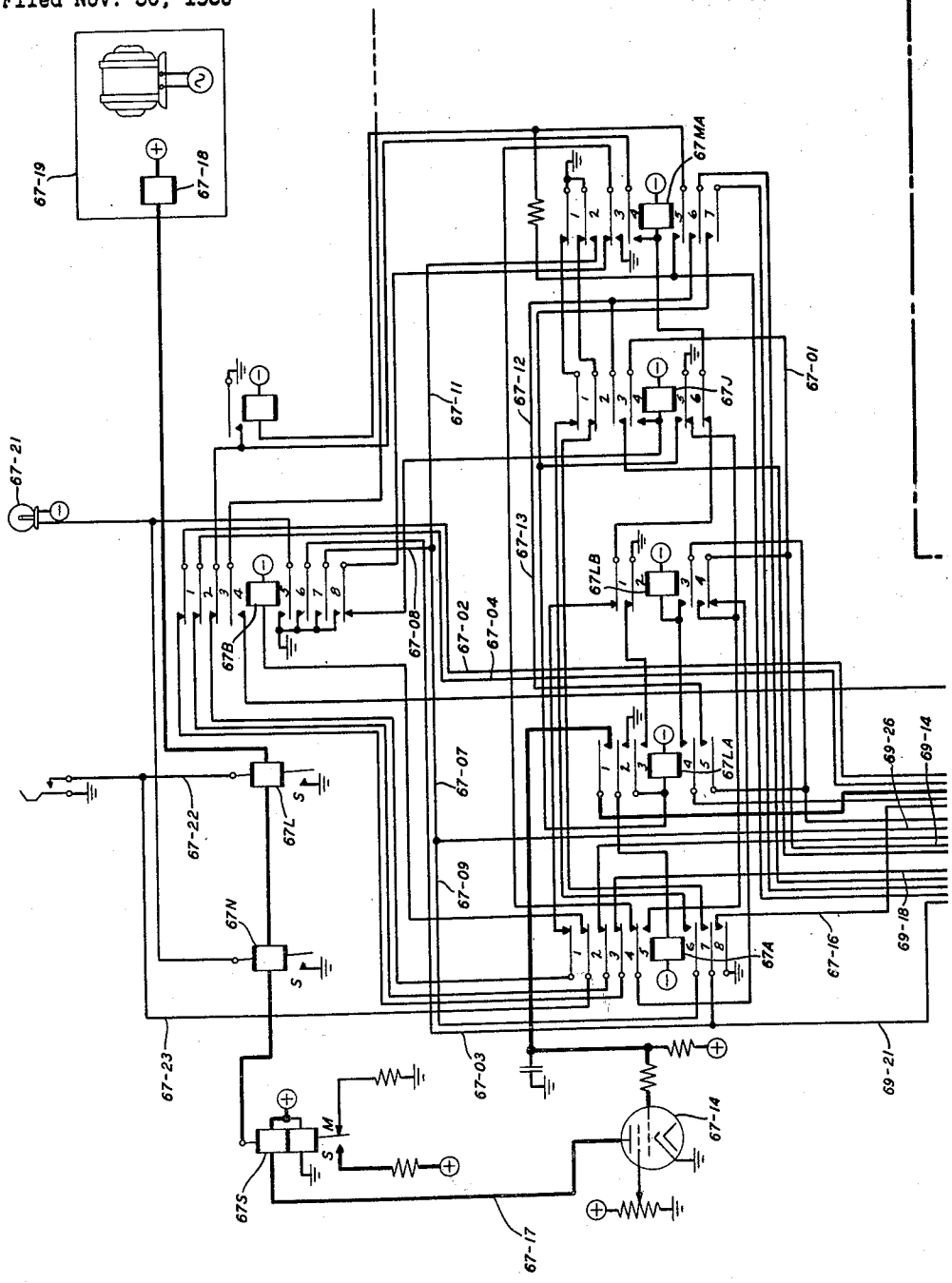


FIG. 67

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 68

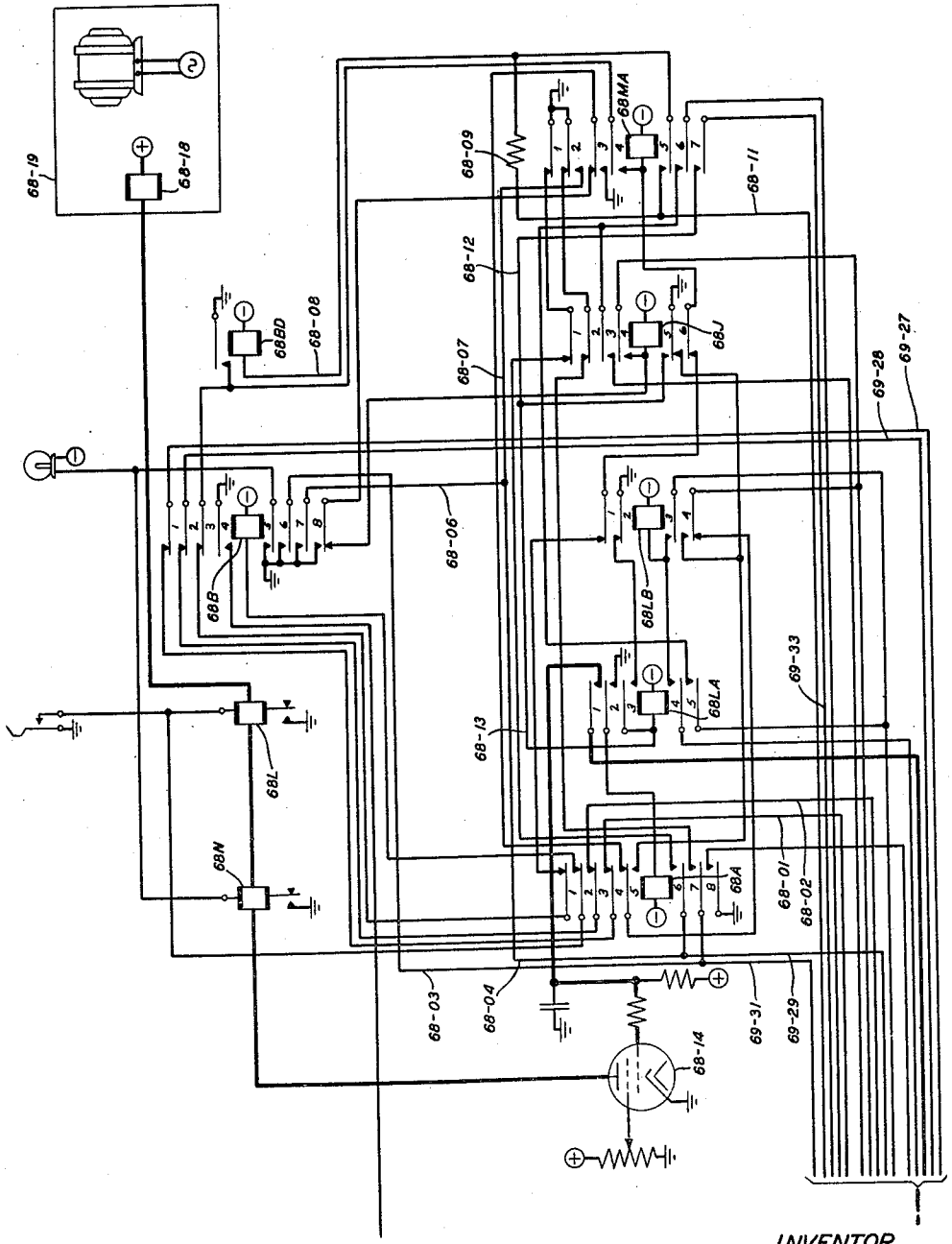


FIG. 68

INVENTOR
G. A. LOCKE
BY
R. C. Leary
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 69

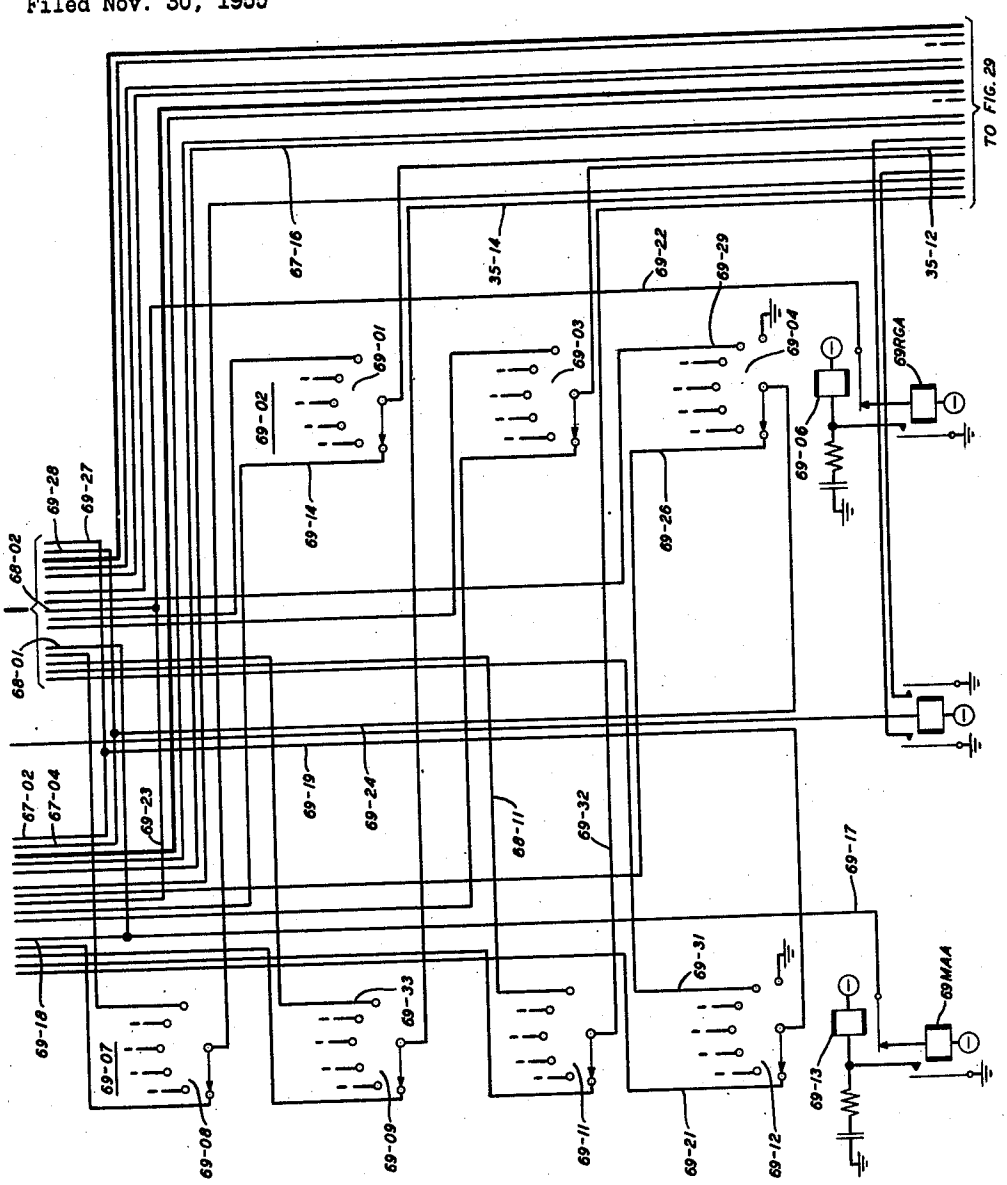


FIG. 69

INVENTOR
G. A. LOCKE
BY R. C. Leroy
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 70

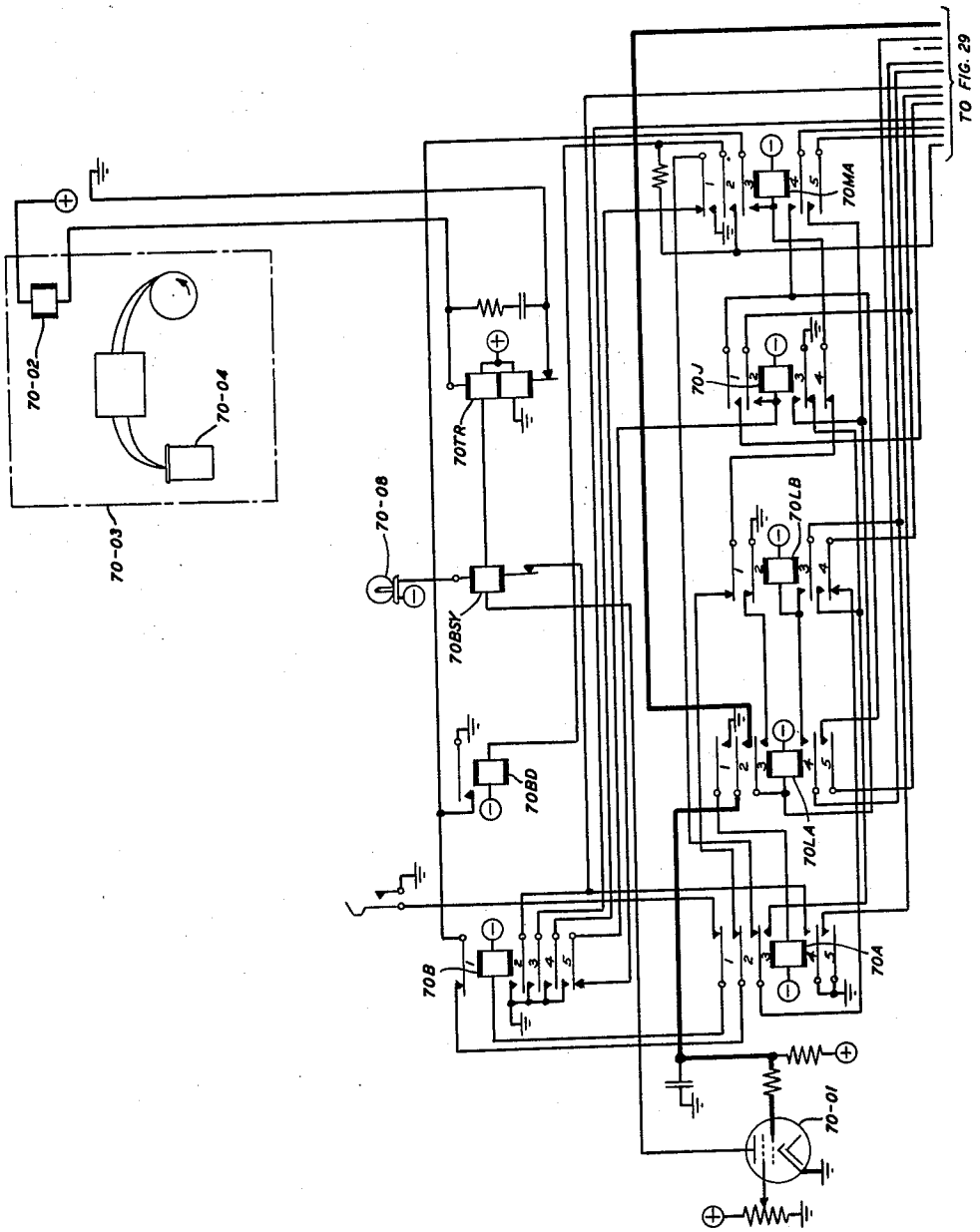


FIG. 70

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 71

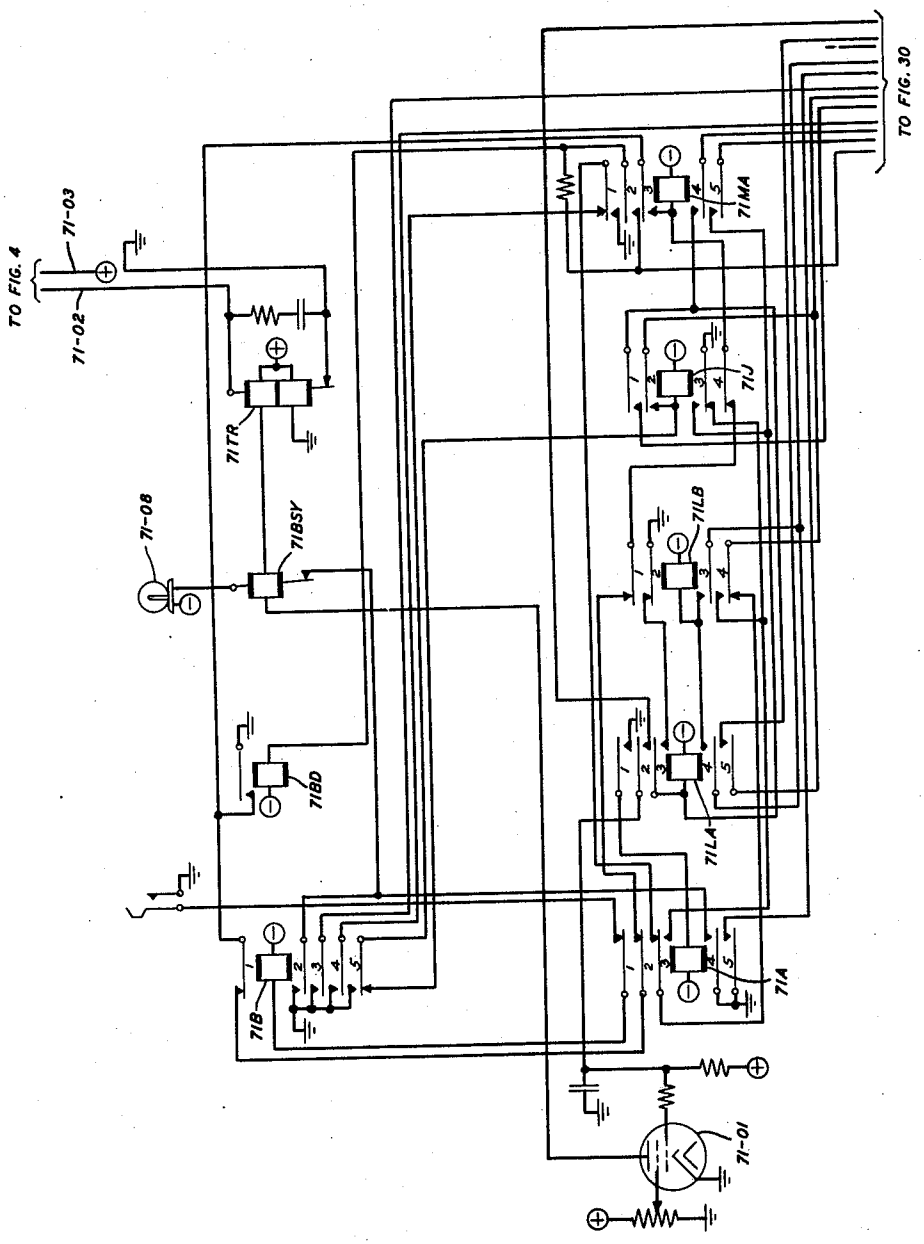


FIG. 71

INVENTOR
G. A. LOCKE
BY R. C. Terry
ATTORNEY

Dec. 8, 1959 G. A. LOCKE 2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

Filed Nov. 30, 1955 72 Sheets-Sheet 72

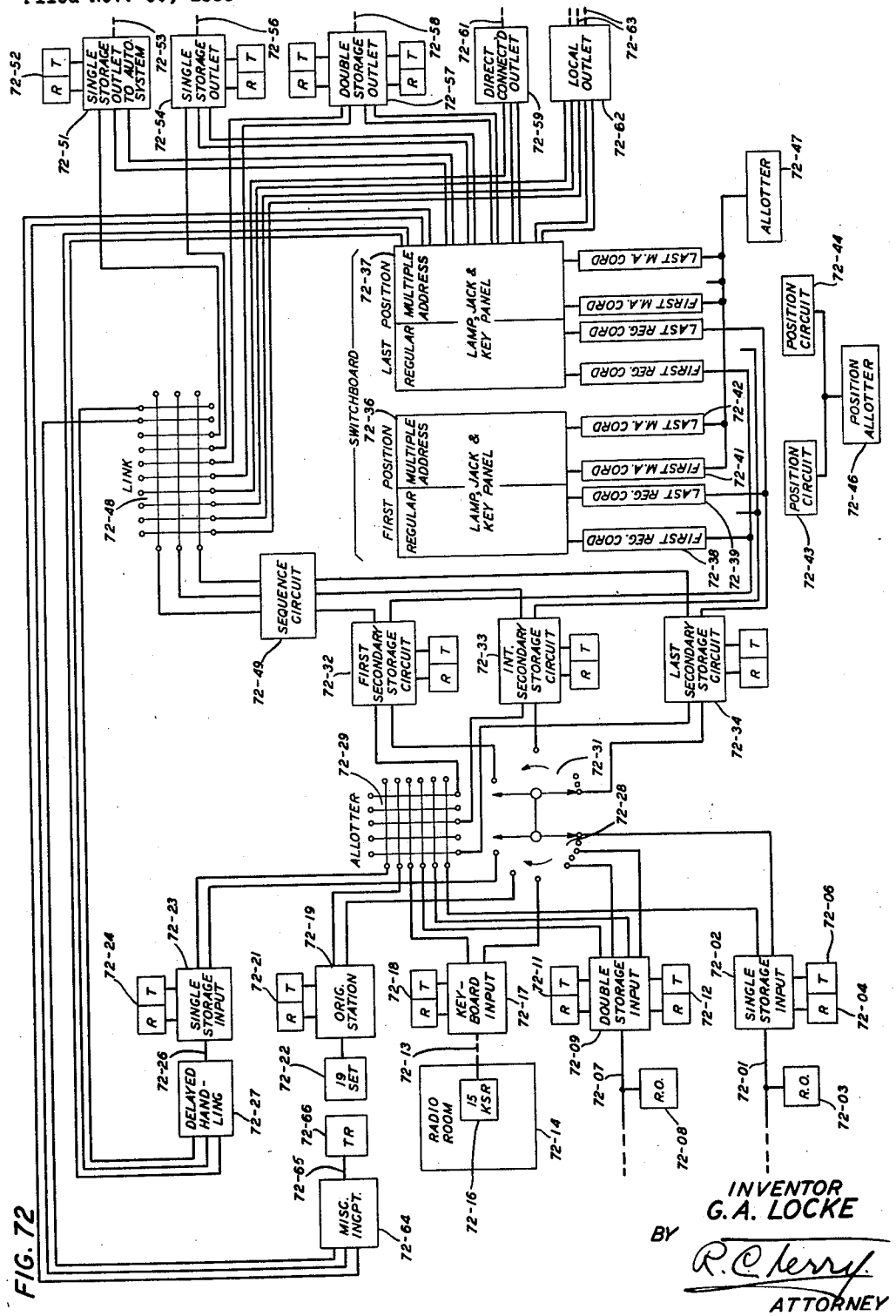


FIG. 72

INVENTOR
G. A. LOCKE
BY
R. C. Terry
ATTORNEY

United States Patent Office 2,916,542 Patented Dec. 8, 1959

2,916,542

SEMIAUTOMATIC TELETYPEWRITER SWITCHING SYSTEM

George A. Locke, Glen Head, N.Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

Application November 30, 1955, Serial No. 550,038

31 Claims. (Cl. 178—2)

This invention relates to teletypewriter switching systems, and particularly to semiautomatic switching arrangements in which the selective establishment of transmission connections in switching centers is accomplished under manual control and the disconnection of transmission paths thus established is accomplished automatically.

Completely automatic teletypewriter switching systems, in which the selective establishment of transmission connections in switching centers is automatically accomplished under the control of address code signals preceding messages, and the disconnection of the transmission paths occurs under the control of end-of-message signals concluding a message, are well known, such systems being disclosed in Patent 2,430,447, granted November 11, 1947, to D. E. Branson, F. S. Kinkead, J. A. Krecek and G. A. Locke, and in application Serial No. 119,184, filed October 1, 1949, by W. M. Bacon, G. J. Knandel, J. A. Krecek and G. A. Locke, now Patent 2,766,318, granted October 9, 1956. Systems of this type are particularly adapted for use as a private telegraph switching network, for the exclusive use of a customer, such as a large business organization having a substantial number of manufacturing or operating plants, locations or units separated from one another geographically. Trained operating personnel, having complete information as to the identity of and identifying data for all of the receiving stations in the system, may originate messages preceded by codes representing the identifying data or station designations and followed by end-of-message or disconnect codes. The station designation codes may be employed to control switching apparatus at one or more principal and/or secondary switching centers, to cause the message to be routed automatically to the destination or destinations designated by the identifying data or address codes, sometimes described as call directing codes. The disconnect codes are effective to restore or break down the transmission connections established under the control of the call directing codes.

For certain types of telegraph switching networks, it is not feasible to provide for the switching of transmission connections under the control of call directing codes. One circumstance under which such a situation could exist is that of a switching network serving a number of customers each having a plurality of transmitting and receiving stations associated with the network, each transmitting station originating messages not only for the receiving stations of the same customer, but also messages destined for the receiving stations of other customers. For example, a switching network may be handling message traffic for a plurality of airline companies. Because of the independence of those companies one from another, it may be inconvenient or unsatisfactory to assign call directing codes, supply all possible message originating points with schedules of all such codes, and employ the codes for automatic switching control. Some of the messages might originate in aircraft in flight, or at overseas and foreign points, or at stations of one airline and

have as their destinations one or more stations of another or other airlines, and in all such circumstances there might be good reasons for not supplying stations remote from the switching network with schedules of call directing code assignments, or relying upon such stations to properly preface messages with codes to control automatic switching apparatus.

The nearest approach to the ideal (full automatic) switching arrangement is a semiautomatic system, in which messages are preceded by the destination addresses expressed in words, so that the addresses may be read by operators who manually control the switching of transmission paths. Disconnections may be accomplished automatically under the control of a universal end-of-message code which even remote message originating stations may be depended upon to append to messages.

Accordingly, it is an object of this invention to provide a semiautomatic telegraph switching system in which the selective establishment of message transmission paths for routing messages to their destinations is controlled manually, and the disconnection of those paths is effected automatically.

Another object of the invention is to provide centralized switching positions for switching messages to their destinations.

Another object of the invention is to receive messages at incoming message storage positions and to transfer them to secondary message storage positions where they await routing to their destinations by manual control by operators.

Another object of the invention is to display the address of destination of incoming messages at the operator positions.

Another object of the invention is to transmit the address of destination of a message to an operator position for display concurrently with its transmission to the intermediate storage position.

Another object of the invention is to transfer any message to only one secondary storage position.

Another object of the invention is to display the address information preceding a message at only one operator position.

Another object of the invention is to give each secondary storage position access to a plurality of operator positions.

Another object of the invention is to cause a secondary storage position, when it is seized by an incoming message storage position, to seize an idle one of the operator positions to which that secondary storage position has access.

Another object of the invention is to delay the transmission of address information and the associated message from an incoming message storage position to a secondary storage position until an idle operator position has been seized to receive and display the address information.

Another object of the invention is to limit the storage of messages in the secondary storage positions to one message at a time.

Another object of the invention is to enable heavily loaded incoming lines to distribute their traffic among secondary or intermediate storage facilities without awaiting access to the addressed outlets.

Another object of the invention is to employ cord and jack facilities for switching operations at the operator positions, the cords and jacks having the function of controlling the establishment of transmission paths, but including no transmission paths themselves.

Another object is to continue transmission of address information and associated message to the seized operator position until suspended under the operator's control.

Another object of the invention is to suspend trans-

mission to an operator's position by intentional operation of a key, or incident to the insertion of a cord plug into a jack.

Another object is to provide facilities at operator positions for handling single address messages and multiple address messages.

Another object of the invention is to provide separate jacks for single address message access and multiple address message access to outlets.

Another object of the invention is to cause the insertion of a cord into a single address jack to effect seizure of the designated outlet, if idle, by the secondary storage position and initiation of transmission thereto.

Another object of the invention is to indicate to the operator when the seizure of an outlet by a secondary storage unit has been completed.

Another object of the invention is to deprive the cord and jack of any effective control over a transmission connection following completion of that connection, so that the time of removal of the cord is thereafter at the operator's discretion.

Another object of the invention is to preclude the seizure of a secondary storage position by a keyboard-controlled input until at least one entire message has been recorded in storage in that input.

Another object of the invention is to count complete messages into and out of storage in a keyboard-controlled storage input.

Another object of the invention is to permit seizure of an outlet by a secondary storage unit and beginning of retransmission to the outlet before or after recording of an entire message in the secondary storage unit.

Another object of the invention is to control the connection of a secondary storage unit to the multiple address circuit through a cord individual to the secondary storage unit and a jack in the multiple address jack field at an operator's position.

Another object of the invention is to control the connection of a secondary storage unit to a plurality of outlets for a multiple address message through a plurality of cords in the multiple address section and the jacks for the particular outlets in the multiple address jack field of an operator's position.

Another object of the invention is to enable an operator, in preparing connections for a multiple address message, to employ, in sequence in a given direction, cords in the multiple address cord section of the operator position, and if the number of cords is insufficient, to continue in the multiple address cord section of the operator position next in the same direction, if the first and succeeding cords in the same direction in that position are available.

Another object of the invention is to indicate the completion of the putting-up of cords for a multiple address message by the operation of a key.

Another object of the invention is to qualify the cords used for controlling the setting-up of multiple address message connections for removal from the several jacks at the discretion of the operator following the completion of all connections.

The invention features several different types of inputs to the switching center including: (*a*) single storage inputs, each comprising a single telegraph reperforator-transmitter terminating an incoming line or trunk circuit; (*b*) double storage inputs, each comprising two reperforator-transmitter units terminating an incoming line or trunk and adapted to be effectively associated with the line or trunk alternately for the recording of successive messages; (*c*) keyboard inputs, each similar to single storage inputs but terminating lines over which messages are received from keyboard operated transmitters, and arranged to be denied access to the secondary storage units until at least one entire message has been received and stored; (*d*) originating station, serving as a facility for introducing into the system messages

originating at the switching center, and comprising a keyboard operated perforator-transmitter and a single storage input unit, as described above, adapted to receive from the transmitter portion of the keyboard operated perforator-transmitter; and (*e*) one or more delayed handling inputs, serving as intercepts for messages, the retransmission of which must be delayed, perhaps on account of trouble on the line outgoing to the addressed station, or because that station is shut down, as in the case of a station in a different time zone, the delayed handling input comprising a single storage input, the nature of which has been described above, normally denied access to the secondary storage units except when a stored message is to be released from storage by release of the transmitter hold key by an attendant for transmission of the message to the addressed station, the delayed handling input receiving messages from one of the outlets of the same switching center, namely, a direct connected output, the nature of which will be described hereinafter.

The invention features several different types of outputs for the switching center including: (*a*) single storage outlets, each comprising a single telegraph reperforator-transmitter, the transmitter portion of which is associated with an outgoing cable, radio or land line circuit for transmission of messages to a remote station or switching center; (*b*) double storage outlets, each comprising two reperforator-transmitter units having their transmitter portions adapted to be effectively associated alternately with an outgoing transmission facility, such as a cable, radio or land line circuit for transmission of successive messages; (*c*) direct connected outlets which are terminations for outgoing transmission facilities that do not include message storage equipment, namely reperforator-transmitters, from which it follows that the transmission channels and the receiving equipment terminating those channels at remote stations must be arranged to operate at the same message transmission speed as the transmitters of the secondary storage units in the switching center; (*d*) single storage outlet serving as a message originating station of a private wire automatic message switching system, such as the one disclosed in Patent 2,430,447, hereinbefore more fully identified, and comprising a single reperforator-transmitter, the transmitter portion of which is controlled by a transmitter start circuit at a switching center of the automatic switching system as if the transmitter were one of the transmitters associated with a party line of the automatic switching system which in fact it may be; (*e*) local outlet, or multiple outlet, comprising a plurality of recording units on the premises of the switching center or at some office which is sufficiently near geographically to the switching center to be considered as a local message receiving point, the entire group of message recorders, numbering up to ten, being identified by a common address and being seizable on the basis of the next idle unit in a sequence as long as any remains idle, this type of outlet being comparable to the local or multiple outlet arrangement described in application Serial No. 119,184, filed October 1, 1949, hereinbefore more fully identified, and a different form thereof being described in application Serial No. 394,339, filed November 25, 1953, by J. A. Krecek and G. A. Locke; (*f*) delayed handling position or outlet comprising a direct connected outlet, the nature of which was hereinbefore described, connected to a single storage input serving as a delayed handling input position, also as previously described; and (*g*) a miscellaneous intercept comprising a typing reperforator to which operators route messages that cannot be routed directly to their destinations on account of some fault in the address information, these units having no transmitters by which the messages may again gain access to the secondary storage units, the message tapes, when corrected by an attendant to include the proper address information being inserted in the trans-

mitter of the originating station, from which they are switched to the designated outlets in the same manner as messages originating at the switching center.

In a switching center comprising inputs and outlets of the kind hereinbefore described, the recording of a message in any one of the inlets results in the registering of a bid by that inlet for access to a secondary storage recorder. As previously stated, the keyboard input circuit cannot bid for access to a secondary storage unit until it has at least one complete message in storage. The originating station cannot bid for access until a tape has been placed in the transmitter portion of its reperforator-transmitter and the transmitter set in operation by manual control. The bid for access to a secondary storage unit is in the form of an indication given to an allotter circuit that a message is waiting for delivery to an outlet. A selector switch, which is part of the allotter circuit, moves its wipers or contactors to the point on its contact banks corresponding to the calling input circuit. More than one input may have a message waiting and the selector will move to and stop on the first calling input that it encounters. The selector always moves in the same direction and, therefore, each input will be served in turn in a rotary sequence so that no input receives preferential treatment.

A similar rotary selector switch has contactors movable into registry with contacts indicating the next idle secondary storage circuit. When a calling input circuit matches with an idle secondary storage circuit, the input and the secondary storage circuit are connected together through a crossbar switch which is part of the allotter circuit. The selectors are then free to make other connections. A number of connections can be present in the crossbar switch at the same time, but the actual setting up of connections can be done only one at a time.

Each secondary storage circuit has associated with it one or more regular cord circuits which are located in operator positions of switchboards with not more than one regular cord of a secondary storage circuit in one operator position. In accordance with one embodiment of the invention, as many as ten cords may be associated with any secondary storage circuit, giving access between the secondary storage circuit and ten operator positions. When a secondary storage circuit is connected to an input, the teletypewriter of an idle operator, the next idle operator after the last one that has been made busy, is connected to the input, and a lamp individual to the cord of that secondary storage circuit is lighted at that operator position. An operator position is not considered idle if the teletypewriter at that position is connected to an input or if a cord for a message register at that position has not yet been plugged into the jack corresponding to the desired outlet.

Following the seizure of an idle operator position, the transmitter portion of the reperforator-transmitter unit of the particular input is set in operation to transmit to the secondary storage unit and to the teletypewriter of the seized operator position the address information followed by the text of the message. The operator, when she has received sufficient address information to determine the destination of the message, may terminate transmission to her teletypewriter by operating a key. This will not disturb the transmission to the secondary storage position which will continue until the complete message, followed by the disconnect signal, has been recorded in the secondary storage unit, whereupon that unit will be disconnected automatically from the input which had seized it.

The operator controls the establishment of a connection between the secondary storage unit and the outlet designated by the address information by plugging the cord of the particular secondary storage unit in the jack of the designated outlet. This operation automatically suspends the transmission to the operator position if that transmission has not been suspended previously by the operation of the key, as hereinbefore described. In the event that the operator neither operates the key nor puts up the cord before the transmission of the entire message from the input has been completed, transmission to the operator position, as well as to the secondary storage unit, will stop.

When the cord has been plugged into the jack for a single address message, the lamp that was lighted at the operator position, to indicate the cord circuit on which the message was waiting, is extinguished and a lamp of a different color lights if the operator had not suspended the transmission by operation of the key or, having been lighted when the operator suspended the transmission to her teletypewriter by the operation of the key, remains lighted. The latter lamp indicates that the cord has been put up, the operator's position circuit has been disconnected from the cord, and that an attempt is being made to connect the particular secondary storage unit to the selected output. If the selected outlet is busy, no further action takes place.

If the selected outlet is idle, or when it becomes idle, its availability is registered in all of the cords that are seeking to establish a connection to it, as there may be more than one secondary storage unit awaiting a connection, and a bid is made to a sequence circuit to obtain permission to establish a connection through a link circuit. The sequence circuit operates on a rotary basis, and a preference is given to the next secondary storage unit in rotary order following the last one to which a connection was made. The sequence circuit comprises a relay chain rather than a selector switch. When the cord circuit that has been put up is given permission to make a connection, the select magnet of the link circuit, which is a crossbar switch, corresponding to the particular secondary storage unit is operated, and a signal is given to the selected output circuit to operate the hold magnet, and the connection is made. Upon the completion of this connection the transmitter portion of the secondary storage unit is set in operation, the lamp at the operator position which had been lighted is extinguished, and another lamp of a still different color is lighted as a signal to the operator to remove the cord from the jack. Because the transmission does not take place through the cord, but instead takes place through the link circuit, the cord serves no further function and, circuitwise, it is completely nullified.

At the end of the message, the secondary storage circuit decodes the disconnect signal and causes the link circuit to release, disconnecting the secondary storage circuit from the outlet, making that secondary storage unit available to another input for the storing of a message, and making the outlet available to another secondary storage circuit if another connection for that outlet has been put up.

The operator's position circuit is arranged so that each time the teletypewriter is disconnected from an input, following the recording of message address information and such fragment of a message as the operator permits to be recorded, before the circuit is made idle and available to another input, the tape upon which the teletypewriter records the information is stepped forward a number of steps to provide a blank tape section following the recorded material. By this means a distinct division is made between successive message portions.

Messages may be accompanied by address information representing a single destination or a plurality of destinations. Messages having a plurality of destinations are called multiple address messages, and the operator permits all of the address information to be recorded before cutting off transmission to the operator position teletypewriter. In the case of a multiple address message, the operator inserts the plug of a regular cord, the cord of the secondary storage unit in which the multiple address message is being recorded, into the jack of the first idle multiple address cord, of which there are a

plurality in each operator position. It is necessary that there be enough idle cords, to the right of and including the one having the jack into which the regular cord has been inserted, to provide for connection to jacks of all the designated outlets in the multiple address jack field. The action of inserting the regular cord into the jack of the first idle multiple address cord causes the lighting of a lamp associated with the first multiple address cord, and the extinguishment of the first and lighting of the second lamp associated with the regular cord, as in the case of a single address message. This causes the operator's teletypewriter to be disconnected from the input, as in the case of a single address message, and this operator position is made available for another call. The particular operator position may be seized by another input, and the address information preceding the message may be recorded by the teletypewriter before the multiple address connection is completely set up. The setting up of the connection for this second call, and there can be only one, must await completion of the setting up of the multiple address connection.

Having inserted the regular cord in a multiple address jack, the operator inserts the cord pertaining to that jack into the jack appearance, in the multiple address jack field, of one of the designated outlets, and using other cords immediately to the right, the operator inserts those cords into the jack appearances of other outlets. The operator, following this procedure, may exhaust the available cords in her position and continue using idle multiple address cords of the operator position next to the right, using the cords in sequence. As an alternative, the operator, in setting up a multiple address connection, may begin with the first idle multiple address cord in the operator position to the left, exhausting the cords available in that position, continuing with idle cords in succession in her own position, and if she also exhausts them, continuing with cords in succession in the operator position at the right. Circuitwise, all the multiple address cords in the office comprise one group and, accordingly, may be used in groups at will.

When cords have been plugged into jacks representing all of the designated outlets, the key associated with the last cord inserted is operated. This causes the lighting of another lamp, of a different color, associated with the last multiple address cord used in setting up the particular set of connections. The operation of the key completes the work of the operator so far as the setting up of the multiple address information is concerned, and the operator is free to handle other calls.

The operation of the key associated with the last used cord results in the seizure of a selector which goes into operation, if not busy setting up another multiple address group of connections, to cause a multiple address bid to be made to all outlets associated with this multiple address group. As the outlets become idle, they will be seized on a priority basis, and when all have been seized, a signal is given to the sequence circuit by way of the secondary storage circuit to make a bid for the use of the link circuit. When the sequence circuit serves the secondary storage circuit having the multiple address message, the select magnet of the link circuit is operated, and this magnet causes the hold magnet of all of the selected outlets to be operated, thereby completing the connection between the secondary storage unit and all of the outlets involved. With all of the outlets connected, the transmitter portion of the secondary storage unit is set in operation to start transmission to the connected outlets. At the same time, the third lamp in the regular cord circuit, that is plugged to the jack associated with the first of the multiple address cords used, is lighted as an indication that this cord and all of the used multiple address cords should be removed. The order of removal of the cords is from right to left, beginning with the last multiple address cord used, proceeding leftwardly in the reverse order and ending with the regular cord of the particular secondary storage unit. The lighting of the third lamp associated with the regular cord results in the complete nullification of effectiveness of the cords so far as the outlets to which they were plugged are concerned.

It was previously mentioned that the multiple address cords have a priority over the regular cords in the seizure of outlets. Because of this arrangement, it is possible to handle a single address message on a priority basis. This is accomplished by treating the message as if it were a multiple address message, namely by plugging the regular cord for the particular secondary storage unit into an idle jack of the multiple address cord group and by plugging the cord associated with that jack into a jack for the designated outlet in the multiple address jack field and operating the key associated with the latter cord. By this means an outlet can be seized in a preferential manner over other secondary storage units seeking to seize the outlet on a regular basis.

When a message address, displayed on an operator's teletypewriter, represents a station or outgoing transmission channel that is shut down, the message cannot be immediately routed to the designated transmission channel. It may be that the channel is out of order or the station terminating the channel is out of order. It also may be that the station is merely not in operation at the time, perhaps because it is in a different time zone and opens for business later than or closes down earlier than the switching center serving it, or it may be shut down in observance of a local holiday. Whatever the cause of the inability to dispose of the message promptly, the operator may place the message in storage for later handling by plugging the regular cord into the jack for the delayed handling outlet, or in the case of a closed down station appearing among the addresses preceding a multiple address message, a multiple address cord may be inserted into a delayed handling outlet jack appearing in the multiple address jack field. There may be several delayed handling outlets, and they may be designated by number or otherwise individually identified, so that when a station is shut down, the operating personnel may be instructed to route messages for that station to a particular one of the delayed handling outlets.

As previously stated, the delayed handling outlet is identical with a direct connected outlet, which is the one directly connected to an outgoing transmission channel and having no reperforator-transmitter for storing and retransmitting a message received from a secondary storage unit. The transmitting channel of the delayed handling outlet is entirely within the switching center, and terminates in a single storage input which is identical with the single storage input units terminating incoming channels. The input portion of the delayed handling position is not given continuous access to the secondary storage units and the operating positions, because operators would be kept busy rerouting messages to the delayed handling outlet. Instead, when a station that has been shut down becomes available to receive messages, a transmitter hold control on the input side of the delayed handling position is disabled to permit the messages stored in the form of perforated tape to be processed. If messages for more than one station or outlet are in storage in a delayed handling position, those for other stations that are still under suspension may be rerouted by the operators to the delayed handling position, and those for the station that is now qualified to receive messages may be routed to it, thereby removing the latter messages from storage in the delayed handling position. When all of the messages for the station that has become available to receive have been transmitted, the transmitter hold control may again be activated to suspend further transmission from the delayed handling position.

In case the delayed handling position has a large

volume of material in storage, including only one or two messages for a particular station, it may be undesirable to permit the release of a large volume of material from the delayed handling position and the restoring of the same material in that position in order to reach the one or two messages. In such case, the portions of the tape containing the one or two messages for the particular station may be severed, and the remaining tape in the delayed handling position may be spliced to restore continuity of that tape. The severed portions may then be introduced, one at a time, into the originating station position, from which they may be routed to the addressed station in the same way as messages originating at the switching center, which are regularly introduced into the system at the originating station position.

It sometimes happens that massages are received at a switching center with garbled or incomplete address information so that an operator cannot readily determine the destination of the message. When such a message is received and the insufficient or defective address portion is displayed on the operator's teletypewriter, the operator inserts the regular cord of the secondary storage position in which the message is being stored into the jack of an outlet which is designated as a miscellaneous intercept. This outlet has a typing reperforator for recording the defective address and the message, but it has no retransmitting facilities. The tape emerging from such a reperforator usually feeds into a receptacle. The tape emerging from the miscellaneous intercept is examined by switching center personnel who undertake to determine, by the examination of the tape or by inquiry or other investigation, what the correct address data for the message should be. When this has been determined, a tape fragment may be prepared at the originating station position to contain the proper address information, and this may be substituted, by splicing, for the defective address information, whereupon the spliced tape may be placed in the transmitter portion of the originating station input. In due course, the corrected message tape will be given access to a secondary storage position, and the address information will be displayed at an operator position where a connection may be established to the indicated outlet, and the message accordingly routed to its destination.

In all of the inputs except the one that receives signals from a keyboard transmitter, the input makes a bid for connection to a secondary storage position and an operator position as soon as the reperforator portion of the input storage unit makes tape available to the transmitter portion thereof. In the case of all inputs except the keyboard input circuit, transmission over the incoming channel is from a tape transmitter so that, except for the possibility of trouble conditions, message reception from address to disconnect signal will be continuous. Thus an input may be given access to a secondary storage position as soon as the introductory portion of a message, comprising the address information, begins to be received, with reasonable assurance that there will be no delay or interruption in the reception of the message text and disconnect signals. In the case of messages received from keyboard transmitting facilities, there is no such assurance that transmission will be continuous. Transmission may be erratic, depending upon the capability of the operator at the keyboard, and there may be interruptions and delays having durations of moments or minutes. Such delays might occur anywhere in the transmission, including interruptions in the address portion of the message, which might tie up secondary storage positions and operator positions for unduly long intervals. To avoid delays of that sort, and also because circuits are provided to give alarms when the smooth flow of traffic through the switching center is interrupted, the keyboard receiving input circuits are not permitted to register a bid for access to a secondary storage position and to an operator position until a whole message has been received. The keyboard input circuits are provided with counting instrumentalities for counting messages received into storage, and messages completely transmitted therefrom. The counting instrumentalities prevent a message fragment following one or more complete messages in the storage tape of the keyboard input position from bidding for access to a secondary storage position and an operator position.

For a complete understanding of the invention, reference may be had to the following detailed description, to be interpreted in the light of the accompanying drawings, in which:

Figs. 2 to 5, when arranged as shown in Fig. 1, represent the circuits and apparatus of a single storage input serving a delayed message handling position;

Figs. 6 to 9, when arranged as shown in Fig. 1, comprise the circuits and apparatus of an originating station;

Figs. 10 to 13, when arranged as shown in Fig. 1, comprise the circuits and apparatus of a single storage input terminating a lightly loaded incoming line or trunk;

Figs. 14 to 20, when arranged as shown in Fig. 1, comprise the circuits and apparatus of a double storage input circuit terminating a heavily loaded incoming line or trunk;

Figs. 21 to 25, when arranged as shown in Fig. 1, comprise the circuits and apparatus of a single storage input terminating a channel having a keyboard transmitter as the regular source or origin of messages;

Figs. 26 to 53, when arranged as shown in Fig. 1, represent the circuits and apparatus of the switching facilities by which messages are routed from the several inputs to the several outlets;

Figs. 54 to 56 comprise the apparatus and circuits of a single storage outlet which is a point of transfer for introducing messages into an automatic teletypewriter switching system;

Figs. 57 to 62 comprise the circuits and apparatus of a double storage outlet;

Figs. 63 to 65 comprise the circuits and apparatus of a single storage outlet;

Fig. 66 comprises the circuits and apparatus of a direct connected outlet;

Figs. 67 to 69 comprise the circuits and apparatus of a local or multiple outlet;

Fig. 70 contains the circuits and apparatus of a miscellaneous intercept;

Fig. 71 contains the circuits and apparatus of the outlet portion of a delayed handling position; and

Fig. 72 is a schematic representation of an entire switching center with its various inputs and outlets, corresponding to the system represented in Fig. 1.

With further reference to the switching circuits and apparatus represented by Figs. 26 to 53, when arranged as shown in Fig. 1, Figs. 37, 44 and 51 comprise the circuits and apparatus of an allotter circuit by which the various inputs are given access to the secondary storage positions;

Fig. 26 contains a sequence circuit for controlling the order in which connections are established from the secondary storage positions to the outlets through the link circuit;

Figs. 31, 32, 38 and 39 comprise the first, and Figs. 45, 46, 52 and 53 comprise the last of a plurality of secondary storage positions;

Figs. 27, 28, 29 and 30 contain the link circuit or crossbar switch through which connections are established from the secondary storage positions to the various outlets;

Figs. 33, 34, 40, 41, 47 and 48 show the circuits and apparatus of the first of a plurality of operator positions; and

Figs. 35, 36, 42, 43, 49 and 50 show the last of the operator positions.

In the drawings, the reference numerals follow a plan in accordance with which relays are designated by nu-

merals and letters, the letters specifically identifying the relays, and the numerals identifying the figures of the drawings in which those relays appear. Reference numerals identifying conductors and other elements, excluding relays, include a dash, the numerals preceding the dash identifying the figure of the drawing in which the element identified appears, and the numerals following the dash being the individualistic portions of the reference characters and identifying the conductor or other element. In the case of a conductor extending through more than one figure of the drawings, the numerals preceding the dash identify the figure of the drawings in which the conductor is first identified as a circuit path. In the case of repetitious occurrence of circuits, for example, corresponding or identical portions of different inputs, different outlets or different operator positions, where only one has been described in detail, corresponding relays and other elements are identified by reference numerals differing only as to the figure identifications preceding the letters, in the case of relays, or the dash, in the case of other reference numerals, so that the detailed description may be read on any of the similar circuits by mental substitution of the prefix portions of the reference numerals. In a few instances, dashes may appear in the reference numerals identifying relays where, because of similarity between certain numerals and letters, as they appear in typed form, it might be difficult to determine what they were intended to be.

Referring now to the drawings, and particularly to Fig. 72, a schematic showing of a complete switching center, with the various types of inputs and outlets and the instrumentalities for effecting the cross-office transmission of received messages from the inputs to the outlets, will be described. Reference numerals 72–01 designates an incoming channel terminating in a single storage input circuit 72–02. A receiving-only teletypewriter 72–03 is connected to channel 72–01 for monitoring purposes, and may be of the type shown in Patent 1,904,164, granted April 18, 1933, to S. Morton, H. L. Krum and E. E. Kleinschmidt. A single storage input 72–02 is provided with a single reperforator-transmitter for recording in the form of perforations in a tape and for re-transmitting a message received over channel 72–01. The reperforator-transmitter has a reperforator portion 72–04 and a transmitter portion 72–06.

Incoming channel 72–07, which may also have a monitoring teletypewriter 72–08, terminates in a double storage input 72–09 which is provided with two reperforator-transmitter units 72–11 and 72–12. Successive messages received over channel 72–07 are routed alternately to reperforator-transmitters 72–11 and 72–12.

Incoming channel 72–13 originates at a remote point which is equipped only for keyboard transmission. For example, the point of origin of channel 72–13 may be a radio receiving station 72–14 which is equipped with a keyboard sending and receiving teletypewriter 72–16, which may be of the type shown in the Morton et al. patent hereinbefore identified. There is no provision for two-way transmission over channel 72–13, and the receiving or recording portion of keyboard sending and receiving unit 72–16 provides a local copy of message material transmitted by the keyboard transmitter over channel 72–13. Channel 72–13 terminates in a keyboard input circuit 72–17, which is somewhat like the single storage input 72–02, and is provided with a single reperforator-transmitter 72–18. The keyboard input unit differs from the single storage input in two principal respects, previously mentioned, namely that the routing of a stored message to the outlet designated by the accompanying address information cannot take place until the message has been completely received in storage, and complete messages are counted into and out of storage in the reperforator-transmitter 72–18.

Another of the inputs to the switch center is originating station 72–19, which has a single reperforator-transmitter 72–21. The source of signals for the originating station 72–19 is a teletypewriter unit, including a keyboard-controlled tape reperforator and associated tape transmitter 72–22. The unit, which may be employed for this service, is shown in Patent 1,965,572, granted July 10, 1934, to C. W. Burcky and A. H. Reiber.

The last of the inputs shown in Fig. 72 is a single storage input 72–23, which may be identical with single storage input 72–02 and which has a single reperforator-transmitter unit 72–24. The transmission channel 72–26, terminating in single storage input 72–23, is entirely local to the switching center, and originates in the delayed handling outlet 72–27.

The hereinbefore described inputs are representative of the various types of inputs that may be employed in the system, and it will be understood that there may be a plurality of any of the types described.

Each of the inputs has control conductors connected to contacts of a selector switch 72–28, over which the inputs register bids for access to the secondary storage circuits when the inputs have messages to be routed through the switching center. The several inputs also have transmission and control conductor paths to a link circuit 72–29, which may be in the form of a crossbar switch through which transmission connections are established from the inputs to the secondary storage circuits. The transmission and control connections from the inputs may enter the crossbar switch on the horizontal conductors of the switch.

Selector switch 72–28 operates as a finder to search out inputs that are bidding for access to the secondary storage circuits. A companion selector switch 72–31 has as its purpose the finding of idle ones of the secondary storage circuits, of which there should be a sufficient number to accommodate traffic through the switching center and prevent excessive accumulation of messages in the inputs. The reference numerals 72–32, 72–33 and 72–34 designate the first secondary storage circuit, an intermediate secondary storage circuit and the last secondary storage circuit, respectively. Each of the secondary storage circuits is provided with a reperforator-transmitter unit like those associated with several inputs, the function of which is to receive from an input and store complete messages, including the address information preceding the message and the disconnect signals at the end of the message. In addition to control connections between the contacts of selector switch 72–31 and the several secondary storage circuits, there are also control paths and transmission paths connected from the vertical conductors of crossbar switch 72–29 to the secondary storage circuits.

One of the objects of the invention, as stated in the foregoing, is to enable heavily loaded incoming lines to distribute their traffic among secondary or intermediate storage facilities without awaiting access to the addressed outlets. It has also been mentioned that selector switch 72–31 has as its purpose the finding of an idle secondary storage circuit, of which there should be a sufficient number to accommodate traffic and prevent excessive accumulation of messages in the input. To elaborate this, attention is called to the fact that if cross office connections were established directly from an input circuit, such as for instance, from double input storage circuit 72–09, to an outlet circuit, such as to single storage outlet circuit 72–54, through the agency of the other facilities, but not including the secondary storage circuits and their necessary complementary circuitry, assuming these latter were not provided, the system would be much less flexible and efficient. What is meant by this is the following: Assume that line 72–07 is heavily loaded and that there are two messages stored in and other messages waiting for access to double storage input 72–09. Assume that the first message must pass through single storage outlet 72–54 to its destination and that the outlet is busy. The messages following the first, even though intended

for transmission through other outlets which are presently available, would be delayed until the first message had cleared. The incoming messages in the present invention are first directed to any secondary storage circuit which may be available. At times during which a particular incoming circuit such as 72–07 may have many incoming messages, three or four or more of them may be directed in rapid succession, by means of switches 72–28 and 72–31 and allotter 72–29, to three or four or more different secondary storage circuits, such as 72–32, 72–33 and 72–34, from where they may be directed to their respective destinations through the outlet circuits. Messages in a particular input circuit following one for which an outlet circuit is not available may therefore pass through the switching center ahead of the delayed message if they are destined to pass through other outlets.

Operator positions, namely the first and last, are designated by the reference numerals 72–36 and 72–37. Each operator position comprises regular and multiple address sections, each such section having a lamp, jack and key panel, and a plurality of cords, the first and last regular cord of position 72–36 being designated by the reference numerals 72–38 and 72–39, respectively, and the first and last multiple address cords of position 72–36 being designated by reference numerals 72–41 and 72–42. Each operator position has a position circuit which includes a teletypewriter on which the address information preceding messages is displayed, the position circuit for operator position 72–36 being designated by reference numeral 72–43, and the position circuit for operator position 72–37 being designated by reference numeral 72–44. The seizure of operator position circuits for the recording of address information to enable the operators to control the establishment of cross-office transmission connections is controlled by a position allotter 72–46 which seizes the operator positions in rotation upon the basis of the next idle position after the last one that was seized.

The multiple address mechanism includes, in addition to the multiple address lamp, jack and key panels, and the multiple address cords, such as cords 72–41 and 72–42, an allotter circuit 72–47 by means of which the multiple address cords are made available sequentially for the establishment of connections to a plurality of outlets by insertion of the cords into jacks in the multiple address panels.

Transmission paths from the several secondary storage circuits extend to the horizontal conductors of the link circuit 72–48, which is a crossbar switch. A sequence circuit 72–49 gives the secondary storage circuits access to the link circuit for the purpose of establishing transmission connections one at a time and in succession. Connections from a plurality of secondary storage circuits through the link circuit to outlets may exist concurrently, but the link circuit is available for the establishment of transmission connections to one secondary storage circuit only at a time.

The several different types of outlets are shown at the right of Fig. 72. One of those outlets, designated by the reference numeral 72–51, is a single storage outlet serving as a station of an automatic teletypewriters switching system and, therefore, as a point of transfer of messages from the semiautomatic switching system represented in Fig. 72 to the automatic teletypewriter switching system which is not shown. Outlet 72–51 has a single reperforator-transmitter 72–52, and the transmission channel outgoing from the outlet is designated 72–53.

Another single storage outlet is designated by reference numeral 72–54, and its transmission channel 72–56 may extend as a line to a remote station, or as a trunk to a remote switching center.

A double storage outlet, provided with two reperforator-transmitters, is designated by the reference numeral 72–57. The two reperforator-transmitters are available for concurrent reception of two different messages from two of the secondary storage circuits, and the transmitter portions of those reperforator-transmitters have access alternately to outgoing transmission channel 72–58.

The direct connected outlet 72–59 has no reperforator-transmitter units, and message signals from a connected secondary storage unit are transmitted directly from the secondary storage unit over outgoing transmission channel 72–61 without being intermediately stored. Local outlet 72–62 is also a direct connected outlet, in that it has no message storage facilities, and it has a plurality of outgoing transmission channels 72–63 extending to a like number of teletypewriter receivers which may be located in one office. Local outlet 72–62 accommodates the situation in which there may be more traffic for a local receiving office than one receiving teletypewriter will accommodate. There is no selection among the teletypewriters terminating the transmission channels 72–62, but instead, the next idle one in a rotational sequence is seized for recording a message so long as there is one idle receiver.

The delayed handling position, previously identified by the reference numeral 72–27, is in effect a direct connected outlet, and its transmission channel 72–26 terminates in the supervised single storage input 72–23. As in the case of the other outlets, the transmission path leading to the delayed handling position 72–27 is connected to a set of vertical conductors of the link circuit 72–48.

Finally, there is a miscellaneous intercept 72–64, which is also in the nature of a direct connected outlet, and is seizable by an operator for the recording of a message which has defective address information accompanying it. The transmission channel 72–65 from miscellaneous intercept 72–64, being wholly within the switching center, terminates in a typing reperforator 72–66 which records the defective address information, the ensuing message and the end-of-message signals. As previously stated, tape emerging from typing reperforator 72–66 is severed on an individual message basis, and after being corrected, is reintroduced into the system at the originating station position 72–19.

Reperforator-transmitters, of which a number are indicated in Fig. 72, and are designated by various reference numerals, including the reference numerals 72–12, 72–11 and 72–18, may be of the type shown in Patent 2,348,214, granted May 9, 1944, to E. A. Gubisch, and may include a tape feed indicating contact mechanism, such as that disclosed in Patent 2,418,464, granted April 8, 1947, to T. L. Corwin. The typing reperforator 72–66 may be of the type shown in Patent 2,042,788, granted June 2, 1936, to H. L. Krum, or Patent 2,255,794, granted September 16, 1941, to R. A. Lake. The disclosures of the several patents above identified are incorporated herein by reference as part of the present specification as if fully disclosed herein.

Typical method of operation of the system

As indicated hereinbefore, telegraph messages comprising address information, the text of the message and a disconnect signal may be received from a remote station over any of the incoming channels by any of the inputs. Since the switching operations are performed manually, the address information may be expected to be in text form. An exception to this might be a message for the outlet 72–51, a station of an automatic switching system. In order for a message to be handled automatically in that switching system, it must be preceded by address codes which a director circuit decodes for the purpose of controlling the switching mechanism. It is not unusual for the address information to appear in text form as well as in switching code form in messages handled in the automatic switching system, in order that information indicating the destination of the message shall be available if the automatic switching address codes should become garbled or mutilated. In the case of a message intended

for outlet 72–51 of the automatic switching system, the automatic switching address codes should precede the text address information in order that the latter information shall not become separated from the message and lost.

The disconnect code is a sequence of signals, and for the purpose of the present invention, the sequence that has been assigned as a disconnect signal is the code combination for Figures, which is the upper case shift code combination, followed by the code combination for H and concluding with the code combination for Letters, which is the lower case or unshift code. This sequence of codes is employed as the disconnect signal in the automatic switching system disclosed in the Branson, Kinkead, Krecek and Locke patent and in the Bacon, Knandel, Krecek and Locke application hereinbefore identified. As will be more fully set forth hereinafter, it serves in the present invention for effecting the automatic disconnection of cross-office paths that had been established from inputs to intermediate or secondary message storage positions, or from such positions to outlets for the retransmission of messages.

Reception of message by single storage input

It will be assumed that a message containing the necessary switching information and the disconnect signals begins to be received by the single storage input 72–02, the detailed circuits of which are contained in Figs. 10 to 13, to which reference will now be had. The incoming transmission channel for single storage input, designated 72–01 in the diagrammatic representation of the entire system, is found in Fig. 12 to comprise conductors 12–01 and 12–02 forming a loop, including the operating windings of repeating relays 12L and 12LA. The biasing windings of relays 12L and 12LA are connected in series in a circuit from battery through resistor 10–01, right-hand break contacts of key 10–02, conductor 10–03, biasing windings of relays 12L and 12LA, conductor 12–03, and left-hand break contacts of key 10–02 to ground. The armature of relays 12L and 12LA are normally held in engagement with their marking contacts by current in the loop conductors 12–01 and 12–02. When current in the loop conductors is cut off, which is the spacing condition, the current through the biasing windings of relays 12L and 12LA operates the armatures away from the marking contacts.

The armature of relay 12L is grounded and the marking contact is connected over conductor 12–04, selector magnet 10–04 of the reperforator mechanism 10–06 of the single reperforator-transmitter with which the input is provided, the path continuing from the select magnet over conductor 10–07 and resistor 13–01 to positive battery. Current through this path, when the armature of relay 12L engages the marking contact, holds selector magnet 10–04 of the reperforator energized, which is the marking condition.

As the selector magnet 10–04 responds to incoming signals, those signals are perforated in tape 10–08 which feeds out of reperforator 10–06. As is fully disclosed in Gubisch Patent 2,348,214, the transmitting head 10–09 of the transmitter portion of the keyboard transmitter will normally be resting against the perforating head 10–11 due to previous transmission, up to and including the last character previously perforated in the tape. It is a characteristic of the reperforator-transmitter unit that when tape is being perforated but not transmitted, the tape emitted from the reperforator pushes the transmitting or tape-sensing head 10–09 away from the perforating head a predetermined distance as limited by a stop, after which tape continuing to emerge from the reperforator unit forms a depending loop. When tape is no longer being perforated but signals are being transmitted therefrom, the transmitting or tape-sensing head 10–09 steps the tape with respect to itself, thereby taking up the loop of tape until the loop has been exhausted and the tape is taut. Further operation of the tape stepping mechanism of the transmitting head causes the head to move with respect to the tape and toward the perforating head until the last code combination is reached and transmitted, and in this condition, the tape-sensing or transmitting head 10–09 rests against the reperforator head.

Consequently, the tape-sensing or transmitting head 10–09 will be in that position prior to reception of signals, but as soon as signals begin to be recorded in tape 10–08 by reperforator 10–06, the tape-sensing head 10–09 will be moving clockwise and contacts 10–12, which it controls, will be permitted to close. These contacts are shown closed in Fig. 10, and a circuit may be traced from ground over conductors 10–13 and 12–06, unidirectional current conducting device 12–07 and winding of relay 12TS to battery, and the relay operates. From conductor 10–13 another conductive path is traced over conductor 12–08, armature 1 and back contact of relay 11TA, conductors 11–01 and 11–02, armature 1 and back contact of relay 11DA, armature 1 and back contact of relay 11DC, armature 4 and back contact of relay 11HM, conductors 11–03 and 11–04, armature 1 and back contact of relay 12TO, conductor 12–09, back contact and armature 1 of relay 13ST, armature 1 and back contact of relay 13MA, conductor 13–02 and the winding of transmitter clutch magnet 10–14 of reperforator-transmitter 10–06, and the clutch magnet operates in a circuit paralleling that of relay 12TS. Magnet 10–14 trips clutch 10–16 for driving shaft 10–17. The shaft carries cams which cause the perforations in tape 10–08 to be sensed by tape-sensing levers 10–18, and through transfer cam 10–19 it causes transfer levers 10–21 to test the setting of sensing levers 10–18 and to position slide members 10–22 in accordance with the signal condition, the slide members being shifted to their uppermost positions for a marking condition and to their lowermost positions for a spacing condition. The slide members 10–22 in turn control contact operating members 10–23, camming those members rightwardly for a marking condition and leaving them presented leftwardly for a spacing condition. After the shaft 10–17 has rotated through part of a revolution, transmitter auxiliary contacts 10–24 close and extend ground over conductors 10–26 and 12–11, back contact and armature 7 of relay 11HM and winding of relay 11TA to battery, and the relay operates.

Relay 11TA locks in a path traced from the right-hand terminal of its winding through its front contact and armature 3, conductor 11–28, armature 3 and back contact of relay 11DC, and the back contact and armature 2 of relay 11HM to ground. The energizing circuit for the transmitter clutch magnet 10–14 was traced through the armature 1 and back contact of relay 11TA, so that with the relay operated, clutch 10–16 will become disengaged and arrest shaft 10–17 at the end of one revolution, and magnet 10–14 will remain released.

At about the same time that the transmitter auxiliary contacts 10–24 closed, the distributor clutch release contacts 10–27 close, extending ground over conductors 10–28 and 10–29 and the winding of distributor clutch magnet 10–31 to battery, and that magnet operates. Magnet 10–31 permits clutch 10–32 to become engaged to drive distributor shaft 10–33. The distributor shaft 10–33 has cams for operating distributor contact levers for transmitting code combinations. With the distributor shaft now set in operation, these contacts attempt to transmit the code combination that has been set up on transmitter contacts controlled by slides 10–23, the transmitter contacts being the make contacts at the extreme left of the contact sets controlled by the slide members 10–23. Because of the fact that no cross-office path has yet been established for the transmission of the signal to a receiving point, the code combination is not effectively transmitted. Shortly

after shaft 10–33 begins to operate, it closes distributor auxiliary contacts 10–34 which extend a ground connection over conductors 10–36 and 11–06, armature 1 and back contact of relay 11DB, conductors 11–07 and 11–08, front contact and armature 4 of relay 11TA, conductors 11–09 and 11–11, and winding of relay 11DA to battery, and that relay operates. At its armature 2 and front contact, the relay 11DA prepares a locking circuit for itself, traced from the right-hand terminal of the relay through that armature and front contact, the winding of relay 11DB, armature 2 and back contact of relay 11DC, conductors 11–12 and 11–13, and back contact and armature 1 of relay 11HM to ground. This path includes the winding of relay 11DB, but the locking circuit for relay 11DA, including the winding of relay 11DB, cannot become effective until the ground connection supplied over the original energizing circuit for relay 11DA, including conductor 11–11, is removed.

With transmitter shaft 10–17 arrested at the end of one revolution and distributor clutch release contacts 10–27 opened, before the end of that revolution, the distributor clutch magnet 10–31 releases and limits distributor shaft 10–33 to one revolution by causing the disengagement of clutch 10–32. Distributor auxiliary contacts 10–34 open, before the end of the revolution of shaft 10–33, disconnecting ground from which the relay 11DA was operated, and permitting the locking circuit for that relay, including the winding of relay 11DB, to become effective so that the latter relay operates.

It will be noted that the operating circuit for relay 11DB was traced through the armature 2 and back contact of relay 11DC. This relay is operable to effect the discarding of certain code combinations that may appear in the tape, specifically the Blank code combination, which has all of its elements of spacing nature, and the Letters signal, which has all its elements of marking nature. The Letters signal is frequently inserted repetitiously before or after a message, as an idle signal and as a means for providing time for the accomplishment of automatic operations, such as disconnect signals. The Blank signal may also be introduced under similar circumstances, or a succession of blanks may appear in a tape, preceding a message, under the circumstance that a new reel of tape is placed in the reperforator. With the transmitter contact slides 10–23 set in accordance with either the Letters or the Blank signal, ground will be extended over conductor 10–37, front contact and armature 3 of relay 11DA, back contact and armature 8 of relay 11TR, conductors 11–14 and 11–16, and winding of relay 11DC which would operate. If relay 11DC operates, it prevents the operation of relay 11DB, and it interrupts, at its armature 3 and back contact, the locking circuit for relay 11TA which accordingly releases. If relay 11TA releases, the relay 11DA cannot remain operated and will release, in turn releasing relay 11DC. With those three relays released, the energizing circuit for transmitter clutch magnet 10–14 is reestablished and transmitter shaft 10–17 operates through another cycle to advance the next code combination into sensing position, and the cycle will be repeated until a code combination other than Blank or Letters is sensed by tape-sensing levers 10–18. When this occurs, relays 11TA and 11DA operate in succession, and because relay 11DC does not operate, relay 11DB operates before the arrestment of distributor shaft 10–33, a cycle of which accompanies each cycle of transmitter shaft 10–17.

Relay 11DB completes a circuit for relay 13STC, traced from battery through the winding of the latter relay, break contacts controlled by its armature 3, back contact and armature 1 of relay 13TH, conductors 13–03 and 13–04, front contact and armature of relay 12TS, which was previously operated from the transmitter stop contacts 10–12, conductor 12–12, front contact and armature 2 of relay 11DB, back contact and armature 1 of relay 11TR, and break contacts controlled by armature 6 of relay 11HM to ground, and over this circuit relay 13STC operates.

Relay 13STC locks through its front contact and armature 3 and conductor 13–06 to conductor 13–04, the path continuing to the ground connection supplied through the break contacts controlled by armature 6 of relay 11HM. Relay 13STC calls upon the secondary storage circuit allotter which is contained in Figs. 37, 44 and 51 to locate an idle secondary storage circuit and associate it with the single storage input circuit contained in Figs. 10 to 13.

Seizure of idle secondary storage circuit

The secondary storage circuit allotter consists of two selector or stepping switches, contained in Fig. 37, and a crossbar switch, contained in Figs. 44 and 51. One of the selector switches, designated 37–01 and having contact banks 37–02, 37–03 and 37—04, is operable by stepping magnet 37–06 to seek and find an input that is bidding for access to a secondary storage circuit. The other selector switch, designated 37–07, and having contact banks 37–08, 37–09 and 37–11, is operable by stepping switch 37–12 to seek and find an idle secondary storage circuit.

Only enough contacts have been shown in each contact bank of switch 37–01 to accommodate the several inputs shown in Figs. 2 to 25, inclusive. Switches of this type usually have a maximum of twenty-two contacts per contact bank. When a switching center involves more than twenty-two inputs, a total of six contact banks may be employed in selector switch 37–01 to provide three pairs of contact banks, and one end of each double-ended contactor may be removed, so that in a half revolution of the contactor shaft, the contactor of one contact bank of a pair will traverse its contacts, and in the next half-revolution of the shaft, the contactor of the other contact bank of the pair will traverse its contacts. The same method may be employed for increasing the selective possibilities of selector switch 37–07 if more than twenty-two secondary storage circuits are required by the volume of traffic to be handled by the switching center. The contactors of switch 37–01 and 37–07 may occupy any positions, and it will be assumed that at the instant that the single storage input circuit makes its bid for access to a secondary storage circuit, they occupy the positions shown in Fig. 37. A normally closed energizing circuit for relay 37LSA is traced from battery through resistor 37–13, break contacts controlled by stepping magnet 37–06, back contact and armature 2 of relay 37LS, and winding of relay 37LSA to ground. Similarly, a circuit will be traced from battery through resistor 37–14, break contacts of stepping magnet 37–12, back contact and armature 2 of relay 37MS and winding of relay 37MSA to ground, and that relay will be operated. A path is thus established from the contactor associated with contact bank 37–02, through the back contact and armature 3 of relay 37LS, the armature and front contact of relay 37LSA, front contact and armature of relay 37MSA, and armature 1 and back contact of relay 37MS to the contactor associated with contact bank 37–08 of switch 37–07. The significance of this path will be described later.

When relay 13STC operates as previously stated, an energizing circuit for relay 37LS is established, the circuit being traced from battery through resistor 37–13, break contacts controlled by stepping magnet 37–06, winding of relay 37LS, conductors 37–16, 44–01, 44–02 and 44–03, front contact and armature 5 of relay 13STC, conductors 13–07, 44–04, 44–06 and 44–07 to the contactor associated with contact bank 37–04. From the contact engaged at this time by that contactor, the path is continued over conductor 37–17, back contact and armature 1 of relay 20STC2, and back contact and armature 4 of relay 20HM2 to ground. Relay 20STC2 is part of the circuit of the double storage input, and assuming that that input is not bidding for access to a

secondary storage circuit, the relays 20STC2 and 20HM2 will be unoperated and ground will be supplied to cause the operation of relay 37LS. At its armature 1 and front contact, the latter relay completes the circuit of stepping magnet 37–06 which operates, interrupting, at its break contacts, the energizing circuit for relay 37LS, which has already interrupted, at its back contact and armature 2, the energizing circuit for relay 37LSA. With relay 37LS released by stepping magnet 37–06, the circuit of the stepping magnet is interrupted at the armature 1 and front contact of relay 37LS and the stepping magnet releases, advancing the contactors of switch 37–01 one step. If there is a ground on the next contact of contact bank 37–04, and there will be if the input associated with that contact is not bidding for access to a secondary storage circuit, the relay 37LS will again be operated to cause the advancement of the contactors of switch 37–01 another step.

Two steps of the contactor associated with contact bank 37–04 will be required, based upon the number of contacts shown, to reach contact 37–18. From that contact, a path extends over conductor 37–19 to the back contact associated with armature 1 of relay 13STC. That armature has ground from armature 3 and back contact of relay 11HM over conductors 11–17 and 13–08, relay 11HM being unoperated, but because relay 13STC is operated, ground has been removed from contact 37–18 of stepping switch 37–01. When the contactor reaches this contact, there is no ground connection for reoperating relay 37LS, and it remains released, preventing the reoperation of stepping magnet 37–06. With relay 37LS and stepping magnet 37–06 released, relay 37LSA reoperates and remains operated. The allotter circuit has now located the input circuit that registered a bid for connection to a secondary storage circuit.

It remains for the allotter circuit to find the next idle secondary storage circuit. In actuality, each time the allotter circuit completes a connection from an input to a secondary storage circuit, it thereupon seeks out the next idle secondary storage circuit in preparation for the next bid by an input. It will be assumed that contact 37–21 of contact bank 37–11 of switch 37–07 is associated with a secondary storage circuit that is busy, in which case contact 37–21 will be grounded by means which will be described hereinafter. It will also be assumed that the secondary storage circuit shown in Figs. 31 and 38 and the ones shown in Figs. 45 and 52 are both idle. With ground on contact 37–21, that ground connection is extended over conductors 37–22 and 37–23, back contact and armature 5 of relay 38B, armature 2 and back contact of relay 38C, conductors 38–01 and 37–24, winding of relay 37MS, break contacts controlled by stepping magnet 37–12 and resistor 37–14 to battery, and relay 37MS will operate over that circuit. It will also be observed that a path may be traced from conductor 37–22, over conductor 37–26, back contact and armature 5 of relay 52B, armature 2 and back contact of relay 52C, conductor 52–01 to conductor 37–24, and thence to the winding of relay 37MS. It will be apparent from this that as long as any secondary storage circuit is idle, a ground applied to the contactor of contact bank 37–11 will be extended to the winding of relay 37MS.

Relay 37MS interrupts the energizing circuit of relay 37MSA, which releases, and completes, at its armature 3 and front contact, the energizing circuit for stepping magnet 37–12, which in turn interrupts, at its break contacts, the energizing circuit for relay 37MS. This causes the release of stepping magnet 37–12 and the advancement of the contactors on step. Assuming that there is a ground on the contactor 37–27 of contact bank 37–11, relay 37MS will be reoperated, and the contactors will be advanced another step. The path from contact 37–28, which the contactor of contact bank 37–11 has now reached, is traced over conductors 37–29 and 52–02 to the front contact associated with grounded armature 4 of relay 52B and in parallel with conductor 52–02, over conductor 52–03 to armature 3 of relay 52C, where the path terminates, because relay 52C is unoperated and armature 3 does not engage its grounded front contacts. Since relay 52B is also unoperated, there is no ground connection for reoperating relay 37MS and it remains released, preventing the reoperation of stepping magnet 37–12, but permitting the reoperation of relay 37MSA.

Relays 37LSA and 37MSA remain released during the time that the contactors of stepping switches 37–01 and 37–07 are being advanced, because each is energizable only when the associated stepping magnet and its control relay, such as magnet 37–06 and relay 37LS, are both unoperated and during a stepping cycle the magnet and control relay operate in alternation so that the relays 37LSA and 37MSA are not operated to interconnect the contactors of contact banks 37–02 and 37–08 until a bidding input and an idle secondary storage circuit have been found by the allotter circuit. When the two stepping switches of the allotter circuit have come to rest and relays 37LSA and 37MSA have reoperated, a circuit is traced from ground on armature 2 of relay 52B, through the associated back contact, armature 1 and back contact of relay 52C, conductor 52–04, lowermost contact of contact bank 37–08 and associated contactor, back contact and armature 1 of relay 37MS, armature and front contact of relay 37MSA, front contact and armature of relay 37LSA, armature 3 and back contact of relay 37LS, contactor of contact bank 37–02 and contact 37–29, conductor 37–31, and front contact and armature 4 of relay 13STC to the winding of relay 13SEL, which operates.

This relay extends ground over its front contact, conductor 13–09 to the winding of select magnet 44–08 of the allotter circuit crossbar switch in Figs. 44 and 51. Select magnet 44–08 operates to prepare for operation the sets of contacts associated with the horizontal conductors that are bracketed as extending to Fig. 13. Select magnet 44–08 also connects ground over its armature and front contact, conductor 44–09, front contact and armature 2 of relay 13STC, conductor 13–11, contact 37–32 and contactor of contact bank 37–03, contactor and contact 37–33 of contact bank 37–09, conductor 37–34, back contact and armature 1 of relay 52B, back contact and armature 4 of relay 52C, and lower winding of relay 52J to battery, and that relay operates. Relay 52J extends ground on its armature 5, over the associated front contact, conductor 52–06, and winding of hold magnet 51–01 of the crossbar switch, causing the operation of one set of crossbar switch contacts prepared for operation by the select magnet 44–08, namely the contacts 44–10, 44–11, 44–12, 44–13, 44–14 and 44–16. In addition to the contacts above enumerated, the hold magnet 51–01 also closes its grounded single armature to the front contact, extending ground over conductors 51–02 and 52–07, front contact and armature 6 of relay 52J, conductor 52–08, crossbar switch vertical conductor 51–04, crossbar switch contacts 44–11, crossbar switch horizontal conductor 44–17, and winding of relay 11HM which operates. Relay 11HM locks over its front contact and armature 5, conductors 11–18, 11–19 and 11–21, and the front contact and armature 4 of relay 11DA to ground.

Relay 11HM connects ground over its front contact and armature 6, the lower armature and back contact of relay 13DS, conductor 13–12, crossbar switch contact 44–12, crossbar switch vertical conductor 44–18, front contact and armature 3 and the upper winding of relay 52J, locking that relay, and also completing an energizing circuit to operate relay 52B which has its winding connected to armature 3 of relay 52J. In applying the ground connection through armature 6 of re-

lay 11HM, and over the circuit previously traced, that ground is disconnected, at the break contacts controlled by armature 6 of that relay, from a previously-traced locking circuit for relay 13STC, and the latter relay releases, in turn releasing relay 13SEL. At its armature 1 and back contact, the relay 11HM interrupts the locking circuits for relays 11DA and 11DB, releasing them. At its armature 2 and back contact, the relay 11HM opens the locking circuit for relay 11TA, and at its armature 7 and back contact, relay 11HM opens the operating circuit for relay 11TA, and that relay releases. With relay 13STC released, the original energizing circuit for relay 52J through its lower winding is interrupted, and the relay remains operated solely through its upper winding and closed contacts of the crossbar switch.

With relay 52B operated, a circuit previously traced for operating relay 37MS is interrupted so that the secondary storage circuit in Figs. 45 and 52, now busy, cannot contribute to the advancement of the contactors of selector switch 37—07 in the manner that it does when idle, and if all secondary storage circuits are busy, that selector switch cannot operate. At its armature 4 and front contact, relay 52B connects ground over conductors 52–02 and 37–29 to selector switch contact 37–28 to indicate that it is busy, and that in any searching cycle of stepping switch 37–07, the contact 37–28 should be passed over. This is the ground connection from which relay 37MS is operated when the contactor of selector switch bank 37–11 engages contact 37–28, and the secondary storage circuit in Figs. 45 and 52 is busy. Relay 52B completes an operating circuit for relay 52BA, traced from battery through the winding of the latter relay, conductor 52–09, and the front contact and armature 2 of relay 52B to ground.

Relay 52BA locks in a circuit through its armature 2 and front contact, conductor 52–11, back contact and armature 1 of relay 53LT2, conductor 53–01, and back contact and armature of relay 46SF to ground. Relay 52BA completes the circuit of relay 13CP in the single storage input, the path being traced from the winding of that relay, through armature 6 and back contact of relay 13STC, now released, conductor 13–13, crossbar switch contacts 44–13 and vertical conductor 44–19, front contact and armature 2 of relay 52J, and front contact and armature 3 of relay 52BA to ground. The operations resulting from operation of relay 13CP will be described before returning to other operations performed by relay 52BA.

At its armature 1 and front contact, the relay 13CP extends ground over conductor 13–14, conductor 13–08, in substitution for a ground previously supplied over armature 3 and back contact of relay 11HM and conductor 11–17 to conductor 13–08, the path continuing over the armature 1 and back contact of relay 13STC, conductor 37–19 to contact 37–18, to provide for advancement of the contactors of stepping switch 37–01 to the next contact in any cycle of operation of switch 37–01 by another input seeking access to a secondary storage circuit. The ground for contact 37–32 of contact bank 37–07 is supplied from armature 3 of relay 11HM when an input is idle and not seeking access to a secondary storage circuit, in which case relays 11HM and 13STC are unoperated and is supplied from armature 1 of relay 13CP when an input has seized a secondary storage circuit and is no longer bidding, the relay 13ST being unoperated and the relay 13CP being operated under that circumstance. The provision of this ground connection qualifies stepping switch 37–01 to operate in response to a bid by another input. Upon operating, relay 13CP locks through its front contact and armature 2, conductor 13–16 and front contact and armature 3 of relay 11HM to ground.

Bid by secondary storage circuit for access to an idle operator position

Returning to consideration of relay 52BA, that relay completes the circuit of relay 52C, traced from the winding of that relay, over conductors 52–12, 52–13 and 52–14, and the front contact and armature 4 of relay 52BA to ground. Relay 52C merely supplements relay 52B in the completion or interruption of certain circuit paths, and does not contribute a positive step to the sequence of operations now being described. Finally, the relay 52BA registers a bid for an operator position, and it does this by operating a bid relay in every operator position in which there is a cord for the particular secondary storage circuit, in this case the storage circuit in Figs. 45, 46, 52 and 53. Two operator positions have been shown and the relays, by means of which the secondary storage circuit just identified registers a bid, are the relays 40BDL and 42BDL, the final letter L in each of those reference numerals designating the last cord circuit in each of the two positions, the other bid relay shown in each of the two operator positions being designated by the reference legends 40BDF and 42BDF to designate the first cord circuit in each position. The energizing circuit for relay 42BDL is traced from the winding of that relay through key 42–01, back contact and armature 8 of relay 42SLL, conductor 42–02 to conductor 40–01. The energizing path for relay 40BDL joins at the junction of conductors 40–01 and 42–02, the circuit for relay 40BDL extending through key 40–02, back contact and armature 8 of relay 40SLL and conductor 40–03 to conductor 40–01, the path continuing in common for the two relays over the latter conductor, armature 1 and back contact of relay 52BCO, back contact and armature 2 of relay 52TR, armature 1 and front contact of relay 52BA, conductor 52–16, back contact and armature 1 of relay 53TH, and back contact and armature 2 of relay 53LT1 to ground.

Each operator position has a line selector, in the form of a stepping switch, the line selector in the operator position in Figs. 33, 40 and 47 comprising contact banks 47–01 and 47–02 having contactors operable by stepping magnet 47–03. Similarly, the operator position in Figs. 35, 42 and 47 has a line selector comprising contact banks 49–01 and 49–02 having contactors operable by stepping magnet 49–03. With relay 40BDL operated, ground supplied through the armature 1 and back contact of relay 40POSL is disconnected at the btck contact and armature 4 of relay 40BDL from a path, including conductors 40–04 and 40–06, to contact 47–04 of contact bank 47–01. At its armature 3 and front contact, the relay 40BDL completes an energizing circuit for relay 47LS, traced from battery through resistor 47–06, break contacts operable by stepping magnet 47–03, winding of relay 47LS, conductors 47–07 and 40–07, front contact and armature 3 of relay 40BDL, conductors 40–08 and 40–09 to the contactor associated with contact bank 47–01 and, with that contactor in the position shown, the path will be extended over conductor 47–08, armature 4 and back contact of relay 40BDF, and back contact and armature 1 of relay 40POSF to ground. It will be recognized that this stepping arrangement is similar to the stepping circuit for selectors 37–01 and 37–07 in the allotter circuit. The circuit just traced will cause the operation of relay 47LS which, at its armature 3, completes the circuit of stepping magnet 47–03. With relay 47LS operated, the circuit normally holding relay 47LSA is interrupted, and the path from the contactor of contact bank 47–02, through the armature and front contact of relay 47LSA, is also interrupted. Stepping magnet 47–03 interrupts the energizing circuit for relay 47LS which releases, releasing the stepping magnet in conjunction with which the contactors advance to the next contacts. Failure of the contactor to find a ground on any contact of bank 47–01 will indicate a cord of a sec-

ondary storage circuit that is making a bid and will result in arrestment of the contactors. It will be assumed that ground is found on all contacts except the contact 47–04, so that the contactors will stop on the last contact in each of the contact banks 47–01 and 47–02.

At the time of setting in operation of the selector switch comprising contact banks 47–01 and 47–02, the selector switch comprising contact banks 49–01 and 49–02 is set in operation by relay 42BDL. Relay 42BDL removes ground from contact 49–04, and the contactors advance under the control of stepping magnet 49–03 and relay 49LS toward contact 49–04, and subject to arrestment if the contactor associated with contact bank 49–01 encounters any other contact from which ground has been removed as a result of a bid registered by another secondary storage circuit for access to an operator position. Assuming that ground is connected to all of the contacts of contact bank 49–01, except contact 49–04, the relay 49LS will find no ground on that contact, and the contactors will be arrested.

At the time of operation of relay 40BDL, a circuit is completed for relay 47BSY, traced from ground on the armature 2 of relay 40BDL, through its front contact, conductors 40–11 and 40–12, back contact and left-hand armature of relay 47TD and winding of relay 47BSY, and the latter relay operates. Similarly, the relay 49BSY operates in a circuit from ground on armature 2 of relay 42BDL, through the front contact, conductors 42–03 and 42–04, back contact and left-hand armature of relay 49TD, and winding of relay 49BSY, which also operates. Relays 47BSY and 49BSY control the operation of a stepping switch which is part of a position allotter circuit that determines the particular operator position at which the bid of the secondary storage circuit shall be registered. The stepping switch is shown at the bottom of Fig. 47 and comprises contact banks 47–09 and 47–11 operable by stepping magnet 47–12. Prior to the operation of relay 47BSY, a ground connection is extended from its armature 3 through the back contact, conductors 47–13 and 47–14 to the contact 47–16 of contact bank 47–11. The contactor associated with contact bank 47–11 is connected over conductors 47–17 and 47–18 to the armature 1 of relay 47BSY which has no back contact so that the path terminates at the armature, and if the contactor associated with contact bank 47–11 engages contact 47–16, the ground connection would terminate at the armature 1 of relay 47BSY. Similarly, a ground connection is extended, before the operation of relay 49BSY, over its armature 3 and front contact, conductors 49–06 and 49–07 to contact 47–19 of contact bank 47–11. From conductor 47–17, which is connected to the contactor associated with contact bank 47–11, a path extends over conductor 47–21 to the armature 1 of relay 49BSY. When none of the relays 47BSY is operated, there will be a ground connection on each contact of contact bank 47–11.

With relays 47BSY and 49 BSY operated, ground is removed from contacts 47–16 and 47–19 of contact bank 47–11. With the contactor engaging any other contact of contact bank 47–11, and with ground supplied to that contact, the ground will be extended through armature 1 and front contact of relay 47BSY, now operated, armature 1 and back contact of relay 47B, conductors 47–22 and 47–23, the winding of relay 47PS, and break contacts controlled by the break contacts of stepping magnet 47–12 to battery. The ground connection is also extended over a parallel path including conductors 47–17 and 47–21, armature 1 and front contact of relay 49BSY, armature 1 and back contact of relay 49B, and conductors 49–08 and 47–23 to the winding of relay 47PS. The operation of stepping switch, driven by relay 47PS and stepping magnet 47–12, is the same as that of stepping switches hereinbefore described, the relay 47PS completing the circuit of stepping magnet 47–12, which in turn interrupts the energizing circuit of relay 47PS and advances the contactors. In addition to operating the stepping magnet 47–12, the relay 47PS and stepping magnet 47–12 jointly control relay 47PSA which is released when relay 47PS or stepping magnet 47–12 is operated.

Upon advancement of the contactors two steps, the contactor of contact bank 47–11 will engage contact 47–19 from which ground has been removed, so that relay 47PS will remain released and relay 47PSA will be reoperated. It will be understood that the contact next before contact 47–19 in contact bank 47–11 might also have had ground removed from it in response to the same bid by the single storage input circuit and due to the operation of the relay in that operator position corresponding to relays 47BSY and 49BSY. On the other hand, the operator position represented by that contact may be busy with a bid by another secondary storage circuit, in which case there would be a ground on the contact either from the right-hand armature and front contact of the relay corresponding to relay 47TD and relay 49TD, or from the armature 4 and front contact of the relay corresponding to relays 47B and 49B, as will be described hereinafter. The relationship among the relays is such that an operator position appears busy to the position allotter stepping switch if the relay 47BSY is unoperated, or if the relay 47TD or 47B is operated, taking the operator position shown in Figs. 33, 40 and 47 as an example. The arrangement is such that a call will always be routed to the next idle operator position which has a cord for the secondary storage circuit that is making a bid, but an operator position that has no cord for the particular secondary storage circuit, even though that position is idle, will be indicated as busy and will be passed over. If such operator position is among a group having cords for a different secondary storage circuit that is bidding for an operator position, the contactor of contact bank 47–11 would come to rest on the contact corresponding to that operator position. It will be assumed that this does not occur, and that the contactor advances to contact 47–11.

With the contactor of contact bank 47–11 arrested in engagement with contact 47–19, an energizing circuit for relay 42POSL is completed, the circuit being traced from ground through the armature and front contact of relay 47PSA, back contact and armature 1 of relay 47PS, contactor and contact 47–24 of contact bank 47–09, conductor 47–26, back contact and armature 5 of relay 49B, front contact and armature 2 of relay 49BSY, armature and front contact of relay 49LSA, if the contactors of the stepping switch in Fig. 49 come to rest on the last contacts before the contactors of the stepping switch, comprising contact banks 47–09 and 47–11, come to rest, or when the contactors of the stepping switch in Fig. 49 come to rest, armature 2 and back contact of relay 49LS, contactor and contact 49–09 of contact bank 49–02, conductor 49–11, back contact and armature 1 of relay 42SLL, armature 1 and front contact of relay 42BDL, and winding of relay 42POSL, and the latter relay operates. It locks through its front contact and armature 4, conductor 42–06 and back contact and armature 7 of relay 42SLL to ground.

At its armature 6 and front contact, the relay 42POSL establishes a transmission path to the teletypewriter 49–12 of the operator's position. This teletypewriter is preferably a tape printing machine and may be of the type shown in Patent 1,745,633, granted February 4, 1930, to S. Morton and H. L. Krum. The receiving instrumentality of teletypewriter 49–12 is a selector magnet 49–13, which has one terminal connected to positive battery, and the other terminal connected to the anode of vacuum tube 49–14. A flow of current through tube 49–14, for maintaining selector magnet 49–13 energized, is normally produced by a positive bias on the grid of tube 49–14 supplied from positive battery through resistors 49–16 and 49–17. A path for controlling the

grid of tube 49–14, specifically for cutting off tube 49–14 to impress a spacing signal element on selector magnet 49–13, is traced over conductors 49–18 and 42–07, back contact and armature 4 of relay 42RLSL to the front contact associated with armature 6 of relay 42POSL. With this relay now energized, the path is extended over conductors 42–08 and 40–13, back contact and armature 1 of relay 52TR and conductors 52–17 and 52–18, contacts 44–10 of the crossbar switch in the allotter circuit contained in Figs. 37, 44 and 51, conductor 44–21 to the distributor contacts of the reperforator-transmitter unit of the single storage input circuit in Fig. 10. At its armature 2 and front contact, the relay 42POSL extends ground over conductors 42–09 and 42–11, to light lamp 42–12. There are three lamps associated with the cord in the operator position, shown in Figs. 35, 42 and 49, for the particular secondary storage circuit that has been seized by the single storage input, and the lamp 42–12 will be referred to as the green lamp, it being customary to distinguish signal lamps at operators' positions by different colored translucent lamp caps. At its armature 1 and front contact, relay 42POSL extends ground over conductors 42–13, 42–14 and 42–16, to the winding of relay 49BY which operates. Relay 49BY completes the circuit of relay 49B, which operates and locks through its front contact and armature 3, and the back contact and armature 1 of relay 49F2 to ground. Relay 49B connects ground over conductors 49–19, 49–06 and 49–07 to contact 47–19 of position allotter switch contact bank 47–11 to indicate that the operator position in Figs. 35, 42 and 49 is busy, and to qualify the contactors of the position allotter switch to advance as required to route another call to the next idle operator position.

Another operation performed by relay 42POSL is the operation of relay 52BC0 in the secondary storage circuit in Figs. 45 and 52, the circuit being traced from the winding of the relay, over conductors 52–19 and 40–14, break contacts controlled by armature 3 of relay 42SLL, and front contact and armature 3 of relay 42POSL, and relay 52BC0 operates. At its armature 1 and back contact, the relay 42POSL disconnects ground from the back contact so that ground cannot be reconnected to contact 49–04 of stepping switch bank 49–01, to requalify the line selector stepping switch in Fig. 49 to again operate until relay 42POSL releases.

The relay 52BC0, being operated as above stated, interrupts, at its armature 1 and back contact, the previously traced energizing circuits for relays 40BDL and 42BDL, and those relays release. Relays 40BDL and 42BDL release relays 47BSY and 49BSY, respectively, the relay 47BSY rendering the operator position in Figs. 33, 40 and 47 available for the handling of another call, the operator position in Figs. 35, 42 and 49 remaining busy and unavailable by virtue of the fact that relay 49B is operated. At its armature 3 the relay 52BC0 transfers an energizing circuit for relay 52BT, normally extending from the winding of the latter relay over conductors 52–31 and 52–32 and break contacts controlled by the armature 3, to that armature and thence through the back contact and armature 1 of relay 52GA, conductor 52–33, break contacts controlled by armature 2 of relay 40SLL, conductor 40–16 and break contacts controlled by armature 2 of relay 42SLL to ground. Relay 52BC0, at its front contact and armature 4, completes the circuit of relay 52BC1 which operates and locks through its armature 2 and front contact, conductors 52–21 and 51–02, and the armature and front contact of hold magnet 51–01. At its front contact and armature 1, relay 52BC1 extends the ground connection on conductor 52–21, over conductor 52–22, armature 4 and front contact of relay 52J, which is operated, conductor 52–23, crossbar switch contacts 44–16, conductor 44–22, front contact and armature 3 of relay 13CP, conductor 13–17, and winding of relay 11TR in the single storage input circuit, and that relay operates. At its armature 6 and front contact, relay 11TR completes an energizing circuit for the distributor clutch magnet 10–31, traced from the winding of that magnet over conductors 10–29, 10–38 and 11–22, armature 6 and front contact of relay 11TR, and front contact and armature 4 of relay 11DA to ground. Magnet 10–31 permits distributor shaft clutch 10–32 to be energized for a revolution of the shaft to transmit the code combination that is stored in the contacts controlled by contact operating members 10–23, specifically the extreme left-hand pair of make contacts in each contact set. Before the distributor shaft begins to rotate, positive battery is connected through resistor 10–39 and rest or stop contact 10–41 of the distributor to transmission channel 44–21, and negative battery is connected to the transmission channel through resistor 10–42. Resistors 10–39 and 10–42 are substantially equal in value and are of the order of 1200 to 1500 ohms. Resistor 49–16 associated with the grid of tube 49–14 has a value of the order of 1 megohm, and when a connection from the grid of tube 49–14 to transmission channel 44–21 was established through the front contact and armature 6 of relay 42POSL and crossbar switch contacts 44–09, there was no significant change in the potential on transmission conductor 44–21, nor at the grid of tube 49–14. Upon the opening of distributor contacts 10–41 for the transmission of the start element, the positive battery connection through resistor 10–39 is disconnected from transmission conductor 44–21, leaving negative battery connected through resistor 10–42. Current now flows from the negative battery through resistor 10–42, and over the transmission paths and through resistor 49–16 to positive battery, and because resistor 49–16 has a value several hundred times that of resistor 10–42, practically all of the voltage drop is across resistor 49–16, and the potential on the control grid of tube 49–14 drops almost to the potential of the negative battery, cutting off current through tube 49–14 and selector magnet 49–13 of teletypewriter 49–12, thereby impressing the start element of spacing nature on the selector magnet.

At the junction of conductors 52–17 and 52–18, which are in the transmission path under the control of the distributor in Fig. 10, is a branch conductor 52–24 which is connected through resistor 52–26 to the grid of tube 52–27, and through resistor 52–28 to positive battery. Resistor 52–28 has substantially the same value as resistor 49–16, and when the transmission path is idle, causes current to flow in the anode circuit of tube 52–27, which includes conductor 52–29 and selector magnet 45–01 of reperforator-transmitter unit 45–02 of the secondary storage circuit in Figs. 45 and 52. Resistor 52–28 and the grid of tube 52–27 become connected to the potential divider, comprising positive and negative batteries and resistors 10–39 and 10–42, through crossbar switch contacts 44–09, before resistor 49–16 and the grid of tube 49–14 become connected to the same transmission path, but the connection of one or several tubes, with their positive biasing batteries connected through high resistances, have only negligible effect upon the potential at the junction of resistors 10–39 and 10–42. The transmission of the code elements of the code combination set up in the contact controlling members 10–23 is accomplished, in the case of marking elements, by connecting positive battery through resistor 10–39, any one of the five transmitter make contact pairs, these being the contacts nearest to the slide members 10–22 and being selectively closed for marking elements, break contacts controlled by relay 11D, and the distributor contacts allocated to the five transmitter contact pairs and controlled by distributor cams 1 to 5, to transmitting conductor 44–21. In the case of spacing code elements, the corresponding transmitter contacts are open, and positive battery, through resistor 10–39, is disconnected from transmission conductor 44–21.

During transmission of the first code combination, the distributor auxiliary contacts 10–34 close and connect

ground over conductors 10–36 and 11–06, armature 1 and back contact of relay 11DB, conductors 11–07 and 11–23, armature 2 and front contact of relay 11TR, and conductors 11–24 and 11–11 to the winding of relay 11DA which operates. As before, relay 11DA prepares a locking circuit for itself, including the winding of relay 11DB. At its armature 4 and back contact, it interrupts the circuit of distributor clutch magnet 10–31 which releases, permitting clutch 10–32 to disconnect at the end of one revolution and arrest shaft 10–33.

When the distributor contacts reopen, relay 11DA locks, and relay 11DB operates in its locking circuit, the circuit being traced from the winding of relay 11DA through its front contact and armature 2, the winding of relay 11DB, armature 2 and back contact of relay 11DC, conductors 11–12 and 11–26, and armature 3 and front contact of relay 11TR to ground.

Relay 11DB completes an energizing circuit for transmitter clutch magnet 10–14, traced from the winding of that magnet over conductor 13–02, back contact and armature 1 of relay 13MA, armature 1 and back contact of relay 13ST, conductor 12–09, back contact and armature 1 of relay 12TO, conductor 11–04, armature 5 and front contact of relay 11TR, armature 3 and front contact of relay 11DB, conductor 11–01, back contact and armature 1 of relay 11TA, conductors 12–08 and 10–13 to the transmitter stop contacts 10–12, which will remain closed as long as there is a supply of tape between perforating head 10–11 and tape-sensing head 10–09 awaiting transmission.

With transmitter clutch magnet 10–14 energized over the circuit traced above, transmitter shaft 10–17 will rotate continuously, sense the code combinations in tape 10–08, and step the tape. In each revolution of the shaft, transmitter auxiliary contacts 10–24 will close and reopen, but the path for operating relay 11TA is open at the armature 7 and back contact of relay 11HM, so that closure and reopening of transmitter auxiliary contacts 10–24 will have no effect. In each revolution of the shaft 10–17, the distributor clutch release contacts 10–27 will close, extending ground over conductors 10–28 and 10–29, to operate distributor clutch magnet 10–31. Thus, for each cycle of transmitter shaft 10–17 in which a code combination is advanced and sensed, a companion cycle of the distributor shaft 10–33 will be initiated, and the code combination will be transmitted over transmission path 44–21, the signals, consisting of the address preceding the message and the text of the message, being repeated by tube 52–27 to selector magnet 45–01 of reperforator 45–02, and the address preceding the message, and as much of the message following the address information as the operator at the operator position in Figs. 35, 42 and 49 permits, being repeated by tube 49–14 to selector magnet 49–13 of teletypewriter 49–12.

Disconnection of input from secondary storage circuit

Before considering the steps involved in setting up a transmission path for retransmission of the message from the secondary storage circuit to the outlets selected by the operator acting in response to the address information recorded on teletypewriter 49–12, the operations resulting from response of the transmitter portion of the reperforator-transmitter 10–06 to the disconnect signal will be considered. The disconnect signal consists of the code combinations for Figures, H and Letters. Each time the code combination for Figures is sensed by the tape-sensing levers 10–18 and transferred to slides 10–22, a circuit is established from ground through maze contacts controlled by contact controlling members 10–23 and over conductor 10–43 to the lower winding of relay 12FG which operates. At its armature 2 and front contact, the relay 12FG establishes a connection through resistor 12–13 to negative battery, and thereby in parallel with its upper winding to impart a slow-release characteristic to the relay. If any other code combination than H follows the Figures signal, and an H will not follow the Figures code combination in the message address information or in its text because that is the disconnect code sequence, relay 12FG will release. When an H code combination follows a Figures code combination and is transferred to the maze contacts, the ground connection will be transferred from conductor 10–43 to conductor 10–44, from which it will be extended over the armature 7 and front contact of relay 11TR, conductor 11–27, front contact and armature 1 and armature 2 and front contact of relay 12FG, and winding of relay 12H to battery, and that relay will operate. Relay 12H locks through its lower winding, armature 3 and front contact, conductors 12–14 and 12–18, and armature 4 and front contact of relay 11TR to ground. At its armature 2 and front contact, relay 12H prepares an energizing circuit for relay 12LT1. In the next rotation of transmitter shaft 10–17, during which the Letters signal following the H signal is transferred to slides 10–22, the transmitter auxiliary contacts complete a circuit, traced from ground over conductors 10–26 and 12–16, front contact and armature 1 of relay 12H, conductor 12–17, and winding of relay 11TA, and the latter relay operates. It locks through its front contact and armature 3, conductors 11–28 and 11–29, and front contact and armature 5 of relay 12H to ground.

At its armature 1 and back contact, relay 11TA opens the circuit of transmitter clutch magnet 10–14, which causes arrestment of shaft 10–17 at the end of the revolution in which the signal following the H signal was transferred and sensed. In the accompanying cycle of the distributor shaft 10–33, the distributor auxiliary contacts 10–34 close and extend ground over conductors 10–36 and 11–06, armature 1 and front contact of relay 11DB, front contact and armature 2 of relay 11TA, conductor 11–31, armature 2 and front contact of relay 12H to the winding of relay 12LT1 which operates. It will be noted that the ground for operating the relay 12LT1 is derived from the distributor auxiliary contacts and not from the maze contacts controlled by the tape-sensing mechanism of the reperforator-transmitter. The character following the H signal should be a Letters signal. The reason for this is that the disconnection of the reperforator-transmitter of the secondary storage circuit from the distributor contacts of the input circuit occurs during the transmission of the code combination following the H signal, as will be described hereinafter. The Letters signal has all of its significant elements of marking nature so that the reperforator-transmitter of the secondary storage circuit, even though it becomes disconnected during the transmission, will interpret the marking condition that is left on the grid of tube 52–27 when the disconnection occurs as the remainder of a Letters signal, followed by a stop condition, and the reperforator-transmitter of the secondary storage circuit will record the Letters signal. If the character following the H signal is other than a Letters signal, it will usually be mutilated as received by the reperforator-transmitter of the secondary storage circuit because spacing elements near the end of the code combination will not reach the reperforator. Such mutilation is sometimes beneficial, particularly if the signal should be another H. No difficulties will be encountered if the signal is a Letters character and that is the preferred signal following the H code combination of the disconnect signal. Because of the possibility that some other signal than Letters may follow the H signal, the ground for operating relay 12LT1 is derived from the distributor auxiliary contacts rather than from the maze contacts.

Relay 12LT1 prepares a locking circuit for itself through its front contact and armature, the winding of relay 12LT2, and conductor 12–19 to conductor 12–18 in the locking circuit of relay 12H. Until the distributor auxiliary contacts open, the operating circuit for relay 12LT1 shunts the locking circuit, and relay 12LT2 re-

mains unoperated. When the distributor auxiliary contacts 10–34 open shortly before shaft 10–33 comes to rest, the locking circuit becomes effective, and relay 12LT2 operates.

The last-mentioned relay extends ground through its armature and front contact, conductors 12–21 and 13–18, and winding of relay 13DS to battery, and relay 13DS operates. It interrupts, at its armature 2 and back contact, the locking circuit for relay 52J in the secondary storage circuit. This occurs in conjunction with the final cycle of the distributor shaft 10–33, in which the last signal sensed by contact levers 10–18 and transferred to the transmitter contacts, preferably a Letters signal as previously stated, is transmitted to reperforator-transmitter 45–02. Relay 52J in turn releases relay 52B. Relay 52J also releases hold magnet 51–01, which permits crossbar switch contacts 44–10, 44–11, 44–12, 44–13, 44–14 and 44–16 to open. The transmission connections to reperforator-transmitter 45–02 and to teletypewriter 49–12 are interrupted, although transmission to the latter may have been interrupted previously by an action of the operator, as will be described later.

With the crossbar switch contacts open, the circuit of relay 11TR is interrupted and it releases. Relay 11TR interrupts the locking circuits of relays 12FG, 12H, 12LT1 and 12LT2, and those relays release. Relay 11TR also interrupts the locking circuits for relays 11DA and 11DB which release. Relay 12H releases relay 11TA, and with relays 11DA, 11DB and 12H released, the relay 11HM releases, and in turn releases relay 13CP. Relay 12LT2, released as stated above, releases relay 13DS.

All of the relays in the single storage input circuit, described as having operated, have now been released with the exception of relay 12TS. If no other message has followed the one assumed to have been received by reperforator-transmitter 10–06, the tape-sensing head 10–09 will close the gap between itself and the reperforator head 10–11, incident to advancement, from the sensing position, of the signal following the H signal in the disconnect pattern. Under that circumstance, contacts 10–12 will open and release relay 12TS. If, instead, another message is received immediately by reperforator-transmitter 10–06, relay 12TS will remain operated or will reoperate and cause the single storage input to make another bid for access to a secondary storage circuit.

Returning now to consideration of the operator position at which the address information is being recorded on teletypewriter 49–12, the relays 42POSL, 49BSY, 49B and 49BY are operated and teletypewriter 49–12 is receiving the address information, and will receive the message and the disconnect signal unless the operator takes certain actions. One action that can be taken is the operation of a release key, which may be operated when all necessary address information has been received. The key is identified by reference numeral 49–21, and upon its momentary operation, ground is extended over conductors 49–22 and 42–17, armature 5 and front contact of relay 42POSL to the winding of relay 42RLSL which operates. The latter relay locks through its front contact and armature 3, and the back contact and armature 7 of relay 42SLL to ground. At its armature 2 and front contact, relay 42RLSL provides an additional ground for lighting green lamp 42–12. At its armature 1, it provides ground for lighting white lamp 42–18. At its armature 4 and back contact, relay 42RLSL disconnects conductor 42–08 from conductor 42–07 in the transmission path to teletypewriter 49–12, thereby suspending transmission to the teletypewriter.

Seizure of double storage outlet by operator

It will be assumed that the operator determines from the address information that the message is intended for the double storage outlet contained in Figs. 47 to 62. Jack 35–01 is the regular (as distinguished from multiple address) point of access of the operator's position in Figs. 35, 42 and 49 to the double storage outlet. The operator initiates seizure of the outlet by inserting plug 42–19 of the cord of the secondary storage circuit in which the message is being stored into jack 35–01. A circuit for relay 42SLL is completed through the plug and jack, the circuit being traced from the winding of the relay, front contact and armature 7 of relay 42POSL, conductors 42–21 and 42–22, and the ring terminal of plug 42–19 to the grounded ring spring of jack 35–01. Relay 42SLL locks through its front contact and armature 4 and conductors 42–23 and 42–22 to the ground from which it operated.

Relay 42SLL interrupts the locking circuit for relay 42POSL, which releases. It also unlocks relay 42RLSL, which releases. The unlocking of these relays occurs at armature 7 and back contact of relay 42SLL. Had relay 42RLSL not been operated to interrupt transmission to teletypewriter 49–12 and to light lamp 42–18, release of relay 42POSL would suspend transmission to the teletypewriter, since the transmission path includes armature 6 and front contact of relay 42POSL. Relay 42SLL maintains lamp 42–18 lighted in the circuit through its own armature 7 and front contact, and armature 4 and back contact of relay 43DSL. Relay 42SLL, at the break contacts controlled by its armature 2, disconnects ground from the previously-traced circuit for holding relay 52BT operated, and extends the circuit over the front contact associated with that armature, armature 5 and back contact of relay 42DSL, tip of plug 42–19, tip spring and make contacts 35–02 of jack 35–01, conductors 35–03 and 33–01, armature 1 and back contact of relay 61BR, conductors 61–01 and 61–02, armature 4 and back contact of relay 61LB1, armature 4 and back contact of relay 61A1, armature 1 and back contact of relay 61MA1, armature 6 and back contact of relay 61B1, armature 7 and back contact of relay 61C1, and winding of relay 61J1 to negative battery which has the same polarity as the battery connection on the winding of relay 52BT.

The double storage outlet circuit, contained in Figs. 57 to 62, includes two reperforator-transmitters, shown in Figs. 57 and 58, which may receive simultaneously from two secondary storage circuits. The reperforator-transmitter in Fig. 57 is considered as the first storage unit of the outlet and all of the relays in Fig. 61 and some of the relays in Fig. 59 pertain to its selection and operation. The reperforator-transmitter in Fig. 58 is considered as the second storage unit, and all of the relays in Fig. 62 and some of the relays in Fig. 60 pertain to its selection and operation. The remaining relays in Figs. 59 and 60 are common to both units. Relay 61J1, to which a path from the winding of relay 52BT has been extended, by its operated or unoperated condition, indicates whether the first storage unit of the double storage outlet is busy or idle. When it is busy, but the second storage unit is idle, the path from the winding of relay 52BT is extended to the winding of relay 62J2, and that relay will be operated or unoperated depending upon the busy or idle condition of the second storage unit. When relays 61J1 and 62J2 are both operated, the path which has been extended into the double storage outlet from the winding of relay 52BT will be terminated in ground, holding that relay operated, as will be described hereinafter. For the present, it will be assumed that the first storage unit of the outlet, in Fig. 57, is idle and available to receive a message. Relay 61J1 will be unoperated, and with like battery polarity at the two ends of the path, relay 61J1 will remain unoperated for the present, and relay 52BT will release.

With relay 52BT released, as an indication of the availability of a storage unit in the outlet to which the message is directed, ground is extended through the armature and back contact of relay 52BT, conductor 52–34 and con-

ductor 26–01 in Fig. 26, which contains the sequence circuit, armature 2 and back contact of relay 26G, and winding of relay 26SE–L to battery. Relay 26SE–L is individual to the particular secondary storage circuit, and there is a corresponding relay for each of the other secondary storage circuits, the relay 26SE–F being allocated to the other secondary storage circuit shown in full in the drawings. Two or more of these relays may operate simultaneously if their associated secondary storage circuits are bidding for use of the crossbar switch to establish connections to outlets. Relay 26SE–L locks through its front contact and armature 5, break contacts controlled by armature 2 of relay 26SSL, armature 1 and back contact of relay 26R, and front contact and armature 1 of relay 26H to ground.

With relay 26SE–L operated, a circuit of relay 26A is interrupted at the armature 5 and back contact of relay 26SE–L, the entire circuit being traced from the winding of relay 26A, over conductor 26–02, break contacts controlled by armature 1 of relay 26R, back contact and armature 5 of relay 26SE–F, break contacts controlled by armature 2 of relay 26SSF, back contact and armature 5 of relay 26SE–L, break contacts controlled by armature 2 of relay 26SSL, armature 1 and back contact of relay 26R, and front contact and armature 1 of relay 26H to ground. Because the circuit of relay 26A has been interrupted by relay 26SE–L, the relay 26A releases.

At its armature 2, the relay 26A removes negative battery connection from the grid of tube 26–03, and condenser 26–04 begins to charge positively. Condenser 26–04 and tube 26–03 comprise a timing circuit for operating relay 26E if the sequence circuit does not perform its function within a predetermined interval. At its armature 1 and back contact, the relay 26A completes the circuit of relay 26G, which operates. With relay 26G released, any operated ones of the relays 26SE, except the farthest to the right in the sequence, will be released. The reason for this is that the energizing circuits for all of the 26SE relays extend through armatures and back contacts of relay 26G, and only one of the relays 26SE can have its locking circuit completed to the armature 1 of relay 26H, that being the relay farthest to the right in the sequence because it interrupts the possible locking circuits of all of the relays 26SE to the left. For example, the armature 5 of relay 26SE–F is in the locking path for that relay, and if the conductive path from armature 5 of that relay is traced, it will be found to extend through the break contacts controlled by armature 2 of relay 26SSF and to the back contact associated with armature 5 of relay 26SE–L. Because the latter relay is operated, the path is interrupted at that point. Other secondary storage circuits awaiting access to the crossbar switch merely must wait until relay 26G is released, when their associated relays 26SE will be reoperated. The energizing circuit for relay 26H is traced, in the idle condition of the sequence circuit, through conductor 26–17, the back contact and armature 3 of relay 26R, break contacts controlled by armature 3 of relay 26SSL, armature 1 and back contact of relay 26SE–L, break contacts controlled by armature 3 of relay 26SSF, armature 1 and back contact of relay 26SE–F, and break contacts controlled by armature 3 of relay 26R to ground. With relay 26SE–L operated, the circuit for relay 26H is placed under the control of relay 52BT, the circuit being traced from the winding of relay 26H, through the back contact and armature 3 of relay 26R, break contacts controlled by armature 3 of relay 26SSL, armature 1 and front contact of relay 26SE–L, and conductor 26–06 to conductor 52–34, over which relay 26SE–L was operated from the armature and back contact of relay 52BT.

With all but one of the 26SE relays released, a circuit for relay 26M is completed, the circuit being traced from the winding of that relay, through the back contact and armature 6 of relay 26SE–F close loops through corresponding armatures and back contacts of others of the relays 26SE, and front contact and armature 7 of relay 26SE–L to ground.

At its armature 2 and front contact, the relay 26M extends ground through the back contact and armature 4 of relay 26A, back contact and armature 4 of relay 26G, armature 2 and front contact of relay 26H, and winding of relay 26J, and the latter relay operates. At its armature 3 and front contact, relay 26M extends ground over conductors 26–07 and 26–08, front contact and armature 3 of relay 26SE–L, unidirectional conducting device 26–09 and winding of relay 26SSL to battery, and the latter relay operates.

Relay 26SSL completes a circuit for relay 26P, traced from the winding of that relay through the front contact and armature 6 of relay 26SSL, it being impossible to trace a path through the back contact and armature 8 of the same relay because it is operated, close loops through armatures and back contacts of intermediate relays 26SS in a sequence leftwardly, and the back contact and armature 6 of relay 26SSF to ground. Relay 26P provides a locking circuit for relay 26SSL, traced through unidirectional current carrying device 26–11, armature 7 and front contact of relay 26SSL, conductors 26–12 and 26–13, and armature 2 and front contact of relay 26P to ground. At its armature 3 the relay 26SSL transfers the holding circuit for relay 26H to by-pass the armature 3 and back contact of relay 26R, the path being traced from the junction of conductors 52–34 and 26–06 over the latter conductor, front contact and armature 1 of relay 26SE–L, front contact and armature 3 of relay 26SSL, conductors 26–14, 26–16 and 26–17 to the winding of relay 26H. Relay 26SSL also transfers the locking circuit for relay 26SE–L, the circuit being traced from the winding of the latter relay through its front contact and armature 5, front contact and armature 2 of relay 26SSL instead of through the break contacts controlled by that armature, conductors 26–18 and 26–19 by-passing the armature 1 and back contact of relay 26R to the grounded armature 1 of relay 26H through the associated front contact.

Relay 26P, in addition to locking the relay 26SSL, completes, at its armature 1 and front contact, the energizing circuit for relay 26R which operates and locks through its armature 2 and front contact, conductors 26–21 and 26–22, and front contact and armature 5 of relay 26SSL to ground. With relay 26R operated, the next 26SE relay to the left of the operated 26SS relay, which is relay 26SSL, will have the preferred position for obtaining access to the link circuit for the next connection.

The operation of relay 26J by relays 26A and 26G was previously mentioned. This relay provides, at its upper armature, a ground connection supplementing the ground of armature 1 of relay 26H for locking relays, such as relay 26SE–L. At its lower armature, the relay 26J extends ground over conductors 26–23 and 26–24, front contact and armature 2 of relay 26SE–L, and conductor 26–26 to select magnet 27–01 in the crossbar switch. Select magnet 27–01 prepares for closure of all of the crossbar switch contacts in Figs. 27, 28, 29 and 30 that are associated with the crossbar switch horizontal conductors that are bracketed to Fig. 46 in Fig. 27. In addition, the select magnet 27–01 extends ground over its armature and front contact and conductor 27–02, which is also in the group bracketed to Fig. 46 in which conductor 27–02 reappears and extends to the winding of relay 52GA which operates. Relay 52GA interrupts, at its armature 1 and back contact, the path over which relay 52BT tested for busy or idle condition of the outlet, and found a reperforator-transmitter idle and available. Since this test resulted in the release of relay 52BT, the interruption of the path to the winding of the relay causes it to remain re-

leased. At its armature 1 and front contact, relay 52GA extends ground over conductor 52–33, break contacts controlled by armature 2 of relay 40SLL, conductor 40–16, front contact and armature 2 of relay 42SLL, armature 5 and back contact of relay 42DSL, tip of plug 42–19 and jack 35–01, conductors 35–03 and 33–01, armature 1 and back contact of relay 61BR, conductors 61–01 and 61–02, armature 4 and back contact of relay 61LB1, armature 4 and back contact of relay 61A1, armature 1 and back contact of relay 61MA1, armature 6 and back contact of relay 61B1, armature 7 and back contact of relay 61C1, and winding of relay 61J1 which operates.

Relay 61J1 locks through its front contact and armature 3, conductor 61–01 and the back contact and armature 1 of relay 61BR to conductor 31–01, by-passing interruption points in its energizing circuit including the back contact and armature 7 of relay 61C1, the back contact and armature 6 of relay 61B1, back contact and armature 1 of relay 61MA1, back contact and armature 4 of relay 61A1, and back contact and armature 4 of relay 61LB1. Relay 61J1 completes an energizing circuit for relay 61LA1, traced from the winding of the latter relay, over conductor 61–03, and the front contact and armature 5 of relay 61J1 to ground. Relay 61LA1 locks through its armature 4 and front contact, and the back contact and armature 1 of relay 61LB1 to ground. At its armature 5 and front contact, relay 61LA1 completes the circuit of relay 61A1. The latter relay extends ground over conductor 61–08 to the winding of hold magnet 27–03 in the crossbar switch, and the hold magnet closes contacts 27–04, 27–06, 27–07 and 27–08 that were prepared by select magnet 27–01. At its armature 2, relay 61LA1 extends a transmission path from the grid of the tube 61–04, over conductor 61–06 armature 2 and front contact of relay 61LA1, conductor 61–07, crossbar switch contacts 27–04, crossbar switch horizontal conductor 27–09 to the distributor contacts of reperfortor-transmitter unit 45–02 of the secondary storage circuit that has in storage a message for the double storage outlet circuit. The grid of tube 61–04 is biased positive by a battery connection, as in the case of tube 52–27, that drives selector magnet 45–01 of reperforator-transmitter unit 45–02, and the anode of tube 61–04 is connected over conductor 61–09, winding of selector magnet 57–01 in reperforator-transmitter unit 57–02 of the double storage outlet, the path continuing over conductor 57–03 and resistor 61–11 to positive battery. Relay 61LA1 also establishes a connection from the junction of resistor 61–11 and conductor 57–03, over its armature 1 and front contact to a resistor network associated with the grids of dual triode tube 61–12 which controls an alarm circuit as will be described hereinafter.

Hold magnet 27–03 extends ground over its armature 2 and front contact, conductors 27–11 and 61–13, armature 6 and front contact of relay 61LA1, conductor 61–14, front contact and armature 4 of relay 61J1, conductor 61–16, back contact and armature 2 of relay 61BR, conductors 61–17 and 33–02, bushing of jack 35–01, sleeve of plug 42–19, conductor 42–24, back contact and armature 1 of relay 42DSL, conductor 42–26, front contact and armature 2 of relay 52GA and winding of relay 52TR to battery. Relay 52TR operates and locks over its front contact and armature 3, conductor 52–36, crossbar switch contacts 27–07 and conductor 27–12, and front contact and armature 1 of hold magnet 27–03 to ground.

At its armature 4, the relay 54TR completes an energizing circuit for the transmitter clutch release magnet 45–03 of reperforator-transmitter unit 45–02, the circuit being traced from battery through the winding of the clutch magnet, conductor 45–04, armature 4 and front contact of relay 52TR, conductor 52–37, armature 3 and back contact of relay 53LT3, conductor 53–02, armature 3 and back contact of relay 53T0, conductor 53–03, back contact and armature 3 of relay 46MA, back contact and armature 3 of relay 46ST, conductors 46–01 and 45–06, and transmitter stop contacts 45–07 to ground. Because of the fact that reperforator-transmitter unit 45–02 has received a part at least of the message retransmitted to it by the single storage input circuit, the tape-sensing head 45–08 of the reperforator-transmitter unit 45–02 will have been moved away from the perforating head 45–09 by tape 45–11, permitting contacts 45–07 to close. The specific details as to the transmission to the seized reperforator-transmitter unit of the double storage outlet circuit will be described later.

At its armature 1, the relay 52TR disconnects conductor 52–17 from conductor 40–13, thereby further interrupting the transmission path to the operator's position. At its armature 6, the relay 52TR extends ground through the front contact, conductors 52–38 and 52–39, front contact and armature 2 of relay 52BC0, conductors 52–41 and 40–17, armature 5 and front contact of relay 42SLL, break contacts controlled by armature 3 of relay 42DSL, and winding of that relay, causing the relay to operate. It locks through its front contact and armature 3, and the front contact and armature 6 of relay 42SLL, to ground. Relay 42DSL interrupts, at its armature 5 and back contact, the busy test circuit through the tip of plug 42–19 and jack 35–01, and transfers a ground connection to the next cord circuit in sequential order for the same secondary storage circuit. The cord circuit in the right-hand portion of Fig. 42, being indicated as the last cord circuit in the sequential order, and the cord circuit at the right of Fig. 40, being indicated as the first cord circuit for the same secondary storage circuit, the ground connection is extended through the front contact and armature 5 of relay 42DSL the armature 2 and front contact of relay 42SLL, conductor 40–16, break contacts controlled by armature 2 of relay 40SLL, conductor 52–33 to armature 1 of relay 52GA at which point ground is also applied because relay 52GA is operated. When relay 52GA subsequently releases, the ground connection will be extended to the armature 3 of relay 52BC0 and ultimately over that armature and front contact, when relay 52BC0 operates for the next message processed by the secondary storage circuit in Figs. 45 and 52, and over conductors 52–32 and 52–31 to hold busy test relay 52BT operated. At its armature 4, the relay 42DSL interrupts the circuit of white lamp 42–18 which is thereby cut off. At its armature 2 and front contact, relay 42DSL connects ground over conductors 42–27 and 42–28 to contact 49–04 of stepping switch bank 49–01 for the purpose of holding a busy indication on the cord circuit at the right of Fig. 42 even if the relay 42BDL should reoperate in response to another bid by the secondary storage circuit in Figs. 45 and 52 for access to an operator position. At its armature 2 and back contact, the relay 42DSL interrupts the circuit for relay 52BC0, which releases, and at its armature 1 and back contact, the relay 42DSL interrupts the locking circuit for relay 61J1 which releases. The operations resulting from the release of these two relays will be described hereinafter.

Still another operation performed by the relay 42DSL is the lighting of red lamp 42–29 in a circuit traced from that lamp through the front contact and armature 4 of relay 42DSL, and the front contact and armature 7 of relay 42SLL to ground. The lighting of the lamp 42–29 is an indication to the operator that the connection from the secondary storage circuit to the outlet has been established, and that the cord plug 42–19 may be withdrawn from jack 35–01. With the cord withdrawn from the jack, the locking circuit for relat 42SLL is interrupted at the ring of the plug and jack, and that relay releases. Relay 42SLL unlocks relay 42DSL at its front contact and armature 6. With relays 42SLL and 42DSL released, the cord circuit is restored to normal, the

restorration including the cutting of red lamp 42–29 and the removal of busy ground from contact 49–04 of contact bank 49–01.

When relay 42SLL operated, it released relay 49BY, but that relay leaves relay 49B locked through its front contact and armature 3, and the back contact and armature 1 of relay 49F2. Relay 49BY, in releasing, extends ground through its armature and back contact, and the front contact and armature 2 of relay 49B to the winding of relay 49F1 which operates. At its right-hand armature, the relay 49F1 disconnects negative battery from condenser 49–23 and the grid of tube 49–24, and the condenser begins to charge from positive battery through resistor 49–26. At its left-hand armature, the relay 49F1 completes a circuit traced from ground through the armature 2 and back contact of relay 49F2, front contact and left-hand armature of relay 49F1, and winding of tape feed-out magnet 49–27 of teletypewriter 49–12. The function of magnet 49–27 is to initiate the feding out of a length of tape, perhaps several inches, to space the address information and any portion of the text of the message that was recorded by teletypewriter 49–12 from the address information of the next message that may be displayed at teletypewriter 49–12. An arrangement employing a feedout magnet corresponding to magnet 49–27 is shown in Patent 2,381,871, granted August 14, 1945, to W. M. Bacon, F. S. Kinkead and J. A. Krecek. The receiving unit shown in Patent 2,381,871, including a tape feedout mechanism, is a printing reperforator rather than a receiving-only printer, but the selector mechanism of the teletypewriter shown in Patent 1,745,633, which discloses a printer suitable for use as the printer 49–12, is basically similar to the selector mechanism of the reperforator shown in Patent 2,381,871, and the feedout mechanism may be applied to the printer shown in Patent 1,745,633 in the same manner. The disclosure of Patent 2,381,871 is incorporated herein by reference as part of the present speecification.

When condenser 49–23 has become charged sufficiently positive to render tube 49–24 conductive, current flows in the plate circuit of that tube which includes the winding of relay 49F2 and the relay operates. At its armature 1, the relay 49F2 unlocks relay 49B which releases, but has a slow-release characteristic. At its armature 2, relay 49F2 interrupts the energizing circuit of feedout magnet 49–27 which arrests the feeding of the tape in teletypewriter 49–12. When relay 49B releases, it interrupts the circuit of relay 49F1 which discharges condenser 49–23, cutting off tube 49–24. Tube 49–24 releases relay 49F2, and the operator position is thus restored to normal.

As previously stated, relay 42DSLL, in releasing to restore the cord circuit, releases relay 52BC0 which in turn releases relay 52BC1. With relay 52BC0 released, the circuit of busy test relay 52BT is reestablished at the break contacts controlled by armature 3 of relay 52BC0, and relay 52BT reoperates. At the back contact of the latter relay, ground is disconnected from conductor 52–34 in the previously-traced energizing circuit for relay 26H in the sequence circuit. Relay 26H releases and interrupts the circuit of relay 26J, which in turn releases relay 26SE–L. Relay 26SE–L reoperates the normally operated relay 26H in a circuit traced from the winding of the latter relay over conductors 26–17 and 26–16, armature 3 and front contact of relay 26SSL, armature 1 and back contact of relay 26SE–L which is now released, break contacts controlled by armature 3 of relay 26SSF, armature 1 and back contact of relay 26SE–F, front contact and armature 3 of relay 26R, and front contact and armature 4 of relay 26SSL to ground. Relay 26SE–L reoperates relay 26A in a circuit traced from the winding of that relay, over conductors 26–27 and 26–28, armature 1 and front contact of relay 26SSL, armature 1 and front contact of relay 26R, back contact and armature 5 of relay 26SE–F, break contacts controlled by armature 2 of relay 26SSF, back contact and armature 5 of relay 26SE–L, front contact and armature 2 of relay 26SSL, conductors 26–18, 26–19 and 26–29, and front contact and armature 1 of relay 26H to ground. With relay 26A reoperated, it interrupts, at its armature 1 and back contact, the energizing circuit for relay 26G which releases. Relay 26A then locks over its front contact and armature 3, and the front contact and armature 3 of relay 26G. Relay 26SE–L also interrupts, at its front contact and armature 7, the energizing circuit for relay 26M which releases and, at its armature 2 and front contact, the relay 26SE–L releases select magnet 27–01, the crossbar switch contacts 27–04, 27–06, 27–07 and 27–08 being held by hold magnet 27–03. Relay 26SSL remains locked to relay 26P, which in turn remains operated through make contacts of relay 26SSL and break contacts of all other 26SS relays that are unoperated. The relay 26SSL, remaining operated, indicates the last secondary storage circuit that was permitted to establish a connection through the link circuit in Figs. 27 to 30. As long as battery connections to the sequence circuit in Fig. 26 are not interrupted, one of the 26SS relays will always be operated, a different one as the bidding secondary storage circuits are successively served, and relay 26R will remain operated.

Select magnet 27–01, in releasing, disconnects ground from conductor 27–02, thereby releasing relay 52GA. Relays 52BA and 52C in the secondary storage circuit remain operated until completion of transmission of the message stored in tape 45–11, preventing seizure of the secondary storage circuit by another input even though the transmission of the message to the secondary storage has been concluded, and the secondary storage circuit has been disconnected from the input.

It was previously stated that relay 42DSL releases relay 61J1 in the double storage outlet circuit to which a connection has been established from the secondary storage circuit in Figs. 45 and 52. Relay 61J1, in releasing, completes energizing circuits for relays 61BR and 62BM, the circuits being traced through the upper winding of relay 61BR and over conductor 61–18, and from the upper winding of relay 62BM over conductor 62–01 to a point of junction with conductor 61–18 from which point the path extends in common for the two relays over conductors 61–19, 61–21 and 61–22, armature 5 and front contact of relay 61A1, conductors 61–23 and 61–24, back contact and armature 1 of relay 61J1, and back contact and armature 6 of relay 61MA1 to ground. Relay 61BR locks through its lower winding, front contact and armature 3, conductors 61–26 and 62–02, back contact and armature 1 of relay 62MA2, conductor 62–03 to a point of junction with conductor 62–04 which provides, through the armature 4 and front contact and lower winding of relay 62BM, a locking path for that relay, the locking paths for the relays 61BR and 62BM continuing in common from that point over conductor 62–06, armature 3 and back contact of relay 62B2, armature 2 and back contact of relay 62C2, and back contact and armature 5 of relay 62A2 to ground. The function of relays 61BR and 62BM is to transfer the busy test leads to the second storage unit of the double storage outlet circuit, comprising the reperforator-transmitter unit in Fig. 58. Relay 61BR pertains to busy testing for a secondary storage circuit having a regular or single address message, and relay 62BM pertains to busy testing in connection with a multiple address message.

Transmission of message from secondary storage circuit to connected outlet

As previously stated, the relay 52TR in the secondary storage circuit completes the energizing circuit of transmitter clutch release magnet 45–03, which operates. As in the case of the previously-described reperforator-transmitter distributor unit, the magnet 45–03 permits clutch 45–12 to become engaged and impart continuous rotation

to transmitter shaft 45–13. Cams on the shaft cause tape-sensing levers 45–14 to sense the code combinations in tape 45–11 to contact controlling members 45–16 through transfer levers 45–18. In each revolution of shaft 45–13, the distributor clutch release contacts 45–19 close and connect ground over conductors 45–21 and 45–22 to the winding of distributor clutch release magnet 45–23, which operates. Transmitter auxiliary contacts 45–24 close in each revolution of shaft 45–13 and extend ground over conductor 45–26, but the path terminates at the front contact associated with armature 1 of relay 53H, which is not operated at this time.

Distributor clutch release magnet 45–23 permits clutch 45–27 to be engaged to impart rotation to distributor shaft 45–28. The transmitter contacts, comprising the make contact pair at the extreme left of each set of contacts controlled by slides 45–16, are connected through back contacts and armatures of relay 52D to the distributor contacts that are closed, in succession, by cams on shaft 45–28. For marking elements, positive battery is connected to resistor 45–29, closed transmitter contacts and closed distributor contacts to transmission conductor 27–09. For spacing elements, the transmitter contacts are open, so that when their corresponding distributor contacts close, positive battery is disconnected from transmission conductor 27–09, and only negative battery remains connected at the transmitting end of the conductor through resistor 45–31. The transmission path is traced over conductor 27–09, cross-bar switch contacts 27–04, conductor 61–07, front contact and armature 2 of relay 61LA1, and conductor 61–06 to the grid of tube 61–04. The tube repeats the signals over conductor 61–09 to the winding of selector magnet 57–01 of reperforator-transmitter unit 57–02. The signals received by selector magnet 57–01 are reperforated in tape 57–04, causing the tape to feed out from the reperforator and move tape-sensing head 57–06 away from perforator head 57–07.

Disconnection of outlet from secondary storage circuit

Each time that a Figures signal is sensed in tape 45–11 of the secondary storage circuit and is transferred to slides 45–16, a ground connection is extended through the maze contacts controlled by slides 45–16, and over conductor 45–32 to the upper winding of relay 53FG, and the relay operates. The arrangement is like that described in connection with the single storage input circuit in that relay 53FG connects a resistor, designated 53–04, in parallel with its lower winding, to impart a slow-release characteristic to the relay. Upon the occurrence of the Figures signal in the address information preceding the message or in the body of the message, the signal that follows the Figures signal will be some code combination other than an H because, as previously stated, the Figures, H and Letters sequence is the disconnect or end-of-message signal. When a signal other than an H code combination following the Figures signal is transferred to the slides 45–16, the previously-traced circuit through the upper winding of relay 53FG will be interrupted, and that relay will release slowly, because resistor 53–04 is connected in parallel with the lower winding.

When the relay 53FG has been operated in response to the Figures signal occurring as part of the disconnect sequence, and the code combination for the H signal has been transferred to slides 45–16, ground will be disconnected from conductor 45–32, but will be connected through the maze contacts to conductor 45–33, break contacts controlled by the armature of relay 52HA, conductor 52–42, armature 2 and front contact of relay 53FG, and lower winding of that relay to hold it operated, and through the front contact and armature 1 of relay 53FG and the lower winding of relay 53H to operate it.

Relay 53H locks through its upper winding and front contact and armature 3, conductors 53–06, 53–07 and 52–43, and front contact and armature 5 of relay 52BA to ground. At its armature 4 and front contact, the relay 53H extends ground over conductor 53–08 to the lower winding of relay 52HA, which operates. Relay 52HA locks to the ground that was supplied over conductor 45–33 for operating relay 53H and disconnects ground from conductor 52–42, thereby permitting relay 53FG to release slowly, relay 53H remaining locked. In the cycle of transmitter shaft 45–13, in which the code combination following the H signal is transferred and the signal being presumed to be a Letters signal, ground is extended from the transmitter auxiliary contacts 45–24 over conductor 45–26, front contact and armature 1 of relay 53H to the winding of relay 53LT3, which operates. This relay locks through its front contact and armature 2, and the armature 5 and front contact of relay 53H. At its armature 3 and back contact, the relay 53LT3 interrupts the energizing circuit for transmitter clutch magnet 45–03, causing the arrestment of shaft 45–13 at the end of the cycle in which the Letters signal is transferred to the contacts controlled by slides 45–16. The distributor shaft 45–28 transmits the Letters signal following the Figures and H sequence, and in the cycle of shaft 45–28 in which the Letters signal is transferred to the outlet, the distributor auxiliary contacts 45–34 extend ground over conductors 45–36 and 52–48, armature 1 and front contact of relay 53LT3, front contact and armature 2 of relay 53H and winding of relay 53LT1, and the latter relay operates. With the slides 45–16 set in accordance with the code combination for the Letters signal, the ground connection supplied over conductor 45–33 for holding relay 52HA operated is removed, and that relay releases. Since relay 53H and 53LT3 have become operated and locked, relay 52HA is no longer required to be operated.

Relay 53LT1 locks through its armature 1 and front contact, the winding of relay 53LT2, conductors 53–09, 53–07 and 52–43 to ground, through the front contact and armature 5 of relay 52BA when distributor auxiliary contacts 45–34 open and disconnect ground from the original energizing circuit for relay 53LT1, traced above, and relay 53LT2 operates in the locking circuit for relay 53LT1. At its armature 2 and front contact, relay 53LT2 completes the circuit of relay 53DS which operates.

The last-mentioned relay connects ground over conductors 53–11, crossbar switch contacts 27–06, conductor 27–13, armature 3 and front contact of relay 61LA1 to the winding of relay 61LB1, which operates. Relay 61LB1 locks through its front contact and armature 3, conductor 27–11, and front contact and armature 2 of hold magnet 27–03 to ground. At its armature 1 and back contact, the relay 61LB1 interrupts the locking circuit of relay 61LA1 which releases. At its armature 4 and front contact, the relay 61LB1 extends a ground connection on the armature 5 of relay 61J1 over the back contact, conductors 61–27 and 61–28, front contact and armature 4 of relay 61LB1, and conductors 61–02 and 61–01 to the back contact associated with the armature 1 of relay 61BR. This ground connection will maintain a busy indication for the first storage unit of the double storage outlet in the event that the second storage unit should be seized and transfer the point of access to the double storage outlet back to the first unit or level of storage, as will be described hereinafter.

Relay 61LA1, released by relay 61LB1, interrupts the energizing circuit for relay 61A1 which also releases. Relay 61LA1 also interrupts, at its armature 2 and front contact, the transmission path to the grid of tube 61–04, thus effecting disconnection of the first storage unit of the double storage outlet circuit from the secondary storage circuit. The relay 61A1, at its armature 6, disconnects ground from conductor 61–08 which extends to the winding of hold magnet 27–03 of the crossbar switch, thereby causing the release of the armatures of the hold magnet and the release of crossbar switch contacts 27–04, 27–06, 27–07 and 27–08. Armature 2 of hold magnet 27–03 disconnects ground from conductor 27–11, thereby

unlocking relay 61LB1 which releases. All of the relays of the double storage outlet that were operated in connection with the establishment of a connection to that outlet have been released with the exception of relays 61BR and 62BM, which will remain operated until another message directed to the double storage outlet results in the seizure of the second storage level thereof, as will be described later.

With hold magnet 27–03 released, the ground supplied over its armature 1 and front contact to conductor 27–12 is removed, this conductor also being disconnected from conductor 52–36, to which the ground connection was extended at the crossbar switch contacts 27–08. This path comprises the locking circuit for relay 52TR which releases. Relay 52TR releases relays 52BA and 52C. Relay 52BA interrupts the locking circuits for relays 53H, 53LT2 and 53LT1, and those three relays release. Relay 53H unlocks relay 53LT3 which releases. The secondary storage circuit thus has been restored to normal, leaving only the relay 52BT operated, and with relay 52C released, the secondary storage circuit in Figs. 45 and 52 again is indicated as available at the allotter circuit in Figs. 37, 44 and 51.

A condition precedent to the release of relay 52C upon the release of relay 52TR is that all of the signals in tape 45–11 shall have been transmitted and tape-sensing head 45–08 shall have closed the gap between itself and perforator head 45–09. The reason for this is that until the gap is closed an energizing circuit for relay 52C is traced from ground through closed transmitter stop contacts 45–07, conductors 45–06 and 45–41, unilateral current conducting device 52–49, conductors 52–51, 52–14, 52–13, 52–12 and winding of relay 52C to battery. Since the release of relay 52C is necessary in order to render the particular level of the secondary storage circuit available to receive another message from an input, the circuit just traced, for holding relay 52C operated until the tape loop is exhausted, prevents the wrong addressing of tape that might be left in the circuit under a trouble condition.

Retransmission of message from double storage outlet

Returning now to consideration of the retransmission of the message stored in the first storage level of the double storage outlet, it was previously stated that tape 57–04 feeds out of the reperforator and pivots the tape-sensing head about its pivotal mounting. This causes transmitter stop contacts 57–08 to close, extending ground over conductor 57–09, armature 1 and back contact of relay 59S1, armature 2 and back contact of relay 59T1, unidirectional current carrying device 59–01 to the winding of relay 59P1, which operates. This relay completes a circuit for relay 59H1, traced from the winding of that relay over conductor 59–02, armature 1 and back contact of relay 60J, conductor 60–01, front contact and armature of relay 59P1, break contacts controlled by armature 5 of relay 59H1, conductor 59–05, break contacts controlled by armature 4 of relay 60H2, conductors 60–02 and 60–03, and front contact and armature 1 of relay 60N to ground, the relay 60N being normally operated. Relay 59H1 operates relay 60J in a circuit traced from the lower winding of that relay over conductor 60–04, armature 3 and front contact of relay 59H1, conductors 59–03 and 60–03, and front contact and armature 1 of relay 60N to ground. At its armature 1 and front contact, the relay 59H1 extends a transmission path from the distributor contacts of the reperforator-transmitter distributor unit in Fig. 57, over conductor 57–11, armature 1 and front contact of relay 59H1, conductor 59–06, break contacts controlled by armature 1 of relay 60H2, conductor 60–06, winding of relay 59AB, conductor 59–04, which is the outgoing side of the transmission channel, and return conductor 57–12 which enters the switching center and is traced through resistor 57–13 to battery. A path from conductor 57–11 is traced through the normally closed stop or rest contacts of the distributor to ground. Prior to the operation of relay 59H1, the ground is connected to conductor 59–06 through the break contacts controlled by armature 1 of relay 59H1 and conductor 59–07. At its armature 8 and front contact, the relay 59H1 interrupts the circuit of normally energized relay 60TC, the circuit being traced from the winding of the latter relay, over conductor 60–07, armature 8 and back contact of relay 60H2, conductor 60–08, and back contact and armature 8 of relay 59H1 to ground. Relay 59H1 also connects ground over its armature 7 and front contact, conductors 59–09, 59–11 and 59–12, armature and marking contact of relay 59AB, conductor 59–13, and lamp 57–14 to battery. Relay 59AB, being included in the transmission circuit comprising conductors 59–04 and 60–06, will follow transmitted signals and cause lamp 57–14 to flash as an indication that transmission is in progress. When relay 60TC has released, it completes a circuit for relay 59G1, traced from the winding of that relay through the front contact and armature 4 of relay 59H1, back contact and armature 3 of relay 59S1, conductors 59–08 and 60–09 to ground, through the front contact and armature 1 of relay 60TC.

At its armatures 1 to 5, the relay 59G1 connects the transmitter contacts controlled by the tape-sensing mechanism of reperforator-transmitter distributor 57–02 to the distributor contacts to provide for the transmission of code combinations sensed by tape-sensing mechanism in tape 57–04. The sensing of the tape and the setting of the transmitter contacts in accordance with the code combinations sensed is controlled by transmitter shaft 57–16, and the operation of the distributor contacts is controlled by distributor shaft 57–17. At its armature 9, the relay 59G1 completes the energizing circuit for transmitter clutch release magnet 57–18, the circuit being traced from the winding of that magnet over conductors 57–19 and 57–28, back contact and armature 1 of relay 59FH, armature 9 and front contact of relay 59G1, back contact and armature 3 of relay 59R1, back contact and armature 1 of relay 59S1, conductor 57–09, and closed transmitter stop contacts 57–08 to ground. In each revolution of transmitter shaft 57–16, the distributor clutch release contacts 57–21 close and connect ground to the winding of distributor clutch release magnet 57–22 which trips off distributor shaft 57–17 for a single revolution. With transmitter clutch release magnet 57–18 energized continuously, the transmission of the message, preceded by the address in formation, proceeds.

It was previously stated that when relay 59H1 was operated, it completed an energizing circuit through its armature 3 and front contact for the lower winding of relay 60J, and that relay operated. The relay 60J prepares, at its front contact and armature 2, a locking circuit for itself which will not become effective unless tape becomes available in the second level of the double storage outlet.

End of retransmission from double storage outlet

During the transmission of the message, relays 59H1, 59G1 and 60J remain operated, and relay 60TC remains released. When any Figures code combination appearing in the tape is sensed and the code combination transferred to the transmitter contacts, a path will be established from ground through the maze contacts and over conductor 57–23, armature 8 and front contact of relay 59G1, and conductors 59–14 and 59–16 to the lower winding of relay 59K which operates. This relay, like the relay 53FG in the secondary storage circuit, connects a resistor in parallel with its upper winding to provide for it a slow-release characteristic. The character signal following a Figures signal appearing in the address information or the text of a message will be anything but an H, and when such signal is sensed and transferred, the energizing circuit for relay 59K will be interrupted, and that relay will release. Relay 59K will be operated in response to the Figures signal appearing as the first code

combination of the disconnect signal, and when the H signal is sensed and transferred, ground will be connected over conductor 57–24, armature 7 and front contact of relay 59G1, conductors 59–17 and 59–18, front contact and armature 1 and upper winding of relay 59K to hold that relay operated, and through the armature 2 and front contact of relay 59K and the upper winding of relay 59L to operate it. Relay 59L locks through its armature 2 and front contact, conductors 59–19 and 59–21, and the front contact and armature 6 of relay 59H1 to ground. When the transmitter auxiliary contacts 57–26 close in the cycle next after the sensing of the H code combination, in which the signal sensed should be a Letters signal, they extend ground over conductor 57–27, front contact and armature 6 of relay 59G1, conductors 59–22 and 59–23, armature 1 and front contact of relay 59L, and winding of relay 59FH, and that relay operates. It locks through its front contact and armature 3, and the front contact and armature 3 of relay 59L to ground. At its armature 1 and back contact, the relay 59FH interrupts the circuit of transmitter clutch magnet, which releases and permits the clutch to disengage and arrest shaft 57–16 at the end of the revolution in which the final signal, presumed to be a Letters signal, was sensed and transferred. At its armature 2 and front contact, the relay 59FH completes the circuit of relay 59M which operates and locks through its front contact and armature 1, conductors 59–24 and 59–26, and front contact and armature 8 of relay 59H1 to ground. At its armature 2, the relay 59M interrupts a path, traced over conductors 59–25 and 60–11, and the armature 3 and front contact and winding of relay 60N, this being the locking circuit for relay 60N which is normally energized but which now releases. Relay 60N has a slow-release characteristic so that adequate opportunity will be given for the distributor to complete the transmission of the final code combination before relay 60N releases. Upon its release it establishes, at its armature 2 and back contact, a circuit for the reoperation of relay 60TC. At its armature 1 and front contact, the relay 60N interrupts the previously-traced locking circuit for relay 59H1 which releases.

Relay 59H1 releases relay 59G1. Relay 59H1 also disconnects the common side of the distributor contacts from the transmission path and recloses the transmission loop at the break contacts controlled by its armature 1. At its armature 8 and back contact, the relay 59H1 provides the ground connection from which relay 60TC is normally operated. The relay 59H1 also interrupts the locking circuit of relay 59L which releases. Relay 59L in turn unlocks relay 59FH which opens the energizing circuit for relay 59M, and the locking circuit for relay 59M having been interrupted at the front contact and armature 8 of relay 59H1, the relay 59M releases. With relay 59M released and relay 60TC operated, the relay 60N will reoperate in a circuit traced from its winding, through the front contact and armature 2 of relay 60TC, and conductors 60–12 and 59–25 to ground, through the back contact and armature 2 of relay 59M.

The transmission control circuit of the double storage outlet circuit has now been restored to normal by the release of all of the relays that had been operated, with the exception of relay 60J which remains operated. The normally operated relays 60N and 60TC have been reoperated. With relay 60J operated, the reperforator-transmitter of the second storage level in Fig. 58 will be afforded access to the transmission channel if it has a message waiting or when it receives a message.

In order to indicate the mode of operation of the input which receives from a keyboard transmitter and the mode of operation of the multiple address circuit, it will be assumed now that reception of a multiple address message commences in the keyboard receiving input, and the message has address information directing it to the double storage outlet circuit, the single storage outlet circuit and the direct connected outlet circuit.

Reception of message by keyboard receiving input

Messages received from some sources, such as radio telephone circuits, are typed on a teletypewriter set which is equipped with a keyboard mechanism that operates a transmitter to cause the transmission of each character as the key lever representing that character is depressed. At the same time that the message is transmitted by the keyboard transmitter, a home copy of the message is made by the receiving mechanism of the teletypwriter. Because the signals thus originating, and transmitted to and received at the switching center, are being sent from a keyboard mechanism, a manually operated device, the transmission may be inherently slow and interspersed with hesitations. Transmission time through the switching office will be conserved by not allowing a connection to be established to a secondary storage circuit until the message has been completely received, whereupon transmission, when it does take place, can do so at full speed.

The keyboard receiving input circuit is shown in Figs. 21 to 25, inclusive. It duplicates substantial portions of the single storage input circuit shown in Figs. 10 to 13, inclusive, previously described. Corresponding elements of various types, including relays, will be identified by reference numerals in Figs. 21 to 25 corresponding to reference numerals in Figs. 10 to 13.

A teletypewriter, which may be a source of message signals for the keyboard receiving input circuit, is designated by reference numeral 23–01. This teletypewriter may be of the type shown in Patent 1,904,164, hereinbefore more fully identified. It includes a keyboard mechanism 23–02, keyboard controlled distributor contacts 23–03, and a selector mechanism 23–04 to control the receiving selector mechanism of the teletypewriter to cause the recording of message signals generated by keyboard controlled contacts 23–03. A transmission channel 23–06 is connected through selector magnet 23–04 and distributor contacts 23–03 to ground, and it extends to the switching center where it traverses the operating windings of relays 23LA and 23L, and terminates at battery supplied through resistor 23–07. Relay 23L will respond to all signals generated by distributor contacts 23–03.

The armature of relay 23L is connected to ground, and the marking contact is connected over transmission conductor 23–08, winding of selector magnet 21–04 of reperforator-transmitter unit 21–06, conductor 21–01, and resistor 25–01 to battery. Each time that the armature of relay 23L leaves its marking contact, the energizing circuit for selector magnet 21–04 of reperforator 21–06 will be interrupted, and in this way the relay 23L will repeat spacing signal elements to selector magnet 21–04. As the selector magnet 21–04 responds to incoming signals, it will cause those signals to be perforated in tape 21–08 by perforator mechanism 21–11, causing tape-sensing head 21–09 to move away from perforator mechanism 21–11, and permitting transmitter stop contacts 21–12 to close.

With contacts 21–12 closed, ground is connected over a path including conductors 21–13 and 21–02, armature 1 and back contact of relay 22TA, conductors 22–01 and 22–02, armature 1 and back contact of relay 22DA, armature 1 and back contact of relay 22DC, armature 3 and back contact of relay 22HM, conductors 22–03 and 22–04, armature 1 and back contact of relay 24TO, conductor 24–01, back contact and armature 1 of relay 25ST, armature 1 and back contact of relay 25MA, conductor 25–02, and winding of transmitter clutch release magnet 21–14 which operates.

As in the case of the single storage input circuit, the energization of transmitter clutch release magnet 21–14 causes the engagement of clutch 21–16 to impart rotation to shaft 21–17. Tape sensing levers 21–18 sense code combinations in tape 21–08 under the control of transmitter cams on shaft 21–17, and transfer the

sensed code combinations through transfer levers 21–21 and slides 21–22 to contact controlling members 21–23. When transmitter auxiliary contacts 21–24 close, they complete a circuit for relay 22TA which operates and locks. When the distributor clutch release contacts 21–27 close, they complete the circuit of distributor clutch release magnet 21–31, which causes clutch 21–32 to become engaged and impart rotation to distributor shaft 21–33. Contacts controlled by the distributor shaft operate as if to transmit the code combination set up on the transmitter contacts, but since no connection has been established to a secondary storage circuit, no transmission occurs. During the rotation of shaft 21–33, the distributor auxiliary contacts 21–34 close and complete a circuit prepared by relay 22TA or relay 22DA which operates. If the code combination transferred to the transmitter contacts is one of those that is to be discarded, namely the Letters combination or the Blank combination, ground will be extended over make contacts of relay 22DA to operate relay 22DC. This relay, if it operates, unlocks relay 22TA which releases, permitting the circuit of transmitter clutch release magnet 21–14 to reclose to initiate another cycle of shaft 21–17. This is the discarded feature previously described in connection with the single storage input circuit. If the code combination transferred to the transmitter contacts is other than one of those to be discarded, or when such other code combination is transferred, the relay 22DC will not operate, and when the distributor auxiliary contacts 21–34 open, the relay 22DB will operate in a locking circuit for relay 22DA. Relay 22TA does not release, the circuit of transmitter clutch release magnet 21–14 is interrupted, and that magnet releases, causing shaft 21–17 to be arrested. Distributor shaft 21–33 also comes to rest at the end of the revolution initiated during the last revolution of shaft 21–17 before that shaft comes to rest. Relays 22TA, 22DA and 22DB are now operated. These operations were fully described in the description of the single storage input circuit.

At the time of closure of transmitter stop contacts 21–12, the ground connection supplied over conductor 21–13 was extended from the junction of that conductor with conductor 21–02, over conductor 21–03 and unilateral current conducting device 24–02 to armature 2 of relay 24MAT. The condition of relay 24MAT will now be examined.

In Fig. 23 two stepping switches are shown, each comprising two contact banks. Stepping switch 23RM comprises contact banks 23–09 and 23–11, the contactors of which are operable by stepping magnet 23–12 and switch 23SM comprises contact banks 23–13 and 23–14, the contactors of which are operable by stepping magnet 23–16. Corresponding contacts of contact banks 23–11 and 23–14 are connected together, and the contactor of contact bank 23–14 is grounded. Jumpers interconnect all the contacts of contact bank 23–13 and a path extends from the jumpers over conductor 23–17 to armature 1 of relay 24MAT. The contactor of contact bank 23–13 is connected through the break contacts of stepping magnet 23–16 and the winding of relay 23–18 to battery. Relay 23–18 is energizable to complete the circuit of stepping magnet 23–16 which in turn will interrupt the energizing circuit of relay 23–18, this being a self-stepping arrangement. Similarly, the contacts of contact bank 23–09 are interconnected by jumpers, and a path is extended from the jumpers over conductor 23–19 to the back contact associated with armature 4 of relay 24MAT. The contactor of contact bank 23–09 is connected through the break contacts of stepping magnet 23–12 and the winding of relay 23–21 to battery. This will be recognized as a self-stepping circuit for stepping switch 23RM.

The function of stepping switch 23RM is to register or count complete messages received from teletypewriter 23–01 and placed in storage in reperforator 21–06, and the function of stepping switch 23SM is to register and count complete messages retransmitted from tape 21–08. When there are no messages in storage in tape 21–08, the contactors of stepping switches 23RM and 23SM occupy corresponding positions whereby a path is extended from ground through the contactors and corresponding contacts of stepping switch banks 23–14 and 23–11 and conductor 23–22 to the winding of relay 24MAT, operating that relay. Since it has been assumed that tape-sensing head 21–09 has just moved away from engagement with punch block 21–11 for the storing of a message, there being no other messages in storage, the contactors of contact banks 23–11 and 23–14 have been shown in engagement with corresponding contacts, and relay 24MAT is shown operated. The stepping magnets 23–12 and 23–16 are interrupted at the armatures 4 and 1, respectively, of relay 24MAT, so that the stepping magnets cannot operate. With relay 24MAT operated, the ground connection extended through the unilateral current conducting device 24–02 to armature 2 of relay 24MAT is continued through the front contact and the winding of relay 24TS to operate that relay, and it locks throught its front contact and armature 2 and conductors 24–03 and 24–04 to the ground supplied through the transmitter stop contacts 21–12 and conductors 21–13 and 21–03, by-passing the armature 2 and front contact of relay 24MAT. At its armatures 1 and 4, relay 24TS disconnects ground from the front contact associated with armature 1 and from the armature 4, respectively, of relay 24MAT, so that the self-stepping circuits for stepping magnets 23–12 and 23–16 cannot become effective until relay 24TS releases, even though relay 24MAT releases first. No operations result immediately from the operation of relay 24TS.

Bid by keyboard receiving input for access to secondary storage circuit

The keyboard receiving input circuit is not permitted to make a bid for access to a secondary storage circuit until one complete message has been recorded. The reception of the complete message is manifested by the response of reperforator 21–06 to the end-of-message or disconnect signal comprising the code combinations for Figures, H and Letters. For this purpose, reperforator 21–06 is provided with contacts 21–28 and 21–29, that close momentarily during the receiving cycles of the reperforator in which the Figures and H signals, respectively, are perforated in tape 21–08. The reperforator 21–06 is also provided with make contacts 21–26 which close momentarily in every receiving cycle of the reperforator. The interval of closure of contacts 21–26 is shorter than that of contacts 21–28 and 21–29, and has its center point coinciding substantially with the center point of the other two intervals so that either of the contacts 21–28 and 21–29 closes before and opens after contacts 21–26.

In response to any Figures code combination received from the teletypewriter 23–01 by reperforator 21–06, contacts 21–28 close and connect ground over conductor 21–36, lower winding of relay 25FGR, and lower winding of relay 25UN to battery. Relay 25FGR operates and the current in this path, flowing through the lower winding of relay 25UN, urges the grounded armature of the latter relay into engagement with its left-hand contact, which it normally engages. During the closure of universal contacts 21–26, ground is extended over conductor 21–37, and the upper winding of relay 25UN to battery. The current through this winding is in the direction to move the armature of relay 25UN away from the left-hand armature, but the current through the lower winding predominates, and being of longer duration, the armature of relay 25UN does not leave its left-hand contact. Relay 25FGR locks through its upper winding

and armature 2 and front contact, and the left-hand contact and armature of relay 25UN.

When an H signal follows the Figures signal, as it would only in the disconnect sequence, ground is connected through contacts 21–29 and conductor 21–38, armature 1 and front contact of relay 25FGR, upper winding of relay 25FHR, and lower winding of relay 25UN to battery. Relay 25FHR operates, and the current through the lower winding of relay 25UN dominates and prevents the current through the upper winding during the closure of contacts 21–26 from operating the armature of relay 25UN away from its left-hand contact. When any other code combination than H follows the Figures signal, as in the body of a message, no circuit is established through the lower winding of relay 25UN at the time that contacts 21–26 are closed to provide a flow of current through the upper winding, and the latter current causes the armature of relay 25UN to be disengaged from its left-hand contact, unlocking and releasing relay 25FGR.

Relay 25FHR, having operated, locks through its lower winding and front contact and armature 2, and the front contact and armature 3 of relay 25FGR to ground. At its armature 1, the relay 25FHR disconnects ground from conductor 25–03 extending to the winding of normally energized relay 24FHA which has a slow-release characteristic. Before this relay has had time to release, a ground is extended from armature 1 of relay 25FHR through the front contact, conductor 25–04, front contact and armature of relay 24FHA, conductor 24–06, and winding of stepping magnet 23–12 of stepping switch 23RM to battery. The stepping magnet operates and prepares to advance the contactors of the stepping switch upon the interruption of the energizing circuit for the stepping magnet. This occurs when relay 24FHA releases, the energizing path for relay 24MAT being interrupted at the contactor associated with stepping switch bank 23–11.

The H signal should be followed by a Letters signal, in connection with the reception of which the energizing circuit for the upper winding of relay 25UN will be completed without corresponding completion of the circuit through the lower winding, whereby the armature will be disengaged from the left-hand contact to interrupt the locking circuit for relay 25FGR. This relay releases and in turn unlocks relay 25FHR which releases. The relay 25FHR interrupts the circuit for stepping magnet 23–12 and reestablishes the energizing circuit for relay 24FHA. The release of the stepping magnet, as a result of the release of relay 25FHR, will probably occur before the release of relay 24FHA, if a Letters signal follows the H signal. If it should happen that another H signal follows instead of a Letters signal, relays 25FGR and 25FHR would remain locked up, but relay 24FHA would release and permit the advancement of the contactors of stepping magnet 23RM. Relays 25FGR and 25FHR would be released in response to the next signal received from teletypewriter 23–01 unless it should also happen to be an H signal, but would remain operated and locked until such next signal were received, it being likely that it would be the first signal of the next message transmission.

With relay 24MAT released, an energizing circuit for relay 25STC is completed, the circuit being traced from the winding of that relay through the break contacts controlled by its armature 3, back contact and armature 1 of relay 25TH, conductors 25–06 and 25–07, back contact and armature 3 of relay 24MAT, now released, front contact and armature 3 of relay 24TS, now operated, conductor 24-07, front contact and armature 2 of relay 22DB, now operated, back contact and armature 1 of relay 22TR, which is unoperated, and break contacts controlled by armature 5 of relay 22HM to ground, and relay 25STC operates. It locks through its front contact and armature 3 and conductors 25–08 and 25–07, the path continuing as previously traced through the break contacts controlled by armature 5 of relay 22HM. Relay 25STC makes a bid for access to a secondary storage circuit in the same manner as relay 13STC, and the description will not be repeated. In the meantime, other messages may be received from teletypewriter 23–01 while the secondary storage circuit is being seized, and an operator's position is also being seized for routing thereto of the address information preceding the message which moved stepping switch 23RM one step out of correspondence with stepping switch 23SM. For each message thus received and recorded in tape 21–08, the contacts 21–28 and 21–29 of reperforator 21–06 that respond to the end-of-message signal will cause the advancement of stepping switch 23RM another step.

Counting of messages received and retransmitted by keyboard receiving input

It will be assumed that the seizure of a secondary storage circuit and an operator's teletypewriter are completed, and that the transmission of the message from tape 21–08 is initiated, these operations being the same as described with reference to the single storage input circuit. Relays 24FG and 24H operate in response to the Figures and H code combinations of the disconnect signal ending the message, and upon the operation of relay 24H a ground connection is extended through its armature 5 and front contact, armature 2 and back contact of relay 24LT1, armature 2 and back contact of relay 24LT2, conductor 24–08, and winding of stepping magnet 23–16 of stepping switch 23SM to energize the magnet and prepare for advancement of the contactors. When relay 24LT1 operates during the closure of the distributor auxiliary contacts 21–34 in connection with the transmission of the code combination following the Figures signal, it interrupts the energizing circuit for stepping magnet 23–16, permitting that magnet to release and advance the contactors of stepping switch 23SM one step. If no additional messages have been received, the contactors of stepping switch 23SM will have advanced into correspondence with those of stepping switch 23RM to reestablish the energizing circuit for relay 24MAT. Relay 24H, in operating, provides a holding circuit for relay 24TS through the armature 7 and front contact of relay 24H. If no additional messages have been received, the contacts 21–12 will have been opened by tape-sensing head 21–09 incident to its last step, unless a series of Letters signals happens to follow the H code combination of the disconnect signal. If there are no Letters signals, the relay 24TS releases when it is unlocked by the release of relay 24H, thus restoring the input to normal. If there should be Letters signals, the contacts 21–12 will not open when relay 24H releases, and relay 24TS will remain locked. The transmitter will then advance, sense and discard the Letters signals, in the manner previously described, until contacts 21–12 open, whereupon relay 24TS will release.

If the reperforator 21–06 should be receiving another message at the time the disconnect signal comprising the code combinations for Figures, H and Letters is decoded by the maze contacts and is transmitted by distributor shaft 21–33, relay 24MAT will reoperate because stepping magnet 23–16 will have been operated and released in response to the disconnect signal, and the positions of the contactors of stepping switches 23RM and 23SM will match. Under this circumstance, relay 25STC cannot reoperate to place another bid for access to a secondary storage circuit, even though relay 24TS remains operated. The operation of relay 25STC will await response of reperforator 21–06 to the Figures, H and Letters code combinations comprising the disconnect signal ending the message then being received. The response of reperforator 21–06 to that sequence of signals causes the advancement of stepping switch 23RM one step, whereupon relay 24MAT will release and relay 25STC

will operate. If more than one additional message is in storage in tape 21–08 when the disconnect signal ending a message is sensed and transmitted from the tape, the advancement of stepping switch 23SM, incident to the transmission of the disconnect signal, will not result in matching of the contactors of that stepping switch with those of stepping switch 23RM, and relay 24MAT will not reoperate. With relay 24MAT released, and relay 24TS remaining operated, relay 25STC can operate to place another bid for access to a secondary storage circuit.

It may happen that tape 21–08 becomes torn, and because of this or some other trouble, the selectors may be out of step with the messages in the tape. An arrangement is provided for automatically advancing the stepping switches to bring them into matching condition. As previously stated, when the contactors of the two stepping switches are out of matching condition, there can be no energizing circuit for relay 24MAT, and that relay will remain released. If relay 24TS should be released due to opening of its locking circuit at the transmitter stop contacts 21–12, the locking circuit also being open at the armature 7 and front contact of relay 24H, a circuit for energizing relay 23–21, through the armature and back contact of stepping magnet 23–12, will be completed, the circuit being traced from ground through the armature 4 and back contact of relay 24TS, armature 4 and back contact of relay 24MAT, conductor 23–19, interconnected contacts of contact bank 23–09 and the associated contactor, back contact and armature of stepping magnet 23–12, and winding of relay 23–21 to battery. The relay completes the energizing circuit for stepping magnet 23–12 which, in turn, interrupts the energizing circuit for relay 23–21, thus comprising a self-stepping circuit for the stepping switch. Similarly, a circuit for relay 23–18 will be completed, traced from ground through the armature 1 and back contact of relay 24TS, back contact and armature 1 of relay 24MAT, conductor 23–17, interconnected contacts of stepping switch bank 23–13 and associated contactor, back contact and armature of stepping magnet 23–16, and winding of relay 23–18 to battery. The contactors of stepping switch 23SM will be self-stepped by means of this circuit. If the contactors should happen to arrive in matching condition before they reach the positions in which they are shown in Fig. 23, a circuit for relay 24MAT will be completed through the contact banks 23–11 and 23–14 and associated contactors. Relay 24MAT, in operating, would interrupt the self-stepping circuits for the stepping switches and they would remain in matching condition. The first contact of each of the stepping switch banks 23–09 and 23–13 is not connected to the other contacts of the bank by a jumper connection. If the stepping switches do not arrive in matching condition before their contactors reach the No. 1 contacts, the positions in which they are shown in Fig. 23, the advancement of the contactors will be arrested upon arrival of the contactors in those positions, because, upon the arrival of both switches in the No. 1 position, the circuit of relay 24MAT will be reestablished through contact banks 23–11 and 23–14.

If, because of some trouble that prevented the orderly retransmission of messages received in storage in the keyboard receiving input circuit, more messages should be received and stored than the message counting apparatus comprising the stepping switches 23RM and 23SM is arranged to accommodate, in the normal operation of the circuit only those messages in excess of that number will be retransmitted automatically, because the relative positions of the two stepping switches would differ only by the number of messages in excess of the normal capacity. The reason for this is that when the excess number had been transmitted, the stepping switches would come into matching positions which would correspond to the condition in which all stored messages have been transmitted, and no further retransmission would take place. Since a system of the type herein described would ordinarily be engineered to accommodate all conditions normally encountered, it is to be expected that adequate message storage capacity would be provided by the stepping switches, and that if the number of contacts in one stepping switch bank did not afford adequate capacity, switches having larger numbers of contacts in the contact banks would be employed or an additional bank of each switch would be allotted for registering messages in storage by employing single ended switch bank contactors disposed 180 degrees out of phase. Upon the occurrence of an abnormal message storage condition, as described above, the situation may be remedied by the momentary operation of selector stepping key 23–23 which connects ground to stepping magnet 23–16 to operate it. Upon the release of key 23–23, the brushes associated with stepping switch 23SM advance one step, thereby bringing them out of correspondence with the brushes of stepping switch 23RM and permitting the retransmission of messages to proceed until all in storage have been retransmitted.

Cord circuit operations routing multiple address message

It will be assumed that the secondary storage circuit seized by the keyboard input circuit for storage of the multiple address message is the one shown in Figs. 31, 32, 38 and 39, and that the operator position, at which the address information preceding the message is disabled, is the one contained in Figs. 33, 34, 40, 41, 47 and 48. The cord circuit in that operator position that is allocated to the secondary storage circuit in Figs. 31, 32, 38 and 39 is the one having relays 40BDF, 40POSF, 40SLF, 40DSF and 40RLSF. The cord circuit operates in the same manner as previously described, and the address signals are impressed upon the grid of tube 47–27. This tube repeats the signals to selector magnet 47–28 of teletypewriter 47–29 in the operator position. When all of the address information has been recorded on teletypewriter 47–29, the operator may disconnect the teletypewriter and suspend transmission of the text of the message thereto by momentarily operating key 40–18.

In order to prepare for the seizure of the three outlets designated by the addresses preceding the message, the operator must establish a connection from the cord circuit of the secondary storage circuit in which the message is being recorded, this being the cord circuit in the left-hand portion of Fig. 40, to jacks and associated cord circuits especially provided for the routing of multiple address messages. Three such cord circuits are shown in Figs. 41 and 48, and their associated jacks are shown in the lower portion of Fig. 33.

It will be assumed that the first of the three cord circuits, at the left of Figs. 41 and 48, is already in use in connection with a multiple address message, and so is not available for routing of the message presently under consideration. It will also be assumed that the three cord circuits shown in Figs. 41 and 48 are the only multiple address cord circuits located in the particular operator's position. Since the message has three destinations, it will be necessary for the operator to use three multiple address cords, and having only two available in her own position, she must look to the operator position at the right for availability of another cord circuit. It will be assumed that the operator position, shown in Figs. 35, 36, 42, 43, 49 and 50, is the one located next at the right, and that it has at least two multiple address cord circuits, shown in Figs. 43 and 50, and further, that the first of those two cord circuits, shown at the left of Figs. 43 and 50, is idle.

The first step is the insertion of cord circuit plug 40–19 into jack 33–03. An energizing circuit is established through the cord and jack for relay 41J2, the circuit being traced from ground through resistor 41–01, winding of relay 41J2, conductor 41–02, ring spring of jack 33–03, ring terminal of plug 40–19 of the cord circuit, conductors 40–21 and 40–22, armature 7 and front contact

of relay 40POSF, which would be operated at this time, and winding of relay 40SLF to battery. The magnitude of resistor 41–01 is such that insufficient current flows to operate relay 40SLF, but the current is sufficient to operate relay 41J2. Relay 41J2 exends ground over conductor 41–03 to the winding of relay 48C2. At its front contact and armature 7, relay 48C2 connects ground over conductor 48–01 to light green lamp 41–04 to indicate the second cord circuit as the first of three to be used in seizing outlets to which the message is directed. At a number of armatures and back contacts, the relay 48C2 severs paths extending to the first multiple address cord circuit at the left, this being necessary because the second cord circuit of the set is to be the first one of three used for routing the message to the designated outlets. No other relay operations result immediately from insertion of plug 40–19 into jack 33–03.

It has been assumed that the message is directed to the double storage outlet, the single storage outlet and the direct connected outlet. The jack, in the operator position shown in Figs. 33, 34, 40, 41, 47 and 48, by which access to the double storage outlet is gained, is jack 34–03, and the operator may insert plug 41–06 of the second cord circuit in Fig. 41 into this jack. The jack in the same operator position, by which access to the single storage outlet is obtained, is jack 34–01, and plug 41–07 of the third cord circuit in Figs. 41 and 48 may be inserted into jack 34–01. Although the dotted line sections in Fig. 48 indicate that there may be more than three multiple address cord circuits in the position and that the one at the extreme right in Figs. 41 and 48 is the last of a plurality exceeding three in number, those dotted sections are being disregarded for the purposes of the present description so that the manner in which an operator may make use of a cord circuit in another operating position may be described. The jack 34–02 is the one that gives access to the direct connected outlet, the plug 43–01 of the first multiple address cord circuit in the operator position in Figs. 35, 36, 42, 43, 49 and 50 may be inserted into that jack. Alternatively, it is permissible for the operator to insert plug 43–01 into jack 36–06 which has its springs and sleeve connected in multiple to the corresponding springs and sleeve, respectively, of jack 34–02, and is the jack in the multiple address jack field of the operator position in Figs. 35, 36, 42, 43, 49 and 50 that gives access to the direct connected outlet. Plug 43–01 may be inserted into whichever of the jacks 34–02 and 36–01 it will most conveniently reach. The dotted sections of conductors extending leftwardly from contacts of relay 50C1 may be taken as indicating that the cord circuit containing that relay is not the first one in this operator position, or that there are other multiple address cord circuits in other positions intervening the last multiple address cord circuit shown in Figs. 41 and 48 and the first multiple address cord circuit shown in Figs. 43 and 50. For the purposes of the present description, these dotted sections are being disregarded.

Multiple address cord circuit plugs have now been inserted into multiple address circuit jacks of the three outlets to which the message is addressed. The operator then momentarily operates key 43–02 associated with the last cord circuit used. Each of the multiple address cord circuits has such a key. Key 43–02 completes a circuit for relay 50KY1, traced from the winding of that relay over conductor 50–01, key 43–02, conductors 43–03 and 50–02, armature 6 and back contact of relay 50C1 which is unoperated, conductor 50–03, which is included in a group of conductors bracketed together and extended over dot and dash line 50–04 to Fig. 48 where conductor 50–03 reappears and the path is continued through the back contact and armature 7 of relay 48KY3, conductor 48–02, armature 6 and back contact of relay 48C3, conductor 48–03, back contact and armature 7 of relay 48KY2, conductor 48–04, and armature 6 and front contact of relay 48C2 to ground, relay 48C2 being operated. Relay 50KY1 operates over this circuit and locks in a path traced from its winding through its front contact and armature 7 to conductor 50–02, and thence over its operating path to ground at the armature 6 and front contact of relay 48C2.

Relay 50KY1 completes a circuit for lighting lamp 35–05 associated with jack 35–04 of that multiple address cord circuit to indicate that the cord circuit is busy and that its jack 35–04 is not available to receive the regular cord plug of a secondary storage circuit for the setting up of another multiple address connection. The circuit of lamp 35–05 is traced from the lamp, which has a battery connection on one terminal, over conductor 35–06 and armature 9 and front contact of relay 50KY1 to ground, this contact being one of a number of contacts of relay 50KY1 that have ground connected thereto. The ground connection is also extended from armature 9 over conductor 50–06, armature 2 and back contact of relay 50C1, conductor 50–07, which is included in the group represented by dot and dash line 50–04, back contact and armature 9 of relay 48KY3, conductor 48–06 to the busy lamp 33–06 associated with jack 33–07 of the second cord circuit of the set of three that is being used for establishing this connection, namely the extreme right-hand cord circuit in Figs. 41 and 48. From armature 9 of relay 48KY3, the ground connection is also extended over conductor 48–07, armature 2 and back contact of relay 48C3, conductor 48–08, back contact and armature 9 of relay 48KY2 and conductor 48–09 to busy lamp 33–08 associated with jack 33–03 which has received the cord plug of the secondary storage circuit in which the multiple address message is awaiting retransmission when the outlets shall have been seized. Because of the fact that relay 48C2 is operated, the ground connection supplied over the back contact and armature 9 of relay 48KY2 is not extended from the armature 2 of relay 48C2 to circuits associated with relay 48KY1. It has been assumed that the multiple address cord circuit at the extreme left of Figs. 41 and 48 was busy at the time that plug 40–19 was to be inserted into multiple address jack 33–03, and under that circumstance, lamp 33–09 associated with jack 33–11 of the first multiple address cord circuit in Figs. 41 and 48 would be lighted directly from relay 48KY1 which would be operated.

At its front contact and armature 4, relay 50KY1 extends ground over conductor 50–32, armature 3 and back contact of relay 50C1, conductor 50–33, included in the group bracketed together and extended over dot and dash line 50–04 to Fig. 48 in which conductor 50–33 continues, the path then extending through armature 3 and back contact of relay 48C3, conductor 48–32, armature 3 and front contact of relay 48C2, which is operated, conductor 48–33 to the junction of resistor 41–01 and the left-hand terminal of the winding of relay 41J2. The ground connection applied over the path just traced short-circuits resistor 41–01 and increases the flow of current in a path previously traced through the winding of relay 41J2, conductor 41–02, ring spring of jack 33–03, ring of plug 40–19, conductors 40–21 and 40–22, armature 7 and front contact of relay 40POSF, and winding of relay 40SLF to battery. The current that flowed in this path prior to the shunting of resistor 41–01 was sufficient to operate relay 41J2, but was insufficient to operate relay 40SLF. With the resistor 41–01 shunted, the increased current permits relay 40SLF to operate in series with relay 41J2. Relay 40SLF locks through its armature 4 to conductor 40–21 over which it has been energized. It performs the operations previously described in connection with the description of operation of relay 42SLL, including the release of relay 40POSF and the lighting of white lamp 40–24, but it does not yet connect the winding of busy test relay 38BT in the secondary storage circuit to the outlets that are to be seized as a result of insertion of the several multiple address circuit cords into the outlet jacks.

With relay 50KY1 operated, ground is disconnected at the back contact and armature 3 of the relay from conductor 50–08, which terminates at one of the contacts of a contact bank 50–09 of a stepping switch which has a second contact bank 50–11 and is operated by stepping magnet 50–12. Another operation performed by relay 50KY1 is the completion of an energizing circuit for relay 50STA in the control circuit for the stepping switch, the energizing path being traced from the winding of that relay over conluctors 50–13, 50–14 and 50–16, front contact and armature 6 of relay 50KY, conductor 50–17, armature 11 and back contact of relay 50C1, conductor 50–18, included in the group extended to Fig. 48 over dot and dash line 50–04, armature 11 and back contact of relay 48C3, conductor 48–11, armature 11 and front contact of relay 48C2, conductor 48–12, and back contact and armature 3 of relay 41ST2 to ground. With the contactor of contact bank 50–09 of the stepping switch engaging any other contact than the one from which ground has been removed, and assuming, therefore, that the contactors are in the positions shown, an energizing circuit for relay 50MAS is completed by relay 50STA, the path being traced from battery through resistor 50–19, armature and back contact of stepping magnet 50–12, winding of relay 50MAS, right-hand armature and front contact of relay 50STA, contactor associated with contact bank 50–09, the contact engaged thereby, conductor 50–21 to armature 3 of relay 48KY1. If that relay should be released, the armature 3 will be receiving ground through the back contact to complete the circuit for relay 50MAS. If relay 48KY1 should be operated, as has been assumed, the armature 3 would engage the front contact, and the path would be extended to the armature 12 of relay 48C1 and to the back contact associated with armature 12 of relay 48C2. Since relay 48C2 is operated, the armature 12 is disengaged from the front contact. If, therefore, the ground connection is to be obtained with relay 48KY1 operated, it must be found through the armature 12 and front contact of relay 48C1, conductor 48–13, and the front contact associated with armature 3 of relay 41ST1. Without determining at this point the circumstances under which relay 41ST1 would be operated, it will be noted that with relay 48KY1 operated, the relay 48C1 must also be operated if a ground connection is to be obtained. This situation should be compared with the presently described condition of the multiple address circuit in accordance with which relay 48C2 of the first cord circuit and relay 50KY1 of the last cord circuit involved in the setting up of a multiple address connection are operated. The only way that relays 48KY1 and 48C1 could both be operated would be that a multiple address cord circuit had been used for setting up a connection for a single address message, by the insertion of the regular cord circuit for a secondary storage circuit into jack 33–11, the insertion of plug 41–05 of the first multiple address cord circuit into the multiple address jack of the desired outlet and by the operation of key 41–08. Such operation, while not serving a particularly useful purpose, is possible although not likely to be employed.

In any case, if not more than one group of multiple address cord circuits is seeking connection to outlets, ground will be removed from only one of the terminals of contact bank 50—09, and all other terminals will have ground so that relay 50MAS will be operated. At its armature 2, the relay 50MAS completes the energizing circuit of stepping magnet 50–12 which, in turn, interrupts the energizing circuit of relay 50MAS, that relay in turn releasing the stepping magnet and causing the advancement of the contactors to the next contact. They will continue to advance until the contactor associated with contact bank 50–09 encounters a contact which is not grounded, and at that point the contactors will be arrested. When the contactors come to rest, ground will be extended over the left-hand armature and front contact of relay 50STA, armature and front contact of relay 50MAA, which is normally energized, but is released by stepping magnet 50–12 and relay 50MAS during the advancement of the contactors, back contact and armature 3 of relay 50MAS, the contactor associated with contact bank 50–11 of the stepping switch, the contact in engagement with which the contactor comes to rest, conductor 50–22, front contact and armature 1 of relay 50KY1, conductor 50–23, and winding of relay 43CONN1 to battery, and this relay operates.

The relay locks through its front contact and armature 4, conductors 43–04 and 50–24, armature 9 and back contact of relay 50C1, conductor 50–26, which is among those grouped and represented by dot and dash line 50–04, conductor 48–14, armature 9 and back contact of relay 48C3, conductors 48–16 and 48–17, armature 9 and front contact of relay 48C2, conductor 48–18, break contacts controlled by armature 2 of relay 41ST2, conductor 41–09, and front contact and armature 8 of relay 48C2 to ground. Relay 43CONN1 extends the ground connection from which it is locked, over its armature 5 and front contact, conductor 43–06, armature 1 and back contact of relay 50C1, conductor 50–27, which is among those represented by dot and dash line 50–04, back contact and armature 1 of relay 48KY3, conductor 48–19, and winding of relay 41CONN3 to battery, and this relay operates. It locks through its front contact and armature 4, conductor 41–11 to conductor 48–14 over which the locking ground was supplied for relay 43CONN1. At its armature 5 and front contact, relay 41CONN3 extends the same ground connection over conductor 41–12, armature 1 and back contact of relay 48C3, conductor 48–21, back contact and armature 1 of relay 48KY2, and conductor 48–22 to the winding of relay 41CONN2, which operates. This relay locks through its front contact and armature 4 and conductor 41–13 to conductor 48–17, included in the locking circuit for relays 41CONN3 and 43CONN1. Relay 41CONN2 connects ground through its front contact and armature 5 to conductor 41–14, which extends to armature 1 of relay 48C2 where the path terminates because that relay is operated and the armature has no front contact.

Each of the relays 41CONN2, 41CONN3 and 43CONN1, at its armatures 1, 2 and 3, connects the tip, ring and sleeve, respectively, of the associated cord plug of the cord circuit to paths which will be described hereinafter. These are the plugs 41–06, 41–07 and 43–01 for the three relays in the order in which the relays were last enumerated. The tip of plug 41–06 is extended to the winding of relay 41TPC2. The sleeve of plug 41–06 is extended to the upper winding of relay 41SLC2. The ring of plug 41–06 is extended through unilateral current conducting device 41–16, conductors 41–17 and 48–23, armature 4 and front contact of relay 48C2, and conductor 48–24 to the front contact of relay 41TPJ2. The ring of plug 41–07 is connected over unilateral current conducting device 41–18, conductors 41–19 and 48–26, armature 4 and back contact of relay 48C3, armature 10 and back contact of relay 48KY2 to conductor 48–23, and armature 4 and front contact of relay 48C2, the path terminating at the front contact of relay 41TPJ2. Similarly, the ring of plug 43–01 is connected through unilateral current conducting device 43–07, conductors 43–08 and 50–28, armature 4 and back contact of relay 50C1, conductor 50–29 grouped with others and represented by dot and dash line 50–04, armature 10 and back contact of relay 48KY3 to conductor 48–26 from which a path has previously been traced to the front contact of relay 41TPJ2. To complete the description of the connections from the plugs, the tip of plug 41–07 is extended to the winding of relay 41TPC3, the sleeve of plug 41–07 is extended to the upper winding of relay 41SLC3, the tip of plug 43–01 is extended to the winding of relay 43TPC1, and the

sleeve of that plug is extended to the upper winding of relay 43SLC1.

Bid by multiple address circuit for access to storage level of double storage outlet

With plug 41–06 inserted into jack 34–03, a test is made for availability of one of the reperforator-transmitter units of the double storage outlet circuit shown in Figs. 57, 58, 59, 60, 61 and 62. This test is made by providing an operating circuit for relay 61BD, the circuit being traced from the winding of that relay over conductors 61–29 and 61–31, resistor 61–32, conductors 61–33, 61–34, 61-36 and 34–04, sleeve bushing of jack 34–03, sleeve of plug 41–06, front contact and armature 3 of relay 41CONN2, and upper winding of relay 41SLC to ground. Resistor 61–32 limits the current that flows in this circuit to a value that is insufficient to operate relay 41SLC, but relay 61BD operates and extends ground over conductors 61–37, 61–38 and 62–07 to armature 1 of relay 62BM. Whether or not the storage level shown in Figs. 57, 59 and 61 has become idle, it has been assumed in this description that it was the last one to be seized and, therefore, the storage level shown in Figs. 58, 60 and 62, if idle, is the one that is available. With this condition of the double storage outlet circuit, relays 61BR and 62BM are operated, and the ground connection traced to the armature 1 of relay 62BM is extended through the front contact, armature 1 and back contact of relay 62B2, armature 1 and back contact of relay 62C2, armature 3 and back contact of relay 62A2, back contact and armature 1 of relay 62LB2, and back contact and armature 1 of relay 62J2 to the winding of relay 62MA2 which operates. If the storage level shown in Figs. 58, 60 and 62 should have been busy at this time, and the storage levels in Figs. 57, 59 and 61, having become idle and again become busy, thereby indicating the reperforator-transmitter in Fig. 58 as the next one to be seized, relay 62A2 would be operated, and the circuit of relay 62MA2 could not be completed until all of the relays in Fig. 62, through back contacts of which the operating circuit of relay 62MA2 was traced, had been released.

Relay 62MA2, having operated, locks through its front contact and armature 3, conductors 62–09, 61–38 and 61–37, and the armature and front contact of relay 61BD to ground. At its armature 7 and front contact, the relay 62MA2 extends ground over conductor 62–12, back contact and armature 4 of relay 62A2, back contact and armature 4 of relay 62LB2, conductors 62–13 and 62–14, front contact and armature 1 of relay 61BR to conductor 33–01 to make busy the regular jacks for the double storage outlet circuit. The relay 62MA2 places a shunt around resistor 61–32, the shunting path being traced from conductor 61–31 which is connected to the left-hand terminal of resistor 61–32 over conductor 61–39, front contact and armature 2 of relay 62MA2, conductors 62–16 and 61–34 to conductor 61–33 which is connected to the right-hand terminal of resistor 61–32. With resistor 61–32 shorted out, current in the energizing circuit for relay 61BD, which includes the upper winding of relay 41SLC2, increases to a sufficient value to operate relay 41SLC2. Relay 41SLC2 prepares a circuit which is completed only upon the seizure of the other two outlets.

Bid by multiple address circuit for access to single storage outlet

Similarly, with plug 41–07 inserted in jack 34–01, a path is traced from the upper winding of relay 41SLC3, armature 3 and front contact of relay 41CONN3, sleeve of plug 41–07 and sleeve bushing of jack 34–01, conductors 34–06 and 65–01, resistor 65–02, conductor 65–03, and the winding of relay 65BD to battery, and that relay operates. It extends ground through its armature and front contact, conductor 65–04, armature 1 and back contact of relay 65B, armature 1 and back contact of relay 65C, armature 2 and back contact of relay 65A, back contact and armature 1 of relay 65LB, back contact and armature 1 of relay 65J, and winding of relay 65MA to battery, and that relay operates, provided none of the relays through the break contacts of which the circuit was traced is operated. For example, if the single storage outlet circuit in Figs. 63, 64 and 65 is in the process of being seized by a regular cord circuit, relay 65J will be operated, if it is busy receiving a message relay 65A would be operated, and if a disconnect operation is in progress, relay 65LB will be operated, and any one of those relays will prevent the operation of relay 65MA. Relay 65MA, upon operating, locks through its front contact and armature 3, conductor 65–06, and the front contact and armature of relay 65BD to ground. At its armature 2 and front contact, relay 65MA short-circuits resistor 65–02, permitting relay 41SLC3 to operate.

Bid by multiple address circuit for access to direct connected outlet

In a like manner, with plug 43–01 inserted into jack 34–02, a path is traced from ground through the upper winding of relay 43SLC1, armature 3 and front contact of relay 43CONN1, sleeve of plug 43–01, sleeve bushing of jack 34–02, conductor 34–07, resistor 66–01 and winding of relay 66BD, and the latter relay operates, but relay 43SLC3 does not operate. Fig. 66 contains the circuit of the direct connected outlet, which includes no reperforator-transmitter for storing and retransmitting a message, but is arranged to repeat signals received from a secondary storage circuit directly to the outgoing transmission channel. Assuming that this outlet is idle, ground will be extended from the armature of relay 66BD through the front contact, armature 1 and back contact of relay 66B, armature 2 and back contact of relay 66A, back contact and armature 1 of relay 66LB, back contact and armature 4 of relay 66J, and winding of relay 66MA to battery, and the relay 66MA will operate. If the direct connected outlet in Fig. 66 should be busy at the time relay 66BD seeks to operate relay 66MA, the operation of the latter relay will be prevented until the circuit becomes idle, and the multiple address circuit will merely wait for it to become idle. The same will be true of the single storage outlet circuit in Figs. 63, 64 and 65. In the case of the double storage outlet circuit, if both storage levels should be busy at the time relay 61BD is operated, neither of the relays 61MA1 nor 61MA2 can operate, but when either level becomes idle, the relay in that level carrying the designation MA will operate.

Connection of seized outlets to secondary storage circuit

When all of the outlets have been seized, as evidenced by the operation of relays 41SLC2, 41SLC3 and 43SLC1, a circuit will be completed for relay 41TPJ2, the circuit being traced from the winding of that relay over conductor 14–21, front contact and armature 5 of relay 48C2, conductor 48–27, armature and front contact of relay 41SLC2, conductor 41–22, armature 8 and back contact of relay 48KY2, conductor 48–28, back contact and armature 5 of relay 48C3, conductor 48–29, armature and front contact of relay 41SLC3, conductor 41–23, armature 8 and back contact or relay 48KY3, conductor 48–31 included in the group of conductors bracketed over dot and dash lines 50–04 to Fig. 50, back contact and armature 5 of relay 50C1, conductor 50–31, armature and front contact of relay 43SLC1, conductor 43–09, and armature 8 and front contact of relay 50KY1 to ground. Relay 41TPJ2 initiates the sequence of operations involved in the connection of the three seized outlets to the secondary storage circuit in which the message for the three outlets has been or is being stored. It has been assumed that this is the secondary storage circuit in Figs. 31, 32, 38 and 39 and the estab-

lishment of the connections is initiated by extending a path from battery through the winding of relay 38BT, conductors 38–02 and 38–03, front contact and armature 3 of relay 38BC0, which would be operated at this time, back contact and armature 1 of relay 38GA, conductor 38–04, front contact and armature 2 of relay 40SLF, which is now operated, armature 5 and back contact of relay 40DSF, conductor 40–26, tip, of plug 40–19, tip spring of jack 33–03 and make contacts controlled thereby, conductor 33–12, armature and front contact of relay 41TPJ2, conductor 48–24, front contact and armature 4 of relay 48C2, conductors 48–23 and 41–17, armature 2 and front contact of relay 41CONN2, unilateral current conducting device 41–16, ring of plug 41–06, ring spring of jack 34–03, conductors 34–08 and 34–09, armature 3 and front contact of relay 62BM, armature 5 and front contact of relay 62MA2 to the winding of relay 62LA2, thus placing battery on the winding of relay 62LA2 in opposition to the battery on the winding of relay 38BT. At the junction of conductors 48–23 and 41–17, a branching path is traced through the back contact and armature 10 of relay 48KY2, back contact and armature 4 of relay 48C3, which is not operated, conductors 48–26 and 41–19, armature 2 and front contact of relay 41CONN3, unilateral current conducting device 41–18, ring of plug 41–07, ring spring of jack 34–01, conductor 34–11, armature 5 and front contact of relay 65MA, and conductors 65–07 and 65–08 to the winding of relay 65LA in the single storage outlet circuit, this path also terminating in battery. At the junction of conductors 48–26 and 41–19, a branching path extends through the back contact and armature 10 of relay 48KY3, conductor 50–29, back contact and armature 4 of relay 50C1, conductors 50–28 and 43–08, armature 2 and front contact of relay 43CONN1, unilateral current conducting device 43–07, ring of plug 43–01, ring spring of jack 34–02, conductor 34–12, armature 5 and front contact of relay 66MA, conductors 66–02 and 66–03 to the winding of relay 66LA, where the path also terminates in battery. The fact that the branching paths traced to Figs. 66, 65 and 62 terminate in battery rather than ground indicates that the seized outlets are idle, and since no ground connection is provided for holding normally operated busy test relay 38BT operated, that relay releases.

Relay 38BT extends ground over conductor 38–06 to place a bid with the sequence circuit for permission to operate the link circuit. The operation is similar to that previously described and will result ultimately in the operation of select magnet 27–14. This magnet prepares for operation the several sets of contacts at its level in the crossbar switch and extends ground over conductor 27–16 to operate relay 38GA in the secondary storage circuit. At its armature 1 and front contact, relay 38GA connects ground to conductor 38–04 from which branching paths have been traced to the windings of relays 62LA2, 65LA and 66LA. The operations performed by relay 62LA2 are similar to the operations performed by relay 61LA1 as previously described, including the operation of relay 62A2 and the completion of the circuit of hold magnet 27–17 by relay 62A2, the circuit being traced from ground through armature 5 and front contact of relay 62A2, and conductor 62–17 to the winding of the hold magnet.

Hold magnet 27–17 extends ground through its armature 2 and front contact, conductors 27–18 and 62–18, armature 6 and front contact of relay 62LA2, conductors 62–19 and 62–21, armature 3 and front contact of relay 62MA2, front contact and armature 2 of relay 62BM, conductors 62–22 and 34–13, break contacts controlled by the tip spring of jack 34–03, tip spring of that jack, tip of plug 41–06, conductor 41–24, front contact and armature 1 of relay 41CONN2 to the winding of relay 41TPC2, which operates to indicate that the necessary connections from the secondary storage circuit to one of the storage levels of the double storage outlet circuit has been completed. These connections are established through the upper three pairs of contacts common to select magnet 27–14 and hold magnet 27–17. The transmission connection begins in Fig. 31 and extends from the several distributor contacts over conductor 31–01, crossbar switch contacts 27–19, conductor 27–21, front contact and armature 2 of relay 62LA2 to the grid of tube 62–23, which will repeat signals over conductor 62–24 to select magnet 58–01 of reperforator-transmitter 58—02, the return path from the selector magnet extending over conductor 58–03 and resistor 62–26 to battery. The hold magnet 27–17, at its armature 1 and front contact, prepares a holding circuit for relay 38TR, which will be traced hereinafter.

With relay 65A in the single storage outlet circuit operated, ground is extended from armature 5 of that relay over the front contact, conductor 65–09 to the winding of hold magnet 28–01, which operates. This magnet extends ground from its armature 2 over conductors 28–02 and 65–11, armature 6 and front contact of relay 65LA, front contact and armature 4 of relay 65MA, conductor 65–12, make contacts controlled by the tip spring of jack 34–01, the tip spring of that jack, the tip of plug 41–07, conductor 41–26, front contact and armature 1 of relay 41CONN3 to the winding of relay 41TPC3 which operates. At its armature 1, the hold magnet 28–01 supplies a ground connection to supplement the one supplied through the corresponding armature of hold magnet 27–17 for locking relay 38TR when that relay operates. The transmission path for the single storage outlet circuit is established from conductor 31–01 through crossbar switch contacts 28–03, conductor 28–04, and front contact and armature 2 of relay 65LA to the grid of tube 65–13. Tube 65–13 repeats signals over its plate conductor 65–14 to selector magnet 63–01 of reperforator-transmitter 63–02, the return path being traced over conductor 63–03 and resistor 65–16 to positive battery.

With relay 66A in the direct connected outlet operated, ground is extended over the armature 5 and front contact of that relay and conductor 66–04 to the winding of hold magnet 28–06, and the hold magnet operates. At its armature 1, the hold magnet 28–06 supplies a ground connection supplementing the others previously described for locking relay 38TR when that relay operates. The transmission path for the direct connected outlet is established from conductor 31–01 through crossbar switch contacts 28–07, conductor 28–08, and front contact and armature 2 of relay 66LA to the grid of repeating tube 66–06. The anode circuit of tube 66–06 is traced from the anode of the tube through the winding of relay 66BSY and the upper winding of relay 66TR to positive battery. Current normally flowing in tube 66–06 maintains the armature of transmitting relay 66TR on its marking contact, closing the loop termination of outgoing line 66–07 which will include suitable potential source for supplying current to the transmission channel. It will be noted that the direct connected outlet has no reperforator-transmitter for storing and retransmitting message signals received from the secondary storage circuit. Instead, the signals are repeated by tube 66–06 and again by relay 66TR directly to the outgoing transmission channel. The current normally flowing in the anode circuit of tube 66–06 during the marking condition also maintains the armature of relay 66BSY on its marking contact, and with relay 66A operated, a circuit is provided for lamp 66–08, traced from the lamp through the armature and marking contact of relay 66BSY, conductors 66–09 and 66–11, and the front contact and armature 4 of relay 66A to ground. When signals are transmitted to tube 66–06 and repeated by it, the relay 66BSY interrupts the circuit for lamp 66–08 during each spacing element of the signals, thereby caus-

ing lamp 66–08 to follow the signals and flash as an indication that transmission is in progress.

Returning to consideration of hold magnet 28–06, it extends a ground connection through its armature 2 and front contact, conductors 28–09 and 66–12, armature 5 and front contact of relay 66LA, conductor 66–13, front contact and armature 4 of relay 66MA, conductor 66–14, make contacts controlled by the tip contact spring of jack 34–02, tip spring of that jack, tip of plug 43–01, front contact and armature 1 of relay 43CONN1, and winding of relay 43TPC1 to battery, operating the last-mentioned relay.

Release of multiple address circuit

A relay carrying the designation TPC has now been operated in each of the three multiple address cord circuits by which connections have been made to the jacks of outlets. With these three relays operated, an operating circuit is established for relay 41ST2 in the first of the three cord circuits, the circuit being traced from battery through the winding of that relay, conductor 41–27, front contact and armature 10 of relay 48C2 which is operated, conductor 48–36, armature and front contact of relay 41TPC2, conductor 41–28, armature 2 and back contact of relay 48KY2, conductor 48–37, back contact and armature 10 of relay 48C3, conductor 48–38, armature and front contact of relay 41TPC3, conductor 41–29, armature 2 and back contact of relay 48KY3, conductor 48–39 which is included in the group extended to Fig. 50 by dot and dash line 50–04, back contact and armature 10 of relay 50C1, conductor 50–34, armature and front contact of relay 43TPC1, conductor 43–11, and armature 2 and front contact of relay 50KY1, which is operated, to ground.

Relay 41ST2 locks through its armature 2 and front contact, conductor 41–09, and front contact and armature 8 of relay 48C2 to ground. At the break contacts that the armature 2 of relay 41ST2 separates in establishing its locking circuit, it interrupts the locking circuits for relays 41CONN2, 41CONN3 and 43CONN1, and those relays release. At its armature 3, the relay 41ST2 disconnects ground from the previously traced energizing circuit for relay 50STA, and at the front contact associated with that armature, the ground connection is extended over conductor 41–31, front contact and armature 12 of relay 48C2, back contact and armature 12 of relay 48C3, conductor 48–41 included in the group extended to Fig. 50, back contact and armature 12 of relay 50C1, conductor 50–36, front contact and armature 3 of relay 50KY1 and conductor 50–08 to contact bank 50–09 of the stepping switch in the lower portion of Fig. 50 to requalify the stepping switch for advancement.

At its armature 1 and front contact, relay 41ST2 extends ground over conductor 41–32, sleeve bushing of jack 33–03 into which plug 40–19 of the regular cord circuit for the secondary storage circuit has been inserted, sleeve of plug 40–19, back contact and armature 1 of relay 40DS2, conductors 40–27 and 40–28, front contact and armature 2 of relay 38GA to the winding of relay 38TR which operates. Relay 38TR locks through its front contact and armature 3, conductor 38–07, and crossbar switch contacts to ground through the front contacts and armatures 1 of the three hold magnets 27–17, 28–01 and 28–06 that are operated.

Relay 38TR performs the functions previously described, including operation of distributor clutch magnet 31–23 to initiate transmission of the message to the three connected outlets. When the relay 41CONN2 was released, it interrupted the energizing circuit for relay 61BD, and that relay in turn interrupted the only effective holding circuit for relay 62MA2 because the original energizing circuit for relay 62MA2 was interrupted when relay 62A2 operated. Accordingly, relay 62MA2 releases. When relay 62A2 operated, it interrupted, at its armature 5 and back contact, one of the locking paths for relay 62BM, that path being traced through the back contact and armature 2 of relay 62C2, the back contact and armature 3 of relay 62B2, and the armature 4 and front contact of relay 62BM. The release of relay 62BM, however, depends upon the situation in the first storage level of the double storage outlet circuit. The primary holding circuit for relay 62BM was traced from the upper winding over conductor 62–01, conductors 61–19, 61–21 and 61–22, armature 5 and front contact of relay 61A1, conductors 61–23 and 61–24, back contact and armature 1 of relay 61J1, and back contact and armature 6 of relay 61MA1 to ground. If the first level becomes idle, while the multiple address message is being transmitted to the second level, relay 61A1 will release and interrupt the circuits of relays 61BR and 62BM, and both will release. If the first level had become idle before the seizure of the second level for transmission thereto of the multiple address message, relay 61BR would have released upon the operation of relay 62MA2 because the locking circuit through the lower winding in armature 3 and front contact of relay 61BR, including conductors 61–26 and 62–02, would have been interrupted at the armature 1 and back contact of relay 62MA2, but relay 62BM would remain operated until relay 62A2 had operated and relay 62MA2 had released, because as previously stated, relay 62A2 in the unoperated condition and relay 62MA2 in the operated condition supply locking paths for relay 62BM. It follows from the foregoing that if, with the first storage level of the double storage outlet circuit remaining busy while the second storage level becomes idle and is released, another bid for access to the double storage outlet circuit is made that bid will be routed to the second level. On the other hand, if the first level becomes idle while the second level is busy or before another bid is made for access, the message will be routed to the first level. This applies whether the message that is to be routed is a single address message or a multiple address message.

Referring now to the single storage outlet circuit in Figs. 63, 64 and 65, and with relay 41CONN3 released, the relay 65BD will release, in turn releasing relay 65MA. Similarly, in the direct connected outlet in Fig. 66, with relay 43CONN1 in a multiple address circuit released, relay 66BD will release in turn unlocking relay 66MA, which releases. In Fig. 66, relay 66LA remains locked to relay 66LB, and in turn holds relay 66A operated. In Fig. 65, relay 65LA remains locked to relay 65LB, and in turn holds relay 65A operated. In Fig. 62, relay 62LA2 remains locked to relay 62LB2, and in turn holds relay 62A2 operated. Relay 62BM remains operated or releases under the circumstances above described.

One of the operations performed by relay 38TR is the operation of relay 40DS2 in a circuit traced from the winding of that relay through the break contacts controlled by its armature 3, front contact and armature 5 of relay 40SL2, conductors 40–29 and 40–31, armature 2 and front contact of relay 38BC0, and front contact and armature 6 of relay 38TR to ground. Relay 40DS2 performs the operations described previously with respect to relay 42DSL, including the transfer of the control circuit for busy test relay 38BT to the regular cord circuit in the next operating position to the right, the extinguishing of white lamp 40–24 and the lighting of red lamp 40–32, the release of relay 38BC0, and the establishment of a locking circuit for itself through its front contact and armature 3 and the front contact and armature 6 of relay 40SL2.

The lighting of red lamp 40–32 is an indication to the operator that all outlets have been seized and transmission has been initiated so that there is no further need for plugs 41–06, 41–07 and 43–01 to remain in jacks 34–03, 34–01 and 34–02, respectively, and the plugs may be removed. As previously stated, green lamp 41–04, associated with the cord circuit having plug 41–06, is lighted by virtue of a ground connection extended over

the front contact and armature 7 of relay 48C2 and conductor 48–01. In the cord circuit having the plug 43–01, white lamp 43–12 is lighted in a path traced from the lamp, over conductor 43–13, and armature 5 and front contact of relay 50KY1, which is operated. In the cord circuit having the plug 41–07, neither of the lamps is lighted because neither of the relays 48KY3 and 48C3 is operated. The lighted green lamp 41–04 indicates that the plug 41–06 was the first multiple address plug of the set by which connections to the outlets were made for the particular message and lighted white lamp 43–12 indicates the last cord in that set. The operator begins taking down the cords by first removing plug 43–01 of the cord circuit having lighted white lamp 43–12, working leftwardly through successive cord circuits that have neither lamp lighted, in this instance only the cord circuit having the plug 41–07, and finally removing the plug 41–06 associated with the cord circuit having green lamp 41–04 lighted. The operator completes the cord removal by disengaging plug 40–19 from jack 33–03.

Disconnection of outlets from intermediate storage circuit

At the end of the multiple address message, the secondary storage circuit decodes the disconnect signal, operating in turn relays 39FG, 39H, 39LT1 and 39LT2 in the manner previously described with reference to the corresponding relays in Fig. 53. Relay 39LT2 operates relay 39DS which, in turn, connects ground over conductor 39–11 and through crossbar switch contacts 27–22, 28–11 and 28–12 to conductors 27–23, 28–13 and 28–14, respectively. The ground on conductor 27–23 is extended through armature 3 and front contact of relay 62LA2 to operate relay 62LB2, which locks through its front contact and armature 3 to the ground supplied over conductor 27–18 from the front contact and armature 2 of hold magnet 27–17. Relay 62LB2 releases relay 62LA2 which, in turn, releases relay 62A2. These relays in turn release hold magnet 27–17 which unlocks relay 62LB2, releasing it. These operations are the same as those previously described in connection with the disconnect of the first level of storage in the double storage outlet circuit, contained in Figs. 57, 59 and 61, the disconnect involving specifically the relays in the lower row in Fig. 61.

The ground connection supplied over conductor 28–13 operates relay 65LB which locks to the ground supplied over conductor 28–02 from armature 2 of hold magnet 28–01. Relays 65LA and 65A are released by relay 65LB, the release of hold magnet 28–01 following, and resulting in the unlocking of relay 65LB. Similarly, the ground supplied over conductor 28–14 operates relay 65LB which locks to the ground on conductor 28–09 and releases relays 66LA and 66A. Hold magnet 28–06 is released and unlocks relay 66LB, which in turn releases.

With hold magnets 27–17, 28–01 and 28–06 released, ground is disconnected from conductor 38–07 which is in the locking circuit for relay 38TR in the secondary storage circuit. This causes the restoration to normal of that circuit in the manner previously described.

Retransmission of message from second level of double storage outlet

Referring to the second level of storage in the double storage outlet circuit, the multiple address message transmitted to reperforator 58–02 is recorded in tape 58–04, and the tape, feeding out of the reperforator, causes tape-sensing head 58–06 to move away from perforator head 58–07 and close transmitter stop contacts 58–08. These contacts extend ground over conductor 58–09, armature 1 and back contact of relay 60S2, armature 1 and back contact of relay 60T2, unidirectional current carrying device 60–13 to the winding of relay 60P2 which operates. Relay 60P2 attempts to complete an operating circuit for relay 60H2 at two points, one of these being traced from the winding of relay 60H2 over conductors 60–14 and 60–16, armature 3 and front contact of relay 60P2, conductor 60–17 to the back contact associated with the armature of relay 59–P1. If the first level of storage of the double storage outlet circuit has not yet completed the transmission of the message that was routed to it before the multiple address message was routed to the second level, relay 69P1 will be operated, and the path will terminate at the back contact. The other path is traced from the junction of conductors 60–14 and 60–16 over conductor 60–18 to the armature 3 of relay 60J which remains operated if the first level has not completed the transmission of its message, the path continuing over conductor 60–19, armature 2 and front contact of relay 69P2, conductor 60–21 to the armature of relay 59P1 and to the contact from which the front contact associated with armature 5 of relay 59H1 disengages when that relay operates. It follows from the foregoing that the path for operating relay 60H2 must extend through break contacts controlled by armature 5 of relay 59H1, and that one of the two paths to those break contacts includes break contacts of relay 59P1 and the other includes make contacts of relay 60J. The path through the make contacts controlled by relay 60J provides for operation of relay 60H2, to afford the second level an opportunity to transmit a message even though another message should be routed to the first level by an operator before the retransmission of the first message has been completed, under which circumstance transmitter stop contacts 57–08 would not close and relay 59P1 would not release. Upon the release of relay 59H1 and the reoperation of normally operated relay 60N, an energizing path for relay 60H2 is completed over conductors 60–14 and 60–18, armature 3 and front contact of relay 60J, conductor 60–19, armature 2 and front contact of relay 60P2, conductor 60–21, break contacts controlled by armature 5 of relay 59H1, conductor 59–05, break contacts controlled by armature 4 of relay 60H2, conductors 60–02 and 60–03, and front contact and armature 1 of relay 60N to ground. Relay 60H2 completes an operating circuit for relay 60G2, and these two relays together initiate message transmission from tape 58–04 in the same manner that relays 59H1 and 59G1 initiate transmission from tape 57–04. With relay 60P2 operated, a locking circuit was established for relay 60J, traced from ground through armature 7 and back contact of relay 60H2, armature 1 and front contact of relay 60P2, armature 2 and front contact and the upper winding of relay 60J. This locking circuit is effective when relay 60P2 is operated to prevent the release of relay 60J should its operating circuit be interrupted at the armature 3 and front contact of relay 59H1 by the release of that relay at a time when the second storage level is bidding for access to the outgoing transmission channel, as evidenced by the energized condition of relay 60P2. With relay 60H2 operated, the locking circuit for relay 60J is interrupted at the armature 7 and back contact of relay 60H2 to effect the release of relay 60J so that the next message transmission turn shall be allotted to the first storage level. At the end of the message being transmitted from tape 58–04, the relays 59K, 59L and 59FH are operated in response to the disconnect signal in the tape to suspend transmission from that tape, effect the release of relay 60H2 and restore to the first storage level access to the transmission channel.

Retransmission of message from single storage outlet

The multiple address message received by reperforator 63–02 is stored in tape 63–04 which causes tape-sensing head 63–06 to move away from perforator head 63–07, the transmitter stop contacts 63–08 being closed thereby. Ground is thereby connected over conductors

63–09 and 64–01, unilateral current conducting device 64–02 to the winding of relay 64P1, and that relay operates. It establishes an energizing circuit for transmitter clutch magnet 63–11, traced from the winding of that magnet over conductors 63–12 and 63–13, front contact and armature 2 of relay 64P1, back contact and armature 1 of relay 64S1, armature 1 and back contact of conductor 64R1, and conductor 63–09 to the transmitter stop contacts 63–08. With transmitter clutch magnet 63–11 operated, transmission will be initiated and will continue until all of the stored message material is transmitted and transmitter stop contacts 63–08 are opened by tape-sensing head 63–06. The end of transmission is not dependent upon the detection of a disconnect signal because the transmitter-distributor mechanism associated with reperforator 63–02 has exclusive access to the channel. Transmission is from ground through any of the transmitter contacts, these being closable selectively under the control of the tape-sensing mechanism, through the corresponding distributor contact when it closes, conductors 63–14 and 63–16, winding of busy-out relay 64AB and conductor 64–03, which is one of the conductors of the outgoing transmission channel, the return being traced through resistor 63–17 to battery. Relay 64AB thus follows outgoing signals, and in the marking condition completes a circuit from ground on the upper armature of relay 64P1 through the front contact, armature and marking contact of relay 64AB, and conductor 64–06 to lamp 63–18. The lamp thus flashes in accordance with the marking and spacing elements of the signals and indicates when transmission is in progress.

Reception of message in double storage input circuit

As previously stated, one of the types of input circuits that the switching center may have is a double storage input circuit provided with two reperforator-transmitter-distributor units comprising two levels of storage which receive messages alternately from the incoming channel with which they are associated. Such a circuit is shown in Figs. 14 to 20, inclusive. The alternate effective association of one or the other of the two reperforator-transmitter-distributor units with the incoming channel is controlled by the disconnect signals ending the incoming messages.

The incoming channel 16–01 extends through the operating windings of relays 16LA and 16L and through resistor 16–02 to battery. The armature of relay 16L is grounded, and the marking contact is connected over conductors 16–03 and 16–04, break contacts controlled by armature 3 of relay 16ALT, conductor 16–06, winding of selector magnet 14–04 of reperforator 14–06, conductor 14–01, and resistor 16–07 to battery. An energizing circuit for selector magnet 15–04 of reperforator 15–06 is traced from ground through the break contacts controlled by armature 5 of relay 16ALT over conductor 16–08, winding of selector magnet 15–04, conductor 15–01, and resistor 16–02 to battery. It will be apparent from consideration of the circuits just traced that with relay 16ALT released, selector magnet 14–04 of reperforator 14–06 is connected to be responsive to signals received by relay 16L, and that selector magnet 15–04 of reperforator 15–06 cannot respond to such signals until relay 16ALT operates. Accordingly, a message received by relay 16L, with the circuit in the condition shown in Figs. 14 to 20, will be recorded by reperforator 14–06. When the disconnect signal is received, reperforator 14–06, upon responding to the figures code combination which is the first code of that signal, closes contacts 14–51 momentarily, connecting ground over conductor 14–52, upper winding of relay 17RFG, conductor 17–01, and lower winding of relay 16UN to battery. Relay 17RFG operates over this circuit. After the figures contacts 14–51 close, universal contacts 14–53 close, and before contacts 14–51 open, contacts 14–53 open, connecting ground during the shorter interval of closure, by comparison with contacts 14–53, over conductors 14–54 and 14–56, and upper winding of relay 16UN to battery, the current in the upper winding tending to operate the relay. The current through the lower winding dominates, and being applied for a greater interval, prevents the operation of relay 16UN. With the relay thus prevented from operating, a locking circuit for relay 17RFG is established, the circuit extending through the lower winding and armature 2 of relay 17RFG, conductors 17–02 and 17–03, and the back contact and armature of relay 16UN to ground.

If the signal sequence is a true disconnect signal, the H code combination will follow the Figures code combination, causing the momentary closure of contacts 14–57. These contacts connect ground over conductor 14–58, armature 1 and front contact of relay 17RFG, upper winding of relay 17RH, and conductors 17–04 and 17–01 to the lower winding of relay 16UN. As before, contacts 14–57 close and apply current through the upper winding of relay 16UN, but the current through the lower winding predominates and prevents the unlocking of relay 17RFG. Relay 17RH operates in this circuit and locks through its lower winding and armature 1, and the front contact and armature 3 of relay 17RFG. At its armature 2 and front contact, relay 17RH connects ground over conductor 17–06, back contact and armature 3 of relay 18BY2, conductors 18–01 and 16–09 to the winding of relay 16ALT which operates. Had any other code combination than H followed the Figures signal, the upper winding of relay 16UN would have been energized due to operation of universal contacts 14–57, but the circuit through the lower winding would not have been completed concurrently, and relay 16UN would have operated, interrupting the locking circuit for relay 17RFG and releasing that relay. In fact, the Letters code combination which normally follows the H code combination and completes the disconnect signal causes the operation of relay 16UN because the universal contacts establish a circuit through the upper winding, but none is established through the lower winding so that the relay 16UN unlocks relay 17RFG in response to the Letters signal, and relay 17RFG unlocks relay 17RH which also releases.

Relay 16ALT locks through its armature 4 and front contact, conductors 16–11 and 16–12, back contact and armature 4 of relay 18BY2, and back contact and armature 2 of relay 18RH2 to ground. At its armature 3, the relay 16ALT disconnects the marking contact of repeating relay 16L from conductor 16–06 extending to the winding of selector magnet 14–04 of reperforator 14–06, and applies a ground conection to conductor 16–06 to hold selector magnet 14–04 in the steady marking condition. At its armature 5, the relay 16ALT disconnects ground from conductor 16–08 extending to the winding of selector magnet 15–04 of reperforator 15–06, and extends a path from conductor 16–08 to the marking contact of line relay 16L to cause the next received message to be recorded by reperforator 15–06. At its armature 6, the relay 16ALT disconnects ground from conductor 16–13 which extends to busy lamp 14–59, extinguishing that lamp, and transfers the ground to conductor 16–14 extending to lamp 15–59 to light that lamp, the lamps 14–59 and 15–59 indicating, by the lighted condition of one or the other, which of the two reperforators 14–06 and 15–06 is effectively associated with the marking contact of line relay 16L. The transfer from one to the other of the two reperforators under the control of armatures 3 and 5 of relay 16ALT occurs during reception of the Letters signal, which is the third code combination of the disconnect signal and follows the H code combination. Since all but the start element of the Letters signal are elements of marking nature, the relay 16L is in the marking condition when the transfer is made from one to the other of the two reperfora-

tors, so that ground is connected to conductor **16–03** through the armature of relay **16L** at the time of the transfer. Moreover, the transfer from one to the other is made by sequence contacts operating on a make-before-break basis, so that the full Letters signal is applied without mutilation to the reperforator that is being disconnected, and the perforator that is being connected is not tripped off and caused to undergo a false receiving cycle. The relay **16ALT** also transfers from one to the other of the two reperforators an alarm mechanism, and the nature of the alarm mechanism together with its mode of operation and the method of transfer will be described hereinafter.

The ground connection that is supplied over conductors **18–01** and **16–09** to operate relay **16ALT** is also extended from conductor **18–01** over conductor **16–16** to the winding of relay **16AS**, which operates to perform functions supplementing those performed by relay **16ALT**. Relay **16AS** locks through its armature **3** and front contact, and conductor **16–17** to conductor **16–12** which supplies the ground connection for locking relay **16ALT**. The operations performed by relay **16AS** also relate to the alarm circuit.

When a message has been received by reperforator **15–06** and the Figures and H code combinations of the disconnect signal cause the operation, in succession, of contacts **15–51** and **15–57**, relays **18RFG2** and **18RH2** operate, in succession, and lock to relay **16UN**, relay **18RH2** interrupting the locking circuits for relays **16ALT** and **16AS**, which release. Relay **16UN** in turn releases relays **18RFG2** and **18RH2** in response to the Letters code combination of the disconnect signal. In this way, reperforator **14–06** is reassociated with the marking contact of repeating relay **16L** and the cycle of alternation is completed.

Machine trouble alarm circuit

The alarm mechanism referred to above as being transferable from one to the other of the two reperforators **14–06** and **15–06** by relays **16ALT** and **16AS** is one of several types of alarm mechanisms that are provided, and, specifically, is a machine alarm to register a trouble indication when the reperforator ceases to respond to incoming signals. The alarm mechanism comprises a twin triode electron discharge tube **16–71** and an associated network of resistors and condensers. Specifically, the grids are returned to negative battery through individual resistors **16–72** and **16–73** and are connected through other resistors **16–74** and **16–76** to condensers **16–77** and **16–78**, respectively. The junctions of the resistors and condensers just mentioned are interconnected by a series of two resistors **16–79** and **16–81**. The anodes are connected together and through the winding of relay **16TM** to positive battery. The cathodes of the tube are grounded. The junction of condenser **16–77** with resistors **16–74** and **16–79** is connected through resistor **16–82** to armature **2** of relay **16ALT**, and the junction of condenser **16–68** with resistors **16–76** and **16–81** is connected through resistor **16–83** to armature **1** of relay **16ALT**. The back contacts, which those armatures engage when relay **16ALT** is released, are connected through conductors **16–21** and **16–22**, respectively, to break and make contacts, respectively, of a universal transfer contact set **14–61**, the swinger of which is connected through normally closed tape feed indicating contacts **14–62** to ground. The junction of resistors **16–79** and **16–81** is connected through condenser **16–84**, shunted by resistor **16–86**, to ground, and through unilateral current carrying device **16–87**, break contacts controlled by armature **2** of relay **16AS**, and resistor **16–07** to positive battery.

With repeating relay **16L** in the marking condition and relays **16AS** and **16ALT** released, the point of connection of unilateral current conducting device **16–87** to resistor **16–07** is only slightly above ground potential, because the resistance of selector magnet **14–04** of reperforator **14–06** is very low as compared with the resistive value of resistor **16–07** so that the junction of condenser **16–84** and resistors **16–79** and **16–81** is substantially at ground potential. Thus condenser **16–84** has only a negligible charge and one of the condensers **16–77** and **16–78** may have a like negligible charge because those condensers are connected to condenser **16–84** through resistors **16–79** and **16–81**, respectively. The other of the two condensers will be fully discharged in the path through tape feed indicating contacts **14–06** and universal transfer contacts **14–61**, and it will be the condenser **16–77** that is fully discharged. When the armature of repeating relay **16L** leaves the marking contact in response to a spacing code element, the flow of current through selector magnet **14–04** and resistor **16–07** is interrupted and condenser **16–84** begins to charge through resistor **16–07**, condenser **16–78** also beginning to charge through resistor **16–81**. When the armature of relay **16L** returns to marking, unilateral current conducting device prevents the charge from leaking off rapidly, but the charge on condenser **16–84** and on condenser **16–78** begins to leak off through resistor **16–86**. During the reception of a complete code combination, condenser **16–84** will acquire a charge and condenser **16–78** will also acquire a charge that will vary in accordance with the number of spacing elements in the code combination. The charge that can be acquired during the reception of one code combination is insufficient to render the right-hand triode of tube **16–71** conductive.

About the time that the last element of a code combination is received by reperforator **14–06**, a shaft is set in operation under the control of a single-revolution clutch that gives effect to the received code combination, such as the perforation of the tape in accordance with the code combination or the performance of a function other than perforation of the tape. During the revolution of that shaft, the universal transfer contacts operate and restore, the break contacts opening and the make contacts closing, and the contacts restoring to initial condition before arrestment of the shaft at the end of the revolution. If a tape feeding operation is involved and the tape feeds normally, the contacts **14–06** do not open so that while the universal contacts **14–61** are off normal, ground is connected through resistor **16–83** to condenser **16–78** to discharge it. While the shaft that causes the operation of the universal transfer contacts is rotating, the relay **16L** may be responding to the next code combination, in response to which the shaft will again be set in operation for a revolution, and this mode of operation is described as involving overlap, in that the operation of the shaft in response to any code combination follows completion of reception of that code combination and may be concurrent with reception of the next code combination. If for each code combination received by relay **16L** and repeated to reperforator **14–06** the universal transfer contacts operate, which is the normal condition, a charge sufficient to activate either section of tube **16–71** cannot accumulate on condenser **16–77** or **16–78**, because universal transfer contacts **14–61** maintain condenser **16–77** discharged in the normal condition of those contacts and discharge condenser **16–78** in the off-normal condition. With reperforator **14–06** responding normally to code combinations successively received by relay **16L**, condensers **16–77** and **16–78** do not have an opportunity to build up a charge. The function of condenser **16–84** is to build up a charge on successive signals and smooth out the positive potential applied to condensers **16–77** and **16–78**.

If reperforator **14–06** ceases to respond properly to incoming signals, the universal transfer contacts **14–61** will not be operated. If the failure of the reperforator to operate properly occurs when the universal transfer contacts are in the normal condition, condenser **16–77** will remain discharged, but condenser **16–78** will charge

up as succeeding code combinations are received by relay 16L. If the universal transfer contacts 14–53 should happen to be in the off-normal condition when failure occurs, the condensers will react oppositely, condenser 16–78 remaining discharged and condenser 16–77 charging. If by coincidence the failure should occur with the swinger in mid-position so that neither the break nor the make contacts are closed, both condensers will be permitted to charge. The time constants of the resistors and condensers are such that upon receipt of a few code combinations, perhaps four or five, following failure of the reperforator, one or the other of the condensers 16–77 and 16–78 will have become charged sufficiently to cause one of the triodes of tube 16–71 to conduct, and operate relay 16TM. It makes no difference which section of the tube conducts because the plates are connected together and to the winding of relay 16TM.

As previously stated, proper feeding of the tape to the tape-sensing head will not have any effect upon the normally closed tape feed indicating contacts 14–62. However, if the tape pulls taut, or if it breaks or otherwise becomes slack, contacts 14–62 will be opened. Those contacts remove ground for discharging condensers 16–77 and 16–78 so that both will charge and cause operation of relay 16TM.

Relay 16TM, upon operating, locks through its front contact and armature 1, and the armature 4 and back contact of relay 16AS, still assuming that reperforator 14–06 has been receiving the message and that, accordingly, relay 16AS is released, conductor 16–88 and back contact and armature 1 of relay 17BY1 to ground. At its armature 2, the relay 16TM completes the circuit of relay 16MT, which operates. At its armature 1 and front contact, relay 16MT extends ground through the armature 1 and back contact of relay 16AS, conductors 16–89 and 17–07 to operate tape-out lamp 14–63 associated with reperforator 14–06. At its armature 2 and front contact, relay 16MT connects ground over conductors 16–91 and 14–64 to light machine trouble lamp 14–66 associated with reperforator 14–06. From the junction of conductors 16–91 and 14–64, the ground is extended over conductor 14–67 to light lamp 15–66. The latter lamp is the machine trouble lamp for reperforator 15–06. This is not to indicate that there is a trouble in machine 15–66 and in fact the lamps 14–66 and 15–66 of themselves will not indicate which of the two machines has failed, because both lamps light. The fact that it is the machine 14–06 that has failed is indicated by the lighting of lamp 14–63 in conjunction with lamp 14–66. Lamp 15–63 which corresponds, for reperforator 15–06, to lamp 14–63 lights only when relay 16AS is operated at a time that relay 16MT operates, the path then being extended over the armature 1 and front contact of relay 16AS, and conductors 16–92 and 18–02 to lamp 15–63. When the attendant, noting the trouble indication afforded by the lighted lamps, which may if desired be supplemented by an audible alarm, has cleared the trouble, the registration of the alarm is canceled by the momentary operation of busy key 14–43 to connect ground over conductor 14–44 to operate busy relay 17BY1. This relay interrupts, at its armature 1 and back contact, the locking circuit for relay 16TM, which in turn releases relay 16MT, the latter relay extinguishing lamps 14–63, 14–66 and 15–66.

Every circuit in the switching center which employs a reperforator-transmitter, whether it be an input circuit, a secondary storage circuit or an outlet, has a machine trouble alarm circuit similar to the one just described. For example, the keyboard receiving input circuit contained in Figs. 21 to 25, inclusive, and hereinbefore described, includes twin triode tube 25–71 having associated with it a network of resistors and condensers, the arrangement being similar to the tube 16–71 and associated network. When either triode of tube 25–71 becomes conductive, it operates relay 25TM which locks under the control of relay 25BY and operates relay 24MT to bring in an alarm. The controlling voltage for the network associated with tube 25–71 is derived from the junction of resistor 25–01 and conductor 21–01 in the circuit of the selector magnet 21–04 of reperforator 21–06. In the case of a secondary storage circuit, such as the one shown in Figs. 45, 46, 52 and 53, the twin triode tube 46–71 has a network of resistors and condensers associated with it, like the network hereinbefore described, and when either triode of the tube is operated, the relay 46TM operates in its plate circuit and locks under the control of relay 46BY. The path for positively charging the condensers associated with tube 46–71 is traced from the apex of the network through unilateral current conducting device 46–87, conductor 46–02, armature 3 and front contact of relay 52B and conductor 52–44 to resistor 45–46 in the operating circuit of selector magnet 45–01 of reperforator 45–02. As previously described, selector magnet 45–01 is operated in the anode circuit of tube 52–27. This is somewhat different from the arrangements for operating the reperforators in the input circuits, those reperforators being driven from the contacts of relays. Since the cathode of tube 52–27 is grounded, the drop through the tube will be small when the tube is conductive, as it is in the marking condition, so that most of the potential difference in the plate circuit of tube 52–27 will appear across resistor 45–46, and the point of connection of conductor 52–44 to that resistor will not be sufficiently above ground to cause significant charging of the condensers associated with tube 46–71. Those of the outlets that are provided with reperforator-transmitter units, which excludes such outlets as the direct connected outlet have the selector magnets of their reperforator-transmitters operated by vacuum tubes, an example being tubes 61–04 and 62–23 that drive the selector magnets 57–01 and 58–01 of reperforators 57–02 and 58–02, respectively. In the case of tube 61–04, the voltage for charging the condensers in the network of the machine trouble alarm circuit is derived from the junction of resistor 61–11 and conductor 57–03 and is applied through the armature 1 and front contact of relay 61LA1 to the network.

Open line alarm circuit

Another alarm circuit detects an open condition of the lines incoming to the switching center. For example, the line 16–01 incoming to the double storage input circuit includes relay 16LA which has its operating winding in series with the operating winding of repeating relay 16L, its armature connected to negative battery, and its marking contact, which the armature engages in the idle condition of the line, connected to the grid of tube 16–93, to one terminal of condenser 16–94, the other terminal of which is grounded, and through resistor 16–96 to positive battery. As long as the armature of relay 16LA remains on the marking contact, or follows signals so that it repeatedly engages the marking contact, condenser 16–94 will be charged negatively and tube 16–93 will be cut-off. If the armature of relay 16LA remains out of engagement with the marking contact for an interval longer than the longest spacing interval normally encountered in telegraph transmission, which it will do if the line goes open, condenser 16–94 will charge positively and render tube 16–93 conductive. The winding of relay 16LO is included in the anode circuit of tube 16–93, whereby relay 16LO operates and extends ground to the winding of relay 16–OLA, which operates. The latter relay in turn extends ground over conductors 16–97 and 14–68 to light line trouble lamp 14–69. From the junction of conductors 16–97 and 14–68, a path is traced over conductor 14–71 for lighting the line trouble lamp 15–69. Since the trouble refers to line 16–01, which is common to the two reperforator-transmitter units 14–06 and 15–06, the bringing in of an alarm associated with

each of the units is proper because a line trouble affects both reperforator-transmitter units. During the interval in which the line is open, relay 16L will be in the spacing condition and will repeat spacing signals to the connected reperforator, presumably reperforator 14–06, to cause the reperforator to emit blank tape, the all-spacing condition involving the punching of no code perforations in the tape, but only the feed perforation.

Tape-out alarm

Still another alarm arrangement that is provided detects and indicates the feeding out of tape or the tearing of tape in the pivoted tape-sensing heads of reperforator-transmitter units. Referring to Figs. 14, 17 and 19, which disclose one of the storage levels of the double storage input circuit a tape-sensing lever 14–83 is provided with a sensing pin (not shown) for sensing a marginal, imperforate portion of the tape. The sensing is controlled by a cam on shaft 14–17 which permits lever 14–83 to sense for presence or absence of tape each time that code-sensing levers 14–18 are permitted to sense the tape. Lever 14–83 closes tape-out contacts 14–84 if it finds no tape in the tape-sensing head. If contacts 14–84 close, ground is extended over conductor 14–86 to operate relay 17TO1. This relay locks over its front contact and armature 3 and conductors 16–41 and 16–42 to normally closed tape alarm release key 14–87. At its front contact and armature 2, relay 17TO1 extends ground over conductors 16–43, 16–44 and 17–07 to light lamp 14–63. At its armature 1 and back contact, the relay 17TO1 interrupts the energizing circuit for transmitter clutch magnet 14–14 to suspend operation of the transmitting portion of reperforator-transmitter 14–06. After an attendant has remedied the tape condition that brought in the alarm, momentary operation of key 14–87 will result in the release of relay 17TO1, extinguishing lamp 14–63 and reenergizing transmitter clutch magnet 14–14 if the circuit of that magnet had been complete at the time the alarm was brought in.

Tape reel alarm

An alarm is also provided for indicating when the supply of tape for a reperforator runs low. Referring to Fig. 14, it will be noted that tape supply sensing lever 14–88 is spring biased into engagement with the tape supply reel for reperforator-transmitter unit 14–06. When the supply of tape has been reduced to a point at which it ought to be replenished, lever 14–88 closes contacts 14–89 extending ground over conductor 14–91 to operate relay 17TRC1. This relay locks to the same circuit as does the relay 17TO1, the circuit including conductor 16–42 and normally closed key 14–87, so that the relay 17TRC1 is releasable by key 14–87. Relay 17TRC1 also completes the circuit of tape-out lamp 14–63, the lighting of which indicates that there is a tape trouble in reperforator-transmitter unit 14–06.

Tape out and tape reel alarms for outlets

The outlets that are equipped with one or two reperforator-transmitters have alarm arrangements similar to those associated with the reperforator-transmitter units of the various input circuits for indicating tape troubles in the transmitter portions of the reperforator-transmitter units and low tape supplies in the reperforator portions of those units. For example, in the case of the single storage outlet circuit contained in Figs. 63 to 65, sensing lever 63–83 detects a torn tape or tape-out condition in tape-sensing head 63–06 and closes contacts 63–84 to cause the operation of relay 64R1 which performs functions similar to those of relay 17TO1, including the interruption of the energizing circuit of transmitter clutch magnet 63–11 and the lighting of lamp 63–41. Relay 64R1 locks under the control of relay 64S1 which is operable by transmitter stop key 63–42. Contacts 63–89 close when the tape supply detection lever 63–88 indicates that the tape supply is nearly exhausted, and operate relay 65C. This relay also causes the lighting of lamp 63–41, and in addition imposes a busy condition on the outlet in order that the outlet cannot be seized by another secondary storage circuit until the tape supply has been replenished. These alarm arrangements are fully described in Patent 2,430,447 hereinbefore more fully identified.

Manufacture of disconnect signal

Each of the input circuits that employs a reperforator-transmitter and the secondary storage circuit, which also employs reperforator-transmitters, has a circuit arrangement for generating a disconnect signal in the event that the reperforator-transmitter fails to receive the Figures, H and Letters signals which comprise the end-of-message signal. It will be remembered that these signals, when properly received and retransmitted by any one of the input circuits, effect the disconnection of the input circuit from the secondary storage circuit, and when properly received and retransmitted by a reperforator-transmitter unit of the secondary storage circuit disconnect that reperforator-transmitter from a connected outlet or outlets. In order that a tie-up shall not result when the disconnect signals are lost or an incoming message has not been properly terminated in disconnect signals, they are automatically generated. The arrangement will be described with reference to the double storage input circuit contained in Figs. 14 to 20. Assuming that the storage level in Figs. 14, 17 and 19 receives no disconnect signal and, accordingly, remains connected to the secondary storage circuit when tape 14–08 becomes taut and causes the release of distributor clutch magnet 14–31 to stop retransmission, an attendant operates transmitter stop key 14–72 to connect ground over conductor 14–73 to the winding of relay 19ST1, which operates. This relay connects ground over conductors 19–01 and 17–08 to light transmitter stop lamp 14–74. The attendant also operates key 14–76 which extends ground over conductor 14–77, armature 3 and front contact of relay 19ST1, conductor 19–02, armature 1 and back contact of relay 18DX2, conductor 18–03, and winding of relay 17D1 to battery, and the relay 17D1 operates.

At its armatures 1 to 5, the relay 17D1 disconnects the transmitter code contacts of the transmitter-distributor in Fig. 14 from the distributor contacts and connects the latter contacts instead to a set of five leads associated with armatures and contacts of relays 16SB and 16SD. These conductors are designated 16–31, 16–32, 16–33, 16–34 and 16–35 corresponding to code elements 1 to 5, respectively, of the code combinations to be transmitted. The marking battery connection supplied through resistor 14–39 to the transmitter code contacts, and also through the normally closed uppermost of the distributor contacts 14–41, these latter contacts when closed providing the rest or stop signal and when open the start element, is extended over conductor 14–78 and the front contact and armature 8 of relay 17D1 to conductor 16–35, thereby coding a marking condition on the distributor contact for the No. 5 code element which cannot be effected by the released or operated conditions of relays 16SB and 16SD.

At its armature 6 and front contact, the relay 17D1 locks over a path including conductor 17–09, and upper armature and back contact of relay 19DS1 to ground. At its armature 9, the relay 17D1 completes the circuit of relay 17DX1 which operates. This relay interrupts, at its armature 1 and back contact, a possible energizing circuit for relay 18D2, thereby preventing the operation of the latter relay. A similar point of possible interruption in the energizing path for relay 17D1 was traced from the armature 1 and back contact of relay 18DX2 from which it follows that relays 17D1 and 18D2 cannot be operated at the same time. Relay 17DX1 completes an energizing circuit for distributor clutch magnet 14–31,

traced from the winding of that magnet over conductors 14–79, 14–81 and 17–11, front contact and armature 3 of relay 17DX1, conductors 17–12, 17–13, 16–23 and 16–24, and front contact and lower armature of relay 16SA to ground. Clutch magnet 14–31 initiates a cycle of distributor shaft 14–33 during which the code combination coded on the distributor contact is transmitted. As previously stated, conductor 16–35 has marking potential connected thereto, and any other conductors that are connected to it will also be at marking potential. At armatures 1, 2 and 3 and back contacts of relay 16SB, conductor 16–35 is connected to conductors 16–32, 16–31 and 16–34, respectively, so that those conductors are also coded marking and because conductors 16–31, 16–32, 16–34 and 16–35 are connected to the distributor contacts 1, 2, 4 and 5, the code combination transmitted by distributor shaft 10–33 will be the Figures code combination in which elements 1, 2, 4 and 5 are of marking nature and element 3 is of spacing nature. It will be noted that no connections are established from conductor 16–35 to any others of the four conductors through armatures of relay 16SD at this time, because the armatures 1, 2 and 3 thereof have only front contacts, and the relay is released.

When the distributor auxiliary contacts 14–34 close during the rotation of shaft 14–33, they extend ground over conductors 14–82 and 17–14, front contact and armature 7 of relay 17D1, conductors 17–16 and 17–17, armature 5 and back contact of relay 16SB, and winding of relay 16SA, and the latter relay operates. At its lower armature, it interrupts the previously-traced energizing circuit for distributor clutch magnet 14–31 to cause the arrestment of shaft 14–33 at the end of the revolution in which the Figures code combination is transmitted. At its upper armature, the relay 16SA prepares a locking circuit for itself, traced through the winding of relay 16SB and conductors 16–26, 16–27, 16–28 and 17–18, armature 2 and front contact of relay 17D1 to the armature 6 of relay 17D from which the path continues over the front contact and conductor 17–09 in the locking circuit for relay 17D1. Upon the reopening of distributor auxiliary contacts 14–34, and removal of ground from the left-hand terminal of the winding of relay 16SA, the locking circuit including the winding of relay 16SB becomes effective, and that relay operates.

At its armatures 1 and 2, the relay 16SD disconnects conductor 16–35 from conductors 16–32 and 16–31, respectively, thereby coding a spacing condition on these two conductors. At its armature 3, the relay 16SB disconnects conductor 16–35 from conductor 16–34 and connects it instead to conductor 16–33, thereby coding a marking condition on conductor 16–33 and a spacing condition on conductor 16–34. The code combination set up on conductors 16–31, 16–32, 16–33, 16–34 and 16–35, with relay 16SB operated, represents the character H, with elements 1, 2 and 4 of spacing nature and elements 3 and 5 of marking nature. At its armature 4, the relay 16SB connects ground through the associated front contact, and lower armature and back contact of relay 16SC, to conductor 16–27, from which a path was previously traced to the winding of distributor clutch magnet 14–31, which initiates another cycle of distributor shaft 14–33 for the transmission of the H signal. At its armature 5, the relay 16SB interrupts the original energizing circuit for relay 16SA which remains operated through its locking circuit. At the front contact associated with armature 5 of relay 16SB, an energizing circuit for relay 16SC is prepared. When the distributor auxiliary contacts 14–34 close and extend a ground connection over a path including conductor 17–17 previously traced to the armature 5 of relay 16SB, the ground connection is continued through the front contact associated with that armature, armature 5 and back contact of relay 16SD to the winding of relay 16SC, which operates. At its lower armature, the relay 16SC interrupts the energizing circuit for distributor clutch magnet 14–31 to cause arrestment of the shaft at the end of the revolution in which the H signal is transmitted. At its upper armature, the relay 16SC prepares a locking circuit for itself through the winding of relay 16SD, and this circuit becomes effective upon the reopening of distributor auxiliary contacts 14–34, the arrangement being similar to that of relays 16SA and 16SB.

At its armatures 1, 2 and 3, the relay 16SD connects conductor 16–35 to conductors 16–32, 16–31 and 16–34, respectively, thus coding a marking condition on those conductors. With relay 16SB remaining operated, a marking condition remains coded on conductor 16–33 so that a Letters signal, comprising a marking condition of all five code elements, is coded on conductors 16–31, 16–32, 16–33, 16–34 and 16–35. At its armature 4, the relay 16SD reestablishes an energizing circuit for distributor clutch magnet 14–31 to cause the transmission of the Letters signal. At its armature 5, the relay 16SD interrupts the original energizing circuit for relay 16SC, and prepares an energizing circuit for relay 16SE. Upon the closure of distributor auxiliary contacts 14–34 during the transmission of the Letters signal, the energizing circuit for relay 16SE is completed, and this relay operates, preparing at its upper armature a locking circuit for itself, including the winding of relay 16SF, and interrupting at its lower armature, the energizing circuit for distributor clutch magnet 14–31 to effect the arrestment of distributor shaft 14–33 at the end of the cycle in which the Letters signal is transmitted. When the distributor auxiliary contacts 14–34 open, they remove a shunt around the locking circuit for relay 16SE, permitting that circuit to become effective, the relay 16SF operating in the circuit. At its armature, the relay 16SF extends ground over conductors 16–36 and 17–19, armature 4 and front contact of relay 17DX1, conductors 17–21 and 19–03, to the winding of relay 19DS1, which operates. This relay corresponds, for the particular level of the double storage input circuit to the relay 25DS of the keyboard receiving input circuit, and has as its function the initiation of a disconnect operation as described in connection with the operation of relay 25DS. In addition, the relay 19DS1, at its upper armature, disconnects ground from conductor 17–09, which is common to the locking circuits for relays 17D1, 17DX1, 16SA, 16SB, 16SC, 16SD, 16SE and 16SF. All of these relays release, the manufacture of a disconnect signal having been accomplished. This signal is transmitted to and recorded by the particular level of the secondary storage circuit that was connected to one of the storage levels of the double storage input circuit, and is available to be effective for disconnecting the storage level of the secondary storage circuit from the particular outlet to which the message is directed, when the transmission of that message to the outlet has been completed.

The control arrangement for initiating the manufacture of disconnect signals in the case of the single storage input circuits, such as the keyboard receiving input circuit contained in Figs. 21, 22, 23, 24 and 25, or the single storage input circuit contained in Figs. 10, 11, 12 and 13, is similar to the one just described. With the two storage levels of the double storage input circuit having access to the secondary storage circuit, the relays D1 and DX1 in the case of one storage level and the relays D2 and DX2 in the case of the other storage level are required to control the manufacture of a disconnect signal. In the input circuits in which there is only a single storage facility, a single relay, such as the relay 11D or the relay 22D, is all that is required. Taking the single storage input circuit in Figs. 10, 11, 12 and 13 as an example, when the disconnect signal is to be manufactured, an attendant first operates transmitter stop key 10–44 which connects ground over conductor 10–46 to the winding of relay 13ST, which operates. Transmitter stop key 10–44 is a locking key and remains operated. Next, the

attendant momentarily operates the disconnect signal control key 10–47 which connects ground over conductor 10–48, armature 2 and front contact of relay 13ST, conductors 13–19, 11–32 and 11–33 to the winding of relay 11D, which operates. Relay 11D locks through its front contact and armature 6 in conductor 11–34 to ground, through the back contact and upper armature of relay 13DS. As previously stated, the relay 13DS operates as part of the disconnect function and will release the relay 11D. The ground connection supplied over conductor 11–34 is also used for locking relays 11SA, 11SB, 11SC, 11SD, 11SE and 11SF as they become operated. Relay 11D performs functions corresponding to those performed by relays 17D1 and 17DX1, including the disconnection of distributor contacts 10–41 from the transmitter control code contacts and connection of the distributor contacts instead to armatures and contacts of relays 11SB and 11SD for the coding of the Figures, H and Letters signals on the distributor contacts.

As previously mentioned, the secondary storage circuit also has an arrangement for manufacturing a disconnect signal in the event that none is received and the circuit is individual to each storage level of the circuit. Taking the storage level in Figs. 45, 46, 47 and 48 as an example, the generation of a disconnect signal is initiated by the operation of locking transmitter stop key 45–36 which extends ground over conductor 45–37 to operate relay 46ST. Following this, key 45–38 is operated momentarily to extend ground over conductor 45–39, front contact and armature 1 of relay 46ST, conductors 46–03, 46–04, 46–06 and 46–07 to the winding of relay 52D which operates. This relay locks through its armature 6 and front contact, and conductor 52–43 to ground supplied through the armature 5 and front contact of relay 52BA. The ground connection that is supplied for locking relay 52D is extended over conductor 46–07 for locking relays 46SA, 46SB, 46SC, 46SD, 46SE and 46SF as they operate in succession. When the disconnect signal has been manufactured and transmitted to the connected outlet, relay 52BA releases as a part of the disconnect operation previously described and unlocks relay 52D, which in turn unlocks relays 46SA, 46SB, 46SC, 46SD, 46SE and 46SF. Because of the fact that relays 52D, 11D, 22D and 17D1 lock in the operated condition, the transmitter stop key, such as the key 45–36 in the case of the secondary storage circuit or the key 10–44 in the case of one of the input circuits, may be released to release the stop relay which it operated.

Machine trouble in connected secondary storage circuit

If a trouble develops in one of the reperforator units of the secondary storage circuit during the transmission thereto of a message from a connected input circuit, it is desirable to suspend further transmission of the message as it cannot be properly recorded. For this purpose, and referring by way of example to the single storage input circuit in Figs. 10, 11, 12 and 13, a relay 13MA is provided, the circuit of which is completed when a machine trouble develops in a connected storage level of the secondary storage circuit, from the winding of the relay over conductor 13–21, contacts of the crossbar switch in Fig. 44, perhaps the contacts 44–14 previously identified as being operable under the joint control of select magnet 44–08 and hold magnet 51–01, conductor 44–23 to the armature 3 of relay 46TM. This relay is operable in the anode circuit of tube 46–71 upon the occurrence of a trouble in reperforator-transmitter unit 45–02, in the manner previously described with reference to another tube corresponding to tube 46–71, and relay 13MA operates from the ground circuit so provided. It locks through its front contact and armature 2, and the armature 1 and back contact of relay 13BY to ground. At its back contact and armature 1, the relay 13MA interrupts the energizing circuit for transmitter clutch magnet 13–02 to suspend message retransmission from the reperforator-transmitter in Fig. 10. At its armature 3 and front contact, the relay 13MA connects ground over conductor 13–22 to lamp 10–49 to light that lamp to indicate that transmission has been suspended. It is thereupon incumbent on an operator to clear the trouble. The relay 13MA may be released, to extinguish lamp 10–49, by the operation of busy key 10–51 which extends ground over conductor 10–52 to the winding of relay 13BY which operates, interrupting the locking circuit for relay 13MA.

Discarding of message material stored in an input circuit

It is sometimes necessary, because of trouble conditions, to discard the tape in an input circuit, such as the single storage input in Figs. 10, 11, 12 and 13. To do this, the transmitter hold key 10–53 is operated to connect ground to conductor 10–54. This conductor extends to the winding of relay 13TH, which operates. At its armature 3 and front contact, the relay connects ground over conductors 13–23 and 13–22 to light lamp 10–49. The operator then operates the disconnect signal generation control key 10–47 which extends ground over conductor 10–48, front contact and armature 2 of relay 13TH, conductors 13–24 and 11–16 to the winding of relay 11DC, which operates.

As previously described, the relay 11DC operates to effect the advancement of the tape in the tape-sensing mechanism without effecting the transmission of the code combination thus advanced, thereby discarding the code combination. As also previously described, Letters or Blank signals, when encountered, will be discarded automatically. For a character other than Letters or Blank, one code combination will be discarded for each operation of key 10–47, and if a series of code combinations is to be discarded, the key must be operated repetitiously.

Routing of message to multiple outlet

One of the types of outlets earlier described as being provided is a multiple outlet, comprising a plurality of receiving teletypewriters representing a single receiving station or message destination, the teletypewriters being available without selection among them, on the basis of the next idle machine in sequence. The circuits of the multiple outlet are shown in Figs. 67, 68 and 69.

It will be assumed that a message for the multiple outlet begins to be received in storage in the secondary storage circuit contained in Figs. 31, 32, 38 and 39, and that the address information is transmitted to the teletypewriter 49–12 at the operator position in Figs. 42, 43, 49 and 50. The cord circuit that becomes activated for controlling the establishment of a connection is the one at the left of Fig. 42, including relays 42BDF, 42POSF, 42SLF, 42DSF and 42RLSF, and plug 42–31. The condition of the cord circuit when the waiting call has been registered, resulting from operations described in detail with reference to the right-hand cord in Fig. 42, is that relay 42BDF has operated, followed by the operation of relay 42POSF, which lights lamp 42–32 and releases relay 42BDF. Jack 35–11 is the one that gives access from the particular operator's position to the multiple outlet, and the operator inserts plug 42–31 into jack 35–11. Ground on the ring spring of jack 35–11 is extended over the ring of plug 42–31 to complete an energizing circuit for relay 42SLF, the circuit being similar to the one previously traced for operating relay 42SLL and including an armature and front contact of relay 42POSF. Relay 42SLF operates and locks in a path to the same ground but by-passing the armature and front contact of relay 42POSF. With relay 42POSF operated, the circuit of busy test relay 38BT of the secondary storage circuit is extended to the tip of plug 42–31 and thence through the tip spring and make contacts of jack 35–11, conductor 35–12 which is included in a group of conductors bracketed to Fig. 69, in which conductor 35–12 terminates at the contactor of contact bank 69–01 of stepping switch 69–02 which includes, in addition, con-

tact banks 69–03 and 69–04. The contactors of stepping switch 69–02 are operable by stepping magnet 69–06. Stepping switch 69–02 and a stepping switch 69–07 control the routing of messages to the several teletypewriter recorders of the multiple outlet contained in Figs. 67, 68 and 69. Stepping switch 69–07 has contact banks 69–08, 69–09, 69–11 and 69–12, the contactors of which are operable by stepping magnet 69–13.

It will be assumed that the contactors of the two stepping switches in Fig. 69 occupy the positions in which they are shown. The busy test path is then extended from the contactor associated with stepping switch bank 69–01 over conductor 69–14, armature 4 and back contact of relay 67LB, armature 5 and back contact of relay 67A, armature 3 and back contact of relay 67MA, armature 8 and back contact of relay 67B and winding of relay 67J which, if unoperated, opposes the battery connection on relay 38BT with the battery connection on relay 67J, permitting relay 38BT to release and to call upon the sequence circuit to give to the secondary storage circuit access to the link circuit for the purpose of establishing a transmission path to the multiple outlet. When the sequence circuit gives the secondary storage circuit permission to route the message to the multiple outlet, the select magnet 27–01 wil be operated and prepare for operation all of the crossbar switch contacts in the upper portions of Figs. 27, 28, 29 and 30. Thereafter, a ground connection is extended over the busy test path, including conductors 35–12 and 69–14, to operate relay 67J. Relay 67J locks over its front contact and armature 4, and conductor 67–01 to conductor 69–14. At its armatures 1 and 2, the relay 67J interrupts potential energizing circuits for relays 69MAA and 69RGA which control the stepping magnets 69–13 and 69–06, respectively. The path over which relay 69MAA is energizable is traced from battery through the winding of that relay, the break contacts of stepping magnet 69–13, conductors 69–17 and 69–18, back contact and armature 4 of relay 67A, back contact and armature 1 of relay 67B, conductors 67–02 and 69–19 to the contactor associated with contact bank 69–12 of stepping switch 69–07. With the contactor in the position shown, the path is extended over conductors 69–21 and 67–03 to armature 6 of relay 67B which has no back contact. From the junction of conductors 69–21 and 67–03 a branch path extends to armature 7 of relay 67A which has no back contact, but from the front contact a path extends through the back contact and armature 2 of relay 67J, and the back contact and armature 2 of relay 67MA to ground. It follows from this that relay 69MAA is energizable upon the operation of relay 67B independently of the condition of relays 67LB, 67J and 67MA, and also that relay 16MAA is energizable upon the operation of relay 67A unless relay 67J or relay 67MA is operated. The function of relay 67B will be set forth hereinafter. Since relay 67J is now assumed to be operated, the operation of relay 67A will not result in the energization of relay 69MAA.

Similarly, a path is traced from battery through the winding of relay 69RGA, break contacts controlled by stepping magnet 69–06, conductors 69–22 and 69–23, back contact and armature 3 of relay 67A, back contact and armature 2 of relay 67B, conductors 67–04 and 69–24, the contactor associated with contact bank 69–04 of stepping switch 69–02, conductors 69–26, 67–07 and 67–08 to the armature 7 of relay 67B which has no back contact. From the junction of conductors 69–26 and 67–07, a path is traced over conductor 67–09, the armature 6 of relay 67A which has no back contact but has a front contact from which a path extends over the back contact and armature 1 of relay 67J, and the back contact and armature 1 of relay 67MA to ground. Thus the same set of operating conditions applying to relay 69MAA applies also to relay 69RGA. However, from the junction of conductors 67–07 and 67–08 a path is traced over conductor 67–11 to the front contact associated with armature 2 of relay 67MA. It follows from this that relay 69RGA is operable directly under the control of relay 67MA regardless of the condition of relays 67J and 67A.

At its armature 5 and front contact, relay 67J connects ground over conductors 67–12 and 67–13 to the winding of relay 67LA which operates. This relay locks through its armature 3 and front contact, and back contact and armature 2 of relay 67LB to ground. At its armature 2 and front contact, the relay 67LA completes the operating circuit for relay 67A which operates.

At its armature 1 and front contact, the relay 67LA extends the transmission path to the grid of tube 67–14 which is controllable to repeat signals in the manner of tube 49–14 and other tubes previously described.

At its armature 8 and front contact, the relay 67A extends ground over conductor 67–16 to operate hold magnet 29–01 of the crossbar switch. The hold magnet initiates transmission from the reperforator-transmitter unit of the connected secondary storage circuit to the grid of tube 67–14. The anode circuit of tube 67–14 may be terminated in either of two ways, one of which is shown in Fig. 67 and the other is shown in Fig. 68 in connection with tube 68–14. The arrangement in Fig. 67 is used where the receiving station is sufficiently distant from the switching center to require a repeating relay. The anode of tube 67–14 is connected through transmission conductor 67–17, and the winding of repeating relay 67S to positive battery. The marking and spacing contacts of relay 67S are respectively connected to ground and to positive battery, and the armature is connected through the windings of relays 67N and 67L to one terminal of the selector magnet 67–18 of the receiving teletypewriter printer 67–19, the other terminal of which is connected to positive battery. Relays 67N and 67L, being included in the transmission circuit to selector magnet 67–18, follow the signals. During each spacing element relay 67N connects ground to the operating circuit for lamp 67–21 to light it, and the lamp thus flickers during the transmission of signals to teletypewriter 67–19, indicating that transmission is in progress. Relay 67L also follows signals attempting to complete an energizing path for relay 67B which includes conductors 67–22 and 67–23, armature 2 and back contact of relay 67A, and the winding of relay 67B. Because the relay 67A operates incident to the establishment of a transmission path to tube 67–14, the circuit of relay 67B is disabled at the armature 2 and back contact of relay 67A, and spacing signals transmitted to teletypewriter 67–19 do not cause relay 67B to operate. Should the transmission path from repeating relay 67S to selector magnet 67–18 become interrupted due to a trouble condition while transmission is in progress, relay 67L will operate to spacing and remain there, preparing an energizing circuit for relay 67B. Upon the release of relay 67A in response to the disconnect signal and under the control of the secondary storage circuit in a manner described with reference to other outlets, a circuit for relay 67B will be completed at the armature 2 and back contact of relay 67A, and relay 67B will operate. Its function is to establish an artificial or intentional busy condition of the teletypewriter 67–19 having the control circuits contained in Fig. 67, so that that teletypewriter canmnot be seized to receive a message, but any messages for the outlet will be routed to other teletypewriters, such as the teletypewriter 68–19 in Fig. 68. Should the transmission path from relay 67S to selector magnet 67–18 be interrupted, as above mentioned, relay 67N will also operate to and remain in the spacing condition, causing lamp 67–21 to be lighted steadily as an indication that a trouble has occurred and the teletypewriter is no longer receiving signals.

As described in connection with the single storage, double storage and direct-connected outlets, the relay

67J releases following withdrawal of plug 42–31 from jack 35–12 by the operator upon the lighting of lamp 42–33 as an indication that the establishment of a connection to the outlet has been completed. At its armatures 1 and 2, the relay 67J completes previously-traced paths from ground over conductors 69–21 and 69–26 to the first contact of the contact banks 69–12 and 69–04, respectively. With the contactors associated with those contact banks engaging the first contacts, the ground connections are extended over conductors 69–19 and 69–24 and conductors 67–02 and 67–04, respectively, through the armatures 1 and 2 of relay 67B to armatures 3 and 4 of relay 67A where the paths terminate because relay 67A is operated. However, from the junction of conductors 69–19 and 69–24 with conductors 67–02 and 67–04, respectively, paths are extended over conductors 69–27 and 69–28, armatures 1 and 2, respectively, of relay 68B, armatures 4 and 3, respectively, of relay 68A, conductors 68–01 and 68–02, respectively, and conductors 69–17 and 69–22, respectively, to the windings of relays 69MAA and 69RGA, respectively. Relay 69MAA completes the energizing circuit for stepping magnet 69–13 which in turn interrupts the circuit for relay 69MAA, and the relay in turn interrupts the circuit of stepping magnet 69–13 to advance the contactors of stepping switch 69–07 one step. Similarly, relay 69RGA and stepping magnet 69–06 cooperate to advance the contactors of stepping switch 69–02 one step. It will be remembered that the operation of relays 69MAA and 69RGA resulted from the release of relay 69J. If the teletypewriter receiver and control circuit associated with the second contact of each of the contact banks 69–12 and 69–04 is also in the process of receiving a message, there will be a ground connection on the second contacts of the two banks to cause the contactors to advance another step. This will continue until the contactors associated with contact banks 69–04 and 69–12 find contacts that are not grounded. It will be assumed that the last of the receivers and associated control circuits of the local outlet is idle. The conductive paths from its allotted contacts in contact banks 69–04 and 69–12 are traced from those contacts over conductors 69–29 and 69–31 to armatures 6 and 7 of relay 68A which is released and has only front contacts associated with those armatures. A branching path extends from conductor 69–31 over conductor 68–03 to armature 6 of released relay 68B, which has only a front contact for that armature and a branching path extends from conductor 69–29 over conductors 68–04 and 68–06 to armature 7 of relay 68B which also has no back contact. From the junction of conductors 68–04 and 68–06 a conductive path 68–07 extends to the front contact associated with armature 2 of relay 68MA. No ground connection is found at the ends of the two paths just traced, and the absence of ground indicates that the last section of the outlet is idle and available so that the contactors associated with contact banks 69–04 and 69–12 will come to rest at that point to prepare for seizure the last teletypewriter receiver of the local outlet. It will be apparent from this that idle sections of the local outlet circuit are seized in succession as long as any is idle, the stepping switches passing over busy sections in order to reach idle ones. Unused contacts may be grounded as indicated in Fig. 69. When all of the sections of the local outlet become busy, the contactors will remain in engagement with the contacts associated with the last section to be seized because there will be no ground connections to complete circuits for the control relays for the stepping magnets. As soon as a section becomes idle, the stepping switches will be reactivated by the presentation of ground to its associated contacts in contact banks 69–04 and 69–12, and the stepping switches will seek out the idle section.

When the secondary storage circuit decodes and retransmits the disconnect signal, it completes the operating circuit for relay 67LB through the front contact and armature 4 of relay 67LA. The operations performed by relay 67LB are like those previously described with respect to relay 61LB1 and 65LB. It locks through an armature and front contact of hold magnet 29–01 so that it will not be released until after the hold magnet has been released. It releases relay 67LA which in turn releases relay 67A. These relays release hold magnet 29–01 which in turn releases relay 67LB. The circuit shown in Fig. 67 is thus restored to normal, rendering this section of the local outlet available for reception of another message. If no other section of the local outlet is idle, the circuits of relay 69MAA will be completed over paths supplied in Fig. 67 to cause the advancement of the contactors of stepping switches 69–02 and 69–07 to the contacts pertaining to that section of the local outlet.

When a multiple address message is to be routed to one of the sections of the local outlet circuit, the establishment of a connection may be initiated by the insertion of any one of the multiple address plugs 41–05, 41–06, 41–07, 43–01 or 43–14 into jack 34–14 or jack 36–01. It will be assumed that at the time that a multiple address connection is to be established, the section of the local outlet circuit contained in Fig. 67 is busy, but the one contained in Fig. 68 is idle. A connection is established through the plug and jack from battery through the winding of relay 68BD, conductor 68–08, resistor 68–09 and conductor 68–11 to the last contact associated with contact bank 69–11 of stepping switch 69–07, the contactor associated with that bank, conductors 69–32 and 35–13, assuming that the plug has been inserted into jack 36–01, sleeve of that jack, and assuming also that plug 43–14 is the one inserted into the jack, the sleeve of the plug, front contact and armature 3 of relay 43CONN2, and upper winding of relay 43SLC2 to ground. Resistor 68–09 prevents relay 43SLC2 from operating, as previously described with reference to relay 43SLC1, but relay 68BD operates. It completes an energizing circuit for relay 68MA traced from battery through the winding of that relay, armature 6 and back contact of relay 68J, armature 1 and back contact of relay 68LD, back contact and armature 1 of relay 68A, back contact and armature 3 of relay 68B, and the front contact and armature of relay 68BD to ground. Relay 68MA locks through its front contact and armature 4, and the front contact and armature of relay 68BD.

Relay 68MA performs a number of operations corresponding to those previously described with reference to the operation of corresponding relays in other outlets, such as the relays 61MA1 and 62MA2 in the double storage outlet circuit and the relay 65MA in the single storage outlet. One of these operations is to impose a busy indication on the tip spring of the jack for regular messages, such as the jack 35–11, to prevent attempted seizure for a single address message. It interrupts, at its armature 3 and back contact, the energizing circuit for relay 68J. It short-circuits the resistor 68–09 to permit the operation of relay 43SLC2. It connects the ring spring of the multiple address jack 36–01 to the winding of relay 68LA, the path being traced from that spring of the jack over conductors 36–02 and 35–14, contactor and last contact of contact bank 69–09 of stepping switch 69–07, conductor 69–33, armature 7 and front contact of relay 68MA, and conductors 68–12 and 68–13 to the relay winding. It will be apparent from this that the function of contact bank 69–09 of switch 69–07 is to associate the operating circuit for relay LA of the particular section of the local outlet circuit that is being seized with the multiple address jack at which the seizure is being initiated.

At its armature 2 and front contact, the relay 68MA extends ground over conductors 68–07, 68–04 and 69–29, contactor of contact bank 69–04 of stepping switch 69–02, conductors 69–24 and 69–28, armature 2 and back con-

tact of relay 68B, armature 3 and back contact of relay 68A, conductors 68–02 and 69–22, and winding of relay 69RGA which controls stepping magnet 69–06 to cause the advancement of the contactors of stepping switch 69–02 to step to another idle section of the local outlet for the routing of a single address message thereto. The contactors of stepping switch 69–07 do not advance at this time because no ground connection is provided for operating the relay 69MAA.

With resistor 68–09 shorted, as previously mentioned, the relay 43SLC2 operates, and when all corresponding relays in the other multiple address cord circuits have operated, the intermediate storage circuit makes its bid to the sequence circuit for use of the crossbar switch and thereafter operates the select magnet for the particular secondary storage circuit. Following the operation of the select magnet, the secondary storage circuit completes the operating circuit for relay 68LA which in turn operates relay 68A. These relays perform the operations described with regard to relays 67A and 67LA, preparing for reception of the message by teletypewriter recorder 68–19. Among these operations is the connection of ground to the tip of the jack and cord to operate the start relay, which in Fig. 43 is the relay 43ST. The operation of this relay results in the release of relays 68BD and 68MA in the seized section of the local outlet and transmission of the message signals to the grid of tube 68–14, to be repeated to teletypewriter recorder 68–19, proceeds.

With relay 68MA released, an energizing circuit for relay 69MAA, which controls the advancement of the contactors of selector switch 69–07, is completed. The circuit extends from the winding of the relay over conductor 69–17, and conductor 69–18 or the corresponding conductor of any section of the local outlet circuit except the one in Fig. 68 which has conductor 68–01 joined to conductor 69–17 and extending to the back contact associated with armature 4 of relay 68A, where the path terminates because the relay is operated. Assuming that the section in Fig. 67 is idle, the path will be extended over conductor 69–18, back contact and armature 4 of relay 67A, back contact and armature 1 of relay 67B, conductors 67–02 and 69–19, the contactor of contact bank 69–12 of stepping switch 69–07, now engaging the last contact of that bank, conductor 69–31, armature 7 and front contact of relay 68A which is operated, back contact and armature 2 of relay 68J and back contact and armature 2 of relay 68MA to ground. Relay 69MA will be energized and will cooperate with stepping magnet 69–13 to advance the contactors of stepping switch 69–07 to the next idle section of the local outlet. These contactors may or may not come to rest on the contacts corresponding to those that are engaged by the contactors of stepping switch 69–02. It may happen that in the interval between advancement of the contactors of stepping switch 69–02 and the advancement of the contactors of stepping switch 69–07 a section of the local outlet circuit that the contactors of stepping switch 69–02 passed over has become idle. In that event, the contactors of stepping switch 69–07 would come to rest when they had identified that level as being idle. It is mere coincidence when the contactors of stepping switches 69–02 and 69–07 engage corresponding contacts. The stepping switch 69–02 has as its purpose the selection of idle sections of the local outlet circuit for the reception of single address messages, and the stepping switch 69–07 has as its purpose the selection of sections of the local outlet circuit for the reception of multiple address messages. Whenever the contactors of the two switches rest on corresponding contacts, both will be advanced incident to the seizure of an idle section for the recording of a single address message, and the contactors of both will come to rest on the contacts pertaining to the next idle section. When the contactors of the two switches are resting on the contacts of different idle sections, the contacts of switch 69–02 will be advanced incident to the seizure of an idle section for the recording of a single address message, but the contactors of switch 69–07 will not be advanced because they are in registry with a section that is idle and available for a multiple address message. When the contactors of the two switches are engaging corresponding contacts, those of switch 69–02 will be advanced as soon as the relay corresponding to relay 67MA or 68MA operates and will select another idle section, if available, for the routing thereto of a single address message. It will be understood that an appreciable interval may elapse between the plugging up of cords to initiate the seizure of outlets for the routing of a multiple address message and the beginning of transmission of the message to the outlets. Some of the indicated outlets may be busy at the time that the multiple address plugs are inserted into the jacks for those outlets, and the crossbar switch will not be operated to set up transmission paths to the several outlets until all have become idle and available. Until relays corresponding to relays 68A and 68LA have operated and the relay corresponding to relay 68MA has been released, the contactors of switch 69–07 are incapable of being advanced. Another multiple address message cannot be routed to the local outlet until the contactors of switch 69–07 have advanced to select an idle section. It will be undesirable to prevent the routing of single address messages to sections of the local outlet circuit during the interval in which connections for a multiple address message are being completed.

The disconnect for a multiple address message is registered in the same way as the disconnect for a single address message. Specifically, with reference to Fig. 68, the relay 68LB is operated and it locks under control of the hold magnet in the crossbar switch through contacts of which the transmission and control paths have been established. Incident to the restoration to normal, the hold magnet releases, unlocking relay 68LB which releases, having previously released relays 68A and 68LA.

Single storage outlet serving as a station of an automatic switching system

As previously stated, Figs. 54 to 56 comprise the apparatus and circuits of a single storage outlet which is a point of transfer for introducing messages into an automatic teletypewriter switching system. The relay circuits that are involved in the seizure of this outlet for the routing thereto of a message are contained in Fig. 56 and are like those of the single storage outlet contained in Figs. 63 to 65. They include the relays 56A, 56LA, 56LB, 56J, 56MA, 56BD, 56B and 56C. These relays have circuits like those of the corresponding relays in Fig. 65 and operate in the same manner and for the same purposes. When the outlet has been seized, the transmission path is extended to the control grid of vacuum tube 56–01. The anode circuit of tube 56–01 includes conductor 56–02, winding of selector magnet 54–01 of reperforator-transmitter unit 54–02, conductor 54–03 and resistor 56–03 to positive battery.

The relationship of the transmitter portion of reperforator-transmitter 54–02 to the transmission channel over which it transmits is different from the relationship of the transmitter portion of reperforator-transmitter 63–02 to the outgoing transmission channel, in that the access of the former transmitter to the transmission channel is controlled from a remote switching center of the automatic switching system. As is disclosed in the Branson-Kinkead-Krecek-Locke patent and the Bacon-Knandel-Krecek-Locke application hereinbefore identified, a number of transmitters may be associated with a transmission channel extending to a switching center of the automatic switching system. Since these transmitters must be restricted to transmission turns, one at a time, the starting of transmitters having message material awaiting transmission is controlled from the remote switching center.

The transmitter portion of reperforator-transmitter 54–02 registers a bid for access to the transmission channel by the closure of transmitter stop contacts 54–08. These contacts close when tape 54–04 emerging from the punch block 54–07 of reperforator-transmitter 54–02 pivots tape-sensing head 54–06 in clockwise direction. Upon the closure of transmitter stop contacts 54–08 ground is connected over conductors 54–09 and 55–01, back contact and lower armature of relay 55T1, unilateral current conducting device 55–02, back contact and armature 1 of relay 55LR, and winding of relay 55HD to battery, and the relay 55HD operates. Relay 55HD operates relay 55TWA in a circuit traced from the winding of the latter relay through the armature 4 and back contact of relay 55LK, and the front contact and armature 3 of relay 55HD to ground. At its armature 1 and back contact, the relay 55HD opens a normally closed section of the energizing circuit for relay 55LK, the path being normally open at the armature 4 and front contact of relay 55STT. At its armature 2 and back contact, relay 55HD interrupts a normally closed section of a possible locking circuit for relays 55H, 55LT1 and 55LT2. It will be recognized from the designations of these relays that they correspond to relay circuits previously described which respond to the end-of-message signals and effect a disconnect operation.

As described in the hereinbefore identified applications disclosing the automatic switching system, the automatic switching center includes a transmitter start circuit in association with each multistation line for transmitting code signals for affording to the transmitters, on a selective basis, the opportunity to transmit. The transmitter start circuit initiates a roll call of the outlying transmitters and as each transmitter is allotted the opportunity to transmit, it does so if it has message material awaiting transmission, or fails to transmit if it has none. In the case of the station shown in Figs. 54, 55 and 56, the operated condition of the relay 55TWA is indicative of the readiness of the transmitter to transmit, that readiness being indicated to a selector mechanism (not shown) that responds to the transmitter start signals, by interconnecting at the armature 2 and front contact of relay 55TWA conductors 55–03 and 55–04 which extend to the circuit of the selector mechanism and complete the circuit of a relay (not shown). When the selector mechanism responds to the transmitter start signals for the transmitter in Fig. 54, it applies operating potentials over conductors 55–04 and 54–11 to operate relay 55STT. This relay provides a locking circuit for relay 55TWA traced from the winding thereof through its front contact and armature 3, armature 2 and front contact of relay 55STT, back contact and armature 2 of relay 55LR, and back contact and armature 1 of relay 55EB to ground. At its armature 4 and front contact, the relay 55STT closes the normally open section in the energizing circuit for relay 55LK, but that path is now open at the armature 1 and back contact of relay 55HD, and relay 55LK does not operate. Relay 55STT also completes the energizing circuit for transmitter clutch magnet 54–12 traced from the winding of that magnet over conductors 54–13 and 54–14, armature 3 and back contact of relay 55R1, armature 1 and back contact of relay 55S1, armature 3 and front contact of relay 55STT, armature 1 and back contact of relay 55LT3, back contact and armature 1 of relay 55LK, and conductors 55–06 and 54–09 to the closed transmitter stop contacts 54–08 where the circuit is completed to ground.

The transmission circuit is traced from one of the outgoing line conductors 54–16 through the winding of relay 55AB, conductors 55–07, 55–08, 55–09, 55–11 and 54–17, stop and start signal generating contacts 54–18 operable by distributor shaft 54–19 to the other of the outgoing line conductors designated 54–21. When the contacts 54–18 are opened as they are during the transmission of the significant elements of the code combination, the conductors 54–16 and 54–21 become interconnected for the transmission of marking code elements through any of the five transmitter contacts controlled by the tape-sensing mechanism, corresponding ones of the group of five conductors 54–22, back contacts and armatures of relay 55CB or break contacts controlled by the armatures of that relay, corresponding ones of a group of five conductors 55–12, and corresponding ones of the five distributor contacts operable by shaft 54–19. It will thus be seen that line conductors 54–16 and 54–21 are interconnected for marking conditions and are disconnected for spacing conditions, and it will be understood that the transmitting potentials are supplied externally of the station shown in Figs. 54, 55 and 56. Since the station is assumed to be one of several associated with a multistation line, any one of those stations, when transmitting, opens the line circuit for spacing elements. Since the transmission circuit includes the winding of relay 55AB, that relay will interrupt its break contacts in response to each spacing signal transmitted. A ground connection supplied through armature 1 and front contact of relay 55TWA extends over conductors 55–13 and 55–14, break contacts of relay 55AB, and conductor 55–16 to lamp 54–23. Each spacing element transmitted from the station causes lamp 54–23 to be extinguished and thus the lamp flashes as an indication that transmission is taking place on the line. The lamp 54–23 does not indicate exclusively that the transmission is taking place from the station shown in Figs. 54, 55 and 56 because relay 55AB, being included in the transmission circuit, will follow signals transmitted from any of the other transmitters on the line. When the station has no message material awaiting transmission and relay 55TWA is not operated, no ground will be provided for the lighting of lamp 54–23, and although relay 55AB will follow signals, there will be no indication thereof at lamp 54–23.

As is described in the application and patent hereinbefore identified as disclosing the automatic switching system, a transmitter which is automatically set in operation under the control of the switching center does not suspend transmission and lose its access to the transmission channel at the end of a single message, but transmits all of the messages in storage awaiting transmission, including the usual disconnect signal at the end of each message. At the end of the last message it transmits a special signal indicating that it has no further messages to transmit, this signal comprising the usual and previously-described end-of-message signal, consisting of the codes for Figures, H and Letters, followed by an additional H and Letters signal. In response to this end of transmission signal, the switching center initiates a roll call of the transmitters to allot a transmitting turn to another transmitter. It may be added that, this end of transmission signal ordinarily appears in the tape. Since it cannot be reliably expected that messages originating within the switching system described in the present specification and intended for a station of the automatic switching system will have the end of transmission signal appended to the end of a message, the station shown in Figs. 54, 55 and 56 is provided with means for generating that signal.

Each time that a Figures code combination is sensed by the tape-sensing mechanism and is transferred to the maze contacts, a circuit of relay 55FG will be completed, and that relay will operate. In the manner described in connection with other circuits, it connects a resistor in parallel with its winding to impart a slow-release characteristic, and extends a connection from the path that becomes grounded in the maze contacts when the H signal has been sensed and transferred, the path being extended to the upper winding of relay 55FG and to the upper winding of relay 55H. Conductors that the maze contacts ground in response to the Figures and H signals are conductors 55–17 and 55–18, respectively. If any

character other than H follows the Figures signal, conductor 55–18 will not be grounded, but the ground will be removed from conductor 55–17 and relay 55FG will be released after a slight delay. When the Figures signal is followed by the H signal, this being an end-of-message signal, relay 55FG will remain operated through its upper winding, and relay 55H will operate. Relay 55–H locks through its lower winding and front contact and armature 2, conductors 55–19 and 55–21, and the front contact and armature of relay 55LT4 which is normally operated in a path from its winding through the back contact and armature 1 of relay 55LT2 to ground. At its armature 1, the relay 55H extends a path to the winding of relay 55LT3 from conductor 55–22, which is the conductor that receives ground from transmitter auxiliary contacts 54–24 when those contacts close incident to each signal sensing and transferring cycle of the transmitter shaft.

In the next cycle of the transmitter shaft, in which the signal following the H signal, presumably a Letters signal, is sensed and transferred, the energizing circuit for the upper winding of relay 55H is interrupted at the maze contacts, but the circuit of relay 55LT3 is completed through the transmitter auxiliary contacts and that relay operates, locking through its armature 3 and front contact, and the front contact and armature 3 of relay 55H. At its armature 1 and back contact, the relay 55LT3 interrupts the previously-traced circuit for the winding of transmitter clutch magnet 54–12 and that magnet releases, causing the arrestment of the transmitter shaft. The transmitter shaft, before it is arrested, closes the distributor clutch magnet contacts 54–26 as it does in each cycle, to initiate a cycle of the distributor shaft 54–19. The distributor auxiliary contacts close in this cycle of the distributor shaft, in which the signal, presumably a Letters signal, following the H signal, is transmitted, the contacts extending a ground over conductors 54–27 and 55–23, front contact and armature 2 of relay 55LT3, now operated, back contact and armature 2 of relay 55LT2, and winding of relay 55LT1 to battery, and the latter relay operates. It prepares a locking circuit for itself through the winding of relay 55LT2, back contact and armature of relay 55LT4 to ground. When the distributor auxiliary contacts open before the end of the cycle of the distributor shaft 54–19, and remove ground from conductor 54–27, a shunt around the winding of relay 55LT2 is removed, and that relay operates in the locking circuit for relay 55LT1. With relay 55LT2 operated, the original energizing circuit for relay 55LT1 is interrupted at the armature 2 and back contact of relay 55LT2, and the energizing circuit of relay 55LT4 is interrupted at the armature 1 and back contact of relay 55LT2. Relay 55LT4 has a slow-release characteristic, and upon its release it interrupts locking circuits for relays 55LT1, 55LT2 and 55H, unless relay 55HD has released. It will be remembered that relay 55HD was operated from the transmitter stop contacts 55–08. If only a single message has been delivered to the station in Figs. 54, 55 and 56, the transmitter stop contacts 54–08 will have been opened incident to the stepping of tape-sensing head 54–06 to sense the last code combination, thereby releasing relay 55HD. With that relay released, a substitute locking circuit for relays 55LT2, 55LT1 and 55H is traced from ground through the armature 4 and front contact of locked relay 55TWA, and the armature 2 and back contact of relay 55HD to conductor 55–21. It will be assumed that another message followed in tape 54–06 so that there remained slack tape when an end-of-message signal was sensed and relays 55H, 55LT1 and 55LT2 operated. Upon the release of relay 55LT4 there remains no locking circuit for relays 55LT1, 55LT2 and 55H, and those relays release. Relay 55H releases relay 55LT3. The latter relay reestablishes the energizing circuit for transmitter clutch magnet 54–12 to permit the initiation of transmission of the next message. With relay 55LT2 released, relay 55LT4 reoperates. Thus the normal condition existing during the transmission of a message is restored and the transmission of the message proceeds.

It will now be assumed that the Figures, H and Letters code combinations comprising the disconnect signal ending the last message in tape 54–04 have been sensed and transferred, and that the gap between tape-sensing head 54–06 and punch block 54–07, has been closed, causing the opening of transmitter stop contacts 54–08 and the release of relay 55HD. As previously stated, the relays 55H, 55LT1 and 55LT2 cannot release because they remain locked through the armature 4 of relay 55TWA. Upon the release of relay 55LT4 a ground connection is extended through its armature and back contact, the back contact and armature 1 of relay 55HD, the armature 4 and front contact of relay 55STT to the winding of relay 55LK which operates, locking through its armature 3 and front contact, the back contact and armature 3 of relay 55LR, and the back contact and armature 2 of relay 55EB to ground. The energizing circuit for transmitter clutch magnet 54–12 was traced through the armature 1 and back contact of relay 55LK, so that circuit is interrupted at a point additional to the interruption at the armature 1 and back contact of relay 55LT3 which is now operated. At its armature 4 and back contact, the relay 55LK interrupts the original energizing circuit for relay 55TWA, thus assuring that if relay 55HD should immediately reoperate due to the reception of more signals, it would not prevent the release of relay 55TWA upon the interruption of the locking circuit for that relay. At its armature 2 and front contact, the relay 55LK completes the operating circuit of relay 55CB which operates.

Relay 55CB disconnects the distributor contacts from the transmitter contacts and codes and H signal on the distributor contacts. It extends a path from distributor auxiliary contact conductor 54–27 over conductor 55–24, the armature 1 and back contact of relay 55DB to the winding of relay 55DA. Relay 55CB completes an energizing circuit for the distributor clutch magnet 54–28, traced from the winding of that magnet over conductors 54–29 and 54–31, armature 7 and front contact of relay 55CB, back contact and armature 2 of relay 55DA, and back contact and armature 1 of relay 55EA to ground. With the distributor clutch magnet 54–28 energized, the distributor shaft 54–19 is set in operation to transmit the H signal coded on the distributor contacts. The distributor auxiliary contacts close during this revolution of shaft 54–19 and complete a previously traced circuit for the winding of relay 55DA which operates. This relay prepares a locking circuit for itself through its armature 1 and front contact, the winding of relay 55DB, and the front contact and armature 8 of relay 55CB to ground. At its armature 2, the relay 55DA interrupts the energizing circuit for distributor clutch magnet 54–28 which releases and arrests the distributor shaft. Before the shaft comes to rest, it opens the distributor auxiliary contacts, thereby removing a shunt around the winding of relay 55DB and permitting that relay to operate in the locking circuit for relay 55DA. Relay 55DB codes a Letters signal on the distributor contacts in substitution for the H signal. At its armature 1 and front contact, it prepares a circuit for energizing relay 55EA from the distributor auxiliary contacts. At its armature 2 and front contact, it reestablishes the circuit for distributor clutch release magnet 54–28 which was interrupted at the armature 2 and back contact of relay 55DA, and another cycle of shaft 54–19 is initiated to effect the transmission of the Letters signal. Upon the closing of the distributor auxiliary contacts, the prepared circuit for relay 55EA is completed, and that relay operates. It interrupts the energizing circuit for the distributor clutch release magnet 54–28 at its armature 1 and back contact, and at its front contact and armature 2 it prepares a locking circuit

for itself through the winding of relay 55EB, and the front contact and armature 8 of relay 55CB. The distributor auxiliary contacts open before shaft 54–19 comes to rest and remove the shunt around the winding of relay 55EB, permitting that relay to operate in the locking circuit of relay 55EA. At its armature 1 and back contact, the relay 55EB interrupts the locking circuit for relay 55TWA, and that relay releases. At its armature 2 and back contact, the relay 55EB interrupts the locking circuit for relay 55LK which releases. Relay 55TWA releases relays 55LT2, 55LT1 and 55H. The latter relay releases relay 55LT3. With relay 55LT2 released, relay 55LT4 reoperates. Relay 55LK releases relay 55CB. The latter relay reconnects the distributor contacts to the transmitter contacts and interrupts the locking circuits for relays 55DA, 55DB, 55EA and 55EB which release.

Delayed handling position

The direct connected outlet in Fig. 71, in cooperation with the single storage input circuit contained in Figs. 2 to 5, has been described hereinbefore as a delayed handling position. Its purpose is to provide for the storage of messages addressed to stations that are shut down for any reason at times when the switching center is in operation so that the retransmission of messages to those stations must be delayed.

The direct connected outlet in Fig. 71 is similar to the one in Fig. 66, previously described, and includes corresponding relays for controlling the routing reception and repeating of messages, those relays being designated by reference numerals having appropriate prefixes for Fig. 71. When a connection has been established from a secondary storage circuit to the direct connected outlet in Fig. 71, signals are received by tube 71–01, which includes in its plate circuit the operating winding of relay 71TR by which marking and spacing signal elements comprising closed and open circuit conditions, respectively, are impressed upon the transmission channel comprising conductors 71–02 and 71–03.

As previously stated, the transmission channel is contained entirely within the switching center and extends to Fig. 4 where conductors 71–02 and 71–03 reappear and are interconnected in a loop through the windings of relays 4LA and 4L. When signals are received from the direct connected outlet in Fig. 71, they are repeated by relay 4L over a path traced through conductor 4–01, selector magnet 2–04 of reperforator 2–06, conductor 2–07, and resistor 5–01 to battery.

The single storage input circuit in Figs. 2 to 5 is like the one in Figs. 10 to 13 previously described and it will not be described in detail. However, because of the fact that messages are to be released from this circuit only when the destinations to which they are addressed have become available, the transmitter hold key 2–01, which is a locking key, is normally operated. This key extends ground over conductor 2–02 to the winding of relay 5TH which operates. This relay, at its armature 1 and back contact, interrupts the energizing circuit for relay 5STC. If the latter relay is not operated at the time of operation of relay 5TH, it cannot become operated while the relay 5TH remains operated to initiate a bid for access to the secondary storage circuit. At its armature 2, the relay 5TH prepares an energizing circuit for discard relay 3DC traced from the winding of that relay over conductors 3–01 and 3–02, armature 2 and front contact of relay 5TH, and conductor 5–02 to the normally open key 2–03. If it should be desired to discard tape in storage, this may be accomplished by the operation of key 2–03 which will cause the operation of relay 3DC to initiate a discard operation in the manner hereinbefore described. At its armature 3 and front contact, the relay 5TH extends ground over a path including conductors 5–03 and 5–04 to light lamp 2–05 which indicates that transmission has been suspended.

It will be understood that when signals are received by reperforator 2–06, those signals are perforated in tape 2–08, causing pivoted tape-sensing head 2–09 to move away from punch block 2–11 and to close contacts 2–12. These contacts initiate a sequence of operations by which the single storage input circuit seeks to seize an idle level of the secondary storage circuit. Because the relay 5STC is prevented from operating, the seizure of a storage level of the secondary storage circuit may not be accomplished and message after message may be accumulated in tape 2–08.

When a station becomes available for which there is a message in storage in tape 2–08, the retransmission of messages from the tape may be initiated by the opening of transmitter hold key 2–01. This key, upon being opened, interrupts the circuit of relay 5TH, which releases, permitting relay 5STC to operate and initiate the seizure of an idle level of the secondary storage circuit. If the transmitter hold key 2–01 is reclosed after being opened momentarily, relay 5TH will reoperate. Assuming that relay 5STC has become operated, its locking circuit is not under the control of relay 5TH so that the transmission of a complete message from tape 2–08 will proceed, the relay 5STC being released incident to the disconnection of the delayed handling input circuit from the secondary storage circuit, and the relay 5STC would be prevented by the operated relay 5TH from again operating to place another bid for access to the secondary storage circuit. If the operator leaves the transmitter hold key open, the messages in tape 2–08 will be released in succession for normal processing.

Assuming that one or more messages precede, in tape 2–08, the message for a destination station that has become available, and that the destination stations for those preceding messages have not become available. The idle operators to whose positions the address information accompanying the latter messages is delivered will route the messages to the delayed handling position comprising the direct connected outlet in Fig. 71 and the single storage input circuit in Figs. 2 to 5. The messages will thus be rerecorded in tape 2–08. When the message that is to be released and retransmitted is reached, whether by leaving key 2–01 operated or by repeated operations of that key, the retransmission of further messages may be prevented by restoring key 2–01 to its normal closed condition. At the end of retransmission of that message from the tape 2–08, the relay 5ST will release and its reoperation will be prevented by relay 5TH which is operated. The operator who processes the message that is to be released will direct it to the outlet designated by the address information instead of to the delayed handling position and in that way the message will be cleared out of the delayed handling position and will be transmitted to its destination.

Originating station circuit

An input circuit which has been designated as an originating station circuit is shown in Figs. 6 to 9, inclusive. Its purpose is to provide facilities in the switching center for introducing messages into the system. It consists of a single storage input circuit like the one employed as part of the delayed handling circuit in Figs. 2 to 5, and the line terminating single storage input circuit contained in Figs. 10 to 13. The source of signals that are impressed upon selector magnet 6–04 of the reperforator 6–06 is a keyboard perforator 8–01 and a tape transmitter 8–02. By means of keyboard perforator 8–01 an attendant may prepare a tape similar to that prepared at remote points of origin of messages containing the necessary address information of the destination station, the body of the message and the end-of-message signal comprising the code combinations for Figures, H and Letters. In order that there shall be no interruption of transmission to reperforator 6–06 between the beginning of a message and the disconnect signals, it is preferable to sever the perforated tape produced by keyboard per-

forator 8–01 before the leading end of the tape is inserted into the tape transmitter 8–02.

The tape transmitter is of a well known and conventional design including a pair of contacts 8–03 that are closed by a plunger 8–04 engaged by the tape upon insertion thereof into the transmitter. Contacts 8–03 prepare an energizing circuit for clutch magnet 8–06 of the tape transmitter, the circuit being traced from ground through a resistor, closed contacts 8–03, the winding of transmitter clutch magnet 8–06, and conductor 8–07 to normally open manually operable contacts 8–08. The operator initiates transmission from the tape transmitter by momentarily closing contacts 8–08 to extend the energizing circuit for clutch magnet 8–06 to battery. Clutch magnet 8–06 disengages its armature from distributor shaft 8–09, and in addition closes, under the control of the armature, a locking circuit for the magnet traced from ground through the resistor and contacts 8–03, the winding of the magnet, conductor 8–11, the closed contacts controlled by the armature, and conductor 8–12 to battery. This locking circuit for the clutch magnet will remain effective until the tape runs out of the transmitter and releases plunger 8–04, thereby permitting contacts 8–03 to open after the disconnect signals have been transmitted.

The transmission path from the transmitter includes conductor 8–13 and the lower windings of relays 8LA and 8L. The latter relay repeats the signals over a path including conductor 8–14, the winding of selector magnet 6–04 of reperforator-transmitter unit 6–06, and conductor 6–01 to battery. As soon as the message begins to appear in tape 6–08 produced by reperforator 6–06, the circuit makes its bid for access to an idle level of the secondary storage circuit. At the end of the message the input is disconnected from the secondary storage circuit following the decoding and transmission of the disconnect signals.

Miscellaneous intercept circuit

In order that improperly traced messages may be corrected preparatory to retransmission, a special intercept output is provided. This intercept circuit, shown in Fig. 70 is, in effect, a direct connected outlet like that in Fig. 71 forming part of the delayed handling circuit and also like a true direct connected outlet shown in Fig. 66. It has the same type and number of relays performing the same functions as the other direct connected outlets. When an operator finds that the address information appearing on the teletypewriter recorded at the operating position is unintelligible or is manifestly incorrect, that operator establishes a connection for the transmission of the defective address information and the body of the message to the intercept circuit in Fig. 70 in which the signals are received on the grid of tube 70–01 and are repeated by that tube to the operating winding of relay 70TR. The relay 70TR in turn repeats the signals into a loop circuit which includes the selector magnet 70–02 of a typing reperforator 70–03. This reperforator punches tape in accordance with the received signals and also prints the characters corresponding to those signals on the tape. The reperforator is not provided with any transmitter, but the tape emerging therefrom may feed into a receptacle 70–04.

As the tape accumulates in the receptacle, it is removed therefrom by attendants and is severed into lengths each containing the message and the faulty address material preceding it. The attendant obtains the necessary information for correcting the address and prepares a fragment of tape containing the proper information. This fragment may be produced by means of a keyboard perforator 8–01 forming part of the originating station circuit. The fragment of tape may be spliced to the length which contains the message and the resulting composite tape may be reintroduced into the system by placing it in the tape transmitter 8–02 of the originating station circuit. Key 8–08 is then operated to initiate transmission of the signals to reperforator 6–06. When the corrected address information is displayed on the teletypewriter recorder at an operator's position, the operator is able to act upon the corrected information by establishing a connection to the outlet designated by that information.

Although a specific embodiment of the invention has been shown in the drawings and described in the foregoing specification, it will be understood that the invention is not limited to the specific embodiment disclosed, but is capable of modification, substitution, and rearrangement of parts and elements without departing from the spirit of the invention.

What is claimed is:

1. A semiautomatic switching center for a telegraph switching system having a plurality of incoming transmission channels, a message recording and retransmitting instrumentality terminating each of said channels, a plurality of other message storing and retransmitting instrumentalities, means for causing each of said first-mentioned instrumentalities to seize and establish transmission connection with one of said other instrumentalities, a plurality of outgoing message transmission channels having terminals in said switching center, manually controllable means adapted for establishing transmission connections between said other instrumentalities and said outgoing channel terminals, and automatically operable means for severing the transmission connections between said first-mentioned and other instrumentalities and between said other instrumentalities and said outgoing channel terminals at the ends of messages transmitted over said connections.

2. A semiautomatic switching center for a telegraph switching system having a plurality of incoming transmission channels, a message recording and retransmitting instrumentality terminating each of said channels, a plurality of other message storing and retransmitting instrumentalities, means for causing each of said first-mentioned instrumentalities to seize and establish transmission connection with one of said other instrumentalities, a plurality of manually controllable switching positions, a teletypewriter printer at each of said positions, means operable incident to seizure of one of said other recording and retransmitting instrumentalities for causing the seizing recording and retransmitting instrumentality to also seize an idle one of said teletypewriter printers, and means for automatically initiating retransmission to the seized other recording and retransmitting instrumentality and to the seized teletypewriter printer.

3. A semiautomatic switching center for a telegraph switching system having a plurality of incoming transmission channels, a message recording and retransmitting instrumentality terminating each of said channels, a plurality of other message storing and retransmitting instrumentalities, means for causing each of said first-mentioned instrumentalities to seize and establish transmission connection with one of said other instrumentalities, a plurality of manually controllable switching positions, a teletypewriter printer at each of said positions, means operable incident to seizure of one of said other recording and retransmitting instrumentalities for causing the seizing recording and retransmitting instrumentality to also seize an idle one of said teletypewriter printers, means for automatically initiating retransmission to the seized other recording and retransmitting instrumentality and to the seized teletypewriter printer, and manually operable means at the switching position for disconnecting said teletypewriter printer.

4. A semiautomatic switching center for a telegraph switching system having a plurality of incoming transmission channels, a message recording and retransmitting instrumentality terminating each of said channels, a plurality of other message storing and retransmitting instru-

mentalities, means for causing each of said first-mentioned instrumentalities to seize and establish transmission connection with one of said other instrumentalities, a plurality of outgoing message transmission channels having terminals of access in said switching center, a plurality of switching positions each having manually controllable means for selectively establishing transmission connections between said other instrumentalities and said outgoing channel terminals, a teletypewriter printer at each of said positions, means operable incident to seizure of one of said other recording and transmitting instrumentalities for causing the seizing recording and retransmitting instrumentality to seize an idle one of said teletypewriter printers, means for automatically initiating retransmission to the seized other recording and retransmitting instrumentality and to the seized teletypewriter printer, and means operable responsive to operation of any of said manually controllable means for disconnecting said teletypewriter printer.

5. A semiautomatic switching center for a telegraph switching system having a plurality of incoming transmission channels, a message recording and retransmitting instrumentality terminating each of said channels, a plurality of other message storing and retransmitting instrumentalities, means for causing each of said first-mentioned instrumentalities to seize and establish transmission connection with one of said other instrumentalities, a plurality of outgoing message transmission channels having terminals of access in said switching center, a plurality of switching positions each having manually controllable means for selectively establishing transmission connections between said other instrumentalities and said outgoing channel terminals, a teletypewriter printer at each of said positions, means operable incident to seizure of one of said other recording and transmitting instrumentalities for causing the seizing recording and retransmitting instrumentality to seize an idle one of said teletypewriter printers, means for automatically initiating retransmission to the seized other recording and retransmitting instrumentality and to the seized teletypewriter printer, and means including said manually controllable means and another manually operable means for causing said teletypewriter printer to be disconnected by whichever of said manually operable means is first operated.

6. A semiautomatic switching center for a teletypewriter switching system having a plurality of incoming transmission channels, a plurality of outgoing transmission channels having terminals of access in said switching center, means for recording and retransmitting messages received over said incoming channels, a plurality of switching positions each having manually operable means adapted for selectively establishing transmission connections between said recording and retransmitting means and said outgoing channel terminals, and means for indicating at one only of said switching positions determined as the next idle position according to a rotational sequence that an incoming message is being recorded in a designated one of said recording and retransmitting means.

7. A semiautomatic switching center for a teletypewriter switching system having a plurality of incoming transmission channels, a plurality of outgoing transmission channels having terminals of access in said switching center, means for recording and retransmitting messages received over said incoming channels, a plurality of switching positions each having manually operable means adapted for selectively establishing transmission connections between said recording and retransmitting means and said outgoing channel terminals, means at each of said switching positions individual to each of a plurality of said recording and retransmitting means for indicating the recording of a message in the designated recording and retransmitting means, and means for causing the activation of one only of the indicating means for any recording and retransmitting means at the next idle switching position according to a rotational sequence among those positions.

8. A semiautomatic switching center for a teletypewriter switching system having a plurality of incoming transmission channels, a plurality of outgoing transmission channels having terminals of access in said switching center, means for recording and retransmitting messages received over said incoming channels, a plurality of switching positions each having manually operable means adapted for selectively establishing transmission connections between said recording and retransmitting means and said outgoing channel terminals, means at each of said switching positions individual to each of a plurality of said recording and retransmitting means for indicating the recording of a message in the designated recording and retransmitting means, means for causing the activation of one only of the indicating means for any recording and retransmitting means at the next idle switching position according to a rotational sequence among those positions, a teletypewriter printer at each of said switching positions, and means for establishing a transmission connection from any of said recording and retransmitting means to the teletypewriter printer at the switching position at which the indicating means for that recording and transmitting means has been activated.

9. A semiautomatic switching center for a teletypewriter switching system having a plurality of incoming transmission channels, a message recording and retransmitting instrumentality terminating each of said channels, a plurality of secondary message recording and retransmitting instrumentalities, a plurality of outgoing transmission channels each having a terminal of access in said switching center, means for causing any one of said first-mentioned recording and retransmitting instrumentalities, upon receiving an incoming message to seize one of said secondary instrumentalities and retransmit the message thereto, manually operable switching means adapted for establishing a transmission connection between the secondary instrumentality receiving said message and an outgoing transmission channel terminal, and means for precluding seizure of the same secondary instrumentality for recording another message until completion of transmission of the first-mentioned message to the connected outgoing transmission channel terminal.

10. A semiautomatic switching center for a teletypewriter switching system having a plurality of incoming transmission channels, a message recording and retransmitting instrumentality terminating each of said channels, a plurality of secondary message recording and retransmitting instrumentalities, and means for causing each of said first-mentioned recording and retransmitting instrumentalities upon receiving a message to seize the next idle one of said secondary instrumentalities according to a rotational sequence and to transmit the received message thereto.

11. A semiautomatic switching center for a teletypewriter switching system having a plurality of recording and retransmitting instrumentalities for recording incoming messages, a plurality of outgoing transmission channels each having a terminal of access in said switching center, a crossbar switch for establishing transmission connections between said recording and retransmitting instrumentalities and said outgoing transmission channel terminals, a switching position having jack circuits representing some or all of said outgoing transmission channel terminals and cord circuits individual to some or all of said recording and retransmitting instrumentalities, and means including any interconnected cord circuit and jack circuits adapted for operating said crossbar switch to establish a transmission connection from a recording and retransmitting instrumentality to an outgoing transmission channel terminal.

12. A semiautomatic switching center for a teletypewriter switching system having a plurality of recording and retransmitting instrumentalities for recording in-

coming messages, a plurality of outgoing transmission channels each having a terminal of access in said switching center, a crossbar switch for establishing transmission connections between said recording and retransmitting instrumentalities and said outgoing transmission channel terminals, a switching position having jack circuits representing some or all of said outgoing transmission channel terminals and cord circuits individual to some or all of said recording and retransmitting instrumentalities, means including any interconnected cord circuit and jack circuits adapted for operating said crossbar switch to establish a transmission connection from a recording and retransmitting instrumentality to an outgoing transmission channel terminal, and means operable incident to establishment of said connection for rendering the connection immune to further control by said interconnected cord and jack circuit.

13. A semiautomatic switching center for a teletypewriter switching system having a plurality of recording and retransmitting instrumentalities for recording incoming messages, a plurality of outgoing transmission channels each having a terminal of access in said switching center, a crossbar switch for establishing transmission connections between said recording and retransmitting instrumentalities and said outgoing transmission channel terminals, a switching position having jack circuits representing some or all of said outgoing transmission channel terminals and cord circuits individual to some or all of said recording and retransmitting instrumentalities, means including any interconnected cord and jack circuits adapted for operating said crossbar switch to establish a transmission connection from a recording and retransmitting instrumentality to an outgoing transmission channel terminal, and means operable incident to the establishment of said connection for indicating completion of the function of the particular cord and jack circuit interconnection.

14. A semiautomatic switching center for a teletypewriter switching system having a plurality of recording and retransmitting instrumentalities for recording incoming message, a plurality of outgoing transmission channels each having a terminal of access in said switching center, a crossbar switch for establishing transmission connections between said recording and retransmitting instrumentalities and said outgoing transmission channel terminals, a switching position having jack circuits representing some or all of said outgoing transmission channel terminals and cord circuits individual to some or all of said recording and transmitting instrumentalities, a teletypewriter printer at said switching position, means for connecting said printer to receive an incoming message along with any of said recording and retransmitting instrumentalities, means including any interconnected cord and jack circuits adapted for operating said crossbar switch to establish a transmission connection from a recording and retransmitting instrumentality to an outgoing transmission channel terminal, and means operable by said interconnected cord and jack circuits for suspending reception by said teletypewriter printer.

15. A semiautomatic switching center for a teletypewriter switching system having a plurality of recording and retransmitting instrumentalities for recording incoming messages, a plurality of outgoing transmission channels each having a terminal of access in said switching center, a switching position having a field of jack circuits representing some or all of said outgoing transmission channels and a set of cord circuits individual to some or all of said recording and retransmitting instrumentalities, a second field of jack circuits including jacks representing some or all of said outgoing transmission circuits and also including a jack adapted to be interconnected with any one of said cord circuits, a second set of cord circuits associable through said last-mentioned jack and a cord circuit of said first-mentioned set with the recording and retransmitting instrumentality allocated to that cord circuit of the first set and interconnectable plurally as well as singly with the outgoing channel jack circuits of said second field, and switching means controllable by interconnected cord circuits and jack circuits of said second set and second field respectively adapted for establishing transmission connections between one of said recording and retransmitting instrumentalities and said outgoing transmission channel terminals corresponding in number to the number of the cord circuits used of said second set.

16. A semiautomatic switching center for a teletypewriter switching system having a plurality of recording and retransmitting instrumentalities for recording incoming messages, a plurality of outgoing transmission channels each having a terminal of access in said switching center, a switching position having a field of jack circuits representing some or all of said outgoing transmission channels and a set of cord circuits individual to some or all of said recording and retransmitting instrumentalities, a second field of jack circuits including jacks representing some or all of said outging transmission circuits and also including a jack adapted to be interconnected with any of said cord circuits, a second set of cord circuits adapted for interconnection through said last-mentioned jack and a cord circuit of said first-mentioned set with the recording and retransmitting instrumentality allocated to that cord circuit of the first set and adapted for interconnection plurally with the outgoing channel jack circuits of said second field, and switching means adapted for control by interconnected cord circuits and jack circuits of said second set and second field respectively for establishing transmission connections between one of said recording and retransmitting instrumentalities and said outgoing transmission channel terminals corresponding in number to the number of the cord circuits used of said second set.

17. A switching center according to claim 16 having a set of relays associated with each of the cord circuits of said second set, and interconnections among said sets of relays arranged to qualify said cord circuits for utilization in succession in a predetermined order of interconnection with jack circuits of said second field representing the outgoing channel terminals to be connected to a storing and retransmitting instrumentality.

18. A switching center according to claim 16 having a set of relays associated with each of the cord circuits of said second set, and interconnections among said sets of relays arranged to qualify said cord circuits for utilization beginning with any one of the cord circuits and continuing in succession in a predetermined order of interconnection with jack circuits of said second field representing the outgoing channel terminals to be connected to a storing and retransmitting instrumentality.

19. A switching center according to claim 16 having at least two of said switching positions, a set of relays associated with each cord circuit of the second set of cord circuits of each switching position, and interconnections among said sets of relays arranged to qualify said cord circuits for utilization beginning with any one of the cord circuits of one position and continuing in succession to the end of the cord circuits of that one position and into the cord circuits of the second set of another position in a predetermined order of interconnection with jack circuits of said second fields representing the outgoing channel terminals to be connected to one of said storing and retransmitting instrumentalities.

20. A switching center according to claim 16 having a set of relays associated with each of the cord circuits of said second set, and interconnections among said sets of relays establishing an ordinal relationship of their cord circuits as first, intermediate and last, and arranged to qualify said cord circuits for utilization beginning with any idle one of those cord circuits and continuing in succession toward said last cord circuit as the order of interconnection with jack circuits of said second field

representing the outgoing channel terminals to be connected to a storing and retransmitting instrumentality.

21. A switching center according to claim 16 having a set of relays associated with each of the cord circuits of said second set, and interconnections among said sets of relays establishing an ordinal relationship of their cord circuits as first, intermediate and last, and arranged to qualify said cord circuits for utilization in groups, each beginning with an idle one of those cord circuits and continuing in succession toward said last cord circuit as the order of interconnection with jack circuits of said second field representing the outgoing channel terminals to be connected to one storing and retransmitting instrumentality per utilized groups of cord circuits.

22. A switching center according to claim 16 having at least two of said switching positions, a set of relays associated with each cord circuit of the second set of cord circuits of each switching position, and interconnections among said sets of relays establishing an ordinal relationship of said switching positions as first, last, and if more than two, intermediate, and further establishing an ordinal relationship of the cord circuits of each of said second sets as first, intermediate and last, and arranged to qualify said cord circuits for utilization beginning with any idle one of the cord circuits of said second set in any of said positions and continuing in succession to the last cord circuit of the set and thence into the cord circuits of the second set of the next position, beginning with the first cord circuit of said next position, as the order of interconnection with jack circuits of said second fields representing the outgoing channel terminals to be connected to a storing and retransmitting instrumentality.

23. A switching center according to claim 16 having a set of relays associated with each of the cord circuits of said second set, interconnections among said sets of relays arranged to qualify said cord circuits for utilization in succession in a predetermined order of interconnection with jack circuits of said second field representing the outgoing channel terminals to be connected to a storing and retransmitting instrumentality, and means adapted for operation upon completion by said switching means of transmission connections to the outgoing transmission channel terminals represented by the jack circuits of said second field having cord circuit interconnections for initiating transmission from said storing and retransmitting means to said transmission channel terminals.

24. A switching center according to claim 16 having a set of relays associated with each of the cord circuits of said second set, interconnections among said sets of relays arranged to qualify said cord circuits for utilization in succession in a predetermined order of interconnection with the jack circuits of said second field representing the outgoing channel terminals to be connected to a storing and retransmitting instrumentality, and manually operable means associated with each of the cord circuits of said second set and adapted to have only the manually operable means associated with the last used cord circuit of said second set operable to initiate operation of said switching means.

25. A switching center according to claim 16 having a set of relays associated with each of the cord circuits of said second set, interconnections among said sets of relays arranged to qualify said cord circuits for utilization in succession in a predetermined order of interconnection with the jack circuits of said second field representing the outgoing channel terminals to be connected to a storing and retransmitting instrumentality, and means adapted for operation upon establishment by said switching means of all of said connections for depriving said interconnected cord circuits and jack circuits of further control over said connections.

26. A switching center according to claim 16 having a set of relays associated with each of the cord circuits of said second set, interconnections among said sets of relays arranged to qualify said cord circuits for utilization in succession in a predetermined order of interconnection with the jack circuits of said second field representing the outgoing channel terminals to be connected to a storing and retransmitting instrumentality, and means adapted for operation upon establishment by said switching means of all of said connections for indicating lack of further utility of said cord circuit and jack circuit interconnections whereby to authorize disestablishment of said interconnections.

27. A semiautomatic switching center for a teletypewriter switching system having a plurality of recording and retransmitting instrumentalities for recording incoming messages, a plurality of outgoing transmission channels each having a terminal of access in said switching center, a switching position having a field of jack circuits representing some or all of said outgoing transmission channels and a set of cord circuits individual to some or all of said recording and retransmitting instrumentalities, a second field of jack circuits including jacks representing some or all of said outgoing transmission circuits, a second set of cord circuits, a jack in said second field of jack circuits individual to each of the cord circuits of said second set and adapted for interconnection with a cord circuit of said first set representing a recording and retransmitting instrumentality having a message awaiting retransmission to a plurality of said outgoing transmission channel terminals, the cord circuits of said second set adapted for interconnection plurally with jack circuits of said second field representing transmission channel terminals to receive the message waiting in said recording and retransmitting instrumentality, and switching means controllable by interconnected cord circuits and jack circuits of said second set and second field respectively adapted for establishing transmission connections between said one recording and retransmitting instrumentality and the transmission channel terminals corresponding to the cord circuits used of said second set.

28. In a telegraph switching system, a switching center having a record controlled transmitter adapted to transmit telegraph code signals at a predetermined rate, a receiving recorder responsive to signals transmissible at a lesser rate for producing a control record for controlling said transmitter, means for registering a count of complete messages received by said recorder, means for registering a count of complete messages transmitted by said transmitter, means for comparing the registrations of said two registering means, and means controlled by said comparing means when detecting like registrations for estopping operation of said transmitter.

29. In a telegraph switching system, a switching center having a record controlled transmitter adapted to transmit telegraph code signals at a predetermined rate, a receiving recorder responsive to signals transmissible at a lesser rate and comprising messages each terminated by an end-of-message signal, means for counting end-of-message signals recorded by said recorder, means for counting end-of-message signals transmitted by said transmitter, means for comparing the counts registered by said counting means, and means controlled by said comparing means for estopping operation of said transmitter while said counts are the same.

30. In a telegraph switching system, a transmission channel, a reperforator connected to the receiving termination of said channel, a transmitter adapted to transmit messages recorded by said reperforator, means for counting messages recorded by said reperforator, means for counting messages transmitted by said transmitter, and means for comparing the registrations of said two counting means and for precluding operation of said transmitter except when said registrations differ by at least one message registration.

31. In a telegraph switching system, a transmission channel, a message recording and retransmitting instru-

mentality terminating said channel, means for counting messages recorded by the recording portion of said instrumentality, means for counting messages transmitted by the transmitting portion of said instrumentality, means for comparing the registrations of said two counting means, a plurality of secondary message recording and retransmitting instrumentalities individually seizable by said first-mentioned instrumentality for transfer of messages to the secondary instrumentalities, and means controlled by said comparing means for precluding seizure of a secondary instrumentality while said registrations are alike.

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