June 26, 1951 J. W. GOODERHAM ET AL 2,558,477

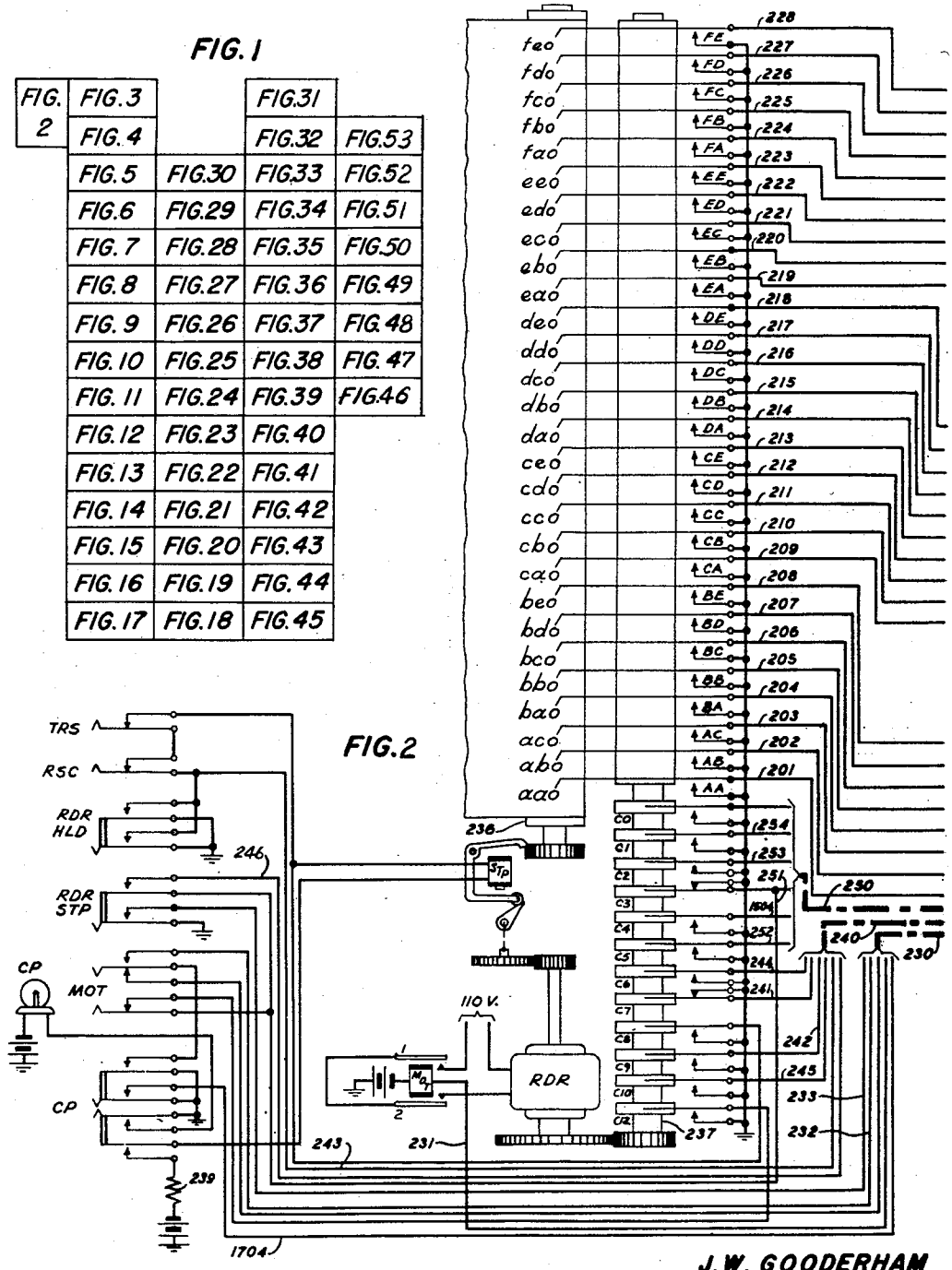
MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 1

FIG. 1

FIG. 2	FIG. 3	FIG. 31	
	FIG. 4	FIG. 32	FIG. 53
	FIG. 5	FIG. 30	FIG. 33	FIG. 52
	FIG. 6	FIG. 29	FIG. 34	FIG. 51
	FIG. 7	FIG. 28	FIG. 35	FIG. 50
	FIG. 8	FIG. 27	FIG. 36	FIG. 49
	FIG. 9	FIG. 26	FIG. 37	FIG. 48
	FIG. 10	FIG. 25	FIG. 38	FIG. 47
	FIG. 11	FIG. 24	FIG. 39	FIG. 46
	FIG. 12	FIG. 23	FIG. 40	
	FIG. 13	FIG. 22	FIG. 41	
	FIG. 14	FIG. 21	FIG. 42	
	FIG. 15	FIG. 20	FIG. 43	
	FIG. 16	FIG. 19	FIG. 44	
	FIG. 17	FIG. 18	FIG. 45	

FIG. 2



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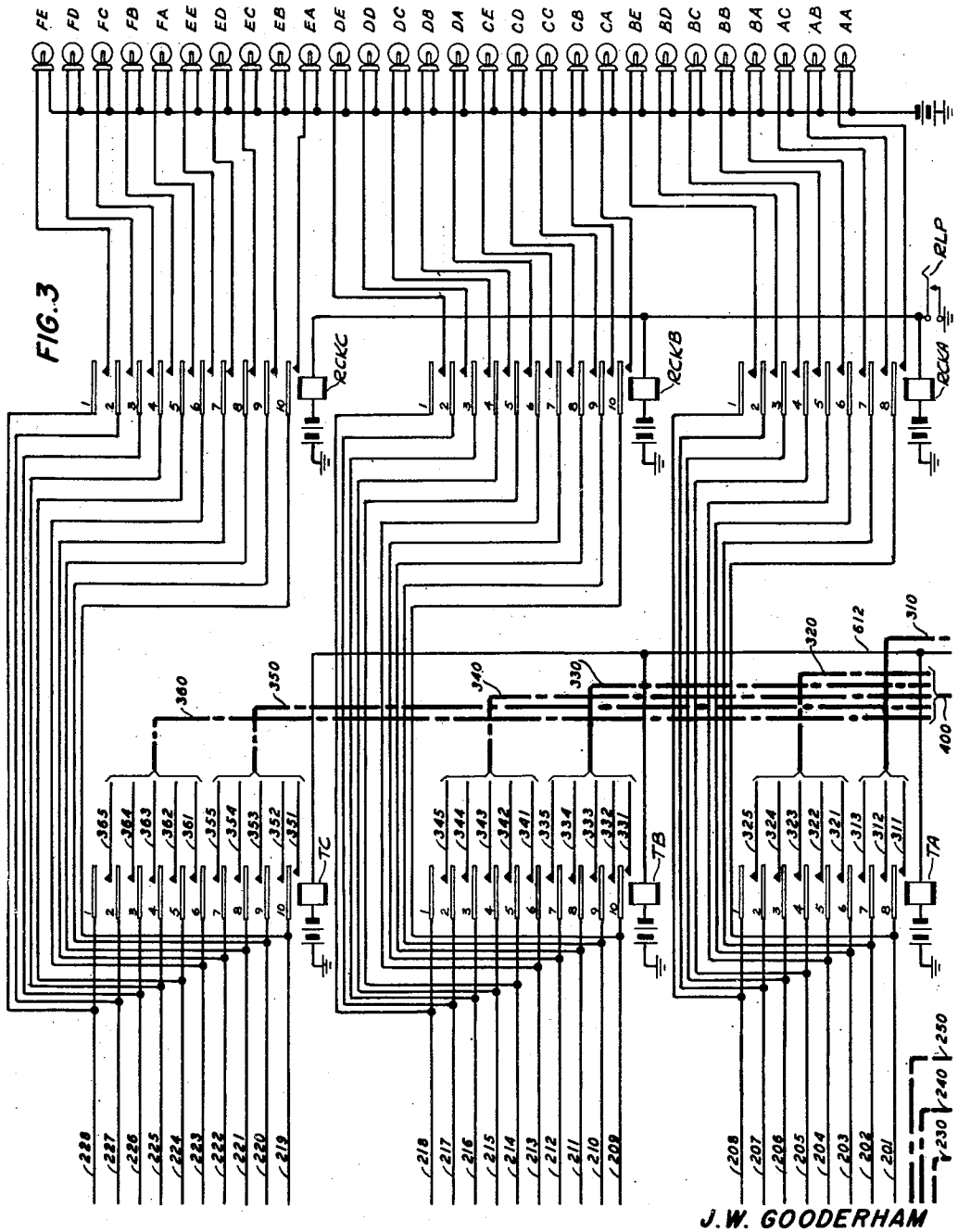

FIG. 3

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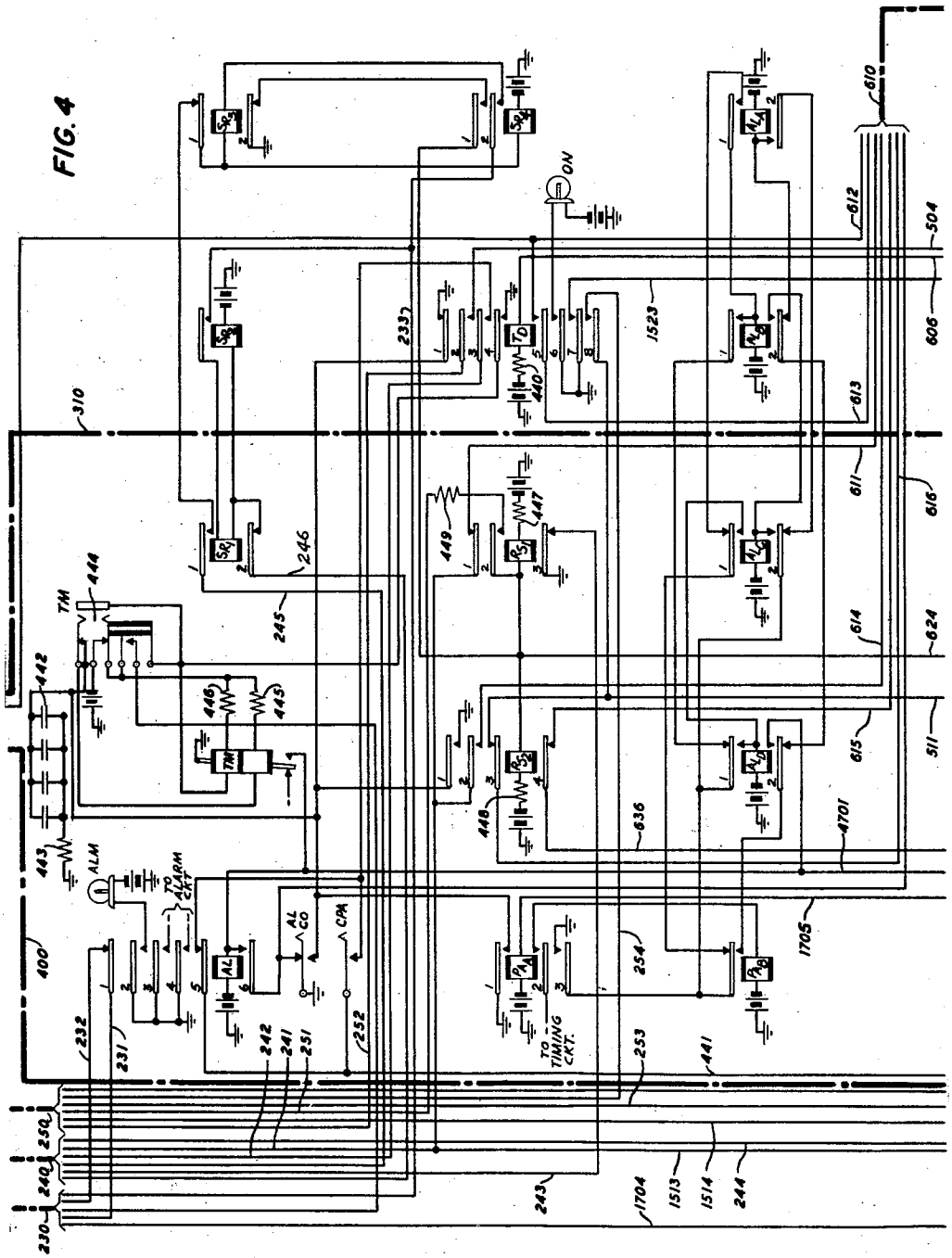
FIG. 4



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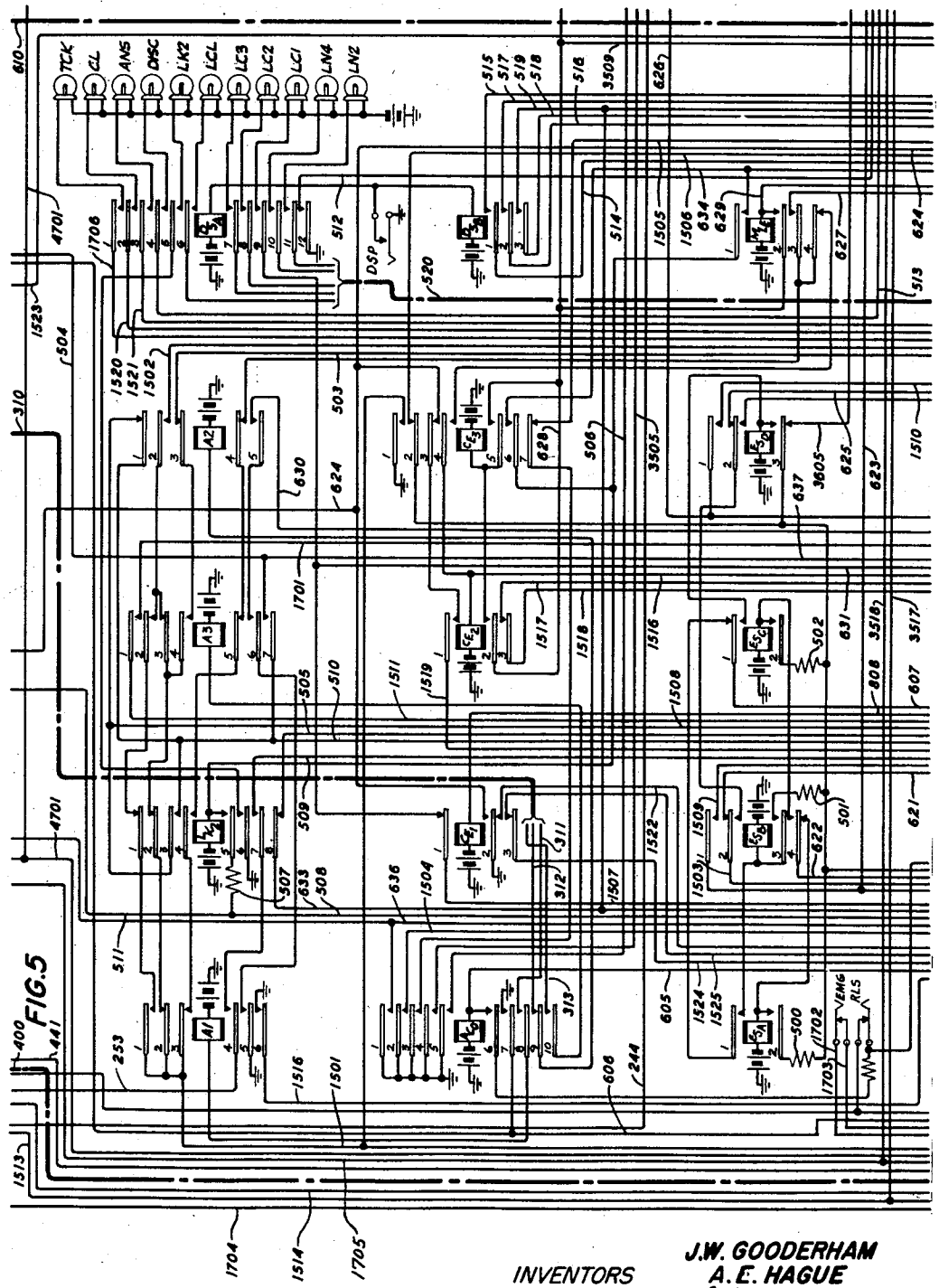

FIG. 5

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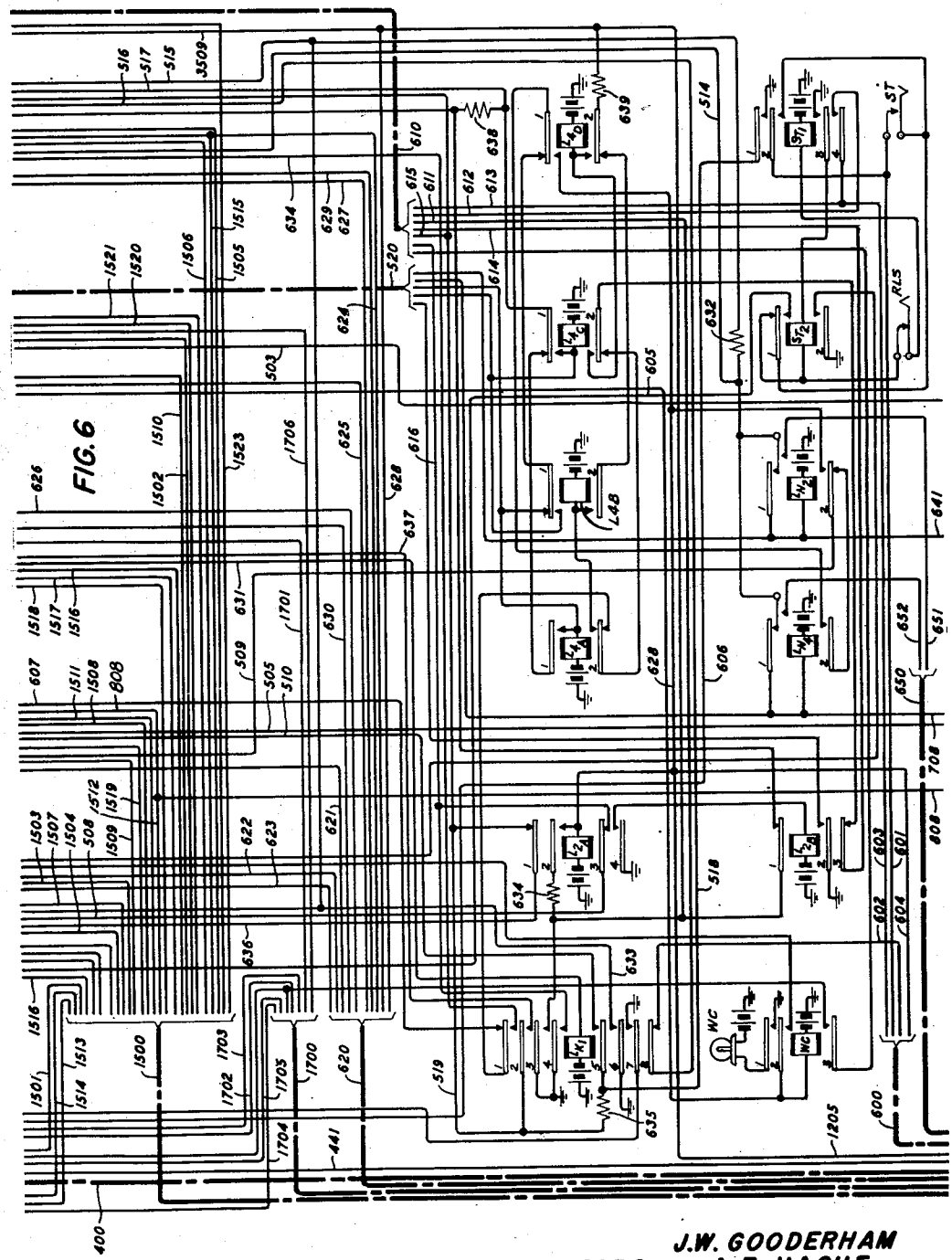

FIG. 6

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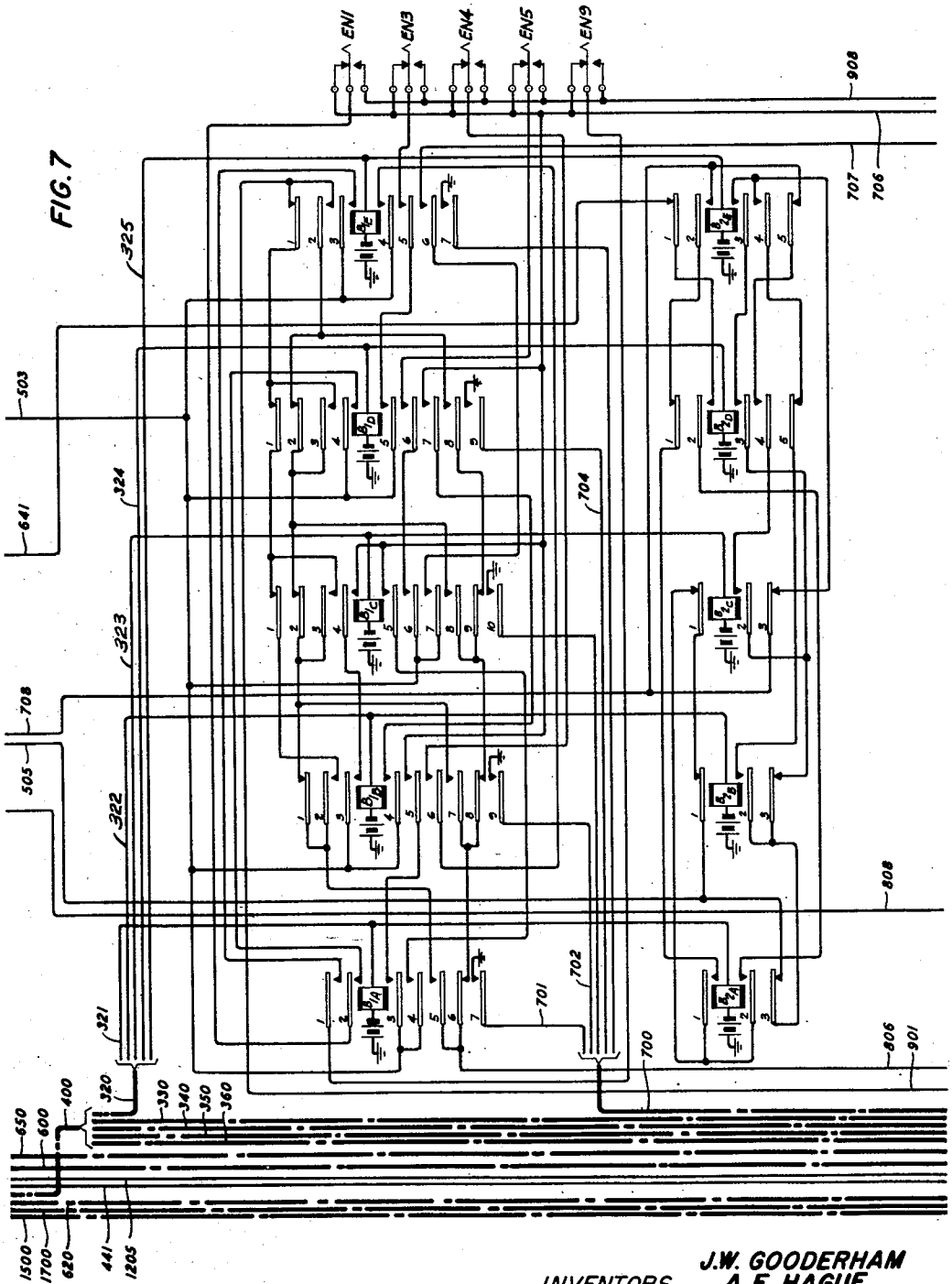
FIG. 7



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Filed Jan. 7, 1948 54 Sheets-Sheet 7

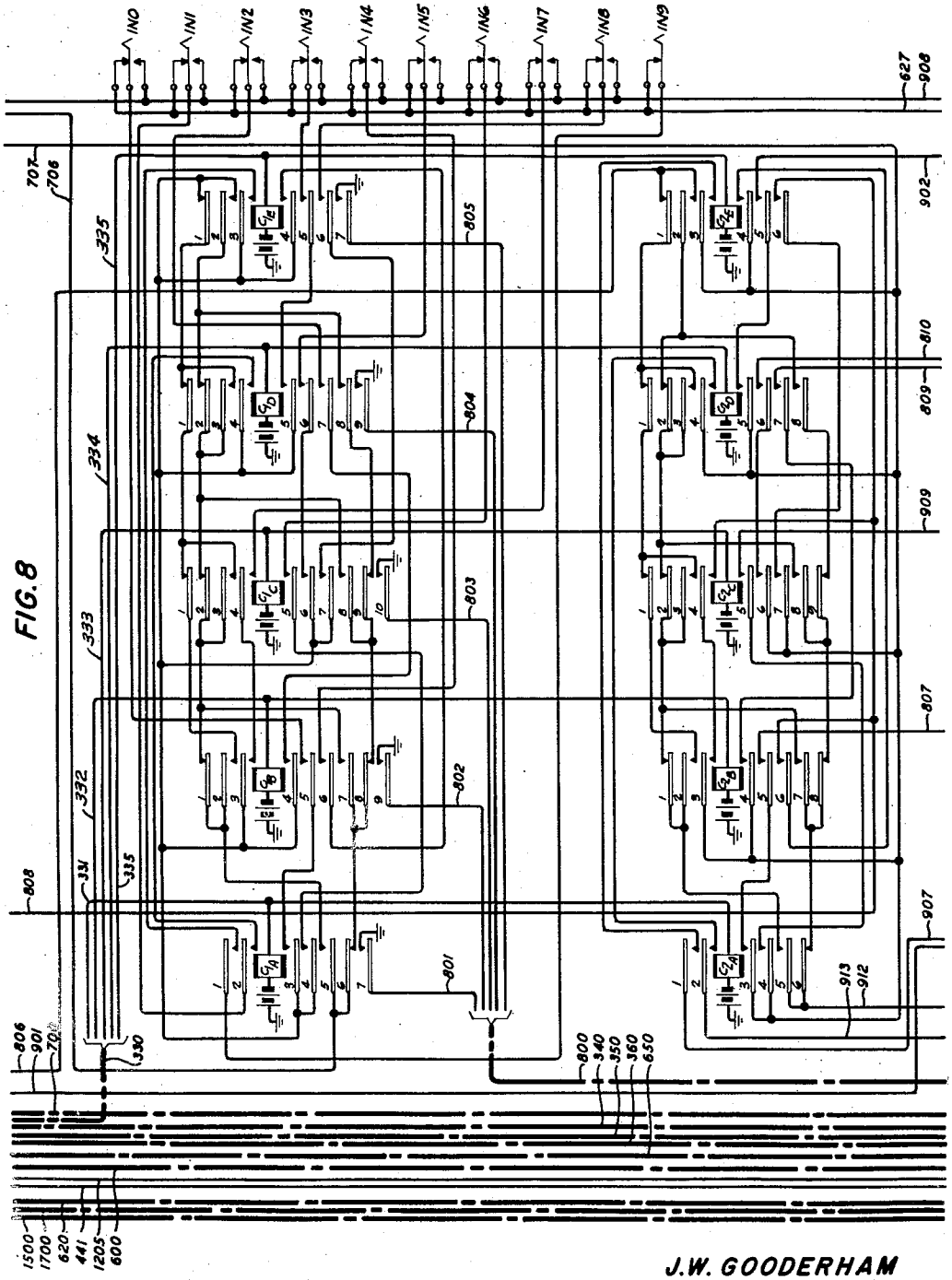

FIG. 8

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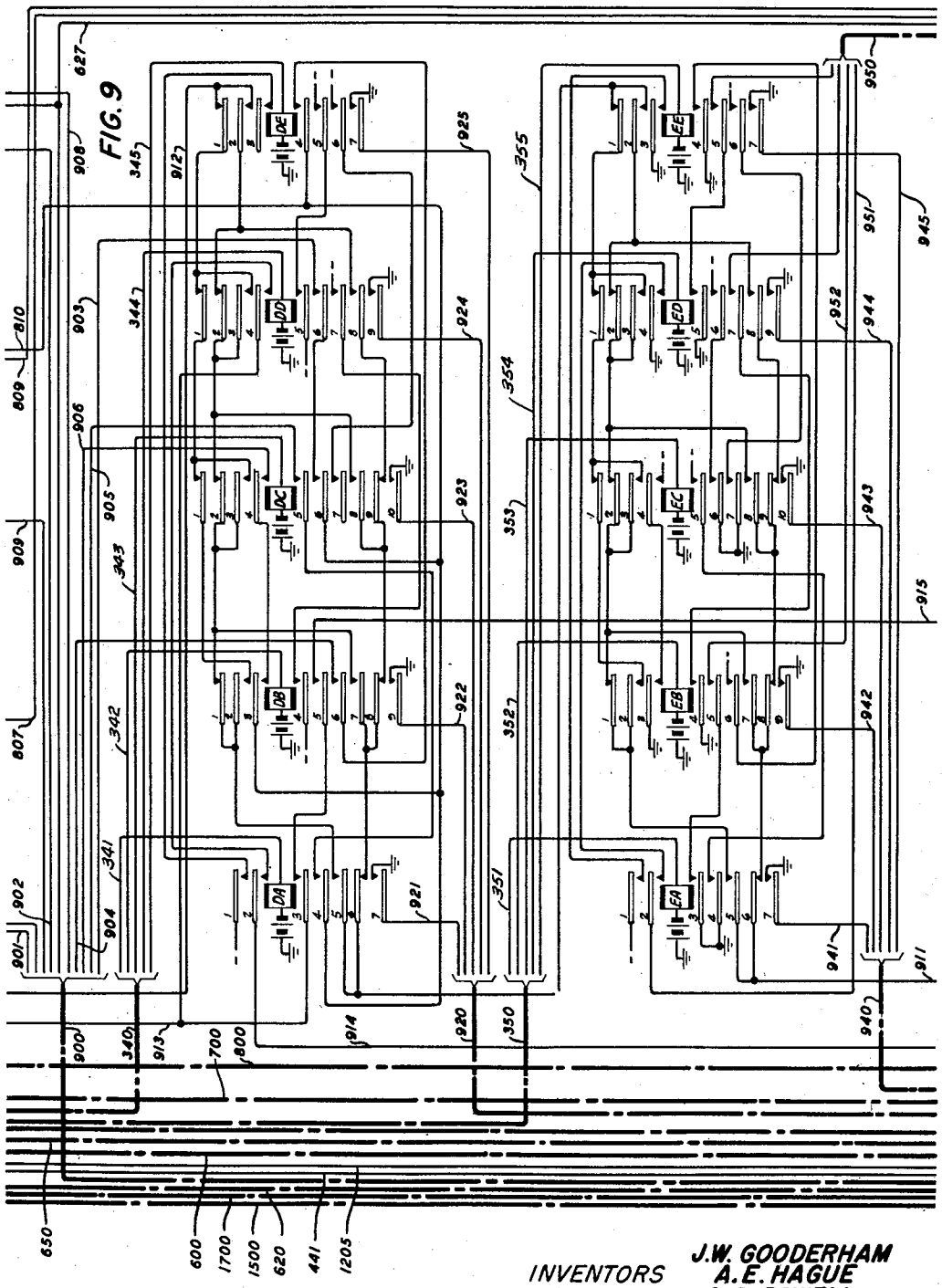

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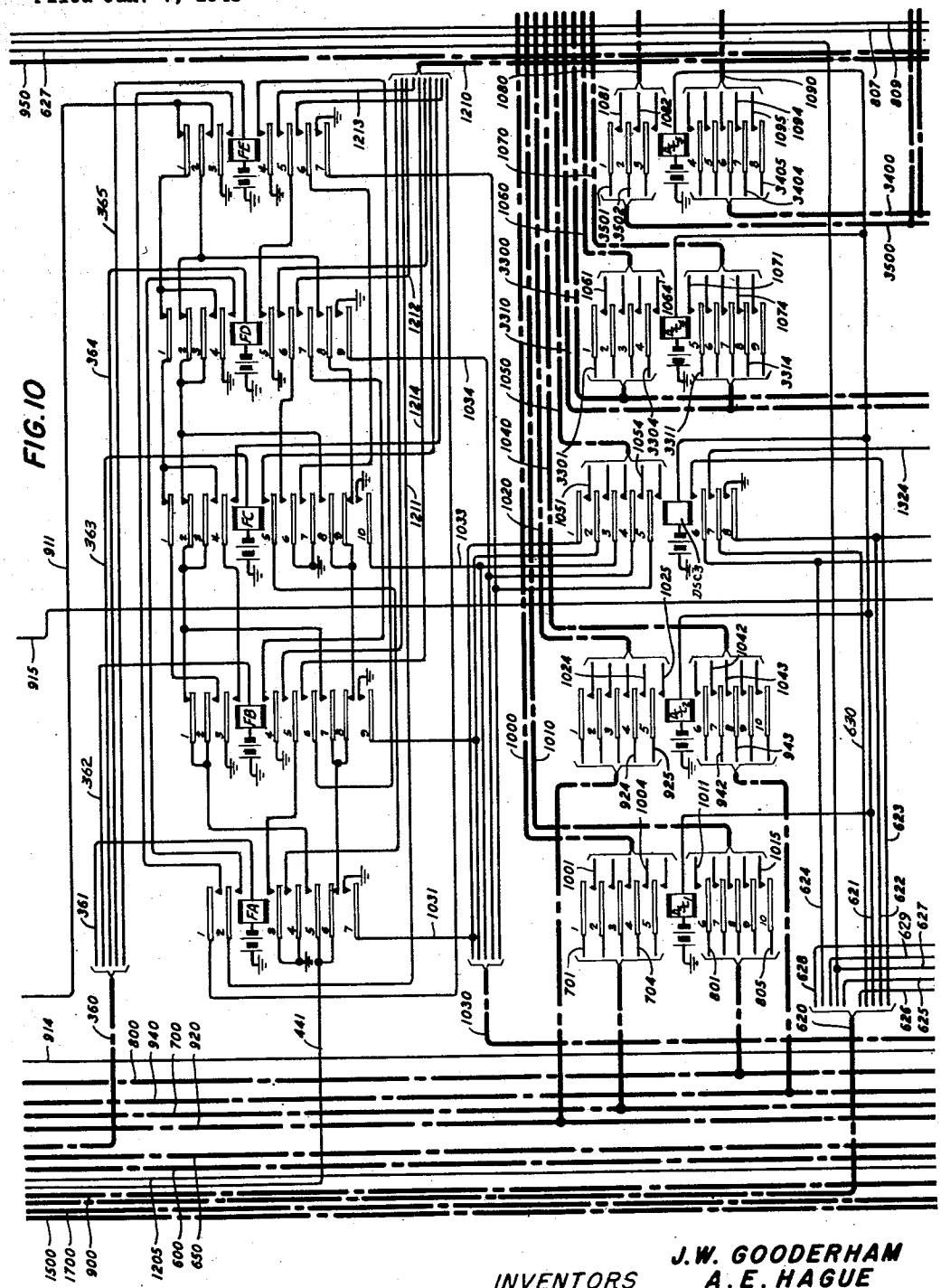

FIG. 10

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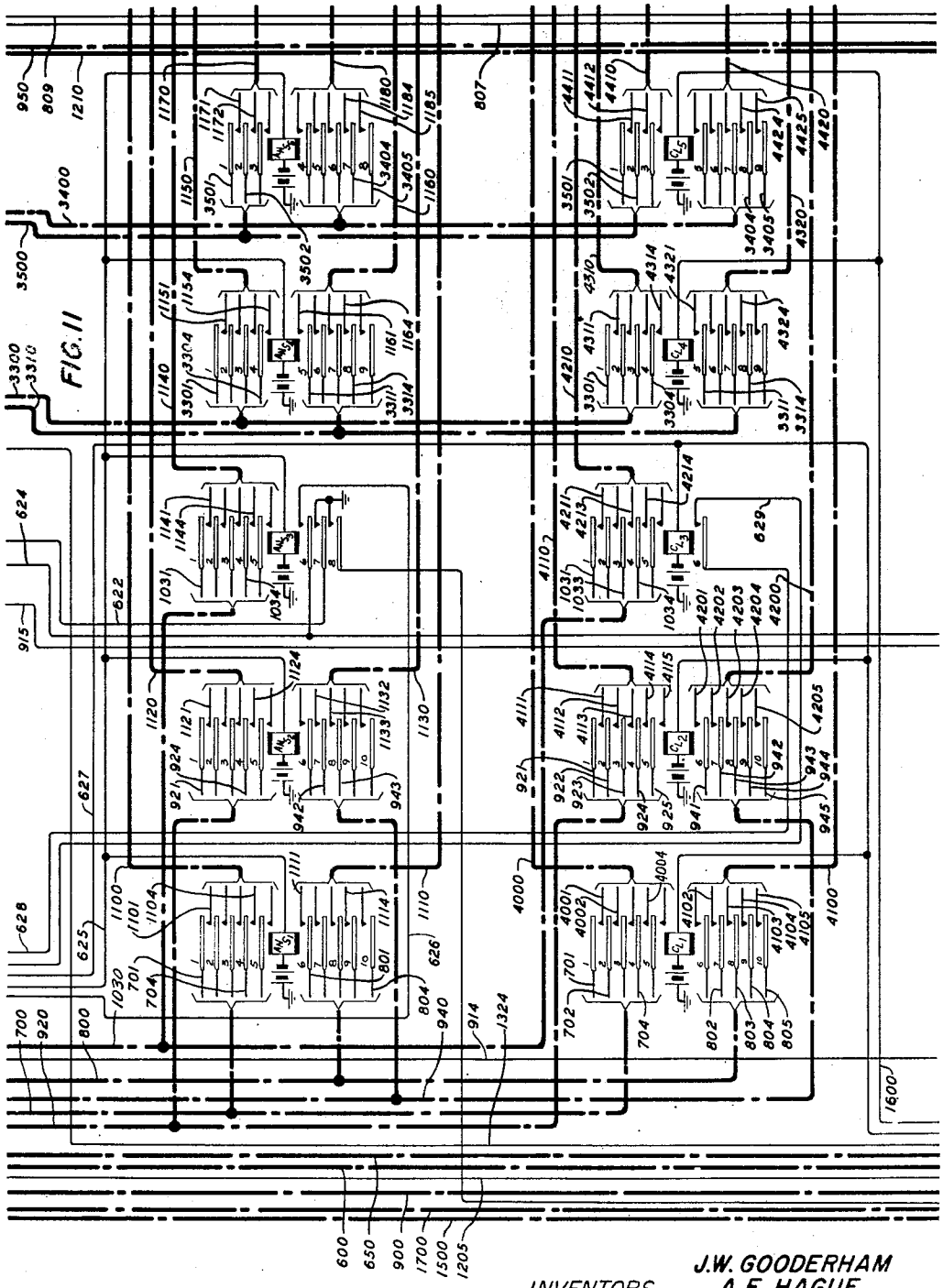

FIG. 11

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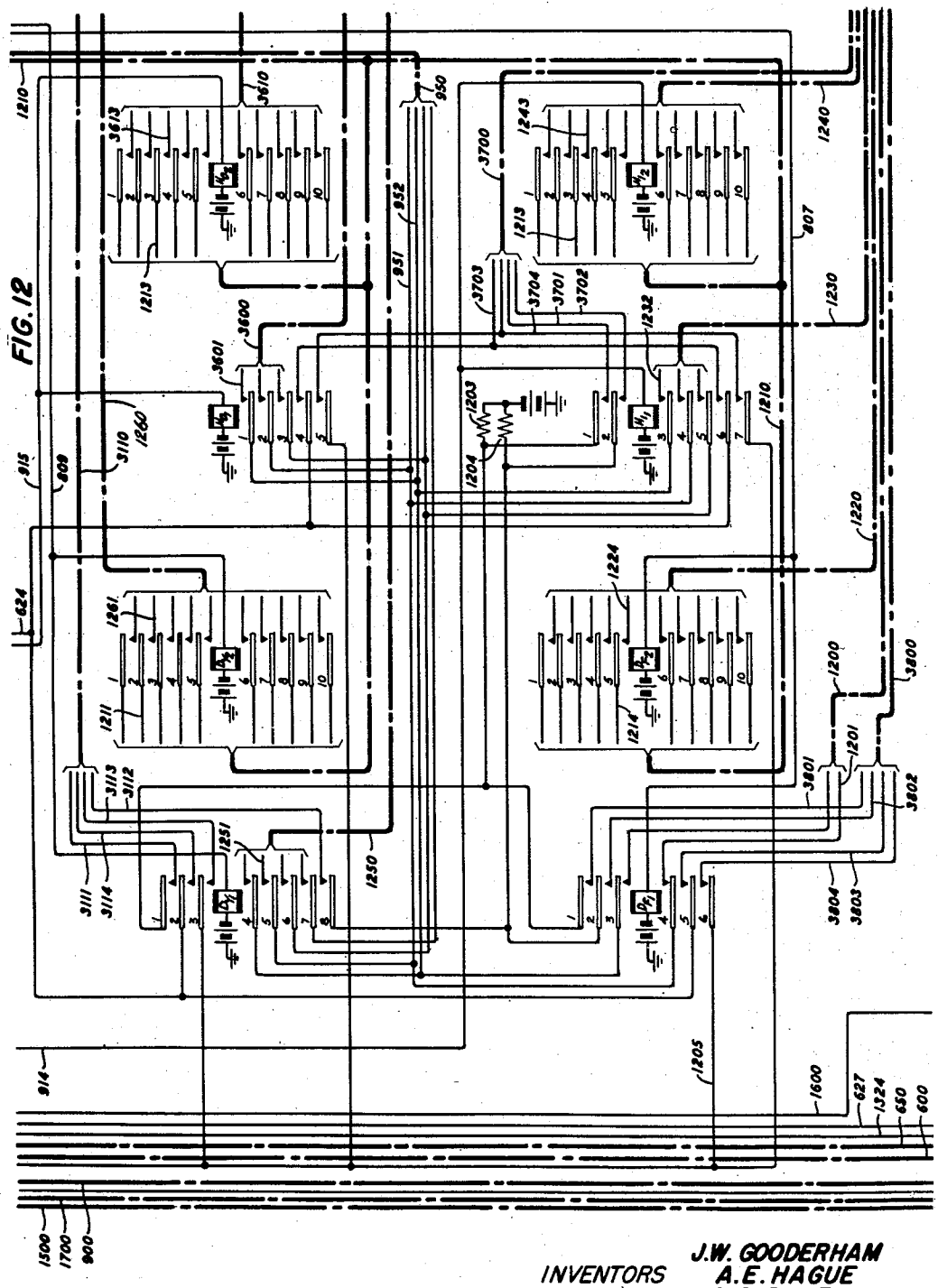
FIG. 12



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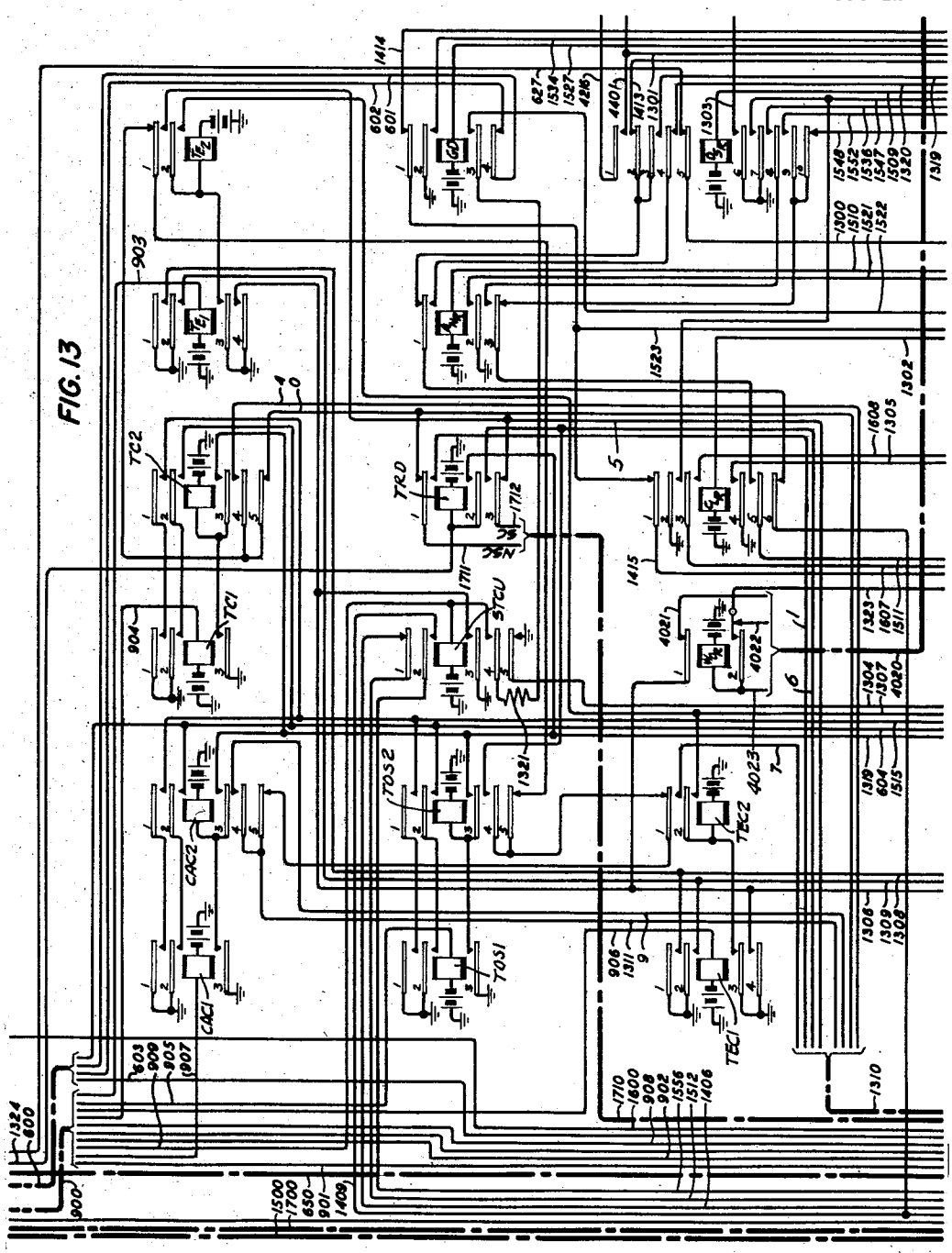

FIG. 13

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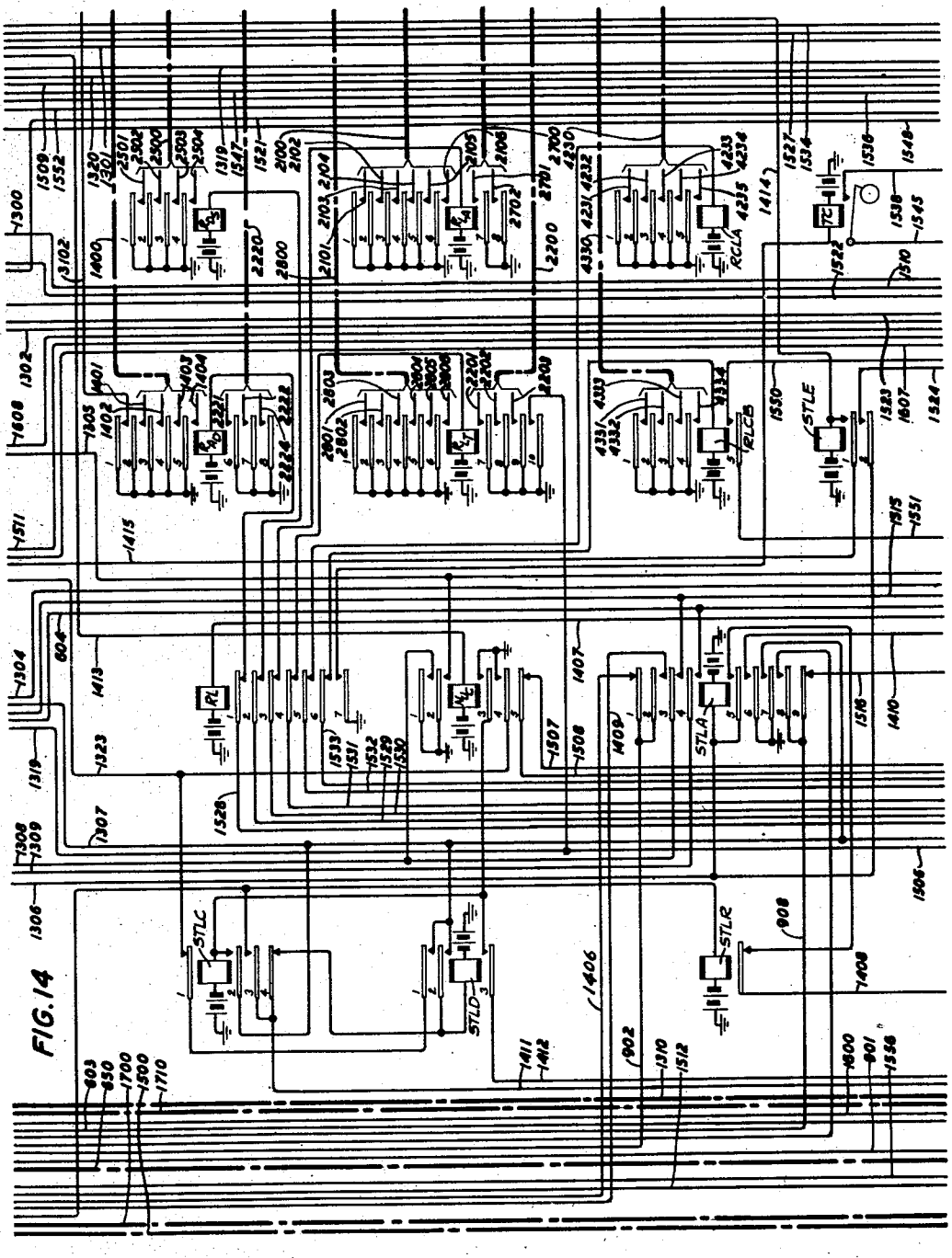

FIG. 14

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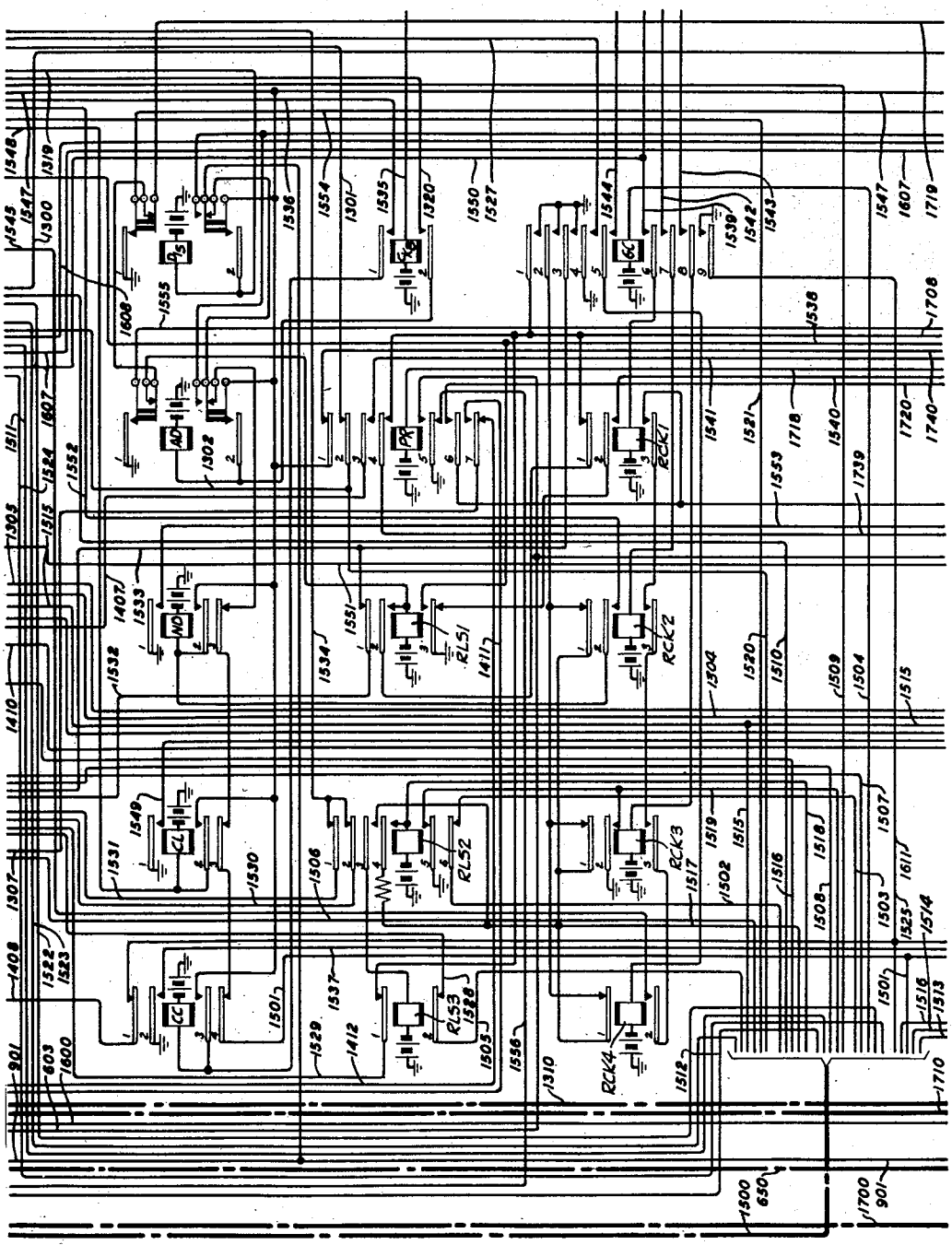

FIG. 15

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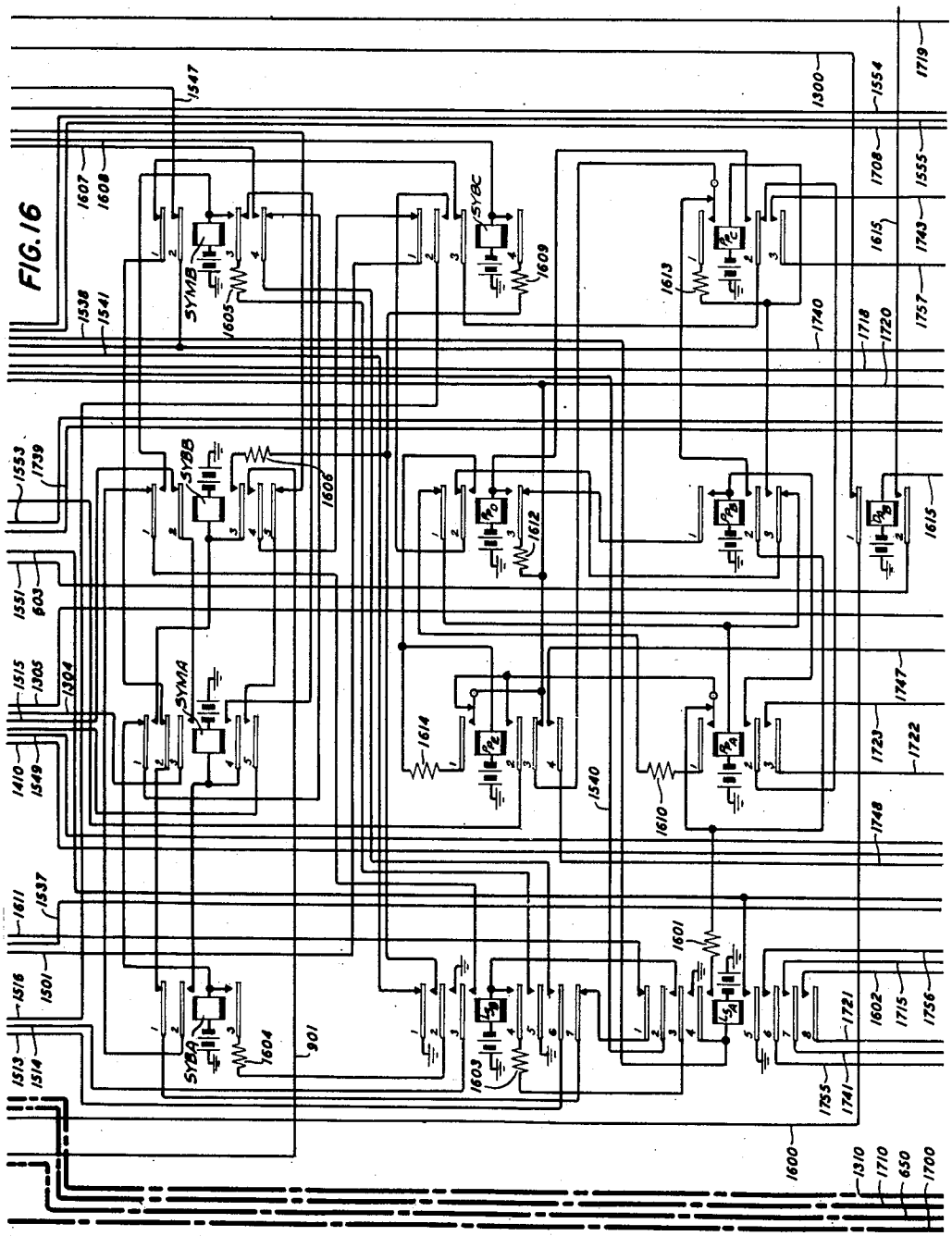
Filed Jan. 7, 1948 54 Sheets-Sheet 15

FIG. 16



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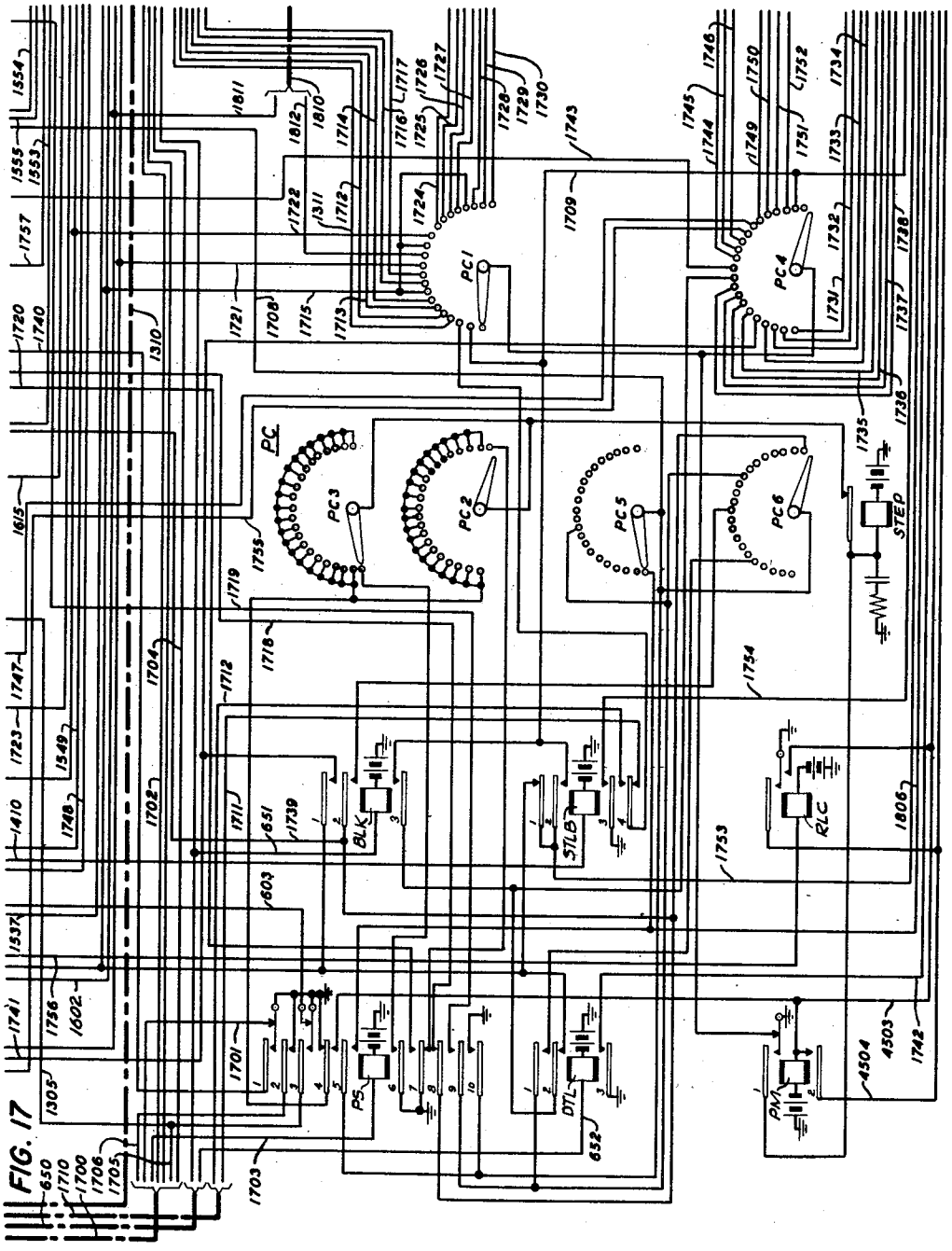

FIG. 17

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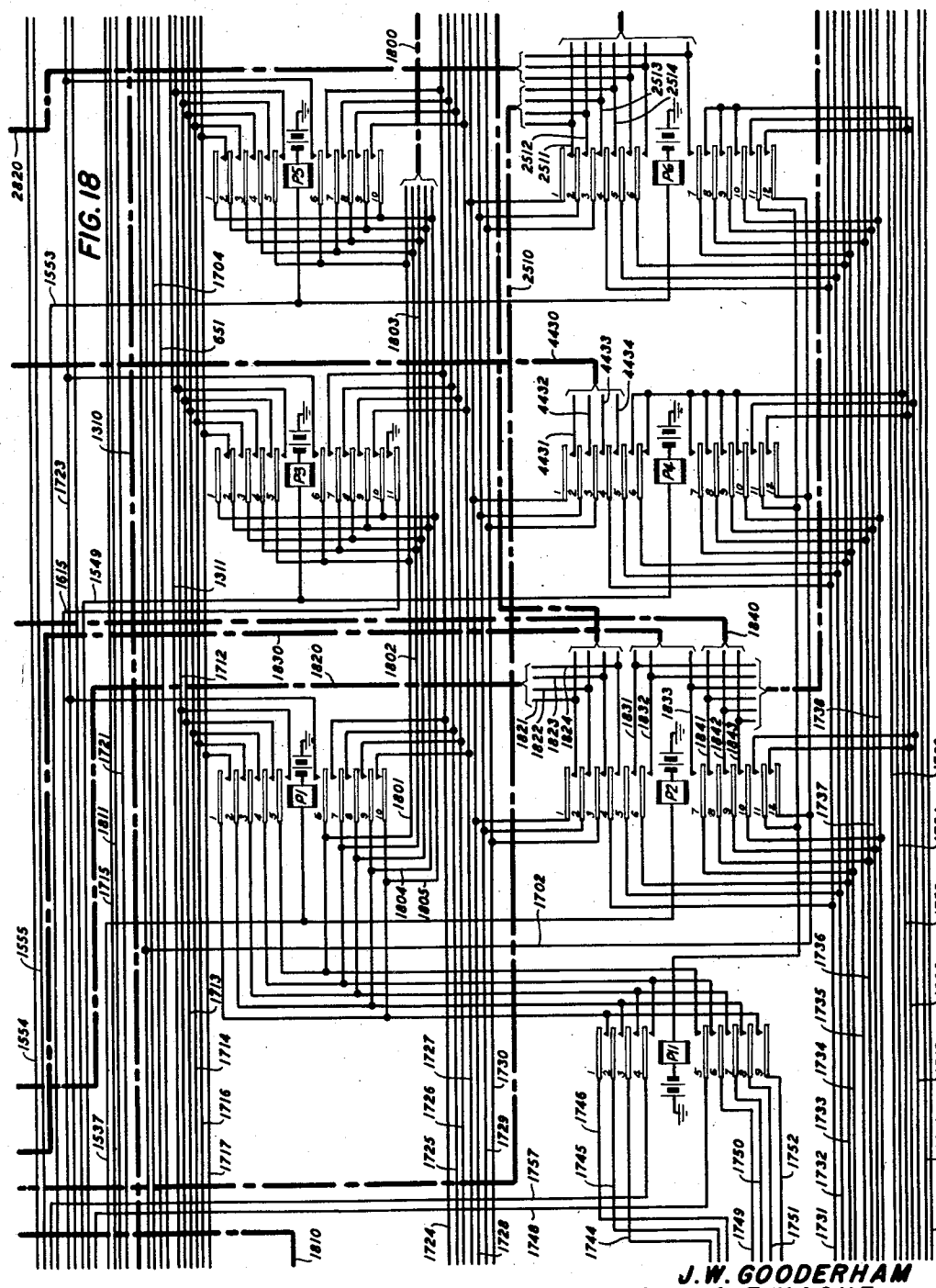

FIG. 18

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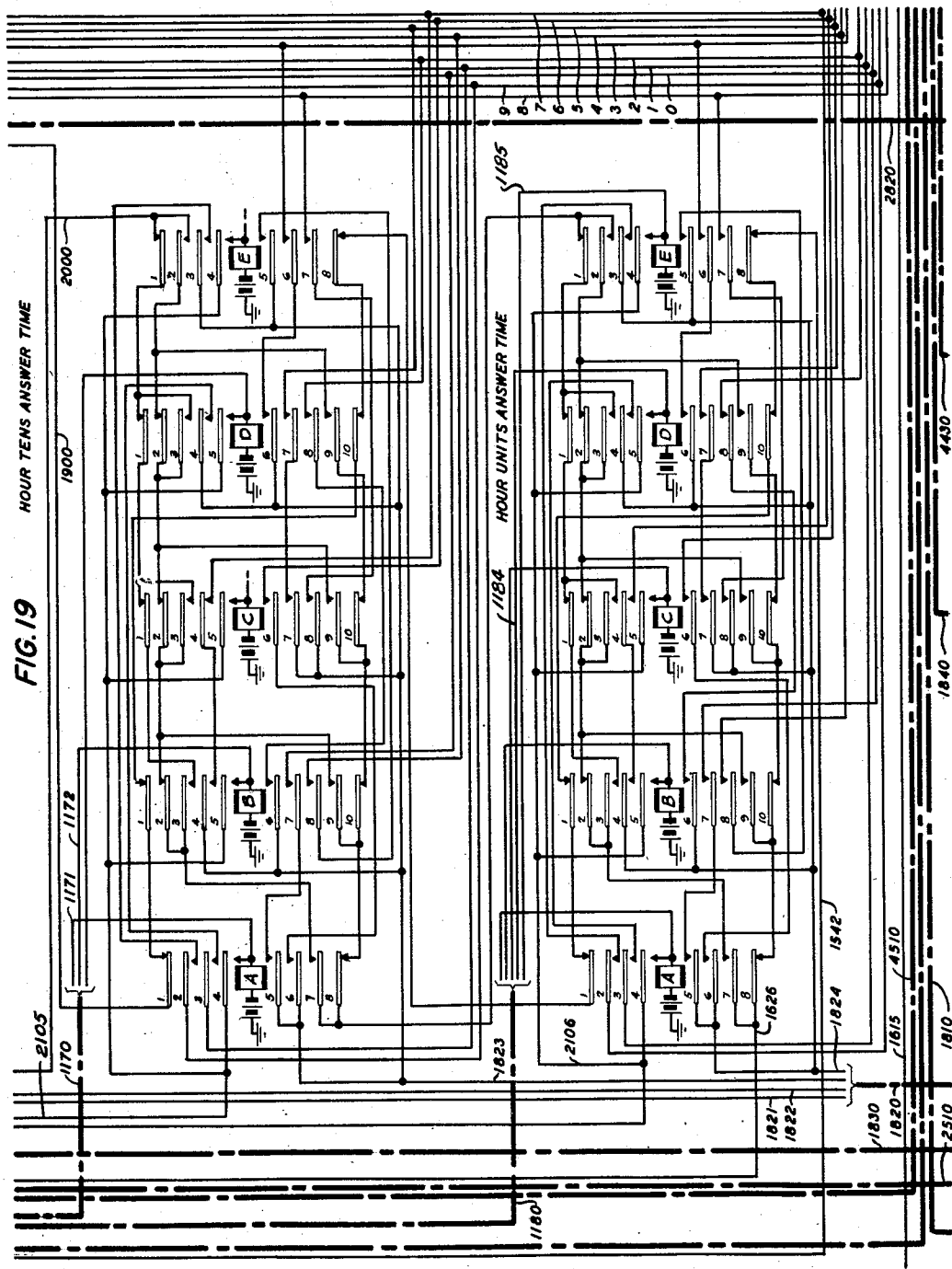

FIG. 19

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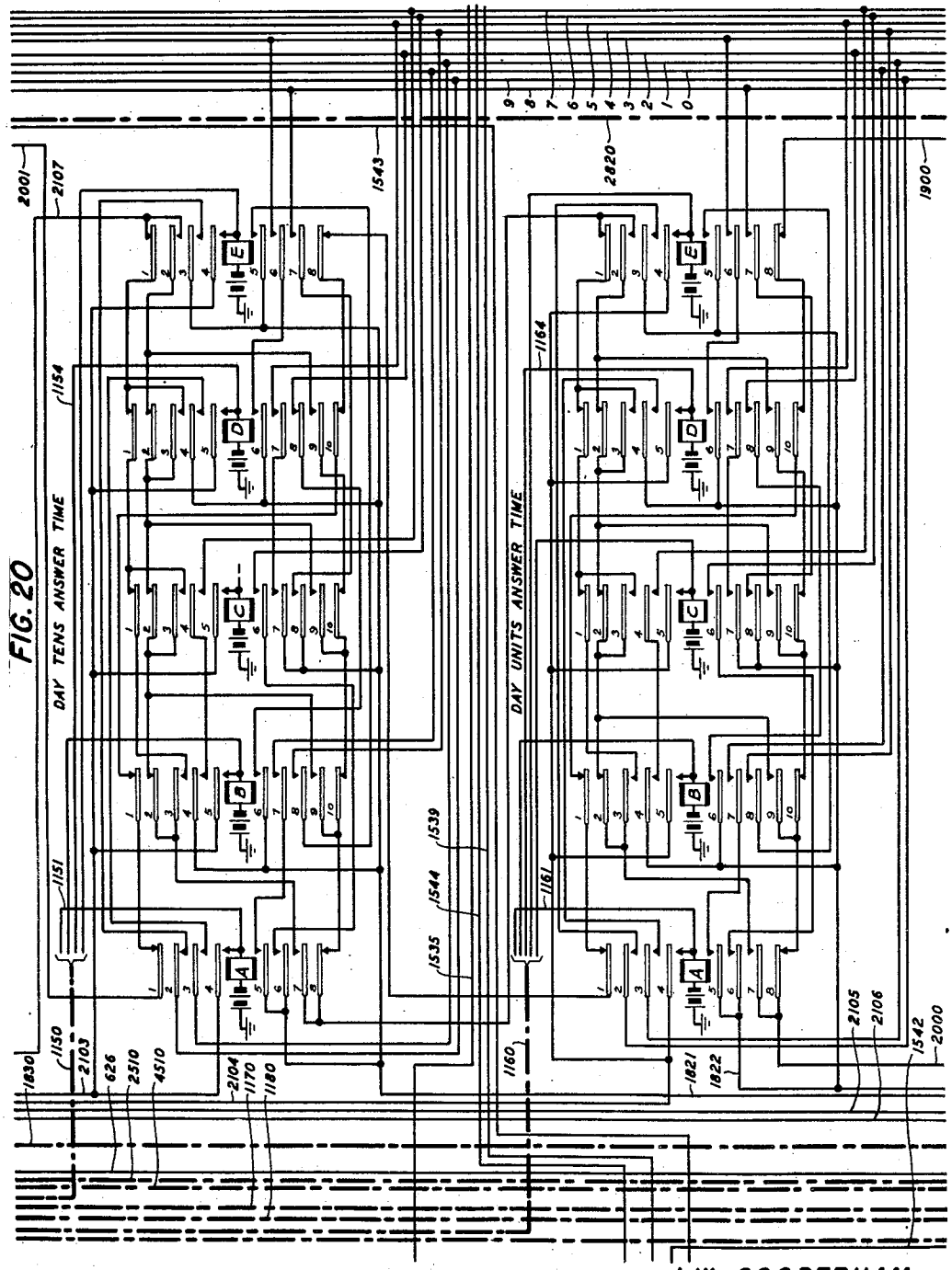

FIG. 20

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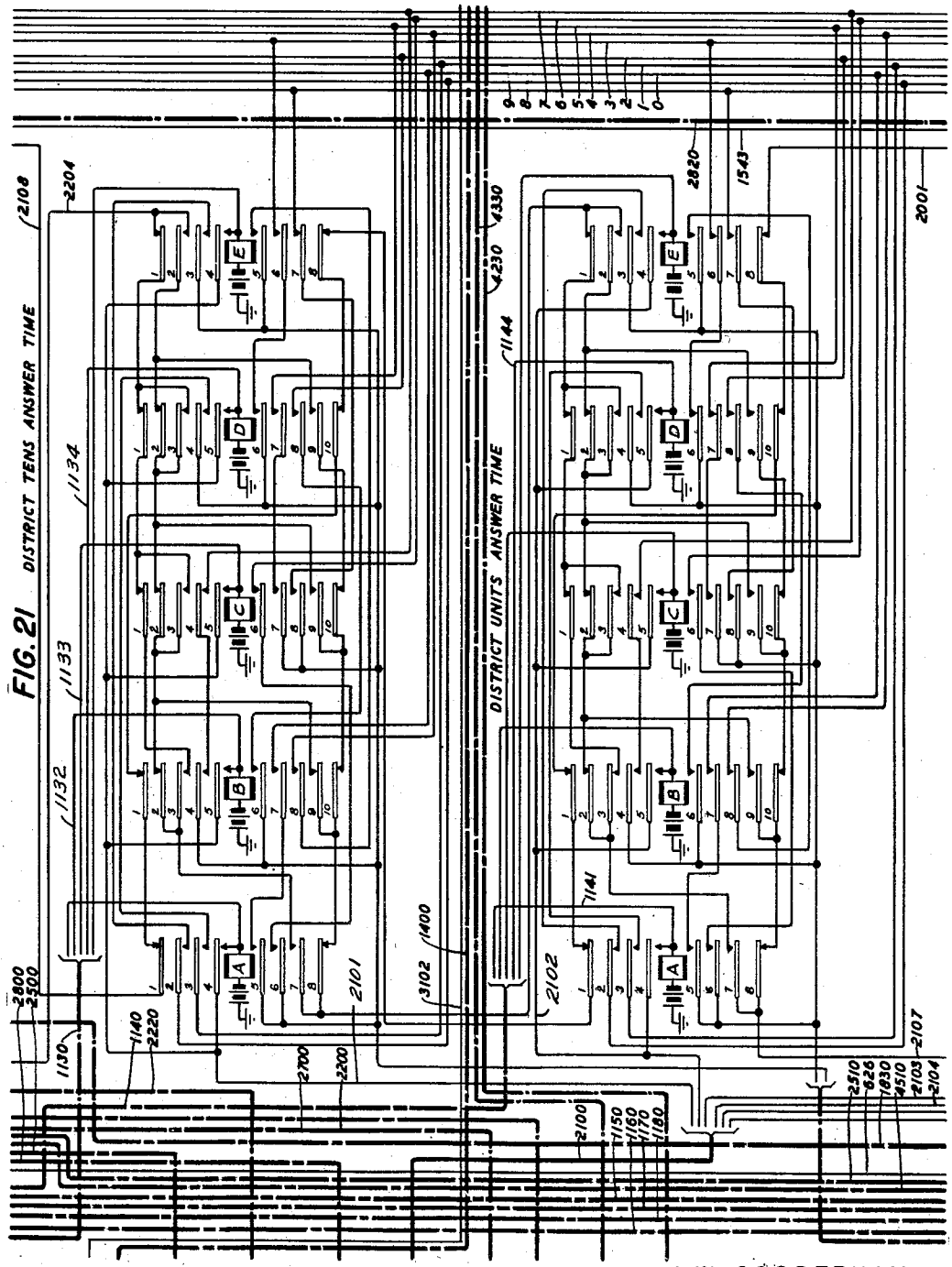

FIG. 21

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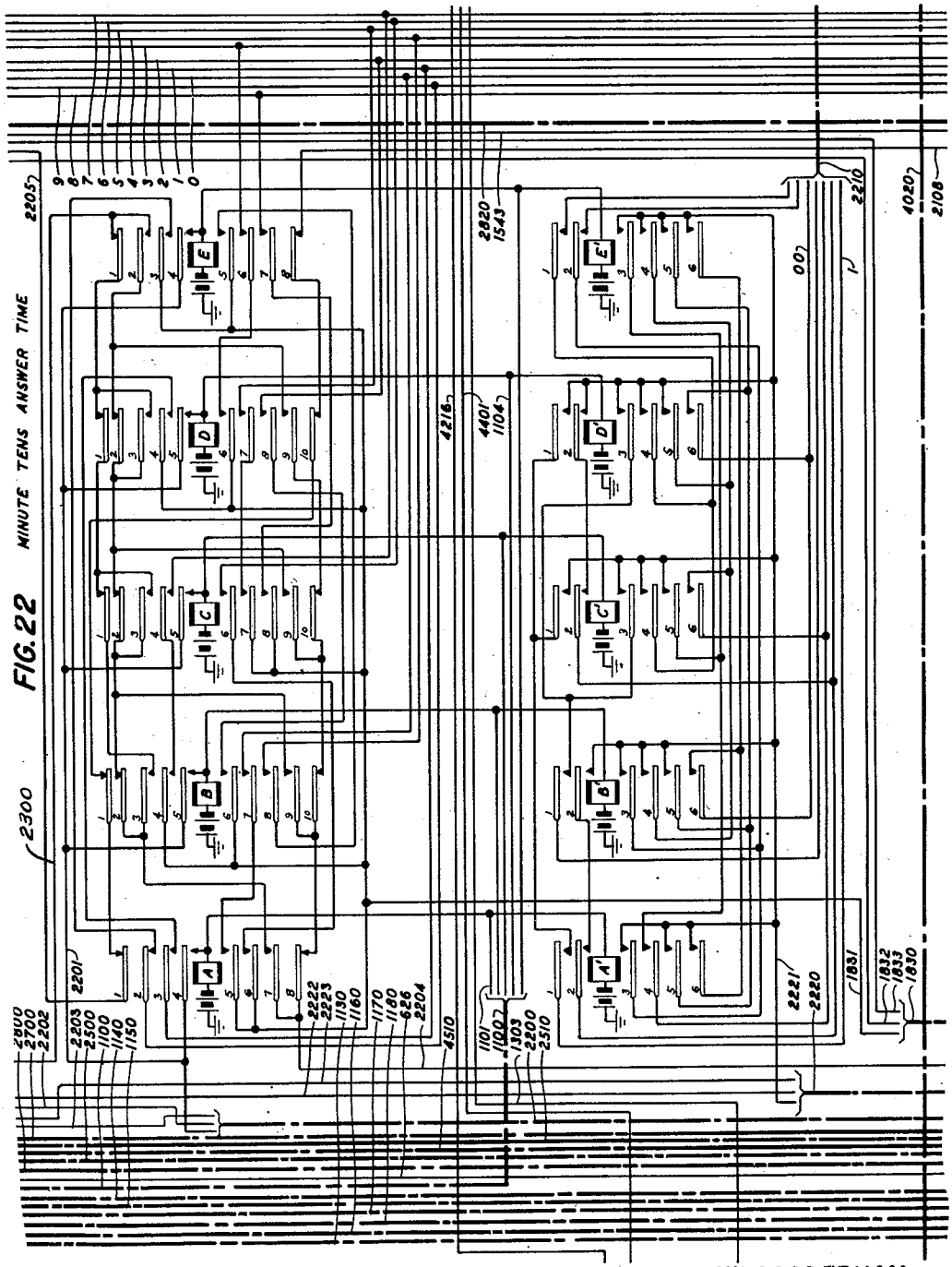

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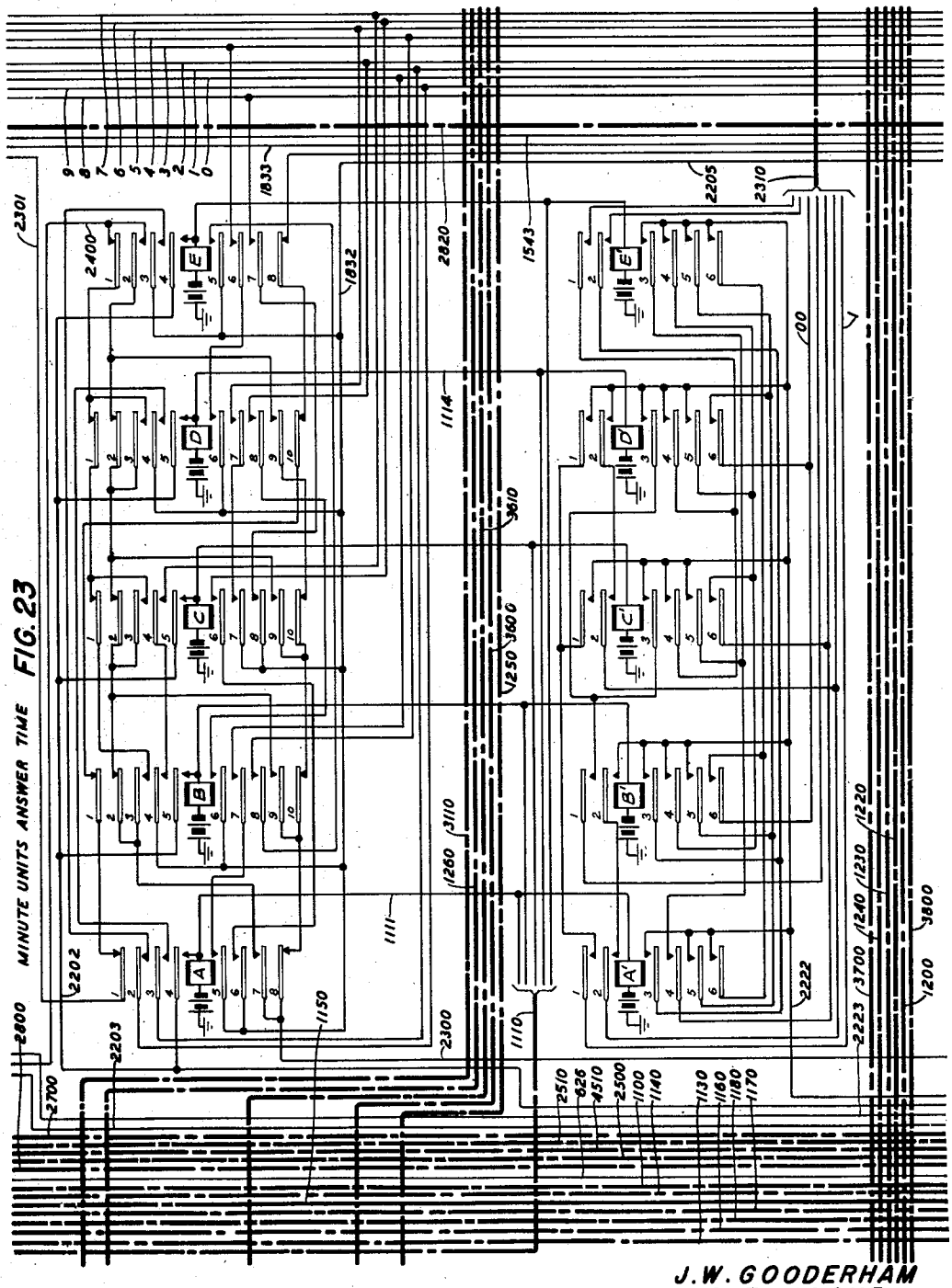

FIG. 23

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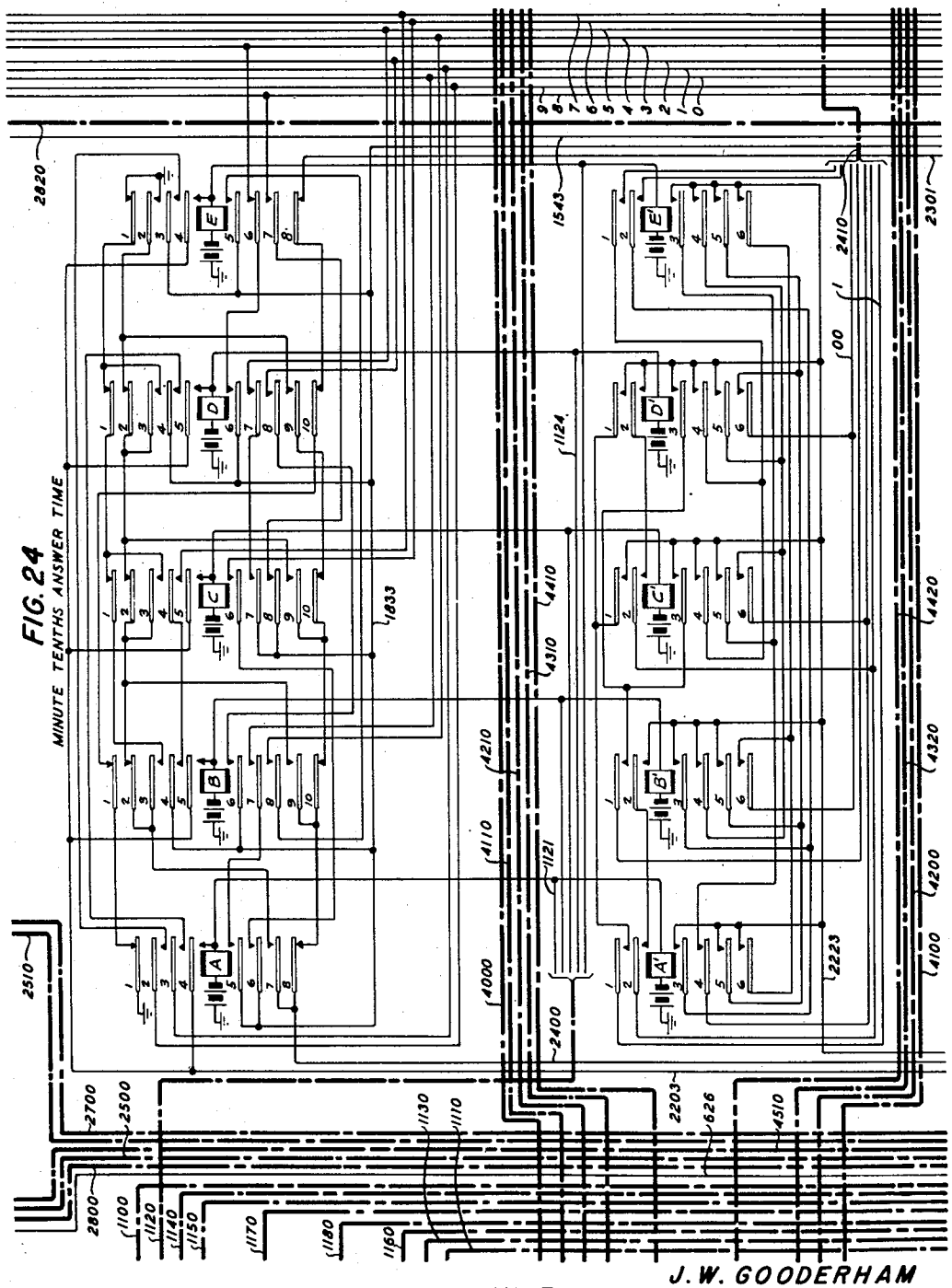

FIG. 24

MINUTE TENTHS ANSWER TIME

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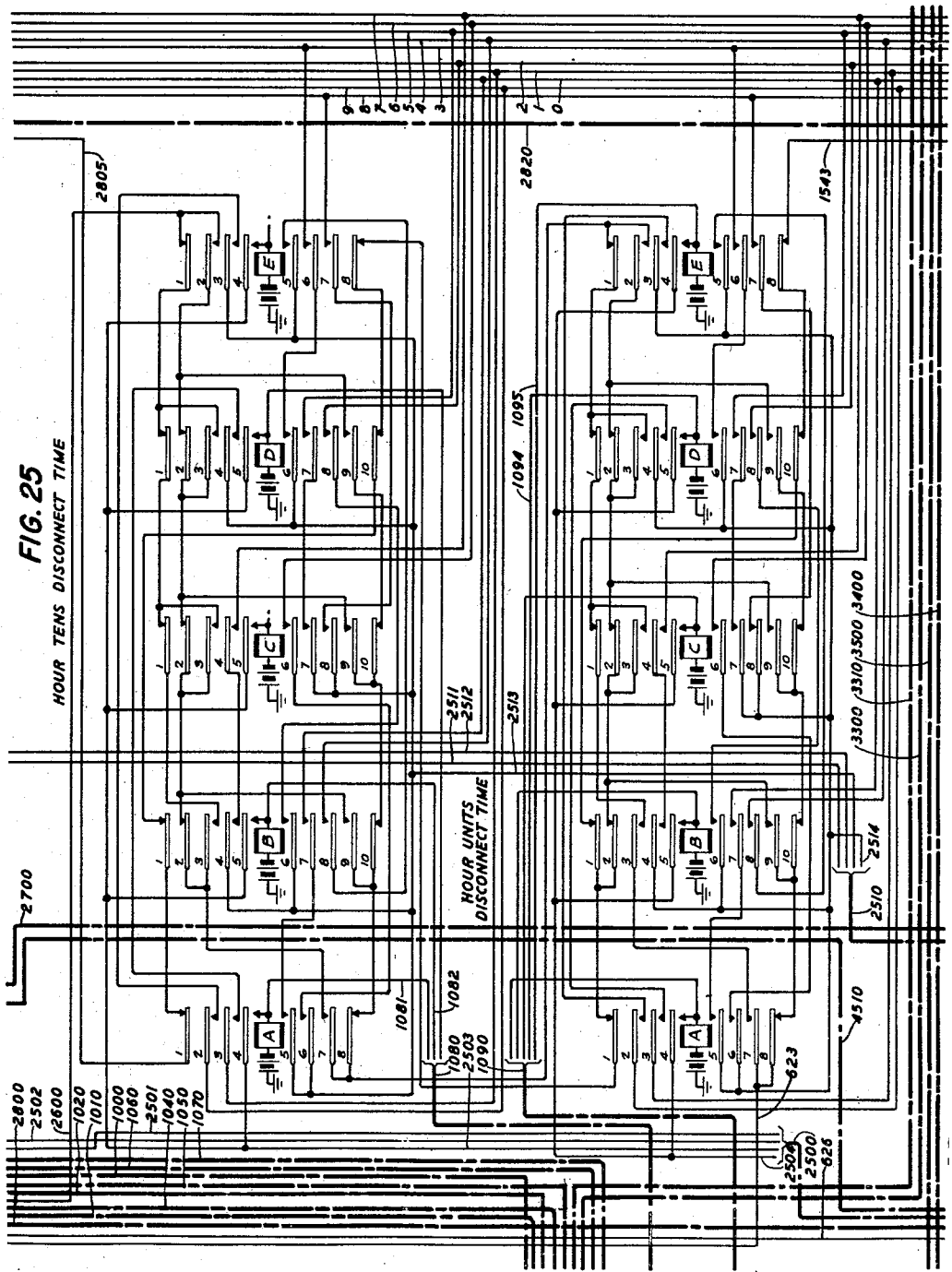

FIG. 25

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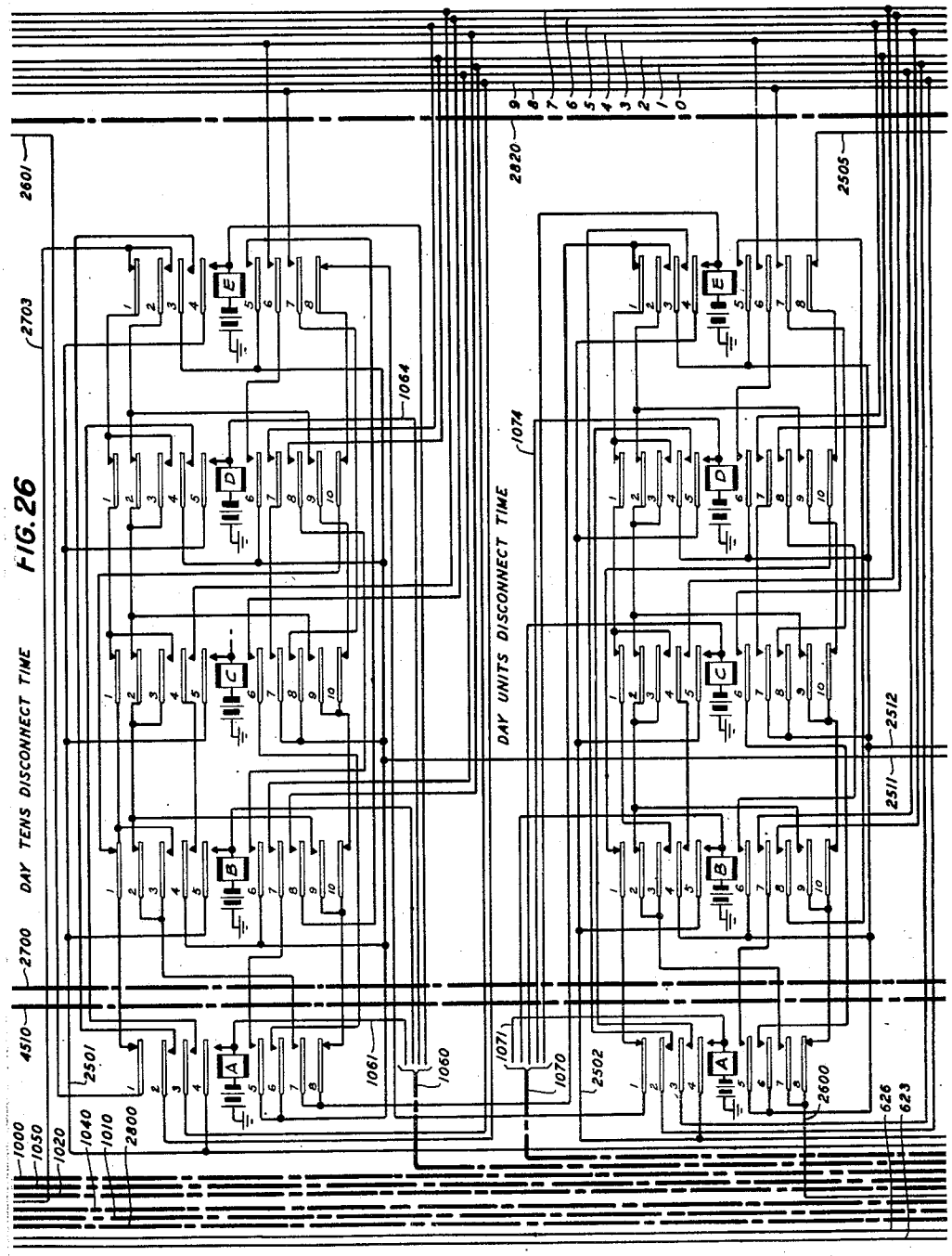

FIG. 26

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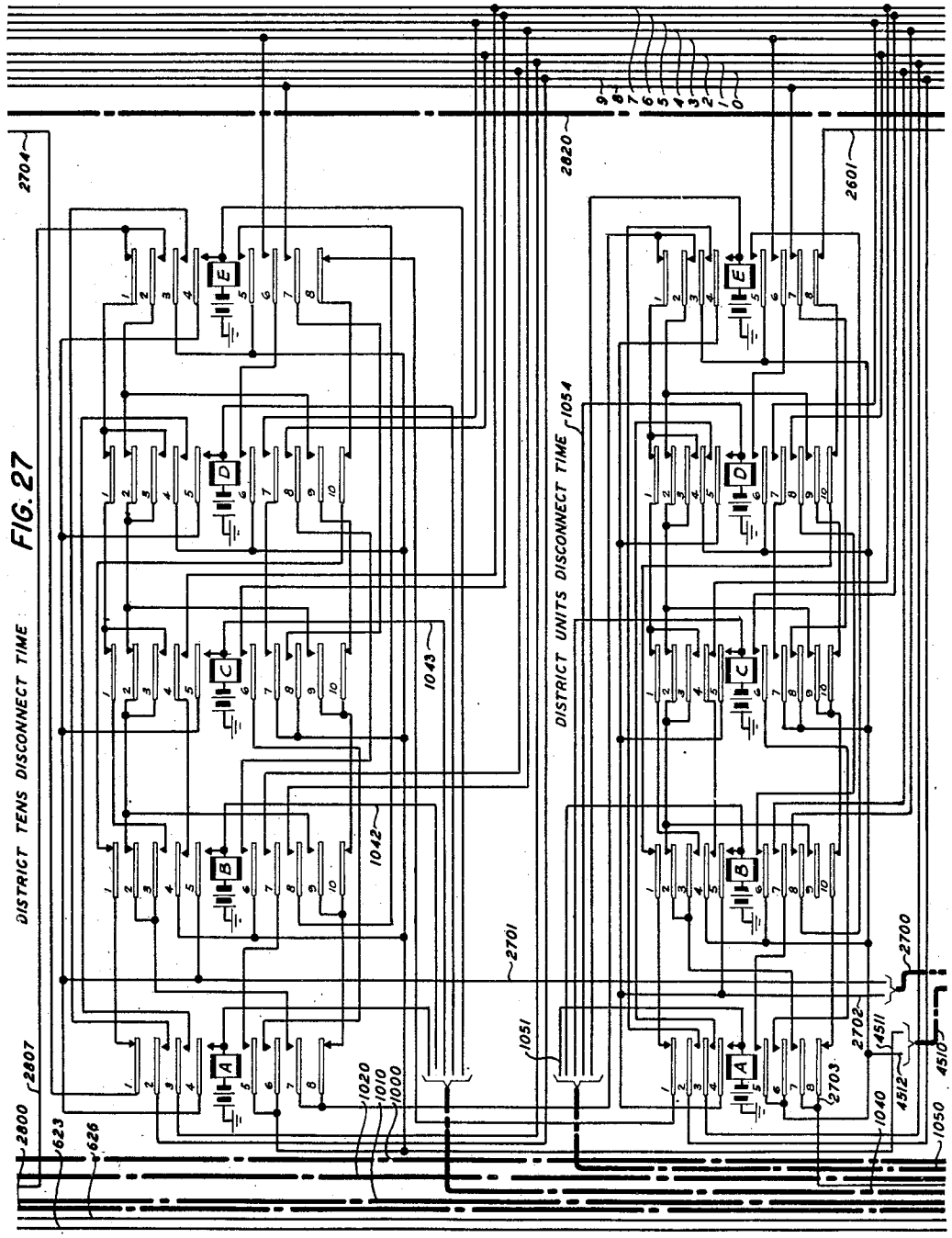

FIG. 27

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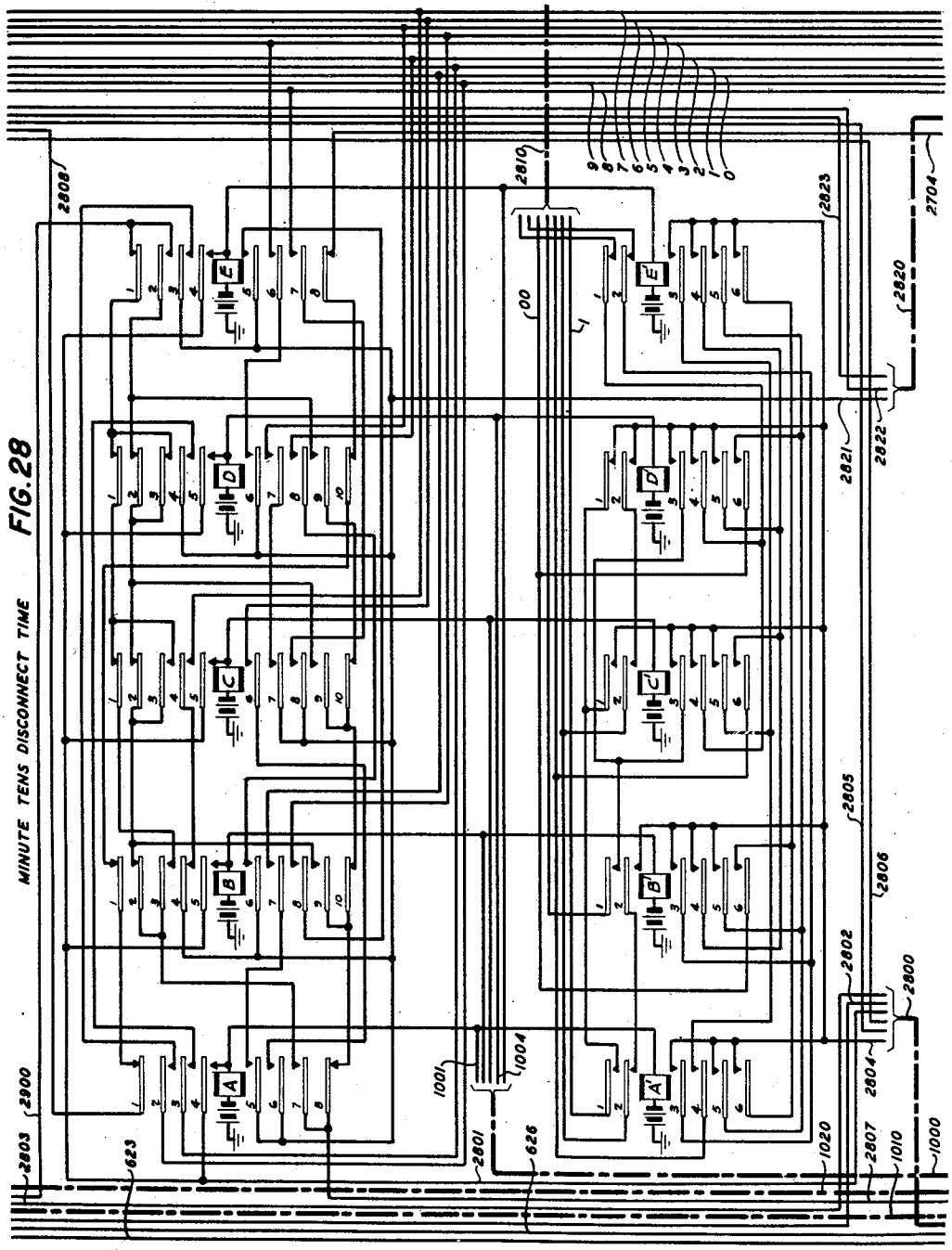

FIG. 28

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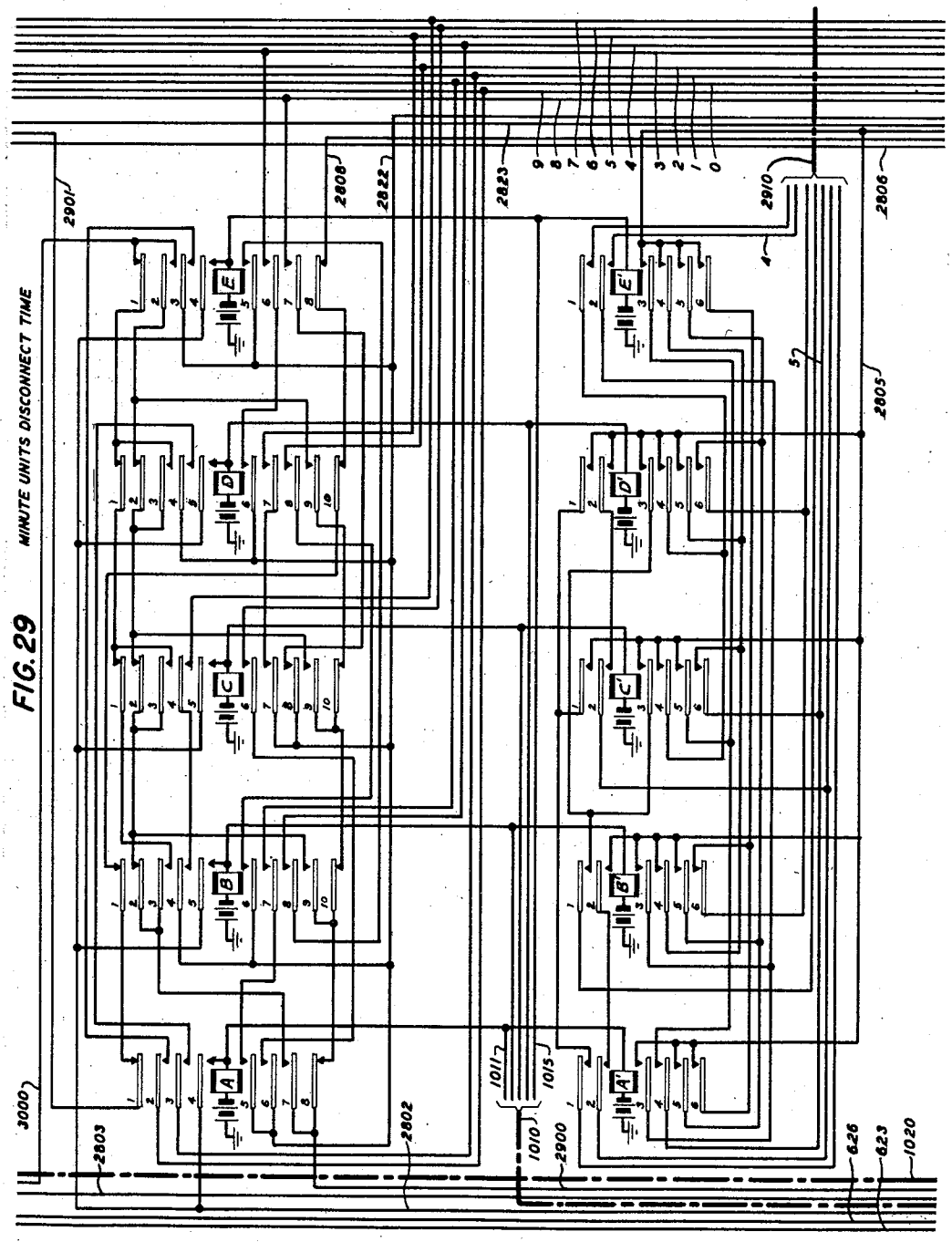

FIG. 29

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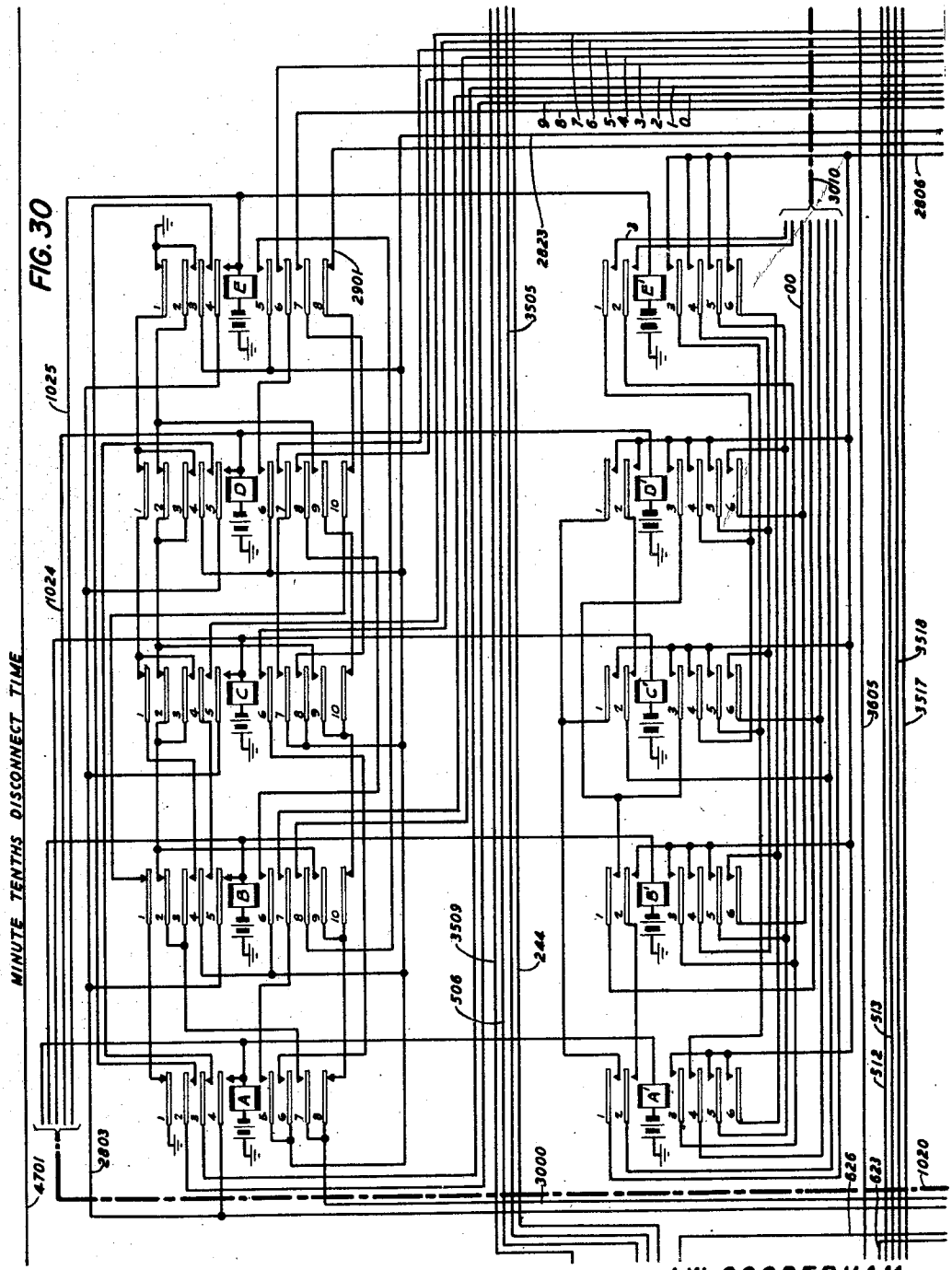

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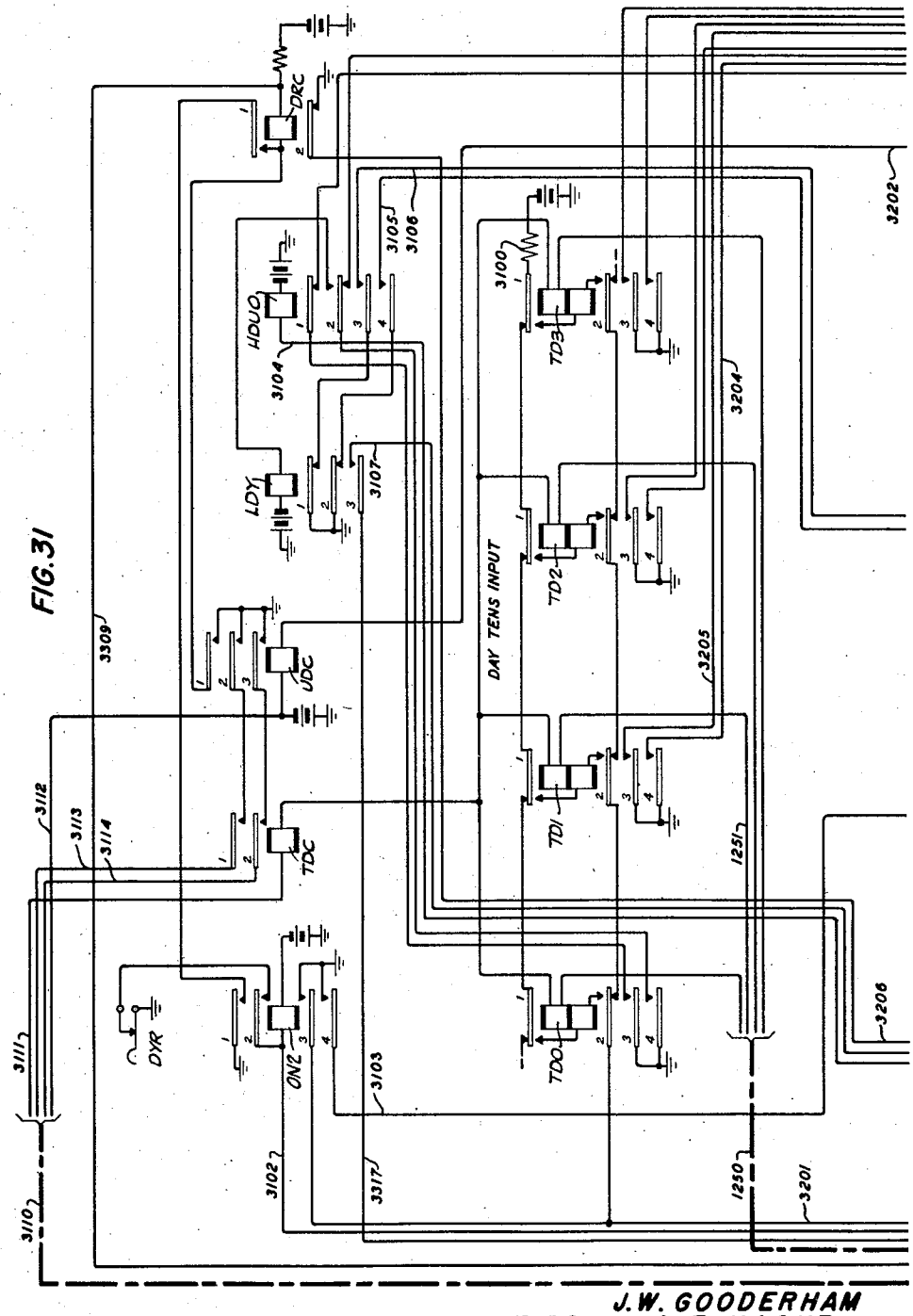

FIG. 31

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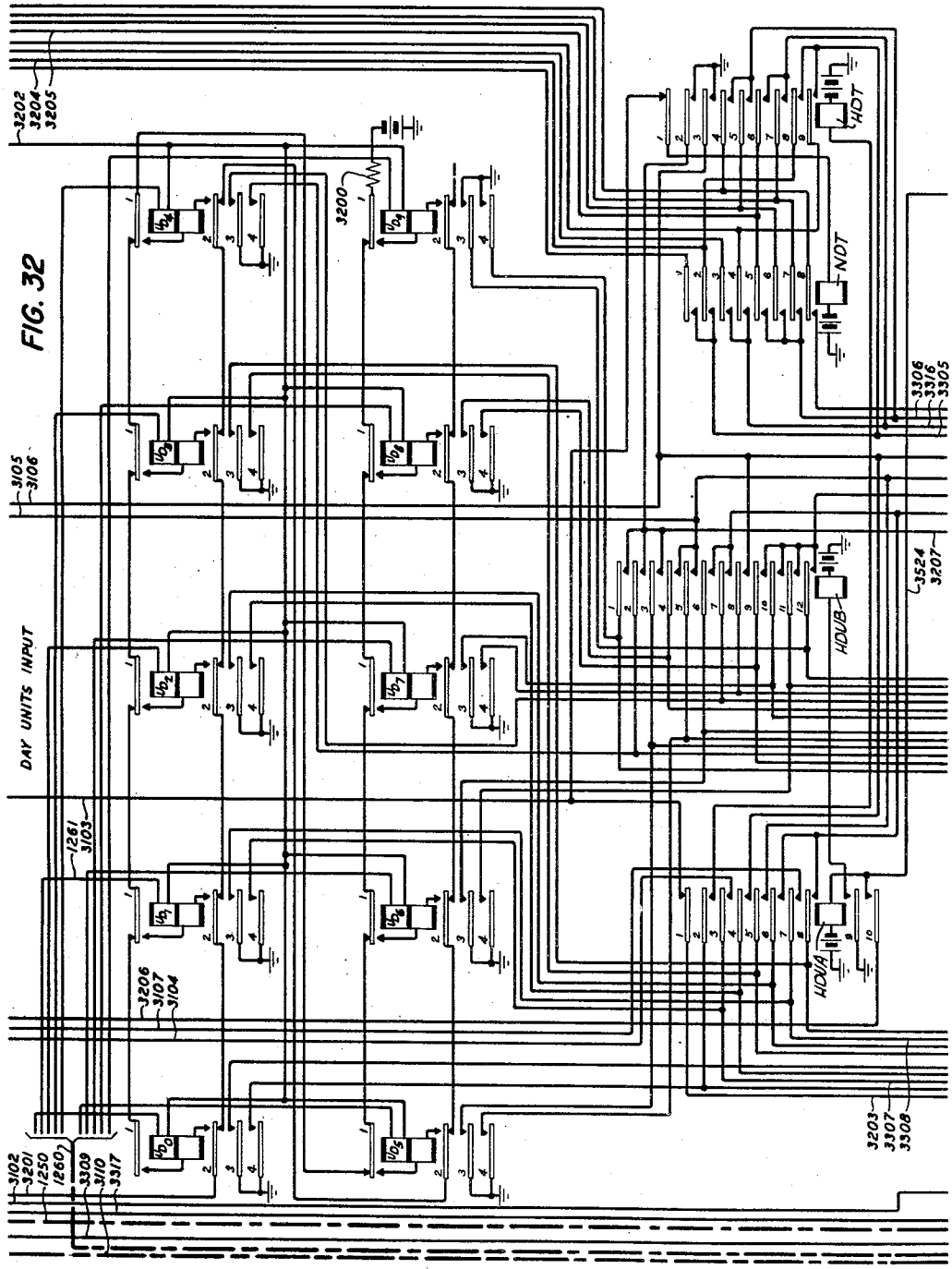

FIG. 32

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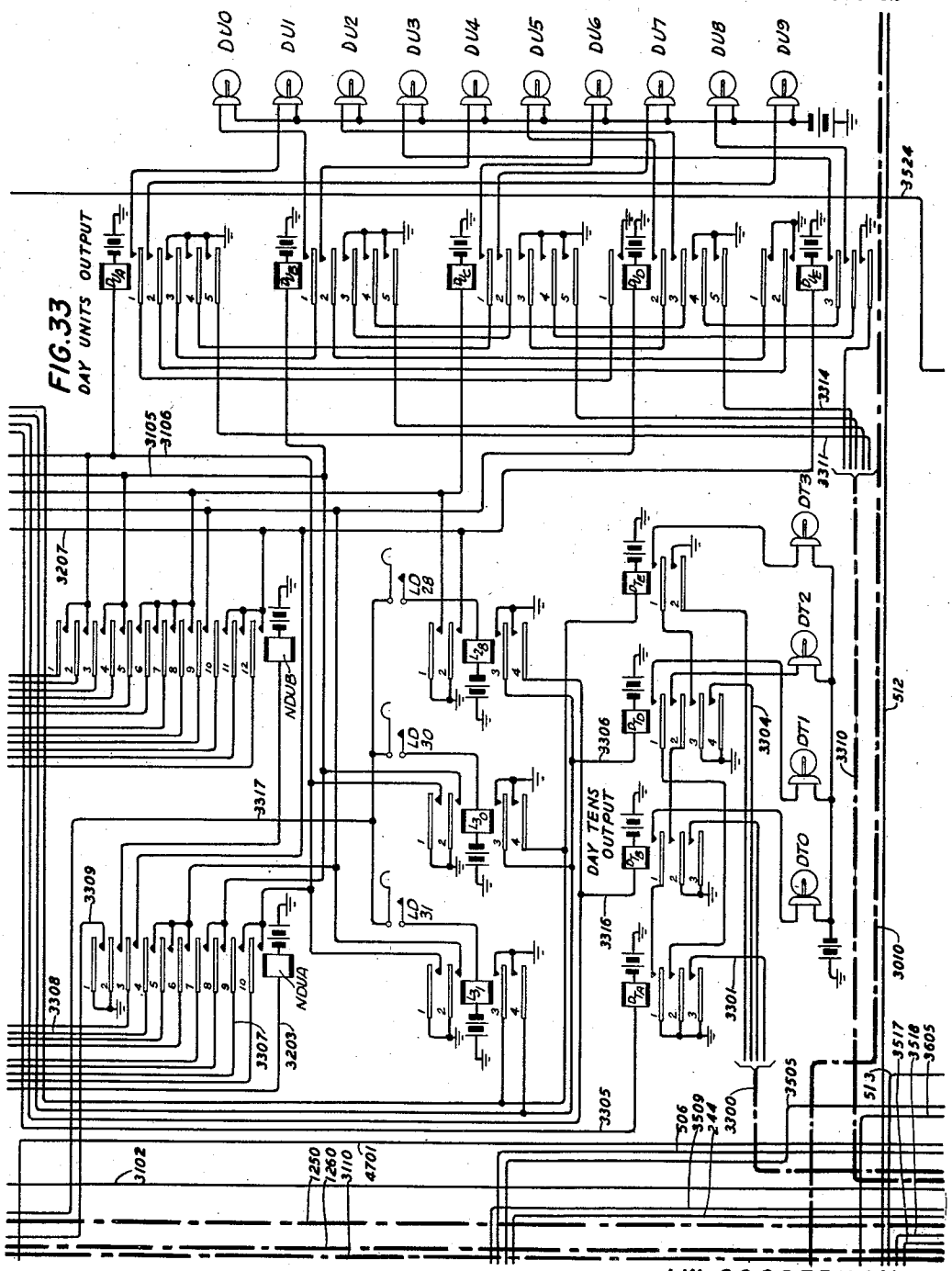

FIG. 33

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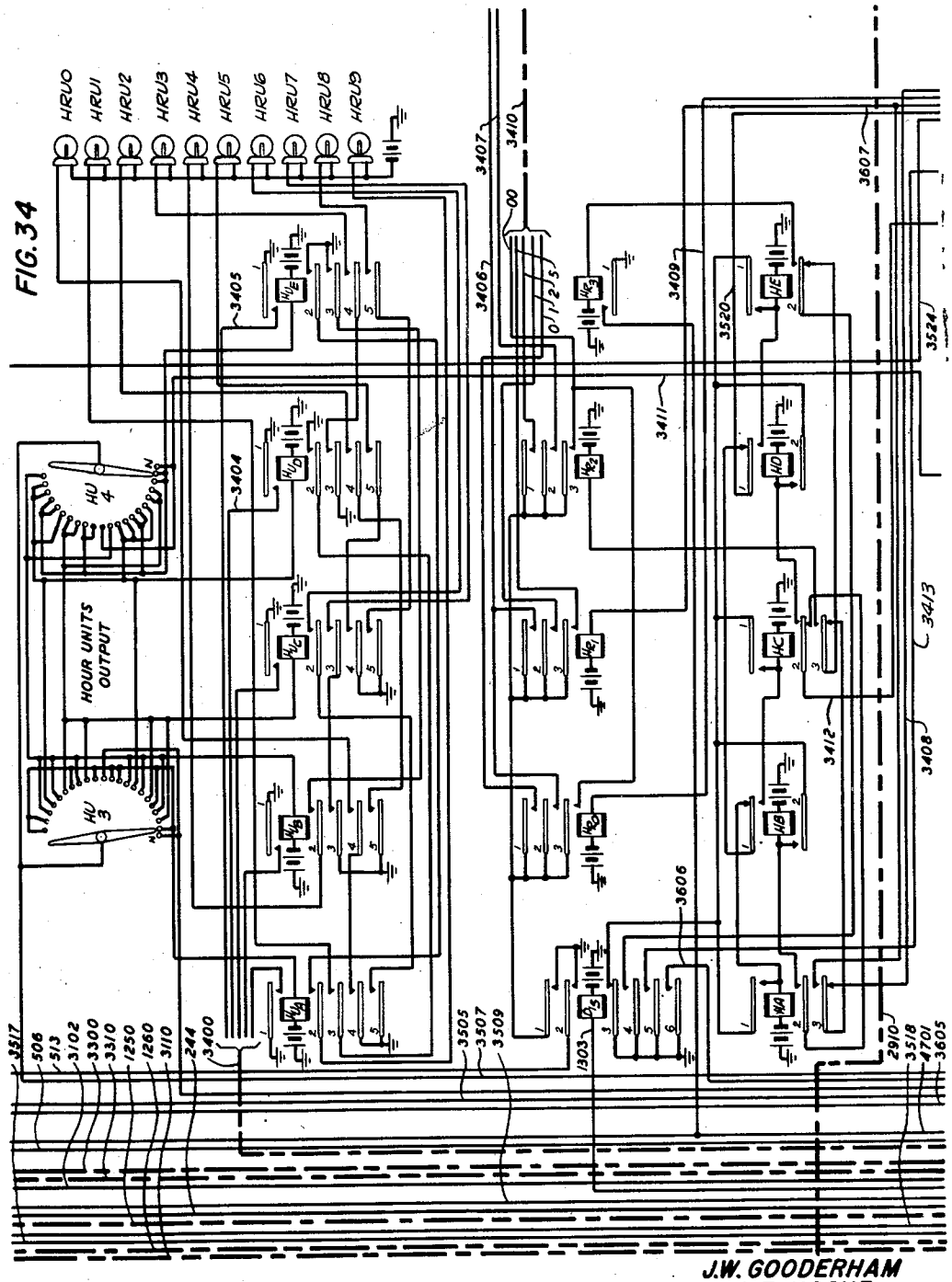
Filed Jan. 7, 1948 54 Sheets-Sheet 33

FIG. 34



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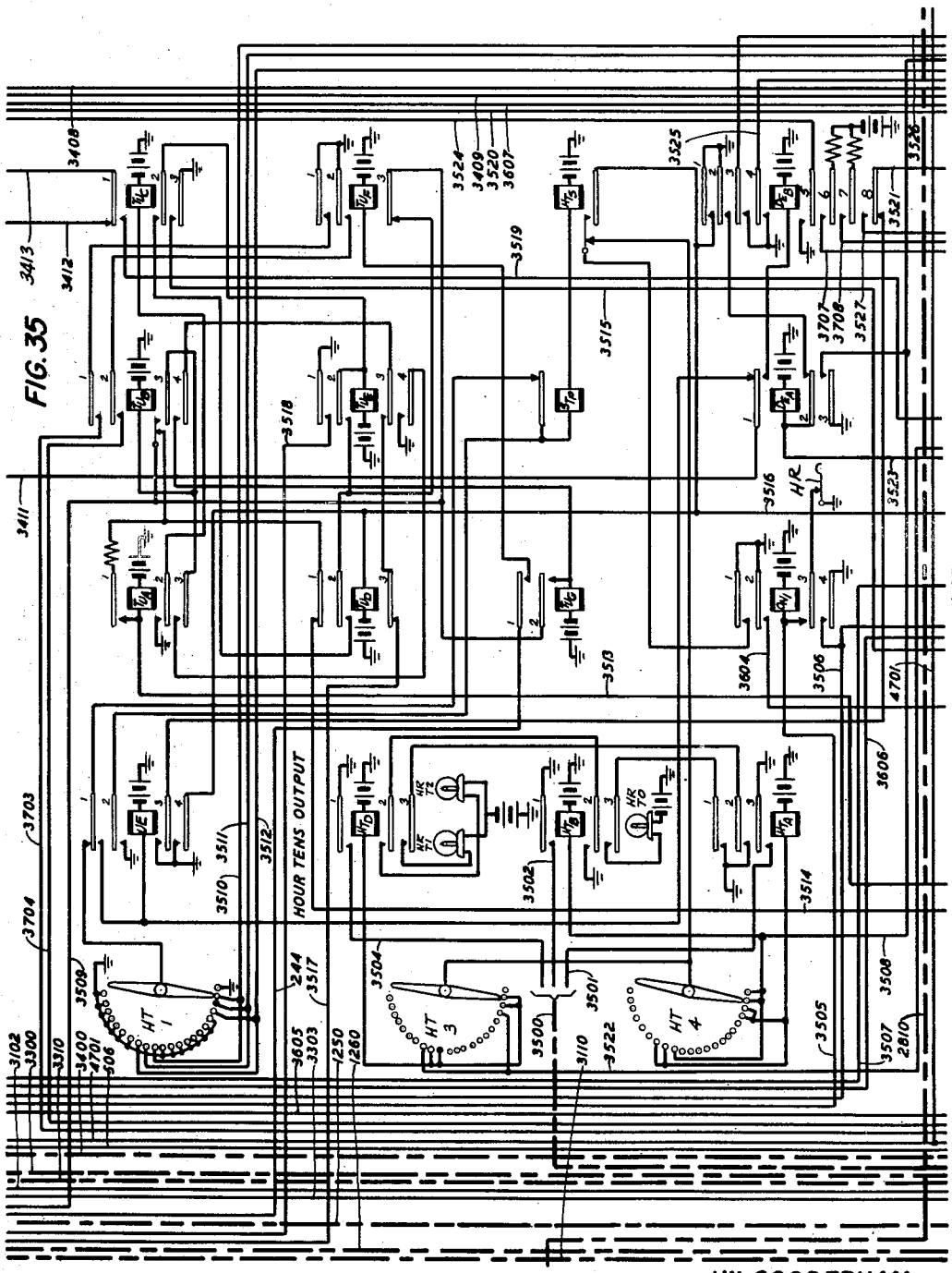

FIG. 35

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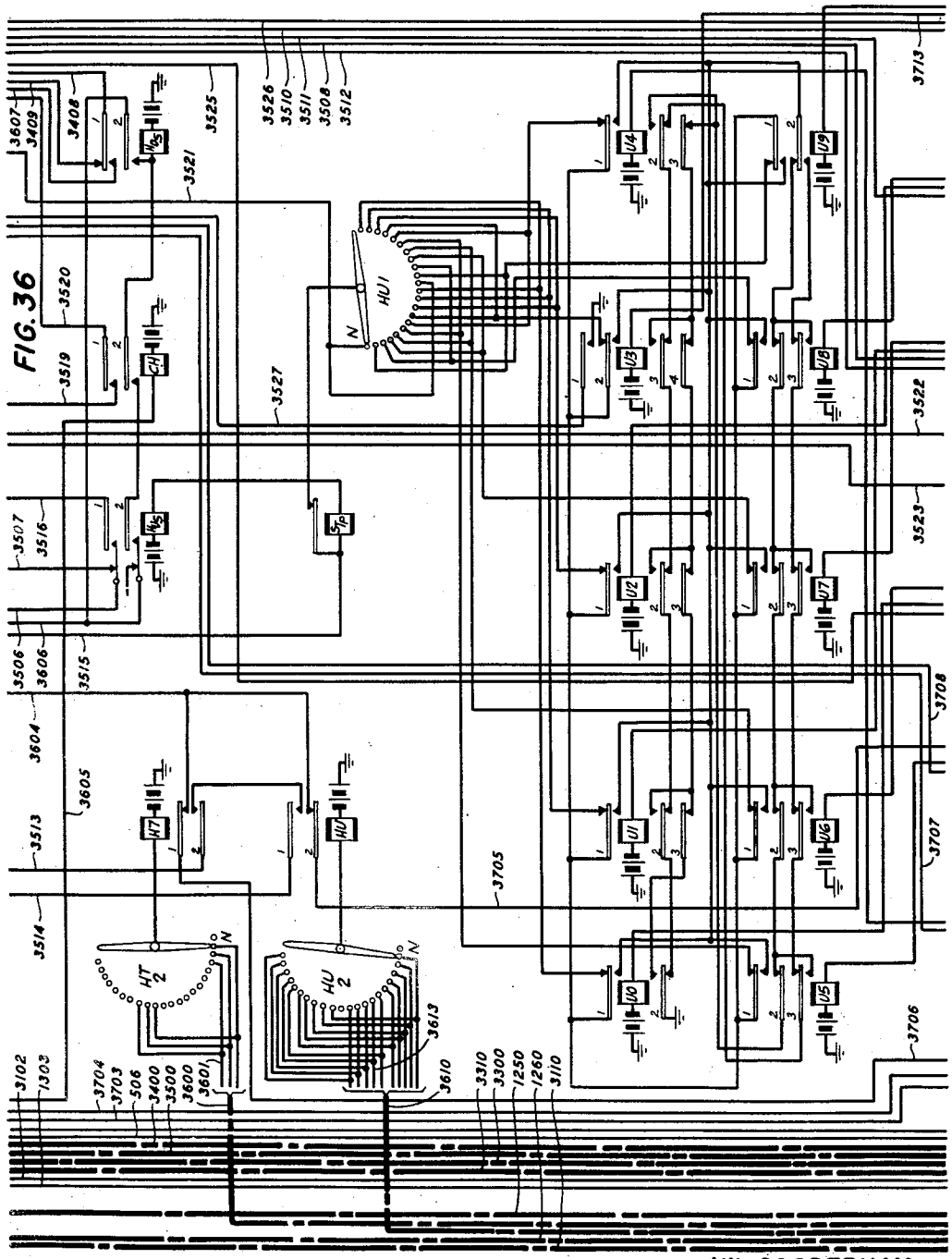

FIG. 36

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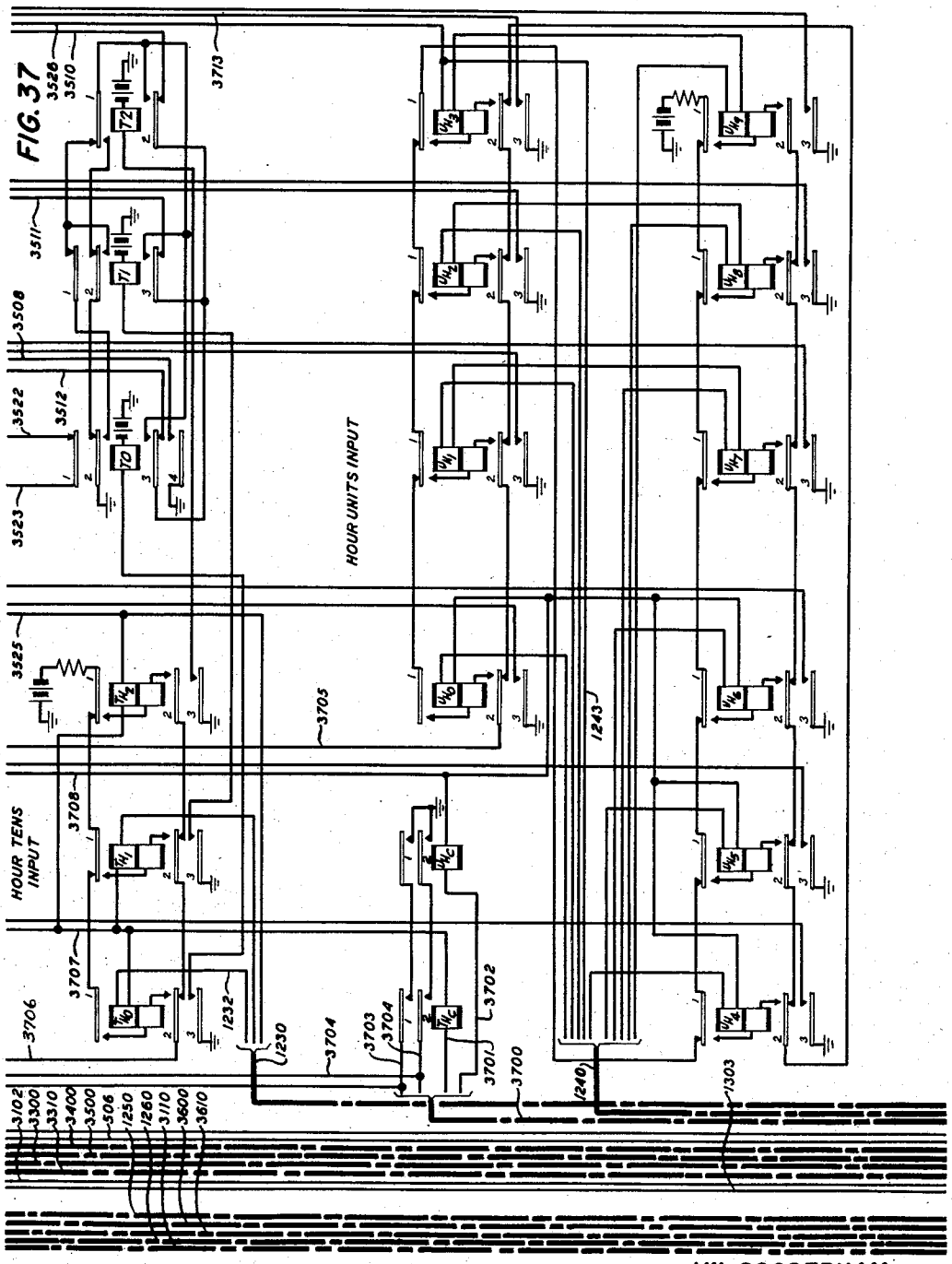
FIG. 37



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A.C. POWELL

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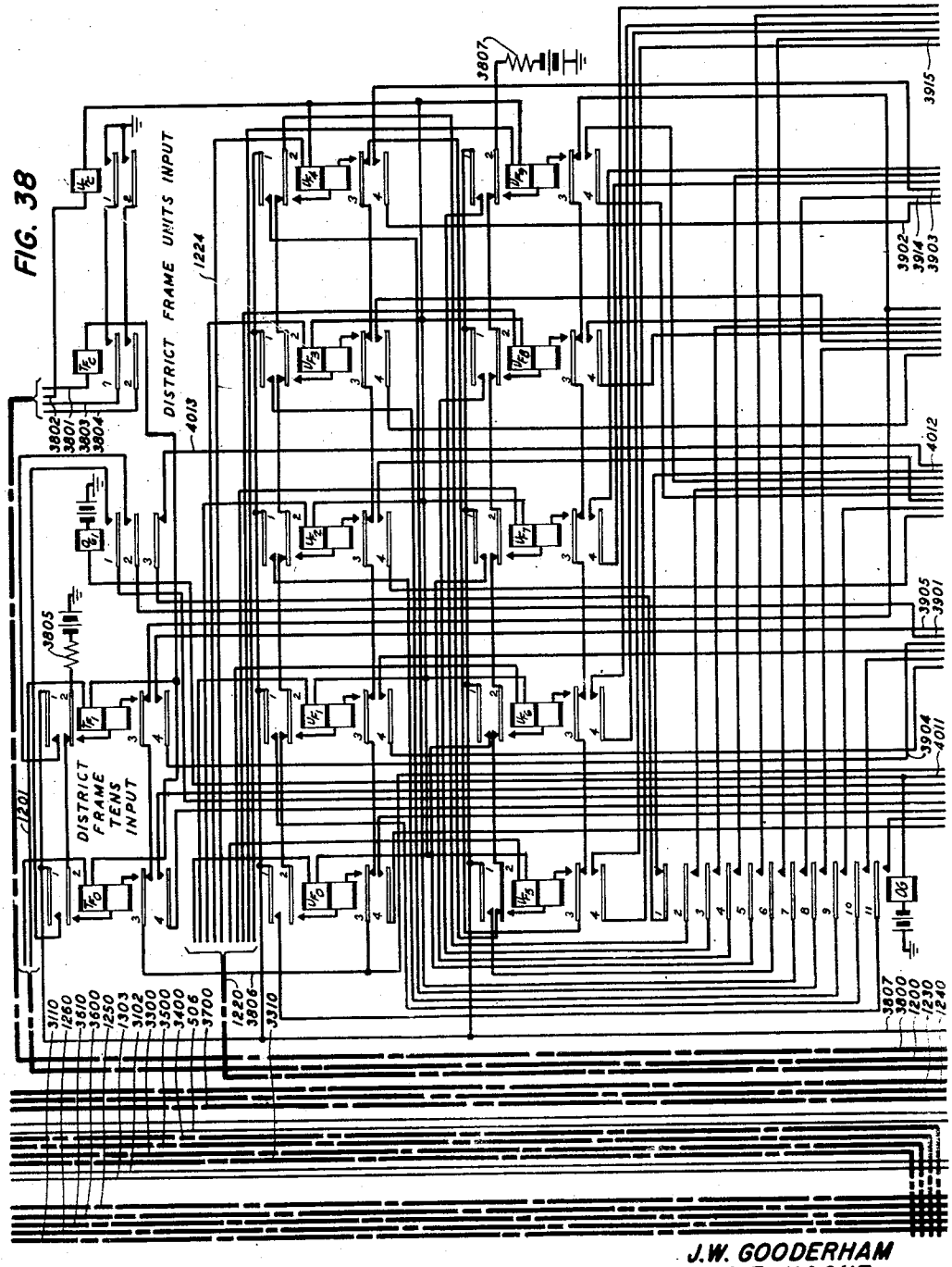
June 26, 1951 J. W. GOODERHAM ET AL 2,558,477

MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 37

FIG. 38



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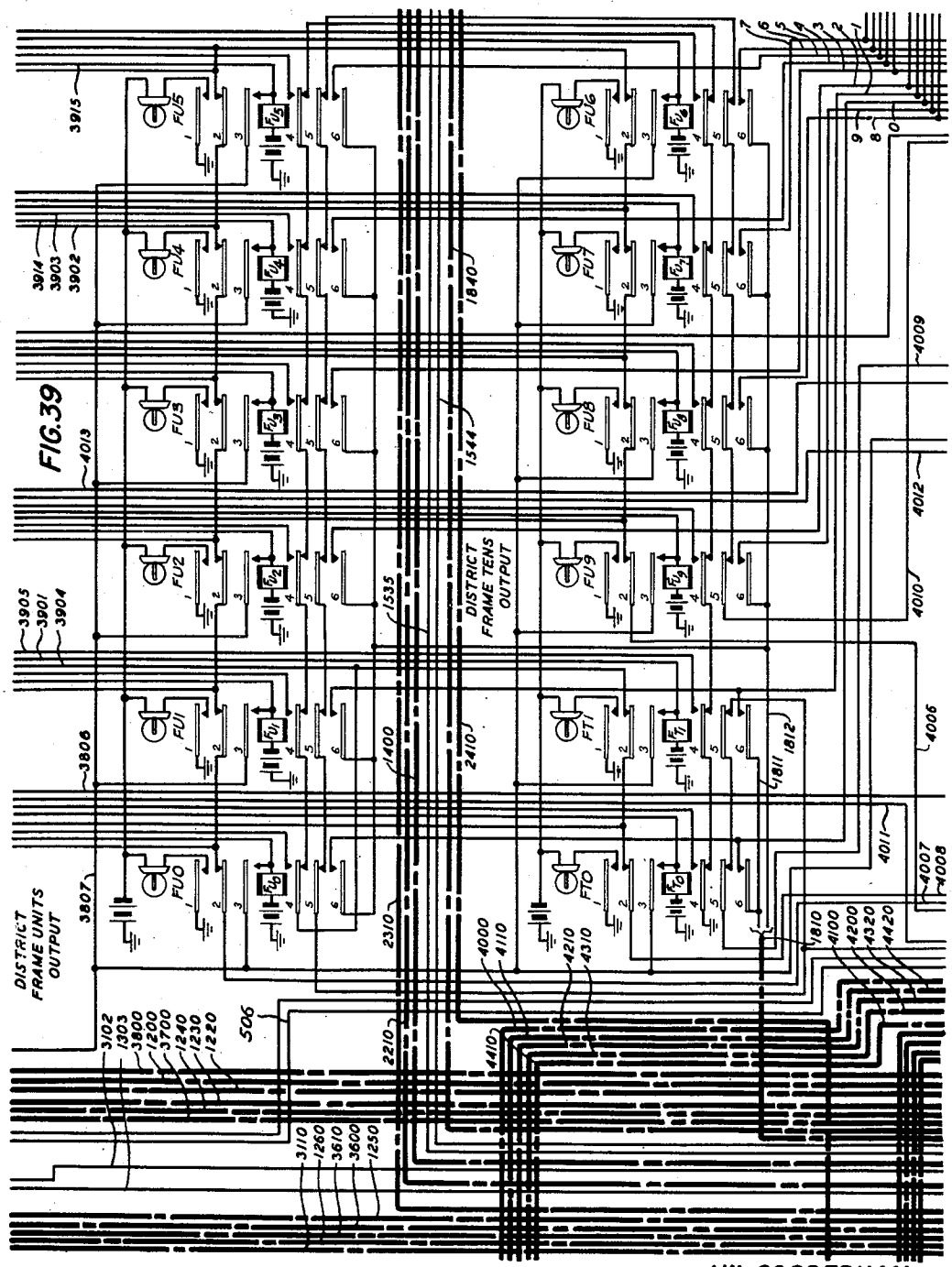
MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 38



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MESSAGE TICKETER

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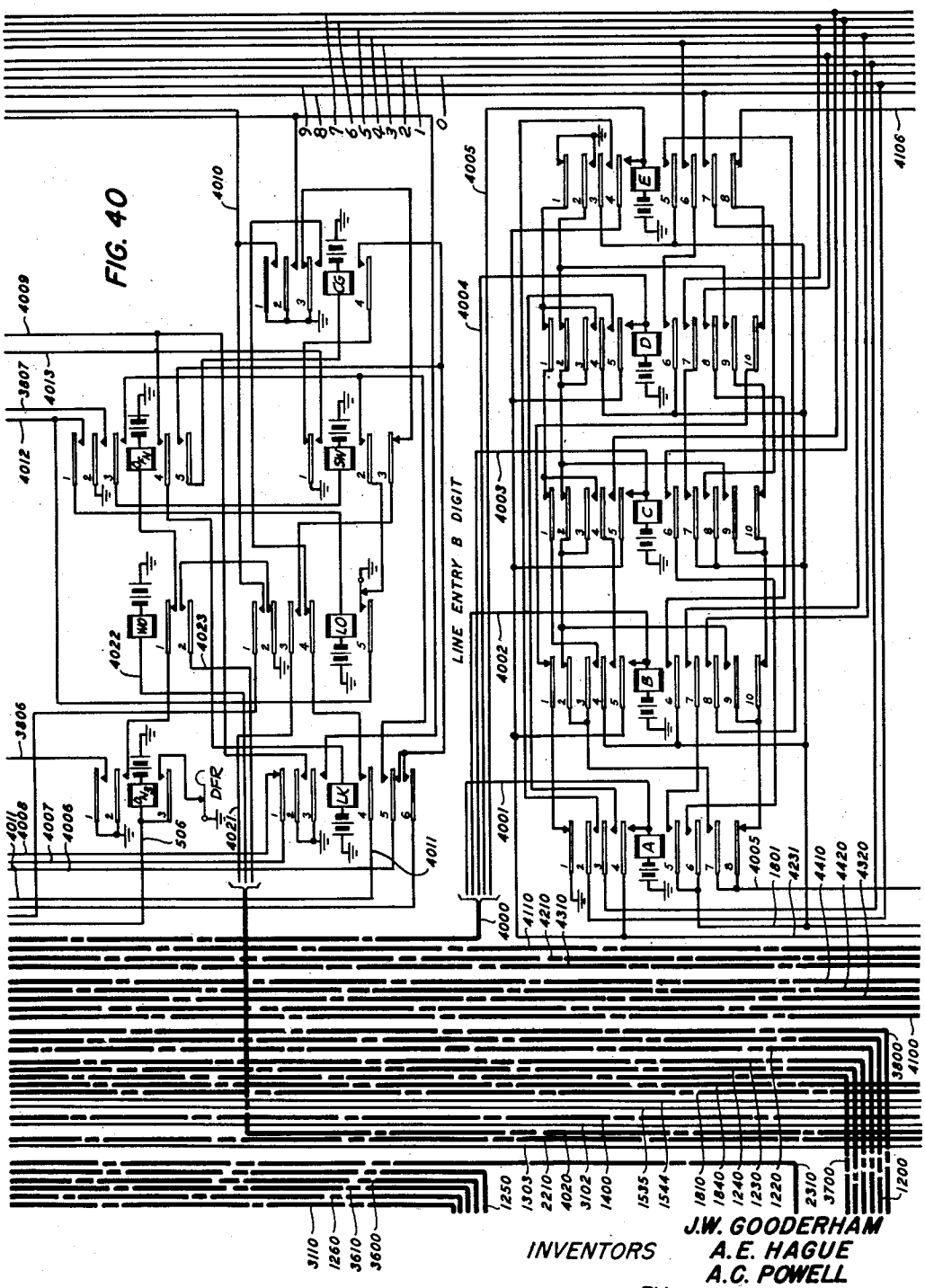

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MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 40

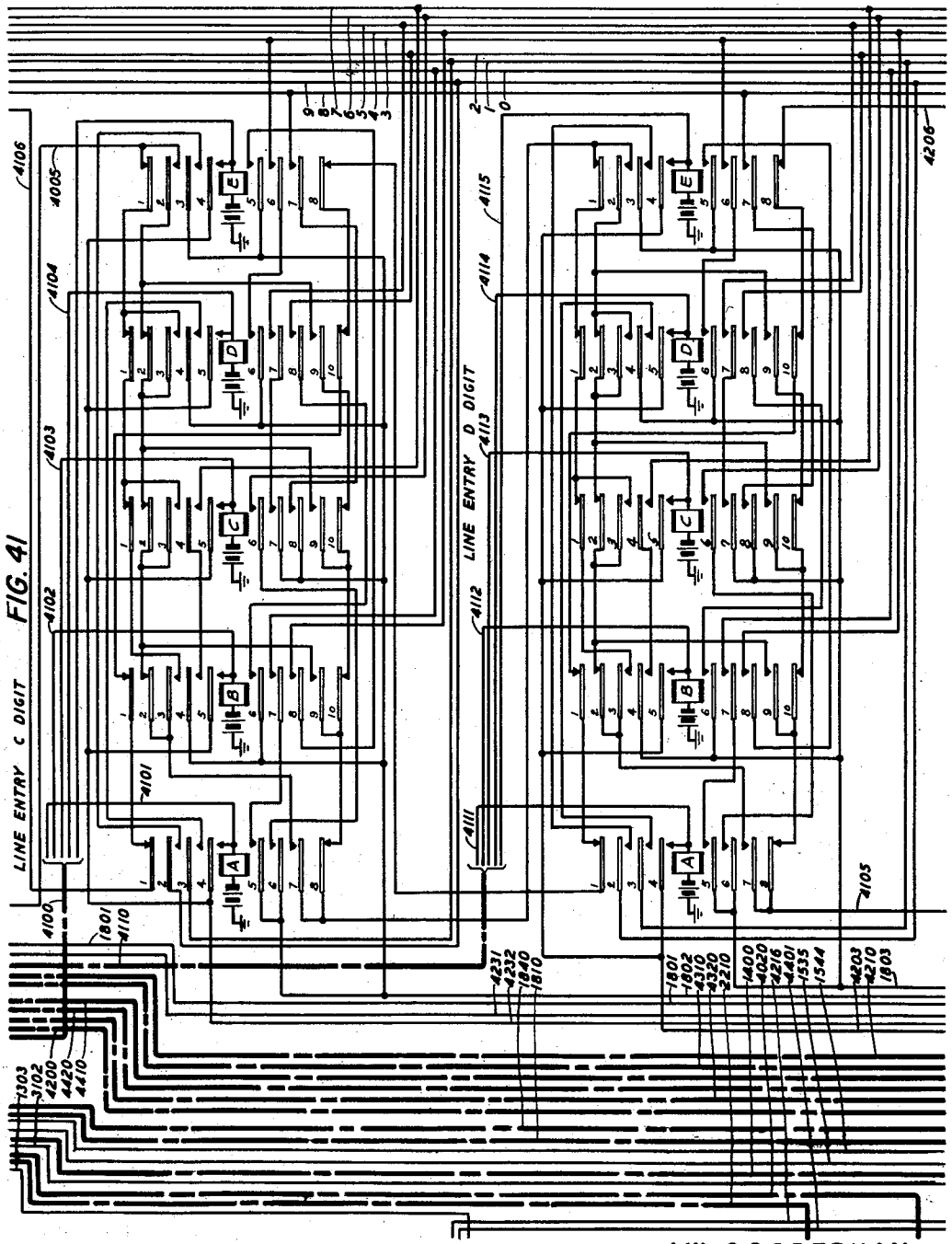

FIG. 41

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Filed Jan. 7, 1948 54 Sheets-Sheet 41

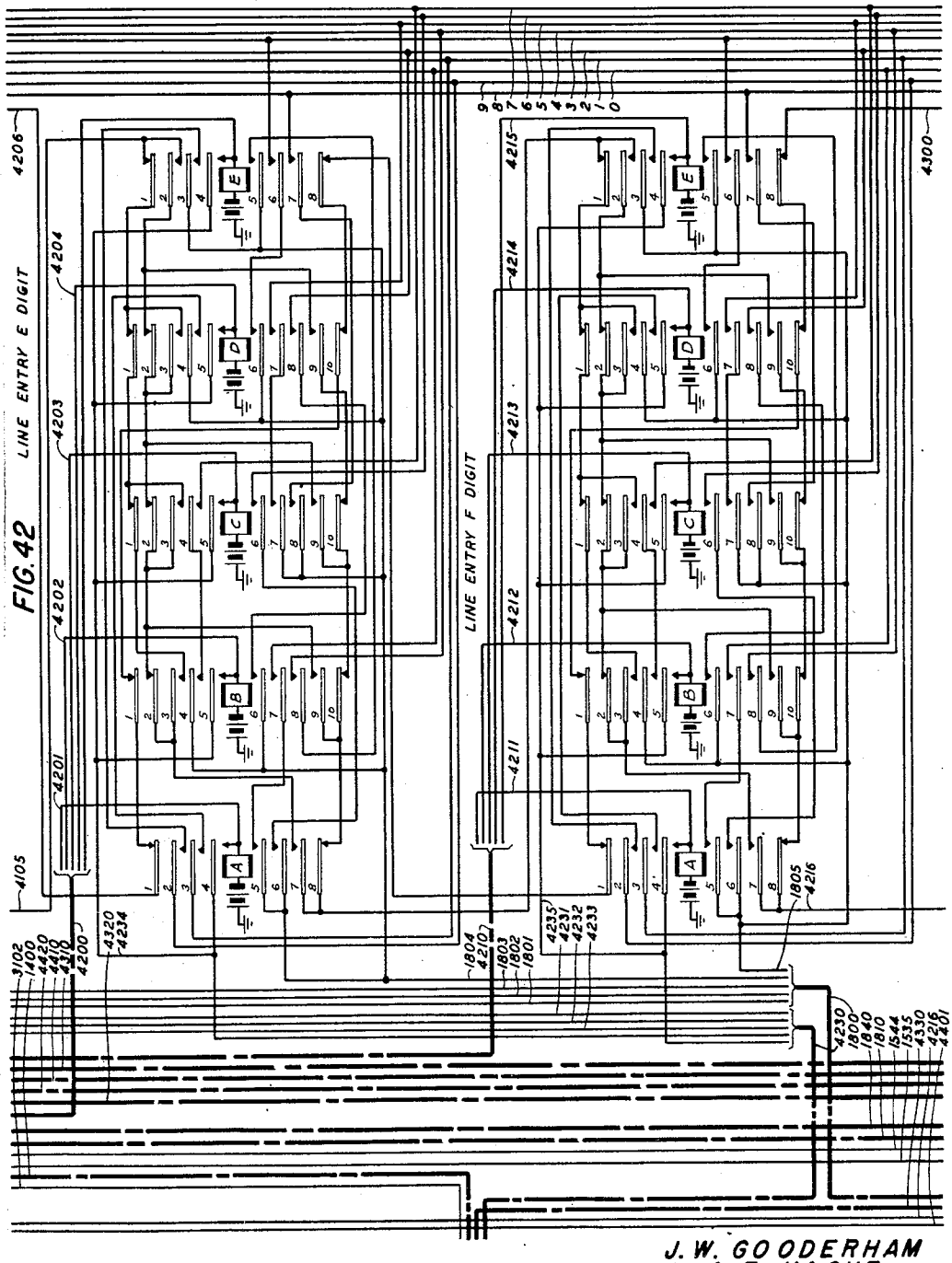

FIG. 42

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MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 42

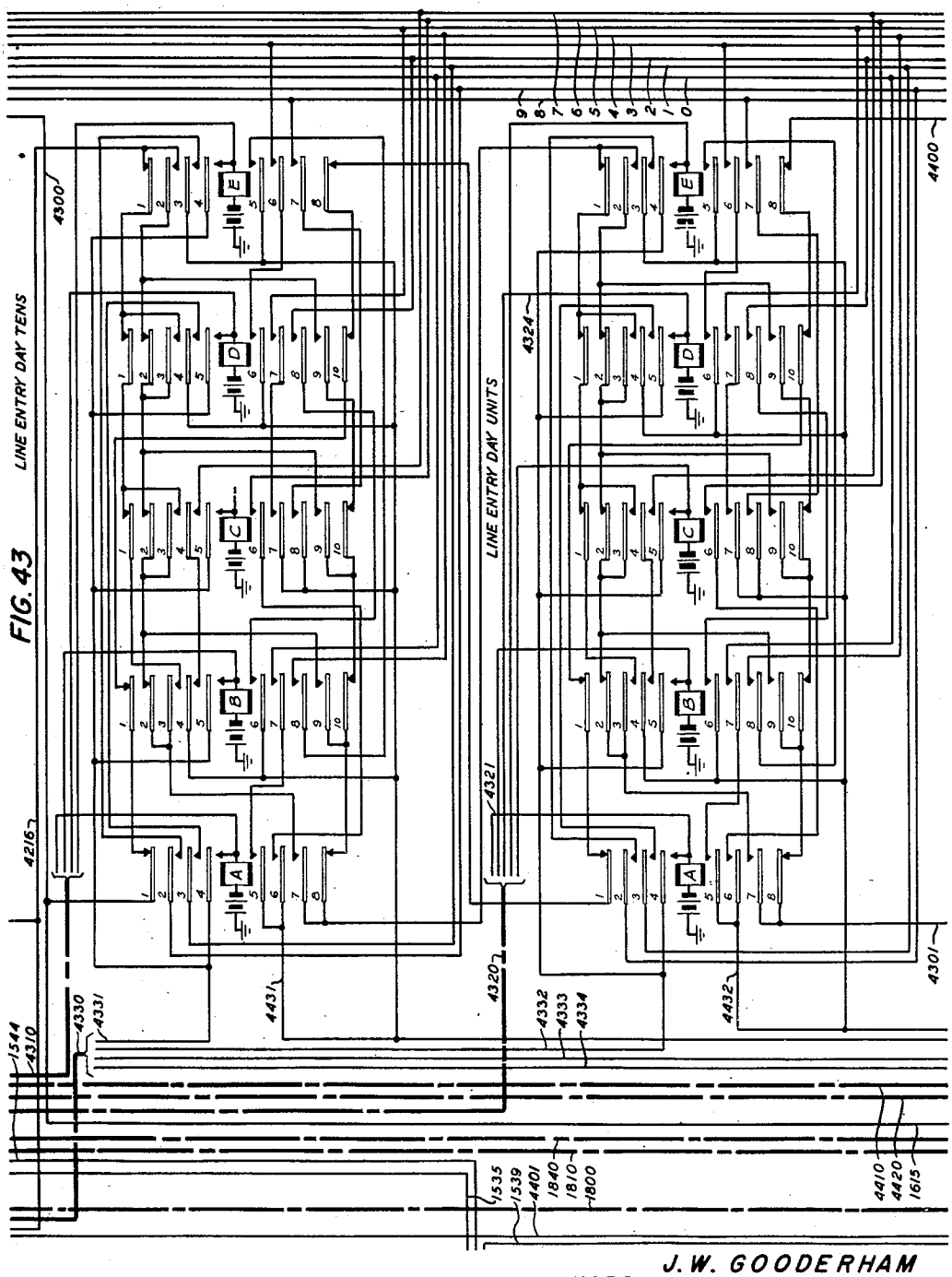

FIG. 43

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June 26, 1951 J. W. GOODERHAM ET AL 2,558,477

MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 43

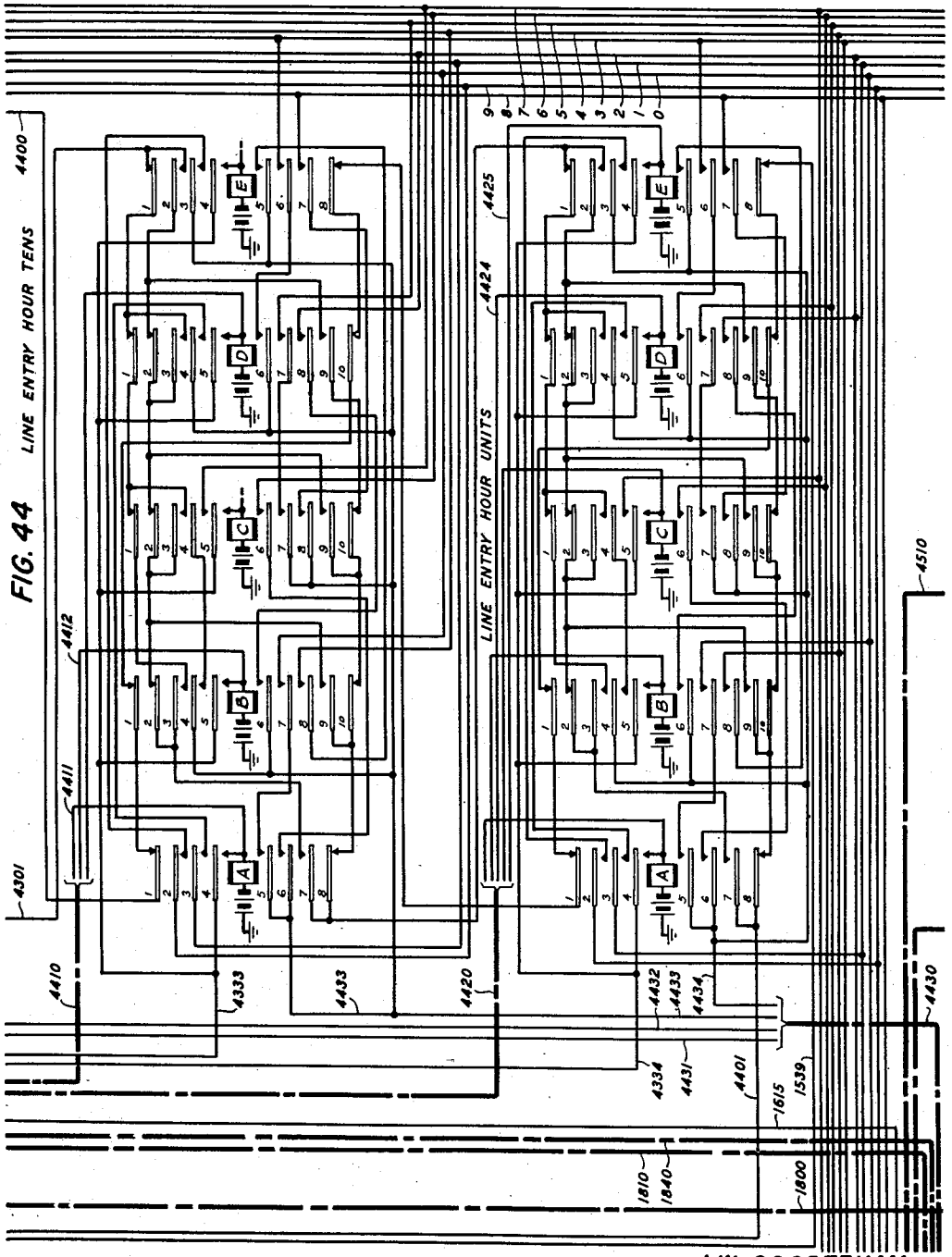

FIG. 44

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June 26, 1951 J. W. GOODERHAM ET AL 2,558,477

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Filed Jan. 7, 1948 54 Sheets-Sheet 44

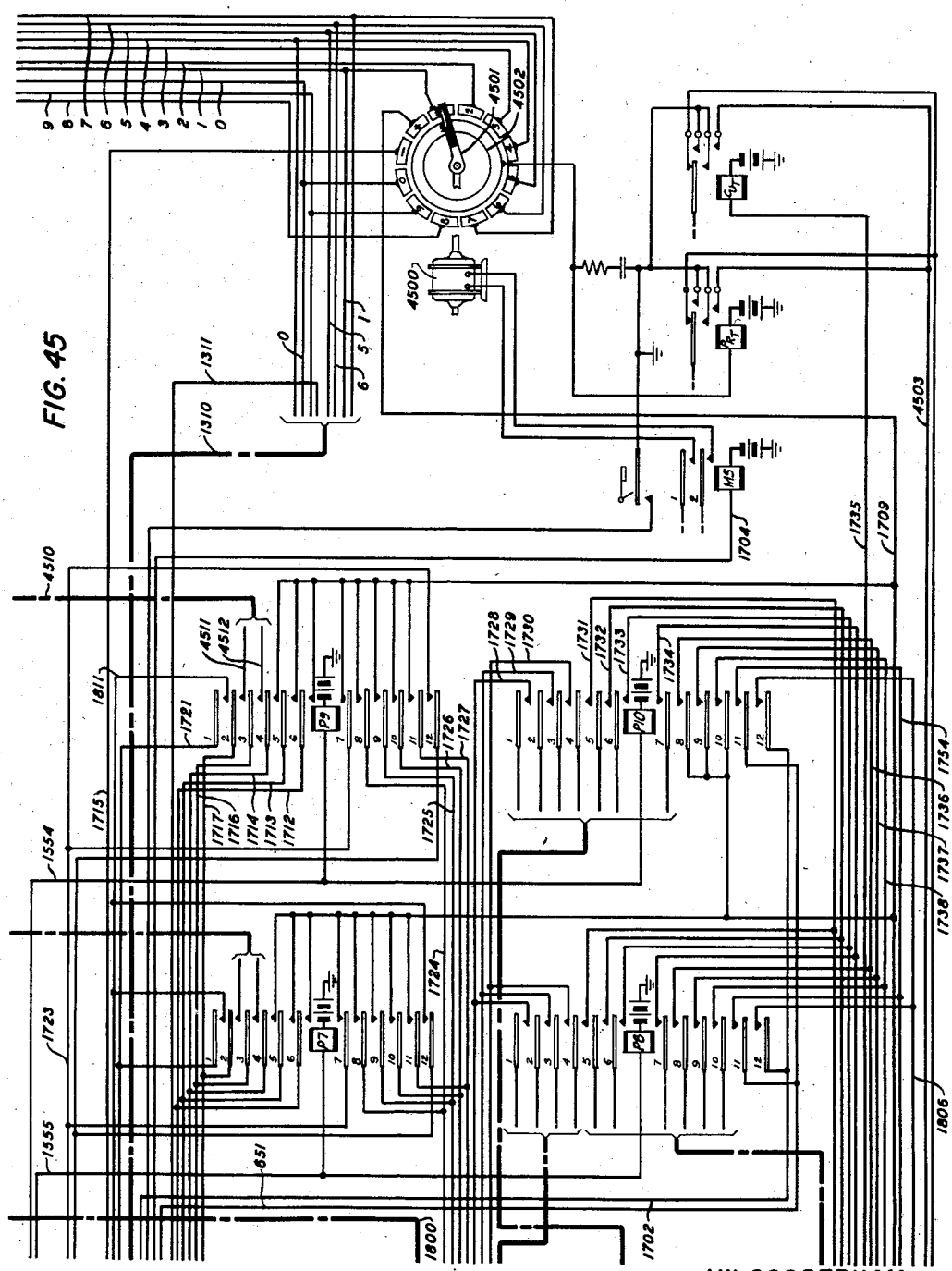

FIG. 45

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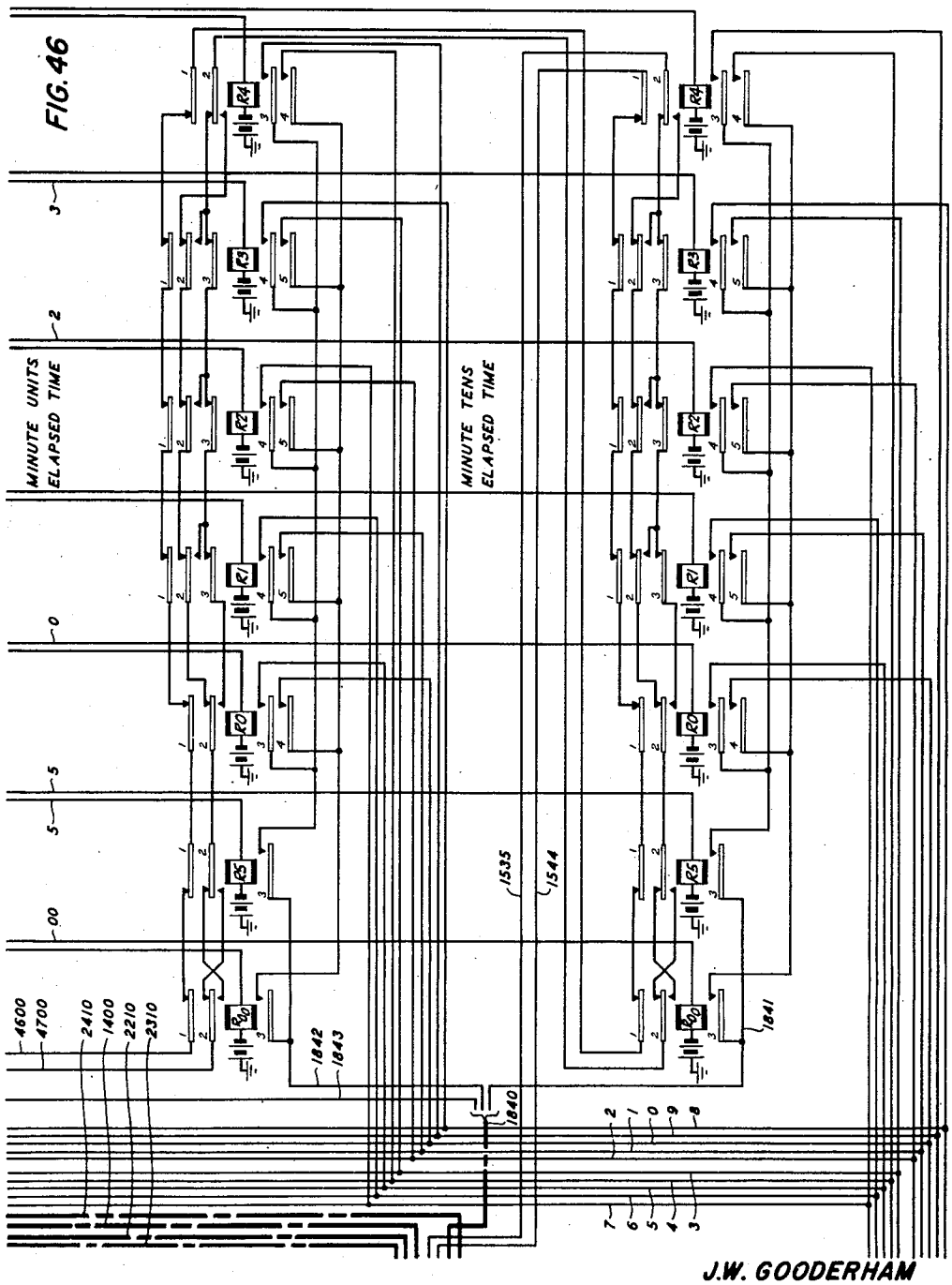
MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 45

FIG. 46



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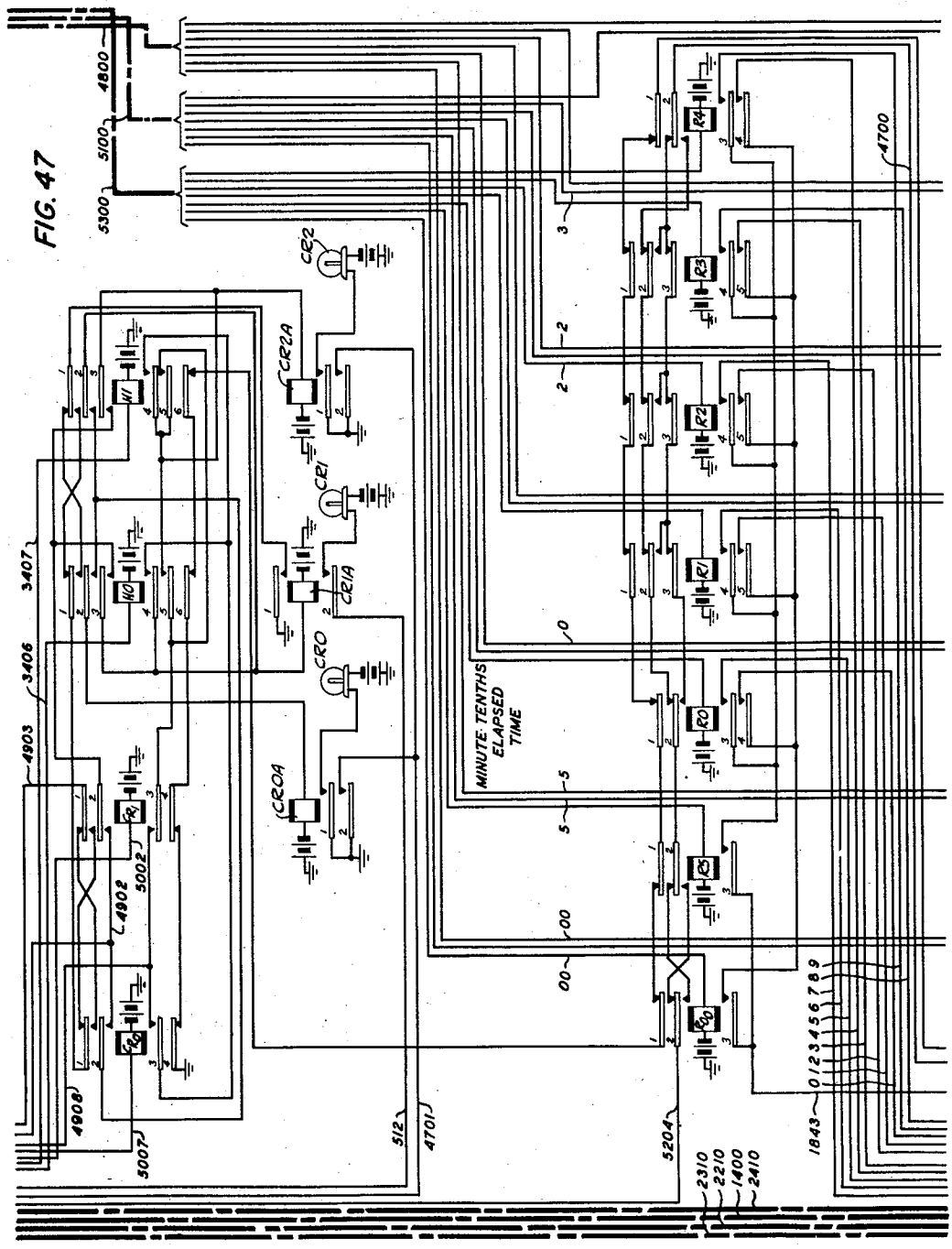
MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 46

FIG. 47



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MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 47

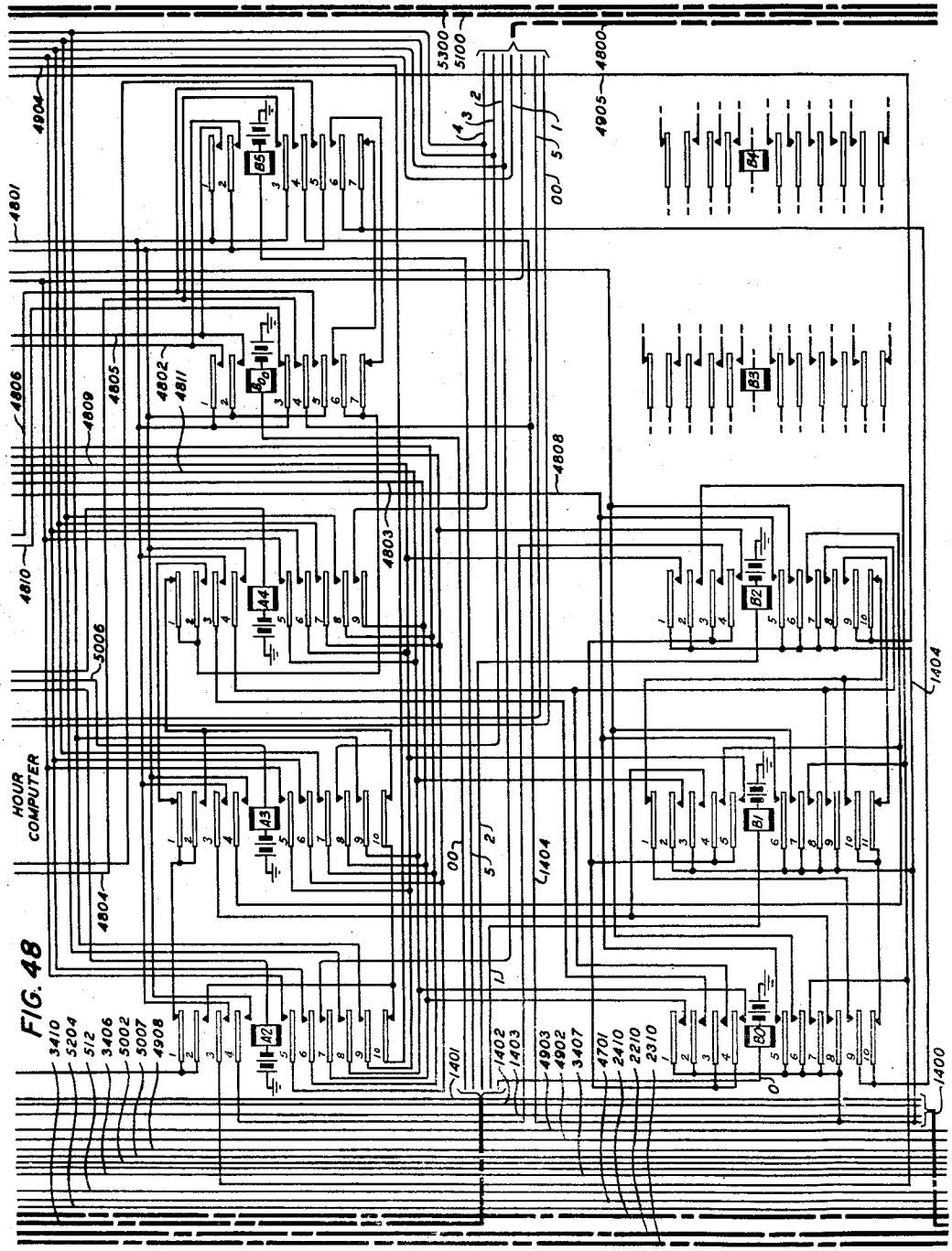

FIG. 48

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MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 48

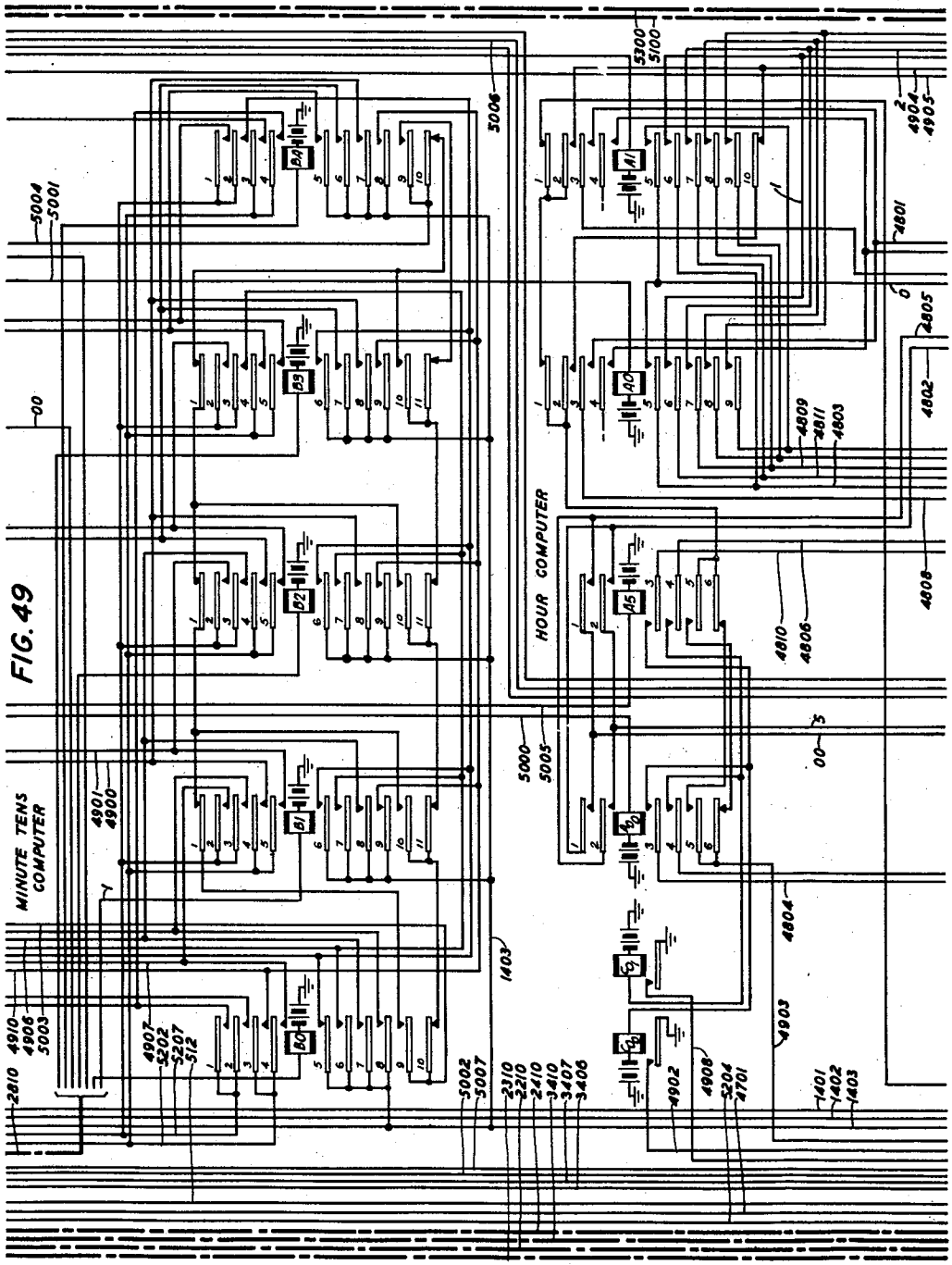

FIG. 49

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MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 49

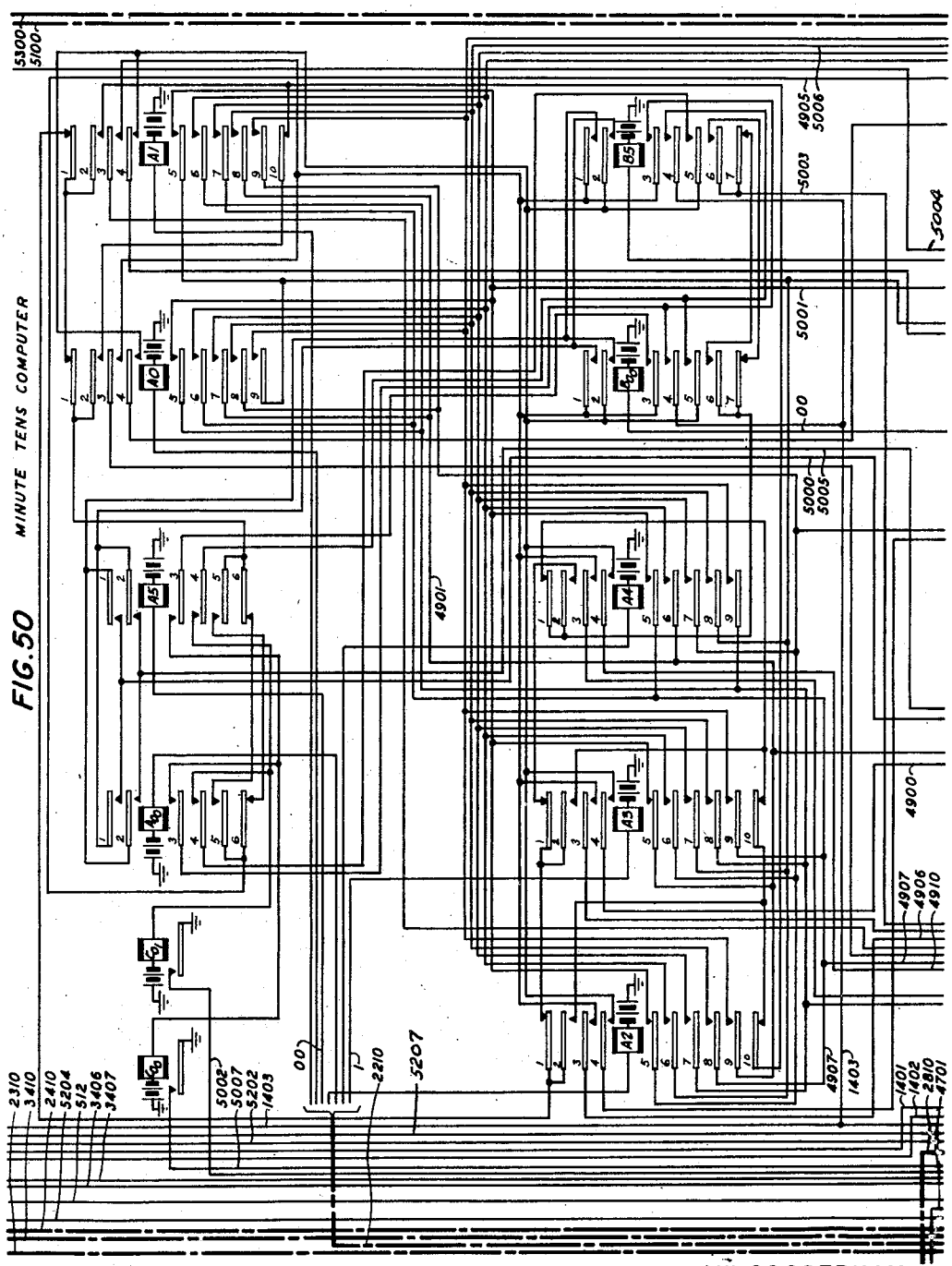

FIG. 50

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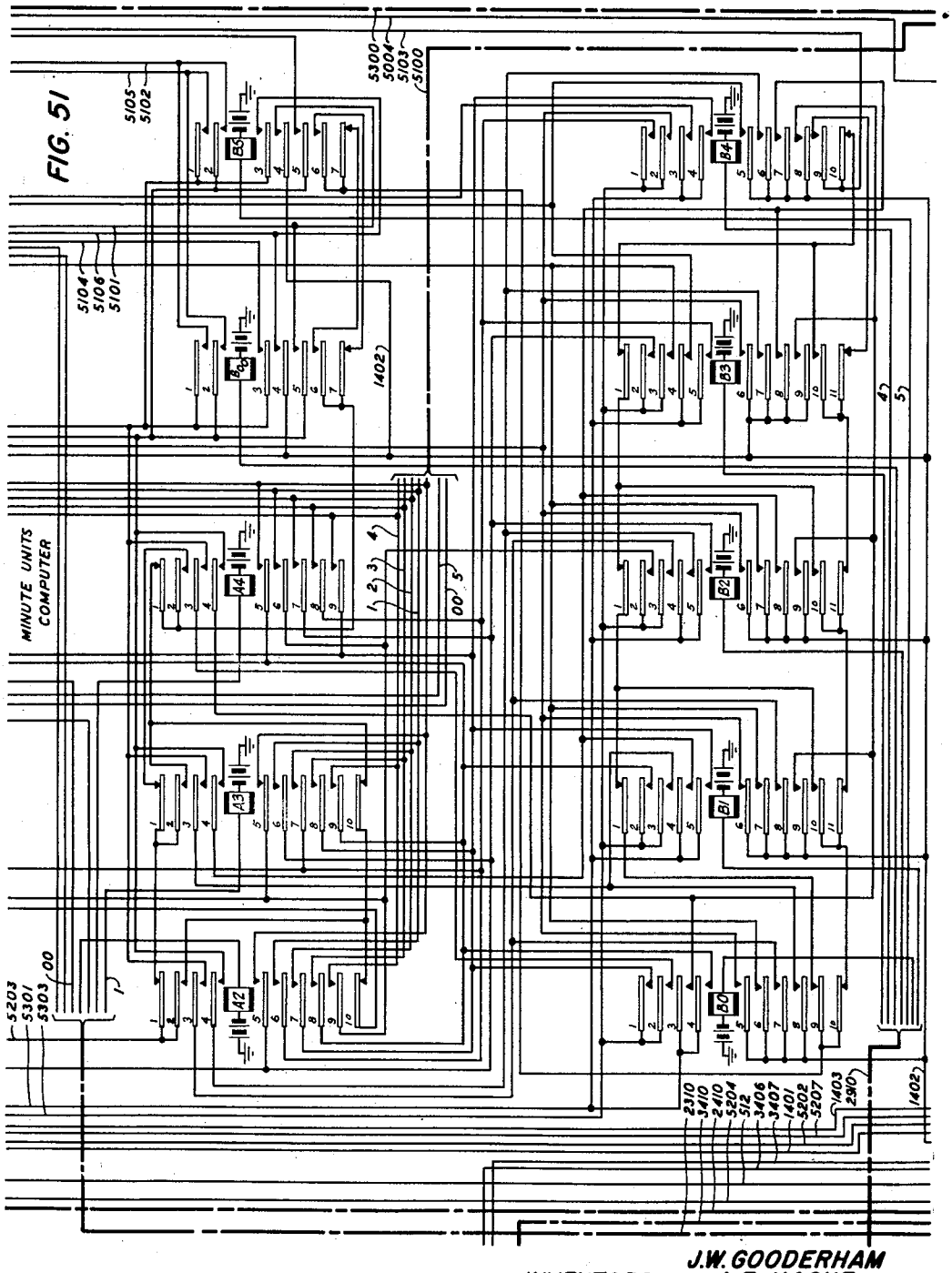
MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 50

FIG. 51



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MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 51

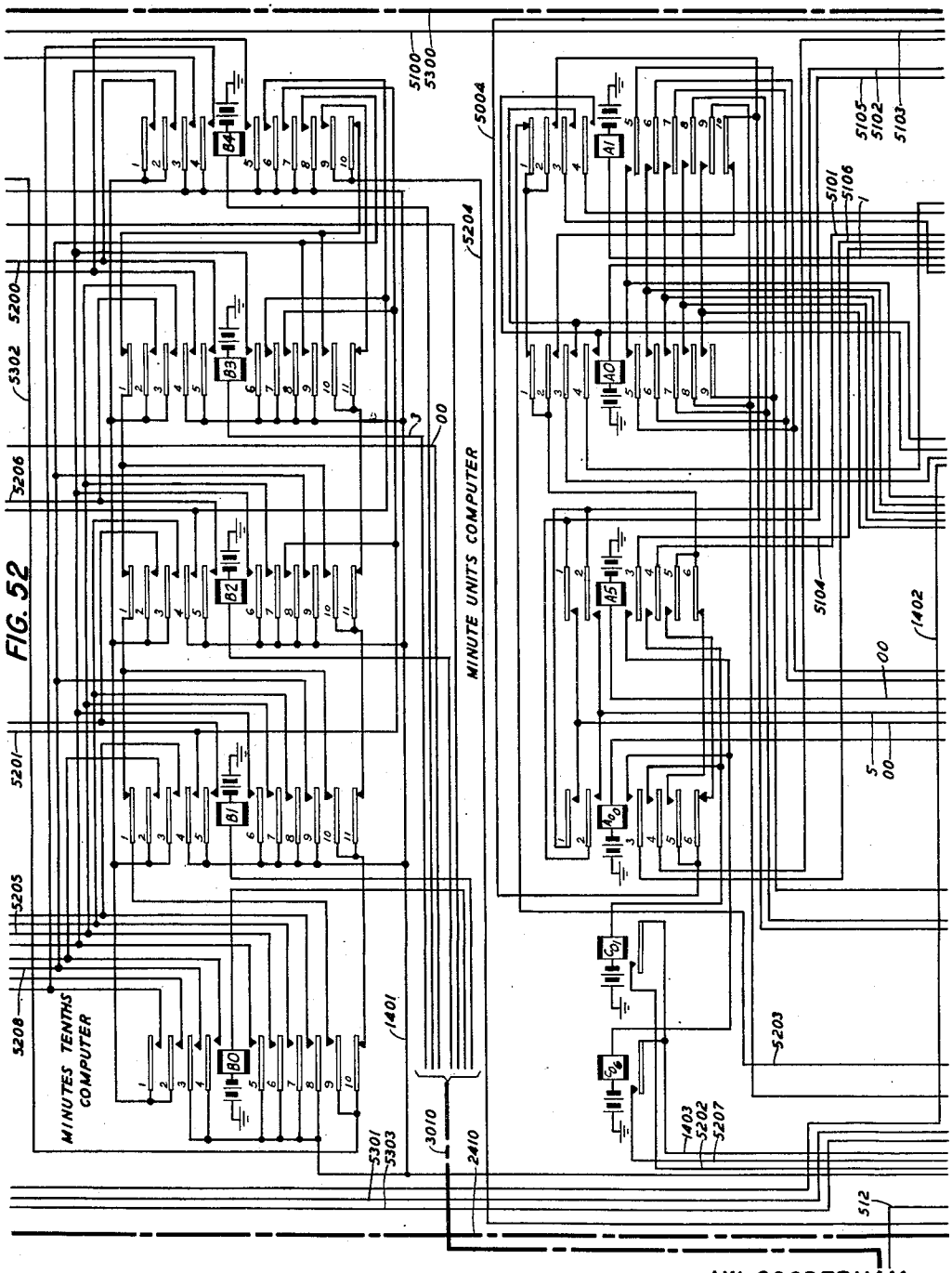

FIG. 52

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MESSAGE TICKETER

Filed Jan. 7, 1948 54 Sheets-Sheet 52

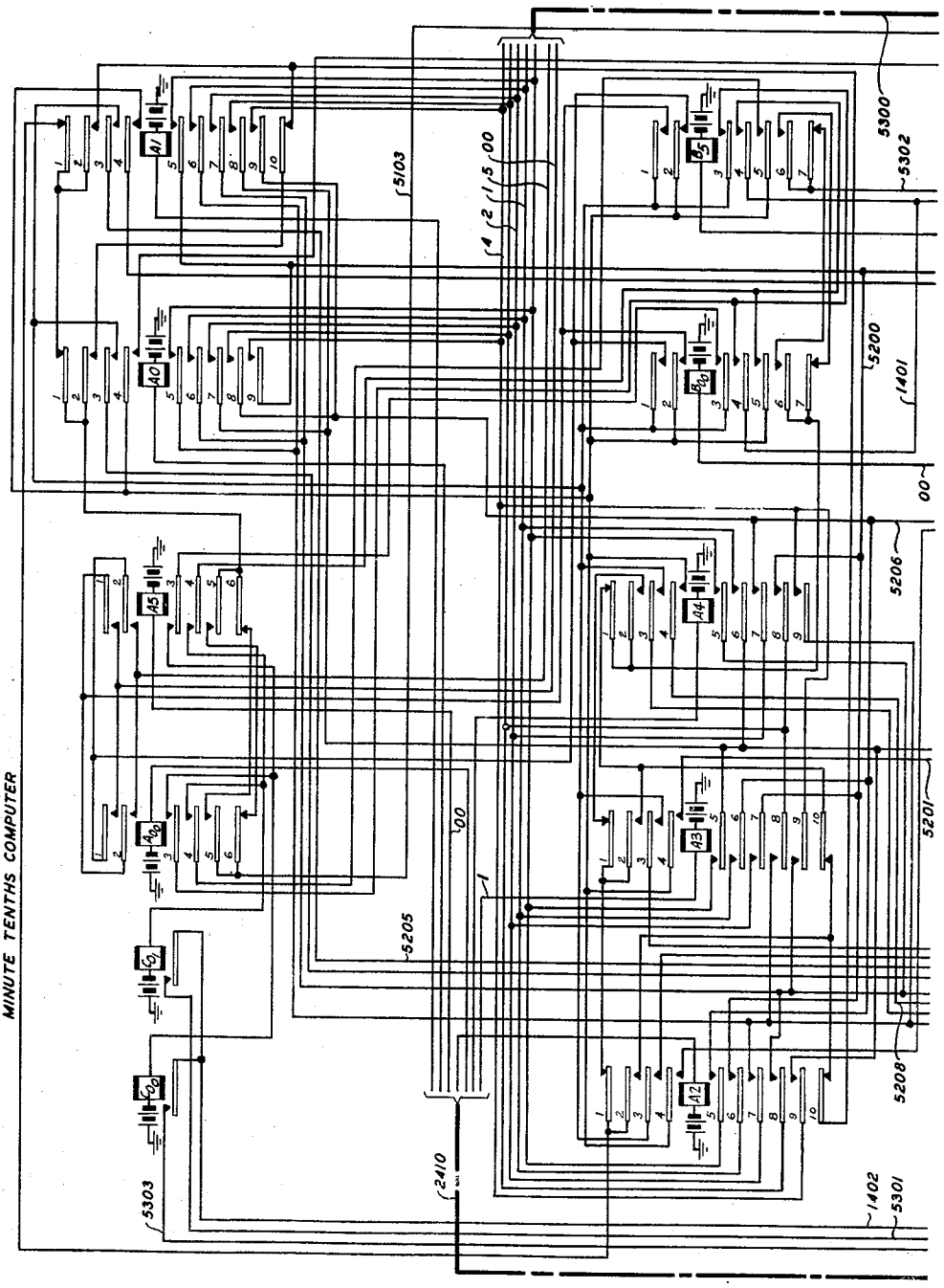

FIG. 53
MINUTE TENTHS COMPUTER

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Filed Jan. 7, 1948 54 Sheets-Sheet 53

FIG. 54A RECORD PUNCH POSITIONS

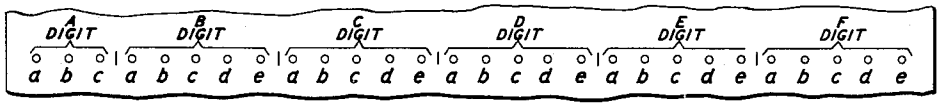


FIG. 54B ANSWER OR DISCONNECT ENTRY

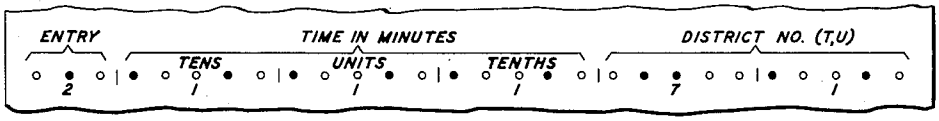


FIG. 54C INITIAL TWO LINE ENTRY

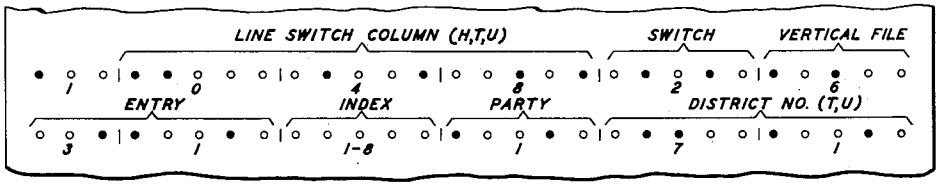


FIG. 54D INITIAL FOUR LINE ENTRY

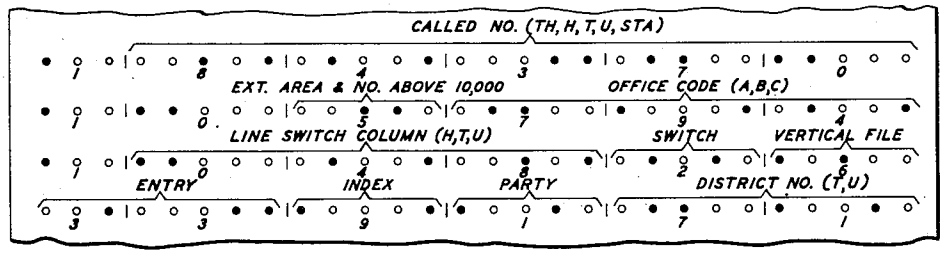


FIG. 54E REGULAR HOUR ENTRY

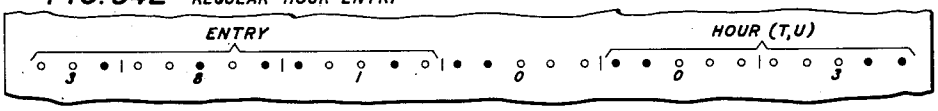
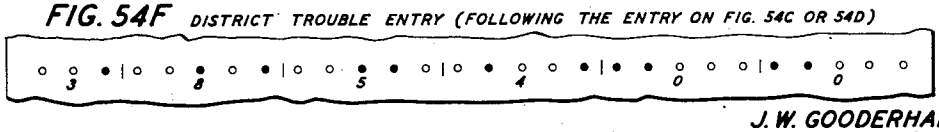


FIG. 54F DISTRICT TROUBLE ENTRY (FOLLOWING THE ENTRY ON FIG. 54C OR 54D)



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Filed Jan. 7, 1948 54 Sheets-Sheet 54

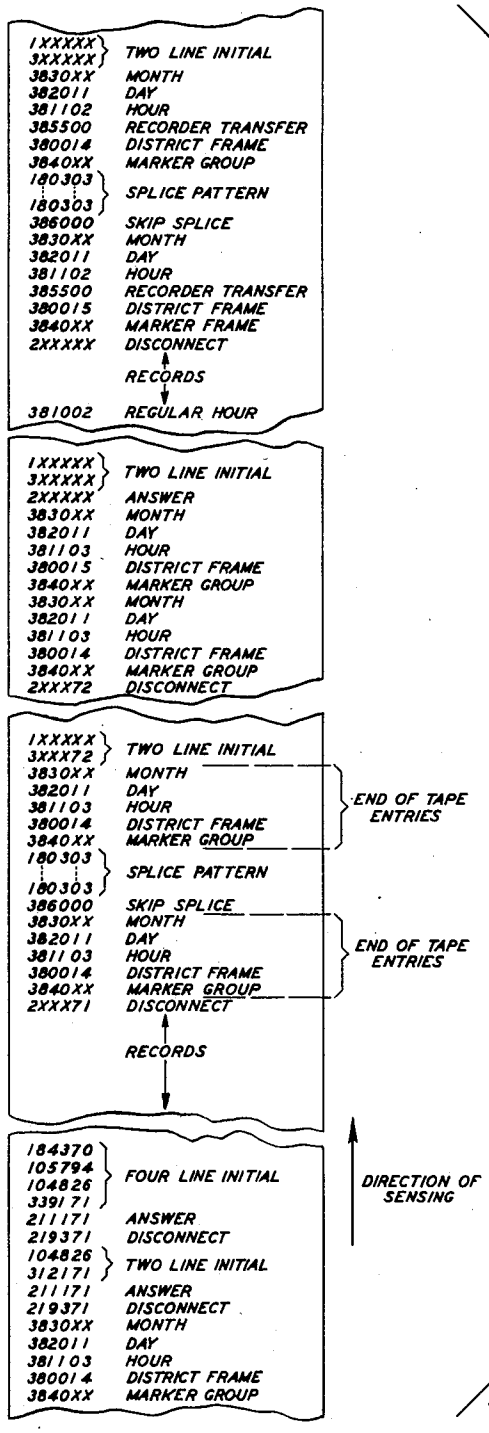

FIG. 55

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Patented June 26, 1951 2,558,477

UNITED STATES PATENT OFFICE

2,558,477

MESSAGE TICKETER

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Application January 7, 1948, Serial No. 920

38 Claims. (Cl. 235—61.1)

1

This invention relates to record-controlled apparatus and more particularly to a message ticketer which operates in response to a perforated tape record that contains record information entries of telephone connections, to compute the elapsed time and to print a ticket for each call which contains all of the necessary information regarding the call including the computed elapsed time.

One feature of the invention is an arrangement of circuits and apparatus whereby the items of information on the record tape may be sensed.

Another feature of the invention is an arrangement of circuits whereby the record is checked to insure that two out of five holes are punched for each of the B, C, D, E and F digits of record information in each line of the record before the circuits proceed to process the line.

Another feature of the invention is an arrangement of circuits whereby the record is checked to insure that only one or/and three holes are punched for the A digit of record information in each line of the record before the circuits proceed to process the line.

Another feature of the invention is an arrangement of circuits whereby certain items of information are sensed but not recorded.

Yet another feature of the invention is an arrangement of circuits whereby the hour entry at the beginning of each tape record is sensed and recorded and whereby the hour record is changed in accordance with the sensing of subsequent hour entries of the record tape.

Yet another feature of the invention is an arrangement of circuits whereby the day entry at the beginning of each tape record is sensed and recorded and whereby the hour record is changed in accordance with the sensing of subsequent day entries made at midnight of each day.

Another feature of the invention is an arrangement of circuits whereby the disconnect time and answer time entered on the tape record are sensed and registered and whereby from such registration and the hour registration the elapsed time is computed and registered.

Yet another feature of the invention is an arrangement of circuits to control a ticket printer whereby the printer is controlled to print a thirty character ticket on a "bulk-billed" call and a forty-character ticket on a "detail billed" call with an indication of the type of billing.

Yet another feature of the invention is the provision of circuits whereby the printer is controlled to print information on the ticket as determined from sensing the record tape if the call was a

2

"busy" call, a "don't-answer" call, or a call with no recorded disconnect time.

Yet another feature of the invention is the provision of circuits whereby the ticket printer is controlled to print a special indication on all partial or "straddled" calls which may appear on the beginning or end of the tape record.

These and other features of the invention will be more clearly understood from the following description, appended claims and attached drawings in which:

Figs. 2 to 53, inclusive, arranged as disclosed in Fig. 1 completely disclose the invention;

Fig. 2 discloses the reader;

Fig. 3 discloses reader-connecting relays;

Figs. 4, 5 and 6 show reader-control circuits;

Figs. 7, 8, 9 and 10 show reader-register relays, Fig. 10 also showing disconnect time connector relays for associating the reader relays with the disconnect time register relays of Figs. 28, 29 and 30;

Fig. 11 shows the answer-connecting relays for connecting the reader relays of Figs. 7, 8, 9 and 10 with the answer time register relays of Figs. 22, 23 and 24;

Figs. 12 to 16, inclusive, show the ticketer control relays;

Figs. 17, 18 and 45 show the ticketer control relays therefor and the ticketer progress switch;

Figs. 19 to 24, inclusive, show the hour tens and units, day tens and units, minutes tens, units and tenths of minutes and district number tens and units register relays for registering the answer time;

Figs. 25 to 30, inclusive, show the hour tens and units, day tens and units, minutes tens, units and tenths of a minute and the district number tens and units register relays for registering the disconnect time;

Figs. 31, 32 and 33 show the day circuit;

Figs. 34 to 37, inclusive, show the hour circuit;

Figs. 38 to 40, inclusive, show the frame number register relays; Fig. 40 also showing the B digit register relays;

Figs. 41 and 42 show the C, D, E and F digit register relays;

Fig. 43 shows the day tens and units relays for registering the day of the initial entry;

Fig. 44 shows the hour tens and units relays for registering the hour of the initial entry;

Figs. 46 and 47 show the elapsed time register relays;

Figs. 48 to 53, inclusive, show the circuits for computing the elapsed time; and

Figs. 54A to 54F, inclusive, show portions of a record tape illustrative of the different types of entries submitted for sensing by the reader of the computer circuits.

Fig. 55 is a schematic of a record to be processed.

SECTION I

The assembled record

In the exemplified form of the invention shown and described herein by way of illustration, the present invention is intended for sensing a perforated record tape prepared by the assembler circuits and apparatus shown and described in the copending application of W. W. Carpenter and J. W. Gooderham, Serial No. 724,992, filed January 29, 1947, and from such record computing the charge to be made for each call and for printing a ticket.

Generally speaking there are three types of entries recorded for each call in the initial central office tape. The first entry, called the "initial" entry, is recorded by the central office perforator after the central office equipment has established the connection between the two subscribers' lines. If the connection is a local connection, to be charged for in terms of standard charge units and requiring no detailed account of the call on the subscriber's bill, the entry usually comprises a first group of characters which record the calling subscriber's line number, another group of characters which record the trunk number over which the connection was established and certain other characters which are either for the purpose of controlling the operation of the assembler or are otherwise for use by the computing device. If the connection is a toll connection, to be charged in money units and requiring a detailed account of the call on the subscriber's bill, the "initial" entry, besides containing the group of characters relating to the information above mentioned for a local connection, also contains other groups of characters which identify the called subscriber's number and which supply certain other items of information for the use of the computing device.

The remaining two entries are the "answer" and "disconnect" entries, respectively, the former being entered on the central office record to record the time of answer when the called subscriber answers and the latter being entered on the record to record the time of disconnect when either subscriber restores his receiver. There is no difference between the two entries other than the difference in the notation of the time and the relative position in the tape record, the remaining characters or groups thereof in both entries being the identity of the trunk (which of course is the same for the same call) and a certain control character which is the same for both entries.

Besides the entries pertaining to established connections the central office record tape also contains certain other entries the details and significance of which will be presently explained. There is, for instance, the "hour" entry which is placed on the tape at the beginning of each hour and the "day" entry which is placed on the tape in addition to the "hour" entry at 3 a. m. of each day and at the beginning and end of a tape record.

Thus a record tape is produced for each group of trunks in a central office and each tape will have recorded thereon a number of entries pertaining to calls established over each of the trunks in the group. As previously stated the

three entries pertaining to each call are not, of course, adjacent to each other but disposed over the tape since, after an entry is made for one call established over a particular trunk in the group, other entries may be made immediately thereafter for calls established over other trunks in the same group. By means of the assembler disclosed in the copending application of W. W. Carpenter and J. W. Gooderham hereinbefore referred to, the three entries pertaining to each call are assembled together and recorded in consecutive order on another tape in the chronological order in which they were recorded on the central office tape and the entries pertaining to calls established over the same trunk are collected together on the tape in the chronological order in which the calls were originated. Since the "district" trunk group for which a central office record tape is produced is limited to one hundred trunks, with each trunk having a designation 00 to 99, the assembler produces ten separate tapes by a first operation known as the "first district sort" in which the entries on the central office record tape are separately recorded on ten different tapes in accordance with the units digit of the district trunk numbers, and by a second operation known as the "second district sort" in which the entries on each of said ten different tapes are then separately recorded on ten other and final tapes according to the tens digits of the district trunk numbers. The final tapes will then have all the entries for all calls established over the trunks collected and chronologically arranged. These final tapes are then joined into one tape which may be used in the computer and ticketer of the present invention.

Having indicated in general terms the form and character of the record tape to be sensed by the computer of the present invention, attention is now directed to certain figures of the drawing which show some of the typical entries on the tape as it is presented to the computer. Attention however is first directed to Fig. 54A which shows the number and general arrangement of the punch positions on the record tape. The latter is wide enough to accommodate twenty-eight punch positions suitably spaced in staggered formation across the tape to conserve tape width, though in all the figures where the tape or portions thereof are illustrated these positions are shown in straight line alignment for ease of perception.

The twenty-eight punch positions in each line of the record across the tape are utilized to record six digits indicated as digits A to F, inclusive, with digit A at the extreme left of the tape and digit F at the extreme right. Obviously the order could be reversed so far as recording and sensing are concerned except that if the order is reversed, the wiring of the punch magnets of the central office perforator and the wiring of certain registers and magnets of the present invention would also have to be reversed.

For the recording of the first digit A three punch positions are allocated, but for the recording of the remaining five digits B to F, inclusive, five punch positions are allocated, thus making a total of twenty-eight punch positions. Now the reason why only three positions are reserved for the A digit is because this digit is used for control purposes to indicate generally the character of the entry. And since no more than three values of this digit are utilized for this purpose, the value of the digit never exceeds 3, a fact which makes it simple to record the value "1"

in the first position, the value "2" in the second position and the value "3" in the third position. Each of the other five digits, however, may have any value from 0 to 9, inclusive, and to record each digital value by punches in the five positions reserved for each of the digits, the following code is used in which, for the value of each digit two, and only two, positions are punched (the punched position being indicated by "X" in the code as follows).

Code of holes punched in the tape

Numeral	Hole Position				
	(a)	(b)	(c)	(d)	(e)
0	X	X			
1	X			X	
2		X		X	
3				X	X
4		X			X
5			X	X	
6	X		X		
7		X	X		
8			X		X
9	X				X

The two-out-of-five code has been adopted because errors that might result in the punching of more or less than two positions may be detected by suitable checking apparatus. It will be noted from Fig 54A that the punch positions for each of the digits B to F, inclusive, are given the small letter designations (*a*) to (*e*), inclusive, beginning with the first punch position allocated to the digit.

Referring now to Figs. 54B to 54F, inclusive, these figures illustrate portions of the final record tape with a typical entry shown recorded in each figure by the filled-in punch positions.

Fig. 54B shows a typical answer or disconnect entry. Of the six digits in the tape, the digit A, the "entry" or control digit, is always "2," said digit being recorded on the tape by a punch in position (*b*) of the three positions reserved for the A digit. Digits B, C and D are reserved for recording the time of answer or disconnect. This time is recorded in tens of minutes (tens), minutes (units) and tenths of a minute (tenths). Thus in the figure the three digits B, C and D are shown to be "111," recorded in terms of the above two-out-of-five code. The digits indicate that the time of answer or disconnect occurred eleven minutes and six seconds after the hour.

The last two digits E and F record the number of the trunk (or district as it is more often called) over which the connection was established. As previously stated, the districts in a central office are divided into groups of a hundred (or fraction thereof) with a perforator for producing the record assigned to each group and available to each district in the group whenever an entry is to be recorded on the tape. In order to record the district involved in the connection, each district in the group is given a numerical designation of from 00 to 99, and when the perforator is seized by a district for the purpose of making an entry (in this case the answer or disconnect entry) the number of the district is recorded along with the time of answer or disconnect and the control digit. In Fig. 54B the district number is illustrated as being "71." As previously mentioned, there is no difference between an answer and a disconnect entry of the same call except in the recorded time

Fig. 54C shows an initial two-line entry for a "bulk-billed" call; that is a call for which no details are to be furnished the calling subscriber

and the charge for which is to be computed in terms of standard local charge units. The entry occupies two lines of the record tape because all of the information making up the entry cannot be put on one line. On the first line (reading from the bottom) are the two entry or control digits A and B (in this case two control digits being necessary) and their values for an initial two-line entry are always "3" and "1," respectively.

The C digit is called the "index" digit and its value determines the charge for the call, in the sense that the value of the digit determines the number of charge units for an initial unit period of conversation and the number of charge units for the intervals of over-time conversations. The value of the index digit (for bulk-billed calls) ranges from 1 to 8, inclusive, as shown.

The D digit is reserved for the party designation. As is well known a modern telephone exchange includes individual lines and party lines and, of course, when a call is made from a party line it is necessary to ascertain which party made the call in order that the charge therefor may be assessed against the subscriber who made it. For the purpose of party identification the D digit of the first line of the initial entry is reserved for line and party distinction. If the calling subscriber has an individual line, the value of the digit recorded is "1," as shown, while if he is one of a group of subscribers whose stations are connected to the same line, a suitable digital value (not shown) is reserved and used for each of the subscribers or "parties." As in the case of a single line answer or disconnect entry, the E and F digits are used for recording the district number which, as in Fig. 54B is indicated in Fig. 54C as "71."

On the second or "supplementary" line of a two-line initial entry the A digit is always "1" and indicates that the line is a supplementary line of an initial entry, the circuit of the computer being so arranged that when an initial entry is sensed and the A and B digits thereof are "31," the equipment is readied to receive the two lines as a part of the same initial entry. The remaining digits B to F, inclusive, of the second line are reserved for the designation of the calling line. In the particular embodiment of the telephone system disclosed in the application of W. W. Carpenter and R. E. Collis, Serial No. 759,402, filed July 7, 1947, the designation of the calling line is recorded in terms of its position in a cross bar switch of a designated array of switches. It is, of course, possible to record the line in terms of its directory number, and when this is done digits B to F, inclusive, of the second line of the entry would record the directory number instead of a designation (as at present) indicating the location of the line on a certain cross bar switch frame. As shown in Fig. 54C the line number indicated therein is "04826."

Fig. 54D illustrates an initial four-line entry. This entry is made for a toll call or for any call the particulars of which are to be furnished to the calling subscriber. The first two lines of the entry are substantially similar to those of an initial two-line entry except that the A and B digits are "33" instead of "31," the different value of the B digit indicating to the computer that there are three supplementary lines for the entry instead of one. The index digit is also different in that it has the value "9" instead of 1 to 8, inclusive, the reason being that the value "9" indicates that the charge for the call is to be made in

money units which must be specifically determined in accordance with the distance between the two subscribers and the duration of the conversation. The A digit of the third supplementary line is "1" to indicate that it is a supplementary line, while the B digit is given the arbitrary value "0." The C digit of the third supplementary line is reserved to indicate the calling numbering area and whether the called number in the identified area is below or above 10,000. The number of areas is limited to five, each of which is designated in the C digit by the values 0 to 4 except that if the called number in the identified area is over 10,000 the value of the C digit designating the area is increased by five. Thus if the called area is "0" and the called subscriber therein has a four-digit number, the C digit will be recorded as "0," but if it is a five-digit number the C digit will be recorded as "5," as indicated in Fig. 54D. Digits D, E and F of the third supplementary line are used to record the office of the called subscriber, which is usually a three-digit number. In the figure the number illustrated is "794."

In the last or fourth supplementary line and excepting for the A digit which has the value "1" to indicate that the line is a supplementary line, the five digits B to F, inclusive, are used to record the numerical portion of the called subscriber's number which is either four digits if it is an individual line or party line, or five digits if it is a party line having an additional digit assigned to the party station. Where the number is a four-digit number the F or last digit is given the arbitrary value "0"; otherwise it will be given the digit which indicates the digit (or letter) assigned to the party station. In Fig. 54D the called line number is illustrated as being "8437."

Fig. 54E illustrates a regular hour entry. This entry is placed at the beginning of each hour on the central office tape and reproduced on the final tape. It is a single line entry and has "381" for the value of the control digits A, B and C, the last two digits of this number indicating to the computer that the entry is one which is to be recorded in the computer. The D digit is given the arbitrary value "0" while the digits E and F are used for recording the hour itself. Since the latter may have any value from "00" to "23" depending on the hour, the E digit may have any digital value 0, 1 or 2 while the F digit may have any digital value 0 to 9, depending on the hour when the entry is made.

Fig. 54F illustrates a "district trouble" entry and has the fixed designation "385400" as illustrated in the figure. In the production of the central office record tape a registering apparatus associated with the district selector (trunk) and controlling the establishment of the call thereover, has as one of its functions a test to determine whether certain charging devices in the district are normal. If this apparatus finds these devices falsely operated the perforator is summoned immediately to perforate the special entry "385400" on the tape, said entry thus being placed on the tape before the district can be used to establish another call thereover which might result in a false charge condition to be perforated on the tape for the call previously established. Such a false charge condition would occur, for example, if the previously established call was not answered and if the next subsequent call was from a flat rate station for which no charge record should be made and for which no

initial entry will be made. In this case, answer and disconnect entries would be made for the flat rate call (because of the trouble condition) and these entries would then become falsely correlated with the initial entry of the previous call that was not answered, thus causing the subscriber who initiated the latter call to be falsely charged therefor. Hence, in order to prevent the false association of the answer and disconnect entries of the flat rate call with the initial entry of the previous not answered call, the special trouble entry "385400" is perforated on the tape before the flat rate call is established. This special entry is punched by the reperforator of the assembler in the final tape where it appears immediately following the initial entry of the connection established over the district having the falsely operated charging device. The computer is designed to look for and recognize the three entries for a call and to recognize them in the reverse chronological order. If it recognizes and registers two answer and disconnect entries it will be expecting thereafter an initial entry. But if, instead of encountering this entry it encounters the special entry "385400," it knows that the two or more previously recognized answer and disconnect entries pertain to flat rate calls established over the defective district which, unless such district is taken out of service immediately, may again be taken into use to establish connections including those from flat rate lines for which no charges should be made. And because of the abnormality of the charging circuits in the district the latter will, for such lines, call in the perforator and record answer and disconnect entries therefor but not initial entries. Hence if the computing apparatus registers two or more answer and disconnect entries and thereafter encounters the "385400" entry it will cancel the answer and disconnect entries.

SECTION II.—GENERAL METHOD OF OPERATION

With the above understanding of the significance of the different entries on the final record tape to be analyzed, the operation of the apparatus of the invention in response to the sensing of the record will now be given.

The perforated tapes are fed into the reader. Upon the operation of the ST key (Fig. 6) the call records on the tape are read by the relays in the control and reading circuits in Figs. 5 to 10 inclusive, the first operation being to insure that the proper number holes are punched in the particular line of the tape being read. As will be described later the call elements are arranged on the perforated tape in the order of "disconnect" time, "answer" time and the initial entry, said entries being sensed on the tape in a reverse direction from that recorded in the local office tape.

The date and the tape identification entries are found on the perforated tape at the beginning and the end of the call records for each district. The district frame number, and the day and the hour will be sensed and recorded in the district frame, day and hour register circuit so that this information will be available for printing on the ticket. The hour and day circuits are arranged to keep a continuous record of the date as the hour and day entries on the tape change as the calls are processed.

On a complete call, the first entry read will be a disconnect time entry. When the control circuit of Figs. 2 to 6 inclusive recognizes the dis-

connect time entry, connector relays, Fig. 10, will be operated which will connect the register relays of Figs. 27 to 30 inclusive to the reading relays of Figs. 7, 8, 9 and 10 to register the three digits of the disconnect time and the two digits of the district number as indicated by the holes punched in the tape. At the same time the connector relays of Fig. 10 will connect register relays of Figs. 25 and 26 to the hour and day circuits of Figs. 31 to 37 inclusive to register the hour and day (two digits each) of the disconnect time on the register relays of Figs. 25 and 26.

The next entry found on the tape will usually be the answer time entry. When the control circuit of Figs. 2 to 6 inclusive recognizes this entry it will cause a set of connector relays of Fig. 11 to be operated to connect the reading relays of Figs. 7, 8, 9 and 10 to the register relays of Figs. 21 to 24 inclusive. This operation will register the three digits of the answer time and the two digits of the district number as indicated by the holes in the tape. At the same time the connector relays of Fig. 11 will connect other sets of register relays of Figs. 19 and 20 to the hour and day circuits of Figs. 21 to 27 inclusive to register the hour and day of the answer time.

Assuming that the next entry on the tape is the initial entry or the calling line identification, the control circuit of Figs. 2 to 6 inclusive will recognize this entry and proceed in a similar manner to operate the connector relays of Fig. 11 to register the five digits of the first line of the calling line entry on the relays of Figs. 40, 41 and 42. This will result in registering the entry number, the index number, the party designation and the two digits of the district number. These B, C, D, E and F digits will be registered on relays of Figs. 40, 41 and 42. At the same time the connector relays will connect other sets of register relays of Figs. 43 and 44 to the hour and day circuits of Figs. 31 to 37 inclusive to register the hour and day of the calling line entry.

When the answer time and disconnect time were registered in the circuits of Figs. 21 to 24 and 27 to 30, these time elements were transferred to the computing circuit of Figs. 48 to 53 inclusive for computing the elapsed time of conversation. The computing circuits of Figs. 48 to 53 inclusive are arranged on a bi-quiniary basis with two sets of seven relays A00, A5, and A0 to A4 inclusive and B00, B5, B0 to B4 inclusive. The circuits are so arranged that when a number is registered on the (A) relays of the computing circuit and another number registered on the (B) relays of the same circuit the paths through the contacts of the relays A— and B— are arranged to register the sum of the two numbers on the register relays of Figs. 46 and 47. As there are three digits of time involved, namely, tens of minutes, units and tenths of minutes, three computing circuits of Figs. 49 to 53 inclusive are required to register the time. In computing the elapsed time it will of course be necessary to make a subtraction operation by subtracting the answer time from the disconnect time. This subtraction operation is performed in the computing circuit by first registering the disconnect time on the relays B— of three of the computing circuits shown in Figs. 49, 50, 51, 52 and 53 and then, by taking the "complements" of the numbers represented by the answer time, registering said complements on the relays A— of the three computing circuits. The correct elapsed time will be found by adding the disconnect time and the "complement" of the answer time. The complement of the answer time is obtained by subtracting each digit of the answer time from the numeral "9" and then adding "1" to the tenths digit in the computing operation. The addition of "1" to the computation is performed by grounding the "carry in 1" conductor to the "tenths" computing circuit. The complement of the answer time (subtracted from "9") is obtained by a proper interchange of the conductors between the answer time registering relays and the relays A— of the three computing circuits. The three computing circuits, tenths, units and tens are connected together by the "carry in 0" and "carry in 1" conductors. Where the sum of the two numbers in the first adding circuit tenths is greater than 9 the "carry out 1" conductor will be grounded which, in turn will ground the "carry in 1" conductor to the next higher digit. If the sum of the two numbers in the first circuit is less than 10, then the "carry out 0" conductor is grounded and the "carry in 0" conductor of the next higher computing circuit would be grounded. The sum of the numbers in the first computing circuit will be registered in the tenths elapsed time circuit of Fig. 47, the next digit in the units time circuit of Fig. 46 and the final digit in the tens time circuit of Fig. 46. As the time recorded in the answer time and disconnect time entries is in minutes and tenths of a minute after the preceding hour entry, it is apparent that a call may straddle an hour entry, or a call may last for a period of one or more hours. In such a case the reader control circuit will find one or more hour entries between the recording of the disconnect time and the answer time. Therefore the computation of the elapsed time must also include the addition of sixty minutes for each hour found between the disconnect and answer time entries on the tape. To care for this an "hour computing" circuit shown in Figs. 48 and 49 is also provided. The circuit is arranged so that when a disconnect time entry has been registered, the hour entries for one or two—60 or 120 minutes—recorded between the disconnect time and the answer time will be registered on the relays B— Fig. 48 of the "hours computing" circuit. If there were no hour entries encountered between the disconnect time and the answer time, the hour circuit would record a "0" hour condition on the relays B— of the hours computing circuit. The circuits are arranged so that the sum of the two numbers in the tens computing circuit of Figs. 49 to 50 is registered on the A— relays of the hours adding circuit of Figs. 48 and 49 instead of directly on the relays of the circuit of Fig. 46. The sum of the two numbers in the hours adding circuit will then be registered on the tens elapsed time register relays of Fig. 46. Where two hour entries are encountered between the disconnect and the answer times, it will be necessary to add a "hundreds" digit or 120 minutes to the elapsed time. The hundreds digit addition is cared for in the simplified computing circuit of Fig. 47. The end result of these computations is that elapsed time, including the hours if any, is registered in three figures on the relays of Figs. 46 and 47.

With the three elements of the call registered in the circuit and the computing operation completed, all of the information is available for printing a ticket for this call. The operation of

these relays will cause the printing operation to be started. The printing circuit is arranged to print 30 characters on a ticket for "bulk-billed" calls and 40 characters on a ticket for "detailed-billed" calls where the called subscriber's number is to be printed. The following information will be printed on each detailed-billed call:

Entry number (second digit of calling line entry)
Message index number
Party
District number (2 digits)
District frame or recorder number (2 digits)
Calling number (5 digits—digits B to F of the second line of the calling entry)
Day (2 digits)—answer time
Hour (2 digits)—answer time
Minute (3 digits)—answer time
Elapsed time (3 digits)
Numbering area (1 digit)
Called office code (3 digits) (third line of calling line entry)
Called number (5 digits) (fourth line of calling line entry)

It will be noted that the first information to be printed will be the digits on the first line of the calling line entry including the entry number, message index number, party, designation and district number, which were registered in the circuit on the relays of Figs. 40, 41 and 42. When this information has been printed by the ticketer circuit of Figs. 17, 18 and 45, the circuit will function to release the register relays of Figs. 40, 41 and 42, to set the reader to the next line and to register the digits of the second line of the calling line entry on the same relays of Figs. 40, 41 and 42. After the second line has been printed on the ticket, the relays of Figs. 40, 41 and 42 will be released again and the circuit will function to set the reader again and to register the digits on the third and fourth lines of the calling line entry (one line at a time) provided it is a detailed-billed call.

The first two digits on the ticket are for special information purposes. The first digit will indicate by a proper numeral when the disconnect entry on the call has been due to a district timed release condition and when the call is a "straddled" call. The second digit on the ticket will be used to indicate the following trouble conditions:

District charge relay trouble (3854);
Transfer to or from emergency recorder (3855);
Master timing circuit out of synchronism (3856);
Master timing circuit out of synchronism and transferred to emergency recorder (3857).

To care for these cases where the elements of a call are straddled by the cutting of the tape in the central office, the printing of the ticket is arranged to print the elements of the call which appear on each end of the tape. In some cases this will involve the printing of a disconnect time element or the disconnect and answer time elements or the answer time and the calling line elements or the calling line element alone depending upon how the call is split when the central office tape is cut. The tickets in the case of these straddled calls will be arranged to record the district number, the frame, and the day and hour and minute, the same as on a complete call. Dashes or asterisks will be printed on the ticket where other call information is not available. Also, tickets will be printed for calling line entries representing "don't answer" and "busy" calls, so indicated on the local office tapes by the recording of initial or calling line entries only.

When the complete ticket has been printed the relays of the circuit will be released and the reader stepped forward to process the next call element on the perforated tape.

Before proceeding with a description of the detailed operation of the invention, a brief description will be given of the component parts and their principal functions.

Fig. 1 shows the reader, the structure of which is adapted for sensing a perforated record though, of course, it may be modified or changed to suit the form of record to be sensed. Its mechanical parts are substantially similar to those of the reader disclosed in the copending application of W. W. Carpenter, Serial No. 666,280, filed May 1, 1946. It comprises a motor driven cam shaft which controls the reciprocal operation of the 28 sensing pins AA to FE, the points of which, for every revolution of the shaft, impinge upon the surface of the record to be analyzed. Each pin is provided with a pair of contacts called "reader contacts" bearing the same designation as the associated pins, and whenever a pin impinges upon the record and enters a perforation therein it closes its associated reader contacts to apply ground to the conductor connected to one of the contacts. Each revolution of the shaft is termed a "sensing cycle," the latter comprising a period during which the pins have entered perforations and closed their respective reader contacts and a period when the pins are out of the perforations and have opened their reader contacts.

Mounted upon the same shaft are 12 eccentric cams each of which controls a set of contacts designated (reading from top to bottom of the figure) C0, C1, C2, C3, C4, C5, C6, C7, C8, C9, C10 and C11. These contacts are closed and opened for a definite period in relationship to the sensing cycle and serve to control certain circuit functions which will later be described in detail. The cams are so cut that contacts C3 and C7 are closed when contacts C0, C1, C2, C4, C5, C8 and C9 are open and are open when the latter contacts are closed. Contacts C10 and C12, though closed and opened for the same time intervals as those of the cycle, nevertheless close a short time after the beginning of the closed period of the cycle. Reference may be had to the time charts shown in Figs. 23A, 23B, 23C and 23D of the Carpenter-Gooderham application hereinbefore referred to for a more complete understanding of the timing of the opening and closing of the various contacts of the reader.

A part of the reader mechanism is the reader drum upon which is mounted the record to be analyzed. The step-by-step rotation of this drum is controlled by a cam operated armature through a simple pawl and ratchet arrangement, the ratchet wheel being secured to the drum shaft. When the magnet STP is operated, the armature is held in the position to which it was moved by the cam so that the pawl which has been moved to engage a tooth of the ratchet wheel is held against the tension of a spring and thus cannot move to step the ratchet wheel. There is, therefore, rotation of the drum and no advance of the record tape. When, however, the magnet is de-energized, the release of its armature causes the pawl to advance the ratchet one tooth space, thus rotating the drum through an arc equal to the distance between two respective lines of perforations of the record mounted thereon and bringing the next line of perforations into coincidence

with the pins when the latter impinge upon the surface of the record during the closed period of the sensing cycle.

One mechanical feature of the reader is the automatic advance of the reader drum one step for every rotation of the reader shaft so that if magnet STP is not energized, both the shaft and drum rotate in synchronism to advance the record one line of perforations for sensing on the next reading cycle. This is accomplished by means of an auxiliary shaft coupled to the shaft of the motor RDR and having an eccentric cam mounted thereon directly under the armature of the stepping magnet STP. The high part of the cam is so positioned that on every revolution it mechanically lifts the armature against the tension of a spring so that for every revolution of the reader cam shaft there is a corresponding step of the reader drum. When the magnet is operated and the armature is held electromagnetically, the attraction of the armature toward the core of the magnet is greater than the spring tension, leaving a little clearance between the high point of the cam and the face of the armature, which causes the cam to rotate freely without affecting the armature and therefore the reader drum. The consequence is that while the magnet is energized, the record is held in the same position and the sensing pins will repetitively sense the same line of perforations. By means of this arrangement it is possible to hold the record in one position for as many sensing cycles as may be desired.

In Fig. 3 are shown two groups of relays, the first group consisting of relays TA, TB, and TC for the purpose of extending the reader contacts to reader relays disclosed in Figs. 7, 8, 9 and 10 and the second group, consisting of relays RCKA, RCKB and RCKC, for the purpose of extending the reader contacts to the bank of lamps AA to FE. The group of relays RCKA, RCKB and RCKC is operated over the contacts of key RLP (Fig. 3). In case of failure, therefore, the attendant, by operating key RLP and noting which lamps light and which are not lighted, will be able to tell which pins have entered perforations.

The automatic ticketer disclosed in Fig. 45 is of the type disclosed in Patent 2,309,688, granted to W. J. Zenner on February 2, 1943. The progress switch for successively controlling the ticketer to print digits on a ticket in accordance with items of registered information, is of the step-by-step type operable in 44 steps to complete one revolution or operating cycle.

SECTION III.—DETAILED OPERATION OF THE CIRCUITS

To start the processing of a record tape the CP and MOT keys of Fig. 2 are operated to close the circuit for the STP magnet and to establish the circuit of the MOT relay. The latter circuit extends from battery through the winding of relay MOT, over conductor **231** of cable **230**, the upper back contact of the AL relay of Fig. 4, conductor **232** of cable **230**, the upper alternate contacts of key MOT and over the upper alternate contacts of key CP to ground. Relay MOT thereupon operates and connects motor RDR to a source of 110-volt commercial power, whereupon the motor operates to rotate the cam shaft **237** of the reader. With the key CP operated the CP lamp **238** is lighted to indicate to the attendant that the reader is in operaion. The record tape is then threaded onto the rotating drum of the reader.

The circuits are arranged so that the reader can be stepped forward by manually operating the key RDR—STP of Fig. 2 once for each desired step. When the key is operated, a circuit is closed from ground over the C3 reader contacts, the upper contacts of the key, conductor **246** of cable **240**, the No. 2 back contact of relay SR1 of Fig. 4 and to battery through the winding of relay SR2. Relay SR2 operates and locks through the winding of relay SR1, over the contacts of relay SR2 and conductor **233** of cable **230** to ground over the lower contacts of key RDR—STP. Relay SR1, being shunted, does not operate in this locking circuit. On the next make cycle of the reader, the contacts C3 open and relay SR1 not then being shunted operates in the locking circuit of relay SR2. Cam contacts C10 now close to establish a circuit from ground thereover, over conductor **245** of cable **240**, the No. 1 contacts of relay SR1, the No. 1 back contact of relay SR3 and to battery through the winding of relay SR4. Relay SR4 thereupon operates and locks through the winding of relay SR3, over its No. 2 contacts and conductor **233** to ground at the lower contacts of key RDR—STP. Relay SR4 now closes a circuit from ground over the No. 2 back contact of relay SR3, the No. 1 contacts of relay SR4 and through the windings of relays RS1 and RS2 to battery, thereby to cause the advance of the reader in the manner subsequently described. When the cam contacts C10 open, the shunt around the winding of relay SR3 is opened and this relay now operates over the locking circuit of relay SR4 and opens the circuit of relays RS1 and RS2. The relays SR– now remain locked to ground over the lower contacts of key RDR—STP until the key is released. When the key is released and these SR– relays release, the reoperation of the key is again effective to cause the reoperation of the SR– relays in the manner just described, to control the advance of the reader a further step. Thus the reader will advance one step only on each operation and release of the key.

The tape record may also be advanced rapidly to pass the splice pattern or any other portion of the record past the sensing pins. This may be accomplished by opening the key TRS of Fig. 2, thereby opening a shunting ground, applied from the No. 3 back contact of relay RS1 of Fig. 4, over conductor **243** of cable **240** and over the contacts of key TRS, from around the cam contacts C8 of the reader, so that the magnet STP may then be intermittently operated and released under the control of cam contacts C8. The circuit of magnet STP may be traced from ground over contacts C8, through the magnet winding, over the lower contacts of operated key CP and through resistor **239** to battery. The reader drum is then advanced under the control of the cam shaft as previously described.

To determine the position to which the record tape has been advanced, the attendant observes the lighted reader checking lamps of Fig. 3 which become selectively lighted through the closure of the sensing pin contacts of the reader over contacts of relays RCKA, RCKB, and RCKKC, which relays are operated under the control of the key RLP.

When the lighted lamps indicate that the end of tape splice pattern has been passed over and that the reader drum has advanced the record tape into the position in which the sensing pins are sensing the first of the tape entries, that is, the marker group entry, the attendant operates

the start key ST of Fig. 6 to start the automatic progression of the tape record. The key RLP may now be released if further observation of the reader checking lamps is not required. The operation of key ST establishes a circuit from battery through the winding of the ST1 relay, the normally closed contacts of the release key RLS, the upper back contact of the ST2 relay, the contacts of key ST, conductor 601 of cable 600, the lower back contact of relay GD of Fig. 13, over conductor 602 of cable 600, the lower back contact of relay LK1 of Fig. 1, conductor 611 of cable 610, the upper back contact of relay RS1 of Fig. 5, conductor 241 of cable 240 to ground over the reader contacts C7 during the closed cycle thereof. Relay ST1, upon operating, locks through the winding of ST2 to ground over its inner lower contacts, but relay ST2, being shunted over its upper back contact to ground at the C7 reader contacts, does not operate until such reader contacts again open. After contacts C7 open, relays ST1 and ST2 remain operated over the locking circuit of ST1 under the control of release key RLS. Upon the next closure of the C7 reader contacts and the connection of ground over the circuit traced to conductor 601, a circuit is established over the inner-upper contacts of relay ST1, over the upper front contacts of relay ST2, conductor 605 and to battery through the winding of relay AC0 of Fig. 5. Relay AC0 operates and locks over its No. 6 contacts, over the lower contacts of key EMG—RLS and to ground over the No. 7 contacts of relay LK1, after relay LK1 subsequently operates, whereby it is held operated until relay LK1 releases at the end of sensing a single line or multi-line entry. A branch of this locking circuit extends to ground over a conductor of cable 250 and reader cam contacts CO to insure that relay AC0 will be maintained operated following the release of relay LK1 until the reader has completed the current sensing cycle.

Relay ST1, upon operating, also establishes the circuit of relay TD which may be traced from ground over its upper contacts, conductor 606, and through the winding of relay TD and resistance 440 to battery. Relay ST1 also establishes a circuit from ground over the upper No. 4, normal contacts of relay PS of Fig. 17, conductor 603 of cable 600, the lower contacts of relay ST1, conductor 612 of cable 600 and in parallel through the windings of relays TA, TB and TC to battery. Relays TA, TB, TC and TD, therefore operate, relay TD upon operating, closing an alternate circuit for relays TA, TB and TC from ground on conductor 603, conductor 613 of cable 600, over the No. 5 contacts of relay TD, then over conductor 612 and through the windings of relays TA, TB and TC to battery.

Relay AC0, upon operating, connects the AA, AB and AC reader contacts with the A1, A2 and A3 reader relays respectively. The AA reader contacts are connected over conductor 201, the No. 8 contacts of connector relay TA, conductor 311 of cable 310, the No. 8 contacts of relay AC0 and to battery through the winding of relay A1. The AB reader contacts are connected over conductor 202, the No. 7 contacts of connector relay TA, conducts 312 of cable 310, the No. 9 contacts of relay AC0 and to battery through the winding of relay A2. The AC reader contacts are connected over conductor 203, the No. 6 contacts of connector relay TA, conductor 313 of cable 310, the No. 10 contacts of relay AC0 and to battery through the winding of relay A3. These three reader contacts read the three primary entry or A Digit perforations punched in the perforated tape.

Relay AC0 also establishes a circuit from ground over its No. 2 contacts and conductor 1504 of cable 1500 to battery through the winding of relay GC of Fig. 15, which relay operates and, in turn, establishes over its No. 4 contacts and conductor 1527 an operating circuit through the winding of relay GD of Fig. 13. With relays AC0, GC and GD operated, the following circuits are also established: From battery through the winding of relay RAD of Fig. 14, the No. 1 back contact of relay RL, conductor 1528, No. 2 back contact of relay RLS3, Fig. 15, conductor 1505 of cable 1500, No. 7 back contact of relay CE3, Fig. 5 and to ground over the No. 3 contacts of relay AC0; from battery through the winding of relay RDS, Fig. 14, over the No. 2 back contact to relay RL, conductor 1529, upper back contact of relay RLS3, Fig. 15, and to ground over the No. 1 contacts of relay GC; from battery through the winding of relay RLA, Fig. 14, over the No. 3 back contact of relay RL, conductor 1530 and the No. 2 back contact of relay RLS2 of Fig. 15, and from battery through the winding of relay RLT, Fig. 14, over the No. 4 back contact of relay RL, conductor 1531 and the No. 2 back contact of relay RLS2 and thence over conductor 1534 to ground over the No. 2 contacts of relay GD; from battery through the winding of relay RCLA, Fig. 14, over the No. 5 back contact of relay RL, conductor 1532 and the upper back contact of relay RLS1 of Fig. 15 to ground over the No. 3 contacts of relay GC and from battery through the winding of relay RLCB, Fig. 14, over the No. 6 contacts of relay RL, over conductor 1533 and to ground over the No. 3 contacts of relay GC.

On the end of the tape to be processed, the marker group, district frame, hour, day and month entries are encountered in the order enumerated. The marker group entry will be identified by the entry "334" followed by a zero and the two digits of the marker group number.

Sensing the marker group entry

When the marker group entry is sensed by the reader of Fig. 2, the sensing of the perforations for the A digit "3" of the entry will find a perforation in the *ac* position on the tape. The reader pin AC will therefore enter this perforation and the AC reader contacts will thereby close to cause the operation of the reader relay A3. Relay A3 upon operating establishes a circuit from battery through the winding of relay LK1, Fig. 6, conductor 631, the No. 1 back contact of relay CE1, conductor 1507 of the cable 1500, the No. 5 back contact of relay NUC of Fig. 15, conductor 1506 of cable 1500, the No. 1 back contact of relay A2, Fig. 5, the No. 7 contacts of relay A3, conductor 504, the No. 2 contacts of relay TD, Fig. 4, conductor 252 of cable 250 and to ground over cam contacts C5 of the reader. Relay LK1 thereupon operates and locks over its operating circuit to the No. 1 back contact of relay A2, thence over conductor 510, the No. 5 contacts of relay LK1, resistance 635, the No. 1 contacts of relay L2A connected in parallel with the lower contacts of relay RS2 over conductor 615 and 636, and to ground over the No. 1 contacts of relay AC0 and also in a branch circuit over the No. 2 contacts of relay LK1, conductors 637 and 504, the No. 2 contacts of relay TD and to ground over cam contacts C5 of the reader. Relay LK1 thus remains oper-

ated until relay CE1 or both relays RS2 and L2A have operated and cam contacts C5 have opened. Relay LK1 functions to supply off-normal grounds but otherwise has no utility unless a multi-line entry is being sensed. There being no perforations in punch positions *aa* and *ab*, the reader pins AA and AB are ineffective to close their contacts and to thereby operate the reader relays A1 and A2. It will be assumed that the marker group number is "00" and that therefore the perforations across the tape are "384000." As previously stated, the perforation for the A digit "3" has caused the operation of reader relay A3. The perforations for the B digit "8" will be in the punch positions *bc* and *be* and will therefore cause the closure of reader contacts BC and BE thereby closing circuits over conductor 206, the No. 3 contacts of connector relay TA to conductor 323 of cable 320, and over conductor 208 and the No. 1 contacts of relay TA to conductor 325 of cable 320, thence through cable 400 and to battery through the windings of reader relays B1C, B2C, B1E and B2E of Fig. 7. These relays therefore operate to register the B digit "8." The perforations for the C digit "4" are in the punch positions *cb* and *ce* and will cause the closure of reader contacts CB and CE, thereby closing circuits over conductor 210 and the No. 9 contacts of connector relay TB to conductor 332 of cable 330, and over conductor 213 and the No. 6 contacts of relay TB to conductor 335 of cable 330, and thence through cable 400 to battery through the windings of reader relays C1B, C2B, C1E and C2E of Fig. 8. These relays therefore operate to register the digit "4." The perforations for the D digit "0" are in the punch positions *da* and *db* and will therefore cause the closure of reader contacts DA and DB and the establishment of circuits over conductor 214 and the No. 5 contacts of connector relay TB to conductor 341 of cable 340, and over conductor 215 and the No. 4 contacts of relay TB to conductor 342 of cable 340, and thence to battery through the windings of reader relays DA and DB of Fig. 9. These relays therefore operate to register the digit "0." The perforations for the E digit "0" are in the punch positions *ea* and *eb* and will therefore cause the closure of reader contacts EA and EB and the establishment of circuits over conductor 219 and the No. 10 contacts of connector relay TC to conductor 351 of cable 350, and over conductor 220 and the No. 9 contacts of relay TC to the conductor 352 of cable 350, and thence to battery through the windings of reader relays EA and EB of Fig. 9. These relays therefore operate to register the E digit "0." The perforations for the F digit "0" are in the punch positions *fa* and *fb* and will therefore cause the closure of reader contacts FA and FB and the establishment of circuits over conductor 224 and the No. 5 contacts of relay TC to conductor 361 of cable 360, and over conductor 225 and the No. 4 contacts of relay TC to conductor 362 of cable 360, and thence to battery through the windings of reader relays FA and FB of Fig. 10. These relays therefore operate to register the F digit "0."

With these relays operated, a check circuit is established from ground over cam contacts C9 of the reader, conductor 242 of cable 240, the No. 3 contacts of connector relay TD, the No. 5 contacts of alarm relay AL, conductor 441, the No. 5 contacts of operated relay FA of Fig. 10, the No. 2 contacts of operated relay FB, the No. 1 back contacts of relays FC, FD and FE, conductor 911, the No. 5 contacts of operated relay EA of Fig. 9, the No. 2 contacts of operated relay EB, the No. 1 back contacts of relays EC, ED and EE, the No. 5 contacts of operated relay DA, the No. 2 contacts of operated relay DB, the No. 1 back contacts of relays DC, DD, and DE, conductor 912, the No. 6 back contact of relay C2A of Fig. 8, the No. 7 front contact of operated relay C2B, the No. 2 back contact of relay C2C, the No. 2 back contact of relay C2D, the No. 2 contacts of operated relay C2E, conductor 806, the No. 6 back contact of relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 8 front contact of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, conductor 901 of cable 900, the inner lower back contact of relay D1S of Fig. 15, the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the lower back contact of relay CC, conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1, the No. 2 back contact of relay LK2, the No. 4 contacts of operated reader relay A3, the No. 3 back contact of reader relay A2, conductor 503, the No. 7 contacts of operated reader relay B1C of Fig. 7, the No. 6 contacts of operated relay B1E, conductor 707, the No. 4 contacts of operated relay C2E of Fig. 8, the No. 6 contacts of operated relay C2B, conductor 808 and to battery through the winding of the cancel entry relay CE1 of Fig. 5. Relay CE1 thereupon operates and over its No. 2 contacts connects ground over conductor 624 and through the windings of relays RS1 and RS2 to battery whereupon the latter relays operate and open the circuit of relay LK1 which releases.

Before proceeding with the functioning of the circuits following the proper operation of the CE1 relay, it will be assumed that in making the above check test for the proper number of perforations across the perforated tape for the marker group entry, it was found that one of the digit registers, for example the F digit register of Fig. 10, was operated in response to the reader sensing an extra perforation in the punch position *fc*, resulting thereby in the operation of reader relay FC in addition to the correct operation of relays FA and FB. As a consequence, the previously traced check circuit is extended from conductor 441, the No. 5 contacts of operated relay FA and the No. 2 contacts of operated relay FB, but is open at the No. 1 contacts of operated relay FC. The check circuit therefore is not completed to cause the operation of relay CE1. A similar condition would result if it were assumed that only one perforation, for example in punch position *fa*, was punched instead of two perforations in positions *fa* and *fb*, resulting in the operation of one relay FA of the F reader register. As a consequence, the previously traced check circuit extended to conductor 441 is now extended over the No. 5 contacts of operated relay FA, the No. 1 back contact of relay FB, and the No. 2 back contacts of relays FC and FD. It is open however at the No. 2 contacts of relay FE and therefore such check circuit is not completed to cause the operation of relay CE1.

The result of the failure to establish the check circuit due to the perforation of too many on too few perforations in a line across the tape, is that the CE1 relay does not operate and the reader is not advanced within approximately a 0.35 second time interval, which should be adequate for the performance of these functions. The time interval is measured by the condenser con-

trolled timing relay TM of Fig. 4. With the ST1 relay operated as previously assumed to start the functioning of the circuit to sense the entry on the tape, relay TD is also operated and, at its No. 1 back contact, removed a shunting ground from the charging circuit through the condensers 442, whereupon such condensers started to charge over a circuit extending from ground through resistance 443, through the condensers, over the upper normal contacts of test jack 444, through resistance 445, through the lower winding of relay TM and over the lower normal contacts of jack 444 to battery. The charging current flowing through the lower winding of relay TM energizes such relay but does so in opposition to the current flowing through the differentially wound upper winding which, with relay TD operated, is also energized over a circuit from ground through such upper winding, through resistance 446 and over the lower normal contacts of jack 444 to battery. Until the condensers 442 become fully charged, the current flowing through the lower winding of relay TM prevents the operation of the armature of this relay. However, after an interval of approximately 0.35 second, the condensers 442 will have become fully charged and current will cease to flow through the lower winding of said relay, causing it to attract its armature and establish an obvious circuit for the alarm relay AL.

Relay AL upon operating, locks over its No. 6 contacts to ground over the normal contacts of alarm cut-off key AL—CO, establishes an obvious circuit over its No. 2 contacts for the alarm lamp ALM, closes circuits over its Nos. 3 and 4 contacts for audible alarms (not disclosed), opens at its No. 1 contacts the previously traced circuit for relay MOT of Fig. 2 which releases to stop the reader motor RDR, and over its No. 5 contacts opens the previously traced check circuit over which the operation of the relay CE1 was attempted. The attendant will then take the necessary steps and remedy the trouble.

It will now be assumed that the CE1 relay is operated and that before the expiration of the time interval the RS1 and RS2 relays will have been operated to advance the reader, as will be later described. When the relay RS2 operates, it connects ground over its No. 1 contacts to establish a short circuit of condensers 442, which circuit may be traced over such relay contacts, through the condensers and resistance 443 to ground, thereby causing the condensers to discharge. With this shunt established, the strength of current flowing through the lower winding of timing relay TM is such that the flux established by the lower winding opposes the flux established by the current flowing through the upper winding. As a consequence, the relay does not operate, its armature is not attracted and relay AL is not operated.

Relay RS1, upon operating as previously described, locks itself and relay RS2 over the No. 2 contacts of relay RS1, through resistance 449 and over conductor 251 of cable 250 to ground supplied over cam contacts C3, and prepares a circuit to step the reader drum forward. All of these operations occur during the make period of the reader contacts. In case the reader relays are not operated to close the check circuit for relay CE1, relays RS1 and RS2 will not be operated and the reader will not step forward but will endeavor to operate the reader relays in the next closed cycle. Several trials to operate the reader relays will be made before the above-described timing circuit functions to stop further operation as previously described.

It will be assumed that relays RS1 and RS2 both operate. Relay RS1 upon operating, removes ground from the circuit of the STP magnet of the reader, which circuit was closed from battery through resistance 239, the lower contacts of key CP when such key was operated as previously described, through the STP magnet, over the normal contacts of the keys TRS and RSC, over conductor 243 of cable 240 and to ground over the No. 3 back contact of relay RS1. The opening of this circuit by relay RS1 permits the stepping of the drum of the reader to advance the next row of perforations on the tape record beneath the reader pins. Relay RS2 blocks the operation of the timing relay TM to terminate the measurement of the timing cycle as previously described. As soon as the reader advances, the operated reader relays release, in turn releasing relay CE1 which, in turn, opens the operating circuit of relays RS1 and RS2. These relays will release as soon as their locking circuit is opened upon the next opening of the cam contacts C3 of the reader.

Sensing the district frame entry

The next line in the end of tape record entry to be encountered by the reader will be that of the district frame entry. This entry is used to control the district frame circuits of Figs. 38, 39 and 40 to provide a running record of the district frame number as the call entries are being processed. The district frame number entry appears as one of the end of tape entries. The district frame entry is sensed before the call entries of the districts on the frame are processed. One of the important functions of the district frame circuit is to signal the control circuits of Figs. 13 to 16, inclusive, when the district frame number is changed. This change of number indicates when the tape was cut in the Central Office, and any partial calls on either side of the "end of tape" record should be printed as "straddle calls."

When the district frame entry, index "380" is sensed by the reader of Fig. 2, the sensing of the perforations for the A digit of the entry will find a perforation in the *ac* position on the tape. The reader pin AC will therefore enter this perforation and close the AC reader contacts, thereby causing the operation of the A3 reader relay. Relay LK1 now operates and locks in the manner previously described. There being no holes in punch positions *aa* and *ab* the reader pins AA and AB are ineffective to close their contacts and to thereby operate the reader relays A1 and A2. The D digit having no function at this time, the tape is therefore perforated for the D digit "0." It will be assumed that the digit frame number is "14." Thus the line of perforations across the tape will be "380014." As previously stated, the perforation "3" for the A digit has caused the operation of reader relay A3. The perforations for the B digit "8" will be in the punch positions *bc* and *be* and will therefore result in the closure of reader contacts BC and BE and the operation of reader relays B2C, B1C, B1E and B2E of Fig. 7 in the manner previously described. These relays will therefore operate to register the B digit "8." The perforations for the C digit "0" are in the punch positions *ca* and *cb* and will result in the closure of reader contacts CA and CB and the completion of circuits over conductor 209, the No. 10 contacts of connector relay TB to con-

ductor 331 of cable 330, and over conductor 210, the No. 9 contacts of relay TB to conductor 332 of cable 330, and thence through cable 400 and through the windings of reader relays C1A, C2A, C1B and C2B of Fig. 8 to battery. These relays therefore operate to register the C digit "0." The perforations for the D digit "0" are in punch positions *da* and *db* and will therefore cause the closure of reader contacts DA and DB, thereby closing circuits over conductor 214, the No. 5 contacts of connector relay TB to conductor 341 of cable 340, and over conductor 215, the No. 4 contacts of relay TB, to conductor 342 of cable 340, and thence through cable 400 and through the windings of reader relays DA and DB of Fig. 9 to battery. These relays therefore operate to register the D digit "0." The perforations for the E digit "1" are in the punch positions *ea* and *ed*, causing the closure of reader contacts EA and ED, the closure of circuits over conductor 219 and the No. 10 contacts of connector relay TC to conductor 351 of cable 350, and over conductor 222, the No. 7 contacts of relay TC to conductor 354 of cable 350, and thence through cable 400 to battery through the windings of reader relays EA and ED of Fig. 9. These relays therefore operate to register the E digit "1." The perforations for the F digit "4" are in the *fb* and *fa* punch positions thereby causing the closure of reader contacts FB and FE and the establishment of circuits over conductor 225, the No. 4 contacts of connector relay TC to conductor 362 of cable 360, and over conductor 228, the No. 1 contacts of relay TC to conductor 365 of cable 360, and thence through cable 400 to battery through the windings of reader relays FB and FE of Fig. 10. These relays therefore operate to register the F digit "4."

With these relays operated, a check circuit is established from ground over cam contacts C9 of the reader, conductor 242 of cable 240, the No. 3 contacts of connector relay TD, the No. 5 contacts of alarm relay AL, conductor 441, the No. 6 back contact of reader relay FA of Fig. 10, the No. 7 contacts of operated relay FB, the No. 2 back contacts of relays FC and FD, the No. 2 contacts of operated relay FE, conductor 911, the No. 5 contacts of operated relay EA of Fig. 9, the No. 1 back contact of relay EB, the No. 2 back contact of relay EC, the No. 3 contacts of operated relay ED, the No. 1 back contact of relay EE, the No. 5 contacts of operated relay DA, the No. 2 contacts of operated relay DB, the No. 1 back contacts of relays DC, DD and DE, conductor 912, the No. 5 contacts of operated relay C2A of Fig. 8, the No. 2 contacts of operated relay C2B, the No. 1 back contacts of relays C2C, C2D and C2E, conductor 806, the No. 6 back contact of relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 8 contacts of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, conductor 901 of cable 900, the inner lower back contact of relay D1S of Fig. 15, the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the lower back contact of relay CC, conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1, the No. 2 back contact of relay LK2, the No. 4 contacts of operated relay A3, the No. 3 back contact of relay A2, conductor 503, the No. 7 contacts of operated reader relay B1C, the No. 6 contacts of operated relay C1E, conductor 707, the No. 3 contacts of operated relay C2A, the No. 5 contacts of operated relay C2B and over conductor 807 to battery through the windings of district frame connector relays DF1 and DF2 of Fig. 12. The result, therefore, of sensing the district frame entry is to operate these connector relays in response to the registration of the A, B and C digits "380" whereby circuits are established to transfer the district frame number "14" recorded by the E and F groups of reader relays in response to sensing the E and F digits of the entry.

With the connector relay DF1 now operated and reader relays EA and ED of Fig. 7 operated to register the tens digit "1" of the district frame number, as assumed, a circuit is established from ground over the No. 4 contacts of relay ED, the No. 2 contacts of relay EA, conductor 951 of cable 950, the No. 4 contacts of connector relay DF1, conductor 1201 of cable 1200, through the upper winding of the tens district frame relay TF1 of Fig. 38, through the winding of relay TFC, conductor 3801 of cable 3800, the No. 1 contacts of connector relay DF1 and through resistance 1203 to battery. Relays TF1 and TFC both operate, relay TF1 locking over a circuit from battery through resistance 3805, the No. 2 front contact, lower winding and No. 3 front contact of relay TF1, the No. 3 back contact of relay TF0 and over conductor 3806 to ground over the No. 1 contacts of operated relay ON3 of Fig. 40.

Relay ON3 is in an operated condition at this time since it was operated when relay AC0 operating upon the initiation of the processing of the tape, completed a circuit therefor from ground over the No. 5 contacts of relay AC0, over conductor 506 and through the winding of relay ON3 to battery. Relay ON3, upon operating, locks over its No. 3 contacts and the contacts of the district frame release key DFR and, over its No. 2 contacts and the No. 1 back contact of relay W0, establishes a circuit for operating relay OFN. Relay OFN, upon operating, establishes a circuit for relay CG, which circuit may be traced from battery through the winding of relay CG, the No. 5 contacts of relay OFN, the No. 5 back contact of relay LK, conductor 4006, the No. 2 back contacts of relays FU9 . . . FU0, conductor 4007, the upper back contact of relay LK of Fig. 40, conductor 4008, the No. 2 back contacts of relays FT0 and FT1 and the No. 4 back contacts of relays FU0 . . . FU9 to ground. Relay CG thereupon operates if all of the register relays are in their normal positions, locks over the No. 5 contacts of relay OFN and over its own No. 4 contacts to ground at the No. 1 back contact of relay SW, and establishes a circuit for relay LK. The circuit of LK may be traced from battery through the winding of relay LK, the No. 4 contacts of relay OFN, conductor 4009, the No. 5 normal contacts of relays FT0 and FT1, the No. 5 normal contacts of relays FU0 . . . FU9 and over conductor 4010 to ground at the No. 1 contacts of relay CG. With relay LK operated a path is now established from ground over the No. 3 front contact of relay CG, the No. 4 back contact of relay L0, the No. 4 contacts of relay LK and over conductor 4011 through the windings of the OG and OG1 relays of Fig. 38 in parallel to battery.

With the connector relay DF2 of Fig. 12 operated and the reader relays FB and FE of Fig. 10 operated, a circuit is established from ground over the No. 4 contacts of relay FE, the No. 6 contacts of relay FB, conductor 1214 of cable 1210, the No. 5 contacts of connector relay DF2, conductor 1224 of cable 1200, through the upper winding of the units district frame register relay

UF4 of Fig. 38, through the winding of relay UFC, conductor 3802 of cable 3800, the No. 2 contacts of relay DF1 and through resistance 1204 to battery. These relays thereupon operate, relay UF4 locking in a circuit from battery through resistance 3807, the No. 2 back contacts of relays UF9 . . . UF5, through the No. 2 front contact, lower winding and No. 3 front contact of relay UF4 and over the No. 3 back contacts of relays UFC . . . UF0 to ground on conductor 3806.

With relays TFC and UFC both operated, a circuit is established from ground over the No. 1 contacts of such relays, conductor 3803 of cable 3800, the No. 5 contacts of relay BF1, over conductor 624 of cable 600 and to battery through the windings of relays RS1 and RS2 of Fig. 4. Relays RS1 and RS2 thereupon operate, relay RS1 establishing a locking circuit for itself and relay RS2 as previously described. A second circuit is established over the No. 2 contacts of relays TFC and UFC, conductor 3804 of cable 3800, the No. 6 contacts of relay DF1, conductor 1205 and to battery through the winding of relay L2A of Fig. 6. Relay L2A thereupon operates and locks over its No. 2 contacts, through resistance 634 and to ground over the No. 3 contacts of operated relay LK1. Register relay TF1 upon operating, establishes a circuit for relay FT1 of Fig. 39 which extends from battery through the winding of relay FT1, the No. 2 contacts of relay OG1 of Fig. 38, the No. 1 contacts of operated relay TF1, conductor 3807 and to ground over the No. 2 contacts of relay OFN of Fig. 40. Relay FT1 thereupon operates and locks over its No. 3 contacts to ground on conductor 3807. Register relay UF4 upon operating, establishes a circuit for relay FU4 of Fig. 39 from battery through the winding of relay FU4, conductor 3914, the No. 7 contacts of relay OG and over the No. 1 contacts of operated relay UF4, to ground on conductor 3807. Relay FU4 upon operating, locks over its No. 3 contacts to ground on conductor 3807. Relay FT1 establishes an obvious circuit over its No. 1 contacts to light the FT1 lamp, and relay FU4 establishes an obvious circuit over its No. 1 contacts to light the lamp FU4 for indicating that the No. 14 district frame has been registered. Over their No. 6 contacts, operated relays FT1 and FU4 also prepare circuits for controlling the ticketer to print the district frame number on the ticket.

A circuit is also established at this time for operating the SW relay of Fig. 40, which may be traced from battery through the winding of such relay, the No. 3 contacts of relay OFN, the No. 5 contacts of relay LK, conductor 4006, the No. 2 back contacts of relays FU9 . . . FU5, conductor 3902, the No. 4 contacts of operated relay UF4, conductor 3903, the No. 4 front contacts of operated relay FU4, the No. 4 back contacts of relays FU3 . . . FU0, conductor 3904, the No. 4 contacts of operated relay TF1, conductor 3905, the No. 4 front contact of operated relay FT1 and to ground over the No. 4 back contact of relay FT0. Relay SW operates if only one of the FT– and FU– relays is operated, locks over its No. 2 contacts to ground over the No. 5 normal contacts of relay L0 and opens at its upper back contact the locking circuit for relay CG. Since, with the FT1 and FU4 relays operated the previously traced initial operating circuit of relay CG is opened, relay CG now releases, in turn releasing relays OG and OG1 of Fig. 38. With relays OG and OG1 released and relay SW operated, a circuit is established from battery through the winding of relay L0, the No. 1 contacts of relay OFN, conductor 4012, the No. 1 back contact of relay OG, the No. 3 back contact of relay OG1, conductor 4013 and to ground over the No. 1 front contact of relay SW. Relay L0 thereupon operates and locks over the No. 1 contacts of relay OFN to ground over its own No. 5 alternate contacts.

It will be recalled that the RS1 and RS2 relays of Fig. 4 operated upon the operation of the TFC and UFC relays of Fig. 38. These relays now function in the manner previously described to advance the reader, whereupon the reader relays of Figs. 7 to 10 and the DF1 and DF2 relays of Fig. 12 release followed by the release of relays RS1 and RS2. When relay RS2 operates (with relay L2A operated) the previously traced locking circuit for relay LK1 is opened and relay LK1 releases upon the advance of the reader and the opening of cam contacts C5. Relays DF1 and DF2, upon releasing, also open the operating circuits of relays TF1, UF4, TFC and UFC, whereupon relays TFC and UFC release but relays TF1 and UF4 remain locked operated over the previously traced locking circuits.

Sensing the end of tape hour entry

The next end of tape entry encountered in processing the tape is the hour entry. The hour entry will comprise punches for the digits "3811" in the A, B, C and D digit positions, followed by the punchings for the tens and units digits of the hour in the E and F digit positions, respectively. It will be assumed that the hour entry is punched for three o'clock in the morning which would be the hour during which the tape would be cut to end a day's business. This line of perforations for the hour entry will then be "381103."

When the hour entry is sensed by the reader of Fig. 2, the sensing of the perforations for the A digit "3" and the B digit "8" will, in the manner previously described, cause the operation of reader relay A3 of Fig. 5 and the operation of the B1C, B2C, B1E and B2E relays of Fig. 7. Relay LK1 again operates and locks in the manner previously described. The perforations for the C digit "1" are in the punch positions *ca* and *cd* and will cause the closure of reader contacts CA and CD, thereby closing circuits over conductor 209 and the No. 10 contacts of connector relay TB to conductor 331 of cable 330, over conductor 212 and the No. 7 contacts of relay TB to conductor 334 of cable 330, and thence through cable 400 to battery through the windings of reader relays C1A, C2A, C1D and C2D of Fig. 8. These relays therefore operate to register the third digit "1" of the hour entry. The perforations for the D digit "1" are in punch position *da* and *dd* and will cause the closure of reader contacts DA and DD, thereby closing circuits over conductor 214 and the No. 5 contacts of connector relay TB to conductor 341 of cable 340, over conductor 217 and the No. 2 contacts of relay TB to conductor 344 of cable 340 and thence to battery through the windings of reader relays DA and DD of Fig. 9. The perforations for the E digit "0" are in the *ea* and *eb* punch positions and will cause the closure of reader contacts EA and EB, thereby closing circuits over conductor 219 and the No. 10 contacts of connector relay TC to conductor 351 of cable 350, and over conductor 220 and the No. 9 con-

tacts of relay TC to conductor 352 of cable 350, and thence through cable 400 to battery through the windings of reader relays EA and EB of Fig. 9. These relays therefore operate to register the tens digit "0" of the hour. The perforations for the F digit "3" are in the *fd* and *fe* punch positions, thereby causing the closure of reader contacts FD and FE to establish circuits over conductor 227 and the No. 2 contacts of relay TC to conductor 364 of cable 360, and over conductor 228 and the No. 1 contacts of relay TC to conductor 365 of cable 360, and thence through cable 400 to battery through the windings of reader relays FD and FE of Fig. 10. These relays therefore operate to register the units digit "3" of the hour.

With the above relays operated as previously described, a check circuit is established from ground over cam contacts C9 of the reader, conductor 242 of cable 240, the No. 3 contacts of connector relay TD, the No. 5 contacts of alarm relay AL, conductor 441, the No. 6 back contact of relay FA of Fig. 10, the No. 8 back contact of relay FB, the No. 9 back contact of relay FC, the No. 8 contacts of operated relay FE, the No. 2 contacts of operated relay FE, conductor 911, the No. 5 contacts of operated relay EA of Fig. 9, the No. 2 contacts of operated relay EB, the No. 1 back contacts of relays EC, ED and EE, the No. 5 contacts of operated relay DA, the No. 1 back contact of relay DB, the No. 2 back contact of relay DC, the No. 3 contacts of operated relay DB, the No. 1 back contact of relay DE, conductor 912, the No. 5 contacts of operated relay C2A of Fig. 8, the No. 1 back contact of relay C2B, the No. 2 back contact of relay C2C, the No. 3 contacts of operated relay C2D, the No. 1 back contact of relay C2E, conductor 806, the No. 6 back contact of relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 8 contacts of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, conductor 901 of cable 900, the inner lower back contact of relay DIS of Fig. 15, over the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the lower back contact of relay CC, conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1, the No. 2 back contact of relay LK2, the No. 4 contacts of operated reader relay A3, the No. 3 back contact of reader relay A2, conductor 503, the No. 7 contacts of operated reader relay B1C of Fig. 7, the No. 6 contacts of operated relay B1E, conductor 707, the No. 4 contacts of operated relay C2D of Fig. 8, the No. 2 contacts of operated relay C2A, conductor 913, the No. 4 contacts of operated relay DD of Fig. 9, the No. 2 contacts of operated relay DA, conductor 914 and to battery through the windings of connector relays H11 and H12 of Fig. 12. The result therefore of sensing the end of tape hour entry is to operate these connector relays in response to the registration of the A, B, C and D digits "3311" whereby circuits are established to transfer the hour entry digits "03" registered by the E and F groups of reader relays to the hour circuits of Figs. 34 and 37 inclusive.

With the connector relay H11 operated and the reader relays EA and EB of Fig. 9 operated to register the tens digit "0" of the hour as assumed, a circuit is established from ground over the No. 3 contacts of relay EA, the No. 5 contacts of relay EB, conductor 952 of cable 950, the No. 3 contacts of connector relay H11, conductor 1232 of cable 1230, through the upper winding of the register relay TH0 of Fig. 37, through the winding of relay THC, conductor 3701 of cable 3700, the No. 1 contacts of connector relay H11 of Fig. 12 and to battery through resistance 1203. Relay TH0, upon operating, locks over a circuit extending from battery over the No. 1 back contacts of relays TH2 and TH1, its No. 1 front contact, through its lower winding and its No. 2 front contact, conductor 3706, the No. 1 back contact of relay HT of Fig. 36, conductor 3604 and to ground over the No. 2 contacts of operated relay ON1 of Fig. 35.

With the connector relay H12 of Fig. 12 operated and the reader relays FD and FE of Fig. 10 operated to register the units digit "3" of the hour, as assumed, a circuit is established from ground over the No. 5 contacts of relay FD, the No. 5 contacts of relay FE, conductor 1213 of cable 1210, the No. 3 contacts of connector relay H12, conductor 1243 of cable 1240, through the upper winding of units register relay UH3 of Fig. 37, through the winding of relay UHC, over conductor 3702 of cable 3700, the No. 2 contacts of relay H11 and through resistance 1204 to battery. Relay UH3, upon operating, locks from battery over the No. 1 back contacts of relays UH0 . . . UH4, over the No. 1 front contact, through the lower winding and over the No. 2 front contact of relay UH3, the No. 2 back contacts of relays UH2, UH1 and UH0, conductor 3705, the No. 2 back contact of relay HU of Fig. 36, conductor 3604 and to ground over the No. 2 contacts of operated relay ON1 of Fig. 35. The locking circuits of the TH— and UH— relays of Fig. 37 are so arranged that it is not possible for more than one TH— or more than one UH— relay to remain locked up after their operate circuits have been opened.

To initiate the operation of the hour circuits of Figs. 34 to 37 inclusive, the ON1 of Fig. 35 is operated over a circuit extending from battery through its winding, conductor 3505 and to ground over the No. 4 contacts of relay AC0 of Fig. 5, it being recalled that relay AC0 was operated immediately following the initiation of the processing of the tape by the depression of the start key ST of Fig. 6. Relay ON1, upon operating, locks under the control of the hour circuit release key HR.

With relays THC and UHC both operated, a first circuit is established from ground over the No. 1 contacts of such relays, conductor 3703 of cable 3700, the No. 6 contacts of connector relay H11 of Fig. 12, conductor 624 and through the windings of relays RS1 and RS2 of Fig. 4 to battery. A second circuit is established from ground over the No. 2 contacts of relays THC and UHC, conductor 3704 of cable 3700, the No. 7 contacts of relay H11 of Fig. 12 and conductor 1205, to battery through the winding of relay L2A of Fig. 6. Relays RS1 and RS2 upon operating, function in the manner previously described to advance the reader, whereupon the reader relays of Figs. 7 to 10, inclusive, and the connector relays H11 and H12 of Fig. 12 release followed by the release of relays RS1 and RS2. With relay L2A operated, the operation of relay RS2 and the opening of reader cam contacts C5 permit relay LK1 to release. The release of connector relays H11 and H12 opens the operating circuits of register relays TH0 and UH3 and the circuits of relays THC and UHC. The latter relays thereupon release, but relays THD and UH3 remain operated over their locking circuits.

With the UH3 relay of Fig. 37 operated, a cir-

cuit is established from ground over its No. 3 contacts, conductor 3713, and to battery through the winding of the units register relay U3 of Fig. 36. With the TH0 relay of Fig. 37 operated, a circuit is established from ground over its No. 3 contacts and to battery through the winding of the tens register relay T0. The operation of relay T0 prepares a stepping circuit for the hour tens switch, four switch arcs of which are shown in Figs. 35 and 36. The circuit may be traced from battery through the winding of relay HTS of Fig. 35, through the winding and interrupter contacts of the magnet STP associated with such switch, over the No. 1 back contact of relay UE, over the brush and No. 2 terminal of arc HT1, over conductor 3510, the No. 2 back contact of register relay T2, the No. 3 front contact of relay T0, the No. 1 back contacts of relays T2 and T1 and to ground over the No. 2 front contact of relay T0. Magnet STP thereupon operates to advance the brushes of switch HT one step. The circuit for magnet STP is now reestablished as traced to the No. 1 back contact of relay UE, over the brush and No. 3 terminal of arc HT1, over conductor 3511, the No. 3 back contact of relay T1, the No. 1 back contacts of relays T2 and T1 and to ground over the No. 2 front contact of relay T0. Magnet STP thereupon operates to advance the brushes of switch HT another step. The circuit for magnet STP is now reestablished as traced to the No. 1 back contact of relay UE, over the brush and No. 4 terminal of arc HT1, over conductor 3512, and to the No. 3 back contact of relay T0. However, since the latter relay has been operated, the stepping circuit is not further extended and therefore the brushes of switch HT remain on the No. 4 terminals of their arcs.

The operation of relay U3 establishes a stepping circuit for the hour units switch, four switch arcs of which are shown in Figs. 36 and 34. This circuit may be traced from battery through the winding of relay HUS of Fig. 36, through the winding and the interrupter contacts of magnet STP of the hour units switch, over the brush and No. 2 terminal of arc HU1 of the switch, the No. 1 back contact of register relay U9, No. 2 front contact of relay U3, No. 2 back contacts of relay U9 . . . U5, the No. 3 back contact of relay U4, the No. 3 front contact of relay U3 and the No. 2 back contacts of relays U2, U1 and U0 to ground. The magnet operates, interrupting its own circuit and advancing the switch brushes one step. A circuit for magnet STP is now established over the No. 3 terminal of arc HU1, the No. 1 back contact of relay UH8 and thence as traced to ground at the No. 2 back contact of relay U0. The magnet again operates, interrupting its own circuit and advancing the switch brushes another step. With the brush in engagement with the No. 4 terminal of its arc a further circuit for the stepping magnet is established over the No. 1 back contact of relay U7 and thence as traced to ground at the No. 2 back contact of relay U0. In the same manner the switch is advanced step-by-step until the brush associated with switch arc HU1 engages the No. 8 terminal. At such time the circuit of magnet STP cannot be completed since it must extend over the No. 2 back contact of relay U3 and such relay, as assumed, has been operated. The brushes of the hour units switch therefore come to rest. The hour tens and hour units switches have now been set into positions indicative of the tens and units digits of the end of tape hour entry. The advance of the HT and HU switches is made dependent upon only one of the T- and only one of the U- relays being operated.

With the brush associated with the arc HT4 of the hour tens switch, shown in Fig. 35, set upon the No. 4 terminal, a circuit is established from ground over the No. 1 contacts of relay ON1, over the normal contacts of relay HTS as soon as the switch HT comes to rest and relay HTS releases, over the brush and No. 4 terminal of arc HT4 to battery through the winding of relay HTA, and from ground over the No. 4 contacts of relay T0 and conductor 3503 to battery through the winding of relay HTB. With relays HTA and HTB operated a circuit is established from ground over the No. 1 contacts of relay HTA and over the No. 3 contacts of relay HTB to battery through the HRT0 lamp which lights to indicate that the switch has been set into the tens digit "0" position. Relays HTA, HTB and HTD are selectively operated in pairs to establish the circuits of lamps HRT1 and HRT2 when the switch is set into its No. 3 or No. 2 terminal positions.

With the brush associated with the arc HU3 of the hour units switch, shown in Fig. 34, set upon the No. 8 terminal of its arc, a circuit is established from ground over the No. 4 contacts of relay ON1 of Fig. 35, conductor 3506, normal contacts of relay HUS as soon as the stepping movement of the hour unit switch ceases, conductor 3507, brush and No. 8 terminal of arc HU3 to battery through the winding of relay HUD and, in parallel over the brush and No. 8 terminal of arc HU4, to battery through the winding of relay HUE. With relays HUD and HUE operated, a circuit is established from ground over the No. 3 contacts of relay HUD and over the No. 4 contacts of relay HUE to battery through the display lamp HRU3 which lights to indicate that the switch has been set into the units digit "3" position. Relays HUA to HUE, inclusive, are selectively operated in pairs to establish the circuits of the ten units display lamps HRU0 . . . HRU9.

As will hereinafter be described, the relays HTA, HTB, HTD and the relays HUA to HUE inclusive are effective to transmit their registrations over conductors of cables 3500 and 3400 to the "Hour tens disconnect time" and "Hour units disconnect time" registers of Fig. 25 and to the "Hour tens answer time" and "Hour units answer time" registers of Fig. 19 when calls are being processed.

Sensing the end of tape day entry

The next end of tape entry encountered in the processing of the tape is the day entry. The day entry will comprise punches for the digits "3821" in the A, B, C and D digit positions followed by punchings for the tens and units digits of the day in the E and F digit positions. It will be assumed that the day entry is provided for the eleventh day of the month. The line of perforations across the tape will then be "382111."

When the day entry is sensed by the reader of Fig. 2, the sensing of the perforations for the A digit "3" and the B digit "8" will, in the manner previously described, cause the operation of reader relay A3 of Fig. 5 and the operation of the reader relays B1C, B2C, B1E and B2E of Fig. 7. Relay LK1 again operates and locks following the operation of relay A3. The perforations for the C digit "2" are in the punch positions *cb* and *cd* and will cause the closure of reader contacts CB and CD and the establishment of circuits over conductor 210, the No. 9 contacts of connector re-

lay TB to conductor 332 of cable 330, and from conductor 212, the No. 7 contacts of relay TB to conductor 334 of cable 330, and thence through cable 400 to battery through the windings of reader relays C1B, C2B, C1D and C2D of Fig. 8. The perforations for the D digit "1" are in punch positions *da* and *dd* and will cause the operation of reader relays DA and DD of Fig. 9, while the perforations for the E digit "1" are in punch positions *ea* and *ed* and will cause the operation of reader relays EA and ED of Fig. 9. The perforations of the F digit "1" are in punch positions *fa* and *fd* and will cause the closure of reader contacts FA and FD to establish circuits over conductor 224, and the No. 5 contacts of connector relay TC to conductor 361 of cable 360 and over conductor 227 and the No. 2 contacts of relay TC to conductor 364 of cable 360 and thence through cable 400 to battery through the windings of reader relays FA and FD of Fig. 10.

With the reader relays thus operated, a check circuit is established from ground over cam contacts C9 of the reader, over conductor 242 of cable 240, the No. 3 contacts of connector relay TD, the No. 5 contacts of alarm relay AL, conductor 441, the No. 5 contacts of operated relay FA of Fig. 10, the No. 1 back contact of relay FB, the No. 2 back contact of relay FC, the No. 3 contacts of operated relay FD, the No. 1 back contact of relay FE, conductor 911, the No. 5 contacts of operated relay EA of Fig. 9, the No. 1 back contact of relay EB, the No. 2 back contact of relay EC, the No. 3 contacts of operated relay ED, the No. 1 back contact of relay EE, the No. 5 contacts of operated relay DA, the No. 1 back contact of relay DB, the No. 2 back contact of relay DC, the No. 3 contacts of operated relay DD, the No. 1 back contact of relay DE, conductor 912, the No. 6 back contact of relay C2A of Fig. 8, the No. 7 contacts of operated relay C2B, the No. 2 back contact of relay C2C, the No. 3 contacts of operated relay C2D, the No. 1 back contact of relay C2E, conductor 806, the No. 6 back contact of relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 8 contacts of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, conductor 901 of cable 900, the inner lower back contact of relay DIS of Fig. 15, the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the lower back contact of relay CC, conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1, the No. 2 back contact of relay LK2, the No. 4 contacts of reader relay A3, the No. 3 back contact of reader relay A2, conductor 503, the No. 7 contacts of operated reader relay B1C of Fig. 7, the No. 6 contacts of operated relay B1E, conductor 707, the No. 4 contacts of operated reader relay C2B of Fig. 8, the No. 7 contacts of operated reader relay C2D, conductor 809 and through the windings of the connector relays DY1 and DY2 of Fig. 12 in parallel to battery. The result therefore of sensing the end of tape day entry is to operate these connector relays in response to the registration of the A, B and C digits "382" whereby circuits are established to transfer the day entry digits "11" registered by the E and F groups of reader relays.

With the connector relay DY1 operated and the reader relays EA and ED of Fig. 9 operated to register the tens digit "1" of the day entry, as assumed, a circuit is established from ground over the No. 4 contacts of relay ED, the No. 2 contacts of relay EA, conductor 951 of cable 950, the No. 5 contacts of connector relay DY1, conductor 1251 of cable 1250 and through the upper winding of relay TD1 of the "Day tens" register of Fig. 31, thence through the winding of relay TDC, conductor 3111 of cable 3110, the No. 1 contacts of relay DY1 of Fig. 12 and to battery through resistance 1203. Relay TD1 operates and locks from battery through resistance 3139, over the No. 1 back contacts of relays TD3 and TD2, the No. 1 front contact, lower winding and No. 2 front contact of operated relay TD1, the No. 2 back contact of relay TD9 and to ground over the No. 3 contacts of operated relay ON2.

With the connector relay DY2 operated and the reader relays FA and FD of Fig. 10 operated to register the units digit "1" of the day entry, as assumed, a circuit is established from ground over the No. 4 contacts of relay FD, the No. 2 contacts of relay FA, conductor 1211 of cable 1210, the No. 2 contacts of connector relay DY2, conductor 1261 of cable 1260, through the windings of relay UD1 of the "Day units" register of Fig. 32, over conductor 3202, through the winding of relay UDC of Fig. 31, conductor 3112 of cable 3110, the No. 3 contacts of relay DY1 of Fig. 12, and through resistance 1204 to battery. Relay UDC, upon operating, establishes over its No. 1 contacts an obvious circuit for relay DRC, but the latter relay does not operate since its winding is shunted by ground applied over the No. 1 contacts of relay NDUA, and conductor 3309. Relay UD1 operates and locks through resistance 3209, over the No. 1 back contacts of relays UD9 . . . UD2, the No. 1 front contact, lower winding and No. 2 front contact of operated relay UD1, the No. 2 back contact of relay UD9, conductor 3201 and to battery over the No. 3 contacts of relay ON2. It will be noted that the locking circuits for the operated register relays TD1 and UD1 extend over back contacts of the other TD- and UD- relays thus making it impossible for more than one TD- and UD- relay to remain operated following the opening of their initial operating circuit.

The ON2 relay which supplies locking ground to the rest of the relays, is at this time operated since a circuit extending from battery through its winding, over conductor 3102 and the No. 1 contacts of relay RAD of Fig. 14 was established when relay RAD operated following the operation of relay AC9 of Fig. 5 as previously described. Relay ON2, upon operating, locked over its No. 2 contacts under the control of the day circuit release key DYR. Relay ON2 also established a circuit from ground over its No. 4 contacts, conductor 3103, over the No. 1 back contact of relay HDT, Fig. 32, to battery through the winding of relay NDT and in parallel over the No. 1 back contact of relay HDUA and conductor 3203 to battery through the winding of relay NDUA of Fig. 33.

With relays TDC and UDC operated, a first circuit is established from ground over the No. 1 contacts of such relays, conductor 3113 of cable 3110, over the No. 3 contacts of connector relay DY1 of Fig. 12 and conductor 1205 to battery through the winding of relay L2A of Fig. 6, and a second circuit is established from ground over the No. 2 contacts of relays TDC and UDC, over conductor 3114 of cable 3110, the No. 2 contacts of relay DY1 and conductor 624 to battery through the windings of relays RS1 and RS2 of Fig. 4. Relays RS1 and RS2, upon operating, function in the manner previously described to

advance the reader, whereupon the reader relays of Figs. 7 to 10 and the connector relays DY1 and the DY2 of Fig. 12 release followed by the release of relays RS1 and RS2. With relay L2A operated, the operation of relay RS2 and the opening of reader cam contacts C5 permit relay LK1 to release. The release of connector relays DY1 and DY2 opens the operating circuits of relays TD1, UD1, TDC and UDC and the latter relays release but relays TD1 and UD1 remain operated over their locking circuits. Relay UDC also opens the operating circuit of relay DRC.

Relay TD1, upon operating, establishes circuits for operating the DTA and DTB relays of the "Day tens" register of Fig. 33. The circuit of relay DTA extends from battery through the winding of such relay, conductor 3305 and the No. 2 contacts of relay NDT, conductor 3204 and to ground over the No. 4 contacts of relay TD1, and the circuit of relay DTD extends from battery through the winding of such relay, conductor 3306, the No. 5 contacts of relay NDT, conductor 3205 and to ground over the No. 3 contacts of relay TD1. Relay UD1, upon operating, establishes circuits for operating relays DUA and DUD of the "Day units" register of Fig. 33. The circuit of relay DUA extends from battery through the winding of relay DUA, over the No. 9 contacts of relay NDUA, conductor 3307 and over the No. 4 contacts of relay UD1 to ground. The circuit of relay DUD extends from battery through the winding of such relay, over the No. 4 contacts of relay NDUA, conductor 3308 and to ground over the No. 3 contacts of relay UD1.

It is to be noted that the relays DTA, DTB, DTD and DTE are operated in pairs to register the tens digit of the day. In the case assumed the operation of relays DTA and DTD registers the digit "1," which is indicated by the lighting of lamp DT1, the circuit of which is completed from ground, the No 2 contacts of relay DTA, the No. 1 contacts of relay DTB and through the lamp to battery. The operation of relays DTA and DTD is also effective to control the operation of relays of the "Day tens disconnect time" and "Day tens answer time" register of Figs. 26 and 20, respectively. Also, relays DUA to DUE inclusive of Fig. 33 are operated in pairs to register the units digit of the day. In the case assumed, the operation of relays DUA and DUD register the digit "1" which is indicated by the lighting of lamp DU1 the circuit of which is completed from ground, the No. 1 contacts of relay DUD and the No. 1 contacts of relay DUA to battery through the lamp DU1. The operation of relays DUA and DUD is also effective to control the operation of relays of the "Day units disconnect time" and "Day units answer time" registers of Figs. 26 and 20.

Sensing the end of tape month entry

The next end of tape entry encountered in the processing of a tape is the month entry. This entry comprises punches for the digit "383" in the A, B and C digit positions followed by a zero in the D digit position and the tens and units digits of the month in the E and F digit positions. Thus across the tape the perforations might be for the digits "383011."

When the month entry is sensed by the reader of Fig. 2, the sensing of the perforations for the the A digit "3" and the B digit "8" will in the manner previously described cause the operation of the reader relay A3 of Fig. 5 and the operation of the reader relays B1C, B2C, B1E and B2E of Fig. 7. Relay LK1 again operates and locks following the operation of relay A3. The perforations for the C digit "3" are in the punch positions *cd* and *ce* and will cause the closure of reader contacts CD and CE and the establishment of circuits over conductor 212 and the No. 7 contacts of connector relay TB to conductor 334 of cable 330, and over conductor 213 and the No. 6 contacts of relay TB to conductor 335 of cable 350, and thence through cable 400 to battery through the windings of reader relays C1D, C2D, C1E and C2E of Fig. 8. The perforations for the D digit "0" will be in the punch positions *da* and *db* and will cause the operation of reader relays DA and DB of Fig. 9; the perforations for the E digit "1" will be in punch positions *ea* and *ed* and will cause the operation of reader relays EA and ED of Fig. 9, while the perforations for the F digit "1" will be in the punch positions *fa* and *fd* and will cause the operation of reader relays FA and FD of Fig. 10 in the manner previously described.

With the reader relays thus operated, a check circuit is established from ground over cam contacts C9 of the reader, conductor 242 of cable 240, the No. 3 contacts of connector relay TD, the No. 5 contacts of alarm relay AL, conductor 441, the No. 5 contacts of operated relay FA and Fig. 10, the No. 1 back contact of relay FB, the No. 2 back contact of relay FC, the No. 3 contacts of operated relay FD, the No. 1 back contact of relay FE, conductor 911, the No. 5 contacts of operated relay EA of Fig. 9, the No. 1 back contact of relay EB, the No. 2 back contact of relay EC, the No. 3 contacts of operated relay ED, the No. 1 back contact of relay EE, the No. 5 contacts of operated relay DA, the No. 2 contacts of operated relay DB, the No. 1 back contacts of relays DC, DD and DE, conductor 912, No. 6 back contact of relay C2A of Fig. 8, the No. 8 back contact of relay C2B, the No. 9 back contact of relay C2C, the No. 8 contacts of operated relay C2D, the No. 2 contacts of operated relay C2E, conductor 806, the No. 6 back contact of relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 8 contacts of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, conductor 901 of cable 900, the inner lower back contact of relay DIS of Fig. 15, the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the lower back contact of relay CC, conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1, the No. 2 back contact of relay LK2, the No. 4 contacts of operated reader relay A3, the No. 3 back contact of reader relay A2, conductor 503, the No. 7 contacts of operated reader relay B1C of Fig. 7, the No. 6 contacts of operated reader relay B1E, conductor 707, the No. 5 contacts of operated relay C2D of Fig. 8, the No. 5 contacts of operated relay C2E, conductor 902 of cable 900, the No. 1 back contact of relay STLA of Fig. 14, conductor 1406, the No. 1 back contact of relay STCU of Fig. 13, conductor 1512 of cable 1500 and conductor 908 through the winding of cancel entry relay CE1 of Fig. 5. Relay CE1 thereupon operates and, over its No. 2 contacts, connects ground over conductor 624 and through the windings of relays RS1 and RS2 to battery. Relays RS1 and RS2 upon operating, function in the manner previously described to advance the reader, whereupon the reader relays of Figs. 7 to 10 and the relay CE1 of Fig. 5 release followed by the release of

relays RS1 and RS2. Relay CE1 also opens the circuit of relay LK1 which releases.

Sensing the disconnect entry

All of the end of tape entries have now been sensed and the processing of the tape may now proceed in connection with call entries. It will be assumed that the next call entry encountered is that of the disconnect time, for which entry a perforation is punched in the *ab* position of the tape. The reader pin AB will therefore enter this perforation and close the AB reader contacts thereby causing the operation of the A2 reader relay. There being no perforations in the punch positions *aa* and *ac*, the reader pins *aa* and *ac* are ineffective to close their contacts and to thereby operate the reader relays A1 and A3.

It will be assumed that the record tape is perforated for a disconnect time "193" and that it has been perforated for the district number "71." Thus the line of perforations across the tape would be "219371." As previously stated, the perforation "2" for the A digit has caused the operation of reader relay A2. The perforations for the B digit "1" will be in the punch positions *ba* and *bd* and will therefore cause the closure of reader contacts BA and BD, thereby closing circuits over conductor 204 and the No. 5 contacts of connector relay TA to conductor 321 of cable 320, and over conductor 207 and the No. 2 contacts of relay TA to conductor 324 of cable 320, thence through cable 400 and through the windings of reader relays B1A, B2A, B1D and B2D of Fig. 7 to battery. These reader relays therefore operate to register the B digit "1." The perforations for the C digit "9" are in the punch positions *ca* and *ce* and will therefore cause the closure of reader contacts CA and CE, thereby closing circuits over conductor 209, the No. 10 contacts of connector relay TB and the conductor 331 of cable 330, and over conductor 213 and the No. 6 contacts of relay TB and conductor 335 of cable 330, thence through cable 400 and through the windings of reader relays C1A, C2A, C1E and C2E of Fig. 8 to battery. These relays therefore operate to register the C digit "9." The perforations for the D digit "3" are in the punch positions *dd* and *de* and will therefore cause the closure of reader contacts DD and DE, thereby closing circuits over conductor 217, the No. 2 contacts of connector relay TB, conductor 344 of cable 340, conductor 218 and the No. 1 contacts of relay TB, conductor 345 of cable 340, thence through cable 400 and through the windings of reader relays DD and DE of Fig. 9 to battery. These relays therefore operate to register the D digit "3." The perforations for the E digit "7" are in the punch positions *eb* and *ec*, resulting in the closure of reader contacts EB and EC and the closure of circuits over conductor 220, the No. 7 contacts of connector relay TC, conductor 352 of cable 350, conductor 221, the No. 8 contacts of relay TC, conductor 353 of cable 350, thence through cable 400 and through the windings of reader relays EB and EC of Fig. 9 to battery. These relays therefore operate to register the E digit "7." The perforations for the F digit "1" are in the *fa* and *fd* punch positions and result in the closure of the reader contacts FA and FD and the establishment of circuits over conductor 224, the No. 5 contacts of relay TC, conductor 361 of cable 360, conductor 227, the No. 2 contacts of relay TC and conductor 364 of cable 360, thence through cable 400 and through the windings of reader relays FA and FD of Fig. 10 to battery. These relays therefore operate to register the F digit "1."

With these reader relays operated, a check circuit is closed upon the closure of cam contacts C9, over conductor 242 of cable 240, the No. 3 contacts of connector relay TD, the No. 5 contacts of alarm relay AL, conductor 441, the No. 5 front contacts of operated reader relay FA, Fig. 10, the No. 1 back contact of relay FB, the No. 2 back contact of relay FC, the No. 3 front contact of operated relay FD, the No. 1 back contact of relay FE, conductor 911, the No. 6 back contact of reader relay EA of Fig. 9, the No. 7 front contact of operated relay EB, the No. 3 front contact of operated relay EC, the No. 1 back contacts of relays ED and relay EE, the No. 6 back contact of relay DA, the No. 8 back contact of relay DB, the No. 9 back contact of relay DC, the No. 8 front contact of operated relay DD, the No. 2 front contact of operated relay DE, conductor 912, the No. 5 front contact of operated reader relay C2A of Fig. 8, the No. 1 back contact of relay C2B, the No. 2 back contacts of relays C2C and C2D, the No. 2 front contacts of relay C2E, conductor 806, the No. 5 front contact of operated reader relay B1A of Fig. 7, the No. 1 back contact of relay B1B, the No. 2 back contact of relay B1C, the No. 3 front contact of operated relay B1D, the No. 1 back contact of relay B1E, conductor 901 of cable 900, the inner lower back contact of relay DIS of Fig. 15, the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the lower back contact of relay CC, conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1 of Fig. 5, the No. 2 back contact of relay LK2, the No. 3 back contact of relay A3, the No. 2 front contact of relay A2, assumed to be operated, conductor 1502 of cable 1500, the No. 6 back contact of relay RLS2 of Fig. 15, conductor 1503 of cable 1500, the No. 2 back contact of relay ESB, Fig. 5, conductor 621 of cable 620, and in parallel through the windings of relays DSC1, DSC2, DSC3, DSC4 and DSC5 of Fig. 10 to battery. Thus, assuming that only one reader relay in the A digit group and two relays in each of the B, C, D, E and F digit reader groups have operated the "disconnect" connector relays will operate.

Before proceeding with the functioning of the circuits resultant upon the proper operation of the DSC– relays, it will be assumed that in making the check for the proper number of holes in the perforated tape for the "disconnect" entry, it was found that one of the digit registers, for example, the F digit register, Fig. 10 was operated in response to the reader sensing an extra hole in the punched position *fb*, thereby resulting in the operation of reader relay FB in addition to the correct operation of relays FA and FD. As a consequence, the previously traced check circuit extended from conductor 441, over the No. 5 front contact of relay FA, the No. 2 front contact to relay FB and the No. 1 back contact to relay FC, is now opened at the No. 1 back contact of relay FD. The check circuit, therefore, cannot be extended over conductor 911 to the E register of Fig. 9. A similar condition would result if it were assumed that only one hole, for example, in punch position *fa* was punched rather than the two holes in positions *fa* and *fb*, resulting in the operation of only one relay FA of the F register. As a consequence, the previously traced check circuit extended from conductor 441, over the No. 5 front contact of relay FA, the No. 1 back contact to relay FB, the No. 2 back contact to relay FC, the

No. 2 back contact to relay FD not now operated, is open at the No. 2 front contact of relay FE. The check circuit is not, therefore, extended to conductor 911.

The result of the failure to establish the check circuit due to the perforation of too many or too few holes in a line across the tape is that the DSC– relays do not operate, the registrations are not transferred to register relays of the elapsed time computing circuit and that the reader is not advanced within a 0.35 second time interval as has been previously described.

It however will be assumed that the DSC– relays are operated and that before the expiration of the time interval the RS2 relay is operated, as will be later described, to advance the reader. When this relay operates, it connect ground over its No. 1 contacts to establish a shunt of condensers 442 the path of which may be traced over such relay contacts, through the condensers and resistance 443 to ground, thereby discharging the condensers. With this shunt established, the strength of current flowing through the lower winding of timing relay TM is such that the flux established by the lower winding opposes the flux established by the upper winding to prevent the attraction of the relay armature. The alarm relay AL therefore does not operate.

With the connector relay DSC1 now operated and reader relays B1A and B1D of Fig. 7 operated to register the B or minute tenths digit "1" of the disconnect time, as assumed, circuits are established from ground over the lower contacts of relays B1A and B1D, conductors 701 and 704 of cable 700, the Nos. 1 and 4 contacts of relay DSC1, conductors 1001 and 1004 of cable 1000 and thence to battery through the windings of register relays A, A', D and D' of the "Minute tens disconnect time" register of Fig. 28, which register relays operate and lock over the inner upper contacts of relays A and D, conductor 2801 of cable 2800 and to ground over the No. 1 contacts of relay RLT. Also, relay DSC1, with reader relays C1A and C1E of Fig. 8 operated, as assumed, to register the C or minute units digit "9" of the disconnect time, establishes circuits from ground over the No. 7 contacts of relays C1A and C1E, conductors 801 and 805 of cable 800, the Nos. 6 and 10 contacts of relay DSC1, conductors 1011 and 1015 of cable 1010 and to battery through the windings of register A, A', E and E' of the "Minute units disconnect time" register of Fig. 29, which register relays operate and lock over the inner upper contacts of relays A and E, over conductor 2802 of cable 2800 and to ground over the No. 2 contacts of relay RLT.

With the connector relay DSC2 now operated and reader relays DD and DE of Fig. 9 operated to register the D or minute tenths digit "3" of the disconnect time, as assumed, circuits are established from ground over the lowermost contacts of relays DD and DE, conductors 924 and 925 of cable 920, the Nos. 4 and 5 contacts of relay DSC2, over conductors 1024 and 1025 of cable 1020 and to battery through the windings of relays D, D', E and E' of the "Minute tenths disconnect time" register of Fig. 30, which register relays operate and lock over the inner upper contacts of relays D and E, conductor 2803 of cable 2800 and to ground over the No. 3 contacts of relay RLT. Also, relay DSC2, with reader relays EB and EC of Fig. 9 operated to register the E or tens digit "7" of the district number, as assumed, establishes circuits from ground over the lowermost contacts of relays E and EC, conductors 942 and 943 of cable 940, the Nos. 7 and 8 contacts of relay DSC2, conductors 1042 and 1043 of cable 1040 and to battery through the windings of relays B and C of the "District tens disconnect time" register of Fig. 27, which register relays operate and lock over their inner upper contacts, over conductor 2701 of cable 2700 and to ground over the No. 7 contact of relay RLA.

With the connector relay DSC3 operated and reader relays FA and FD of Fig. 10 operated to register the F or units digit "1" of the district number, as assumed, circuits are established from ground over the lowermost contacts of relays FA and FD, conductors 1051 and 1054 of cable 1050 and to battery through the windings of relays A and D of the "District units disconnect time" register of Fig. 27, which register relays operate and lock over their inner upper contacts, over conductor 2702 of cable 2700 and to ground over the No. 8 contacts of relay RLA.

It will be assumed that the day circuits of Figs. 31, 32 and 33 have previously been operated, as described, to register the eleventh day and that the hour circuits of Figs. 34 to 37, inclusive, have been operated to register the third hour of the eleventh day. For these registrations relays DTA and DTD of the "Day tens" output register and DUA and DUD of the "Day units" output register of Fig. 33 have been operated to register the day digits "11," and relays HTA and HTB of the "Hour tens" output register of Fig. 35 and relays HUD and HUE of the "Hour units" output register of Fig. 34 have been operated to register the hour digits "03."

With the DSC4 relay operated, as previously described, and relays DTA and DTD operated, circuits are established from ground over the No. 3 contacts of relay DTA and the No. 4 contacts of relay DTD, conductors 3301 and 3304 of cable 3300, the Nos. 1 and 4 contacts of relay DSC4 of Fig. 10, conductors 1061 and 1064 of cable 1060 and to battery through the windings of the A and D relays of the "Day tens disconnect time" register of Fig. 26. These relays therefore operate and lock over their inner upper contacts and conductor 2501 of cable 2500 to ground over the No. 1 contacts of relay RDS of Fig. 14. With register relays DUA and DUD operated, circuits are established from ground over the No. 5 contacts of relays DUA and DUD, conductors 3311 and 3314 of cable 3310, the Nos. 5 and 8 contacts of relay DSC4 of Fig. 10, conductors 1071 and 1074 of cable 1070 and through the windings of relays A and D of the "Day units disconnect time" register of Fig. 26. These relays therefore operate and lock over their inner upper contacts and conductor 2502 of cable 2500 to ground over the No. 2 contacts of relay RDS of Fig. 14.

With relay DSC5 operated and register relays HTA and HTB of Fig. 35 operated, circuits are established from ground over the No. 1 contacts of relays HTA and HTB, conductors 3501 and 3502 of cable 3500, the Nos. 1 and 2 contacts of relay DSC5, conductors 1081 and 1082 of cable 1080 and to battery through the windings of relays A and B of the "Hour tens disconnect time" register of Fig. 25. These relays therefore operate and lock over their inner upper contacts, over conductor 2503 of cable 2500 to ground over the No. 3 contacts of relay RDS of Fig. 14. With register relays HUD and HUE of Fig. 34 operated, circuits are established over the No. 1 contacts of such relays, conductors 3404 and 3405 of cable 3400, the Nos. 7 and 8 contacts of relay DSC5 of Fig. 10, conductors 1094 and 1095 of cable 1090

and to battery through the windings of the D and E relays of the "Hour units disconnect time" register of Fig. 25. These relays therefore operate and lock over their inner upper contacts and conductor **2504** of cable **2500** to ground over the No. 4 contacts of relay RDS of Fig. 14.

In addition, connector relay DSC**3** establishes a circuit from ground over its No. 8 contacts, conductor **622** of cable **620**, the No. 4 back contact of relay ESB of Fig. 5 and through the winding of relay ESA to battery. Relay ESA thereupon operates and locks over its lower contacts, through resistance **500**, the No. 2 back contact of relay CE**3**, conductor **1506** of cable **1500** and to ground over the No. 10 contacts of relay RLT of Fig. 14. Relay DSC**3** also establishes a check circuit to determine if two only of the relays of each of the registers of Figs. 25 to 30 inclusive have been operated in response to the sensing of the disconnect time entry. This check circuit may be traced from ground over the No. 2 contacts of operated relay E of the "Minute tenths disconnect time" register of Fig. 30, the No. 9 contacts of operated relay D of such register, the lowermost back contacts of relays C, B and A of such register, conductor **3000**, the No. 1 back contact of relay E of "Minute units disconnect time" register of Fig. 29, the No. 3 contact of operated relay D of such register, the No. 2 back contacts of relays C and B of such register and the No. 7 contacts of the operated relay A of such register, conductor **2900**, the No. 2 contacts of operated relay E of the "Minute tens disconnect time" register of Fig. 28, and the No. 2 back contacts of relays B, C and D of such register, the No. 7 contacts of operated relay A of such register, conductor **2807**, the No. 1 back contacts of relay E and D of the "District tens disconnect time" register of Fig. 27, the No. 3 contacts of operated relay C of such register, the No. 9 contacts of operated relay B of such register, the No. 8 back contact of relay A of such register, the No. 2 contacts of operated relay E of the "District units disconnect time" register of Fig. 27, the No. 9 contacts of operated relay D of such register, the lowermost back contacts of relays C, B and A of such register, conductor **2703**, the No. 1 back contact of relay E of the "Day tens disconnect time" register of Fig. 26, the No. 3 contacts of operated relay D of such register, the No. 2 back contacts of relays C and B of such register, the No. 7 contacts of operated relay A of such register, the No. 1 back contact of relay E of the "Day units disconnect time" register of Fig. 26, the No. 3 contacts of operated relay D of such register, the No. 2 back contacts of relays C, B and A of such register, the No. 7 contacts of relay A of such register, conductor **2600**, the No. 1 back contacts of relays E, D and C of the "Hour tens disconnect time" register of Fig. 25, the No. 3 contacts of operated relay B of such register, the No. 7 contacts of operated relay A of such register, over the No. 2 contacts of operated relay E of the "Hour units disconnect time" register of Fig. 25, the No. 9 contacts of operated relay D of such register, the lowermost back contacts of relays C, B and A of such register, conductor **623** of cable **620**, the No. 6 contacts of relay DSC**3** of Fig. 10, conductor **624** of cable **620** through the winding of relay RS**1** of Fig. 4 and resistance **447** to battery, and in parallel through the winding of relay RS**2** and resistance **448** to battery. If two relays and only two of each of the registers have been operated the check circuit just traced will be closed and relays RS**1** and RS**2** will operate. Relay RS**1**, upon operating, locks itself and relay RS**2** over the No. 2 contacts of relay RS**1**, through resistance **449** and over conductor **251** of cable **250** to ground supplied over cam contacts C**3**, and will prepare a circuit to step the reader drum forward. All of these operations occurred during the make period of the reader contacts. In case the register relays are not operated, the circuits previously traced for relays RS**1** and RS**2** will not be closed and the reader will not step and on the break cycle of the reader when cam contacts C**9** open, the DSC-relays will release. The reader relays will release but the operated register relays will remain locked up. The reader will endeavor to operate the register relays on the next closed cycle of the reader when the DSC-relays and the reader relays will again be operated. Several trials to operate the register relays will be made before the timing circuit operates to stop further trials as previously described.

It will be assumed that the relays RS**1** and RS**2** both operate. Relay RS**1**, upon operating, will remove ground from the circuit of the STP magnet of the reader, which circuit was closed from battery through resistance **239**, over the lower contacts of key CP when such key was operated as previously described, through the STP magnet, over normal contacts of the keys TRS and RSC, over conductor **243** of cable **240** and to ground over the No. 3 back contact of relay RS**1**. The opening of this circuit by the operation of relay RS**1** permits the stepping of the drum of the reader to advance the next row of perforations on the tape record beneath the reader pins. Relay RS**2** blocks the operation of the timing relay TM to terminate the measurement of the timing cycle as previously described, and over its No. 2 contacts establishes a circuit from ground over the C**7** cam contacts, conductor **241** of cable **240**, over the No. 2 contacts of relay RS**2**, conductor **614** of cable **610**, over the No. 3 back contact of relay L2B of Fig. 6, over the No. 2 back contact of relay L4C, over the No. 2 back contact of relay L4A, over the No. 1 back contact of relay LK**1**, conductor **607**, over the No. 1 back contact of relay ESC of Fig. 5, over the No. 1 contacts of operated relay ESA and to battery through the winding of relay ESB which operates and locks over its No. 3 contacts, through resistance **501** and thence as traced to ground over the No. 10 contacts of relay RLT of Fig. 14. On the next opening of the contacts C**3** of the reader, relays RS**1** and RS**2** release. When relays RS**1** and RS**2** operated to advance the reader, the operated reader relays were released, in turn releasing the operated connector relays DSC**1**, DSC**2**, DSC**3**, DSC**4** and DSC**5**. The release of the latter relays opens the operating circuits of the disconnect time register relays of Figs. 25 to 30 but the operated relays remain operated over their locking circuits.

Relay ESB, upon operating, establishes a circuit from ground applied over the previously traced checking circuit to conductor **623**, thence over the No. 1 contacts of relay ESB and over conductor **1509** of cable **1500** to battery through the winding of relay DSR of Fig. 13. Relay DSR operates and is indicative of the fact that the disconnect time entry has been registered. Relay DSR upon operating establishes a circuit from ground over its No. 6 contacts, conductor **1303** and to battery through the winding of relay DIS of Fig. 34. Relay DIS thereupon operates and establishes a circuit from ground over its No. 4 contacts, the No. 2 back contact of relay HE,

the No. 3 back contact of relay HC, the No. 3 back contacts of relay HA, conductor **3408**, the No. 1 back contact of relay HDS, Fig. 36, conductor **3409** and to battery through the winding of relay HR0 of Fig. 34, which relay operates to indicate that no new hour entry has been encountered following the end of tape hour entry.

Sensing the answer entry

The next entry encountered on the tape record is the answer entry for which a hole will be punched in the *ab* position of the tape, resulting in the operation of the A2 reader relay, as previously described for the disconnect entry. At the same time the reader relays of Figs. 7, 8, 9 and 10 will be operated in accordance with the punchings for the B, C, D, E and F digits in the answer entry. It will be assumed that the record tape is perforated for an answer time "111" and that it has been perforated for the district number "71." Thus the line of perforations across the tape will be "211171." As previously stated, the perforation for the A digit "2" has caused the operation of relay A2. The perforations for the B digit "1" will cause the operation of reader relays B1A, B2A, B1D and B2D of Fig. 7, the perforation for the digit "1" for the digit C will cause the operation of reader relays C1A, C2A, C1D and C2D of Fig. 8, the perforations for the D digit "1" will cause the operation of reader relays DA and DD of Fig. 9, the perforations for the E digit "7" will cause the operation of the reader relays EB and EC of Fig. 9 and the perforations for the F digit "1" will cause the operation of the reader relays FA and FD of Fig. 10.

With these reader relays operated a check circuit is established from ground over the cam contacts C9 of the reader, conductor **242** of cable **240**, over the No. 3 contacts of relay TD, over the No. 5 contacts of alarm relay AL, conductor **441**, the No. 5 front contact of operated reader relay FA of Fig. 10, the No. 1 back contact of relay FD, the No. 2 back contact of relay FC, the No. 3 front contact of operated relay FD, the No. 1 back contact of relay FE, conductor **911**, the No. 6 back contact of relay EA of Fig. 9, the No. 7 front contact of operated relay EB, the No. 3 front contact of operated relay EC, the No. 1 back contact of relay ED, the No. 1 back contact of relay EE, the No. 5 front contact of operated relay DA, the No. 1 back contact of relay DB, the No. 2 back contact of relay DC, the No. 3 front contact of operated relay DD, the No. 1 back contact of relay DE, conductor **912**, the No. 5 front contact of operated relay C2A of Fig. 8, the No. 1 back contact of relay C2B, the No. 2 back contact of relay C2C, the No. 3 front contact of operated relay C2D, the No. 1 back contact of relay C2E, conductor **806**, the No. 5 front contact of operated relay B1A of Fig. 7, the No. 1 back contact of relay B1B, the No. 2 back contact of B1C, the No. 3 front contact of operated relay B1D, the No. 1 back contact of relay B1E, conductor **901** of cable **900**, the contacts of relay DIS of Fig. 15, the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the lower back contact of relay CC, conductor **1501** of cable **1500**, the No. 2 back contact of reader relay A1 of Fig. 5, the No. 2 back contact of relay LK2, the No. 3 back contact of relay A3, the No. 2 front contact of relay A2, over conductor **1502** of cable **1500**, the No. 6 back contact of relay RLS2 of Fig. 15, conductor **1503** of cable **1500**, the No. 2 front contact of relay ESB of Fig. 6, the No. 2 back contact of relay ESD, conductor **625** of cable **620**, and in parallel through the windings of relays ANS1, ANS2, ANS3, ANS4 and ANS5 of Fig. 11 to battery. Thus assuming that only one reader relay in the A digit group and two relays in each of the B, C, D, E and F digit groups have operated, the ANS- connector relays of Fig. 11 will operate.

With the connector relay ANS1 now operated and reader relays B1A and B1D of Fig. 7 operated to register the B or minute tens digit "1" of the answer time, as assumed, circuits will be established from ground over the lowermost contacts of relays B1A and B1D, conductors **701** and **704** of cable **700**, the Nos. 1 and 4 contacts of relay ANS1, over conductors **1101** and **1104** of cable **1100** and to battery through the windings of relays A', A, D and D' of the "Minute tens answer time" register of Fig. 22, which register relays operate and lock over the inner upper contacts of relays A and D, conductor **2201** of cable **2200** and to ground over the No. 7 contacts of operated relay RLT of Fig. 14. Also, relay ANS1, with reader relays C1A and C1D of Fig. 8 operated to register the D or minute units digit "1," as assumed, establishes circuits from ground over the lowermost contacts of relays C1A and C1D, conductors **801** and **804** of cable **800**, the Nos. 6 and 9 contacts of relay ANS1, over conductors **1111** and **1114** of cable **1110** and to battery through the windings of relays A, A', D and D' of the "Minute units answer time" register of Fig. 23, which register relays operate and lock over the inner upper contacts of relays A and D and over conductor **2202** of cable **2200** to ground over the No. 8 contacts of relay RLT of Fig. 14.

With the connector relay ANS2 now operated and reader relays DA and DD of Fig. 9 operated to register the D or minute tenths digit "1" of the answer time, as assumed, circuits are established from ground over the Nos. 7 and 9 contacts of relays DA and DD, conductors **921** and **924** of cable **920**, the Nos. 1 and 4 contacts of relay ANS2, conductors **1121** and **1124** of cable **1120** and to battery through the windings of relays A, A', D and D' of the "Minute tenths answer time" register of Fig. 24, which register relays operate and lock over the inner upper contacts of relays A and B, over conductor **2203** of cable **2200**, and to ground over the No. 9 contacts of relay RLT of Fig. 14. Relay ANS2, with reader relays EB and EC of Fig. 9 operated to register the E or tens digit "7" of the district number, as assumed, establishes circuits from ground over the lowermost contacts of relays EB and EC, conductors **942** and **943** of cable **940**, the Nos. 7 and 8 contacts of relay ANS2, conductors **1132** and **1133** of cable **1130** and to battery through the windings of relays B and C of the "District tens answer time" register of Fig. 21, which relays operate and lock over their inner upper contacts, over conductor **2101** of cable **2100** and to ground over the No. 1 contacts of relay RLA of Fig. 14.

With the connector relay ANS3 operated, and reader relays FA and FD of Fig. 10 operated to register the F or units digit "1" of the district number, as assumed, circuits are established from ground over the lowermost contacts of relays FA and FD, conductors **1031** and **1034** of cable **1030**, the Nos. 1 and 4 contacts of relay ANS3, conductors **1141** and **1144** of cable **1140**, and to battery through the windings of relays A and D of the "District units answer time" register of Fig. 21, which relays operate and lock over their inner upper contacts, conductor **2102** of cable **2100** and

to ground over the No. 2 contacts of relay RLA of Fig. 14.

It has been assumed that the relays DTA and DTD of the "Day tens" output register and relays DUA and DUD of the "Day units" output register of Fig. 33 of the day circuit have been operated to register the day digits "11," and that relays HTA and HTB of the "Hour tens" output register of Fig. 35 and relays HUD and HUE of the "Hour units" output register of Fig. 34 have been operated to register the hour digits "03."

With the relay ANS4 operated as previously described and register relays DTA and DTD operated, circuits are established from ground over the No. 3 contacts of relay DTA and the No. 4 contacts of relay DTD, conductors 3301 and 3304 of cable 3300, over the Nos. 1 and 4 contacts of relay ANS4 of Fig. 11, conductors 1150 and 1154 of cable 1150 and to battery through the windings of relays A and D of the "Day tens answer time" register of Fig. 20, which relays operate and lock over their inner upper contacts and conductor 2103 of cable 2100 to ground over the No. 3 contacts of relay RLA of Fig. 14. With register relays DUA and DUD operated, circuits are established from ground over the No. 5 contacts of relays DUA and DUD, conductors 3311 and 3314 of cable 3310, the Nos. 5 and 8 contacts of relay ANS4 of Fig. 11, conductors 1161 and 1164 of cable 1160, and through the windings of relays A and D of the "Day units answer time" register of Fig. 20, which relays operate and lock over their inner upper contacts and conductor 2104 of cable 2100 to ground over the No. 4 contacts of relay RLA of Fig. 14.

With relay ANS5 operated and register relays HTA and HTB of Fig. 35 operated, circuits are established from ground over the No. 1 contacts of relays HTA and HTB, conductors 3501 and 3502 of cable 3500, the Nos. 1 and 2 contacts of relay ANS5, over conductors 1171 and 1172 of cable 1170 and to battery through the windings of relays A and B of the "Hour tens answer time" register of Fig. 19. These relays therefore operate and lock over their inner upper contacts and over conductor 2105 of cable 2100 to ground over the No. 5 contacts of relay RLA of Fig. 14. With register relays HUD and HUE of Fig. 34 operated, circuits are established over the No. 1 contacts of such relays, conductors 3404 and 3405 of cable 3400, the Nos. 7 and 8 contacts of relay ANS5 of Fig. 11, over conductors 1184 and 1185 of cable 1180 to battery through the windings of the D and E relays of the "Hour units answer time" register of Fig. 19. These relays therefore operate and lock over their inner upper contacts and over conductor 2106 of cable 2100 to ground over the No. 6 contacts of relay RLA of Fig. 14.

In addition, connector relay ANS3 establishes a circuit from ground over its No. 7 contacts, conductor 622 of cable 620, the No. 4 front contacts of relay ESB of Fig. 5 and to battery through the winding of relay TSC. Relay ESC operates and locks through resistance 502 and thence as traced to ground over the No. 10 contacts of relay RLT of Fig. 14. Relay ANS3 also establishes a check circuit to determine if two only of the relays of each of the registers of Figs. 19 to 24 inclusive have been operated in response to the sensing of the answer time entry. This checking circuit may be traced from ground over the No. 1 contacts of relay E of the "Minute tenths answer time" register of Fig. 24, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B, the No. 7 contacts of operated relay A of such register, conductor 2400, over the No. 1 back contact of relay E of the "Minute units answer time" register of Fig. 23, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B and the No. 7 contacts of operated relay A of such register, conductor 2300, the No. 1 contacts of relay E of the "Minute tens answer time" register of Fig. 22, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B and the No. 7 contacts of operated relay A of such register, conductor 2204, the No. 1 back contacts of relays E and D of the "District tens answer time" register of Fig. 21, the No. 3 contacts of operated relay C, the No. 9 contacts of operated relay B and the No. 8 back contact of relay A of such register, the No. 1 back contact of relay E of the "District units answer time" register of Fig. 21, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B, the No. 7 contacts of operated relay A of such register, conductor 2107, over the No. 1 back contact of relay E of the "Day tens answer time" register of Fig. 20, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B and the No. 7 contacts of operated relay A of such register, the No. 1 back contact of relay E of the "Day units answer time" register of Fig. 20, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B and the No. 7 contacts of operated relay A of such register, conductor 2000, the No. 1 back contacts of relays E, D and C of the "Hour tens answer time" register of Fig. 19, the No. 3 contacts of operated relay B and the No. 7 contacts of operated relay A of such register, the No. 2 contacts of operated relay E of the "Hour units answer time" relay of Fig. 19, the No. 9 contacts of operated relay D and the lowermost back contacts of relays C, B and A of such register, conductor 626 of cable 620, the No. 6 contacts of ANS3 relay of Fig. 11, conductor 624 of cable 620 and through the winding of relay RS1 of Fig. 4 and resistance 447 to battery and in parallel through the winding of relay RS2 and resistance 448 to battery.

In case the register relays are not so operated as to close the check circuit to operate relays RS1 and RS2, the reader will not be advanced a step and in the break cycle of the reader the ANS-relays will release, the reader relays will release but the operated register relays will remain locked up. The reader will then endeavor on the next closed cycle, when relays ANS and the reader relays will have again operated, to operate the register relays to establish the check circuit. Several trials to operate the register relays will be made before the timing circuit operates to stop the operation of the reader, as previously described.

It will be assumed that the RS1 and RS2 relays both operate and lock over the No. 2 contacts of relay RS1 under the control of cam contacts C3 of the reader, to terminate the timing cycle, and to cause the advance of the drum of the reader one step in the manner previously described. The reader relays now release, but the operated register relays of Figs. 19 to 24, inclusive, remain locked. Relay RS2 now establishes a circuit from ground over the C7 reader contacts, conductor 241 of cable 240, the No. 2 contacts of relay RS2, conductor 614 of cable 610, the No. 3 back contact of relay L2B of Fig. 6, the No. 2 back contact of relay L4C, the No. 2 back contact of relay L4A, the No. 1 back contact of relay LK1, conductor 607, the No. 1 front contact of relay

ESC and to battery through the winding of relay ESD. Relay ESD thereupon operates and locks over its No. 3 front contact to ground over the No. 10 contacts of relay RLT of Fig. 14. On the next opening of the cam contacts C3 of the reader, relays RS1 and RS2 release.

Relay ESD, upon operating, establishes a circuit from ground over the previously traced check circuit to conductor 626, thence over the No. 1 front contact of relay ESD and over conductor 1510 of cable 1500 to battery through the winding of relay ANR of Fig. 13, whereupon the latter relay operates to indicate that the answer time entry has been registered.

OPERATION OF ELAPSED TIME COMPUTER

As soon as the disconnect time has been registered on the registers of Figs. 28 to 30 inclusive, such registrations are transferred to the computing circuits of Figs. 49 to 53 inclusive. To transfer the minute tens registration, circuits are established from ground over the No. 4 contacts of relay RLT of Fig. 14, conductor 2804 of cable 2800, the No. 1 contacts of operated relays D' and A' of the "Minute tens disconnect time" register of Fig. 28, to conductor 1 of cable 2810 and, also, from conductor 2804 over the No. 5 contacts of relay A' and the No. 6 contacts of relay D', to conductor 00 of cable 2810 and thence to battery through the windings of relays B1 and B00 of the "Minute tens computer" register of Figs. 49 and 50. The relays B1 and B00 thereupon operate to register the tens digit "1" of the disconnect time. To transfer the minute units registration, circuits are established from ground over the No. 5 contacts of relay RLT of Fig. 4, over conductor 2805 of cable 2800, the No. 3 contacts of operated relay E' and the No. 4 contacts of operated relay A' of the "Minute units disconnect time" register of Fig. 29, to conductor 5 of cable 2910 and, also, from conductor 2805, over the No. 3 contacts of relay A', and over the No. 2 contacts of relay E' to conductor 4 of cable 2910, and thence to battery through the windings of relays B4 and B5 of the "Minute units computer" register of Figs. 51 and 52. The relays B4 and B5 thereupon operate to register the units digit "9" of the disconnect time. To transfer the minute tenths registration, circuits are established from ground over the No. 6 contacts of relay RLT of Fig. 14, conductor 2806 of cable 2800, the No. 4 contacts of operated relay D' and the No. 1 contacts of operated relay E' of the "Minute tenths disconnect time" register of Fig. 30, to conductor 3 of cable 3010 and, also, from conductor 2806, over the No. 5 contacts of relay E' and the No. 6 contacts of relay D', to conductor 00 of cable 3010, and thence to battery through the windings of relays B00 and B3 of the "Minute tenths computer" register of Figs. 52 and 53. The relays B00 and B3 thereupon operate to register the tenths digit "3" of the disconnect time.

As soon as the answer time has been registered on the registers of Figs. 22 and 24, such registrations are transferred to the computing circuits of Figs. 49 to 53 inclusive. To transfer the minute tens registration, circuits are established from ground over the No. 6 contacts of relay RAD of Fig. 14, conductor 2221 of cable 2220, the No. 1 contacts of operated relays D' and A' of the "Minute tens answer time" register of Fig. 22, to conductor 1 of cable 2210 and, also, from conductor 2221 over the No. 5 contacts of relay A' and the No. 6 contacts of relay B' to conductor 00 of cable 2210 and thence to battery through the windings of relays A3 and A5 of the "Minute tens computer" register of Figs. 49 and 50. Relays A3 and A5 thereupon operate to register the tens digit "8" of the answer time. To transfer the minute units registration, circuits are established from ground, over the No. 7 contacts of relay RAD of Fig. 14, conductor 2222 of cable 2220, the No. 1 contacts of operated relays D' and A' of the "Minute units answer time" register of Fig. 23 to conductor 1 of cable 2310 and, also, from conductor 2222 over the No. 5 contacts of relay A' and the No. 6 contacts of relay D', to conductor 00 of cable 2310, and thence to battery through the windings of relays A3 and A5 of the "Minute units computer" register of Figs. 50 and 51. Relays A3 and A5 thereupon operate to register the units digit "8" of the answer time. To transfer the minute tenths registration, circuits are established from ground over the No. 8 contacts of relay RAD of Fig. 14, conductor 2223 of cable 2220, the No. 1 contacts of operated relay D' and A' of the "Minute tenths answer time" register of Fig. 24, to conductor 1 of cable 2410 and, also, from conductor 2223 over the No. 5 contacts of relay A' and the No. 6 contacts of relay D' to conductor 00 of cable 2410 and thence to battery through the windings of relays A3 and A5 of the "Minute tenths computer" register of Figs. 52 and 53. Relays A3 and A5 operate to register the tenths digit "8."

The computing circuits now have registered therein the tens, units and tenths digit "193" of the minutes of disconnect time on the B sets of relays and have registered therein the complements of the tens, units and tenths digits "111" of the minutes of answer time on the A sets of relays. As previously stated the complementary values of the answer time digits are arrived at by subtracting each answer time digit from 9 and adding 1 to the digit value in the tenths digit place. Thus in the case assumed, the minute tenths digit "1" is subtracted from 9, resulting in the digit 8. To accomplish this, the operating conductors 1 and 00 of cable 2210 which, if connected to relays of the A– set in the same manner as similar conductors 1 and 00 of cable 2810 are connected to relays of the associated B– set, would cause the operation of relays A1 and A00 to register the digit "1," are, however, connected in a manner to control the operation of the A3 and A5 relays to register the complementary digit "8." Similarly the minute units digit "1" is subtracted from 9, resulting in the digit 8, which is accomplished by connecting conductors 1 and 00 of cable 2310 to the windings of relay A3 and A5 of the units digit set rather than to relays A1 to A00 of that set. Also, the minute tenths digit "1" is subtracted from 9, resulting in the digit 8, by the connection of conductors 1 and 00 of cable 2410 to the windings of relays A3 and A5 of the tenths digit set rather than to relays A1 and A00 of that set.

To compute the elapsed time for a call it is necessary to subtract the registered answer time from the registered disconnect time, and it is well known that the equivalent of a subtraction operation may be performed by the addition of the complement of the subtrahend to the other number. This equivalent operation is easier to perform by relays and therefore it has been accomplished by first registering the disconnect time digits in the B sets of relays and the complement of the answer time digits in the A sets of relays, as has been described, and then by suitable interconnections between the sets of relays,

adding the digit values represented by the operated sets of relays. It is to be noted that each B– set of relays is so constituted that the B00 relay always operates together with some one of the B0 to B4 relays to register a digit from 0 to 4; that the B5 relay always operates together with some one of the B0 to B4 relays to register a digit from 5 to 9; that each A set of relays is so constituted that the A00 relay is operated together with some one of the A4 to A0 relays to register the digits 4 to 0, and that the A5 relay always operates together with some one of the A4 to A0 relays to register the digits 9 to 5. The following table indicates the manner in which digits are registered in any digit section of the computing circuits.

Input Digit	Disconnect Time		Answer Time	
	Relays Operated	Digit Registered	Relays Operated	Digit Registered
0	B00, B0	0	A5, A4	9
1	B00, B1	1	A5, A3	8
2	B00, B2	2	A5, A2	7
3	B00, B3	3	A5, A1	6
4	B00, B4	4	A5, A0	5
5	B5, B0	5	A00, A4	4
6	B5, B1	6	A00, A3	3
7	B5, B2	7	A00, A2	2
8	B5, B3	8	A00, A1	1
9	B5, B4	9	A00, A0	0

To secure the full complement of the answer time it is necessary to add 1 in the tenths place. This is accomplished by connecting ground to a carry-in-1 lead entering the computing circuit shown in the upper portion of Fig. 52 and in Fig. 53. Thus in the example shown, in which the disconnect time was "193" and the answer time was "111," the subtraction performed is accomplished by adding the complement of "111" or 888 registered by the A relay sets to 193 registered by the B relay sets, resulting in 1081, then adding the carry-in digit 1 in the last digit place, resulting in the sum 1082, and then ignoring the digit 1 in the first place, giving a final result 082. This result, it will be noted, is the same as would be secured by subtracting "111" from "193."

Returning now to a more detailed description of the operation of the computing circuits with respect to the computation of elapsed time from the data registered therein, a circuit is established from ground over the No. 2 contacts of relay RAD of Fig. 14, carry-in-1 conductor 1401 of cable 1400, the No. 5 contacts of operated relay B3 of Fig. 52, conductor 5200, the No. 7 contacts of operated relay A3 of Fig. 53 to conductor 2 of cable 5300 and, also, from conductor 1401, over the No. 8 contacts of operated relay B3 of Fig. 52, conductor 5201, the No. 4 contacts of operated relay A3 of Fig. 53, the No. 2 contacts of operated relay B00 of Fig. 53 and the No. 1 contacts of operated relay A5 of Fig. 53, to conductor 00 of cable 5300, and thence through the windings of relays R00 and R2 of the "Minute tenths elapsed time" register of Fig. 47 to register the digit "2." Since the sum of the digits "3" and "9" in the tens place is greater than ten, a circuit is also established from ground on conductor 4101, over the No. 8 contacts of relay B3 of Fig. 52, conductor 5201, the No. 4 contacts of relay A3 of Fig. 53, the No. 5 contacts of relay B00 and the No. 4 contacts of relay A5 to battery through the winding of carry-out-1 relay CO1.

A circuit is also established from conductor 1402, over the No. 7 contacts of relay B4 of Fig. 51, the No. 4 contacts of relay A3, the No. 2 contacts of relay B5, conductor 5102, the No. 2 contacts of relay A5 of Fig. 52 to conductor 5 of cable 5100. A circuit is also established from ground on conductor 1402, over the contacts of relay CO1 of Fig. 53, conductor 5301, the No. 4 contacts of relay B4 of Fig. 51, the No. 8 contacts of relay A3 and to conductor 3 of cable 5100. With ground thus connected to conductors 3 and 5 of cable 5100, relays R3 and R5 of the "Minute units elapsed time" register of Fig. 46 operate to register the units digit "8."

Since the sum of the digits "9" and "8" registered in the units section of the computing circuit is greater than 10 a circuit is also established from ground over the No. 2 contacts of relay RAD of Fig. 14, conductor 1402 of cable 1400, the No. 4 contacts of operated relay B5 of Fig. 51, conductor 5101, the No. 4 contacts of operated relay A5 of Fig. 52 and to battery through the winding of carry-out-1 relay CO1 of Fig 51.

It will be noted that through the operation of the carry-out-1 relay CO1 of Fig. 53, a digit "1" has been added into the units place so that the addition of the units digits "9" and "8" of the disconnect time and the complement of the answer time, respectively, which would be 17 is now augmented by 1 to become 18, the 8 of this augmented sum being registered as previously described in the elapsed time register of Fig. 46 and the 1 being carried out by the operation of the carry-out-1 relay CO1 of Fig. 52.

A circuit is also established from ground over the No. 4 contacts of relay RAD of Fig. 14, conductor 1403 of cable 1400, the contacts of relay CO1 of Fig. 52, conductor 5202, the No. 4 contacts of relay B1 of Fig. 49, conductor 4900, the No. 4 contacts of relay A3 of Fig. 50, the No. 2 contacts of relay B00, the No. 1 contacts of relay A5 of Fig. 50 and conductor 5000 to battery through the winding of relay A00 of the "Hour computer" register of Figs. 48 and 49. An additional circuit is also established from ground on conductor 5202, over the No. 5 contacts of relay B1 of Fig. 49, conductor 4901, the No. 5 contacts of relay A3 of Fig. 50 and conductor 5001, through the winding of relay A0 of Fig. 49 to battery. Relays A00 and A0 of the "Hour computer" circuit thus become operated to register the tens digit "0." It will be noted that through the operation of the carry-out-1 relay CO1 of Fig. 52 a digit "1" has been added into the minute tens place, so that the addition of the tens digit "1" of the disconnect time and the complement "8" of the answer time which would be 9 is now augmented by 1 to become 10, of which the 0 is registered through the operation of the A00 and A0 relays of Fig. 49, as just described.

Also a circuit is established from conductor 1403, over the contacts of relay CO1 of Fig. 52, over conductor 5202, over the No. 4 contacts of relay B1 of Fig. 49, conductor 4900, the No. 4 contacts of relay A3 of Fig. 48, the No. 5 contacts of relay B00, the No. 4 contacts of relay A5 and to battery through the winding of carry-out-1 relay CO1 of Fig. 50.

The "Hour computer" circuit of Figs. 48 and 49 is provided for adding the hours which may be involved in the elapsed time should a conversation extend over sixty minutes. That is, if an hour entry is encountered on the tape between the disconnect time and the answer time, then it will be necessary to add one hour or sixty minutes in computing the elapsed time. The "Minute tens computer" circuit of Figs. 49 and 50 is ar-

ranged so that, instead of registering its output directly on the register relays of Fig. 46, it is registered as just described on the A– relays of the "Hour computer" circuit. If no hour entry has been encountered on the tape between the disconnect entry and the answer entry, the hour circuits of Figs. 34 to 37 will cause the operation of the B– relays B00 and B0 of Fig. 49 to register the digit "0." When an hour entry has been encountered, the hour circuits will cause the operation of the B– relays B1 and B5 to register the tens digit "6." Since the other digits of this hour entry are 0 (600) it is not necessary to add to the units and tens circuits. If two hour entries are encountered or 120 minutes, it is necessary to add a digit "2" in the tens place, which is accomplished by the operation of the B– relays B00 and B2 of Figs. 48 and 49. Provision is made, of course, for adding the digit 1 as a hundreds digit in the computation. The manner in which either 60 or 120 minutes is added will be discussed later.

It will be assumed that no intervening hour entry on the tape has been encountered and that therefore relays B0 and B00 have been operated over conductors 00 and 0 of cable 3410 under the control of relay HR0 of Fig. 34 of the hour circuits in the manner to be later described. A circuit is therefore established from ground over the No. 4 contacts of relay RAD of Fig. 14, conductor 1404 of cable 1400, the No. 5 contacts of relay B0 of Fig. 48, conductor 4808, the No. 3 contacts of relay A0 of Fig. 49, conductor 4801, over the No. 1 contacts of relay B00 of Fig. 48, conductor 4802, the No. 1 contacts of relay A00 of Fig. 49 and conductor 00 of cable 4800 to battery through the winding of relay R00 of the "Minute tens elapsed time" register of Fig. 46. Another circuit is established from ground on conductor 1404, over the No. 1 contacts of relay B0 of Fig. 48, conductor 4803, the No. 5 contacts of relay A0 of Fig. 49 and conductor 0 of cable 4800 to battery through the winding of relay R0 of the "Minute tens elapsed time" register. The relays of the elapsed time register of Fig. 46 have thus been operated to register the elapsed time digits "082" for the elapsed time of 08.2 minutes.

A further circuit is established from ground on conductor 1404, over the No. 4 contacts of relay B00 of Fig. 48, conductor 4804 and the No. 3 contacts of relay A00 of Fig. 49 to battery through the winding of carry-out-0 relay C00. Relay CO1 of Fig. 50 upon operating, as previously described, establishes a circuit from ground over its contacts, conductor 5002 and to battery through the winding of relay CR1 of Fig. 46. A circuit is also established from ground over the No. 2 contacts of relay HR0 of Fig. 37, conductor 3406 and through the winding of relay H0 of Fig. 47 to battery. With relays CR1 and H0 both operated, a circuit is established from ground over the contacts of relay C00 of Fig. 49, conductor 4902, the No. 2 contacts of relay CR1 and the No. 3 contacts of relay H0 to battery through the winding of relay CR1–A. This relay operates to prepare a circuit for lamp CR1 and to prepare a check circuit through the operated relays of the elapsed time registers and relays of the computers.

The check circuit may be traced from ground over the upper contacts of relay CR1–A, over the No. 1 back contact of relay H1, over the No. 1 front contact of relay H0, over the No. 1 back contact of relay CR0, over the No. 1 front contact of relay CR1, conductor 4903, the No. 5 contacts of relay A00 of Fig. 49, the No. 6 back contact of A5, the No. 2 contacts of relay A0, the No. 10 contacts of relay A1, conductor 4904, the No. 10 back contacts of relays A2 and A3 of Fig. 48, the No. 1 back contact of relay A4, the No. 6 contacts of relay B00, the No. 7 back contact of relay B5, the No. 9 contacts of relay B0, the No. 1 back contact of relay B1, the No. 10 back contact of relay B2, conductor 4905, the No. 6 back contact of relay A00 of Fig. 50, the No. 5 contacts of relay A5, the No. 1 back contacts of relays A0 and A1, the No. 1 back contact of relay A2, the No. 2 contacts of relay A3, the No. 1 back contact of relay A4, the No. 6 contacts of relay B00, the No. 7 back contact of relay B5, conductor 5003, the No. 10 back contact of relay B0, the No. 10 contacts of relay B1, the No. 1 back contacts of relays B2 and B3, the No. 10 back contact of relay B4, conductor 5004, the No. 6 back contacts of relay A00 of Fig. 52, the No. 5 contacts of relay A5, the No. 1 back contacts of relays A0 and A1, conductor 5203, the No. 1 back contact of relay A2 of Fig. 51, the No. 2 contacts of relay A3, the No. 1 back contact of relay A4, the No. 7 back contact of relay B00, the No. 6 contacts of relay B5, the No. 10 back contact of relay B0, the No. 11 back contacts of relays B1, B2 and B3, the No. 9 contacts of relay B4, conductor 5103, the No. 6 back contact of relay A00 of Fig. 53, the No. 5 contacts of relay A5, the No. 1 back contacts of relays A0, A1 and A2, the No. 2 contacts of relay A5, the No. 1 back contact of relay A4, the No. 6 contacts of relay B00, the No. 7 back contact of relay B5, conductor 5302, the lowermost back contacts of relays B0, B1 and B2, of Fig. 52, the No. 10 contacts of relay B3, the No. 10 back contact of relay B4, conductor 5204, the No. 2 front contacts of relay R00 of the register of Fig. 47, the No. 2 back contacts of relays R5, R0 and R1, the No. 2 front contact of relay R2, the No. 3 back contact of relay R3, the No. 2 back contact of relay R4, conductor 4700, the No. 2 back contact of relay R00 of the units register of Fig. 46, the No. 2 front contact of relay R5, the No. 2 back contacts of relays R0, R1 and R2, the No. 2 front contact of relay R3, the No. 2 back contact of relay R4, the No. 2 front contact of relay R00 of the tens register of Fig. 46, the No. 2 back contact of relay R5, the No. 2 front contact of relay R0, the No. 3 back contacts of relays R1, R2 and R3, the No. 2 back contact of relay R4, and conductor 1535 to battery through check relay CKB of Fig. 15. This check relay, upon operating, establishes the fact that the register circuits check properly and that printing of the ticket may proceed as soon as the first line of the initial entry has been properly registered.

Before proceeding with the description of the sensing of the initial entry for a complete call and the printing of the ticket, it would appear advisable at this time to consider the situation in which an hour entry is encountered on the tape between the disconnect time and the answer time. Then it would be necessary to add one or more hours in the computation of the elapsed time. To illustrate this condition, it will be assumed that the disconnect time as registered on the registers of Figs. 28 to 30, inclusive, was "122" and that the answer time as registered on the registers of Figs. 22 to 24, inclusive, was "223." Then, as such a call would encompass an hour entry, it would be necessary to add sixty minutes to the elapsed time computation to obtain the correct elapsed conversational time.

To register the disconnect time, relays A, A',

D and D' of Fig. 28 will have been operated to register the minute tens digit "1," relays B, B', D and D' of Fig. 29 will have been operated to register the minute units digit "2," and relays B, B', D and D' of Fig. 30 will have been operated to register the minute tenths digit "2" and, in the manner previously described, these registrations are then transferred to the computer circuits of Figs. 48 to 53, inclusive, to cause the operation of relay B00, Fig. 50, and B1, Fig. 49, of the "Minute tens computer," to cause the operation of relays B00 and B2, Fig. 51, of the "Minute units computer," and to cause the operation of relay B00, Fig. 53, and relay B2, Fig. 52, of the "Minute tens computer."

To register the answer time, relays B, B', D and D' of Fig. 22 have been operated to register the minute tens digit "2," relays B, B', D and D' of Fig. 23 have been operated to register the minute units digit "2," and relays D, D', E and E' of Fig. 24 have been operated to register the minute tenths digit "3." These digit registrations are each subtracted from 9 to secure the complements thereof, and in the manner previously described, the complements of these registrations are transferred to the computing circuits of Figs. 48 to 53, inclusive. The complements of the registered digits "223" are 776 and, accordingly, relays A5 and A2 of Fig. 50 of the "Minute tens computer" are operated to register the complement digit "7," relay A2, Fig. 51 and relay A5 of Fig. 52 of the "Minute units computer" are operated to register the complement digit "7" and relays A1 and A5 of Fig. 53 of the "Minute tenths computer" are operated to register the complement digit "6."

The conjoint operation of relays A1, A5, B00 and B2 of the "Minute tenths computer" is to add the minute tenths digits "2" and "6" together and to register the sum on the relays of the "Minute tens elapsed time" register of Fig. 47. To accomplish this a first circuit is established from ground on conductor 1401, over the No. 7 contacts of relay B2 of Fig. 52, conductor 5205, the No. 3 contacts of relay A1 of Fig. 53, the No. 1 contacts of relay B00 and the No. 2 contacts of relay A5 to conductor 5 of cable 5300. Another circuit is established from conductor 1401, over the No. 5 contacts of relay B2 of Fig. 52, conductor 5206 and the No. 9 contacts of relay A1 of Fig. 53 to conductor 4 of cable 5300. The grounding of conductors 4 and 5 of cable 5300 results in the operation of relays R4 and R5 of the "Minute tenths elapsed time" register of Fig. 47 to register the tenths digit "9" of the elapsed time. In addition, the connection of ground to conductor 1401 results in the establishment of a circuit over the No. 7 contacts of relay B2, conductor 5205, the No. 3 contacts of relay A1, the No. 3 contacts of relay B00, the No. 3 contacts of relay A5 and to battery through the winding of carry-out-0 relay C00. The operation of relay C00 is indicative of the fact that the sum of the minute tenths digits is less than 10 and there is no carry-out into the "Minute units computer."

The conjoint operation of relays A2, A5, B00 and B2 of the "Minute units computer" is to add the minute units digits "2" and "7" together and to register the sum on the relays of the "Minute units elapsed time" register of Fig. 46. To accomplish this a first circuit is established from ground on conductor 1402, over the contacts of relay C00 of Fig. 53, conductor 5303, the No. 3 contacts of relay B3 of Fig. 51, the No. 3 contacts of relay A2, the No. 1 contacts of relay B00, conductor 5102, the No. 2 contacts of relay A5 of Fig. 52 and to conductor 5 of cable 5100. Another circuit is established from ground on conductor 5303, over the No. 2 contacts of relay B2 of Fig. 51, the No. 9 contacts of relay A2 and to conductor 4 of cable 5100. The grounding of conductors 4 and 5 of cable 5100 results in the operation of relays R4 and R5 of the "Minute units elapsed time" register of Fig. 46 to register the units digit "9" of the elapsed time. In addition the connection of ground to conductor 5303 establishes a circuit over the No. 3 contacts of relay B2 of Fig. 51, the No. 3 contacts of relay A2, the No. 3 contacts of relay B00, conductor 5104, the No. 3 contacts of relay A5 and to battery through the winding of carry-out-0 relay C00. The operation of relay C00 is indicative of the fact that the sum of the minute units digits is less than 10 and that there is no carry-out into the "Minute tens computer."

The conjoint operation of relays A2, A5, B00 and B1 of the "Minute tens computer" is to add the minute tens digits "1" and "7" together and to register the sum in the relays of the "Hour computer" of Figs. 48 and 49. To accomplish this a first circuit is established from ground on conductor 1403, over the No. 8 contacts of relay B1 of Fig. 49, conductor 4906, the No. 3 contacts of relay A2 of Fig. 50, the No. 1 contacts of relay B00, the No. 2 contacts of relay A5 and conductor 5005 to battery through the winding of relay A5 of the "Hour computer" of Fig. 49. A circuit is also established from ground on conductor 1403, over the contacts of relay C00 of Fig. 52, conductor 5207, the No. 2 contacts of relay B1 of Fig. 49, conductor 4907, the No. 8 contacts of relay A2 of Fig. 50 and conductor 5006 to battery through the winding of relay A3 of Fig. 48 of the "Hour computer." Relays A3 and A5 of the computer have therefore been operated. In addition, a circuit is established from ground on conductor 1403, over the No. 8 contacts of relay B1 of Fig. 49, conductor 4906, the No. 3 contacts of relay A2 of Fig. 50, the No. 3 contacts of relay B00, the No. 3 contacts of relay A5 and to battery through the winding of carry-out-0 relay C00. Relay C00 operates to indicate that the sum of the minute tens digits is less than 10 and that there is no carry-out into the "Hour computer."

It has been assumed that there has been an hour entry intervening between the answer and disconnect entries and that therefore the HR1 relay of Fig. 34 in the hour circuits has been operated to cause connection of ground over its Nos. 2 and 3 contacts to conductors 1 and 5 of cable 3410 and thereby to cause the operation of relays B1 and B5 of Fig. 48 of the "Hour computer" to register the tens digit "6" of the intervening hour. The conjoint operation of relays A3, A5, B1 and B5 is to add the minute tens digit "8" brought over from the "Minute tens computer" to the digit "6" brought over from the hour circuits and to cause the registration of this sum in the "Minute tens elapsed time" register of Fig. 46. To accomplish this, ground on conductor 1404 is applied over the No. 3 contacts of relay B1 of Fig. 48, the No. 3 contacts of relay A3, the No. 1 contacts of relay B5 of Fig. 48, conductor 4805, the No. 1 contacts of relay A5 of Fig. 49 and to the 00 conductor of cable 4800. A circuit is also established from conductor 1404, over the No. 2 contacts of relay B1 of Fig. 48, and the No. 9 contacts of relay A3 to conductor 4 of cable 4800. Thereupon relays R00 and R4 of

the "Minute tens elapsed time" register of Fig. 46 are operated to register the tens digit "4." The elapsed time registers have now been operated to register the elapsed time "499."

A further circuit is established from ground on conductor 1404, over the No. 4 contacts of relay B5 of Fig. 48, conductor 4805, the No. 4 contacts of relay A5 of Fig. 49 and to battery through the winding of carry-out-1 relay CO1. Relay C00 of Fig. 50, upon operating, establishes a circuit from ground over its contacts and over conductor 5007 to battery through the winding of relay CR0 of Fig. 47 to indicate the fact that there is no carry-out from the "Minute tens computer." Also a circuit is established from ground over the No. 1 contacts of relay HR1 of the hour circuits of Fig. 34, conductor 3406 and to battery through the winding of relay H0 of Fig. 47. With relays CR0 and H0 operated a circuit is established from ground over the contacts of relay C01 of Fig. 49, conductor 4903, the No. 3 contacts of relay CR0, the No. 4 contacts of relay H0 and to battery through the winding of relay CR1A. Relay CR1A operates to prepare the circuit of lamp CR1 and to apply ground over its upper contacts to the check circuit. This check circuit extends over contacts of the operated relays H0, CR0, the contacts of relays of the computers and relays of the elapsed time registers and through the winding of relay CKB of Fig. 15 if the check circuit is completed as it should be.

It will now be assumed that the computing circuits have functioned as just described to cause the registration of the minute tens digit "9" and the minute units digit "9" in the elapsed time registers of Figs. 46 and 47 and that the "Minute tens computer" has caused the operation of relays A3 and A5 of the "Hour computer" and that no intervening hour registration has been encountered between the answer and disconnect time entries. Under these circumstances the HR0 relay of Fig. 34 will be operated and will cause the operation of the B00 and B0 relays of the "Hour computer." The conjoint operation of the relays A3, A5, B00 and B0 is to add the tens digit "8" brought over from the "Minute tens computer" and the digit "0" brought over from the hour circuit. To accomplish this a circuit is established from ground on conductor 1404, over the No. 8 contacts of relay B0 of Fig. 48, the No. 3 contacts of relay A3, the No. 1 contacts of relay B00, conductor 4802, the No. 2 contacts of relay A5 of Fig. 49 and to conductor 5 of cable 4800. A second circuit is established from ground on conductor 1404, over the No. 1 contacts of relay B0 of Fig. 48 and over the No. 8 contacts of relay A3 to conductor 3 of cable 4800. The grounding of conductors 3 and 5 of cable 4800 causes the operation of relays R3 and R5 of the "Minute tens elapsed time" register of Fig. 46 to register the digit "8" and thus the total elapsed time registered is "899."

In addition a circuit is established from ground on conductor 1404, over the No. 8 contacts of relay B0 of Fig. 48, over the No. 3 contacts of relay A3, the No. 3 contacts of relay B00, conductor 4810, the No. 3 contacts of relay A5 and to battery through the winding of relay C00 of Fig. 49. With relay HR0 of the hour circuits, Fig. 34, operated a circuit is established from ground over the No. 2 contacts of such relay, over conductor 3406 and to battery through the winding of relay H0 of Fig. 47. Relay C00 of Fig. 50, upon operating, has also established over conductor 5007 the circuit of relay CR0 of Fig. 47. Thus with relays H0 and CR0 operated, a circuit is established from ground over the contacts of relay C00 of Fig. 49, over conductor 4902, over the No. 2 contacts of relay CR0 and over the No. 2 contacts of relay H0 to battery through the winding of relay CR0A. Relay CR0A thereupon operates to light lamp CR0 and to establish a circuit from ground over its lower contacts and conductor 4701 to battery through the winding of alarm relay AL of Fig. 4, which latter relay then operates to operate visual and audible alarms. The lighting of lamp CR0 and the operation of the alarms is an indication that the computation of the elapsed time was not complete and that the registered elapsed time "899" is not accurate.

As a further illustration it will be assumed that two hour entries are encountered on the tape between the disconnect time and the answer time and that it is therefore necessary to add two hours to the elapsed time registration. To illustrate this condition it will be assumed that the disconnect time as registered on the registers of Figs. 28 to 30, inclusive, was "122" and that the answer time as registered on the registers of Figs. 22 to 24, inclusive, was "523." Then as such a call would encompass two hour entries it would be necessary to add 120 minutes to obtain the correct elapsed conversational time.

To register the disconnect time, relays A, A', D and D' of Fig. 28 will have been operated to register the minute tens digit "1," relays B, B', D and D' of Fig. 29 will have been operated to register the minute units digit "2," and relays B, B', D and D' of Fig. 30 will have been operated to register the minute tens digit "2" and, in the manner previously described, these registrations are then transferred to the computer circuits of Figs. 48 to 53, inclusive, to cause the operation of relays B00, Fig. 50, and B1, Fig. 49, of the "Minute tens computer," to cause the operation of relays B00 and B2 of Fig. 51 of the "Minute units computer," and to cause the operation of relay B00, Fig. 53, and relay B2, Fig. 52, of the "Minute tenths computer."

To register the answer time, relays C, C', D and D' of Fig. 22 will have been operated to register the minute tens digit "5," relays B, B', D and D' of Fig. 23 will have been operated to register the minute units digit "2" and relays B, B', E and E' of Fig. 24 will have been operated to register the minute tenths digit "3." These digit values are each subtracted from 9 to secure the complements thereof and, in the manner previously described, the complements of these digit registrations are then transferred to the computing circuits from Figs. 48 to 53 inclusive. The complements of the registered digits "523" are 476 and, accordingly, relays A00 and A4 of Fig. 50 of the "Minute tens computer" are operated to register the complement digit "4," relays A2 Fig. 51 and A5 Fig. 52 of the "Minute units computer" are operated to register the complement digit "7" and relays A1 and A5 of the "Minute tenths computer" of Fig. 53 are operated to register the complement digit "6."

The conjoint operation of relays A1, A5, B00 and B2 of the "Minute tenths computer" is to add the minute tenths digit "2" and "6" together and to register the sum in the relays of the "Minute tenths elapsed time" register of Fig. 47. To accomplish this, ground is applied to conductor 5 of cable 5300 over conductor 1401, the No. 7 contacts of relay B2 of Fig. 52, conductor 5205, the No. 3 contacts of relay A1 of Fig. 53, the No. 1 contacts of relay B00 and the No. 2

contacts of relay A5 to conductor 5 of cable 5300. Another ground is applied to conductor 4 of cable 5300 from conductor 1401 over the No. 5 contacts of relay B2 of Fig. 52, over conductor 5206 and over the No. 9 contacts of relay A1 of Fig. 53 to conductor 4 of cable 5300. The grounding of conductors 4 and 5 of cable 5300 results in the operation of relays R4 and R5 of the "Minute tenths elapsed time" register of Fig. 47 to register the tenths digit "9" of the elapsed time. In addition, the connection of ground to conductor 1401 results in the establishment of a circuit over the No. 7 contacts of relay B2, conductor 5205, the No. 3 contacts of relay A1, the No. 3 contacts of relay A5 and to battery through the winding of carry-out-0 relay C00. The operation of relay C00 is indicative of the fact that the sum of the minute tenths digits is less than 10 and that there is no carry out into the "Minute units computer."

The conjoint operation of relays A2, A5, B00 and B2 of the "Minute units computer" is to add the minute units digits "2" and "7" together and to register the sum in the relays of the "Minute units elapsed time" register of Fig. 46. To accomplish this, ground is applied to conductor 5 of cable 5100 from ground on conductor 1402, over the contacts of relay C00 of Fig. 53, conductor 5303, the No. 3 contacts of relay B3 of Fig. 51, the No. 3 contacts of relay A2, the No. 1 contacts of relay B00, conductor 5102 and, the No. 2 contacts of relay A5 of Fig. 52 and to conductor 5 of cable 5100. Another ground is applied to conductor 4 of cable 5100 from ground on conductor 5303, over the No. 2 contacts of relay B2 of Fig. 51, and the No. 9 contacts of relay A2 and to conductor 4 of cable 5100. The grounding of conductors 4 and 5 of cable 5100 results in the operation of relays R4 and R5 of the "Minute units elapsed time" register of Fig. 46 to register the units digit "9" of the elapsed time. In addition, the connection of ground to conductor 5303 establishes a circuit over the No. 3 contacts of relay B2 of Fig. 51, the No. 3 contacts of relay A2, the No. 3 contacts of relay B00, conductor 5111, the No. 3 contacts of relay A5 and to battery through the winding of carry-out-0 relay C00. The operation of relay C00 is indicative of the fact that the sum of the minute units digits is less than 10 and that there is no carry out into the "Minute tens computer."

The conjoint operation of relays A00, A4, B00 and B1 of the "Minute tens computer" is to add the minute tens digits "4" and "1" together and to register the sum in the relays of the "Hour computer" of Figs. 48 and 49. To accomplish this, a first circuit is established from ground over conductor 1403, the No. 9 contacts of relay B1 of Fig. 49, conductor 4910, the No. 4 contacts of relay A4 of Fig. 50, the No. 2 contacts of relay B00, the No. 2 contacts of relay A00 and conductor 5005 to battery through the winding of relay A5 of the "Hour computer" of Fig. 49. A circuit is also established from ground on conductor 1403, over the contacts of relay C00 of Fig. 52, over conductor 5207, the No. 2 contacts of relay B1 of Fig. 49, conductor 4907, the No. 5 contacts of relay A4 of Fig. 50 and conductor 5001 to battery through the winding of relay A0 of Fig. 49. Relays A0 and A5 of the "Hour computer" therefore are operated. In addition, a circuit is established from ground on conductor 1403, over the No. 4 contacts of relay B00 of Fig. 50, the No. 3 contacts of relay A00 and to battery through the winding of the carry-out-0 relay C00 of Fig. 50. Relay C00 operates to indicate the fact that the sum of the minute tens digits is less than 10 and that there is no carry out into the "Hour computer."

It has been assumed that there have been two hour entries intervening between the answer and disconnect entries and that therefore the HR2 relay of Fig. 34 in the hour circuits has been operated and caused the connection of ground over its Nos. 1 and 3 contacts to conductors 00 and 2 of cable 3410 and to thereby cause the operation of relays B00 and B2 of the "Hour computer" to register the tens digit "2" of the 120 minutes intervening time. The conjoint operation of relays A0, A5, B00 and B2 of the "Hour computer" is to add the minute tens digit "5" brought over from the "Minute tens computer" to the digit "2" brought over from the hour circuits, and to cause the registration of the sum in the "Minute tens elapsed time" register of Fig. 46. To accomplish this, ground on conductor 1404 is applied over the No. 1 contacts of relay B2 of Fig. 48, over conductor 4809, the No. 7 contacts of relay A0 and to conductor 2 of cable 4800. Ground on conductor 1404 is also applied over the No. 5 contacts of relay B2 of Fig. 48, conductor 4808, the No. 3 contacts of relay A0 of Fig. 49, conductor 4801, the No. 1 contacts of relay B00 of Fig. 48, conductor 4802, the No. 2 contacts of relay A5 of Fig. 49 and to conductor 5 of cable 4800. The grounding of conductors 2 and 5 of cable 4800 results in the operation of relays R2 and R5 of the "Minute tens elapsed time" register of Fig. 46 to register the tens digit "7." The elapsed time registers have now been set to register the elapsed time "799."

A further circuit is established from ground on conductor 1404, over the No. 5 contacts of relay B2 of Fig. 48, conductor 4808, the No. 3 contacts of relay A0 of Fig. 49, conductor 4801, the No. 3 contacts of relay B00 of Fig. 48, conductor 4810, the No. 3 contacts of relay A5 of Fig. 49 to battery through the winding of relay C00 of Fig. 50. Relay C00, upon operating, establishes a circuit from ground over its contacts and conductor 5007 to battery through the winding of relay CR0 of Fig. 47, and indicates the fact that there is no carry-out from the "Minute tens computer." A circuit is also established from ground, over the No. 2 contacts of relay HR2 of the hour circuits in Fig. 34, conductor 3407 and to battery through the winding of relay H1 of Fig. 47. With relays CR0 and H1 operated, a circuit is established from ground over the contacts of relay C00 of Fig. 49, conductor 4902, the No. 2 contacts of relay CR0, the No. 2 contacts of relay H1 and to battery through the winding of relay CR1A of Fig. 47. Relay CR1A, upon operating, prepares the circuit of lamp CR1 and applies ground over its upper contacts, over the No. 1 front contact of relay H1, over the No. 1 back contact of relay H0, the No. 1 front contact of relay CR0, the No. 1 back contact of relay CR1 and thence over contacts of the operated relays of the computers, the relays of the elapsed time registers and thence to battery through the winding of relay CKB of Fig. 15, if the check circuit is completed as it should be.

As a still further illustration, it will be assumed that two hour entries are encountered on the tape between the disconnect time and the answer time entries and that the disconnect time is registered on the registers of Figs. 28 to 30 in-

clusive as "122" and that the answer time as registered on the registers of Figs. 22 to 24 was "055." Then as such a call would encompass two hour entries it would be necessary to add 120 minutes in the computation of the elapsed time.

The disconnect time is registered and transferred to the computer in the manner previously described, resulting in the operation of relays B00 Fig. 50 and B1 Fig. 49 of the "Minute tens computer," in the operation of relays B00 and B2 of Fig. 51 of the "Minute units computer" and in the operation of relay B00 Fig. 53 and relay B2 Fig. 52 of the "Minute tenths computer."

To register the answer time, relays A, A', B and B' of Fig. 22 will have been operated to register the minute tens digit "0," relays C, C', D and D' of Fig. 23 will have been operated to register the minute units digit "5" and relays C, C', D and D' of Fig. 24 will have been operated to register the minute tens digit "5." These digit values are each subtracted from 9 to secure the complements thereof and in the manner previously described, the complements of these digit registrations are transferred to the computer circuits of Figs. 48 to 53 inclusive. The complement of the registered digits "055" are 944 and, accordingly, relays A4 and A5 of Fig. 50 of the "Minute tens computer" are operated to register the complement "9," relays A00 of Fig. 52 and relay A4 of Fig. 51 of the "Minute units computer" are operated to register the complement digit "4" and relays A00 and A4 of Fig. 53 of the "Minute tenths computer" are operated to register the complement digit "4."

The conjoint operation of relays A00, A4, B00 and B2 of the "Minute tenths computer" is to add the minute tenths digits "2" and "4" together and to register the sum in the relays of the "Minute tenths elapsed time" register of Fig. 47. To accomplish this ground over conductor 1401 is applied to conductor 5 of cable 5300, over the No. 9 contacts of relay B2 of Fig. 52, conductor 5203, the No. 4 contacts of relay A4 of Fig. 53, the No. 2 contacts of relay B00, the No. 2 contacts of relay A00 and to conductor 5 of cable 5300, and ground on conductor 1401 is further applied to conductor 2 of cable 5300, over the No. 5 contacts of relay B2, Fig. 52, conductor 5206, the No. 7 contacts of relay A4, Fig. 53 and to conductor 2 of cable 5300. The grounding of conductors 2 and 5 of cable 5300 results in the operation of relays R2 and R5 of the "Minute tenths elapsed time" register of Fig. 47 to register the tenths digit "7" of the elapsed time. In addition, the connection of ground to conductor 1401 results in the establishment of a circuit over the No. 4 contacts or relay B00 of Fig. 53, the No. 3 contacts of relay A00 and to battery through the winding of carry-out-0 relay C00. The operation of relay C00 is indicative of the fact that the sum of the minute tenths digits is less than 10 and that there is no carry-out into the "Minute units computer."

The conjoint operation of relays A00, A4, B00 and B2 of the "Minute units computer" is to add the minute units digits "2" and "4" together and to register the sum in the relays of the "Minute units elapsed time" register of Fig. 46. To accomplish this ground on conductor 1402 is applied to conductor 5 of cable 5100, over the No. 9 contacts of relay B2 Fig. 51, the No. 4 contacts of relay A4, the No. 2 contacts of relay B00, conductor 5105 and the No. 2 contacts of relay A00 to conductor 5 of cable 5100. Ground on conductor 4102 is further applied to conductor 1 of cable 5100, over the contacts of relay C00 of Fig. 53, conductor 5303, the No. 2 contacts of relay B2 Fig. 51 and the No. 6 contacts of relay A4 to conductor 1 of cable 5100. The grounding of conductors 1 and 5 of cable 5100 thus results in the operation of relays R1 and R5 of the "Minute units elapsed time" register of Fig. 46 to register the units digit "6" of the elapsed time. In addition, a circuit is established from ground on conductor 1402, over the No. 4 contacts of relay B00 of Fig. 51, conductor 5106 and the No. 3 contacts of relay A00 of Fig. 52 to battery through the winding of the carry-out-0 relay of Fig. 52. The operation of relay C00 is indicative of the fact that the sum of the minute units digits is less than 10 and that there is no carry-out into the "Minute tens computer."

The conjoint operation of relays A4, A5, B00 and B1 of the "Minute tens computer" is to add the minute tens digits "1" and "9" and to register the sum in the A-relays of the "Hour computer." To accomplish this a first circuit is established from ground on conductor 1403, over the No. 9 contacts of relay B1, Fig. 49, conductor 4910, the No. 4 contacts of relay A4 of Fig. 50, the No. 2 contacts of relay B00, the No. 1 contacts of relay A5 and conductor 5000 to battery through the winding of relay A00, Fig. 49, of the "Hour computer." A second circuit is established from ground on conductor 1403, over the contacts of relay C00 of Fig. 52, conductor 5207, the No. 2 contacts of relay B1 of Fig. 49, conductor 4907, the No. 5 contacts of relay A4 of Fig. 50 and conductor 5001 to battery through the winding of relay A0, Fig. 49, of the "Hour computer." Relays A00 and A0 of the "Hour computer" have therefore been operated. In addition a circuit is established from conductor 1403, over the No. 9 contacts of relay B1 of Fig. 49, conductor 4910, the No. 4 contacts of relay A4 of Fig. 50, the No. 5 contacts of relay B00, the No. 4 contacts of relay A5 and to battery through the winding of carry-out-1 relay C01 of Fig. 50. The operation of relay C01 is indicative of the fact that the sum of the minute tens digits "1" and "9" was 10 and that a digit "1" should be carried out into the "Hour computer."

It has been assumed that there have been two hour entries intervening between the answer and disconnect time and that therefore the HR2 relay of Fig. 34 has been operated and caused the operation of relays B00 and B2 of the "Hour computer" in the manner previously described. The conjoint operation of relays A00, A0, B00 and B2 of the "Hour computer" is to add the minute tens digit "0" brought over from the "Minute tens computer" to the digit "2" brought over from the hour circuits and to cause the registration of the sum in the "Minute tens elapsed time" register of Fig. 46. To accomplish this, ground on conductor 1404 is connected over the No. 5 contacts of relay B2 of Fig. 48, conductor 4808, the No. 3 contacts of relay A0 of Fig. 49, conductor 4801, the No. 1 contacts of relay B00 of Fig. 48, conductor 4802 and the No. 1 contacts of relay A00 of Fig. 49 to conductor 00 of cable 4800. Ground on conductor 1404 is also applied, over the No. 1 contacts of relay B2 of Fig. 48, conductor 4809, the No. 7 contacts of relay A0 and to conductor 2 of cable 4800. The grounding of conductors 00 and 2 of cable 4800 results in the operation of relays R00 and R2 of the "Minute tens elapsed time" register of Fig. 46 to register the tens digit "2."

The elapsed time registers have now been operated to register the elapsed time "267."

A further circuit is established from ground on conductor 1404, over the No. 4 contacts of relay B00 of Fig. 48, over conductor 4804 and over the No. 3 contacts of relay A00 of Fig. 49 to battery through the winding of carry-out-0 relay C00 of Fig. 49. Relay CO1 of Fig. 50, upon operating, establishes the circuit from ground over its contacts and conductor 5002 to battery through the winding of relay CR1 of Fig. 47. A circuit is also established from ground over the No. 2 contacts of relay HR2 of Fig. 34, over conductor 3407 and to battery through the winding of relay H1 of Fig. 47. With relays CR1 and H1 operated, a circuit is established from ground over the contacts of relay C00 of Fig. 49, over conductor 4902, over the No. 2 contacts of relay CR1 and over the No. 3 contacts of relay H1 to battery through the winding of relay CR2A which operates to indicate that a digit "2" has been carried over into the hundreds place for the elapsed time instead of the correct digit "1." Relay CR2A closes the circuit to light the lamp CR2 and establishes the circuit over conductor 4701 for the alarm relay AL of Fig. 4, which causes the operation of visible and audible alarms. The lighting of lamp CR2 indicates that the carry-out digit "2" was greater than "1" and the elapsed time was greater than 99.9 minutes or the maximum elapsed time for which the message ticketer is arranged to print.

Sensing the first line of the initial call entry

In the meantime, the reader has proceeded to sense the tape record for the first line of the initial call entry. It will be assumed that the entry is a two line entry of a "bulk-billed" call and that therefore a perforation will be punched in the *ac* position of the tape, resulting in the operation of the A3 reader relay in the manner previously described. At the same time the reader relays of Figs. 7, 8, 9 and 10 will be operated in accordance with the perforations for the B, C, D, E and F digits of the first line of the initial entry. It will be assumed that the record tape is perforated for a B digit "1" for the second digit of the control entry, for a C digit "2" for the index entry, for a D digit "1" indicative of an individual line entry and for E and F digits "7" and "1" for the district number entry. Thus the line of perforations across the tape would be "312171." As previously stated the perforation for the A digit "3" has caused the operation of reader relay A3. The perforations for the B digit will cause the operation of reader relays B1A, B2A, B1D and B2D of Fig. 7, the perforations for the C digit will cause the operation of reader relays C1B, C2B, C1D and C2D of Fig. 8, the perforations for the D digit will cause the operation of reader relays DA and DD of Fig. 9, the perforations for the E digit will cause the operation of the reader relays EB and EC of Fig. 9 and the perforations for the F digit will cause the operation of the reader relays FA and FD of Fig. 10.

With reader relay A3, operated in response to sensing the record for the first control entry digit "3," a circuit is established for relay LK1 of Fig. 6, over conductor 631, the No. 1 back contact of relay CE1, conductor 1507 of cable 1500, the No. 5 back contact relay NUC of Fig. 14, conductor 1508 of cable 1500, the No. 1 back contact of relay A2 of Fig. 5, the No. 7 contacts of relay A3, conductor 504, the No. 2 contacts of relay TD of Fig. 4, conductor 252 of cable 250 and to ground over the cam contacts C5 of the reader. Relay LK1 operates, locks in a circuit from battery through its winding to conductor 1508 of cable 1500, thence over the No. 1 back contact of relay A2, conductor 510, over the No. 5 contacts of relay LK1, through resistance 635, over the No. 1 back contact of relay L2A, conductor 636 and to ground over the No. 1 contacts of relay ACO of Fig. 5. On operating, relay LK1 establishes a circuit from ground over its No. 6 contacts, conductor 633, the No. 8 back contact of relay LK2, conductor 505, the No. 1 back contacts of relays B2B and B2C of Fig. 7, the No. 2 contacts of operated relay B2A, the No. 2 contacts of operated relay B2D, the No. 1 back contact of relay B2E, conductor 641 and to battery through the winding of relay LN2 of Fig. 6. Relay LN2, upon operating, locks over its upper contacts and through resistance 632 to ground over the No. 6 contacts of relay LK1, and establishes a circuit from its locking ground, over its upper contacts and conductor 651 of cable 650 to battery through the winding of relay BLK of Fig. 17, to inform the ticketer control circuit that the call is a two line entry local or bulk-billed call.

A check circuit is now established from ground over the cam contacts C9 of the reader, conductor 242 of cable 240, the No. 3 contacts of relay TD, the No. 5 contacts of alarm relay AL, conductor 441, the No. 5 contacts of operated relay FA of Fig. 10, the No. 1 back contact of relay FB, the No. 2 back contact of relay FC, the No. 3 contacts of operated relay FD, the No. 1 back contact of relay FE, conductor 911, the No. 6 back contact of relay EA of Fig. 9, the No. 7 contacts of operated relay EB, the No. 3 contacts of operated relay EC, the No. 1 back contact of relay ED, the No. 1 back contact of relay EE, the No. 5 contacts of operated relay DA, the No. 1 back contact of relay DB, the No. 2 back contact of relay DC, the No. 3 contacts of operated relay DD, the No. 1 back contact of relay DE, conductor 912, the No. 6 back contact of relay C2A, the No. 8 back contact of relay C2B, the No. 8 contacts of operated relay C2C, the No. 3 contacts of operated relay C2D, the No. 1 back contact of relay C2E, over conductor 906, the No. 5 contacts of operated relay B1A of Fig. 7, the No. 1 back contact of relay B1B, the No. 2 back contact of relay B1C, the No. 3 contacts of operated relay B1D, the No. 1 back contact of relay B1E, conductor 901 of cable 900, the inner lower back contact of relay DIS of Fig. 15, the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the lower back contact of relay CC, conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1 of Fig. 5, the No. 2 back contact of relay LK2, the No. 4 contacts of operated relay A3, the No. 3 back contact of relay A2, conductor 503, the No. 4 contacts of operated reader relay B1D of Fig. 7, the No. 2 contacts of operated relay B1A, the normal contacts of key EN1, conductor 706, the No. 6 back contact of relay C1A of Fig. 8, the No. 7 contacts of operated relay C1B, the No. 2 back contact of relay C1C, the No. 3 contacts of operated relay C1D, the No. 1 back contact of relay C1E, the No. 4 contacts of relay C1B, the No. 7 contacts of relay C1D, the normal contact of key IN2, conductor 627 and to battery through the windings of connector relays CL1, CL2 and CL3. Thus assuming that only one

reader relay in the A digit group and two relays of the B, C, D, E and F reader groups have been operated, the calling line entry connector relays of Fig. 11 will operate.

Connector relays CL4 and CL5 will be operated in parallel with relays CL1, CL2 and CL3 over an extension of conductor 627, the No. 5 back contact of relay DSR of Fig. 13, conductor 1309, the No. 1 back contact of relay DAB of Fig. 16, conductor 1600 and through the windings of the CL4 and CL5 relays if the answer time entry has not been registered and relay DAB is not operated. If the answer time has been registered, then it does not become necessary to register the day and hour with the initial entry. If it has been assumed that the answer time has been registered and relay DAB has therefore been operated indicative of an answered call, relays CL4 and CL5 will not operate. The day and hour data, supplied from register relays in the day and hour circuits through the operation of connector relays CL4 and CL5, need be registered with the initial entry registration only when tickets covering "don't answer," "busy" and "straddle" calls are to be printed and when the answer time day and hour data are not available.

With the connector relay CL1 now operated and reader relays B1A and B1D of Fig. 7 operated to register the B digit "1," indicating that there is a second line for the initial entry, circuits are established from ground over the lower contacts of relays B1A and B1D, conductors 701 and 704 of cable 700, the Nos. 1 and 4 contacts of connector relay CL1, conductors 4001 and 4004 of cable 4000 and to battery through the windings of relays A and D of the "Line entry B digit" register of Fig. 40. These relays thereupon operate and lock over their inner upper contacts, conductor 4231 of cable 4230 and to ground over the No. 1 contacts of relay RCLA of Fig. 14. Relay CL1, with reader relays C1B and C1D of Fig. 8 operated to register the index digit "2," establishes circuits from ground over the lower contacts of relays C1B and C1D, conductors 802 and 804 of cable 800, the Nos. 7 and 9 contacts of relay CL1, conductors 4102 and 4104 of cable 4100 and to battery through the windings of relays B and D of the "Line entry C digit" register of Fig. 41. These relays thereupon operate and lock over their inner upper contacts, conductor 4232 of cable 4230 and to ground over the No. 2 contacts of relay RCLA of Fig. 14.

With connector relay CL2 and reader relays DA and DD of Fig. 9 operated to register the D or party identification digit "1" circuits are established from ground over the lower contacts of relays DA and DD, conductors 921 and 924 of cable 920, the Nos. 1 and 4 contacts of relay CL2, conductors 4111 and 4114 of cable 4110 to battery through the windings of relays A and D of the "Line entry D digit" register of Fig. 41. These relays thereupon operate and lock over their inner upper contacts, over conductor 4233 of cable 4230 and to ground over the No. 3 contacts of relay RCLA of Fig. 14. Also relay CL2, with reader relays EB and EC of Fig. 9 operated to register the E or district tens digit "7," establishes circuits from ground over the lower contacts of relays EB and EC, conductors 942 and 943 of cable 940, the Nos. 7 and 8 contacts of relay CL2, conductors 4202 and 4203 of cable 4200 and to battery through the windings of relays B and C of the "Line entry E digit" register of Fig. 42. These relays thereupon operate and lock over their inner upper contacts and conductor 4234 of cable 4230 to ground over the No. 4 contacts of relay RCLA of Fig. 14.

With connector relay CL3 and reader relays FA and FD of Fig. 10 operated to register the F district units digit "1," circuits are established from ground over the lower contacts of relays FA and FD, conductors 1031 and 1034 of cable 1030, the Nos. 1 and 4 contacts of relay CL3, conductors 4211 and 4214 of cable 4210 and to battery through the windings of relays A and D of the "Line entry F digit" register of Fig. 42. These relays thereupon operate and lock over their inner upper contacts and conductor 4235 of cable 4230 to ground over the No. 5 contacts of relay RCLA of Fig. 14. Relay CL3 also establishes a circuit extending from ground over the No. 3 contacts of relay LK1 of Fig. 6, conductor 628 of cable 620, the No. 6 contacts of relay CL3 and over conductor 629 of cable 620 through the winding of relay MLE of Fig. 5 to battery. Relay MLE operates preparatory to the control of the CL-relays of Fig. 11, over the contacts of reader relay A1 for controlling the registration of the supplementary lines of the initial line entry. Relay MLE locks over its No. 2 contacts, conductor 628 and to ground over the No. 3 contacts of relay LK1 of Fig. 6.

A checking circuit is now established to determine if two relays, and only two, of each of the digit registers of Figs. 40 to 42 inclusive have been operated. This circuit may be traced from ground over the No. 1 back contact of relay E of the "Line entry B digit" register of Fig. 40, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B, the No. 7 contacts of operated relay A, conductor 4005, the No. 1 back contact of relay E of the "Line entry C digit" register of Fig. 41, the No. 3 contacts of operated relay D, the No. 2 back contact of relay C, the No. 9 contacts of operated relay B, the No. 8 back contact of relay A, the No. 1 back contact of relay E of the "Line entry D digit" register of Fig. 41, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B and the No. 7 contacts of operated relay A, conductor 4105, the No. 1 back contacts of relays E and D of the "Line entry E digit" register of Fig. 42, the No. 3 contacts of operated relay C, the No. 9 contacts of operated relay B, the No. 8 back contact of relay A, the No. 1 back contact of relay E of the "Line entry F digit" register of Fig. 42, the No. 3 contacts of operated relay D, the No. 2 back contacts of relays C and B, the No. 7 contacts of operated relay A, conductor 4216, the No. 1 contacts of relay DSR of Fig. 13, conductor 1301, the No. 2 back contact of relay PR of Fig. 15, conductor 1302 to battery through the winding of relay CLR of Fig. 13.

When relay CLR operates, a circuit is established from ground over its No. 4 contacts, conductor 1305, conductor 1705 of cable 1700 and to battery through the winding of relay PAA of Fig. 4. Relay PAA thereupon operates and remains operated until relay CLR releases or until the line entry registers have become released. Upon operating, it connects ground over its No. 1 contacts to the lower winding of timing relay TM to hold said relay from measuring the usual 0.35 second interval and, over its No. 2 contacts, connects the six seconds lead from the central office master timing circuit to the winding of relay PAB so that the latter relay operates and releases every six seconds. On the first operation of relay PAB a circuit is established from ground

over the No. 3 contacts of relay PAA, the front contact of relay PAB, the No. 2 back contact of relay ALD, the No. 2 back contact of relay ALB and to battery through the winding of relay ALA. Relay ALA operates and locks over its No. 2 contacts and the No. 2 back contact of relay ALC to ground over the No. 3 contacts of relay PAA. On the next release of relay PAB a circuit is established from ground over the No. 3 contacts of relay PAA, the back contact of relay PAB, the No. 1 back contact of relay ALC, the No. 1 front contact of relay ALA and to battery through the winding of relay ALB. Relay ALB operates and locks over its No. 1 contacts, the No. 1 back contact of relay ALD and to ground over the No. 3 contacts of relay PAA. On the next operation of relay PAB, a circuit is established from ground over the No. 3 contacts of relay PAA, the front contact of relay PAB, the No. 2 back contact of relay ALD, the No. 2 front contact of relay ALB and to battery through the winding of relay ALC. Relay ALC operates and locks over its No. 2 front contact to ground over the No. 3 contacts of relay PAA and opens the locking circuit of relay ALA which releases. On the next release of relay PAB a circuit is established from ground over the No. 3 contacts of relay PAA, the back contact of relay PAB, the No. 1 front contact of relay ALC and to battery through the winding of relay ALD. Relay ALD operates and locks over its No. 1 front contact and to ground over the No. 3 contacts of relay PAA, opens the locking circuit of relay ALB which releases, and opens the operating circuit of relay ALA to prevent the recycling of relays ALA, ALB and ALC. On the next operation of relay PAB, a circuit is established from ground over the No. 3 contacts of relay PAA, the front contact of relay PAB, the No. 2 front contact of relay ALD and to battery through the winding of alarm relay AL which operates and closes circuits for audible and visual alarms. The alarms are thus operated after a minimum interval of twelve seconds if relay CLR has not released. Relay AL also prevents the advance of the reader until the trouble condition has been cleared. Under proper conditions relay CLR should be released before the time interval is completed, thereby releasing relay PAA to restore relays PAB and the operated ones of relays ALA, ALB, ALC and ALD.

Initial operation of message ticketer

With the DSR, ANR and CLR relays of Fig. 13 now operated, indicative of the fact that the disconnect time, answer time and first line of the initial entry have been sensed and registrations thereof made, and with relay CKB of Fig. 15 operated indicating that the elapsed time has been computed, the message ticketer of Fig. 45 may now be started to print the available information on a ticket. A circuit is now established from battery through the winding of relay CC of Fig. 15, the upper contacts of relay CKB, conductor **1536**, the No. 8 contacts of relay DSR, the No. 3 front contact of relay ANR, the No. 5 contacts of relay CLR, conductor 1511 of cable **1500**, No. 1 contacts of relay **A3** of Fig. 5, conductor **1701** of cable **1700** and to ground over the No. 1 normal contacts of relay PS of Fig. 17. Relay CC, upon operating, establishes a circuit from ground over its No. 2 contacts, over conductor **1537** and in parallel through the windings of relays P1 and P2 of Fig. 18 to battery. The latter relays, upon operating, prepare the necessary circuits to control the message ticketer.

The message ticketer is under the control of the printer control switch PC of Fig. 17, the brushes of which are advanced step-by-step by the STEP magnet. To start the control it is necessary to advance the switch out of its normal or position 1 into position 2. To accomplish this a circuit is established for relays PS of Fig. 17 which may be traced from battery through its winding, over conductor **1703** of cable **1700**, the upper contact of the EMG—RLS key of Fig. 5, conductor **1702** of cable **1700**, the No. 12 contacts of relay P2 of Fig. 18, conductor **1806**, the normal terminal and brush engaged therewith of switch arc PC5, conductor **1708** to ground over the No. 1 contacts of relay GC of Fig. 15. Relay PS thereupon operates and locks over its operating circuit, previously traced to conductor **1806**, thence over the No. 5 contacts of relay PS and to ground over conductor **1708** and the No. 1 contacts of relay GC.

Relay PS, upon operating, removes at its No. 3 normal contacts ground from conductor **603**, thereby releasing connector relays TA, TB and TC of Fig. 3 so that the circuits for the reader relays will not be established to needlessly and repeatedly operate the reader relays during the time that the printing operations are being carried out. Over the alternate No. 3 contacts of relay PS ground is connected to conductor **1705** of cable **1700** to hold relay PAA of Fig. 4 operated whereby a timing interval of a minimum of twelve seconds may be measured. The printing operations initiated by the operation of relay PS should be completed in eight or nine seconds, in which case relay PS will be released, in turn releasing relay PAA to stop the operation of the timing relays and to release relay PAB and any operated ones of relays ALA, ALB, and ALC. If, however, the printing has not been completed, the alarm relay AL will be operated to stop the reader and to operate alarms.

Relay PS also closes a circuit from ground over its No. 6 contacts, the normal terminal and brush of switch arc PC3 and the interrupter contacts, and through the winding of magnet STEP to battery. Magnet STEP thereupon operates over its self-interrupting circuit to advance the brushes of switch PC into engagement with the No. 2 terminals of their arcs, whereupon the circuit for magnet STEP is opened at the switch arc PC3.

With the brush of switch arc PC1 in engagement with the No. 2 terminal of its arc, a circuit is established from ground over the normal contacts of relay PM of Fig. 17, the No. 2 terminal of arc PC1 and conductor **1709** to the asterisk segment of the distributor of the message ticketer of Fig. 45. At this time the motor start relay MS of Fig. 17 will have been operated to connect the motor **4500** of the message ticketer with a commercial source of power. The circuit of relay MS may be traced over conductor **1704** of cables **1700** and **230** to ground over the inner upper contacts of key CP of Fig. 2, which key was operated to initiate the operation of the circuits. The motor advances the brush **4501** of the distributor over the segments until it encounters the grounded asterisk segment, whereupon a circuit is completed over the brush, slip ring **4502** and to battery through the winding of printer magnet PRT. The printer magnet, upon operating, moves a stabber into a slot associated with the distributor, to arrest the further motion of the brush **4501** and the type wheel connected on the same shaft, and also causes the

engagement of the type wheel with the ticket tape to print an asterisk on the tape.

The magnet PRT also establishes a first circuit from ground over its inner contacts, over conductor **4503** and to battery through the winding of relay PM of Fig. 17, which relay thereupon operates, locks over its No. 2 contacts and conductor **4504** to ground over the upper contacts of the printer magnet PRT. It opens the circuit previously traced over its No. 1 normal contacts for applying ground to the asterisk segment of the ticketer distributor to thereby release the printer magnet PRT, and establishes over its No. 1 alternate contacts on obvious circuit for magnet STEP of the printer control switch PC. Magnet PRT, upon releasing, first opens the operating circuit of relay PM and then opens the locking circuit thereof, whereupon relay PM releases and, at its upper alternate contacts, opens the circuit of magnet STEP to advance the brushes of switch PC into engagement with the No. 3 terminals of their arcs. The release of magnet PRT now permits the rotation of the distributor brush **4501** and type wheel of the ticketer.

With switch PC in position **3**, ground over the No. 1 normal contacts of relay PM is connected over the brush and No. 3 terminal of switch arc PC**1**, the No. 4 back contact of relay STLB, conductor **1711** of cable **1710**, the No. 1 back contact of relay TRD of Fig. 13, which will be normal since no disconnect entry is to be printed on the ticket at this time due to a timed release of the district, and over the 0 conductor of cable **1310** to the 0 segment of the distributor of the ticketer Fig. 45. When thereafter the distributor brush **4501** engages this terminal, printer magnet PRT will operate to arrest the rotation of the type wheel, to cause the printing of a 0 on the ticket; relay PM will operate, lock, open the circuit of magnet PRT and close the circuit of the STEP magnet of switch PC. Magnet PRT will then release, in turn releasing relay PM, whereupon magnet STEP will release to advance the brushes of switch PC into engagement with the No. 4 terminals of their arcs. The printing of the character 0 is indicative that the call was a normal call.

In case the call was a "straddle call" for which the STLB relay of Fig. 17 would be operated as will be later described, ground applied over the No. 1 normal contacts of relay PM and the No. 3 terminal of switch arc PC**1** is applied over the No. 4 front contact of relay STLB, over conductor **1712** of cable **1710** and, with relay TRD of Fig. 13 normal to indicate no timed district release, the circuit is further extended over the No. 3 back contact of relay TRD, the **5** conductor of cable **1310** to the **5** segment of the distributor of the ticketer Fig. 45, thereby resulting in the operation of the ticketer to print a 5 on the ticket. Had the TRD relay been operated, with the STLB relay normal, then ground would have been applied over conductor **1711** of cable **1710** and the No. 1 front contact of relay TRD, conductor **1** of cable **1310** and to the **1** segment of the distributor of the ticketer to cause the printing of the character 1. Had the relay STLB been operated and the TRD relay also operated, then ground would have been extended over conductor **1712** of cable **1710**, over the No. 3 front contact of relay TRD, conductor **6** of cable **1310** to the **6** segment of the distributor of the ticketer, thereby to cause the printing of the character 6 on the ticket. The information printed as the second character on the ticket may therefore be a 0 for a normal call, a 1 for a timed release disconnect, a 5 for a "straddle" call or a 6 for a "straddle" call with a timed release disconnect.

With the switch PC advanced into its fourth position the third character on the ticket will be printed. This character covers the trouble condition indication. A circuit is now established from ground over the No. 1 normal contacts of relay PM, over the brush and No. 4 terminal of arc PC**1** of the switch PC, over the trouble conductor **1311** of cable **1310**, the No. 5 back contact of relay CAC**2** of Fig. 13, the No. 1 back contact of relay TEC**2**, the No. 5 back contact of relay TOS**2**, the No. 1 back contact of relay TE**2**, the No. 5 back contact of relay TC**2** and the **0** conductor of cable **1300** to the **9** segment of the distributor of the ticketer, Fig. 45. When therefore the distributor brush **4501** engages this **0** segment, printer magnet PRT will operate to cause the printing of a 0 on the ticket, relay PM will operate, lock, open the circuit of magnet PRT and close the circuit of the STEP magnet of Fig. 17. Magnet PRT will then release, in turn causing the release of relay PM and the release of magnet STEP. Upon the release of magnet STEP the brushes of switch PC are advanced into engagement with the No. 5 terminals of their arcs. The printing of the character 0 is indicative that the call was a normal call having no trouble.

Had there been a cancel charge signal from the assembler then relay CAC**2** of Fig. 13 would have been operated to extend the ground applied to conductor **1311** of cable **1310**, over its No. 4 contacts and conductor **9** of cable **1300** to the **9** segment of the ticketer distributor to control the printing of a 9 on the ticket. Had the relay TEC**2** of Fig. 13 been operated indicative of the fact that the master timer was out of synchronism and transferred to the emergency recorder, then the ground applied to conductor **1311** would be extended over the No. 5 back contact of relay CAC**2** of Fig. 13, over the No. 1 front contact of relay TEC**2** and over conductor **7** of cable **1310** to the **7** segment of the ticketer distributor to control the printing of a 7 on the ticket. Had the relay TOS**2** been operated to indicate the master timer out of synchronism, then the ground applied to conductor **1311** would be extended over the No. 5 back contact of relay CAC**2** of Fig. 13, over the No. 1 back contact of relay TEC**2**, over the No. 4 front contact of relay TOS**2** and conductor **6** of cable **1310** to the **6** segment of the ticketer distributor to control the printing of a 6 on the ticket. Had relay TE**2** been operated indicative of a transfer to the emergency recorder, then the ground applied to conductor **1311** would be extended over the No. 5 back contact of relay CAC**2**, the No. 1 back contact of relay TEC**2**, the No. 5 back contact of relay TOS**2**, the No. 1 front contact of relay TE**2** and over conductor **5** of cable **1310** to the **5** segment of the ticketer distributor to control the printing of a 5 on the ticket. Had relay TC**2** been operated indicative of a district charge trouble, then ground on conductor **1311** would be extended over the No. 5 back contact of relay CAC**2**, over the No. 1 back contact of relay TEC**2**, over the No. 5 back contact of relay TOS**2**, the No. 1 back contact of relay TE**2**, the No. 4 front contact of relay TC**2**, over conductor **4** of cable **1310** to the **4** segment of the ticketer distributor to control the printing of

a 4 on the ticket. Thus the third character printed on the ticket is indicative of a no trouble condition or a particular trouble. The manner in which the relays CAC2, TEC2, TC2, TE2, and TOS2 are operated will be considered hereinafter.

With the advance of the brushes of switch PC into position 5, the ticketer is controlled to print the B digit of the first line of the initial or calling line entry registered in the "Line entry B digit" register of Fig. 40. This entry will be the second digit of the type of call designation assumed to be the digit "1." A circuit is now established from ground over the No. 1 normal contacts of relay PM of Fig. 17, the brush and No. 5 terminal of switch arc PC1, conductor 1712, the No. 5 contacts of relay P1 of Fig. 18, conductor 1801 of cable 1800, the No. 4 contacts of operated relay D in Fig. 40 and over the No. 3 contacts of operated relay A of such register, thence over conductor 1 to the 1 segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages this 1 segment, printer magnet PRT will operate to cause the printing of the digit "1" on the ticket and the printer control switch PC will be advanced one step into its sixth terminal position.

With the brushes of switch PC in their sixth terminal position, the ticketer is controlled to print the C digit of the first line of the initial or calling line entry registered in the "Line entry C digit" register of Fig. 41. This entry will be the index number, assumed to be "2." A circuit is now established from ground over the No. 1 normal contacts of relay PM of Fig. 17, the brush and No. 6 terminal of switch arc PC1, conductor 1713, the No. 4 contacts of relay P1 of Fig. 18, conductor 1802 of cable 1800, the No. 6 contacts of operated relay B of the "Line entry D digit" register of Fig. 41, the No. 8 contacts of operated relay D of such register and over conductor 2 to the 2 segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the 2 segment, printer magnet PRT will operate to cause the printing of the digit 2 on the ticket and the printer control switch PC will be advanced one step into its seventh terminal position.

With the brushes of switch PC in their seventh terminal position, the ticketer is controlled to print the D digit of the first line of the initial or calling line entry registered on the "Line entry D digit" register of Fig. 41. This digit will be the party line entry which has been assumed to be "1." A circuit now established from ground over the No. 1 normal contacts of relay PM of Fig. 17, over the brush and No. 7 terminal of switch arc PC1, conductor 1714, the No. 3 contacts of relay P1 of Fig. 18, conductor 1803 of cable 1800, the No. 4 contacts of operated relay D of the "Line entry D digit" register of Fig. 41, the No. 3 contacts of operated relay A of such register and over conductor 1 to the 1 segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the 1 segment, printer magnet PRT will operate to cause the printing of the digit "1" on the ticket and the printer control switch PC will be advanced one step into its eighth terminal position.

With the brushes of switch PC in their eighth terminal position, the ticketer is controlled to print a dash on the ticket. To accomplish this a circuit is established from ground over the No. 1 normal contacts of relay PM, over the brush and the eighth terminal of switch arc PC1, and over conductor 1715 to the (—) segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the (—) segment, the magnet PRT will operate to cause the printing of (—) on the ticket and the printer control switch PC will be advanced one step into its ninth terminal position.

With the brushes of switch PC in their ninth terminal position a circuit is established from ground over the No. 1 normal contacts of relay PM, over the brush and ninth position terminal of switch arc PC1, conductor 1716, the No. 2 contacts of relay P1 of Fig. 18, conductor 1804 of cable 1800, the No. 4 contacts of operated relay B of the "Line entry E digit" register of Fig. 42, the No. 4 contacts of opearted relay C of such register and over conductor 7 to the 7 segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the 7 segment the magnet PRT will operate to cause the printing of the tens digit 7 of the district number on the ticket and the printer control switch PC will be advanced one step into its tenth terminal position.

With the brushes of switch PC in their tenth terminal position a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and tenth position terminal of switch arc PC1, conductor 1717, the No. 1 contacts of relay P1 of Fig. 18, conductor 1805 of cable 1800, the No. 4 contacts of operated relay D of the "Line entry digit F" register of Fig. 42, the No. 3 contacts of operated relay A of such register and over conductor 1 to the 1 segment of the ticketer distributor. When thereafter brush 4501 of the ticketer engages the 1 segment, printer magnet PRT will operate to cause the printing of the units digit "1" of the district number on the ticket and the printer control switch PC will be advanced one step into its eleventh terminal position.

All of the information covered in the first line of the initial entry has now been printed, the relays of Figs. 40, 41 and 42 may now be released and the reader may be advanced to read the second line of the initial entry. To initiate these operations a circuit is established from ground over the No. 10 contacts of relay PS, over the brush and No. 11 terminal of arc PC5 of switch PC, the No. 9 contacts of relay PS, conductor 1719, over the No. 1 normal contacts of relay DIS of Fig. 15, the No. 1 normal contacts of relay AD and to battery through the winding of relay RLS1. Relay RLS1 thereupon operates, locks over its No. 2 contacts and over the No. 1 back contact of relay RCK1, to ground over the No. 1 contacts of relay GC, and closes a circuit from ground over its No. 3 front contact, conductor 1538 and to battery through the winding of relay LSA of Fig. 16. Relay LSA operates and locks over its No. 4 contacts, through resistance 1601, over the No. 1 normal contacts of relay PPA, the No. 1 normal contacts of relay PPE and over conductor 1720 to ground over the No. 7 contacts of relay PS of Fig. 17. Relay LSA, upon operating, also connects ground over its No. 5 contacts to conductor 603, whereupon the connector relays TA, TB and TC of Fig. 3 reoperate to enable the reoperation of the reader relays. Relay RLS1, upon operating, also opens at its upper No. 1 contacts the previously traced circuit for relay RCLA which thereupon releases and, at its contacts, removes ground from the locking circuits extending over the conductors of cable 4230 for the relays of the line entry digit registers of Figs. 40, 41 and 42. All operated relays of such regis-

ters now release, in turn releasing relay CLR of Fig. 13.

When the line entry register relays have released, a circuit is established from battery through the winding of relay RCK1, over the No. 6 contacts of relay GC, conductor 1539, the lowermost back contacts of relays E, D and the uppermost back contacts of relays B and A of the "Hour units" register of Fig. 44, the lowermost back contacts of relays E, D and the uppermost back contacts of relays B and A of the "Hour tens" register of Fig. 44, conductor 4400, the lowermost back contacts of relays E and D, and the uppermost back contacts of relays B and A of the "Day units" register of Fig. 44, the lowermost back contacts of relays E and D, the uppermost back contacts of relays B and A of the "Day tens" register of Fig. 43, conductor 4300, the lowermost back contacts of relays E, D and the uppermost back contacts of relays B and A of the "Line entry F digit" register of Fig. 42, the lowermost back contacts of relays E and D, the uppermost back contacts of relays B and A of the "Line entry E digit" register of Fig. 42, conductor 4206, the lowermost back contacts of relays E and D, the uppermost back contacts of relays B and A of the "Line entry D digit" register of Fig. 41, the lowermost back contacts of relays E and D, the uppermost back contacts of relays B and A of the "Line entry C digit" register of Fig. 41, conductor 4106, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Line entry B digit" register of Fig. 40 and to ground. Relay RCK1 thereupon operates, indicative of the fact that the operated register relays have released. It also opens the locking circuit of relay RLS1.

In position eleven the brush of arc PC1 of switch PC, a circuit is also established thereover from ground applied over the No. 1 normal contacts of relay PM, over conductor 1721, the No. 8 contacts of relay LSA of Fig. 16, conductor 1602, conductor 1811 of cable 1810, the No. 6 contacts of relay FT1 of the district frame tens register of Fig. 39 and conductor 1 to segment 1 of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the segment 1, the printer magnet PRT operates to cause the printing of the tens digit "1" of the district frame number on the ticket and to cause the printer control switch PC to be advanced one step into its twelfth position. When the brush of arc PC1 leaves its No. 11 terminal, the initial operating circuit of relay RLS1 of Fig. 15 is opened and if the RCK1 relay has operated to open the locking circuit of relay RLS1, such relay releases.

With the RLS1 relay released, a circuit is closed from ground over the No. 3 back contact of relay RLS1, the No. 2 contacts of relay RCK1 of Fig. 15, conductor 1540, the No. 2 contacts of relay LSA and to battery through the winding of relay LSB of Fig. 16. Relay LSB operates and locks over its No. 4 contacts, through resistance 1603 and to ground over the No. 3 contacts of relay LSA. A circuit is thereupon established from battery through the winding of synchronizing relay SYBA, the No. 1 back contact of relay SYMA, the No. 4 back contact of relay SYMB, the No. 6 contacts of relay LSB, conductor 1513 of cable 1500 and to ground over the cam contacts C7 of the reader. Relay SYBA operates upon the next closure of the cam contacts C7 and locks over its No. 3 contacts and through resistance 1604 to ground over the No. 2 contacts of relay LSB, and establishes a circuit for relay SYMA extending from battery through the winding of such relay, the No. 2 contacts of operated relay SYBA, the No. 1 back contact of relay SYBB, the No. 3 contacts of relay LSB, conductor 1514 of cable 1500 and to ground over the cam contacts C4 of the reader on the next make cycle. Relay SYMA thereupon operates and locks over its No. 4 contacts, the No. 3 back contact of relay SYMB, through resistance 1605, and to ground over the No. 5 contacts of relay LSB.

With relay SYMA operated, a circuit is established from ground over the No. 5 back contact of relay STCU of Fig. 13, conductor 1334, the No. 3 contacts of relay SYMA, the No. 2 back contact of relay SYBB, conductor 1515 of cable 1500, conductor 624 and to battery through the windings of relays RS1 and RS2 of Fig. 4, which relays thereupon operate to advance the reader and to release the operated reader relays and CL– relays in the manner previously described. Relay RS2, upon operating, establishes a circuit from ground upon the next closure of cam contacts C7 of the reader, over conductor 241, the No. 2 contacts of relay RS2, conductor 614 of cable 610, the No. 3 back contact of relay L2B of Fig. 6, the No. 2 back contact of relay L4C, the No. 2 back contact of relay L4A (which latter relays will not be operated since a two-line initial entry has been assumed) over the No. 1 front contact of relay LK1, previously operated, conductor 634, the No. 1 contacts of operated relay MLE and to battery through the winding of relay LK2 of Fig. 5. Relay LK2 thereupon operates and locks over its No. 5 contacts, through resistance 507, conductor 508, over the No. 3 back contact of relay L2A of Fig. 6 and to ground over the No. 4 contacts of operated relay LK1.

Also on the closure of cam contacts C7, a circuit it established from ground thereover, over conductor 1513 of cable 1500, the No. 6 contacts of relay LSB, the No. 4 back contact of relay SYMB, the No. 2 front contact of relay SYMA and to battery through the winding of relay SYBB, whereupon relay SYBB operates and locks over its No. 3 contacts and through resistance 1606 to ground over the No. 1 front contact of relay LSB. Relay SYBB, upon operating, opens the circuit of relays RS1 and RS2 which then release and prepare the check circuit for enabling the second line of the initial entry to be sensed and recorded.

With the brushes of switch PC in their twelfth position, a circuit is established from ground over the brush and No. 12 terminal of switch arc PC1, conductor 1812 of cable 1810, the No. 6 contacts of relay FU4 of the district frame units register of Fig. 39 and conductor 4, to the segment 4 of the ticketer distributor. When thereafter brush 4501 of the distributor engages the segment 4, the printer magnet PRT operates to cause the printing of the units digit "4" of the district frame number on the ticket, and to cause the printer control switch PC to be advanced one step into its thirteenth position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 13 terminal of switch arc PC1 and conductor 1715, to the (—) segment of the printer distributor, whereupon the printer magnet PRT is operated when the distributor brush engages such segment to cause the printing of a dash on the ticket and to cause the printer control switch PC to be advanced one step to its fourteenth position. The switch PC will now wait in this position until the second line of the initial

or call entry has been registered on the line entry registers of Figs. 40, 41 and 42.

Sensing the second line of the initial call entry

Since it has been assumed that for the control entry of the two-line entry a perforation will be found in the *aa* position of the tape, the operation of the A1 reader relay of Fig. 5 results, indicative of the fact that the line entry sensed is supplemental to a previously sensed line. The circuit for relay A1 may be traced from ground over the reader contacts AA, conductor **201**, the No. 8 contacts of connector relay TA, conductor **311** of cable **310**, the No. 8 contacts of relay ACO and to battery through the winding of relay A1. At the same time, the reader relays of Figs. 7, 8, 9 and 10 will be operated in accordance with the perforations for the B, C, D, E and F digits of the second line of the entry. It will be assumed that the record tape is perforated for a B digit "0" for the hundreds digit of the line switch column number, for a C digit "4" for the tens digit of the line switch switch column number, for a D digit "8" for the units digit of the line switch column number, for an E digit "2" for the switch number and for the F digit "6" for the vertical file number. The line switch and vertical file numbers identify the calling line on an equipment number basis. Thus the line of perforations across the tape will be for the digits "104826."

As previously stated, the perforation for the A digit "1" has caused the operation of reader relay A1. The perforations for the B digit "0" will be in the *ba* and *bb* punch positions of the tape and, through the operation of reader contacts BA and BB, will establish circuits from ground over such contacts, conductor **204**, the No. 5 contacts of connector relay TA and to conductor **321** of cable **320**, over conductor **205**, the No. 4 contacts of relay TA and to conductor **322** of cable **320**, and thence through cable **400** and to battery through the windings of reader relays B1A, B2A, B1B and B2B of Fig. 7. The perforations for the C digit "4" will cause the operation of reader relays C1B, C2B, C1E and C2E of Fig. 8 in the manner previously described. The perforations for the D digit "8" will be in punch positions *dc* and *de*, and the closure of reader contacts DC and DE will establish circuits from ground over such contacts, conductor **216**, the No. 3 contacts of connector relay TB to conductor **343** of cable **340**, and over conductor **218** to No. 1 contacts of relay TB, to conductor **345** of cable **340**, and thence through cable **400** to battery through the windings of reader relays DC and DE of Fig. 9. The perforations for the E digit "2" will cause the operation of reader relays EB and ED of Fig. 9 in the manner previously described. The perforations for the F digit "6" will be in punch positions *fa* and *fc* and through the closure of reader contacts FA and FC will establish circuits from ground over such contacts, conductor **224** and the No. 5 contacts of connector relay TC to conductor **361** of cable **360**, and over conductor **226**, the No. 3 contacts of relay TC and to conductor **363** of cable **360**, and thence through cable **400** and to battery through the windings of reader relays FA and FC of Fig. 10.

With reader relays operated as just described, a check circuit is now established from ground over the cam contacts C9 of the reader, conductor **242** of cable **240**, the No. 3 contacts of relay TD, the No. 5 contacts of alarm relay AL, conductor **441**, the No. 5 contacts of operated relay FA of Fig. 10, the No. 1 back contact of relay FB, the No. 3 contacts of operated relay FC, the No. 1 back contacts of relays FD and FE, conductor **911**, the No. 6 back contact of reader relay EA of Fig. 9, the No. 7 contacts of operated relay EB, the No. 2 back contact of relay EC, the No. 3 contacts of operated relay ED, the No. 1 back contact of relay EE, the No. 6 back contact of reader relay DA, the No. 8 back contact of relay DB, the No. 8 contacts of operated relay DC, the No. 2 back contact of relay DD, the No. 2 contacts of operated relay DE, conductor **912**, the No. 6 back contact of reader relay C2A of Fig. 8, the No. 7 contacts of operated relay C2B, the No. 2 back contacts of relays C2C and C2D, the No. 2 contacts of operated relay C2E, conductor **806**, the No. 5 contacts of operated reader relay B1A of Fig. 7, the No. 2 contacts of operated relay B1B, the No. 1 back contacts of relays B1C, B1D and B1E, conductor **901** of cable **900**, the No. 4 contacts of relay SYBB of Fig. 16, now operated, the No. 1 back contact of relay SYBC, conductor **1501** of cable **1500**, the No. 3 contacts of operated reader relay A1 of Fig. 5, the No. 4 contacts of relay LK2, the No. 5 back contact of relay A3, the No. 4 back contact of relay A2, the No. 3 contacts of operated relay MLE, conductor **627** of cable **620** and to battery through the windings of the CL1, CL2 and CL3 connector relays of Fig. 11. Thus assuming that only one reader relay in the A digit group and two relays, and only two, of each of the B, C, D, E and F reader groups have been operated, the calling line entry connector relays of Fig. 11 will operate. As before assumed, the connector relays CL4 and CL5 will not be operated.

During the period that the reader contacts are closed, reader cam contacts C2 will be closed and establish a circuit from ground thereover, over conductor **253** of cable **250**, the No. 4 contacts of operated reader relay A1, the No. 7 contacts of operated relay LK2, conductor **509**, the No. 2 front contact of relay LN2 of Fig. 6 which operated during the sensing of the first line of the entry to register the fact that the entry comprises two lines, and to battery through the winding of relay L2A. Relay L2A thereupon operates and locks through resistance **634** to ground over the No. 3 contacts of relay LK1, and over its No. 4 contacts establishes an obvious circuit for causing the operation of relay L2B. Relay L2A, upon operating, also opens at its No. 3 back contact the previously traced locking circuit for relay LK2 of Fig. 5, and opens the locking circuit of relay LK1 at its No. 1 back contact so that when the reader cam contacts C1 and C5 open, relays LK1 and LK2 will release. It should be noted in this connection that the locking paths of both the LK1 and LK2 relays are controlled by both direct grounds connected over the circuits previously traced over the back contacts of relay L2A, and by ground connected over reader contacts C1 and C5. The locking circuit of relay LK2 extends over its No. 5 contacts, through resistance **507**, conductor **511**, the No. 8 contacts of relay TD and over conductor **254** of cable **250** to ground over reader contacts C1, and the locking circuit of relay LK1 extends as traced over its No. 5 contacts, through resistance **635**, over its No. 2 contacts, conductor **637**, conductor **504**, the No. 2 contacts of relay TD of Fig. 4, conductor **252** of cable **250** and to ground over reader contacts C5. It should also be noted that the upper contacts of relay L2A are connected in parallel over conductor **636** and conductor **615** of cable

610 with the No. 4 contacts of relay RS2 of Fig. 4, and the No. 3 contacts of relay L2A are connected in parallel over conductors 508 and 511 and conductor 616 of cable 610 with the No. 3 contacts of relay RS2. Relays LK1 and LK2 will therefore not release until these locking paths are all opened, or until the sensing of the second line of the entry has been completed and the registers in the line entry registers have been checked.

With the connector relay CL1 now operated and reader relays B1A and B1B of Fig. 7 operated to register the B digit "0," circuits are established from ground over the lower contacts of relays B1A and B1B, conductors 701 and 702 of cable 700, the Nos. 1 and 2 contacts of connector relay CL1, conductors 4001 and 4002 of cable 4000 and to battery through the windings of relays A and B of the "Line entry B digit" register of Fig. 40. These relays thereupon operate and lock over their inner upper contacts, conductor 4231 of cable 4230 and to ground over the No. 1 contacts of relay RCLA of Fig. 14. Relay RCLA reoperated over its previously traced operating circuit following the release of relay RLS1 upon the completion of the check to determine if the line entry register relays were all properly released following the printing of the first line entry registered in such line entry register relays.

Relay CL1, with reader relays C1B and C1E of Fig. 8 operated to register the C digit "4," establishes circuits from ground over the lower contacts of relays C1B and C1E, conductors 802 and 805 of cable 800, the Nos. 7 and 10 contacts of relay CL1, conductors 4102 and 4105 of cable 4100 and to battery through the windings of relays B and E of the "Line entry C digit" register of Fig. 41. These relays thereupon operate and lock over their inner upper contacts, conductor 4232 of cable 4230 and to ground over the No. 2 contacts of relay RCLA of Fig. 14.

With connector relay CL2 and reader relays DC and DE of Fig. 9 operated to register the D digit "3," circuits are established from ground over the lower contacts of relays DC and DE, conductors 923 and 925 of cable 920, the Nos. 3 and 5 contacts of relay CL2, conductors 4113 and 4115 of cable 4110 to battery through the windings of relays C and E of the "Line entry D digit" register of Fig. 41. These relays thereupon operate and lock over their inner upper contacts, conductor 4233 of cable 4230 and to ground over the No. 3 contacts of relay RCLA of Fig. 14.

Also, relay CL2 with reader relays EB and ED of Fig. 9 operated to register the E digit "2," establishes circuits from ground over the lower contacts of relays EB and ED, conductors 942 and 944 of cable 940, the Nos. 7 and 9 contacts of relay CL2, conductors 4202 and 4204 of cable 4200 and to battery through the windings of relays B and D of the "Line entry E digit" register of Fig. 42. These relays thereupon operate and lock over their inner upper contacts and conductor 4234 of cable 4230 to ground over the No. 4 contacts of relay RCLA of Fig. 14.

With connector relay CL3 and reader relays FA and FC of Fig. 10 operated to register the F digit "6," circuits are established from ground over the lower contacts of relays FA and FC, conductors 1031 and 1033 of cable 1030, the Nos. 1 and 3 contacts of relay CL3, conductors 4211 and 4213 of cable 4210 and to battery through the windings of relays A and C of the "Line entry F digit" register of Fig. 42. These relays thereupon operate and lock over their inner upper contacts and conductor 4235 of cable 4230 to ground over the No. 5 contacts of relay RCLA of Fig. 14.

A checking circuit is now established to determine if two relays, and only two, of each of the digit registers of Figs. 40 to 42 inclusive have been operated. This circuit may be traced from ground over the No. 1 back contacts of relays E, D and C of the "Line entry B digit" register of Fig. 40, the No. 3 contacts of operated relay B, the No. 7 contacts of operated relay A, conductor 4005, the No. 2 contacts of operated relay E of the "Line entry C digit" register of Fig. 41, the No. 2 back contacts of relays C and B, the No. 9 contacts of operated relay B, the No. 8 back contact of relay A, the No. 2 contacts of operated relay E of the "Line entry D digit" register of Fig. 41, the No. 2 back contact of relay D, the No. 9 contacts of operated relay C, the lower back contacts of relays B and A, conductor 4105, the No. 1 back contact of relay E of the "Line entry E digit" register of Fig. 42, the No. 3 contacts of operated relay D, the No. 2 back contact of relay C, the No. 9 contacts of operated relay B, the lower back contact of relay A, the No. 1 back contacts of relays E and D of the "Line entry F digit" register of Fig. 42, the No. 3 contacts of operated relay C, the No. 2 back contacts of relay B, the No. 7 contacts of operated relay A, conductors 4215 and 4216, the No. 1 contacts of relay DSR of Fig. 13, conductor 1301, the No. 2 back contact of relay PR of Fig. 15, conductor 1302 and to battery through the winding of relay CLR of Fig. 13. Relay CLR, which released following the previous release of the line entry register relays of Figs. 40, 41 and 42, now reoperates.

It will be recalled that the synchronizing relays SYBA and SYBB were operated and locked following the printing of the first line of the initial entry. Therefore as soon as the cam contacts C4 of the reader again close following the sensing of the second line of the initial entry and the registration of the digits of such entry in the registers of Figs. 40, 41 and 42, as will be indicated by the operation of relay CLR as previously described, a circuit is established from ground over contacts C4 of the reader, conductor 1514 of cable 1500, the No. 3 contacts of relay LSB of Fig. 16, the No. 1 front contact of relay SYBB and to battery through the winding of relay SYMB. The latter relay then operates and locks over its No. 3 contacts and through resistance 1605 to ground over the No. 5 contacts of relay LSB, and opens at its No. 3 back contact the locking circuit of relay SYMA which thereupon releases. On the next closure of cam contacts C7 of the reader, a circuit is established from ground thereover, over conductor 1513 of cable 1500, the No. 6 contacts of relay LSB, the No. 4 contacts of relay SYMB, conductor 1607, the No. 3 contacts of relay CLR and conductor 1608 to battery through the winding of relay SYBC. Relay SYBC then operates and locks over its No. 4 contacts and through resistance 1609 to ground over the No. 1 front contact of relay LSB.

Relay SYBC now establishes a circuit for relay PPA of Fig. 16 which may be traced from battery through its winding, over the No. 3 back contact of relay PPB, through the No. 2 back contact of relay PPD, the No. 2 contacts of relay SYBC, conductor 1516 of cable 1500 and to ground over the No. 6 contacts of operated reader relay

A1 of Fig. 5. Relay PPA, upon operating, locks in a circuit from battery through its winding, over the No. 1 back contact of relay PPD, resistance 1610, the No. 1 contacts of relay PPA, the No. 1 normal contacts of relay PPE and conductor 1720 to ground over the No. 7 front contact of relay PS of Fig. 17. Relay PPA, at its upper normal contacts, also opens the locking circuit of relay LSA which thereupon releases, in turn releasing relay LSB and the connector relays TA, TB and TC of Fig. 3. Relay LSB, upon releasing, opens the locking circuits of synchronizing relays SYBA, SYBB, SYMB and SYBC which now release. With these synchronizing relays released, a circuit is established from battery through the winding of relay PPB, over the No. 2 contacts of relay PPA, the No. 2 back contact of relay PPC, the No. 3 back contact of relay SYBC, the No. 1 back contact of relay SYMB, the No. 2 back contact of relay SYMA, the No. 1 back contact of relay SYBA, the No. 7 back contact of relay LSB, the No. 1 back contact of relay LSA and conductor 1611 to ground over the No. 9 contacts of relay GC of Fig. 15. Relay PPB, upon operating, locks over its No. 1 contacts, over the No. 3 back contact of relay PPD and through resistance 1612 to ground on conductor 1720.

CONTROL OF MESSAGE TICKETER TO PRINT DATA OF SECOND LINE OF INITIAL ENTRY

Relay PPA upon operating, also establishes a circuit for controlling the message ticketer to proceed with the printing of information on the ticket in accordance with the registrations in the line entry registers of Figs. 40, 41 and 42. At this time the brushes of the printer control switch PC will be in the fourteenth terminal position, and the circuit prepared by the operation of relay PPA may be traced from ground over the upper No. 1 normal contacts of relay PM, the brush and No. 14 terminal of switch arc PC1, conductor 1722, the No. 3 contacts of relay PPA of Fig. 16, conductor 1723, the No. 6 contacts of relay P1 of Fig. 18, conductor 1801 of cable 1800, the No. 5 contacts of operated relay A of the "Line entry B digit" register of Fig. 40, the No. 7 contacts of the operated relay B of such register and over conductor 0 to the 0 segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages this segment, the magnet PRT will operate to cause the printing of the hundreds digit "0" of the line switch column number on the ticket and to cause the printer control switch PC to be advanced one step into its fifteenth position.

With the brushes of switch PC in their fifteenth terminal position, the ticketer is controlled to print the tens digit "4" of the line switch column number. A circuit is now established from ground over the No. 1 normal contacts of relay PM of Fig. 17, the brush and No. 15 terminal of switch arc PC1, conductor 1724, the No. 7 contacts of relay P1, conductor 1802 of cable 1800, the No. 5 contacts of operated relay E of the "Line entry C digit" register of Fig. 41, the No. 8 contacts of operated relay B of such register and conductor 4 to the 4 segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the 4 segment, the printer magnet PRT will operate to cause the printing of the tens digit "4" on the ticket and to cause the printer control switch PC to be advanced one step into its sixteenth terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, over the brush and No. 16 terminal of switch arc PC1, conductor 1725, the No. 8 contacts of relay P1, conductor 1803 of cable 1800, the No. 8 contacts of operated relay C of the "Line entry D digit" register of Fig. 41, the No. 7 contacts of operated relay E of such register and conductor 8 to the 8 segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the 8 segment, the printer magnet PRT will operate to cause the printing of the units digit "8" of the line switch column number on the ticket and to cause the printer control switch PC to be advanced one step into its seventeenth terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, over the brush and No. 17 terminal of switch arc PC1, conductor 1726, the No. 9 contacts of relay P1, conductor 1804 of cable 1800, the No. 6 contacts of operated relay B of the "Line entry E digit" register of Fig. 42, the No. 8 contacts of operated relay D of such register and conductor 2 to segment 2 of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the 2 segment, the printer magnet PRT is operated to cause the printing of the digit "2" of the switch designation on the ticket and to cause the advance of control switch PC one step into its eighteenth terminal position.

With switch PC now in its eighteenth terminal position, a circuit is established from ground over the No. 1 normal contacts of relay PM, over the brush and No. 18 terminal of switch arc PC1, conductor 1727, the No. 10 contacts of relay P1, conductor 1805 of cable 1800, the No. 6 contacts of operated relay A of the "Line entry F digit" register of Fig. 42, the No. 6 contacts of operated relay C of such register and conductor 6 to the 6 segment of the ticketer distributor. When thereafter the brush 4501 of the distributor engages the 6 segment, printer magnet PRT operates to cause the printing of the digit "6" of the vertical column designation on the ticket and to cause the printer control switch PC to be advanced one step into its nineteenth terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, over the brush and No. 19 terminal of switch arc PC1 and conductor 1715 to the (—) segment of the ticketer distributor, and when thereafter brush 4501 engages such segment, the printer magnet PRT becomes operated to cause the printing of a dash on the ticket and to cause the printer control switch PC to advance one step into its twentieth terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, over the brush and No. 20 terminal of switch arc PC1, conductor 1728, the No. 1 contacts of operated relay P2 of Fig. 18, conductor 1821 of cable 1820, the No. 4 contacts of operated relay D of the "Day tens answer time" register of Fig. 20 and the No. 3 contacts of operated relay A of such register to the No. 1 conductor and 1 segment of the ticketer distributor. Thereafter when brush 4501 engages such segment, the printer magnet PRT becomes operated to cause the printing of the tens digit "1" of the day of the answer time on the ticket and to cause the printer control switch PC to be advanced one step into its twenty first terminal position.

With switch PC now in its twenty-first termi-

nal position, a circuit is established from ground over the No. 1 normal contacts of relay PM, over the brush and No. 21 terminal of switch arc PC1, conductor 1729, the No. 2 contacts of relay P2, conductor 1822 of cable 1820, the No. 4 contacts of operated relay D of the "Day units answer time" register of Fig. 20, the No. 3 contacts of operated relay A of such register and over the 1 conductor to the segment 1 of the ticketer distributor. When thereafter brush 4501 engages such segment, the printer magnet PRT becomes operated to cause the printing of the units digit "1" of the day of the answer time on the ticket and to cause the advance of the control switch PC one step into its twenty second terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, over the brush and No. 22 terminal of switch arc PC1, conductor 1730, the No. 3 contacts of relay P2, conductor 1823 of cable 1820, the No. 5 contacts of operated relay A of the "Hour tens answer time" register of Fig. 19, the No. 7 contacts of operated relay B of such register and conductor 0 to segment 0 of the ticketer distributor. When thereafter brush 4501 engages such segment, the printer magnet PRT is operated to cause the printing of the tens digit "0" of the hour of the answer time and the printer control switch PC is advanced one step into its twenty-third terminal position.

In its twenty-third terminal position, the brush associated with arc PC4 is engaged with the No. 1 terminal of such arc and a circuit is established from ground applied to such brush over the No. 1 normal contacts of relay PM, thence over conductor 1731, the No. 4 contacts of relay P2, conductor 1824 of cable 1820, the No. 6 contacts of operated relay D of "Hour units answer time" register of Fig. 19, the No. 6 contacts of operated relay E of such register and conductor 3 to segment 3 of the ticketer distributor. When thereafter brush 4501 engages such segment, the printer magnet PRT is operated to cause the printing of the units digit "3" of the hour of the answer time and to cause the printer control switch PC to be advanced one step into its twenty-fourth terminal position.

With the switch PC in terminal position twenty-four, a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 2 terminal of switch arc PC4, conductor 1732, the No. 5 contacts of relay P2, conductor 1831 of cable 1830, the No. 4 contacts of operated relay D of the "Minute tens answer time" register of Fig. 22, the No. 3 contacts of operated relay A of such register and conductor 1 to the segment 1 of the ticketer distributor. When thereafter brush 4501 engages such segment, the printer magnet PRT is operated to cause the printing of the tens digit "1" of the minutes of the answer time and to cause control switch PC to be advanced one step into its twenty-fifth terminal position.

With the switch PC in terminal position twenty-five, a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 3 terminal of switch arc PC4, conductor 1733, the No. 6 contacts of relay P2, conductor 1832 of cable 1830, the No. 4 contacts of operated relay D of the "Minute units answer time" register of Fig. 23, the No. 3 contacts of operated relay A of such register and conductor 1 to the segment 1 of the ticketer distributor. When thereafter brush 4501 engages such segment, the printer magnet PRT is operated to cause the printing of the units digit "1" of the answer time on the ticket and to cause the advance of the printer control switch PC one step into terminal position twenty-six.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 4 terminal of switch arc PC4, conductor 1734, the No. 7 contacts of relay P2, conductor 1833 of cable 1830, the No. 4 contacts of operated relay D of the "Minute tenths answer time" register of Fig. 24, the No. 3 contacts of operated relay A of such register and conductor 1 to segment 1 of the ticketer distributor. When thereafter brush 4501 engages such segment, printer magnet PRT is operated to cause the printing of the tenths digit "1" of the minutes of the answer time on the ticket and to cause the advance of the printer control switch PC one step into terminal position twenty-seven. The digits "11" of the day, the digits "03" of the hour and the digits "111" of the minutes when the call was answered have now been printed on the ticket.

When the brushes of switch PC reach their twenty-seventh terminal position, a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 5 terminal of switch arc PC4, the No. 1 contacts of relay BLK, which it will be recalled was operated to indicate a bulk-billed or local call, and conductor 1715 to the (—) segment of the ticketer distributor. When thereafter brush 4501 engages such segment, the printer magnet PRT is operated to cause the printing of a dash upon the ticket and to cause the advance of the printer control switch PC into its twenty-eighth terminal position.

In this position a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 6 terminal of switch arc PC4, conductor 1735 and to battery through the cut magnet CUT of Fig. 45 of the message ticketer, whereupon this magnet operates and controls the operation of relay PM in the same manner as previously described in connection with the operation of the printer magnet PRT, to cause the advance of the printer control switch another step into its tweny-ninth terminal position. Magnet CUT is also effective to cut from the roll of the ticket tape the ticket printed for the call preceding the call under consideration.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 7 terminal of switch arc PC4, conductor 1736, the No. 8 contacts of relay P2, conductor 1841 of cable 1840, the No. 3 contacts of operated relay R00 of the "Minute tens elapsed time" register of Fig. 46, the No. 4 contacts of operated relay R0 of such register and conductor 0 to the 0 segment of the ticketer distributor, whereupon when brush 4501 engages such segment, the printer magnet PRT is operated to cause the printing of the minute tens digit "0" of the computed elapsed time on the ticket and to cause the advance of the printed control switch PC one step into its thirtieth terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 8 terminal of switch arc PC4, conductor 1737, the No. 9 contacts of relay P2, conductor 1842 of cable 1840, the No. 3 contacts of operated relay R5 of the "Minute units elapsed time" register of Fig. 46, the No. 4 contacts of operated relay R3 of such register and conductor 8 to the 8 segment of the ticketer distributor. When thereafter brush 4501 engages such segment, the printer magnet PRT is operated to cause the printing of the minute units digit "8" of the computed elapsed time on the ticket and

to cause the advance on the printer control switch PC one step into its thirty-first terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 9 terminal of switch arc PC4, conductor 1738, the No. 10 contacts of relay P2, conductor 1843 of cable 1840, the No. 3 contacts of the operated relay R09 of the "Minute tenths elapsed time" register of Fig. 47, the No. 5 contacts of operated relay R2 of such register and conductor 2 to segment 2 of the ticketer distributor, whereupon when brush 4501 engages such segment, the printer magnet PRT is operated to cause the printing of the tenths minute digit "2" of the computed elapsed time on the ticket and to cause the advance of the printer control switch PC one step into its thirty-second terminal position. The digits "082" of the elapsed time have now been printed on the ticket.

Since all of the data required to be printed on the ticket for a local or bulk-billed call has now been printed, an asterisk is now printed on the ticket to denote the termination of the printed data. To control the printing of the asterisk, a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 10 terminal of switch arc PC4, the lower No. 3 contacts of relay BLK and conductor 1709 to the asterisk segment of the ticketer distributor. When thereafter brush 4501 engages this segment, printer magnet PRT is operated to cause the printing of an asterisk on the ticket and to cause the advance of the printer control switch PC to its thirty-third terminal position. The data now printed on the ticket is as follows *00111—7114—04826—1103111—082*.

With the brushes of switch PC in their thirty-third positions and relay BLK operated, a circuit is established from ground over the No. 10 contacts of relay PS, the brush and No. 11 terminal of switch arc PC6, the No. 2 contacts of relay BLK, the No. 8 contacts of relay PS and conductor 1718 to battery through the winding of the PR relay of Fig. 13. Relay PR, upon operating, locks in a circuit from battery through its winding, over conductor 1718, the No. 8 contacts of relay PS, conductor 1739, the No. 4 contacts of relay PR and to ground over the No. 1 contacts of relay GC, and establishes a circuit from battery through the winding of relay RL of Fig. 14, conductor 1407, the No. 3 contacts of relay PR, conductor 1541 and to ground at the No. 1 back contact of the LSB relay of Fig. 16. Relay RL thereupon operates to release the operated relays RAD, RDS, RLT, RLA, RLCB and RCLA of Fig. 14 which now release and open the locking circuits of all operated registered relays. Relay PR also applies ground over its No. 5 contacts to conductor 603, whereupon connector relays TA, TB and TC of Fig. 3 reoperate to enable the reoperation of the reader relays.

The release of relay RLT removes ground at its No. 10 contacts from conductor 1506 of cable 1500, to which conductor relays ESA, ESC and ESD of Fig. 5 were locked, and such relays release, in turn releasing relays DSR and ANR of Fig. 13. The operation of relay PR of Fig. 15 has also opened the circuit of relay CLR which also releases.

When the line entry register relays of Figs. 40, 41 and 42 have released, the previously traced circuit for relay RCK1 of Fig. 15 is established. The release of the answer time register relays of Figs. 19 to 24 inclusive establishes a circuit for relay RCK2 of Fig. 15 which may be traced from battery through the winding thereof, over the No. 7 contacts of relay GC, conductor 1542, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Hour units answer time" register of Fig. 19, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Hour tens answer time" register of Fig. 19, conductor 1900, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Day units answer time" register of Fig. 20, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Day tens answer time" register of Fig. 20, conductor 2001, the lowermost back contacts of relays E and D and the uppermost back contact of B and A of the "District units answer time" register of Fig. 21, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "District tens answer time" register of Fig. 21, conductor 2108, the lowermost back contacts of relays E and D and the uppermost back contact of relays B and A of the "Minute tens answer time" register of Fig. 22, conductor 2205, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Minute units answer time" register of Fig. 23, conductor 2301, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Minute tenths answer time" register of Fig. 24 to ground.

The release of the disconnect time register relays of Figs. 25 to 30 inclusive establishes a circuit for relay RCK3 of Fig. 15 which may be traced from battery through the winding thereof, over the No. 8 contacts of relay GC, conductor 1543, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Hour units disconnect time" register of Fig. 25, the back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Hour tens disconnect time" register of Fig. 25, conductor 2505, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Day units disconnect time" register of Fig. 26, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Day tens disconnect time" register of Fig. 26, conductor 2601, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "District units disconnect time" register of Fig. 27, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "District tens disconnect time" register of Fig. 27, conductor 2704, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Minute tens disconnect time" register of Fig. 28, conductor 2808, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Minute units disconnect time" register of Fig. 29, conductor 2901, the lowermost back contacts of relays E and D and the uppermost back contacts of relays B and A of the "Minute tenths disconnect time" register of Fig. 30 to ground.

The release of the elapsed time registers of Figs. 46 and 47 establishes a circuit for relay RCK4 of Fig. 15 which may be traced from battery through the winding thereof, over the No.

5 contacts of relay GC, conductor 1544, over the No. 1 back contacts of the windings of the "Minute tens elapsed time" and "Minute units elapsed time" registers of Fig. 46, conductor 4600, over the No. 1 back contacts of all of the relays of the "Minute tenths elapsed time" register of Fig. 47 and the lowermost back contacts of relays H1, H0, CR1 and CR0 to ground.

If the relays of all of the registers are now in their normal positions as they should be, relays RCK1, RCK2, RCK3 and RCK4 of Fig. 15 will all be operated and a circuit will be established from ground over the No. 7 contacts of relay PS of Fig. 17, conductor 1720, the No. 6 contacts of relay PR of Fig. 15, the lower contacts of relays RCK1, RCK2, RCK3 and RCK4, conductor 1545, the contacts of relay TC of Fig. 14 (which was operated upon the operation of relay RL). conductor 1538 and to battery through the winding of relay LSA of Fig. 16. Relay LSA thereupon operates, locks over its No. 4 contacts through resistance 1601, the No. 2 contacts of relay PPB, the No. 1 normal contacts of relay PPC, the No. 3 back contact of relay PPE and to ground on conductor 1720, and establishes the circuit of relay LSB which extends from battery through the winding thereof, over the No. 2 contacts of relay LSA, conductor 1540, the No. 2 contacts of relay RCK1 of Fig. 15 and to ground at the No. 3 back contact of relay RLS1. Synchronizing relays SYBA, SYMA, SYBB and SYMB will now operate in the manner previously described under the control of cam contacts C7 and C4 of the reader, and the circuits of relays RS1 and RS2 of Fig. 4 will be established in the manner previously described. The operation of relays RS1 and RS2 advances the reader in the manner previously described, whereupon relay LK2 of Fig. 5 and relays LK1, L2A and L2B of Fig. 6 and relay BLK of Fig. 17 release. It will be recalled that relay DSR released upon the release of relay RLT and that relay CLR released upon the operation of relay PR, thereby removing locking ground at the No. 2 contacts of relay CLR and the No. 7 contacts of relay DSR from conductor 1647 to which relay CC of Fig. 15 was locked. But relay CC remains locked to ground applied to conductor 1547, over the No. 2 back contact of relay SYMB and conductor 1740 and over the No. 1 alternate contacts of relay PS of Fig. 17, until relay SYMB operates as just described, whereupon relay CC releases and, in turn, opens the circuit for relays P1 and P2 of Fig. 18. Relay P2, upon releasing, in turn opens at its No. 12 contacts the holding circuit for relay PS of Fig. 17, which also releases.

Relay PS, upon releasing, establishes a restoring circuit for printer control switch PC, which may be traced from battery through the winding of the STEP magnet of such switch, over the interrupter contacts of such magnet, the brush and strapped terminals of switch arc PC2 and to ground over the No. 4 back contact of relay PS, whereby the switch brushes are advanced until the brush of arc PC2 engages the No. 22 terminal of such arc, whereupon the circuit of magnet STEP is extended to ground at the No. 7 back contact of relay PS and the switch brushes are advanced another step to their normal positions at which no further stepping circuit is effective over the brushes associated with restoring arcs PC2 and PC3. The control circuits of the message ticketer are now restored to normal preparatory to printing a ticket for another call. The release of relay PS is also effective to cause the release of relay PR of Fig. 15, the release of relays PPA and PPB, the release of the synchronizing relays SYBA, SYBB and SYMB of Fig. 16 and the reconnection of ground at its No. 4 normal contacts to conductor 603 to hold connector relays TA, TB and TC of Fig. 3 operated. The control circuits are now in the condition to sense another entry on the record tape.

It will now be assumed that the initial entry, instead of being a two line entry for a local or bulk-billed call, was a four line entry for a short-haul toll call to be billed on a detail basis. For convenience, it will be assumed that the information punched in the record tape for the first two lines of the entry is the same as for the two line entry just described, except for the second or B digit and the third or C digit of the first line of the entry. For a two line initial entry, the B digit is "1," indicating that only one supplemental line for the entry is to be expected. For a four line entry, necessary to provide all the data for detail billing, the B digit is "3," indicating that three supplemental lines are to be expected and the C digit is "9." Under the assumptions thus made, the perforations across the tape for the first line of the entry will therefore be for the digits "339171" and the perforations across the tape for the second line of the entry will be for the digits "104826."

Sensing the first line of the initial four line entry

In response to the sensing of the first line of the initial entry, reader relay A3 is operated in response to the sensing of the perforations for the A digit "3." Upon the operation of said relay, relay LK1 operates and locks as previously described. For the B digit "3" perforations are punched in punch positions *bd* and *be*, and circuits are established from ground over reader contacts BD, conductor 207, the No. 2 contacts of connector relay TA and to conductor 324 of cable 320, and from ground over reader contacts BE, conductor 208, the No. 1 contacts of relay TA and to conductor 325 of cable 320, and thence through cable 400 to battery through the windings of reader relays B1D, B2D, B1E and B2E of Fig. 7. The perforations for the C digit "9" will cause the operation of reader relays C1A, C2A, C1E and C2E of Fig. 8, the perforations for the D digit "1" will cause the operation of reader relays DA and DB of Fig. 9, the perforations for the E digit "7" will cause the operation of the reader relays EB and EC of Fig. 9 and the perforations for the F digit "1" will cause the operation of reader relays FA and FD of Fig. 10 in the manner previously described.

With reader relays A3, B1D, B2D, B1E and B2E operated in response to sensing the record for the two control entry digits "33," and relay LK1 operated following the operation of relay A3, a circuit is established from ground over the No. 6 contacts of relay LK1, conductor 633, the No. 3 back contact of relay LK2, conductor 505, the lower back contacts of reader relays B2A and B2B of Fig. 7, the No. 3 contacts of operated relays B2D and B2E, the No. 3 back contact of relay B2C, conductor 708 and to battery through the winding of relay LN4 of Fig. 6. Relay LN4 operates and locks over its upper No. 1 contacts through resistance 632 to ground over the No. 6 contacts of relay LK1, and establishes circuit from its locking ground, over its upper contacts and conductor 652 of cable 650 to battery through the winding of relay DTL of Fig. 17. The operation of the latter relay informs the ticketer

control circuit that the call is a four line entry toll or detail-billed call. Relay DTL, upon operating, also establishes a circuit over its No. 3 contacts, conductor 1742 and through the No. 11 contacts of relay P2 to battery through the winding of relay P1!, which relay thereupon operates.

A check circuit is now established which may be traced from ground over the contacts of cam C9 of the reader in the same manner as the check circuit established through contacts of the reader relays after sensing the first line of the two line initial entry to conductor 806, and thence over the No. 6 back contact of reader relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 9 back contact of relay B1C, the No. 8 contacts of operated relay B1D, the No. 2 contacts of operated relay B1E, thence as traced to conductor 503, and thence over the No. 5 contacts of operated reader relays B1D and B1E of Fig. 7, the normal contacts of key EN3, conductor 706, the No. 5 contacts of operated relay C1A of Fig. 8, the No. 1 back contact of relay C1B, the No. 2 back contact of relay C1C, the No. 2 back contact of relay C1D, the No. 2 contacts of operated relay C1E, the No. 5 contacts of relay C1D, the No. 5 contacts of relay C1E, the normal contacts of key IN3, conductor 627 and to battery through the windings of connector relays CL1, CL2 and CL3 of Fig. 11. Thus assuming that only one reader relay in the A digit group and two relays, and only two, of each of the B, C, D, E and F reader groups have been operated, the calling line entry connector relays of Fig. 17 will operate. It will be assumed that the answer time has been registered and that therefore connector relays CL4 and CL5 are not operated at this time.

With the connector relay CL1 now operated and reader relays B1D and B1E of Fig. 7 operated to register the B digit "3," indicating thereby that there are three supplemental lines for the initial entry, circuits are established from ground over the lower contacts of relays B1D and B1E, conductors 704 and 705 of cable 700, the Nos. 4 and 5 contacts of connector relay CL1, conductors 4004 and 4005 of cable 4000 and to battery through the windings of relays D and E of the "Line entry B digit" register of Fig. 40. These relays thereupon operate and lock over their inner upper contacts, conductor 4231 of cable 4230 and to ground over the No. 1 contacts of relay RCLA of Fig. 14.

The C, D, E and F line entry registers of Figs. 41 and 42 are operated under the control of the operated reader relays to register the C, D, E and F digits "9171" of the first line of the initial entry in the manner previously described. Connector relay CL3 also establishes the previously traced circuit for relay MLE of Fig. 5 which operates preparatory to the control of the CL- relays of Fig. 11 over the contacts of reader relay A1 for controlling the registration of the supplemental line of the line entry. Relay MLE locks over its No. 2 contacts, conductor 628 and to ground over the No. 3 contacts of relay LK1 of Fig. 6.

A checking circuit is now established to determine if two relays, and only two, of each of the digit registers of Figs. 40 to 42 inclusive have been operated. This circuit may be traced from ground over the No. 2 contacts of operated relay E of the "Line entry B digit" register of Fig. 40, the No. 9 contacts of operated relay D of such register, the lowermost back contacts of relays C, B and A of such register and thence as previously traced over contacts of the relays of the registers as set for the C, B, E and F digits "9171" to battery through the winding of relay CLR of Fig. 13.

From this point the circuits function as previously described to control the message ticketer to print digits on the ticket in accordance with the B, C, D, E and F digits registered in the line entry registers of Figs. 40, 41 and 42, and relays RLS1, LSA, LSB, RCK1 and the synchronizing relays SYBA and SYMA of Fig. 16 and relays RS1 and RS2 of Fig. 4 are operated as previously described to advance the reader for sensing the next line of the entry. Relay RS2, upon operating, establishes a circuit from ground upon the next closure of cam contacts C7 of the reader, conductor 241, the No. 2 contacts of relay RS2, conductor 614 of cable 610, the No. 3 back contact of relay L2B, the No. 2 back contact of relay L4C, the No. 2 back contact of relay L4A, over the No. 1 front contact of relay LK1, conductor 634, the No. 1 contacts of operated relay MLE and to battery through the winding of relay LK2 of Fig. 5. Relay LK2 thereupon operates and locks over its No. 5 contacts through resistance 507, conductor 503, over the No. 3 back contact of relay L2A of Fig. 6 and to ground over the No. 4 contacts of operated relay LK1. Also the closure of cam contacts C7 is effective as previously described to cause the operation of synchronizing relay SYBB of Fig. 16, whereupon relay SYBB operates to open the circuit of relays RS1 and RS2, which release and prepare the check circuit to enable the second line of the initial entry to be sensed and registered. When relay RLS1 operated, it caused the release of relay RCLA to release all operated relays of the line entry registers of Figs. 40, 41 and 42. These registers are then ready to register digits of the second line of the initial entry.

The message ticketer then proceeds to print the tens and units digits of the district frame number registered in the registers of Fig. 39 whereupon the printer control switch PC of Fig. 17 will come to rest in its fourteenth position as previously described.

Sensing the second line of the initial four line entry

When the second line of the four line entry is sensed, the A1 reader relay will be operated since the A or control digit is assumed to be "1" to indicate that the entry line is supplemental to the entry line just previously sensed. Also reader relays of Figs. 7, 8, 9 and 10 are operated in accordance with the perforations for the assumed B, C, D, E and F digits "04826" and thus relays B1A, B2A, B1B and B2B of Fig. 7, relays B1B, B2B, C1E and C2E of Fig. 8, relays BC and BE and DB and DD of Fig. 9 and relays FA and FC wil be operated. The previously traced check circuit through contacts of the A1 reader relay and contacts of the B, C, D, E and F groups of reader relays is then established to cause the reoperation of the CL1, CL2 and CL3 connector relays of Fig. 11.

During the period that the reader contacts are closed, cam contacts C2 will also be closed and establish a circuit from ground thereover, over conductor 253 of cable 250, the No. 4 contacts of operated reader relay A1, the No. 7 contacts of operated relay LK2, conductor 509, the No. 2 back contact of relay LN2 of Fig. 6, the No. 2 contacts of operated relay LN4, the No. 1 back contact of relay L4D, the No. 1 back contact of relay L4B and to battery through the winding of relay L4A. Relay L4A thereupon operates to indicate that the

first line of the entry has been sensed, and locks over its No. 1 contacts, the No. 1 back contact of relay L4C, through resistance 638, the No. 1 back contact of relay L2B and to ground over the No. 3 contacts of relay LK1.

With the connector relays CL1, CL2 and CL3 and the reader relays of Figs. 7, 8, 9 and 10 operated as just described, relays of the B, C, D, E and F line entry registers of Figs. 40, 41 and 42 are operated to register the second line entry B, C, D, E and F digits "04826," and such operated relays become locked to ground over contacts of relay RCLA which reoperated upon the release of relay RLS1 after the register relays released following the completion of the printing of the data of the first line of the initial entry registered thereby. The previously traced check circuit is then established through the contacts of the register relays, resulting in the reoperation of the CLR relay of Fig. 13.

It will be recalled that the synchronizing relays SYBA and SYBB of Fig. 16 were operated and locked following the printing of the first line of the initial entry. Therefore as soon as the cam contacts C4 of the reader close following the reoperation of relay CLR, the previously traced circuit for relay SYMB is closed and such relay operates, in turn releasing relay SYMA. On the next closure of cam contacts C7 of the reader, the previously traced circuit for synchronizing relay SYBC is closed and relay SYBC operates, in turn causing the operation of relay PPA which locks and causes the release of relay LSA, followed by the release of relays LSB, SYBA, SYBB, SYMB and SYBC. With these synchronizing relays released and relay PPA operated, the previously traced circuit for relay PPB is established and such relay operates and locks under the control of relay PPD. Relay PPA, upon operating, also initiates the further operation of the message ticketer which proceeds as previously described to print data on the ticket in accordance with the information registered in the line entry registers of Figs. 40, 41 and 42 and in accordance with the day, hour and minute of the answer time of the call as registered in the registers of Figs. 20, 19, 22, 23 and 24. Following the printing of the tenths minute digit of the answer time on the ticket, the printer control switch PC will have advanced into terminal position 27.

When the brushes of switch PC reach the twenty-seventh terminal position, a circuit is established from ground over the No. 10 contacts of relay PS, the brush and No. 5 terminal of switch arc PC6, the No. 1 contacts of operated relay DTL, the No. 9 contacts of relay PS, conductor 1719, the No. 1 normal contacts of relay DIS of Fig. 15, the No. 1 normal contacts of relay AD and to battery through the winding of relay RLS1. Relay RLS1 then operates and locks over its No. 2 contacts and the No. 1 back contact of relay RCK1 to ground over the No. 1 contacts of relay GC and, at its No. 1 back contact, opens the circuit of relay RCLA which releases, in turn releasing all of the operated relays of the line entry registers of Figs. 40, 41 and 42. When such relays release, the CLR relay releases and the previously traced check circuit over the contacts of the relays of the registers is established for causing the operation of relay RCK1 of Fig. 15 if all of the relays of such registers become released. Relay RCK1, upon operating, causes the release of relay RLS1 and the reoperation of relay RCLA. While relay RLS1 was operated a circuit was established from ground over its No. 3 contacts and conductor 1538 to battery through the winding of relay LSA of Fig. 16 and relay LSA locked over its No. 4 contacts, through resistance 1601, the No. 2 contacts of operated relay PPB, the No. 1 normal contacts of relay PPC, the No. 3 back contact of relay PPE, conductor 1720 and to ground over the No. 7 contacts of relay PS of Fig. 17.

With relay LSA operated, a circuit is established from ground over the No. 1 normal contacts of relay PM, of Fig. 17, the brush and No. 5 terminal of switch arc PC4, conductor 1741, the No. 7 contacts of relay LSA, conductor 1715 and to the (—) segment of the ticketer distributor. When thereafter the brush 4501 engages such segment, the printer magnet PRT is operated to print a dash on the ticket and to cause the advance of the printer control switch PC one step to its twenty-eighth terminal position.

In the twenty-eighth terminal position, the control switch controls the cutting of the tape, and in its twenty-ninth, thirtieth and thirty-first positions the message ticketer is controlled in the manner previously described in accordance with the elapsed time registrations on the registers of Figs. 46 and 47 to print the elapsed time on the ticket, following which the printer control switch PC is advanced to position thirty-two.

With relay DTL operated, indicative of a detail-billed call for which additional information must be printed on the ticket, an asterisk is not printed at this time but a dash is printed. To accomplish this a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 10 terminal of switch arc PC4, the No. 2 contacts of relay DTL and conductor 1715 to the (—) segment of the ticketer distributor. When thereafter brush 4501 engages such segment, the printer magnet PTR is operated to cause the printing of a dash on the ticket and to cause the advance of the printer control switch one step to its thirty-third position, in which position it awaits the sensing of the third line of the initial entry and the reoperation of the line entry registers of Figs. 40, 41 and 42.

Following the release of relay RLS1 and with the checking relay RCK1 operated, the previously traced circuit for relay LSB is established and such relay operates and locks under the control of relay LSA as previously described. The synchronizing relays SYBA and SYMA then function as previously described, relay SYMA, upon operating, causing the operation of relays RS1 and RS2 of Fig. 2 to cause the advance of the reader for sensing the third line of the initial entry. Relay RS2, upon operating, opens one of the locking paths for relays LK1 and LK2, but since relay L2A has not been operated, these relays do not release. Relay RS2 also establishes a circuit from ground over reader cam contacts C7, conductor 241 of cable 240, the No. 2 contacts of relay RS2, conductor 614 of cable 610, the No. 3 back contact of relay L2B of Fig. 6, the No. 3 back contact of relay L4C, the No. 2 front contact of relay L4A and to battery through the winding of relay L4B. Relay L4B thereupon operates and locks over its No. 2 contacts, the No. 2 back contact of relay L4D and through resistance 639 to ground over the No. 3 contacts of relay LK1, indicative of the fact that the second line of the entry has been sensed. Synchronizing relay SYBB of Fig. 16 operates in the manner previously described upon the next closure of cam contacts C7 of the reader and opens the circuit of relays RS1 and RS2 which then release and prepare the check circuit

for enabling the third line of the initial entry to be sensed and registered.

Sensing the third line of the initial four line entry

When the third line of the four line entry is sensed, the A1 reader relay will be operated since the A or control digit is assumed to be "1," to indicate that the entry line is supplemental to the to the preceding line just sensed. Also, the reader relays of Figs. 7, 8, 9 and 10 are operated in accordance with the perforations for the assumed B, C, D, E and F digits. The B digit will be given an arbitrary value "0" since it performs no function, the C digit will be given a value "5," indicating an extended area or a number above 10,000, and the D, E and F digits will be assumed to be "794" or the numerical values of the office code letters of the called line number. Thus the punchings across the tape will be for the digits "105794."

Readers relay A1 also establishes a circuit from ground over the contacts of reader cam C2, conductor 253 of cable 250, the No. 4 contacts of relay A1, the No. 7 contacts of relay LK2, conductor 509, the No. 2 back contacts of relay LN2, the No. 2 contacts of relay LN4, the No. 1 back contact of relay L4D, the No. 1 front contact of relay L4B, and to battery through the winding of relay L4C. Relay L4C upon operating locks over its No. 1 contacts, resistance 638, the No. 1 back contact of relay L2B and to ground over the No. 3 contacts of relay LK1 and, at its No. 1 back contact, opens the locking circuit of relay L4A which then releases.

Reader relays B1A, B2A, B1B and B2B of Fig. 7 will therefore be operated in accordance with the punchings for the B digit "0" in the manner previously described. The perforations for the C digit "5" will be in punch positions *cc* and *cd*; therefore the closure of reader contacts CC and CD will establish circuits from ground thereover, over conductor 211 and the No. 8 contacts of connector relay TB to conductor 333 of cable 330, over conductor 212 and the No. 7 contacts of relay TB to conductor 334 of cable 330, and thence over cable 400 to battery through the windings of reader relays C1C, C2C, C1D and C2D of Fig. 8. The perforations for the D digit "7" will be in punch positions *db* and *dc*; therefore the closure of reader contacts DB and DC will establish circuits from ground thereover, over conductor 215 and the No. 4 contacts of relay TB to conductor 342 of cable 340, over conductor 216 and the No. 3 contacts of relay TB to conductor 343 of cable 340, and thence through cable 400 to battery through the windings of reader relays DB and DC of Fig. 9. The perforations for the E digit "9" will be in punch positions *ea* and *ee*; therefore the closure of reader contacts EA and EE will establish circuits from ground thereover, over conductor 219 and the No. 10 contacts of connector relay TC to conductor 351 of cable 350, over conductor 223 and the No. 6 contacts of relay TC to conductor 355 of cable 350, and thence through cable 400 to battery through the windings of reader relays EA and EE of Fig. 9. The perforations for the F digit "4" will be in punch position *fb* and *fe* and therefore the reader relays FB and FE of Fig. 10 will be operated in the manner previously described.

A check circuit from the reader cam contacts C9 is now established through the contacts of the reader relays, which may be traced as previously described to conductor 441, thence over the No. 6 back contact of reader relay FA of Fig. 10, the No. 7 contacts of operated relay FB, the No. 2 back contacts of relays FC and FD, the No. 2 contacts of operated relay FE, conductor 911, the No. 5 contacts of operated reader relay EA of Fig. 9, the No. 1 back contact of relay EB, the No. 2 back contacts of relays EC and ED, the No. 2 contacts of operated relay EE, the No. 6 back contact of relay DA, the No. 7 contacts of operated relay DB, the No. 3 contacts of operated relay DC, the No. 1 back contacts of relay DD and DE, conductor 912, the No. 6 back contact of relay C2A of Fig. 8, the No. 8 back contact of relay C2B, the No. 8 contacts of operated relay C2C, the No. 3 contacts of operated relay C2D, the No. 1 back contact of relay C2E, conductor 806, the No. 5 contacts of operated relay B1A of Fig. 7, the No. 2 contacts of operated relay B1B, the No. 1 back contacts of relays B1C, B1D and B1E, thence as previously traced to conductor 1501 of cable 1500, the No. 3 contacts of operated reader relay A1 of Fig. 5, the No. 4 contacts of operated relay LK2, the No. 5 back contact of relay A3, the No. 4 back contact of relay A2, the No. 3 contacts of operated relay MLE, conductor 627 of cable 620 and to battery through the windings of the CL1, CL2 and CL3 connector relays of Fig. 11.

With the connector relays CL1, CL2 and CL3 and the reader relays of Figs. 7, 8, 9 and 10 operated as just described, relays of the B, C, D, E and F line entry registers of Figs. 40, 41 and 42 are operated to register the third line entry digits B, C, D, E and F having assumed values "05794." The transfer of the B digit "0" is accomplished as previously described to cause the operation of relays A and B of the "Line entry B digit" register of Fig. 40. The operation of connector relay CL1, with reader relays C1C and C1D of Fig. 8 operated, establishes circuits from ground over the lowermost contacts of relays C1C and C1D, conductors 803 and 804 of cable 800, the Nos. 8 and 9 contacts of relay CL1, conductors 4103 and 4104 of cable 4100 and to battery through the windings of relays C and D of the "Line entry C digit" register of Fig. 41. The operation of connector relay CL2, with reader relays DB and DC of Fig. 9 operated, establishes circuits from ground over the lowermost contacts of such relays, conductors 922 and 923 of cable 920, the Nos. 2 and 3 contacts of relay CL2, conductors 4112 and 4113 of cable 4110 and to battery through the windings of relays B and C of the "Line entry D digit" register of Fig. 41. The operation of connector relay CL2, with reader relays EA and EE of Fig. 9 operated, also establishes circuits from ground over the lowermost contacts of such relays, conductors 941 and 945 of cable 940, the Nos. 6 and 10 contacts of relay CL2, conductors 4201 and 4205 of cable 4200 and to battery through the windings of relays A and E of the "Line entry E digit" register of Fig. 42. The operation of connector relay CL3, with reader relays FB and FE of Fig. 10 operated, is effective to cause the operation of the B and E relays of the "Line entry F digit" register of Fig. 42 in the manner previously described. The register relays, upon operating, lock in the manner previously described to ground over contacts of relay RCLA of Fig. 14, which relay reoperated upon the release of relay RLS1 after these register relays released following the completion of the printing of the data of the second line of the initial entry registered thereby.

A check circuit is now established to determine if two only of the relays of each of the line entry registers have been operated, which cir-

cuit may be traced from ground over the No. 1 back contacts of relays E, D and C of the "Line entry B digit" register of Fig. 40, the No. 3 contacts of operated relay B of such register, the No. 7 contacts of operated relay A of such register, conductor **4005**, the No. 1 back contact of relay E of the "Line entry C digit" register of Fig. 41, the No. 3 contacts of operated relay D of such register, the No. 9 contacts of operated relay C of such register, the lowermost back contacts of relays B and A of such register, No. 1 back contact of relays E and D of the "Line entry D digit" register, the No. 3 contacts of operated relay C of such register, the No. 9 contacts of operated relay B of such register, the No. 8 back contact of relay A of such register, conductor **4105**, the No. 2 contacts of operated relay E of the "Line entry E digit" register of Fig. 42, the No. 2 back contacts of relay D, C and B of such register, the No. 7 contacts of operated relay A of such register, the No. 2 contacts of operated relay E of the "Line entry F digit" register, the No. 2 back contacts of relays D and C of such register, the No. 9 contacts of operated relay B of such register, the No. 8 back contact of relay A of such register, conductor **4216**, the No. 1 contacts of relay DSR of Fig. 13, conductor **1301**, the No. 2 back contact of relay PR of Fig. 15 and conductor **1302** to battery through the winding of relay CLR of Fig. 13.

It will be recalled that the synchronizing relays SYBA and SYBB of Fig. 16 were operated and locked following the printing of the second line of the initial entry, therefore as soon as the cam contacts C4 of the reader close following the reoperation of relay CLR, the previously traced circuit for relay SYMB is closed and such relay operates, in turn releasing relay SYMA. On the next closure of cam contacts C7 of the reader, the previously traced circuit for synchronizing relay SYBC is closed and such relay operates. With relay PPB operated, it established a circuit from ground applied over the lower contacts of reader relay A1, conductor **1516** of cable **1500**, the No. 2 contacts of relay SYBC, the No. 2 back contact of relay PPD, the No. 3 front contact of relay PPB and to battery through the winding of relay PPC. Relay PCC thereupon operates and locks through resistance **1613**, the No. 1 alternate contacts of relay PPC, the No. 3 back contact of relay PPE and to ground on conductor **1720**. The operation of relay PPC is indicative of the fact that the third line of the initial line entry has been sensed and that the message ticketer may proceed with the printing of the data now registered in the line entry registers.

The operation of relay PPC also open the locking circuit of relay LSA which thereupon releases followed by the release of relays LSB, SYBA, SYBB, SYMB and SYBC. With these synchronizing relays released and relay PCC operated, a circuit is established from battery through the winding of relay PPD, the No. 2 front contact of relay PPC, the No. 3 back contact of relay SYBC, the No. 1 back contact of relay SYMB, the No. 2 back contact of relay SYMA, the No. 1 back contact of relay SYBA, the No. 7 back contact of relay LSB, the No. 1 back contact of relay LSA, conductor **1611** to ground over the No. 9 contacts of relay GC of Fig. 15. Relay PPD operates and locks over its No. 3 front contact and through resistance **1612** to ground on conductor **1720**, and at its No. 3 back contact, opens the locking circuit of relay PPB which now releases.

Printing third line of the initial entry data

It will be recalled that printer control switch PC of Fig. 17 was arrested in terminal position thirty-three with relay PPC of Fig. 16 now operated, a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 11 terminal of switch arc PC4, conductor **1743**, the No. 3 contacts of relay PPC, conductor **1757**, the No. 4 contacts of relay P11, conductor **1802** of cable **1800**, the No. 7 contacts of operated relay C of the "Line entry C digit" register of Fig. 41, the No. 7 contacts of operated relay D of such register and conductor **5** to the segment **5** of the ticketer distributor. When thereafter brush **4501** engages such segment, the printer magnet PRT is operated to cause the printing of the digit "5" on the ticket indicative of the area number in which the called office is located and to cause the advance of the printer control switch one step to its thirty-fourth terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 12 terminal of switch arc PC4, conductor **1744**, the No. 3 contacts of relay P11, conductor **1803** of cable **1800**, the No. 4 contacts of operated relay B of the "Line entry D digit" register of Fig. 41, the No. 4 contacts of operated relay C of such register and conductor **7** to segment **7** of the ticketer distributor. When thereafter brush **4501** engages such segment, the printer magnet PRT is operated to cause the printing of the A office code digit "7" of the called line number on the ticket and to cause the advance of the printer control switch PC one step to its thirty-fifth terminal position.

A circuit is then established from ground over the No. 1 normal contacts of relay PM, the brush and No. 13 terminal of switch arc PC4, conductor **1745**, the No. 2 contacts of relay P11, conductor **1804** of cable **1800**, the No. 3 contacts of operated relay E of the "Line entry E digit" register of Fig. 42, the No. 2 contacts of operated relay A of such register and conductor **9** to the segment **9** of the ticketer distributor. When thereafter brush **4501** engages such segment, the printer magnet PRT is operated to cause the printing of the B office code digit "9" of the so-called line number on the ticket and to cause the advance of the printer control switch PC one step to its thirty-sixth terminal position.

A circuit is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 14 terminal of switch arc PC4, conductor **1746**, the No. 1 contacts of relay P11, conductor **1805** of cable **1800**, the No. 5 contacts of operated relay E of the "Line entry F digit" register of Fig. 42, the No. 8 contacts of operated relay B of such register and conductor **4** to segment **4** of the ticketer distributor. When thereafter the brush **4501** engages such segment, the printer magnet PRT is operated to cause the printing of the C office code digit "4" of the called line number on the ticket and to cause the advance of the printer control switch PC one step to its thirty-seventh terminal position.

It is to be noted that the B digit "0" registered on the "Line entry B digit" register is without utility in printing the ticket, since it was employed only as a control digit. Consequently the printer control switch PC skipped the B digit register.

The brush associated with switch arc PC6 is now engaged with the No. 15 terminal of its arc

and a circuit is established from ground over the No. 10 contacts of relay PS, the brush and No. 15 terminal of switch arc PC6, the No. 9 contacts of relay PS, conductor 1719, the No. 1 normal contacts of relay DIS of Fig. 15, the No. 1 normal contacts of relay AD and to battery through the winding of relay RLS1, which relay operates and locks in a circuit over its No. 2 contacts and the No. 1 back contact of relay RCK1 to ground over the No. 1 contacts of relay GC. Relay RLS1, upon operating, causes the operation of relay LSA of Fig. 15 which locks over its No. 4 contacts through resistance 1601, the No. 1 normal contacts of relay PPA, the No. 1 normal contacts of relay PPE and to ground on conductor 1720, and causes the release of relay RCLA of Fig. 14 which, in turn, opens the locking circuits of the operated relays of the line entry registers of Figs. 40, 41 and 42. Thereupon, such relays release and if they release properly, as will be assumed, the previously traced circuit for checking relay RCK1 is established and the locking circuit of relay RLS1 is opened.

With relay LSA operated and the printer control switch PC in terminal position thirty-seven, a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 15 terminal of switch arc PC4, conductor 1755, the No. 6 contacts of relay LSA, conductor 1756 and to battery through the winding of relay RLC of Fig. 17. Relay RLC then functions to control the operation of relay PM, followed by the operation of magnet STEP of switch PC. The release of relays RLC and PM and the release of magnet STEP in the manner fully described in connection with the operation of printer magnet PRT, function to advance the switch PC one step to its thirty-eighth terminal position. The advance of switch PC opens the previously traced circuit for relay RLS1 which will release since its locking circuit has been opened upon the operation of relay RCK1. With relay RLS1 released and relay RCK1 operated, the previously traced circuit for relay LSB is established and such relay locks under the control of relay LSA. The release of the line entry registers also causes the release of relay CLR of Fig. 13. The printer control switch PC now remains in terminal position thirty-eight.

With relay LSB operated, the synchronizing relays SYBA and SYMA function as previously described. Relay SYMA, upon operating, causes the operation of relays of RS1 and RS2 of Fig. 4 to cause the advance of the reader for sensing the fourth line of the initial line entry. Relay RS2, upon operating, opens one of the locking paths for relays LK1 and LK2, but since relay L2A has not been operated, these relays do not release. Relay RS2, upon operating, also establishes a circuit from ground over reader contacts C7, conductor 241 of cable 240, the No. 2 contacts of relay RS2, conductor 614 of cable 610, the No. 3 back contact of relay L2B of Fig. 6, the No. 2 front contact of relay L4C and to battery through the winding of relay L4D. Relay L4D thereupon operates, locks over its No. 2 front contact and through resistance 639 to ground over the No. 3 contacts of relay LK1 and, at its No. 2 back contact, opens the locking circuit of relay L4B which releases. The operation of relay L4D is indicative of the fact that the third line of the initial entry has been sensed and printed. Synchronizing relay SYBB of Fig. 16 also operates in the manner previously described upon the next closure of cam contacts C7 of the reader, and opens the circuit of relays RS1 and RS2 which then release and prepare the check circuit for enabling the fourth line of the initial entry to be sensed and registered.

Sensing the fourth line of the initial entry

When the fourth line of the initial entry is sensed, the A1 reader relay will be operated since the A or control digit is assumed to be "1" to indicate that the entry line is supplemental to the preceding line just sensed. Relay A1 also establishes a circuit which may be traced from ground over cam contacts C2 of the reader, conductor 253 of cable 250, the No. 4 contacts of operated relay A1, the No. 7 contacts of relay LK2, conductor 509, the No. 2 back contact of relay LN2 of Fig. 6, the No. 2 contacts of operated relay LN4, the No. 1 front contact of relay L4D and to battery through the winding of relay L2A which operates, locks over its No. 2 contacts and through resistance 634 to ground over the No. 3 contacts of relay LK1, and establishes an obvious circuit for relay L2B which operates, opening the locking circuit of relay L4C which then releases. Also, reader relays of Figs. 7, 8, 9 and 10 are operated in accordance with the perforations across the tape for the assumed B, C, D, E and F digits. These digits will be assumed to be "84370" for the thousands, hundreds, tens, units and stations digits of the called line number. Thus the perforations across the tape will be for the digits "184370."

Reader relays B1C, B2C, B1E and B2E of Fig. 7 will therefore be operated in accordance with the punchings for the B digit "8," reader relays C1B, C2B, C1E and C2E of Fig. 8 will be operated in accordance with the punchings for the C digit "4," reader relays DD and DE of Fig. 9 will be operated in accordance with the punchings for the D digit "3," reader relays EB and EC of Fig. 9 will be operated in accordance with the punchings for the E digit "7" and reader relays FA and FB of Fig. 10 will be operated in accordance with the punchings for the F digit "0."

A check circuit from the reader cam contacts C9 is now established through the contacts of the reader relays, which circuit may be traced as previously described to conductor 441, thence over the No. 5 contacts of operated relay FA of Fig. 10, the No. 2 contacts of operated relay FB, the No. 1 back contacts of relays FC, FD and FE, conductor 911, the No. 6 back contact of relay EA of Fig. 9, the No. 7 contacts of operated relay EB, the No. 3 contacts of operated relay EC, the No. 1 back contacts of relays ED and EE, the No. 6 back contact of relay DA, the No. 8 back contact of relay DB, the No. 9 back contact of relay DC, the No. 8 contacts of operated relay DD, the No. 2 contacts of operated relay DE, conductor 912, the No. 6 back contact of relay C2A of Fig. 8, the No. 7 contacts of operated relay C2B, the No. 2 back contacts of relays C2C and C2D, the No. 2 contacts of operated relay C2E, conductor 806, the No. 6 back contact of relay B1A, the No. 8 back contact of relay B1B, the No. 8 contacts of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, thence as previously traced to conductor 1501 of Fig. 5, the No. 3 contacts of operated relay A1, the No. 4 contacts of operated relay LK2, the No. 5 back contact of relay A3, the No. 4 back contact of relay A2, the No. 3 contacts of operated relay MLE, conductor 627 of cable 620 and to battery through

the windings of the connector relays CL1, CL2 and CL3 of Fig. 11.

With the connector relays and the FA, FB, EB, EC, DD, DE, C2B, C2E, B1C and B1E reader relays operated, circuits are established in the manner previously described for relays A and B of the "Line entry F digit" register of Fig. 42, for relays B and C of the "Line entry E digit" register of Fig. 42, for relays D and E of the "Line entry D digit" register of Fig. 41, for relays B and E of the "Line entry C digit" register of Fig. 41 and for relays C and E of the "Line entry B digit" register of Fig. 40. These register relays thereupon operate and lock over their inner upper contacts to ground supplied at the contacts of relay RCLA of Fig. 14, which relay reoperated following the release of relay RLS1 of Fig. 15.

A check circuit is now established to determine if two only of the relays of each of the line entry registers have been operated, which circuit may be traced from ground over the No. 2 contacts of operated relay E of the "Line entry B digit" register of Fig. 40, the No. 2 back contact of relay D of such register, the No. 9 contacts of operated relay C of such register, the lowermost back contacts of relays B and A of such register, conductor **4005**, the No. 2 contacts of operated relay E of the "Line entry C digit" register of Fig. 41, the No. 2 back contacts of relays D and C of such register, the No. 9 contacts of operated relay B of such register, the No. 8 back contact of relay A of such register, the No. 2 contacts of operated relay E of the "Line entry D digit" register of Fig. 41, the No. 9 contacts of operated relay D of such register, the lowermost back contacts of relays C, B and A of such register, conductor **4105**, the No. 1 back contacts of relays E and D of the "Line entry E digit" register of Fig. 42, the No. 3 contacts of operated relay C of such register, the No. 9 contacts of operated relay B of such register, the No. 8 back contact of relay A of such register, the No. 1 back contacts of relays E, D and C of the "Line entry F digit" register of Fig. 42, the No. 3 contacts of operated relay B of such register, the No. 7 contacts of operated relay A of such register, conductors **4215** and **4216**, the No. 1 contacts of relay DSR of Fig. 13, conductor **1301**, the No. 2 back contact of relay PR of Fig. 15 and conductor **1302** to battery through the winding of relay CLR of Fig. 13.

It will be recalled that synchronizing relays SYBA and SYBB of Fig. 16 were operated and locked following the printing of the third line of the initial entry; therefore as soon as the cam contacts C4 of the reader close following the reoperation of relay CLR, the previously traced circuit for relay SYMB is closed and such relay operates, in turn releasing relay SYMA. On the next closure of cam contacts C7 of the reader, the previously traced circuit for synchronizing relay SYBC is closed and such relay operates. With relay PPD operated, it establishes a circuit from ground applied over the lower contacts of reader relay A1, conductor **1516** of cable **1500**, the No. 2 contacts of relay SYBC, the No. 2 front contact of relay PPD and to battery through the winding of relay PPE. Relay PPE now operates and locks through resistance **1614** and its upper No. 1 contacts to ground on conductor **1720** as an indication that the fourth line of the initial entry has been sensed and that the message ticketer may proceed with the printing of the data now registered in the line entry registers of Figs. 40, 41 and 42.

Printing the fourth line of the initial entry data

The operation of relay PPE also opens the locking circuit of relay LSA which thereupon releases, followed by the release of relays LSB, SYBA, SYBB, SYMA and SYBC. At its No. 3 contacts, relay PPE also opens the locking circuit of relay PPC which releases. With relay PPE now operated and the brushes of the printer control switch PC in their thirty-eighth terminal position, a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 16 terminal of switch arc PC4, conductor **1747**, the No. 4 contacts of relay PPE, conductor **1748**, the No. 5 contacts of relay P11, conductor **1801** of cable **1800**, the No. 8 contacts of operated relay C of the "Line entry B digit" register of Fig. 40, the No. 7 contacts of operated relay E of such register and conductor **8** to segment **8** of the ticketer distributor. When thereafter brush **4501** engages such segment, printer magnet PRT is operated to cause the printing of the thousands digit "8" of the called line number on the ticket and to cause the advance of the printer control switch PC one step into its thirty-ninth terminal position.

A path is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 17 terminal of switch arc PC4, conductor **1749**, the No. 6 contacts of relay P11, conductor **1802** of cable **1800**, the No. 5 contacts of operated relay E of the "Line entry C digit" register of Fig. 41, the No. 8 contacts of operated relay B of such register and conductor **4** to segment **4** of the ticketer distributor. When brush **4501** engages such segment, the magnet PRT is operated to cause the printing of the hundreds digit "4" of the called line number of the ticket and to cause the advance of the printer control switch PC one step to its fortieth terminal position.

A path is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 18 terminal of switch arc PC4, conductor **1750**, the No. 7 contacts of relay P11, conductor **1803** of cable **1800**, the No. 6 contacts of operated relay D of the "Line entry D digit" register of Fig. 41, the No. 6 contacts of operated relay E of such register and conductor **3** to segment **3** of the ticketer distributor. When brush **4501** engages such segment, printer magnet PRT is operated to cause the printing of the tens digit "3" of the called line number on the ticket and to cause the advance of the printer control switch PC one step to its forty-first terminal position.

A path is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 19 terminal of switch arc PC4, conductor **1751**, the No. 8 contacts of relay P11, conductor **1804** of cable **1800**, the No. 4 contacts of operated relay B of the "Line entry E digit" register of Fig. 42, the No. 4 contacts of operated relay C of such register and conductor **7** to segment **7** of the ticketer distributor. When brush **4501** engages such segment, the printer magnet PRT is operated to cause the printing of the units digit "7" of the called number on the ticket and to cause the advance of the printer control switch PC one step to its forty-second terminal position.

A path is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 20 terminal of switch arc PC4, conductor **1752**, the No. 9 contacts of relay P11, conductor **1805** of cable **1800**, the No. 5 contacts of operated cable A of the "Line entry F digit" register of Fig. 42, the No. 7 contacts of operated relay B

of such register and conductor 0 to the segment 0 of the ticketer distributor. When brush 4501 engages such segment, printer magnet PRT operates to cause the printing of the station digit "0" on the ticket, indicative of the fact that the called line was an individual line having no stations designation, and to cause the advance of the printer control switch PC one step to its forty-three terminal position.

A path is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 21 terminal of switch arc PC4 and conductor 1709 to the asterisk segment of the ticketer distributor. When the brush 4501 engages such segment, the printer magnet PRT becomes operated to cause the printing of an asterisk on the ticket, indicative of the completion of the printing of the data required for a detail-billed call and to cause the advance of the printer control switch PC to its forty-four terminal position. The printed ticket will now appear as follows:

00391—7114—04826—1103111—082—579484370

With the brush associated with switch arc PC6 in engagement with the No. 22 terminal of the arc, a circuit is established from ground over the No. 10 contacts of relay PS, the brush and arc terminal, the No. 8 contacts of relay PS, conductor 1718 and to battery through the winding of relay PR of Fig. 15. Relay PR operates, locks and causes the operation of relay RL and the release of relay CLR as previously described. Relay RL, upon operating, causes the release of relays RAD, RDS, RLT, RLA, RLCB and RCLA of Fig. 14, which release and open the locking circuits of all operated register relays. The release of relay RLT in turn causes the release of operated relays ESA, ESB, ESC and ESD of Fig. 5 as previously described and, in turn, the release of relays DSR and ANR of Fig. 13. With the register relays released, circuits should be established to cause the operation of the check relays RCK1, RCK2, RCK3, and RCK4 which, with relay PR operated, establish the previously traced circuit for relay LSA of Fig. 16. Relay LSA, upon operating, in turn causes the operation of relay LSB and the operation of synchronizing relays SYBA, SYMA, SYBB and SYMB in the manner previously described under the control of reader cam contacts C7 and C4. The circuit for relays RS1 and RS2 of Fig. 4 will be established in the manner previously described.

The operation of relays RS1 and RS2 advances the reader and since the fourth line of the initial entry has been sensed and relays L2A and L2B of Fig. 6 have been operated, the operation of relay RS2 opens the remaining locking path for relays LK1 causing LK2 and such relays to release, in turn releasing relays L2A, L2B, LN4 and L4D of Fig. 6 and relay DTL of Fig. 17. The release of relays DSR and CLR causes the release of relay CC which in turn causes the release of connector relays P1, P2, and P11 of Fig. 18 and the release of relay PS of Fig. 17 followed by the release of relays PPD, PPE, PR and the synchronizing relays SYBA, SYBB and SYMB.

Relay PS, upon releasing, establishes a restoring circuit for the printer control switch PC, which may be traced from battery through the winding of STEP magnet of such switch, over the interrupter contacts of such magnet, the brush and No. 22 terminal of switch arc PC2 to ground at the No. 7 back contact of relay PS, whereupon the switch brushes are advanced one step into their normal position. The control circuits of the message ticketer are now in their normal condition preparatory to printing a ticket for another call and the control circuits are in condition to sense another entry on the record tape.

Sensing a regular hour entry

It will be assumed that the next entry encountered is a regular hour entry. It will be recalled that it was previously assumed that the end of tape hour entry was for the third hour and the punchings therefor across the tape were for the digits "381103," the first three digits being indicative of the fact that it was an hour entry and the fourth or D digit "1" being indicative of the fact that it was an end of tape hour entry. Since the last succeeding or end of tape entry was assumed to be for the third hour, the next hour entry following it would be for the beginning of the third hour or 03. This hour entry should agree with the hour entry registered in the hour circuits of Figs. 34 to 37 inclusive. However, after this hour has been checked, the hour circuit must be progressed and the switches moved to indicate the next previous hour. This is because the record tape in the accounting office is processed in the reverse manner from that in which the tape was recorded in the central office. All of the call entries which follow the hour entry at the beginning of each hour will be referred to the hour previous to this hour entry. Therefore, the hour records on the switches of the hour circuit are arranged so that, as the switches progress forward, the hour indication progresses backwards. When the hour switches reach "00" hour, then on the next hour entry on the tape the switches must be moved to the position to indicate the hour "23." Also, as the hour is changed from the 00 to the 23 indication, a signal is given to the day circuits of Figs. 31, 32 and 33 so that said day circuits may be advanced to indicate the next previous day. As assumed, the tape will be punched for the hour entry digits "381003."

When the hour entry is sensed by the reader, the sensing of the perforations for the A, B, C, D and E digits will, in the manner previously described, cause the operation of reader relay A3 of Fig. 5, reader relays B1C, B2C, B1E, and B2E of Fig. 7, reader relays C1A, C2A, C1D and C2D of Fig. 8 and reader relays DA, DB, EA and EB of Fig. 8. For the F digit "3" perforations are provided in punch positions *fd* and *fe* and upon the closure of reader contacts FD and FE, circuits are established from ground thereover, over conductor 227 and the No. 2 contacts of connector relay TC to conductor 364 of cable 360, and over conductor 228 and the No. 1 contacts of relay TC to conductor 365 of cable 360, and thence through cable 400 to battery through the windings of reader relays FD and FE of Fig. 10. Reader relay A3, upon operating, also establishes the previously traced circuit for relay LK1.

With the reader relays thus operated, a check circuit is established from ground over cam contacts C9 of the reader, conductor 242 of cable 240, the No. 3 contacts of connector relay TD, the No. 5 contacts of alarm relay AL, conductor 441, the No. 6 back contact of reader relay FA of Fig. 10, the No. 8 back contact of relay FB, the No. 9 back contact of relay FC, the No. 3 contacts of operated relay FD, the No. 2 contacts of operated relay FE, conductor 911, the No. 5 contacts of operated relay EA of Fig. 9, the No. 2 contacts of operated relay EB, the No. 1 back

contacts of relays EC, ED and EE, the No. 5 contacts of operated reader relay DA, the No. 2 contacts of operated relay DB, the No. 1 back contacts of relay DC, DD and DE, conductor **912**, the No. 5 contacts of operated relay C2A, the No. 1 back contact of relay C2B, the No. 2 back contact of relay C2C, the No. 3 contacts of operated relay C2D, the No. 1 back contact of relay C2E, conductor **806**, the No. 6 back contact of relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 8 contacts of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, thence as previously traced to conductor **503**, the No. 7 contacts of operated relay B1C of Fig. 7, the No. 6 contacts of operated relay B1E, conductor **707**, the No. 4 contacts of operated relay C2D of Fig. 8, the No. 2 contacts of operated relay C2A, conductor **913**, the No. 3 contacts of operated relay DA of Fig. 10, the No. 5 contacts of operated relay DB, conductor **915** and to battery through the windings of connector relays HO1 and HO2 of Fig. 12.

With connector relay HO1 operated and reader relays EA and EB of Fig. 9 operated to register the tens digit "0" of the hour, as assumed, a circuit is established from ground over the No. 3 contacts of relay EA, the No. 5 contacts of relay EB, conductor **952** of cable **950**, the No. 1 contacts of connector relay HO1, conductor **3601** of cable **3600**, the brush and No. 4 terminal of arc HT2 of the hour tens switch HT of Fig. 36 and to battery through the winding of relay HT of Fig. 36. With connector relay HO2 operated and reader relays FD and FE of Fig. 10 operated to register the units digit "3" of the hour as assumed, a circuit is established from ground over the No. 5 contacts of relay FD, the No. 5 contacts of relay FE, conductor **1213** of cable **1210**, the No. 3 contacts of connector relay HO2, conductor **3613** of cable **3610**, the No. 8 terminal upon which the brush of switch arc HU2 is standing and to battery through the winding of relay HU of Fig. 36. This first hour indication on the tape should always be the same as the hour indicated by the position of the switches HT and HU of the hour circuit before the hour entry was read. Thus with the HT and HU switches in the proper positions, the relays HT and HU will both be operated and will thereby establish a circuit from battery through the winding of relay TUA of Fig. 35, conductor **3513**, the front contacts of relays HT and HU, conductor **3514**, the No. 1 back contact of relay TUD, the No. 3 normal contacts of relay TUB, conductor **3509** and to ground over the No. 3 contacts of relay LK1 of Fig. 6.

Relay TUA, upon operating, locks over its No. 1 contacts and the No. 3 normal contacts of relay TUB to ground over conductor **3509**. Over its No. 2 contacts it establishes an obvious circuit for relay TUC which, in turn, operates and establishes a circuit from ground over its No. 3 contacts, conductor **3515**, through the winding of the STEP magnet of the HU switch and to battery through the winding of relay HUS. Magnet STEP and relay HUS both operate preparatory to advancing the brushes of the HU switch one step, and relay HUS establishes a circuit from ground on conductor **3506**, over the No. 1 alternate contacts of relay HUS, conductor **3516** and to battery through the winding of relay TUD which operates. With relay TUC operated, it establishes a circuit from battery through the winding of relay TUE, over the No. 2 contacts of relay TUC, the No. 2 contacts of relay TUD, the No. 3 back contact of relay TUF and to ground on conductor **3509**. Relay TUE operates and locks over its No. 2 contacts and the No. 3 back contact of relay TUF to ground on conductor **3509**, and establishes the circuit of relay TUB extending from battery through the winding of such relay, the No. 3 contacts of relay TUA and to ground over the No. 4 contacts of relay TUE. Relay TUB operates, locks over its No. 3 alternate contacts to ground on conductor **3509** and at its No. 3 normal contacts opens the locking circuit of relay TUA.

As soon as the reader contacts open to release the reader relays and thereby the HT and HU relays of Fig. 36, relay TUA releases, in turn releasing relay TUC which, in turn, releases the STEP magnet and relay HUS. Thereupon the brushes of switch HU are advanced one step into engagement with the No. 9 terminals of their arcs. Relay HUS, upon releasing, releases relay TUD whereupon a circuit is established from battery through the winding of relay TUG, the No. 4 contacts of relay TUB, the No. 3 contacts of relay TUE, the No. 3 back contact of relay TUD, conductors **3517** and **1513**, conductor **241** of cable **240** and to ground over the reader cam contacts C7 upon the next break cycle of the reader. Relay TUD operates and locks over its No. 2 contacts to ground on conductor **3509** and prepares the circuit of relay TUF extending over its No. 1 contacts and conductor **244** of cable **240** to ground over the contacts of reader cam C6 upon the next make cycle of the reader. With relays TUB and TUF both operated, a circuit is established from ground over the Nos. 1 and 2 contacts of such relays, over conductors **3703** and **3704** of cable **3700**, the Nos. 4 and 5 contacts of connector relay HO1, conductors **1205** and **624** and to battery through the windings of relay L2A in Fig. 6 and relays RS1 and RS2 of Fig. 4. Relay L2A, upon operating, locks under the control of relay LK1 as previously described. Relay TUF, upon operating, also opens at its No. 3 back contact the locking circuit for relay TUE which releases.

Relays RS1 and RS2, upon operating, cause the advance of the reader in the manner previously described and, with relays RS2 and L2A both operated, the holding paths for relay LK1 are opened and such relay releases, in turn releasing relays TUB and TUG followed by the release of relay TUF. With relays TUB and TUF both released, relays RS1, RS2 and L2A release. The circuits are now in readiness to sense another tape entry.

During the time that relay TUE remains operated, a circuit is established from ground over its No. 1 contacts and conductors **3518** and **1705** to battery through the winding of relay PAA of Fig. 4. Relay PAA operates to control relays PAB, ALA, ALB, ALC and ALD in the manner previously described to cause the measurement of an interval of the minimum of twelve seconds which should be adequate to advance the hour units switch HU. If the hour switch is advanced before the expiration of the timing interval, relay PAA will release and release the operated alarm relays. If the switch does not advance, however, the operation of relay ALD will cause the operation of alarm relay AL to cause the operation of audible and visual alarms, and to arrest the further advance of the reader until the trouble has been remedied.

The hour switch HT is now in position **4**, in which position relays HTA and HTB of Fig. 35 are operated to indicate that the hour tens digit is "0" and that the hour switch HU is now in

position 9. In position 9 a circuit is established from ground applied to conductor 3507 as soon as the HU switch comes to rest and relay HUS has released, over the brush and No. 9 terminal of switch arc HU3, to battery through the winding of relay HUB, and over the brush and No. 9 terminal of switch arc HU4 to battery through the winding of relay HUD. With relays HUB and HUD both operated, a circuit is established from ground over the No. 5 contacts of relay HUB and the No. 4 contacts of relay HUD to battery through lamp HRU2. The advance of switch HU releases relay HUE to extinguish the lamp HRU3. Lamps HRTO and HRU2 now lighted indicate to the attendant that the hour switches have been set for the hour 02.

For any answer or disconnect time entries sensed during the hour 02, the "Hour tens answer time" and "Hour tens disconnect time" registers of Figs. 19 and 25 will be set from the relays HTA and HTB as previously described for the hour tens digit "0" and the "Hour units answer time" and "Hour units disconnect time" registers of Figs. 19 and 25 will be set from the relays HUB and HUD in the manner previously described for the hour units digit "2."

Upon sensing subsequently encountered hour entries for the 02 and 01 hours, the hour unit switch HU will be advanced step-by-step. In response to the sensing of the entry for the hour 02, switch HU will advance its brushes to terminal position 10, in which position relays HUA and HUD will be operated to establish the circuit of lamp HRU1 and control circuits will be prepared for setting the "Hour units answer time" and "Hour units disconnect time" registers of Figs. 19 and 25 for the hour units digit "1." In response to sensing the entry for the hour 01 switch HU will advance its brushes into terminal position 11, in which position relays HUA and HUB will be operated to establish the circuit of lamp HRU0 and control circuits will be prepared for setting the "Hour units answer time" and "Hour units disconnect time" registers of Figs. 19 and 25 for the hour units digit "0." The tens switch HT will not be advanced and, consequently, the HTA and HTB relays will remain operated to light lamp HRT0 and to control the setting of the "Hour tens answer time" and "Hour tens disconnect time" registers of Figs. 19 and 25 for the hour tens digit "0."

The hour circuits are arranged so that when a disconnect time entry is recorded in the circuits of Figs. 26 to 30 inclusive, and relay DSR has operated, relay DIS of Fig. 34 will be operated in a circuit over the No. 6 contacts of relay DSR of Fig. 13 and conductor 1303. With relay DIS operated, a means is provided for counting the number of hour entries which are recorded in the hour circuits between the time the disconnect entry is sensed and the answer time entry is sensed. When the HU switch is operated, the operation of relay TUC closes a circuit which may be traced from ground over the No. 5 contacts of relay DIS, conductor 3413, the No. 1 front contact of relay TUC, conductor 3519, the No. 1 contacts of relay CH of Fig. 36, conductor 3520, the No. 1 back contact of counting relay HD, the No. 1 back contact of counting relay HB and to battery through the winding of counting relay HA. Relay HA will therefore operate and lock over its No. 1 contacts and the No. 3 contacts of relay DIS to ground upon the first operation of relay TUC following the operation of relay DIS. It is to be noted that relay CH operated in a circuit from battery through its winding, over conductor 3605, the No. 3 back contact of relay ESD of Fig. 5, the No. 2 back contact of relay CE3 and to ground over conductor 1506, and remains operated until relay ESD operates at the end of the sensing and recording of the answer time entry. On the release of relay TUC to cause the advance of the switch HU as previously described, a circuit is established from ground on conductor 3413, over the No. 1 back contact of relay TUC, conductor 3412, the No. 2 back contact of counting relay HC, the No. 2 contacts of counting relay HA and to battery through the winding of counting relay HB. Relay HB thereupon operates and locks over its No. 2 contacts and the No. 3 contacts of relay DIS to ground. At its No. 1 back contact it opens the initial operating circuit of relay HA. On the next operation of relay TUC, the previously traced circuit from ground to conductor 3520 is established and the circuit is then further extended over the No. 1 back contact of counting relay HD and the No. 1 front contact of counting relay HB to battery through the winding of counting relay HC, whereupon such relay operates, locks over its No. 1 contacts and the No. 3 contacts of relay DIS to ground, and opens the operating circuit of relay HA. On the next release of relay TUC to cause the advance of switch HU another step, the circuit previously traced from ground over the No. 1 back contact of relay TUC and conductor 3412 is extended over the No. 2 front contact of counting relay HC to battery through the winding of relay HD which operates, locks over its No. 2 contacts and the No. 3 contacts of relay DIS to ground and opens the operating circuit of relay HC. On the next operation of relay TUC, the circuit previously traced from ground to conductor 3520 is extended over the No. 1 front contact of relay HD to battery through the winding of counting relay HE, whereupon relay HE operates and locks over its No. 1 contacts and the No. 3 contacts of relay DIS. Thus the counting relays HA to HE inclusive are capable of counting three changes in the hour entry between the time when the disconnect entry is sensed and the time when the answer time entry is sensed.

These counting relays control the operation of the HR1, HR2 and HR3 relays of Fig. 34 in the following manner: When relay HA operates, a circuit is established from ground over the No. 4 contacts of relay DIS, the No. 2 back contact of relay HE, the No. 3 back contact of relay HC, the No. 3 front contact of relay HA, and to battery through the winding of relay HR1. When relay HC operates, the circuit of relay HR1 is opened at its No. 3 back contact, whereupon such relay releases and the circuit traced from ground over the No. 2 back contact of relay HE is extended over the No. 3 front contact of relay HC to battery through the winding of relay HR2. When relay HE operates, the circuit of relay HR2 is opened at its No. 2 back contact, whereupon such relay releases and the circuit traced from ground over the No. 4 contacts of relay DIS is extended over the No. 2 front contact of relay HE and through the winding of relay HR3 to battery. Thus if the hour changes once between the disconnect and answer time entry, relay HR1 will be operated; if the hour changes twice relay HR2 will be operated, and if the hour changes three times, relay HR3 will be operated to indicate the number of hour entries that should be included in the elapsed time computation as previously considered.

It may be that a recorder at the originating

office is made busy for a brief interval and that an hour entry period may have passed which would not be recorded on the regular tape. To take care of this condition, the hour circuits are arranged so that when the end of tape hour entry is recorded after the recorder has been placed back into service, the HUS relay will be operated as previously described when the end of tape hour entry is sensed, and will cause the operation of relay HOS of Fig. 36 when and if the HU switch is operated. The circuit for relay HOS is established from ground over the No. 6 contacts of relay DIS, conductor 3606, the No. 2 contacts of relay HUS when such relay operates, the No. 2 contacts of relay CH and to battery through the winding of relay HOS. Relay HOS, upon operating, locks over its No. 2 contacts to ground on conductor 3606 and, at its upper contacts, establishes a circuit for the HR1 relay. This circuit may be traced from ground over the No. 4 contacts of relay DIS, the lower back contacts of relays HE, HC and HA, conductor 3408, the No. 1 front contact of relay HOS, conductor 3607 and through the winding of relay HR1 to battery. Relay HR1 will therefore be effective to add one missing hour in the operation of the computing circuits. It is apparent that it would be possible for more than one hour to be passed while the recorder is out of service, but this condition is unlikely and it is considered to be sufficient to provide for the addition of only one hour to a conversation time.

The hour circuits are arranged so that when the HU switch is recycled from the "0" point on the switch to the "9" point on the switch, the HT switch will be moved one position forward. When the brushes of the HU switch have been moved into their No. 12 terminal position in response to the sensing of the hour entry 00, a circuit is established from ground over the No. 1 contacts of relay ON1, the normal contacts of relay HTS, the No. 4 terminal and brush of arc HT3 of switch HT, conductor 3522, the No. 1 back contact of relay T0 of Fig. 37, conductor 3523 and to battery through the winding of relay DEA of Fig. 35. A circuit is also established from ground on conductor 3507, the No. 12 terminal and brush of arc HU4 of switch HU, conductor 3411, the No. 1 front contact of relay DEA and to battery through the winding of relay DEB. Relay DEB, upon operating, establishes a locking circuit for relay DEA, extending over the No. 2 contacts of relay DEA and to ground over the No. 2 contacts of relay DEB. Relay DEB establishes a circuit from ground over its No. 5 contacts, conductor 3524 and to battery through the winding of relay HDUA of the day circuits of Fig. 32, whereupon relay HDUA operates, locks over its No. 10 contacts and conductor 3206 to ground over the No. 2 back contact of relay DRC of Fig. 31 and establishes the circuit of relay HDUB which also operates. Relay HDUA, upon operating, releases relay NDUA which, in turn, releases relays DUA, DUD and NDUB, and establishes the circuit of relay HDUC of Fig. 31, which circuit may be traced from battery through the winding of such relay, conductor 3104, the No. 3 contacts of relay HDUA and to ground over the No. 4 contacts of relay UD1, which previously operated and locked in response to the sensing of the end of tape day entry. Relay HDUO, upon operating, connects ground over the Nos. 1 and 2 back contacts of relay LDY, the Nos. 3 and 4 contacts of relay HDUO and conductors 3105 and 3106 through the windings of output register relays DUA and DUB which thereupon operate. With these relays operated, a circuit is established from ground over the No. 3 contacts of relay DUA and the No. 1 contacts of relay DUB through lamp DU0 to battery, which lamp lights to indicate that the day units digit has been changed to "0." The previously traced circuits for the day tens register relays DTA and DTB are unchanged and lamp DT1 remains lighted to indicate the day tens digit "1."

The DTA and DTB relays also are effective to control the operation of relays of the "Day tens answer time" and "Day tens disconnect time" registers of Figs. 20 and 26 to register the tens digit "1" of the day, and relays DUA and DUB also are effective to control the operation of relays of the "Day units answer time" and "Day units disconnect time" registers of Figs. 20 and 26 to register the units digit "0" of the day. It will be noted that this day registration will be for the day preceding the registration for the end of tape day entry.

Relay DEB also establishes a circuit from ground over its No. 4 contacts, conductor 3525, through the upper winding of relay TH2 of Fig. 37, over conductor 3707 and the No. 6 contacts of relay DEB to battery, whereupon relay TH2 operates, opening at its No. 1 back contact the locking circuit of relay TH0 which releases, in turn releasing relay T2 and closing a circuit from battery over its No. 1 front contact, through its lower winding and over its No. 2 contacts, the No. 2 back contacts of relays TH1 and TH0 and to ground on conductor 3706. Over its No. 3 contacts, relay TH2 closes an obvious circuit for relay T2 which thereupon operates. With relay T2 operated, a circuit is established from ground over the No. 2 back contacts of relays T0 and T1, the Nos. 1 and 2 front contacts of relay T2, the No. 3 back contact of relay T0, conductor 3512, the No. 4 terminal and brush of switch arc HT1 of the hour tens switch HT, the No. 1 back contact of relay UE, the interrupter contacts and winding of the STP magnet of such switch and through the winding of relay HTS to battery. Switch HT is thereby advanced one step, whereupon the brush of switch arc HT1 engages the strapped terminals of such arc and magnet STP is intermittently operated to advance the switch brushes into terminal position 13. However, with the brush now engaged with the No. 13 terminal of arc HT1, the circuit for magnet STP is extended over conductor 3513 but is now open at the No. 2 back contact of operated relay T2. The switch HT therefore stops in terminal position 13. A circuit is now closed from ground over the No. 1 contacts of relay ON1, the normal contacts of relay HTS, brush HT4 and the No. 13 terminal of its arc and to battery through the winding of register relay HTA and, in parallel over the brush and No. 13 terminal of switch arc HT3, to battery through the winding of register relay HTB. With relays HTB and HTD now operated, a circuit is established from ground over the No. 2 contacts of relay HTB and the No. 2 contacts of relay HTD through lamp HRT2 to battery, which lamp lights to indicate the tens digit "2" of the hour.

Relay DEB also establishes a circuit from ground over its No. 3 contacts, conductor 3526, through the winding of relay UH3, conductor 3708 and to battery over the No. 7 contacts of relay DEB. It will be recalled that relay UH3 was operated in response to the sensing of the end of tape hour record so no change is effected in the

operated condition of relays UH3 and U3. Therefore, with relays U3 and DEB operated, a circuit is established from ground over the No. 1 contacts of relay U3, conductor 3527, the No. 8 contacts of relay DEB, conductor 3521, the No. 12 terminal and brush of arc HU1 of the hour units switch HU, the interrupter contacts and winding of the stepping magnet STP of switch HU and to battery through the winding of relay HUS. Switch HU is thereupon stepped forward one step, whereupon the stepping circuit is reestablished over the brush and the No. 13 terminal of switch arc HU1, the No. 1 back contact of relay U9, the No. 2 front contact of relay U3, the No. 2 back contacts of relays U9, U8, U7, U6, U5, the No. 3 back contact of relay U4, the No. 3 front contact of U3, the No. 2 back contacts of relays U2, U1 and U0 and to ground. The stepping magnet is again operated and released to advance the brushes of switch HU into their fourteenth terminal position, in which position the stepping circuit is established from the No. 14 terminal of switch arc HU1, over the No. 1 back contact of relay U8 and thence as traced to ground, whereupon the stepping magnet is again operated to advance the switch brushes into their fifteenth terminal position. In a similar manner the switch is advanced step-by-step until the brushes are in their nineteenth terminal position, in which position the circuit for the stepping magnet STP extended over the brush and No. 19 terminal of switch arc HU1 is open at the No. 2 back contact of operated relay U3. The further advance of the switch is thereby arrested.

When the brush associated with switch arc HU4 advanced, the previously traced circuit for relay DEB is opened and relay DEB releases, in turn releasing relay DEA. A circuit is now established from ground on conductor 3507, over the No. 19 terminal of switch arc HU3 and to battery through the winding of register relay HUD and, in parallel over the brush and No. 19 terminal of switch arc HU4, to battery through the winding of register relay HUE. With relays HUD and HUE operated, a circuit is established from ground over the No. 3 contacts of relay HUD and the No. 4 contacts of relay HUE to battery through the lamp HRU3, which lights to indicate that the switch HU has been set into the hour units digit position "3."

With the hour tens register relays HTB and HTD operated, circuits are prepared for setting the "Hour tens answer time" and "Hour tens disconnect time" registers of Figs. 19 and 25 for the hour tens digit "2," and the operation of the hour units relays HUD and HUE prepares circuits for setting the "Hour units answer time" and "Hour units disconnect time" registers of Figs. 19 and 25 for the hour units digit "3."

As the reader senses successively encountered hour entries, the switch HU will be advanced step-by-step in the manner previously described in connection with the advance of such switch from the position in which the hour 03 was changed to the hour 02, until the hour units switch HU is in terminal position 22, at which time relays HUA and HUB will be operated over the No. 22 terminal positions of the brushes of switch arcs HU3 and HU4 to close the circuit extending from ground over the No. 4 contacts of relay HUA and the No. 4 contacts of relay HUB, through the lamp HRU0 to battery, to light such lamp to indicate the hour units digit "0." During such time, the hour tens switch HT will not have advanced; consequently relays HUD and HUE will remain operated to cause the lighting of lamp HRT2 to indicate the hour tens digit "2." The indicated hour will then be 20.

When the reader senses the next hour entry, the hour units switch HU will be advanced another step, at which time its brushes will engage the No. 1 terminals of their arcs. A circuit will then be established from ground on conductor 3507, the brush and No. 1 terminal of switch arc HU4, conductor 3411, the No. 1 back contact of relay DEA to battery through the winding of relay UE. Relay UE, upon operating, extends its operating ground over its No. 1 front contact, through the interrupter contacts and winding of the STP magnet of the hour tens switch HT and to battery through the winding of relay HTS, whereupon the magnet operates and releases to advance the brushes of switch HT one step to their No. 3 terminal position. Until the stepping magnet becomes fully operated, relay UE remains locked over a circuit over its No. 1 front contact, the interrupter contacts of magnet STP and to ground over the No. 2 contacts of relay UE.

Relay UE also establishes a circuit from ground over its No. 3 contacts, the No. 8 back contact of relay DEB, conductor 3521, the normal or No. 1 terminal and brush of switch arc HU1, the interrupter contacts and winding of the magnet STP of the hour units switch HU and to battery through the winding of relay HUS, whereupon magnet STP operates and releases to advance the brushes of switch HU to their second terminal position.

With the brushes of switch HT in their No. 3 terminal position, ground from the No. 1 contacts of relay ON1, is applied over the normal contacts of relay HTS as soon as switch HTS has completed its step, the brush and No. 3 terminal of switch arc HT4 to battery through the winding of relay HTA, and in parallel over the brush and No. 3 terminal of switch arc HT3, to battery through the winding of relay HTD, causing the operation of such relays to close the circuit of lamp HRT1 to indicate the hour tens digit "1." With the brushes of switch HU in their No. 2 terminal position, ground applied to conductor 3507 is extended over the brush and No. 2 terminal of switch arc HU3 to battery through the winding of relay HUA, and in parallel over the brush and No. 2 terminal of switch arc HU4, to battery through the winding of relay HUE, whereby a circuit is established from ground over the No. 2 contacts of relay HUE and the No. 2 contacts of relay HUA to battery through the lamp HRU9. Lamp HRU9 then lights to indicate the hour units digit "9." The hour thus indicated is 19. As previously discussed, the operated register relays HTA, HTD, HUA and HUE are effective to control the setting of the "Hour tens disconnect time" and "Hour units disconnect time" registers of Fig. 25 and the "Hour tens answer time" and "Hour units answer time" registers of Fig. 25 and the "Hour tens answer time" and "Hour units answer time" registers of Fig. 19.

The hour tens and hour units switches HT and HU are similarly advanced when the hour units switch HU reaches terminal position 12, at which time the hour 10 will be indicated. In this case, the hour tens switch HT will be advanced to terminal position No. 4 and the hour units switch HU will be advanced to terminal position 12. With switch HT in terminal

position 4 a circuit is established from ground over the No. 1 contacts of relay ON1, the normal contacts of relay HTS, the brush and No. 4 terminal of switch arc HT4 and to battery through the winding of relay HTA, and in parallel over the brush and No. 4 terminal of switch arc HT3, conductor 3522, the No. 1 back contact of relay T0 of Fig. 37, conductor 3523 and to battery through the winding of relay DEA of Fig. 35. Relay DEA then operates and over its No. 3 contacts establishes a circuit extending from ground and through the winding of relay HTB to battery. With relays HTA and HTB thus operated, the circuit of lamp HRT0 is established and such lamp lights to indicate the registration of the hour tens digit "0." With the brushes associated with arcs HU3 and HU4 on the No. 13 terminals thereof, relays HUA and HUE are operated to establish the circuit of lamp HRU9 to indicate the hour units digit "9." The hour thus indicated is 09.

It will be recalled that when the hour indication was changed from 00 to 23, the day units register was changed from "1" to "0" by the operation and locking of the day units relay UD0 and the release of relay UD1 of Fig. 32. As a consequence, the day units register relays DUA and DUB were operated to cause the lighting of the day units indicating lamp DU3. No change however was made in the day tens registration; consequently register relays DTA and DTD remain operated to maintain the day tens lamp DT1 of Fig. 33 lighted. After midnight of the next day when the hour changes from 00 to 23, it will become necessary to change the day indication from "10" to "09." This is accomplished as follows. With the UD0 relay operated as previously described, a circuit is established from ground over the No. 4 contacts of relay UD0, the No. 2 contacts of relay HDUA, which it will be recalled operated and locked during the operation of the hour circuits in changing from the "00" to the "23" hour indication, and to battery through the winding of relay HDT. Relay HDT establishes a circuit over its No. 3 contacts and conductor 3106 through the winding of register relay DUA to battery, and establishes a circuit over its No. 2 contacts and conductor 3207 through the winding of register relay DUE to battery. Relays DUA and DUE are thus operated to establish the circuit of lamp DU9 which lights to indicate the change of the day units to "9."

Relay HTD also releases relay NDT, the latter opening the previously traced circuits of the DTA and DTD register relays which thereupon release. However, with relay HDT operated, new circuits are established from ground over the No. 4 contacts of operated relay TD1, conductor 3204, the No. 8 contacts of relay HDT, conductor 3305 and to battery through the winding of relay DTA, and from ground over the No. 3 contacts of relay TD1, conductor 3205, the No. 5 contacts of relay HDT, conductor 3316 and through the winding of relay DTB to battery. With relays DTA and DTB operated, a circuit is established to light lamp DTO to indicate the day tens digit "0." The operated register relays DTA. DTB, DUA and DUE are effective to control the resetting of the "Day tens disconnect time" and "Day units disconnect time" registers of Fig. 20 and the "Day tens answer time" and "Day units answer time" registers of Fig. 26.

The day circuits are changed in a similar manner from day 20 and day 30 to day 19 and day 29 respectively. Prior to the change from day 20 to day 19, the day tens relay TD2 and the day units relay UD0 will have been operated in response to the hour circuits; consequently when relay HDT operates and relay NDT releases, the operated day tens output register relays DTB and DTD will be released, the relays DTA and DTD will be operated to register the day tens digit "1" and the day units output register relays DUA and DUE will be operated to register the day units digit "9." Prior to the change from day 30 to day 29, the day tens relay TD3 and the day units relay UD0 will have been operated in response to the hour circuits; consequently when relay HDT operates and relay NDT releases, the operated day tens output register relays DTD and DTE will be released, the relays DTB and DTD will be operated to register the day tens digit "2" and the day units output register relays DUA and DUE will be operated to register the day units digit "9."

To care for the condition where the day is changed from the first day of the month to the last day, the operation of the day circuits is as follows: One of the keys LD28, LD30 or LD31 of Fig. 33 must be operated in accordance with which day is the last day of the month involved during the month that the tapes are being processed. Assuming that the day circuits have been set for the day 01, then relay HDUA is operated at the midnight hour as previously described, and relay HDU0 is operated over the circuit extending from battery through its winding, conductor 3104, the No. 3 contacts of relay HDUA and to ground over the No. 4 contacts of operated relay UD1. The HDU0 relay operated will arrange the circuits in conjunction with the operated key to cause the indication of the day 28, 30 or 31. With the HDU0 relay operated, the day tens being 0, a circuit is established from battery through the winding of relay LDY, the No. 2 front contact of relay HDU0 and to ground over the No. 4 contacts of the day tens relay TD0, and will cause the operation of the L28, L30 or L31 relay of Fig. 33 dependent upon which one of the keys LD28, LD30 or LD31 has been operated.

It will be assumed that the key LD28 has been operated. Upon the operation of said key and the operation of relay LDY a circuit is then established which may be traced from battery through the winding of relay L28, the contacts of key LD28, conductor 3317, the No. 3 contacts of relay LDY, conductor 3107, the No. 7 contacts of relay HDUA and to ground over the No. 3 contacts of day units relay UD1. The operation of relay HDUA has released relays NDUA and NDUB to open the circuits of the day units register relays DUA and DUD which have released, and the operation of relay HDU0 opens the circuit of the day tens register relays DTA and DTB which release. Now with relay L28 operated, obvious circuits are established for the day tens register relays DTB and DTD to register the day tens digit "2" and to indicate such registration by closing the circuit of lamp DT2. Obvious circuits are established for the day units register relays DUC and DUE to register the day units digit "8" and to indicate such registration by closing the circuit of lamp DU8.

Similarly, if relay L30 is operated, register relays DTD and DTE are operated to register and cause the indication of tens digit "3," while register relays DUA and DUB are operated to register and cause the indication of units digit "0." If relay L31 is operated, register relays DTD and

DTE are operated to register and cause the indication of the tens digit "3," while register relays DUA and DUD are operated to register and cause the indication of the units digit "1."

It is expected that there will be at least one "3AM" splice pattern with the end of tape entries included in the central office tape each day, so that the normal day entry will be registered in the TD– UD– relays as previously described in connection with the sensing of the end of tape day entry. When this regular day entry is recorded in the day circuits, the UDC relay of Fig. 31 operates as previously described, in turn causing the operation of relay DRC which locks under the control of relay ON2, and at its back contact opens the locking circuit of relay HDUA. Relay HDUA thereupon releases, in turn releasing relay HDUB. Relay NDUA thereupon operates as previously described in turn causing the operation of relay NDUB and the shunting down of relay DRC. The release of relay DRC will again prepare the locking circuit for relay HDUA to enable such relay to lock at the next midnight period.

Establishment of records of trouble condition

During the processing of a tape, entries may be encountered relating to five different types of trouble. An entry punched for the A, B, C and D digits "3854" will produce a record indicative of trouble encountered in connection with the charge relay in the district. An entry punched for the A, B, C, D digits "3855" will produce a record indicative of the trouble which necessitated a transfer to the emergency recorder at the originating office. An entry punched for the A, B, C, D digits "3856" will produce a record indicative of the fact that the master timing circuit was out of synchronism. An entry punched for the A, B, C and D digits "3857" will produce a record indicative of the fact that the master timing circuit was out of synchronism and that a transfer was made to the emergency recorder. An entry punched for the A, B and C digits "389" will produce a record indicating that the charge for the call should be canceled. On all trouble entries the remaining digits of the entry not used for identifying the particular type of trouble are punched for the digit "0."

The entry for the charging trouble in the district may occur on the tape between any disconnect time and answer time entry. As previously stated the punchings across the tape for that entry will be for the digits "385400." When this entry is sensed, reader relays A3, B1C, B2C, B1E, B2E, C1C, C2C, C1D, C2D, DB, DE, EA, EB, FA and FD are operated in the manner previously described and a check circuit is established upon the closure of the C9 reader contacts which extends as previously traced over contacts of the digit F and E reader relay groups to the No. 6 back contact of relay DA of Fig. 9, the No. 7 contacts of operated relay DB, the No. 2 back contact of relay DC, the No. 3 contacts of operated relay DD, the No. 1 back contact of relay DE, thence as traced to conductor 810, the No. 4 contacts of operated relay DE of Fig. 9, the No. 6 contacts of operated relay DB, conductor 904 of cable 900 and to battery through the winding of relay TC1 of Fig. 13. Relay TC1 operates and establishes an obvious circuit for relay TC2 which also operates and locks over its No. 3 contacts to ground supplied to conductor 1319 over the No. 10 contacts of relay RLT which will at the time be operated. As previously described, relay TC2 connects the trouble lead 1311 extending from the message ticketer, over its No. 4 contacts and conductor 4 of cable 1310 to the segment 4 of the ticketer distributor so that when, later, the ticketer is started to print the third character on the ticket for the particular call, a digit "4" will be printed for such character.

Relays TC1 and TC2 when both operated, establish a circuit from ground over their No. 1 contacts, conductor 1515 of cable 1500, conductor 624 and to battery through the windings of relays RS1 and RS2 of Fig. 4, and establish a circuit from ground over their No. 2 contacts and conductor 624 of cable 620, to battery through the winding of relay L2A of Fig. 6. As previously described, the operation of relays RS1, RS2 and L2A is effective to cause the advance of the reader. When the reader advances, the reader relays release, in turn releasing relay TC1 which, in turn, releases relays RS1, RS2 and LK1 followed by the release of relay L2A. Relay TC2, however, remains operated until after the last line of the line entry has been printed and relay RLT has released.

The entry for the trouble arising from the master timer circuit being out of synchronism will be placed on the tape following the end of tape district frame entry and as previously stated the punchings across the tape will be for the digits "385600." When this entry is sensed, reader relays A3, B1C, B2C, B1E, B2E, C1C, C2C, C1D, C2D, DA, DC, EA, EB, FA and FB are operated in the manner previously described and a check circuit is established upon the closure of the C9 reader contacts which extends as traced over contacts of the digit F and E reader relay groups to the No. 5 contacts of operated relay DA of Fig. 9, the No. 1 back contact of relay DB, the No. 3 contacts of operated relay DC, the No. 1 back contacts of relays DD and DE, thence as traced to conductor 810, the No. 4 contacts of operated relay DA, the No. 5 contacts of operated relay DC, conductor 905 of cable 900 and to battery through the winding of relay TOS1 of Fig. 13. Relay TOS1 operates and establishes an obvious circuit for relay TOS2 which also operates and locks over its No. 3 contacts and conductor 1319 to ground over the No. 10 contacts of relay RLT. As previously described, relay TOS2 connects the trouble lead 1311 extending from the message ticketer, over its No. 4 contacts and conductor 6 of cable 1310 to the segment 6 of the ticketer distributor so that when, later, the ticketer is started to print the third character on the ticket, a digit "6" will be printed for such character.

Relays TOS1 and TOS2, when both are operated, establish the previously traced circuits for relays RS1 and RS2 of Fig. 4 and relay L2A of Fig. 6, which operate to cause the advance of the reader. When the reader advances, the reader relays release, in turn releasing relay TOS1 which, in turn, releases relays RS1, RS2 and LK1 followed by the release of relay L2A. Relay TOS2, however, remains operated until after the last line of the line entry has been printed and relay RLT has released.

The entry "389000" is applied to the tape during the sorting operation when it becomes necessary due to some encountered difficulty to signify that the charge for a particular call should be omitted. When this entry is sensed, the reader relays A3, B1C, B2C, B1E, B2E, C1A, C2A, C1E, C2E, DA, DB, EA, EB, FA and FB are operated and a check circuit is established upon the closure

of the C9 reader contacts, which circuit extends as traced over contacts of the F and E reader relay groups, thence over the No. 5 contacts of operated relay DA of Fig. 9, the No. 2 contacts of operated relay DB, the No. 1 back contacts of relays DC, DD and DE, conductor 912, the No. 5 contacts of operated relay C2A of Fig. 8, the No. 1 back contact of relay C2B, the No. 2 back contacts of relays C2C and C2D, the No. 2 contacts of operated relay C2E, thence as traced to conductor 707, the No. 3 contacts of operated relay C2E of Fig. 8, the No. 1 contacts of operated relay C2A, conductor 907 of cable 900 and to battery through the winding of relay CAC1 of Fig. 13. Relay CAC1 operates and establishes an obvious circuit for relay CAC2 which also operates and locks over its No. 3 contacts to ground supplied to conductor 1319 over the No. 10 contacts of relay RLT. As previously described, relay CAC2 connects the trouble lead 1311 extending from the message ticketer over its No. 4 contacts to conductor 9 of cable 1310 and to the segment 9 of the ticketer distributor, so that when the ticketer is started to print the third character on the ticket for the particular call, a digit "9" will be printed for such character.

Relays CAC1 and CAC2, when both are operated, establish over their Nos. 1 and 2 contacts and conductors 1515 and 624 the previously traced circuits for relays RS1, RS2 and L2A which operate to cause the advance of the reader. When the reader advances, the reader relays release to in turn release relay CAC1, which in turn releases relays RS1, RS2 and LK1 followed by the release of relay L2A. Relay CAC2, however, remains operated until after the last line of the line entry has been printed and relay RLT has released.

The manner in which relays TE1 and TE2 are operated and function to control the message ticketer in response to sensing the trouble entry "385500," and the manner in which relays TEC1 and TEC2 are operated and function to control the message ticketer in response to sensing the trouble entry "385700" will be described in connection with straddle calls which may occur when a transfer has been made to the emergency recorder.

Operation for canceling an entry for which no ticket is to be printed

There may be occasions when it is desirable to omit the printing of tickets on certain calls. This is particularly true when a new office installation is being tested out prior to cut-over and a large number of test calls are being made to determine the ability of Central Office equipment to handle the traffic. To enable printing to be canceled, two groups of keys EN– and IN– are provided, the EN– set of keys being associated with the B digit reader relays of Fig. 7 and the IN– set being associated with the C digit reader relays of Fig. 8. If, for example, it should be considered desirable to omit the printing of a ticket for any call, the control entry digits for which are 31, 33, 34, 35 or 39, one of the EN– keys of Fig. 7 would be operated. Should it be desirable to omit the printing of a ticket for any call having a C digit 0 to 9, inclusive, one of the IN– keys of Fig. 8 would be operated. Of course it is obvious that more that one key in each set may be operated at the same time.

To illustrate the manner in which the ticket printing is canceled under the control of the keys, it will be assumed that the key EN1 of Fig. 7 is operated so that when any call entry having the control digits 31 is sensed, no ticket will be printed. On calls which are to be canceled, the disconnect and answer time entries will have already been sensed before the initial or call entry is encountered the latter entry determining whether or not a ticket is to be printed. When the circuits have been conditioned to sense the call entry and the sensing thereof indicates that no ticket is to be printed, it is necessary to release all register relays which have been locked up in order to prepare the circuits for processing the next call. It will be assumed that the record tape is perforated across the tape for the digits "312171" corresponding to the digits of the first line of a two line entry. When this line entry is sensed, reader relays A3, B1A, B2A, B1D, B2D, C1B, C2B, C1D, C2D, DA, DB, EB, EC, FA and FD are operated.

With reader relay A3 operated in response to sensing the record for the first control entry digit "3," the previously traced circuit for relay LK1 of Fig. 6 is established. Relay LK1 operates and locks under the joint control of relays RS2 and L2A, and establishes the previously traced circuit for relay LN2 which locks under the control of relay LK1 and indicates that the entry being sensed is the first line of a two line entry.

A circuit is now established upon the closure of reader cam contacts C9 which extends as previously traced over contacts of the F, D, C and B groups of reader relays to conductor 503, thence over the No. 4 contacts of operated relay B1D of Fig. 7, the No. 2 contacts of operated relay B1A, the alternate contacts of operated key EN1, conductor 908 of cable 900, the No. 9 back contact of relay STLA of Fig. 14, conductor 1516 of cable 1500 and to battery through the winding of cancel entry relay CE2 of Fig. 5. Relay CE2 operates and establishes a circuit for relay CE3, which may be traced from battery through the winding of relay CE3, over the No. 2 contacts of relay CE2 and conductors 628 and 3509 to ground over the No. 3 contacts of relay LK1. Relay CE3 thereupon operates and locks over its No. 5 contacts to ground on conductor 3509. With relay CE2 operated, a circuit is established from battery through the winding of relay RLS2 of Fig. 15, conductor 1518 of cable 1500, the No. 3 contacts of relay CE2, conductor 1517 of cable 1500, thence in parallel over the No. 1 back contacts of relays RCK2, RCK3 and RCK4 and to ground over the No. 2 contacts of relay GC. Relay RLS2 operates, locks over its No. 4 contacts to ground on conductor 1517 and establishes a circuit for relay RLS3 through the winding thereof and the No. 3 contacts of relay RLS2 to ground on conductor 1517. At its Nos. 1 and 2 back contacts, relay RLS3 opens the circuits of relays RAD and RDS of Fig. 14, and at its Nos. 1 and 2 back contacts relay RLS2 opens the circuits of relays RLA and RLT of Fig. 14. Relays RAD, RDS, RLA and RLT now release, in turn releasing the operated relays of the answer time registers of Figs. 19 to 24, inclusive, and the operated relays of the disconnect time registers of Figs. 25 to 30, inclusive, the latter in turn releasing the relays of the elapsed time computing circuits of Figs. 48 to 53 and the elapsed time register relays of Figs. 46 and 47.

Relay RLS2 also establishes a circuit for relays RS1 and RS2 of Fig. 4, which may be traced from ground over the No. 5 contacts of relay RLS2, conductor 1519 of cable 1500, the No. 1 contacts of relay CE2 of Fig. 5, the No. 3 contacts of relay

CE3, conductor 624 and to battery through the windings of relays RS1 and RS2. Relays RS1 and RS2 thereupon operate to advance the reader in the manner previously described. When the reader advances, reader relay A3 and the reader relays of Figs. 7, 8, 9 and 10 release, in turn releasing relay CE2 which, in turn, releases relays RS1 and RS2. Relay RS2, upon operating, opens one holding circuit for relay LK1, but since the second line of the entry has not been sensed and relay L2A has not operated, the second holding circuit for relay LK1 is not opened, thereby causing the latter relay to remain operated and hold relay CE3 operated. Relay CE2, upon releasing, opens the operating circuit of relay RLS2, but the latter relay remains locked until the check relays RCK2, RCK3 and RCK4 will have operated denote the release of the answer time, disconnect time and other operated register relays.

Since the CL– connector relays of Fig. 11 have not been operated, none of the line entry register relays of Figs. 40, 41 and 42 will have been operated. Consequently the check relay RCK1 will be operated. With relays RCK2, RCK3 and RCK4 operated, the locking circuit for relay RLS2 is opened and such relay releases, in turn releasing relay RLS3. The release of relays RLS2 and RLS3 reestablishes the circuits for relays RAD, RDS, RLA and RLT which now reoperate.

When relay RS2 operated to advance the reader, a circuit was established for the LK2 relay from ground over the C7 reader contacts, conductor 241, the No. 2 contacts of relay RS2, conductor 614 of cable 610, the No. 3 back contact of relay L2B, the No. 2 back contact of relay L4C, the No. 2 back contact of relay L4A, the No. 1 front contact of relay LK1, conductor 634, the No. 6 contacts of relay CE3 and to battery through the winding of relay LK2, which relay thereupon operates and locks under the joint control of relays LK1 and L2A as previously described.

In response to the sensing of the second line of the initial entry, reader relay A1 operates and a circuit is thereupon established from ground over the C2 reader contacts, conductor 253, the No. 4 contacts of relay A1, the No. 7 contacts of relay LK2, conductor 598, the No. 2 contacts of relay LN2 and to battery through the winding of relay L2A which operates and locks over its No. 2 contacts and the No. 3 contacts of relay LK1 and causes the operation of relay L2B. Relay A1 also establishes a circuit from ground over the No. 1 contacts of relay CE3, the No. 3 contacts of relay A1, the No. 4 contacts of relay LK2, the No. 5 back contact of relay A3, the No. 4 back contact of relay A2, the No. 4 back contact of relay MLE, the No. 4 contacts of relay CE3 and to battery through the winding of relay CE2. With relays CE2 and CE3 now both operated, a circuit is established from ground over the No. 2 contacts of operated relay RCK3 of Fig. 15, conductor 1519 of cable 1500, the No. 1 contacts of relay CE2, the No. 3 contacts of relay CE3, conductor 624 and to battery through the windings of relays RS1 and RS2. These relays now operate to cause the advance of the reader, whereupon relay A1 releases, in turn releasing relay CE2 which, in turn, releases relays RS1 and RS2. When relay RS2 operates, relays LK1 and LK2 are released since, with relay L2A operated, all holding circuits for these relays are opened. Relay LK1, upon releasing, also opens the holding circuits of relays L2A, LN2 and CE3 and such relays release, relay L2A in turn releasing relay L2B.

Relay RLS2, upon releasing, closes its No. 6 back contact to prepare the path previously traced over conductors 1502 and 1503 of cable 1500 for the establishment of the check circuit for the DSC– connector relays of Fig. 11 upon the subsequent operation of reader relay A2 when the reader senses the next entry on the tape, which entry should be the disconnect entry for another call. It will be noted that since the check circuit extends over the back contact of relay RLS2, the disconnect entry cannot be registered unless relay RLS2 has released.

If the initial entry was a four line entry for which the perforations across the tape were, for example "336171," and the key IN6 of Fig. 8 is operated to cancel the printing of such entry, then the cancel entry relay CE2 will be operated. For this entry, reader relays A3, B1D, B2D, B1E, B2E, C1A, C2A, C1C, C2C, DA, DD, EB, EC, FA and FD will be operated, and the circuit of relay CE2 will therefore be established upon the closure of reader cam contacts C9, extending as previously traced over contacts of the F, D, C and B groups of reader relays to conductor 903, thence over the No. 5 contacts of operated relay B1D of Fig. 7, the No. 5 contacts of operated relay B1E, the normal contacts of key EN3, conductor 706, the No. 5 contacts of operated relay C1A of Fig. 8, the No. 1 back contact of relay C1B, the No. 3 contacts of operated relay C1C, the No. 1 back contact of relays C1D and C1E, the No. 4 contacts of relay C1A, the No. 5 contacts of relay C1C, the alternate contacts of operated key IN6, conductor 908 and thence as previously traced to battery through the winding of relay CE2 of Fig. 5.

Reader relay A3, upon operating, also establishes the previously traced circuit for relay LK1 of Fig. 6, which operates, locks and establishes the previously traced circuit for relay LN4 which locks under the control of relay LK1, indicating thereby that the initial line entry being sensed is the first line of a four line entry.

Relay CE2, upon operating, establishes the previously traced circuit for relay CE3 which operates and locks. With relays CE2 and CE3 both operated, the previously traced circuit for relay RLS2 of Fig. 15 is established and such relay operates, locks under the control of the RCK2, RCK3 and RCK4 relays and establishes the circuit of relay RLS3 which operates. With relays RLS2 and RLS3 both operated, relays RAD, RDS, RLA, and RLT of Fig. 14 release, in turn releasing the operated register relays of Figs. 19 to 53, inclusive. Relay RLS2 also establishes the circuit for relays RS1 and RS2 of Fig. 4, which thereupon operate to advance the reader. When the reader advances, the operated reader relays of Figs. 7, 8, 9 and 10 release, in turn releasing relay CE2 which, in turn, releases relays RS1 and RS2. Relay RS2, upon operating, opens one holding circuit for relay LK1 but since relay L2A has not been operated, relay LK1 remains locked, holding relay CE3 operated. Relay CE2 opens the operating circuit of relay RLS2 but such relay remains operated until the check relays RCK2, RCK3 and RCK4 have operated denoting the release of all operated register relays.

When relay RS2 operates to advance the reader, the previously traced circuit for relay LK2 is established. Relay LK2 operates and locks under the joint control of relays LK1 and L2A. In response to the sensing of the second line of the initial entry, reader relay A1 operates

and a circuit is established from ground over the C2 reader contacts, conductor 253, the No. 4 contacts of relay A1, the No. 7 contacts of relay LK2, conductor 509, the No. 2 back contact of relay LN2, the No. 2 contacts of operated relay LN4, the No. 1 back contact of relay L4D, the No. 1 back contact of relay L4B and to battery through the winding of counting relay L4A. Relay L4A then operates and locks under the control of relays L4C and LK1 to indicate that the first line of the initial four line entry has been sensed. Relay A1 also establishes the previously traced circuit for relay CE2 which operates. With relay CE3 and relay RCK3 operated, it establishes the previously traced circuit for relays RS1 and RS2 of Fig. 4. These relays now operate to advance the reader, whereupon relay A1 and the other operated reader relays release. Relay A1, upon releasing, releases relay CE2 which, in turn, releases relays RS1 and RS2. When relay RS2 operated, it established a circuit from ground over the C7 cam contacts of the reader, conductor 241, the No. 2 contacts of relay RS2, conductor 614 of cable 610, the No. 3 back contact of relay L2B, the No. 2 back contact of relay L4C, the No. 2 front contact of relay L4A and to battery through the winding of counting relay L4B, which operates and locks under the joint control of relays L4D and LK1 to indicate that the second line of the initial entry has been sensed and that the reader has been advanced.

With the reader advance, reader relay A1 reoperates together with other reader relays in response to the sensing of the third line of the initial entry. Relay A1, upon operating, establishes a circuit from ground over the C2 reader contacts, conductor 253, the No. 4 contacts of relay A1, the No. 7 contacts of relay LK2, conductor 509, the No. 2 back contact of relay LN2, the No. 2 contacts of relay LN4, the No. 1 back contact of relay L4D, the No. 1 front contact of relay L4B and to battery through the winding of counting relay L4C. Relay L4C then operates, locks under the control of relay LK1 and causes the release of relay L4A. The operation of relay L4C is indicative of the fact that the third line of the entry has been sensed. Relay A1 also causes the reoperation of relay CE2 which, with relay CE3 and relay RCK3 operated, establishes the circuit of relays RS1 and RS2. These relays now operate to advance the reader, whereupon relay A1 and the other operated reader relays release. Relay A1, upon releasing, releases relay CE2 which, in turn, releases relays RS1 and RS2. When relay RS2 operated, it established a circuit from ground over the C7 cam contacts of the reader, conductor 241, the No. 2 contacts of relay RS2, conductor 614 of cable 610, the No. 3 back contact of relay L2B, the No. 2 front contact of relay L4C and to battery through the winding of relay L4D. Relay L4D now operates, locking under the control of relay LK1 and releases relay L4B. The operation of counting relay L4D is indicative of the fact that the third line of the initial entry has been sensed and that the reader has been advanced.

With the reader advanced, reader relay A1 reoperates together with other reader relays in response to the sensing of the fourth line of the initial entry. Relay A1, upon operating, establishes a circuit from ground over the C2 reader contacts, conductor 253, the No. 4 contacts of relay A1, the No. 7 contacts of relay LK2, conductor 509, the No. 2 back contact of relay LN2, the No. 2 contacts of relay LN4, the No. 1 front contact of relay L4D and to battery through the winding of relay L2A which relay operates and locks under the control of relay LK1. Relay A1 also closes the circuit for relay CE2 which reoperates and, with relay CE3 and relay RCK3 operated, establishes the circuit of relays RS1 and RS2. These relays now operate to advance the reader, whereupon relay A1 and the other operated reader relays release. Relay A1, upon releasing, releases relay CE2 which, in turn, releases relays RS1 and RS2. When relay RS2 operates, relays LK1 and LK2 release since, with relay L2A now operated, the locking circuits for these relays are all opened. Relay LK1, upon releasing, also opens the locking circuits of relays L2A, LN4, L4C, L4D and CE3 and such relays release, relay L2A in turn releasing relay L2B.

Operation of the display key to show the progress of operations

The operation of display key DSP of Fig. 5 is effective to establish the circuits of relays DSA and DSB. With relay DSA operated, lamp TCK will be lighted over the No. 1 contacts of said relay and conductor 1706 of cable 1700, to ground over the No. 2 contacts of relay PS of Fig. 17 to indicate when the PS relay is operated to initiate the operation of the message ticketer. Over its Nos. 2, 3 and 4 contacts, relay DSA establishes circuits for lamps CL, ANS and DISC, which circuits extend, respectively, over conductors 1520 and 1521 of cable 1500 and conductor 513 to ground over the operating circuit of relay CLR of Fig. 13, to ground over the No. 2 contacts of relay ANR of Fig. 13 and to ground over the No. 2 contacts of relay DIS of Fig. 34 respectively, to indicate when, respectively, the call line, answer time and disconnect time entries have been registered. Over its No. 5 contacts, relay DSA establishes the circuit for lamp LK2 which is completed over the No. 6 contacts of relay LK2 of Fig. 5 to ground when such relay operates following the sensing of the first line of an initial entry. Lamps LCL, LC3, LC2, LN4 and LN2 are lighted over circuits extending over the Nos. 6, 7, 8, 10 and 11 contacts of relay DSA and the conductors of cable 520 to ground over contacts of or to the operating grounds of relays L2B, L4C, L4A, LN4 and LN2 of Fig. 6, respectively, when such relays operate to indicate whether the initial entry being sensed is a two or four line entry, and to indicate the progress of sensing the several lines of the entry. Relay DSA, over its No. 9 contacts and conductor 631, establishes a circuit for lamp LC1 which lights whenever the LK1 relay of Fig. 6 is operated. Also, relay DSA establishes a circuit over its No. 12 contacts and conductor 512, which becomes completed over the contacts of relay CR1A of Fig. 47 to battery through lamp CR1 when relay CR1A operates to indicate that the check circuit over contacts of the relays of the elapsed time computer has been successively closed and the elapsed time has been computed and registered.

With relay DSB operated, a shunt of resistance 632 in the holding circuit of either relay LN2 or LN4 of Fig. 6 is established over conductors 514 and 515 and the No. 1 contacts of relay DSB, to increase the holding current flowing in the holding circuit of such operated relay, so that such relay will not release when the lamp LN2 or lamp LN4 is lighted in parallel with the relay winding. Over its No. 2 contacts and conductors

516 and 517, relay DSB establishes a shunt around resistance 638 in the holding circuit of either relay L4A or L4C to increase the holding current flowing in the holding circuit of the operated one of these relays so that such relay will not release when the lamp LD2 or LD3 is lighted in parallel with the relay winding. Also over its No. 3 contacts and conductors 518 and 519, relay DSB establishes a shunt around resistance 635, connected into the holding circuit of relay LK1 to increase the holding current flowing through the holding circuit of such relay so that it will not release when the lamp LK1 is lighted in a circuit established in parallel with the winding of relay LK1.

Disconnect entry due to timing out of the district

To care for the local office condition where the disconnect entry is recorded on the tape being processed at the accounting office due to the district timing out with the calling subscriber's receiver off the switchhook and the called subscriber not connected, the message ticketer circuits are arranged to print a special entry as the second character on the ticket to indicate this condition. When a district release occurs, three holes are punched in the tape in the *aa*, *ab* and *ac* punch positions for the A digit, and when therefore the reader of the message ticketer control circuit senses this entry, the reader relays A1, A2 and A3 will all be operated. It will also be assumed that the B, C, D, E and F digits are "19371" and that in sensing the disconnect entry, reader relays B1A, B2A, B1D, B2D, C1A, C2A, C1E, C2E, DD, DE, EB, EC, FA and FD are operated.

With these reader relays operated, a check circuit is closed upon the closure of cam contacts C9 of the reader, over conductor 242 of cable 240, the No. 3 contacts of relay TD, the No. 5 contacts of relay AL, conductor 441, thence as previously traced over contacts of relays of the B, C, D, E and F reader groups to conductor 1501 of cable 1500, the No. 1 contacts of operated reader relay A1, the No. 1 back contact of relay LK2, the No. 2 contacts of operated reader relay A3, the No. 2 contacts of operated reader relay A2, conductor 1502 of cable 1500, the No. 6 back contacts of relay RLS2 of Fig. 15, conductor 1503 of cable 1500, the No. 2 back contact of relay ESB of Fig. 5, conductor 621 of cable 620, and in parallel through the windings of connector relays DSC1 to DSC5, inclusive, of Fig. 10. These connector relays operate and function as previously described to cause the selective operation of relays of the disconnect time registers of Figs. 25 to 30, inclusive.

A further circuit for relay TRD of Fig. 13 is established from ground over the No. 5 contacts of relay A1, the No. 6 contacts of relay A3, the No. 5 contacts of relay A2, conductor 630 of cable 620, the No. 7 contacts of connector relay DSC3 of Fig. 10, conductor 1324 and to battery through the winding of relay TRD of Fig. 13. Relay TRD thereupon operates and locks over its No. 2 contacts and conductor 1319 to ground over the No. 10 contacts of relay RLT. Over its No. 3 contacts it prepares the previously traced circuit whereby a digit "1" or "6" is printed on the ticket as the second character, dependent upon whether or not the call is a straddle call. The manner in which this character is printed has been previously described.

Don't answer or busy line calls

In the previous discussion it was assumed that the calls were completed, that the CLR, ANR and DSR relays of Fig. 13 were all operated and that the message ticketer was, therefore, controlled to print tickets for completed calls. It will now be assumed that a calling line entry is sensed and that as a result of the operation of reader relays of Figs. 7, 8, 9 and 10 the previously traced circuit for the CL1, CL2 and CL3 connector relays of Fig. 11 was established. At the time the calling line entry is sensed, no answer and disconnect entries for such calls will have been sensed and, therefore, relays ANR and DSR of Fig. 13 will not have been operated. When, therefore, the circuit for the CL1, CL2 and CL3 connector relays is established, a branch of such circuit is extended from conductor 627, over the No. 5 back contact of unoperated relay DSR of Fig. 13, conductor 1300, the No. 1 back contact of relay DAB of Fig. 16 and over conductor 1600 to battery through the windings of connector relays CL4 and CL5 of Fig. 11. Thus connector relays CL4 and CL5 are also operated. The connector relays CL1, CL2 and CL3, as before described, are effective to cause the setting of the line entry registers of Figs. 40, 41 and 42 under the control of the operated reader relays.

Relay CL4, upon operating, extends the conductors of cables 3300 and 3310 extending from the "Day tens" and "Day units" registers of Fig. 33 of the day circuits, to conductors of cables 4310 and 4320 extending to the "Line entry day tens" and "Line entry day units" registers of Fig. 43, whereby the relays of such registers are operated to register the tens and units digits of the day when the call being sensed was made. It will be assumed that the day was "11" and that therefore, with the DTA and DTD relays of Fig. 33 operated for the day tens digit "1," circuits are established over conductors 3301 and 3304 of cable 3300, over the Nos. 1 and 4 contacts of relay CL4 and conductors 4311 and 4314 of cable 4310 to battery through the windings of relays A and D of the "Line entry day tens" register of Fig. 43. These relays therefore operate and lock over their inner upper contacts and conductor 4331 of cable 4330 to ground over the No. 1 contacts of relay RLCB of Fig. 14. With register relays DUA and DUD of Fig. 33 operated to register the day units digit "1," circuits are established over conductors 3311 and 3314 of cable 3310, over the Nos. 5 and 8 contacts of relay CL4 and conductors 4321 and 4324 of cable 4320 to battery through the windings of relays A and D of the "Line entry day units" register of Fig. 43. These relays thereupon operate and lock over their inner upper contacts and conductor 4332 of cable 4330 to ground over the No. 2 contacts of relay RLCB of Fig. 14.

Relay CL5, upon operating, extends the conductors of cables 3400 and 3500 extending from the "Hour units" and "Hour tens" registers of Figs. 34 and 35 of the hour circuits, to conductors of cables 4410 and 4420 extending to the "Line entry hour tens" and "Line entry hour units" registers of Fig. 44, whereby the relays of such registers are operated to register the tens and units digits of the hour when the call being sensed was made. It will be assumed that the hour was "03" and that therefore with the HTA and HTB relays of Fig. 35 operated for the hour tens digit "0," circuits are established over conductors 3501 and 3502 of the cable 3500, the Nos. 1 and 2 contacts of connector relay CL5 and conductors 4411 and 4412 of cable 4410 to battery through the windings of relays A and B of the "Line entry hour tens" register of Fig. 44. These relays there-

upon operate and lock over their inner upper contacts and conductor **4333** of cable **4330** to ground over the No. 3 contacts of relay RLCB of Fig. 14. With register relays HUD and HUE of Fig. 34 operated to register the hour units digit "3," circuits are established over conductors **3404** and **3405** of cable **3400**, the Nos. 7 and 8 contacts of connector relay CL5 and conductors **4424** and **4425** of cable **4420** to battery through the windings of relays D and E of the "Line entry hour units" register of Fig. 44. These relays therefore operate and lock over their inner upper contacts and conductor **4334** of cable **4330** to ground over the No. 4 contacts of relay RLCB of Fig. 14.

When the line entry registers have all been set, a check circuit is established from ground at the No. 1 back contact of relay E of the "Line entry B digit" register of Fig. 40, thence as previously traced over contacts of relays of the line entry B, C, D, E and F digit registers of Figs. 40, 41 and 42 to conductor **4216**, thence over the No. 1 back contact of relay E of the "Line entry day tens" register of Fig. 43, the No. 3 contacts of operated relay D of such register, the No. 2 back contacts of relays C and B of such register, the No. 7 contacts of operated relay A of such register, the No. 1 back contact of relay E of the "Line entry day units" register of Fig. 43, the No. 3 contacts of operated relay D of such register, the No. 2 back contacts of relays C and B of such register, the No. 7 contacts of operated relay A of such register, conductor **4301**, the No. 1 back contacts of relays E, D and C of the "Line entry hour tens" register of Fig. 44, the No. 3 contacts of operated relay B of such register, the No. 7 contacts of operated relay A of such register, the No. 2 contacts of operated relay E of the "Line entry hour units" register of Fig. 44, the No. 9 contacts of operated relay D of such register, the lowermost back contacts of relays C, B and A of such register, conductor **4401**, conductor **1301**, the No. 2 back contact of relay PR of Fig. 15 and conductor **1302** to battery through the winding of relay CLR of Fig. 13. The operation of relay CLR is indicative of the fact that two relays only of each of the line entry registers, including the day tens, day units, hour tens and hour units registers have been operated.

When such relay CLR operates (with relays ANR and DSR unoperated) a circuit is established from battery through the winding of relay CL of Fig. 15, conductor **1548**, the No. 10 back contact of relay DSR, the No. 3 back contact of relay ANR, the No. 5 contacts of operated relay CLR, conductor **1511** of cable **1500**, the No. 1 contacts of reader relay A3, conductor **1701** and to ground over the normal contacts of relay PS of Fig. 17. Relay CL, upon operating, locks over its No. 2 contacts, the No. 1 back contact of relay PR and conductor **1740** to ground over the No. 1 contacts of relay PS. At its No. 1 contacts it establishes a circuit from ground thereover, over conductor **1549** and to battery through the windings of connector relays P3 and P4 of Fig. 18. Relays P3 and P4 thereupon operate, relay P3 establishing over its No. 11 contacts and conductor **1615** the circuit of relay DAB which operates, and relay P4 establishing over its No. 12 contacts the previously traced circuit for relay PS of Fig. 17 to initiate the operation of the message ticketer.

Relay DAB, upon operating, opens the previously traced circuit for the CL4 and CL5 connector relays which thereupon release. Over its lower contacts it prepares a check circuit for checking the released condition of the line entry relays when they are subsequently released following the printing of the data of the first line of the calling line entry registered upon the relays of Figs. 40 to 44, inclusive.

Under the control of connector relay P3 the message ticketer proceeds to print on the ticket all of the first nine characters including all the data secured in sensing the first line of the calling line entry, after which the printer control switch PC of Fig. 17 advances into terminal position eleven. The line entry register relays of Figs. 40, 41 and 42 are now released in the manner previously described through the operation of relay RLS1 of Fig. 1 which, at its No. 1 back contact, opens the previously traced circuit for relay RCLA of Fig. 14 which then releases. At its contacts it removes ground from the locking circuits of the operated relays of the line entry registers of Figs. 40, 41 and 42. When the operated relays of such registers release, relay CLR of Fig. 13 also releases. It is to be noted that the circuit of relay RLCB, which relay supplies locking ground to the day and hour register relays of Figs. 43 and 44, extends as traced over the No. 6 back contact of relay RL, conductor **1533** and directly to ground over the No. 3 contacts of relay GC, so that the register relays of Figs. 43 and 44 are maintained operated until relay RL is operated, as will be subsequently described. Relay RLS1, upon operating, also establishes the previously traced circuit for relay LSA which operates, locks under the control of relays PPA and PPE and causes the reoperation of the connector relays TA, TB and TC of Fig. 3, all as previously described.

When the line entry register relays of Figs. 40, 41, and 42 have released, in turn releasing relay CLR, a circuit is established from battery through the winding of relay RCK1, over the No. 6 contacts of relay GC, conductor **1550**, the No. 5 contacts of relay RLCB of Fig. 14, conductor **1551**, the lower contacts of operated relay DAB, conductor **1615**, conductor **4300** and thence as previously traced over back contacts of relays of the line entry F, E, D, C and B digit registers to ground. Relay RCK1 thereupon operates to indicate that the operated register relays have been released, and opens the locking circuit of relay RLS1 which releases to permit the reoperation of relay RCLA of Fig. 14 and to cause the operation of relay LSB. The synchronizing relays now function in the manner previously described to advance the reader for sensing the second line of the calling line entry. When the second or subsequent lines of the calling line entry are sensed with relay DAB operated, only connector relays CL1, CL2, and CL3 will be operated, since the day and hour registers of Figs. 43 and 44 have been operated and will remain operated until relay PR becomes operated following the printing of the entire call data on the ticket and causes the operation of relay RL of Fig. 14 to release relay RLCB and in turn the operated day and hour register relays.

In the meantime through the operation of relay LSA, the message ticketer has been controlled to print the next three characters on the ticket after which the printer control switch PC will be advanced to terminal position fourteen, there to await the sensing of the second line of the initial or call entry and the reoperation of the line entry registers of Figs. 40, 41 and 42.

The functioning of the circuit now proceeds in the manner previously described and the 13th to 17th characters are printed on the ticket in

terminal positions fourteen to eighteen, inclusive, of the printer control switch PC under the control of connector relay P3. In terminal position nineteen of the printer control switch a dash is printed on the ticket, whereafter switch PC advances into terminal position twenty. In terminal positions twenty, twenty-one, twenty-two and twenty-three of switch PC, circuits are established over the Nos. 1, 2, 3 and 4 contacts of relay P4, conductors 4431 to 4434 of cable 4430 and contacts of relays of the day and hour registers of Figs. 43 and 44 to conductors extending to segments of the ticketer distributor in a manner similar to that previously described in connection with a completed call. Digits for the day "11" and hour "03" are thereby printed on the ticket.

Following the printing of the day and hour digits the printer control switch PC is advanced into terminal position twenty-four, in which a circuit is established from ground over the No. 1 normal contacts of relay PM, the brush and No. 24 terminal of switch arc PC4, conductor 1732, the No. 5 contacts of relay P4, conductor 1753, the No. 1 back contact of relay STLB, the No. 1 contacts of relay BLK if operated for a two-line entry call or the No. 2 contacts of relay DTL if operated for a four-line entry call, conductor 1741, the No. 7 contacts of relay LSA and conductor 1715, to the dash segment of the ticketer distributor, whereupon a dash is printed on the ticket and the control switch PC is advanced to the twenty-fifth terminal position. In a similar manner, dashes are printed in the twenty-fifth and twenty-sixth terminal positions of control switch PC, ground being applied to the dash segment of the ticketer distributor over the Nos. 6 and 7 contacts of relay P4. Thus dashes are printed on the ticket in lieu of the tens, units and tenths minute digits of the time when the call was made. Following the printing of these dashes the printer control switch will advance into its twenty-sixth terminal position. In this terminal position a dash is printed as previously described for a completed call and the printer control switch PC is advanced to its twenty-eighth terminal position.

In terminal position twenty-eight the cut magnet is operated as previously described and the printer control switch PC is advanced to its twenty-ninth terminal position. In this terminal position and the two following positions thirty and thirty-one, the ticketer is controlled over the Nos. 8, 9 and 10 contacts of relay P4 to print dashes on the ticket in lieu of the tens, units and tenths minute digits of the elapsed time. From this point the circuits function in the manner previously described to print the remaining data on the ticket, dependent upon whether the call was a two-line or four-line initial entry call. Dashes printed on the ticket in lieu of the minutes of the time when the call was made and in lieu of the minutes of the elapsed time are indicative of the fact that the call was a "don't answer" or a "busy" line call.

Disconnect entry not entered on the central office tape

To care for cases when the disconnect entry was not put on the tape, the ND relay of Fig. 15 is provided. It will now be assumed that the answer entry has been sensed and that, as a result of the operation of the reader relays of Figs. 7, 8, 9 and 10, the relays of the disconnect time registers of Figs. 25 to 30 have been operated to register the answer time therein, resulting in the operation of relay DSR of Fig. 13 and the advance of the reader for sensing the next entry on the tape, which should be the first line entry of either a two or four line initial entry for the same call. When the first line of this entry is sensed and the reader relays of Figs. 7, 8, 9 and 10 are operated, the CL1, CL2 and CL3 connector relays of Fig. 11 will be operated, but relays CL4 and CL5 will not be operated, to cause the operation of the line entry registers of Figs. 40, 41 and 42 and the consequent operation of relay CLR of Fig. 13. A circuit is therefore established for the relay ND which may be traced from battery through its winding, over the No. 2 contacts of relay RCK2 which will be operated since the answer time register relays of Figs. 19 to 24 have not been operated, conductor 1552, the No. 9 contacts of operated relay DSR of Fig. 13, the No. 3 back contacts of relay ANR, the No. 5 contacts of relay CLR, conductor 1511, the No. 1 contacts of operated reader relay A3 of Fig. 5, conductor 1701 and to ground over the No. 1 normal contacts of relay PS of Fig. 17. Relay ND thereupon operates, locks over its No. 2 contacts, the No. 1 back contact of relay PR and conductor 1740 under the control of relay PS. As soon as relay PS operates, a circuit is established from ground over its No. 1 contacts and conductor 1553 to battery through the windings of connector relays P5 and P6 of Fig. 18 and, at its back contact, opens the circuit which controls the advance of the reader.

Under the control of connector relay P5 the message ticketer proceeds to print on the ticket all of the first eighteen characters, after which the printer control switch PC advances to its twentieth terminal position. In terminal positions twenty, twenty-one, twenty-two and twenty-three of switch PC, circuits are established over the Nos. 1, 2, 3 and 4 contacts of connector relay P6, conductors 2511 to 2514 of cable 2510 and contacts of the day and hour disconnect time registers of Figs. 26 and 25 to conductors extending to segments of the ticketer distributor of Fig. 45 in a manner similar to that previously described in connection with a completed call.

Following the printing of the day and hour digits the printer control switch PC is advanced into terminal position twenty-four. In this position and in the subsequent positions twenty-five and twenty-six, circuits are established over the Nos. 5, 6 and 7 contacts of relay P6, conductors 2821, 2822 and 2823 of cable 2820 and contacts of the minute tens, units and tenths disconnect time registers of Figs. 28, 29 and 30, to conductors extending to segments of the ticketer distributor of Fig. 45 in a manner similar to that described in connection with a completed call. Following the printing of the minutes digits the printer control switch will be advanced into terminal position twenty-seven, in which position a dash will be printed on the ticket. The printer control switch PC then advances to terminal position twenty-eight, in which position the ticket tape is cut. The control switch then advances to terminal position twenty-nine. In terminal positions twenty-nine, thirty and thirty-one the ticketer is controlled over the Nos. 8, 9 and 10 contacts of relay P6 to print dashes on the ticket in lieu of the tens, units and tenths minute digits of the elapsed time since, with no recorded disconnect time, there has been no computation of the elapsed time. From this point the circuits function in the manner previously described to print the remaining data on the ticket, dependent upon whether the call was a two-line or four-line initial entry call. Dashes printed on the ticket

in lieu of the minutes of the elapsed time indicate that no charge should be made for the call.

Straddle calls

When the tape at the central office is cut, for example, just after three o'clock in the morning, a time when traffic through the office would ordinarily be lightest, there may be calls in progress over several district trunks. Therefore, the call entries for the calls in progress will straddle the two tapes. When these tapes are processed in the accounting center, the call elements of these straddle calls will be found on both ends of the tapes. When these calls are encountered by the message ticketer circuits, the elements of these straddle calls will be found at the beginning and the end of the tape record for each district. In the message ticketer circuits these straddle call elements will be printed as separate tickets. The circuits under consideration have provision for indicating as the second character printed on the ticket that the call is a straddle call. These straddle calls may involve several combinations of call elements (*a*) a disconnect entry alone; (*b*) both a disconnect and an answer entry; (*c*) both an answer and a calling line entry; (*d*) a calling line entry alone. The CL, DIS, AD and ND relays of Fig. 15 are operated in connection with these straddle calls. These relays cause the proper connector relays of Fig. 18 and Fig. 45 to be operated to set the message ticketer for printing the ticket in connection with the particular type of straddle call encountered. Some of the typical straddle calls are illustrated by the diagrammatic disclosure of a tape in Fig. 55.

It will be assumed that when processing the calls for a particular district the reader senses the end-of-tape entries on the tape and encounters a changed district frame number indicative of calls from a different recorder. If this district frame number is, for example, to be changed to "15," then when the reader relays are operated as previously described, circuits will be established through the upper windings of the TF1 and UF5 relays of Fig. 38 in the manner previously described. Relay TF1, having been previously operated, the reclosure of the operating circuit through its upper winding is without effect. However, when relay UF5 operates, it opens at its No. 2 back contact the previously traced locking circuit for relay UF4 which thereupon releases, and closes at its No. 2 front contact a locking circuit for itself which may be traced from battery through resistor 3807, over the No. 2 back contacts of relays UF9 . . . UF6, the No. 2 front contact, lower winding and No. 3 front contact of relay UF5, the No. 3 back contacts of relays UF4 . . . UF0 and conductor 3806 to ground over the No. 1 contacts of relay ON3 of Fig. 40. At the time the TF1 and UF5 relays operated, relays TFC and UFC also operated as previously described to advance the reader.

The circuit paths between the TF– and FT– relays of Figs. 38 and 39 and the UF– and FU– relays are arranged so that when a new district frame number is recorded on the TF– and UF– relays of Fig. 38, and the TF– and UF– relays previously operated are released, the check circuit over which the SW relay of Fig. 40 was operated is opened and such relay then releases. It will be recalled that the circuit for relay SW was previously traced from battery through the winding of such relay, the No. 3 contacts of relay OFN, the No. 5 contacts of relay LK, conductor 4006, the No. 2 back contacts of relays FU9 . . . FU5 to conductor 3902, and is now open at the No. 4 contacts of relay UF4 of Fig. 38, which relay has now released and relay SW will therefore release. A circuit is then established from ground over the No. 3 back contact of relay CG, the No. 3 back contact of relay SW, the No. 3 contacts of relay L0, conductor 4021 of cable 4020, the No. 1 back contact of relay WOR of Fig. 13 and conductor 1306 to battery through the winding of relay STLA of Fig. 14. Relay STLA thereupon operates and locks over its No. 5 contacts, the normal contacts of relay STLR, conductor 1408, the No. 1 back contact of relay CC and to ground over the No. 9 contacts of relay GC. The operation of relay STLA at this time indicates that a new district frame number has been recorded on the TF– and UF– relays of Fig. 38 and that there may be straddle calls to be processed. Relay STLA also establishes a circuit from ground over its No. 6 contacts and conductor 1410, through the winding of relay STLB of Fig. 17. Relay STLB, in turn, establishes a circuit from ground over its No. 3 contacts, conductor 1754, the No. 11 contacts of relay P10, conductor 651 and through the winding of relay BLK of Fig. 17 to battery, whereupon relay BLK operates.

The circuits of Figs. 38 and 39 are so arranged that the new district frame number will be recorded on the TF– and UF– relays while the previous district frame number will still be recorded by the FT– and FU– relays of Fig. 39. This arrangement is required, as will be described later since it is necessary that the circuits be in a position to print a straddle call ticket with the previous district frame number and then permit the circuits to progress and print another straddle call ticket with the new frame number.

Straddle call-disconnect time entry only

It will now be assumed that just before sensing the end-of-tape entries a disconnect time entry has been sensed. The end-of-tape entries on the adjoined ends of the two tapes are sensed in the manner previously described and, in sensing the second district frame number entry, the STLA relay is operated as just described. Under this condition the operation of the STLA relay would indicate that the disconnect time call element should be printed as a part of a straddle call. Although the new district frame entry is encountered in the second end-of-tape entry the circuits will progress through the sensing and recording of the hour and day entries before any action is taken. However, when the reader senses the month entry of the second group of end-of-tape entries, the A3 reader relay of Fig. 5 will be operated and a check circuit will be established as previously traced over contacts of the operated reader relays of Figs. 7, 8, 9 and 10, operated for the digits of the month entry, to conductor 902 of cable 900, thence over the No. 2 front contact of relay STLA, conductor 1409, the No. 6 back contact of relay CLR, the No. 1 back contact of relay ANR, the No. 3 contacts of relay DSR, which has operated following the sensing of the disconnect entry, conductor 1319 and to battery through the winding of relay DIS of Fig. 15. Relay DIS thereupon operates and locks over its No. 2 contacts, the No. 1 back contact of relay PR, conductor 1740 and to ground over the No. 1 alternate contacts of relay PS of Fig. 17 as soon as relay PS operates. Relay DIS opens at its No. 2 normal contacts the circuit previously traced from the C9 cam contacts of

the reader to the contacts of the A- reader relays of Fig. 5, to stop the progress of the reader and to establish a circuit from ground over its No. 1 contacts, conductor 1554 and through the windings of connector relays P9 and P10 of Fig. 45.

Relay P10, over its No. 12 contacts and conductors 1702 and 1806, establishes the previously traced circuit for relay PS of Fig. 17, which operates to initiate the printing of a ticket. In terminal position two of the printer control switch PC an asterisk is printed on the ticket in the manner previously described, after which the control switch PC advances to terminal position three. With relay STLB operated, indicative of a straddle call, the message ticketer is controlled to print the digit "5" as the second character on the ticket. The printer control switch PC then progresses into terminal position four, in which position a digit is printed on the ticket indicative of the trouble or no-trouble condition, after which the printer control switch advances to terminal position five. With relay P9 operated, a circuit is now established from ground over the No. 1 normal contacts of relay PM, the brush and No. 5 terminal of switch arc PC1, conductor 1712, the No. 6 contacts of connector relay P9 and conductor 1709 to the asterisk segment of the ticketer distributor, whereby the message ticketer is controlled to print an asterisk on the ticket. As the printer control switch PC advances through terminal positions six and seven, circuits are established over the Nos. 5 and 4 contacts of relay P9 whereby the message ticketer is controlled to print two other asterisks on the ticket, after which the control switch is advanced into terminal position eight. Thus three asterisks are printed on the ticket as the fourth, fifth and sixth characters in place of the type, index and party entries. In terminal position eight the ticketer is controlled in the manner previously described to print a dash on the ticket, following which the printer control switch is advanced into terminal position nine.

In terminal positions nine and ten, circuits are extended over conductors 1716 and 1717, the Nos. 2 and 3 contacts of relay P9, conductors 4511 and 4512 of cable 4510, over contacts of relays of the "District tens disconnect time" and "District units disconnect time" registers of Fig. 27 to conductors extending to segments of the ticketer distributor whereby the ticketer is controlled to print on the ticket the tens and units digits of the district involved in the connection. When the printer control switch PC reaches terminal position eleven, the disconnect time register relays are released as previously described and, with relay LSA operated, a circuit is established from ground over the normal No. 1 contacts of relay PM, the brush and No. 11 terminal of switch arc PC1, conductor 1721, the No. 1 contacts of relay P9, conductor 1811 of cable 1810 and thence over the No. 6 contacts of relay FT1 of Fig. 39, assumed to be operated, and conductor 1 to segment 1 of the ticketer distributor, whereupon the ticketer is controlled to print the tens digit "1" of the district frame number on the ticket and the printer control switch is advanced into terminal position twelve.

In terminal position twelve, the circuit previously traced over conductor 1812 of cable 1810 and the No. 6 contacts of operated relay FU4 of Fig. 39 to the segment 4 of the ticketer distributor is established to cause the message ticketer to print the units digit "4" of the district frame number on the ticket and the printer control switch is then advanced into terminal position thirteen. It will be noted that the district frame number "14" is the number of the frame registered when the district frame number entry on the first end of the tape was sensed, that is, when processing of the tape was started. With the control switch in terminal position thirteen, a dash is printed on the ticket in the manner previously described.

Following the printing of a dash as the twelfth character on the ticket and the advance of the control switch through terminal positions fourteen to eighteen, inclusive, circuits are established over conductors 1723 to 1727, the Nos. 7 to 11 contacts of relay P9 and conductor 1709 to the asterisk segment of the ticketer distributor, whereby the ticketer is controlled to print asterisks on the ticket as the thirteenth to seventeenth characters. As the printer control switch PC progresses through terminal positions nineteen to twenty-four, inclusive, a dash followed by the day tens and units digits, the hour tens and units digits, the minute tens, units and tenths digits and then followed by a further dash, are printed on the ticket as the eighteenth through twenty-sixth characters. The information for printing the day, hour and minutes digits is secured through the operation of connector relay P10, over conductors 1728 to 1734, inclusive, the Nos. 1 to 7 contacts of relay P10, conductors of cable 2510 and 2820, contacts of relays of the minutes tens, units and tenths disconnect time registers of Fig. 28 and contacts of relays of the hour tens and units disconnect time registers of Fig. 25, thence over conductors extending to segments of the ticketer distributor of Fig. 45.

Following the printing of this information on the ticket the printer control switch PC advances into terminal position twenty-eight, in which position the ticket cutting magnet CUT is operated to cut the previously prepared ticket from the tape, whereupon the control switch advances to terminal position twenty-nine. As the switch passes through terminal positions twenty-nine to thirty-one, circuits are established over conductors 1736, 1737 and 1738 and the Nos. 8, 9 and 10 contacts of relay P10 to conductor 1709 extending to the asterisk segment of the ticketer distributor, whereupon the ticketer is controlled to print asterisks as the twenty-seventh, twenty-eighth and twenty-ninth characters on the ticket. When, thereafter, the printer control switch PC advances into terminal position thirty-two, a circuit is established which may be traced from ground over the No. 1 normal contacts of relay PM, the brush and No. 32 terminal of switch arc PC4, the No. 3 contacts of relay BLK and conductor 1709, to the asterisk segment of the ticketer distributor, whereby the ticketer is controlled to print a terminating asterisk on the ticket.

With the brushes of switch PC in their thirty-third terminal position and relay BLK operated, the previously traced circuit for relay PR of Fig. 13 is established and relay PR operates, locks as previously described and establishes a circuit from battery through the winding of relay STLD, over the No. 4 back contact of relay STLC, conductor 1411, the No. 7 front contact of relay PR, conductor 1307 and to ground over the No. 7 contacts of relay STLA. Relay STLD operates and locks over its No. 2 contacts to ground on conductor 1307 as an indication that the partial call before the end of tape entries has been printed.

Relay STLD, upon operating, establishes a

circuit from ground over the No. 7 contacts of relay STLA, the No. 1 contacts of relay STLD, the No. 1 back contact of relay STLC, conductor 1323, the No. 1 normal contacts of relay WOR of Fig. 13, conductor 4022 of cable 4020 and to battery through the winding of relay W0 of Fig. 40. Relay W0 operates and opens the circuit of relay OFN which releases, in turn releasing relays LK and L0 and the FT1 and FU4 relays which registered the previous district frame number. With relay W0 operated and relay L0 released, a circuit is established from ground over the No. 2 back contact of relay L0, the No. 2 contacts of relay W0 and conductor 4023 of cable 4020 to battery through the winding of relay WOR of Fig. 13, whereupon such relay operates, locks over its No. 2 alternate contacts and conductor 1323 to ground over the No. 7 contacts of relay STLA and, at its No. 2 normal contacts, opens the circuit of relay W0 of Fig. 40 which latter relay releases and again establishes the circuit of relay OFN. With relay OFN reoperated and the FU– and FT– relays all released, the previously traced circuit for relay CG of Fig. 40 is closed and such relay reoperates, in turn reoperating relays OG and OG1. With relay TF1 operated, the previously traced circuit for relay FT1 is reestablished. With relay UF5 now operated (since the units digit of the district frame number has been changed to "5") a circuit is established for register relay FU5 from battery through the winding of relay FU5, conductor 3915, the No. 6 contacts of relay OG, the No. 1 contacts of relay UF5 and conductor 3807 to ground over the No. 2 contacts of relay OFN. The operated relays FT1 and UF5 now register the new frame number "15." Subsequent calls will now be printed with the new district frame number.

Relay PR, upon operating, also establishes the circuit of relay RL of Fig. 14 which operates and releases relays RAD, RDS, RLT, RLCB and RCLA of Fig. 14; the latter relays open the locking circuits of the operated disconnect time register relays. The release of the disconnect time register relays establishes the previously traced circuit for check relay RCK3 and causes the release of relay DSR. Since no answer time line entry and elapsed time registrations have been made, check relays RCK1, RCK2 and RCK4 will be operated and, with all of the RCK– relays now operated, the circuits will function as previously described to advance the reader under the control of the synchronizing relays into a position for sensing the first call entry following the end of tape entries.

When the reader has been advanced and the synchronizing relay SYMB has been operated, the locking circuit of relay DIS is opened and such relay releases, in turn releasing relays P9 and P10 of Fig. 45 followed by the release of relays PR and PS. A circuit is now established from battery through the winding of relay STLC, the No. 3 contacts of relay STLD, conductor 1412, the No. 7 back contacts of relay PR, conductor 1307 to ground over the No. 7 contacts of relay STLA. Relay STLC thereupon operates and locks to ground over conductor 1307 preparatory to enabling the printing of a second straddle ticket if found necessary.

It will now be assumed that the first entry encountered is an answer-time entry and that this entry is then followed by a calling line entry. Under this condition, with relay STLA operated to indicate that such entries are a part of a straddle call, the circuits will progress as previously described to sense the answer time entry, but this entry will be registered by the relays of the disconnect time registers of Figs. 25 to 30, inclusive, following which relay DSR of Fig. 13 will be operated. The reader will then be advanced into position for sensing the first line of the calling line entry which will be registered on the line entry digit registers of Figs. 40, 41 and 42 in the manner previously described. When the registration has been completed, relay CLR of Fig. 13 will be operated. Since no relays of the answer time registers of Figs. 19 to 24 have been operated, check relay RCK2 of Fig. 15 will not be operated at this time and a circuit will be established for relay ND as previously traced. Relay ND will, in turn, cause the operation of relays P5, P6 and PS. The circuits will then function as previously described for a call on which the disconnect time entry was not placed on the tape except that, with relays STLA and STLB operated, the second character printed on the ticket will be the digit "5" indicative of the fact that the call is a part of a straddle call.

When all of the lines of the call line entry have been sensed and the printing of the ticket has been completed, relay PR of Fig. 15 operates to establish a circuit from ground over the No. 7 contacts of relay STLA of Fig. 14, conductor 1307, the No. 7 front contact of relay PR, conductor 1411, the No. 3 contacts of relay STLC and to battery through the winding of relay STLR, which relay operates and opens the locking circuit of relay STLA. Relay STLA then releases, in turn permitting the release of relays STLB, STLC, STLD and STLR. Relay PR, upon operating, also opens the locking circuit of relay ND which releases, in turn releasing relays P5 and P6 of Fig. 18 which, in turn, release relays PS and PR. In the manner previously described, the operation of relay PR, through the operation of the synchronizing relays, has caused the advance of the reader.

Straddle call calling line entry only

It will now be assumed that just after sensing the end-of-tape entries as just described, a calling line entry is sensed. In other words there are no disconnect and answer time entries on the tape relating to the same call. With relay STLA operated as described to indicate a straddle call, the circuits will function as previously described to sense the first line of the calling line entry and to cause the operation of relays of the line entry registers of Figs. 40, 41 and 42, following which relay CLR of Fig. 13 will be operated. Since no relays of the disconnect and answer time registers of Figs. 19 to 30, inclusive, have been operated, relays DSR and ANR of Fig. 13 will not be operated. As a consequence, relay CL of Fig. 15 is operated in the manner previously described. The circuits will then function as previously described for a "don't-answer" or "busy" line call except that, with relays STLA and STLB operated, the second character printed on the ticket will be the digit "5" to indicate that the call was a straddle call. The operation of relay PR, upon the completion of the printing of the ticket, will cause the operation of relay STLR, followed by the release of relays STLA, STLB, STLC, STLD and STLR, the release of relay CL followed by the release of relays P3 and P4 of Fig. 18 and the release of relays PS and PR. In the manner previously described the operation of relay PR, through the operation of the syn-

chronizing relays, has caused the advance of the reader.

Straddle call—disconnect and answer time entries only

In the previous discussion it has been assumed that the entry just preceding the end-of-tape entries, including the old district frame number entry, was a disconnect entry. It will now be assumed that just before sensing the end-of-tape entries, a disconnect time entry is encountered followed by an answer time entry. Under this condition the operation of the STLA relay in response to the change in the district frame number will indicate that the data relevant to the time when the call was made and the completed elapsed time should be printed on a ticket as a part of a straddle call. The circuits will then progress through the sensing and recording of the hour and day entries of the second group of end of tape entries as previously described before any action is taken with respect to the straddle call. However, when the reader senses the month entry of the second group, the A3 reader relay of Fig. 5 will be operated together with the reader relays of Figs. 7 to 10, inclusive, and a check circuit will be established as previously traced over contacts of the reader relays operated for the digits of the month entry, to conductor **902** of cable **900**, thence over the No. 2 front contact of relay STLA, conductor **1409**, the No. 6 back contact of relay CLR, the No. 1 front contact of relay ANR, which operated following the sensing of the answer time entry, the No. 4 contacts of relay DSR, which operated following the sensing of the disconnect time entry, conductor **1320**, the No. 2 contacts of relay CKB of Fig. 15, which operated as previously described upon the completion of the computation of the elapsed time, and to battery through the winding of relay AD. Relay AD thereupon operates, locks over its No. 2 front contact and the No. 1 back contact of relay PR to ground on conductor **1740**, as soon as relay PS of Fig. 17 becomes operated, opens at its No. 2 normal contacts the circuit previously traced from the C9 cam contacts of the reader to the contacts of the A-reader relays of Fig. 5 to stop the progress of the reader, and establishes a circuit from ground over its No. 1 contacts and conductor **1555** through the windings of connector relays P7 and P8 of Fig. 45 to battery.

Relay P8, over its No. 12 contacts and conductors **1702** and **1806**, establishes the previously traced circuit for relay PS of Fig. 17 which operates to initiate the printing of a ticket. Under the control of relays P7 and P8 and the printer control switch PC, the message ticketer is operated to print the first twenty-six characters on the ticket in the manner previously described in connection with a straddle call for a disconnect time entry only, except that as the printer control switch PC passes through terminal positions twenty through twenty-six, inclusive, the control circuits established over contacts Nos. 1 to 7 of relay P8 are completed over conductors of cable **1820**, contacts of relays of the day tens and units answer time registers, hour tens and units answer time registers of Figs. 19 and 20, over conductors of cable **1830** and contacts of relays of the minute tens, units and tenths answer time registers of Figs. 22, 23 and 24 and conductors extending to segments of the ticketer distributor of Fig. 45.

Following the printing of this information on the ticket the printer control switch PC advances through terminal positions twenty-seven and twenty-eight. In the former position it controls the printing of a dash on the ticket as the twenty-sixth character and in the latter position it controls the magnet CUT to cut the previously printed ticket from the tape, whereupon the control switch advances into terminal position twenty-nine. As the switch passes through terminal positions twenty-nine through thirty-one, circuits are established over conductors **1736**, **1737** and **1738**, the Nos. 8, 9 and 10 contacts of relay P8 and conductors of cable **1840**, thence over contacts of the elapsed time register relays of Figs. 46 and 47 and conductors extending to segments of the ticketer distributor, whereby the ticketer is controlled to print the tens, units and tenths digits of the elapsed time on the ticket.

From this point the circuits function as described in connection with the previously discussed straddle call.

Straddle call when calls of a particular district frame are processed alone

In the previous discussion of straddle calls it was assumed that the tape being processed contained entries of calls established over the district trunks of more than one district frame so that there was a change in the district frame number during the processing. There are several conditions involving straddle calls when assembled tapes involving the same district frame are spliced together, the straddle calls being at the end and beginning of the tapes. These conditions are the same as previously outlined.

To care for these straddle call conditions, the assembler circuit is arranged to reperforate the entry "386000" or skip splice entry between the two groups of end-of-tape entries whenever the units of the district number changes. This operation occurs in the second district sort operation of the assembler as set forth in the application of W. W. Carpenter and J. W. Gooderham hereinbefore referred to. It will first be assumed that there is a partial straddle call before the tape splice and a partial straddle call after the splice and that the entry before the splice was a disconnect entry. When this entry is sensed, the disconnect time entry register relays are operated as previously described and the reader is advanced over the end-of-tape entries into a position to sense the next entry which, in this case, will be the "386000" or skip splice entry. When this entry is sensed, reader relays A3, B1C, B2C, B1E, B2E, C1A, C2A, C1C, C2C, DA, DB, EA, EB, FA and FB will be operated.

With these relays operated, the circuit for relay STCU of Fig. 13 will be established. This circuit is established from ground over the contacts of reader cam C9, conductor **242** of cable **240**, the No. 3 contacts of connector relay TD, the No. 5 contacts of alarm relay AL, conductor **441**, over the No. 5 contacts of operated relay FA of Fig. 10, the No. 2 contacts of operated relay FB, the No. 1 back contacts of relays FC, FD and FE, conductor **911**, the No. 5 contacts of operated relay EA of Fig. 9, the No. 2 contacts of operated relay EB, the No. 1 back contacts of relays EC, ED and EE, the No. 5 contacts of operated relay DA, the No. 2 contacts of operated relay DB, the No. 1 back contacts of relays DC, DD and DE, conductor **912**, the No. 5 contacts of operated relay C2A of Fig. 8, the No. 1 back contact of relay C2B, the No. 3 contacts of operated relay C2C, the No. 1 back contacts of relays C2D and C2E, conductor **806**, the No. 6 back contact of relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 8

contacts of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, conductor 901 of cable 900, the inner lower back contact of relay DIS of Fig. 15, the inner lower back contact of relay AD, the back contact of relay ND, the back contact of relay CL, the inner back contact of relay CC, conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1, the No. 2 back contact of relay LK2, the No. 2 back contact of reader relay A1, the No. 4 contacts of operated reader relay A3, the No. 3 back contact of reader relay A2, conductor 503, the No. 7 contacts of relay B1C of Fig. 7, the No. 6 contacts of relay B1E, conductor 707, the No. 4 contacts of relay C2A of Fig. 8, the No. 5 contacts of relay C2C, conductor 909 of cable 900 and through the winding of relay STCU of Fig. 13 to battery. Relay STCU operates, locks over its No. 4 contacts through resistance 1321, the No. 3 contacts of relay GD, conductor 1522 of cable 1500 to ground over the No. 2 back contact of relay CE1 of Fig. 5 and establishes a circuit from ground over its No. 3 contacts and conductor 1306 to battery through the winding of relay STLA.

It has been assumed that the last call entry sensed before the end of the tape record was for a disconnect time entry and that following the sensing of such entry relay DSR of Fig. 13 operated. Therefore, when relay STCU operates and extends ground from the No. 5 back contact of relay PR, conductor 1556, the No. 2 contacts of relay STCU, conductor 1409, the No. 6 back contact of relay CLR, such circuit is further extended over the No. 1 back contact of relay ANR, the No. 3 contacts of operated relay DSR, conductor 1319 and through the winding of relay DIS of Fig. 15 to battery. Relay DIS then operates, locks as previously described under the control of relay PR of Fig. 15 and causes the operation of connector relays P8 and P9 of Fig. 45 to set the ticketing circuit for printing a straddle call. The printing of the ticket then progresses in the manner previously described and when the printing is completed relay PR of Fig. 15 is operated to indicate the fact. Relay PR causes the operation of relay RL which releases relays RDS, RLA, RLCA, RAD, RLT and RLCB of Fig. 14 to, in turn, cause the release of all operated register relays. When the register relays become released, relays RCK1, RCK2, RCK3 and RCK4 will all be operated and will cause the operation of relays LSA, LSB and the synchronizing relays, as previously described, to synchronize the circuits of the reader and, when in step, to cause the advance of the reader out of the skip splice entry position.

With relay PR operated, a circuit is established from battery through the winding of relay STLD, over the No. 4 back contact of relay STLC, conductor 1411, the No. 7 front contact of relay PR, conductor 1307 and to ground over the No. 7 contacts of relay STLA. Relay STLD thereupon operates and locks over its No. 2 contacts to ground on conductor 1307. The operation of this relay indicates that the partial call before the splice pattern has been printed.

When the RS1 and RS2 relays are operated to cause the advance of the reader in response to the operation of the synchronizing relays, the relay RS1 removes ground from conductor 243, thereby opening the shunt around the reader cam contacts C8 so that the STP magnet of the reader is repeatedly operated over ground supplied by the cam contacts to advance the reader step by step so long as relay RS1 is held operated. After the reader has been advanced across any splice pattern that may be on the tape and into position to read the end-of-tape marker group entry "384" following the splice pattern entries, the operation of the cancel entry relay CE1 of Fig. 5 in the manner previously described will open the locking circuit of relay STCU which will release, in turn releasing relays RS1 and RS2. The reader then advances in the manner previously described into the position for sensing the end-of-tape month entry.

At this time relays CLR, ANR and DSR will have released, and ground applied to conductor 902 over contacts of the reader relays in response to sensing the month entry, is extended over the No. 2 contacts of relay STLA, conductor 1409, the No. 6 back contact of relay CLR, the No. 1 back contact of relay ANR, the No. 2 back contact of relay DSR, conductor 1413 and to battery through the winding of relay NUC. Relay NUC thereupon operates and establishes a circuit from ground over its No. 1 contacts, the No. 3 contacts of relay STLA and conductors 1515 and 624 to battery through the windings of relays RS1 and RS2. These relays operate to cause the advance of the reader into position for sensing the first call entry on the end of the new tape following the end of tape entries.

When the reader has been advanced and the synchronizing relay SYMB has operated, the locking circuit of relay DIS is opened and relay DIS releases, in turn releasing relays P8 and P9 of Fig. 45, followed by the release of relay PS and the release of relay PR. A circuit is now established from battery through the winding of relay STLC, the No. 3 contacts of relay STLD, conductor 1412, the No. 7 back contact of relay PR, conductor 1307 to ground over the No. 7 contacts of relay STLA. Relay STLC thereupon operates and locks to ground on conductor 1307 preparatory to enabling the printing of a second straddle call ticket if necessary.

It will be assumed that there is a straddle call entry following the splice pattern, such as a calling line entry. When this entry has been sensed and registered in the calling line entry registers of Figs. 40, 41 and 42, relay CLR will be operated and, in the manner previously described, will cause the circuit for relay CL of Fig. 15 to be established over front contacts of relay CLR and normal contacts of relays ANR and BSR. Relay CL will then proceed to control the ticketer in the manner previously described. Since relays STLA and STLB are both operated at this time the call will be printed as a straddle call. After the completion of printing, relay PR will be operated and a circuit will be established from ground over conductor 1307, the No. 7 front contact of relay PR, conductor 1411, the No. 3 contacts of relay STLC and through the winding of relay STLR to battery. Relay STLR will then operate, opening the locking circuit of relay STLA which will release, in turn releasing relay STLB so that no further straddle calls will be printed following the specific splice condition. It is necessary to take the precaution described above to prevent the printing of another straddle call ticket if another calling line entry alone on a "busy" or "don't-answer" call entry is next encountered in sensing the tape.

If there is no partial call involved on the tape before the splice pattern is encountered, relays CLR, ANR and DSR of Fig. 15 will all be normal. When relay STCU operates in response to the sensing of the skip splice entry, a circuit is established from ground over the No. 5 back contact of relay PR, conductor 1556, the No. 2 contacts of relay STCU, the No. 6 back contact of relay CLR, the No. 1 back contact of relay ANR, the No. 2 back contact of relay DSR, conductor 1413 and to battery through the winding of the "no uncompleted call" relay NUC of Fig. 14. Such relay operates and establishes a circuit from ground over its No. 3 contacts and to battery through the winding of relay STLC which operates and locks to ground over the No. 7 contacts of relay STLA. Also, relay NUC establishes a circuit from ground over its No. 1 contacts, the No. 3 contacts of relay STLA, conductor 1515 of cable 1500, conductor 624 and to battery through the windings of relays RS1 and RS2 of Fig. 4, to cause the advance of the reader over the splice pattern entries and the following end-of-tape entries on the next tape preparatory to sensing the next entry on such tape in the manner previously described. If a patrial call is found on the tape after the splice pattern, the CLR or the CLR and DSR relays will be operated and the partial straddle call will be printed on the ticket in the manner previously described.

When the call processed after the splice pattern is a complete call and relay STLA operated in response to sensing the skip splice entry, the reader will be advanced as just described to the first entry following the end-of-tape entries, and if it be assumed that these entries are for a complete call, relays DSR, ANR and CLR will all be operated and will close the circuit for relay CC as previously described. Relay CC, upon operating, will then open the locking circuit for relay STLA, following which all operated straddle call relays STLB, STLC and STCU will be released and the call will be printed as a normal complete call.

Straddle calls due to transfer to an emergency recorder at the originating office

The straddle call indication may be given upon sensing the entry "385500" when a trouble condition at the central office has necessitated a transfer to the emergency recorder, or upon sensing the entry "385700" when a trouble condition at the central office has arisen with respect to the master timing circuit getting out of synchronism so that a transfer to the emergency recorder is necessitated. When this transfer is made for either reason while calls are in progress, straddle calls will result on the tape, which must be printed the same as other straddle calls. It will be assumed that the last entry on the tape prior to the transfer was a disconnect time entry which, upon being sensed, has resulted in the operation of relay DSR of Fig. 13.

When the trouble entry 385500 is present, it will be found following the end-of-tape entry for the district frame number. When the entry is sensed, the reader relays A3, B1C, B2C, B1E, B2E, C1C, C2C, C1D, C2D, DC, DD, EA, EB, FA and FB will be operated in the manner previously described and a check circuit is established upon the closure of the C9 reader contacts, which extends from ground over such contacts, thence as traced to conductor 441, the No. 5 contacts of operated relay FA of Fig. 10, the No. 2 contacts of operated relay FB, the No. 1 back contacts of relays FC, FD and FE, conductor 911, the No. 5 contacts of operated relay EA of Fig. 7, the No. 2 contacts of operated relay EB, the No. 1 back contacts of relays EC, ED and EE, the No. 6 back contact of relay DA, the No. 8 back contact of relay DB, the No. 8 contacts of operated relay DC, the No. 3 contacts of operated relay DD, the No. 1 back contact of relay DE, conductor 912, the No. 6 back contact of relay C2A of Fig. 8, the No. 8 back contact of relay C2B, the No. 8 contacts of operated relay C2C, the No. 3 contacts of operated relay C2D, the No. 1 back contact of relay C2E, conductor 806, the No. 6 back contact of relay B1A of Fig. 7, the No. 8 back contact of relay B1B, the No. 8 contacts of operated relay B1C, the No. 2 back contact of relay B1D, the No. 2 contacts of operated relay B1E, thence as previously traced to conductor 1501 of cable 1500, the No. 2 back contact of reader relay A1 of Fig. 5, the No. 2 back contact of relay LK2, the No. 4 contacts of operated reader relay A3, the No. 3 back contact of relay A2, conductor 503, the No. 7 contacts of operated relay B1C of Fig. 7, the No. 6 contacts of operated relay B1E, conductor 707, the No. 6 contacts of operated relay C2C of Fig. 8, the No. 6 contacts of operated relay C2D, conductor 810, No. 6 contacts of operated relay DC of Fig. 9, the No. 6 contacts of operated relay DD, conductor 903 of cable 900 and to battery through the winding of relay TE1 of Fig. 13. Relay TE1 thereupon operates and establishes the circuit for relay STLA of Fig. 14, which circuit may be traced from ground over the No. 4 contacts of relay TE1 and conductor 1306, through the winding of relay STLA to battery. Relay STLA thereupon operates and locks over its No. 5 contacts, the back contact of relay STLR, conductor 1408, the No. 1 back contact of relay CC and to ground over the No. 9 contacts of relay GC. Relay TE1 also establishes an obvious circuit for relay TE2 which operates and locks over its No. 2 contacts and conductor 1307 to ground over the No. 7 contacts of relay STLA. As previously described, relay TE2 connects the trouble lead 1311 extending from the message ticketer, over its No. 1 front contact and conductor 5 of cable 1310, to the segment 5 of the ticketer distributor so that when, later, the ticketer is operated to print the third character on the straddle call ticket, it will print a digit "5" for such character.

When the reader relay A3 operates as just described, the previously traced circuit for relay LK1 is also established and this relay operates and locks under the joint control of relays RS2 and L2A.

Relay TE1, upon operating, establishes a circuit from ground over its No. 1 contacts, conductor 1308, the No. 3 contacts of relay STLA, conductor 1515 of cable 1500, conductor 624 and to battery through the windings of relays RS1 and RS2 of Fig. 4. Relay TE1 also establishes a circuit from ground over its No. 2 contacts, conductor 1309, the No. 4 contacts of relay STLA, conductor 604 of cable 600 and to battery through the winding of relay L2A of Fig. 6. As previously described, the operation of relays RS1, RS2 is effective to cause the advance of the reader. When the reader advances, the reader relays release, in turn releasing relay TE1 which, in turn, releases relays RS1, RS2 and LK1 followed by the release of relay L2A. Relay TE2, however, remains operated under the control of relay STLA.

When the reader has thereafter been advanced into position for sensing the end-of-tape month

entry and the reader relays are operated in the manner previously described, ground is applied over conductor 902, the No. 2 front contact of relay STLA, conductor 1403, the No. 6 back contact of relay CLR, the No. 1 back contact of relay ANR, the No. 3 contacts of relay DSR, which operated in response to sensing the disconnect time entry, conductor 1319 and to battery through the winding of relay DIS of Fig. 15. Relay DIS then functions to cause the operation of connector relays P9 and P10 of Fig. 45 to start the message ticketer to print the straddle call in the manner previously described.

After the printing has been completed and relay PR has operated, the disconnect time register relays are released and the reader is advanced under the control of the synchronizing relays as previously described. The reader is then advanced over the marker group and district frame entries into the position for sensing the 385500 entry which has also been inserted in the end-of-tape entries of the new tape. That is, the records on the tape when the circuits were transferred back from the emergency recorder cause relay TE1 to again function to advance the reader. The reader is then advanced in the manner previously described into the next position in which the hour entry will be sensed. From this point the reader advances as previously described into position for sensing the first call entry on the new tape. Following the sensing of this entry, relay STLR will become operated to release all operated STL relays, relay STLA, in turn, releasing relay TE2.

The entry for the trouble arising from the master timing circuit being out of synchronism, on which trouble condition the circuits were transferred at the originating office to the emergency recorder, will be placed on the tape following the end-of-tape district frame entry. As previously stated, the punchings across the tape for this trouble entry will be for the digits "385700." When this entry is sensed, reader relays A3, B1C, B2C, B1E, B2E, C1C, C2C, C1D, C2D, DB, DC, EA, EB, FA and FB are operated in the manner previously described, and a check circuit is established upon the closure of the C9 reader contacts which extends as previously traced over contacts of the F and E reader relay groups to the No. 6 contacts of relay DA of Fig. 9, the No. 7 contacts of operated relay DB, the No. 3 contacts of operated relay DC, the No. 1 back contacts of relays DD and DE, thence as traced to conductor 810, the No. 3 contacts of operated relay DB, the No. 4 contacts of operated relay DC, conductor 906 of cable 900 and to battery through the winding of relay TEC1 of Fig. 13. Relay TEC1 operates and establishes the previously traced circuit for relay STLA of Fig. 14, which locks under the control of relay STLR. Relay TEC1 also establishes an obvious circuit for relay TEC2 which locks over its No. 2 contacts to ground applied to conductor 1307 over the No. 7 contacts of relay STLA. As previously described, relay TEC2 connects the trouble lead 1311 extending from the message ticketer, over its No. 1 front contact and conductor 7 of cable 1310 to segment 7 of the ticketer distributor so that when, later, the ticketer is operated to print the third character on the ticket it will print a digit "7" for such character.

Relay TEC1 also establishes a circuit from ground over its No. 1 contacts, conductor 1308, the No. 3 contacts of relay STLA, conductor 1515 of cable 1500, conductor 624 and to battery through the windings of relays RS1 and RS2 of Fig. 4 and establishes a circuit from ground over its No. 2 contacts, conductor 1309, the No. 4 contacts of relay STLA, conductor 604 of cable 620 and to battery through the winding of relay L2A of Fig. 6. As previously stated, the operation of relays RS1, RS2 is effective to cause the advance of the reader. When the reader advances, the reader relays release, in turn releasing relay TEC1 which, in turn, releases relays RS1, RS2 and LK1, followed by the release of relay L2A. Relay TEC1, however, remains operated under the control of relay STLA.

When the reader has thereafter been advanced into the position for sensing the end-of-tape month entry and the reader relays are operated in the manner previously described, ground is applied over conductor 902, the No. 2 front contact of relay STLA, conductor 1409, the No. 6 back contact of relay CLR, the No. 1 back contact of relay ANR, the No. 3 contacts of relay DSR, which operated in response to sensing the disconnect time entry, conductor 1319 and to battery through the winding of relay DIS of Fig. 15. Relay DIS then functions to cause the operation of connector relays P9 and P10 of Fig. 45 to start the message ticketer to print the straddle call in the manner previously described.

After the printing has been completed and relay PR has operated, the disconnect time register relays are released and the reader is advanced under the control of the synchronizing relays as previously described. The reader is then advanced over the marker group and district frame entries into the position for sensing the "385700" entry which was inserted in the end-of-tape entries of the new tape. Relay TEC1 again functions to advance the reader as previously described. The reader is then advanced in the manner previously described into the next position in which the hour entry will be sensed. From this point the reader advances as previously described into position for sensing the first call entry on the new tape. Following the printing of a ticket for this entry, relay STLR will become operated as previously described to release all operated STL-relays, relay STLA in turn releasing relay TEC2.

Straddle calls—processing first or last tape

In processing the first tape of a series for a billing period, the first entry which is encountered on the tape following the end of tape entries may, for example, be an answer time entry or an initial entry. In such a case, a ticket should be printed for a partial or straddle call. It will be recalled that to start the processing of tapes, the attendant operated the start key ST of Fig. 6, resulting in the operation of relays ST1, ST2 and TD. When relay TD operated, a circuit was established from ground over its No. 2 contacts, conductor 1523 of cable 1500, the No. 1 back contact of relay GD of Fig. 13, prior to the operation of the latter relay, conductor 1414 and to battery through the winding of relay STLE of Fig. 14. Relay STLE operated and locked over its No. 1 contacts, conductor 1415, the No. 1 back contact of relay CLR and to ground on conductor 1523 whereby relay STLE remains operated after the operation of relay GD and until relay CLR becomes operated.

When the reader processes the first of the end of tape entries, that is the marker group entry, the CE1 relay of Fig. 5 is operated in the manner

previously described, resulting in the establishment of a circuit for relay STLA of Fig. 14, which circuit may be traced from battery through its winding, the No. 2 contacts of relay STLE, conductor 1524 of cable 1500, the No. 3 contacts of relay CE1, conductor 1525 of cable 1500 and to ground over the No. 9 contacts of relay GC. Relay STLA thereupon operates and locks as previously described under the control of relay STLR. The circuits then function as previously described to sense the remaining end of tape entries, relay NUC of Fig. 14 operating in response to the sensing of the end of tape month entry since, at this time, relay STLA is operated. Relay NUC, upon operating, causes the advance of the reader and the operation of relay STLC as previously described, the operation of relay STLC being indicative of the fact that only one straddle call ticket need be printed. The reader then proceeds to sense the next entry on the tape which, if it is an answer time entry, will cause such entry to be registered on the disconnect time registers, whereafter relay DSR of Fig. 13 will be operated, the reader will be advanced and the following initial call entry will be sensed. The latter will result in the operation of relay CLR of Fig. 13 as previously described or, if the first entry encountered after the end of tape entry is an initial call entry, relay CLR will be operated and relay DSR will not be operated. As previously described, the CL relay of Fig. 15 will be operated if an initial entry only is encountered or the ND relay of Fig. 15 will be operated if an answer time and initial call entry are encountered. The operation of either one of these relays will result in the control of the message ticketer to print the appropriate type of straddle call ticket.

Following the completion of printing when relay PR operates and with relay STLC previously operated, relay STLR is operated to release relay STLA, following which relays STLB, STLC and STLR will release. When relay CLR operated, the locking circuit of relay STLE was opened so that now all of the straddle call relays are released. The message ticketer control circuit is restored to normal by the release of relay PS following the operation of relay PR. The reader is advanced into a position to sense the next call entry in the manner previously described.

In processing the last tape, a skip splice entry "386000" will be encountered just before the splice pattern at the end of the tape. If a partial call entry has been sensed just before the end of tape entry, with the relay STCU operated, the circuits will cause a ticket to be printed in accordance with the partial call information registered when the partial call entry or entries are sensed. Under this condition the message ticketer circuits are controlled in the manner previously described under the subheading "Straddle call when calls of a particular district frame are processed alone."

Restoration of the circuit when processing is completed

To restore the circuits when processing is completed, the attendant operates the release key RLS of Fig. 6, thereby restoring relays ST1 and ST2. Relay ST1, upon releasing, opens the circuit of relay AC0 of Fig. 5 and the circuit of relay TD of Fig. 4, which relays release. Relay AC0, upon releasing, opens the operating circuits of all off-normal relays of the control circuit, which release, in turn releasing any relays which may be locked over their contacts. To stop the reader, the attendant opens the keys CP and MOT of Fig. 2.

While we have illustrated our invention in this application with respect to a particular kind of a telephone system, it is not limited to such application nor to the specific arrangements disclosed therein. It will be evident to one skilled in the art that many applications, arrangements and modifications, other than those herein disclosed, are within the scope of the invention.

Further, the terms and expressions which have been used in reference to the invention and its limits are used as terms of description and not of limitation, and we have no intention by the use of such terms and expressions of excluding thereby the equivalents of the features shown and described or portions thereof, but, on the contrary, intend to include therein any and all equivalents and modifications which may be employed wtihout departing from the spirit of the invention.

What is claimed is:

1. Record controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types, each line of any entry comprising a plurality of items of information, of means selectively responsive to the sensing of any one of said entries, a plurality of groups of register means, means responsive to the selective operation of said first means in accordance with the type of the entry which has been sensed, and means controlled by said latter means for selecting one of said groups of register means and for causing the selective operation of the register means of the selected group in accordance with the selective operation of said first means.

2. Record controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types, each line of any entry comprising a plurality of items of information, of groups of reader relays corresponding to the number of items of information, the relays of which groups are selectively responsive to the sensing of any one of said entries, a plurality of groups of register relays, connector relays responsive to the selective operation of said reader relays in accordance with the type of the entry which has been sensed, and means controlled by said connector relays for selecting one of said groups of register relays and for causing the selective operation of the relays of the selected group in accordance with the selective operation of said reader relays.

3. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types, each line of any entry comprising a plurality of items of information, of groups of reader relays corresponding to the number of items of information, the relays of which groups are selectively responsive to the sensing of any one of said entries, a plurality of groups of registering means, means responsive to the selective operation of said reader relays in accordance with the type of the entry which has been sensed for selecting one of said groups of registering means and for causing the selective operation of the registering means of the selected group in accordance with the selective operation of said first means, a relay operative indicative of the selective operation of said registering means, and means controlled by said relay for advancing said sensing device for sensing the next entry of said record.

4. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, relays selectively responsive to the operation of a predetermined number of the relays of each of said groups for registering the type of entry which has been sensed, means responsive to the operation of one of said latter relays for advancing said sensing device for sensing the next entry of said record, a timing device, means for initiating the operation of said timing device at the start of sensing of an entry, alarms, and an alarm circuit relay operated by said timing device at the expiration of a predetermined interval for arresting the operation of said sensing device and for operating said alarms if said one relay has failed to operate due to an improper operation of said reader relays.

5. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, a plurality of registers each comprising a plurality of groups of register relays, connector relays responsive to the operation of said reader relays in accordance with the type of entry which has been sensed, means controlled by said connector relays for selecting one of said registers and for causing the selective operation of a predetermined number of the relays of each group of the selected register in accordance with the selective operation of said reader relays, a check relay responsive if a predetermined number of relays of each group of the selected register are operated to cause the advance of said sensing device for sensing the next entry on said record, a timing device, means for initiating the operation of said timing device at the start of sensing of an entry, alarms, and an alarm relay operable by said timing device at the expiration of a predetermined interval for arresting the operation of said sensing device and for operating said alarms if said check relay has failed to operate due to an improper operation of the relays of the selected register.

6. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including an entry of the hour when transactions were in progress, each line of any entry comprising a plurality of items of information, of groups of reader relays corresponding to the number of items of information, the relays of which groups are selectively responsive to the sensing of any one of said entries, hour tens and hour units input registers, connector relays responsive to the selective operation of said reader relays upon the sensing of said hour entry for causing the selective operation of said hour tens and said hour units input registers, memory switches respectively operative in response to the selective operation of said hour tens and said hour units registers, and hour tens and hour units output registers selectively operable in response to the setting of said memory switches.

7. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including an end-of-record entry of the hour when transactions were in progress, entries relating to a plurality of transactions and an interim entry of the hour when the recorded transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, hour tens and hour units input registers, connector relays responsive to the selective operation of said reader relays upon the sensing of said end-of-record hour entry for causing the selective operation of said hour tens and said hour units input registers, memory switches operative respectively in response to the selective operation of said hour tens and said hour units registers, hour tens and hour units output registers selectively operable in response to the setting of said memory switches, connector relays responsive to the selective operation of said reader relays upon the sensing of said interim hour entry, and means controlled by said latter connector relays for resetting said switches whereby said output registers are reset to register the tens and units digits of the preceding hour.

8. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including an end-of-record entry of the hour when transactions were in progress, entries relating to a plurality of transactions and an interim entry of the hour when the recorded transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, hour tens and hour units input registers, connector relays responsive to the selective operation of said reader relays upon the sensing of said end-of-record hour entry for causing the selective operation of said registers, memory switches operative respectively in response to the selective operation of said hour tens and said hour units registers, hour tens and hour units output registers selectively operable in response to the setting of said memory switches, connector relays responsive to the selective operation of said reader relays upon the sensing of said interim hour entry, means responsive to said latter connector relays for checking the digits of the interim hour entry with the digits of the previously registered hour entry, and means effective if the check determines the digits to be unchanged for resetting said switches whereby said output registers are reset to register the tens and units digits of the preceding hour.

9. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including an end-of-record entry of the hour when transactions were in progress, entries relating to a plurality of transactions and an interim entry of the hour when the recorded transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, hour tens and hour units input registers, connector relays responsive to the selective operation of said reader relays upon the sensing of said end-of-record hour entry for causing the selective operation of said registers, memory switches operative respectively in response to the selective operation of said hour tens and said hour units registers, hour tens and hour units output registers selectively operable in response to the setting of said memory switches, connector relays responsive to the selective operation of said reader relays upon the sensing of said interim hour entry, means controlled by said latter connector relays for resetting said switches whereby said output registers are reset to register

the tens and units digits of the preceding hour, a timing device, means for initiating the operation of said timing device in response to the sensing of said interim hour entry, alarms, and an alarm relay operable by said timing device at the expiration of a predetermined interval for arresting the operation of said sensing device and for operating said alarms if said switches fail to advance.

10. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including the answer time and disconnect time entries for a plurality of transactions and one or more interim entries of the hours when the recorded transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, a first relay operable in response to the selective operation of said reader relays upon sensing the disconnect time entry of a transaction, a second relay operable in response to the selective operation of said reader relays upon sensing the answer time entry for the same transaction, means operable in response to the selective operation of said reader relays upon sensing each of said interim hour entries, means for counting the number of operations of said latter means intervening between the operation of said first relay and said second relay, and means controlled by said latter means for registering the number of changes in the hour elapsing during the recorded transaction.

11. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including the answer time and disconnect time entries for a plurality of transactions and one or more interim entries of the hours when the recorded transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, a first relay operative in response to the selective operation of said reader relays upon sensing the disconnect time entry of a transaction, a second relay operable in response to the selective operation of said reader relays upon sensing the answer time entry of the same transaction, means operable in response to the selective operation of said reader relays upon sensing each of said interim hour entries, means for counting the number of operations of said latter means intervening between the operation of said first and said second relays for registering the number of changes in the hour elapsing during the recorded transaction, an alarm relay, alarms, and means controlled by said counting means for operating said alarm relay to arrest the operation of said sensing device and for operating said alarms if more than a predetermined number of changes in the hour are counted.

12. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including disconnect time and answer time entries of a transaction and intervening end-of-record hour entries if an originating recorder was removed from and then returned to service during the recording of the transaction, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, a first relay operable in response to the selective operation of said reader relays upon the sensing of said disconnect time entry, means operable in response to the selective operation of said reader relays upon the sensing of the end-of-record entry of the hour when the recorder was removed from service if such entry is for an hour different than that of the entry when the recorder was restored to service, and a register relay jointly responsive to said first relay and said latter means for registering the elapse of an hour during which the recorder was out of service.

13. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including an entry of the day when transactions were in progress, each line of any entry comprising a plurality of items of information, of groups of reader relays corresponding to the number of items of information, the relays of which groups are selectively responsive to the sensing of any one of said entries, day tens and day units input registers, connector relays responsive to the selective operation of said reader relays upon sensing said day entry for causing the selective operation of said registers, and day tens and day units output registers selectively operable in response to the setting of said input registers.

14. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including entries of the day and hour when transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, means responsive to the selective operation of said reader relays upon the sensing of entries of successive hours to retrogressively register the tens and units digits of the hour when transactions were in progress, day tens and day units input registers, connector relays responsive to the selective operation of said reader relays upon sensing said day entries for causing the selective operation of said day tens and day units registers, day tens and day units output registers selectively operable in response to the setting of said input registers, and means controlled by said latter means when said latter means is operated in response to the change of the hour at midnight to reset said day tens and day units output registers to register the tens and units digits of the preceding day.

15. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including entries of the day and hour when transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, hour tens and hour units memory switches progressively operable in response to the selective operation of said reader relays upon the sensing of entries for successive hours to retrogressively register the tens and units digits of the hours when transactions were in progress, day tens and day units input registers, connector relays responsive to the selective operation of said reader relays upon sensing said day entries for causing the selective operation of said day tens and said day units registers, day tens and day units output registers selectively operable in response to the setting of said input registers, and means controlled by said switches when said switches are set into a position to register the digits of the midnight hour to reset said day tens and day units output registers to register the tens and units digits of the preceding day.

16. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including entries of the day and hour when transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, means responsive to the selective operation of said reader relays upon the sensing of entries for successive hours to retrogressively register the tens and units digits of the hour when transactions were in progress, day tens and day units input registers, connector relays responsive to the selective operation of said reader relays upon sensing said day entries for causing the selective operation of said day tens and said day units registers, day tens and day units output registers selectively operable in response to the selective operation of said input registers, and relays operable when said day units input register registers the digit 0 and when said hour registers have been set to register the digits for the midnight hour to reset said day units output register to register the units digit 9 and to reset said day tens output register to register the next smaller tens digit.

17. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including entries of the day and hour when transactions were in progress, of groups of reader relays, the relays of which groups are selectively responsive to the sensing of any one of said entries, means responsive to the selective operation of said reader relays upon the sensing of entries for successive hours to retrogressively register the tens and units digits of the hour when transactions were in progress, day tens and day units input registers, connector relays responsive to the selective operation of said reader relays upon sensing said day entries for causing the selective operation of said day tens and said day units registers, day tens and day units output registers selectively operable in response to the selective operation of said input registers, keys operable in accordance with whether the month during which the transactions were in progress has 28, 30 or 31 days, and relay means controlled by said keys when said day input registers have been set to register the 01 day of a month and when said hour registers have been set to register the digits of the midnight hour to cause the day tens and day units output registers to register the day of the month as 28, 30 or 31 dependent upon which key has been operated.

18. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including entries of the numbers of the district frames over which transactions have been in progress, each line of any entry comprising a plurality of items of information, of groups of reader relays corresponding to the number of items of information, the relays of which groups are selectively responsive to the sensing of any one of said entries, district frame tens and district frame units input registers, connector relays responsive to the sensing of said district frame number entry for causing the selective operation of said registers and district frame tens and district frame units output registers selectively operable in response to the setting of said input registers.

19. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including entries of the numbers of the district frames over which transactions have been in progress, each line of any entry comprising a plurality of items of information, of groups of reader relays corresponding to the number of items of information, the relays of which groups are selectively responsive to the sensing of any one of said entries, district frame tens and district frame units input registers, connector relays responsive to the sensing of a district frame number entry for causing the selective operation of said registers, district frame tens and district frame units output registers selectively operable in response to the setting of said input registers, and means effective upon the resetting of the said reader relays upon the sensing of the entry for a different frame number for resetting said input registers while maintaining the said output registers in the previously set condition whereby both the previous and the new district frame numbers are registered.

20. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a disconnect time entry and an answer time entry for each of a plurality of different transactions, of means responsive to the sensing of each of the time entries for a particular transaction to make a registration of the digits of each such entry, a computing circuit comprising answer time and disconnect time registers, means effective upon the completion of the registration of the digits of the disconnect time to transfer such registration to the disconnect time registers of said computing circuit, means effective upon the completion of the registration of the digits of the answer time to transfer the complements of the registered answer time digits to the answer time registers of said computing circuit, circuits interconnected between the disconnect and answer time registers of said computing circuit whereby the digits registered therein are added for securing the elapsed time of the transaction and for registering said elapsed time, and means responsive to the registration of the elapsed time for printing said elapsed time.

21. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including an answer time entry and a disconnect time entry appertaining to a transaction and one or more hour entries intervening between said time entries, each line of any entry comprising a plurality of items of information, of a first means selectively operable in response to sensing any one of said entries, means selectively controlled by said first means in response to sensing said answer time entry for registering the digits of the minutes of answer time, means selectively controlled by said first means in response to sensing said disconnect time entry for registering the digits of the minutes of the disconnect time, means for computing from said registrations the digits of the minutes of elapsed time, means selectively controlled by said first means in response to sensing said hour entries for registering the number of hours to be included in the computation of the elapsed time, means for increasing said elapsed time computation in accordance with said hour registration, and means for registering the total elapsed time.

22. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including an answer time entry and a disconnect time entry appertaining to a transaction and one or more hour entries intervening

between said time entries, of a first means selectively operable in response to sensing any one of said entries, means selectively controlled by said first means in response to sensing said answer time entry for registering the digits of the minutes of the answer time, means selectively controlled by said first means in response to sensing said disconnect time entry for registering the digits of the minutes of the disconnect time, means for computing from said registrations the digits of the minutes of the elapsed time, means selectively controlled by said first means in response to sensing said hour entries for registering the number of hours to be included in the computation of the elapsed time, means for increasing said elapsed time computation in accordance with said hour registration, an alarm relay, alarms, and means for causing the operation of said alarm relay to operate said alarms and to arrest the operation of said sensing device if the total computed elapsed time exceeds a predetermined maximum.

23. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries of different types including an answer time entry and a disconnect time entry appertaining to a transaction and one or more hour entires intervening between said time entries, of a first means selectively operable in response to sensing any one of said entries, means selectively controlled by said first means in response to sensing said answer time entry for registering the digits of the minutes of the answer time, means selectively controlled by said first means in response to sensing said disconnect time entry for registering the digits of the minutes of the disconnect time, means for computing from said registrations the digits of the minutes of the elapsed time, means selectively controlled by said first means in response to sensing said hour entries for registering the number of hours to be included in the computation of the elapsed time, means for increasing said elapsed time computation in accordance with said hour registration, an alarm relay, alarms, and means for causing the operation of said alarm relay to operate said alarms and to arrest the operation of said sensing device if the total elapsed time is less than a predetermined amount indicative of an incomplete computation.

24. Record-control'ed apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries including entries the data of which is recorded in two or more lines across the record, of means selectively operable in response to the sensing of each line of an entry, means selectively controlled by said latter means for registering the data of any line of a multi-line entry, means responsive to the completion of registration of a line of said entry for printing said registered data, and means responsive to the completion of printing said registered data to cause said sensing device to advance, whereby said selectively operable means is reoperable in response to the sensing of each supplemental line of said line entry, said registration means is reoperable to register the data of each supplemental line, and said printing means is reoperable to print the data of each supplemental line.

25. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries including entries the data of which is recorded in two or more lines across the record, of means selectively operable in response to the sensing of the first line of a multi-line entry for registering the number of lines of the entry, means selectively operable in response to the sensing of each line of an entry, means selectively controlled by said latter means for registering the data of the several lines of an entry, means responsive to said latter registering means for printing said registered data, and means controlled by said first registering means for terminating the operation of said printing means following the printing of all data appertaining to a two line entry or following the printing of all data appertaining to an entry of more than two lines.

26. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries including an entry the data of which is recorded in a plurality of lines across the record, of means selectively operable in response to the sensing of the first line of the multi-line entry for registering the number of lines of the entry, means selectively operable in response to sensing each line of said entry, means selectively controlled by said latter means for registering the data on any line of said entry, means responsive to the completion of registration of a line of said entry for printing said registered data, means responsive to the completion of printing of said registered data to cause said sensing device to advance whereby said printing means is controlled in a similar manner to print the data of supplemental lines of said entry, and counting means to determine whether all of the lines of said entry have been sensed and a printed record of the data thereof has been made.

27. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries including an entry the data of which is recorded in a plurality of lines across the record, of means selectively operable in response to the sensing of each line of said entry, means selectively controlled by said latter means upon the sensing of each line of said entry for registering the data of the line thus sensed, means responsive to each operation of said registering means for printing the data registered therein, and means responsive to the completion of the printing of the registered data of each line to synchronize the operation of the sensing device with the operation of the printing means and to cause said device to sense the next line of recorded data.

28. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries appertaining to a transaction and any one of a plurality of entries indicative of different trouble conditions which may have been encountered at the time the transaction was in progress, of a first means selectively operable in response to sensing said entries, means selectively controlled by said first means for registering the data appertaining to the transaction, means selectively controlled by said first means for registering the type of trouble encountered, and means responsive to said registering means for printing the registered data appertaining to the transaction and a digit indicative of the registered trouble condition.

29. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries appertaining to a transaction each line of any entry comprising a plurality of items of information, including an answer time entry and an initial entry but no disconnect time entry, of means selectively operable in response to sensing said entries, means selectively controlled by said latter means for registering the data of said several

entries, and means responsive to the registration of the answer time and initial entries only for printing on a ticket all the registered data concerning the transaction together with special characters indicative of the fact that in the absence of registered data concerning the disconnect time for the transaction no computation of the elapsed time for the transaction has been made.

30. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries and including the initial entry for a particular transaction but no answer time and disconnect time entries for such transaction, of means selectively operable in response to sensing said entries, means selectively controlled by said latter means for registering the data of said initial entry, and means responsive to the registration of the data of the initial entry in the absence of registrations for the answer time and disconnect time data for the same transaction for printing on a ticket all of the registered data concerning the transaction together with special characters indicative of the fact that the transaction was incomplete.

31. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon a plurality of entries appertaining to a plurality of transactions, of means selectively operable in response to sensing said entries, means selectively controlled by said first means for registering data appertaining to a transaction, means operative in response to the completion of said registration for printing the registered data on a ticket, a time measuring device, means controlled upon the initiation of the printing of said registered data to initiate the operation of said time measuring device, alarms, and an alarm relay operable by said time measuring device to cause the operation of said alarms and to arrest the operation of said sensing device if said printing means does not complete its operation within a predetermined interval.

32. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon some of the entries appertaining to a first transaction followed by two groups of end-of-record entries and then followed by some of the entries appertaining to a second transaction, of means responsive to the sensing of the entry or entries of said first transaction for registering the data thereof, means responsive to the sensing of the entry or entries of said second transaction for registering the data thereof, means operative indicative of the fact that said registrations relate to two partial transactions, and means responsive to said first registrations to print a first partial ticket for said first transaction and responsive to said second registrations to print a second partial ticket for said second transaction.

33. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon some of the entries appertaining to a first transaction followed by two groups of end-of-record entries and then followed by some of the entries appertaining to a second transaction, of means responsive to the sensing of the entry or entries of said first transaction for registering the data thereof, means responsive to the sensing of the entry or entries of said second transaction for registering the data thereof, means operative indicative of the fact that said registrations relate to two partial transactions, means responsive to said first registrations to print a first partial ticket for said first transaction and responsive to said second registrations to print a second partial ticket for said second transaction, and means for causing said printing means to print characters of each of said partial tickets indicative of the fact that each ticket is a partial ticket and indicative of the transaction data missing from each ticket.

34. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon some of the entries appertaining to a first transaction followed by two groups of end-of-record entries each including a special entry indicative of the fact that a recorder which made an original record was removed from and then restored to service and then followed by some of the entries appertaining to a second transaction, of means responsive to the sensing of the entry or entries of said first transaction for registering the data thereof, means responsive to the sensing of the entry or entries of said second transaction for registering the data thereof, means responsive to the sensing of said special entry indicative of the fact that the first data should be printed on one partial transaction ticket and that the second data should be printed on a second partial transaction ticket, and means controlled by said register means for printing said partial tickets.

35. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon the entry of the number of a district frame over which a first transaction has been conducted, some of the entries appertaining to a first transaction followed by two groups of end-of-record entries each including an entry of a change in the district frame number and then followed by some of the entries appertaining to a second transaction, of means responsive to the sensing of the entry or entries of said first transaction for registering the data thereof, means responsive to the sensing of the entry or entries of said second transaction for registering the data thereof, means responsive to the sensing of said changed district frame number entry indicative of the fact that said registrations relate to two partial transactions, and means responsive to said first registrations to print a first partial ticket for said first transaction and responsive to said second registrations to print a second partial ticket for said second transaction.

36. Record-controlled apparatus comprising in combination with a device for sensing a record containing thereon the entry of the number of a district frame over which a first transaction has been conducted, some of the entries appertaining to a first transaction followed by two groups of end-of-record entries each including an entry of a change in the district frame number and then followed by some of the entries appertaining to a second transaction, of means responsive to the sensing of said first district frame number entry for registering the digits of said number, means responsive to the sensing of said changed district frame number entry to register the digits of said changed number, means responsive to the sensing of the entry or entries of said first transaction to register the data thereof, means responsive to the sensing of the entry or entries of said second transaction to register the data thereof, means responsive to the registration of said changed district frame number indicative of the fact that said data registrations relate to two partial transactions, and means responsive to said first data registrations and to said first district frame number registration to print a first partial ticket for

said first transaction and responsive to said second data registrations and to said second district frame number registration to print a second partial ticket for said second transaction.

37. Record-controlled apparatus comprising in combination a device for sensing a record containing thereon some of the entries appertaining to a first transaction followed by a first group of end-of-record entries, a skip splice entry, splice pattern entries, a second group of end-of-record entries and some of the entries appertaining to a second transaction, of means responsive to the sensing of the entry or entries of said first transaction for registering the data thereof, means responsive to the sensing of the entry or entries of said second transaction for registering the data thereof, means operative in response to sensing said skip splice entry indicative of the fact that said registrations relate to two partial transactions, and means responsive to said first registrations to print a first partial ticket for said first transaction and responsive to said second registrations to print a second partial ticket for said second transaction.

38. Record-controlled apparatus comprising in combination a device for sensing a record containing thereon a plurality of entries of different types, means for initiating the operation of said apparatus, a release key, a relay operable under the control of said means to maintain said apparatus in operation under the control of said release key, and a locking circuit for said relay maintained following the operation of said key until said apparatus has completed the required processing incident to the sensing of certain entries or incident to the sensing of a group of entries appertaining to a transaction.

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