Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

Filed Jan. 22, 1944 16 Sheets-Sheet 1

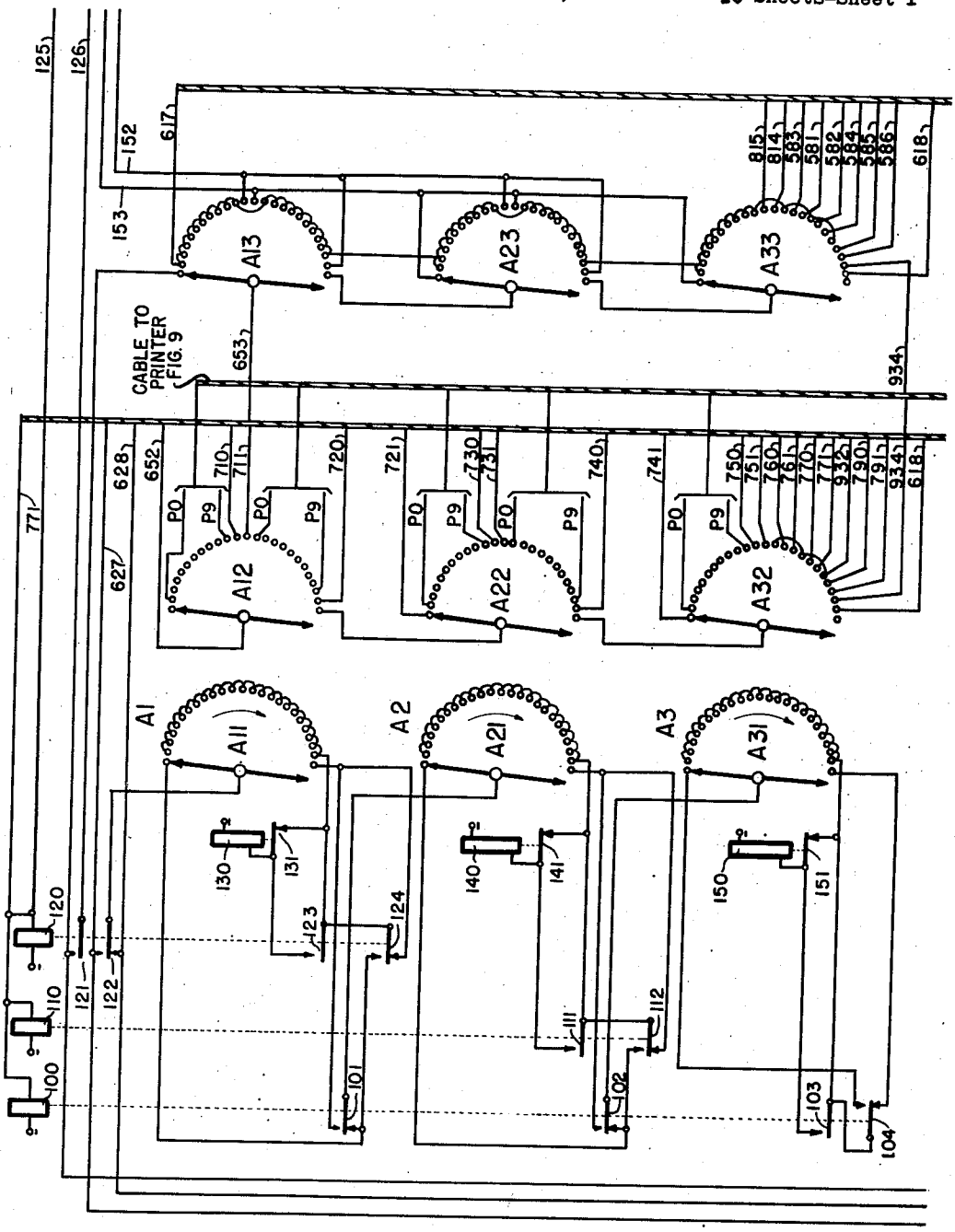

FIG. 1A

INVENTOR.
JOHN E. OSTLINE

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ATTORNEY

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TELEPHONE TRAFFIC RECORDING SYSTEM

Filed Jan. 22, 1944 16 Sheets-Sheet 2

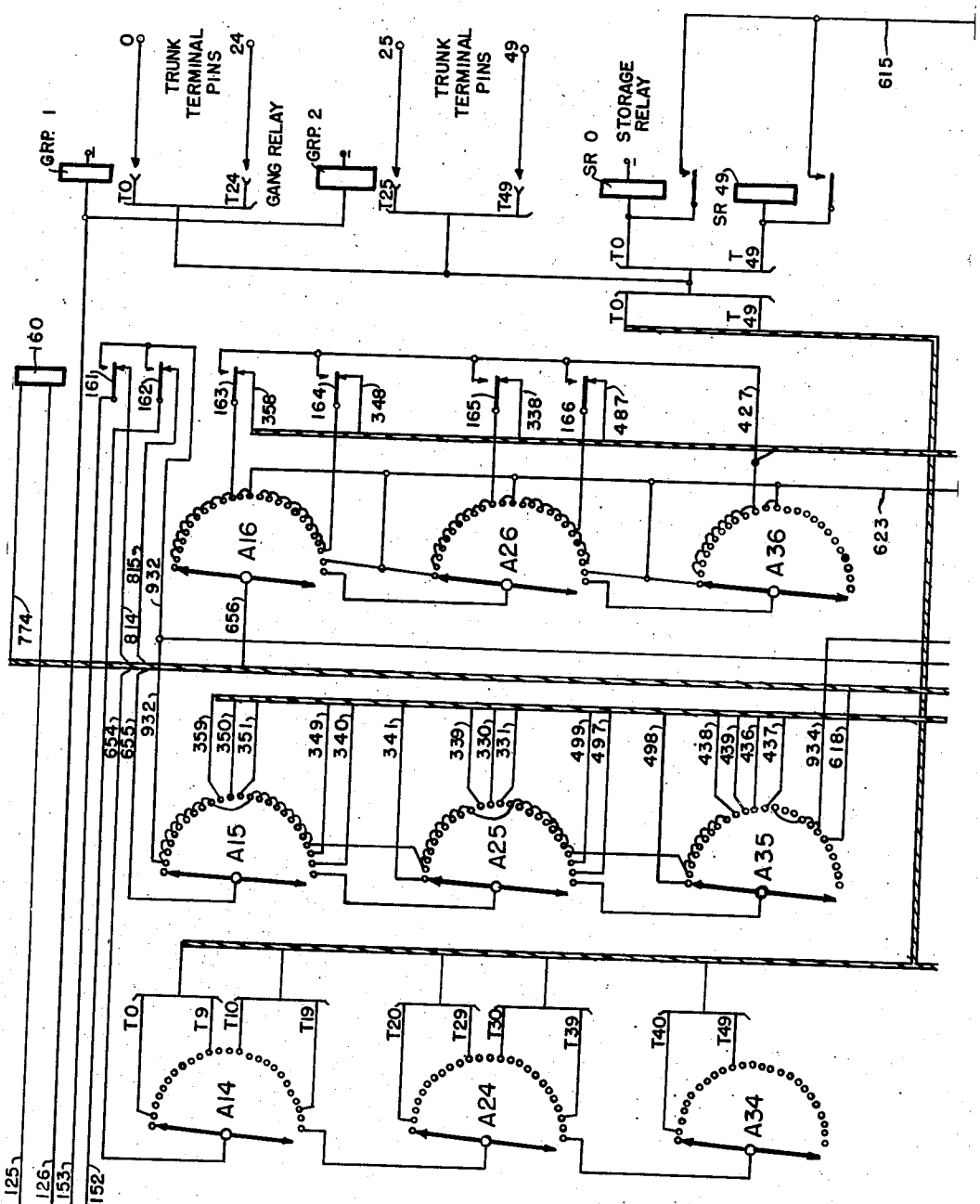

FIG. 18

INVENTOR.
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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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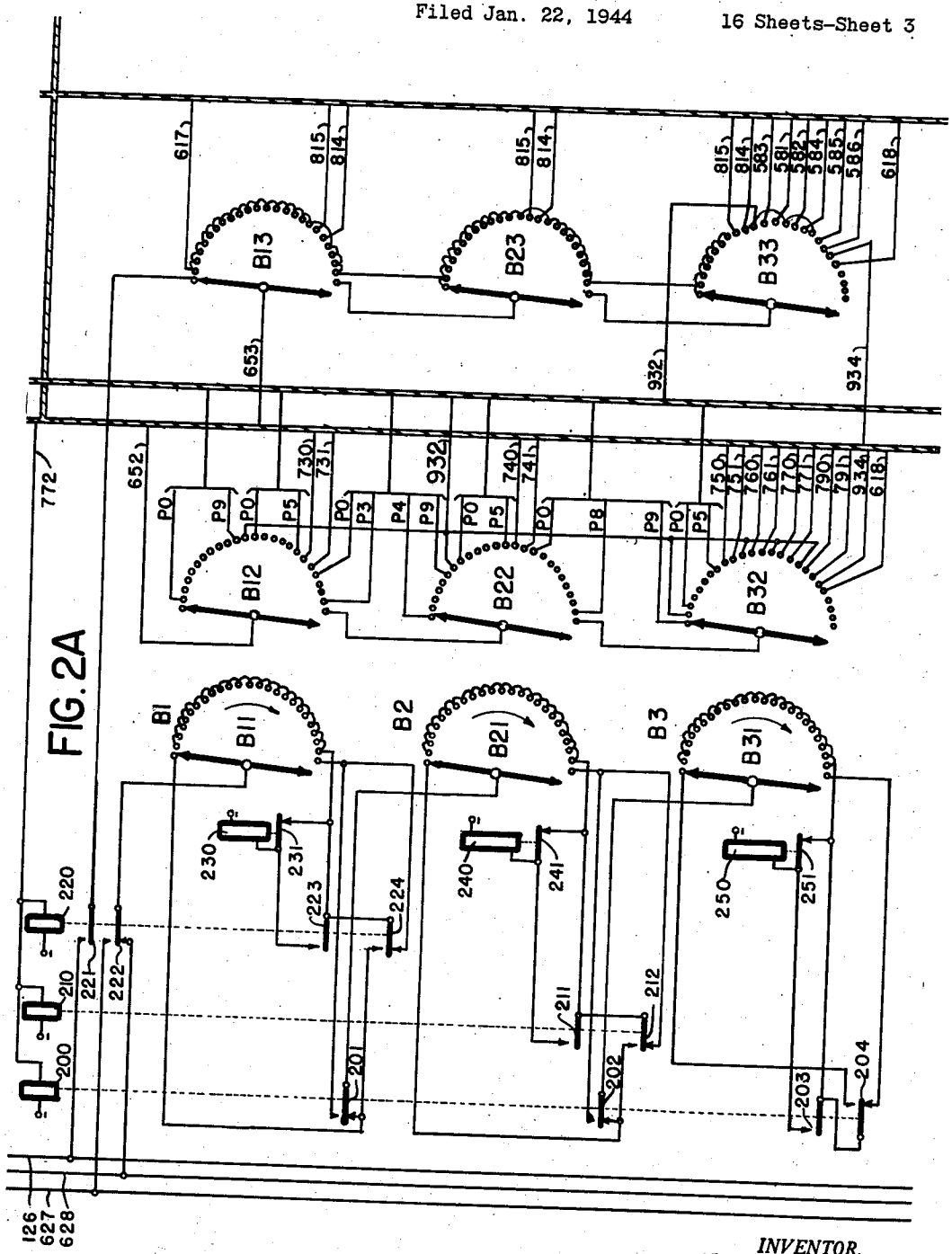

FIG. 2A

INVENTOR.
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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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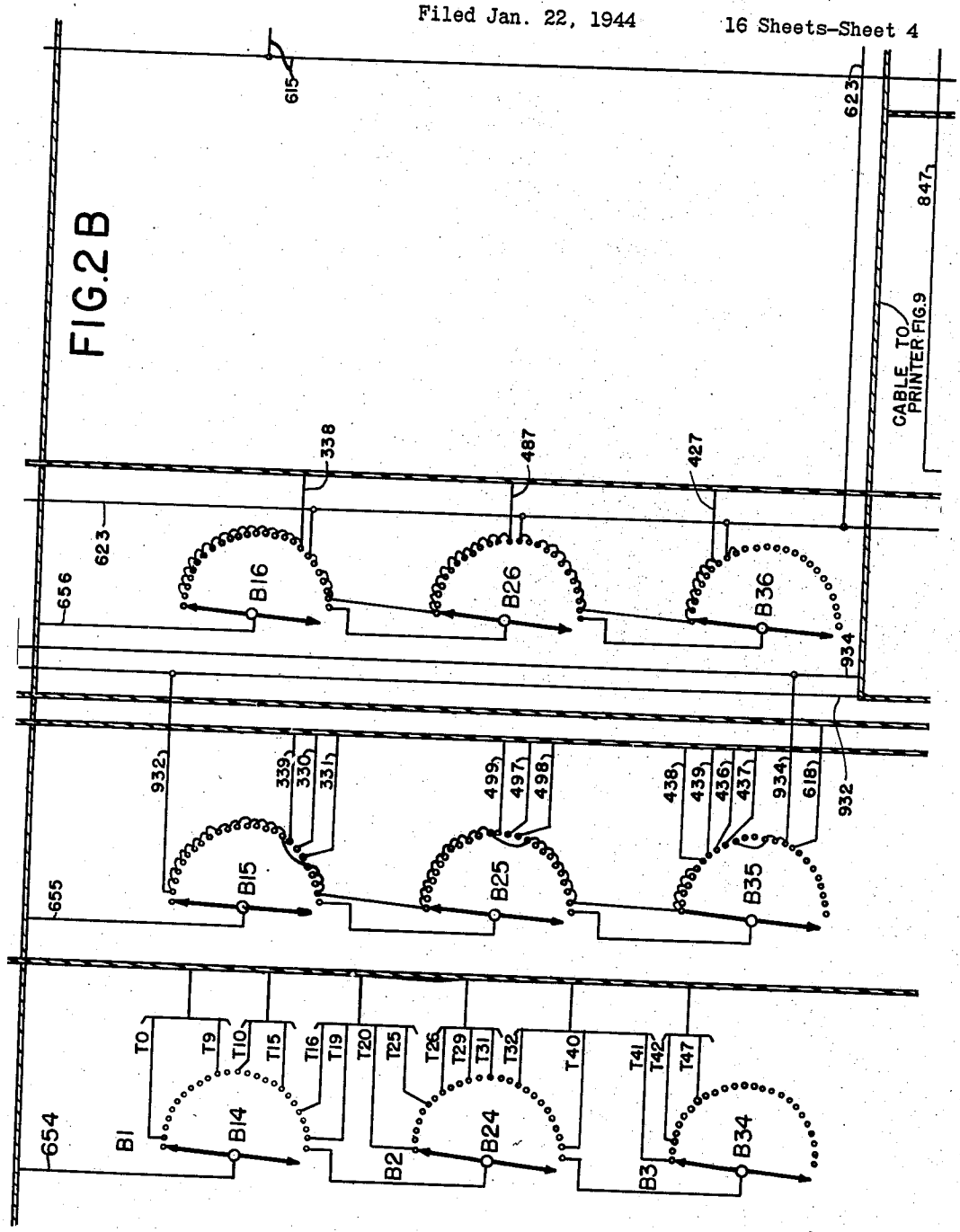
FIG.2B



INVENTOR.
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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

Filed Jan. 22, 1944 16 Sheets-Sheet 5

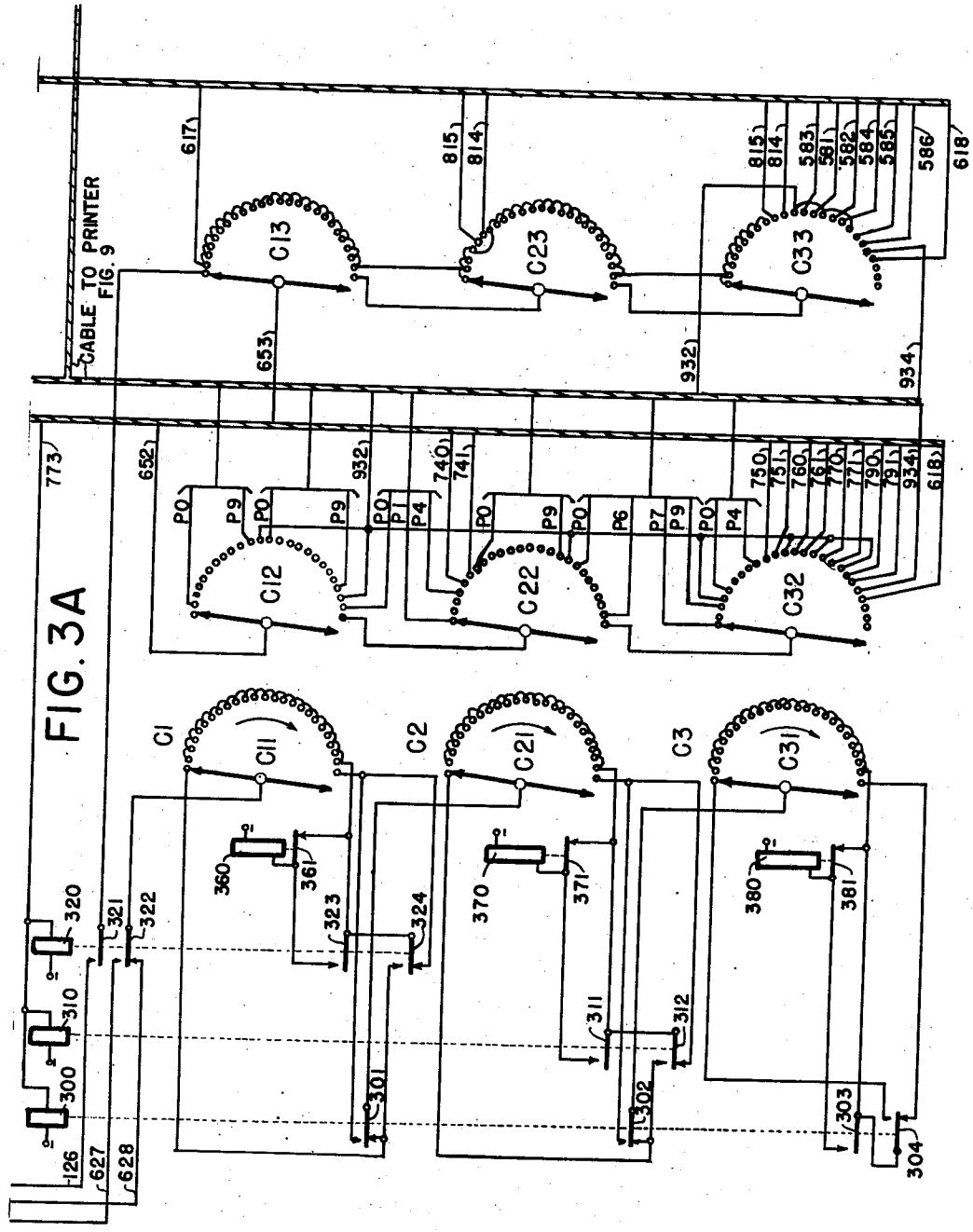

FIG. 3A

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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

Filed Jan. 22, 1944 16 Sheets-Sheet 6

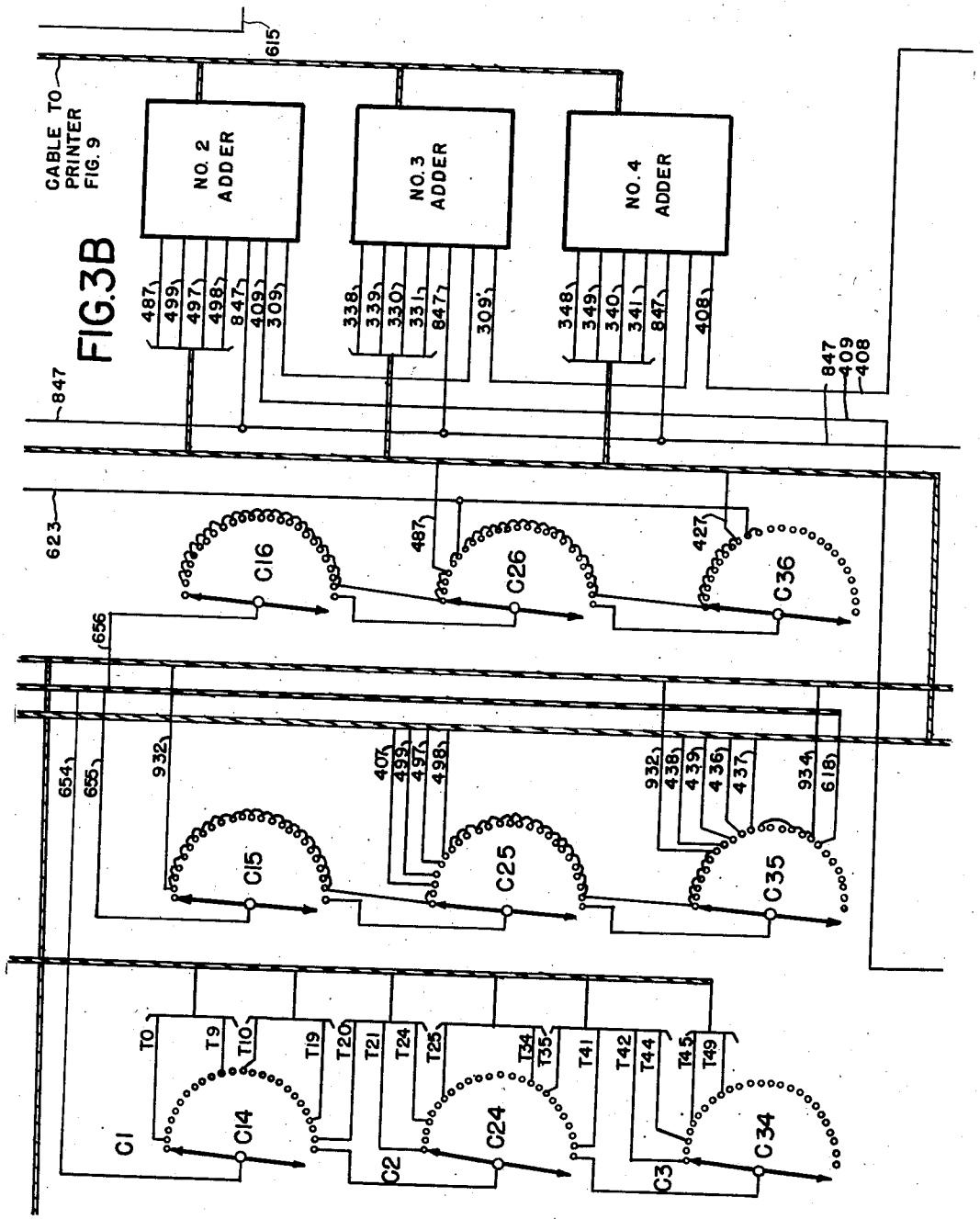

FIG. 3B

INVENTOR.
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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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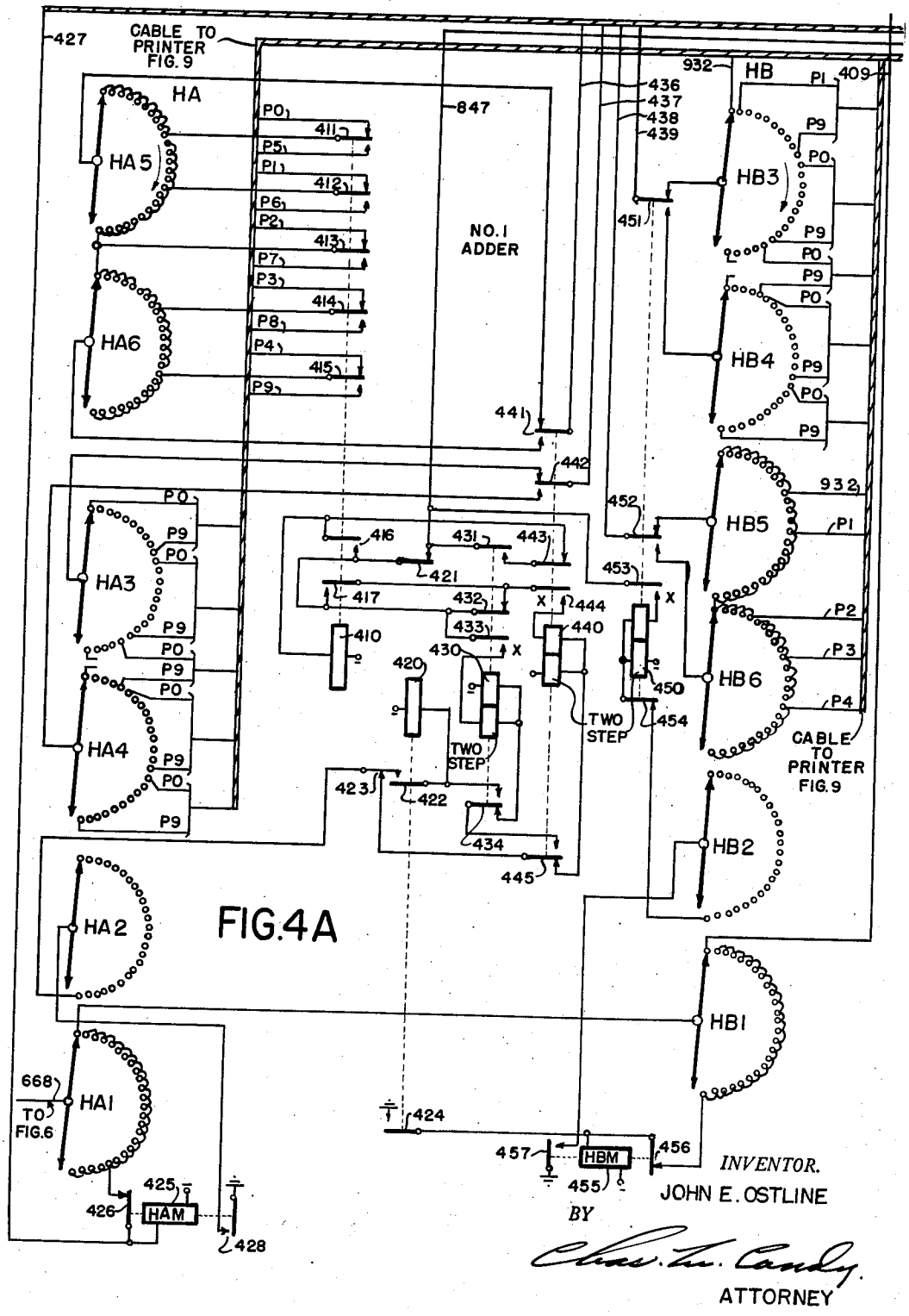

FIG.4A

INVENTOR.
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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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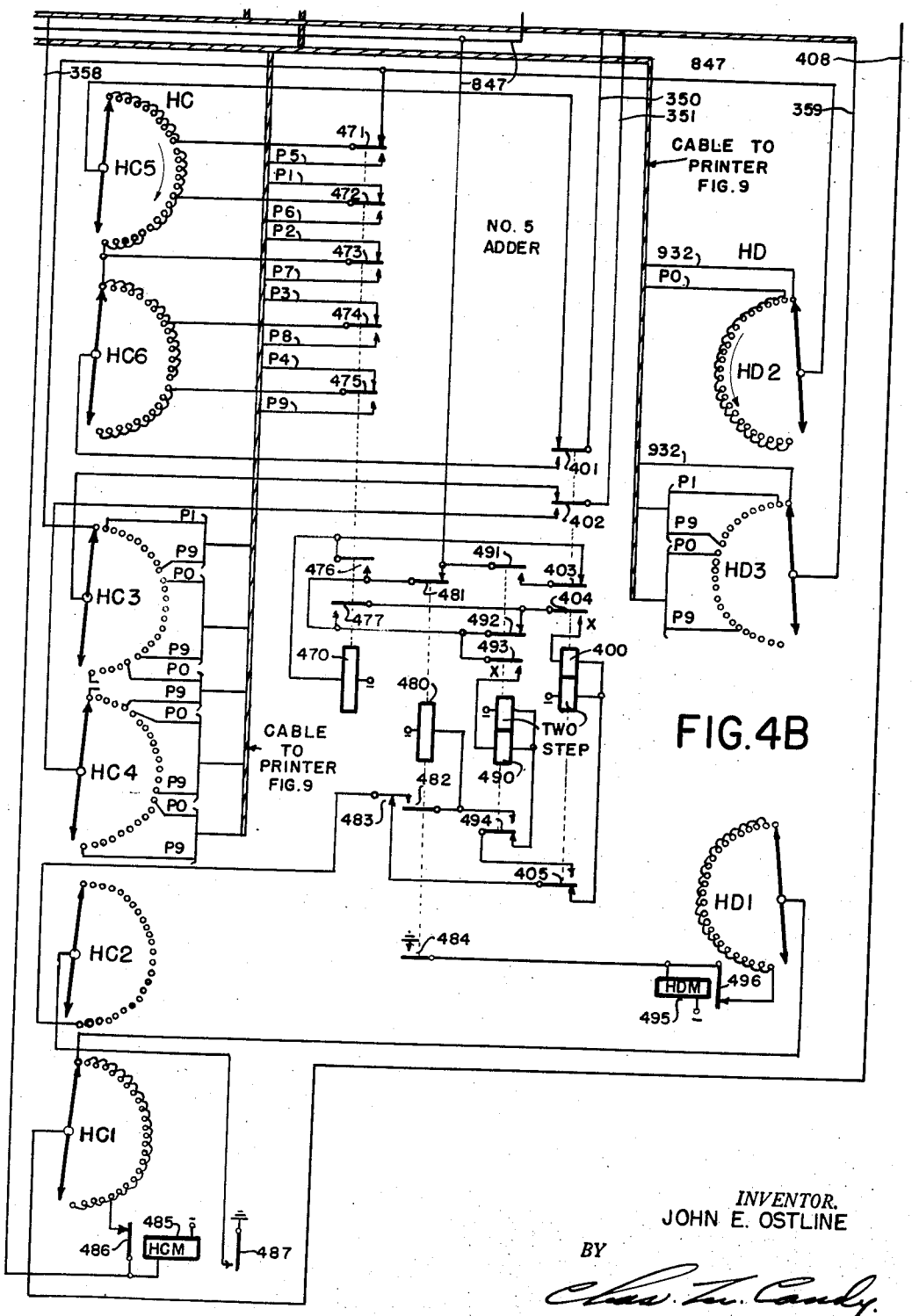

FIG.4B

INVENTOR.
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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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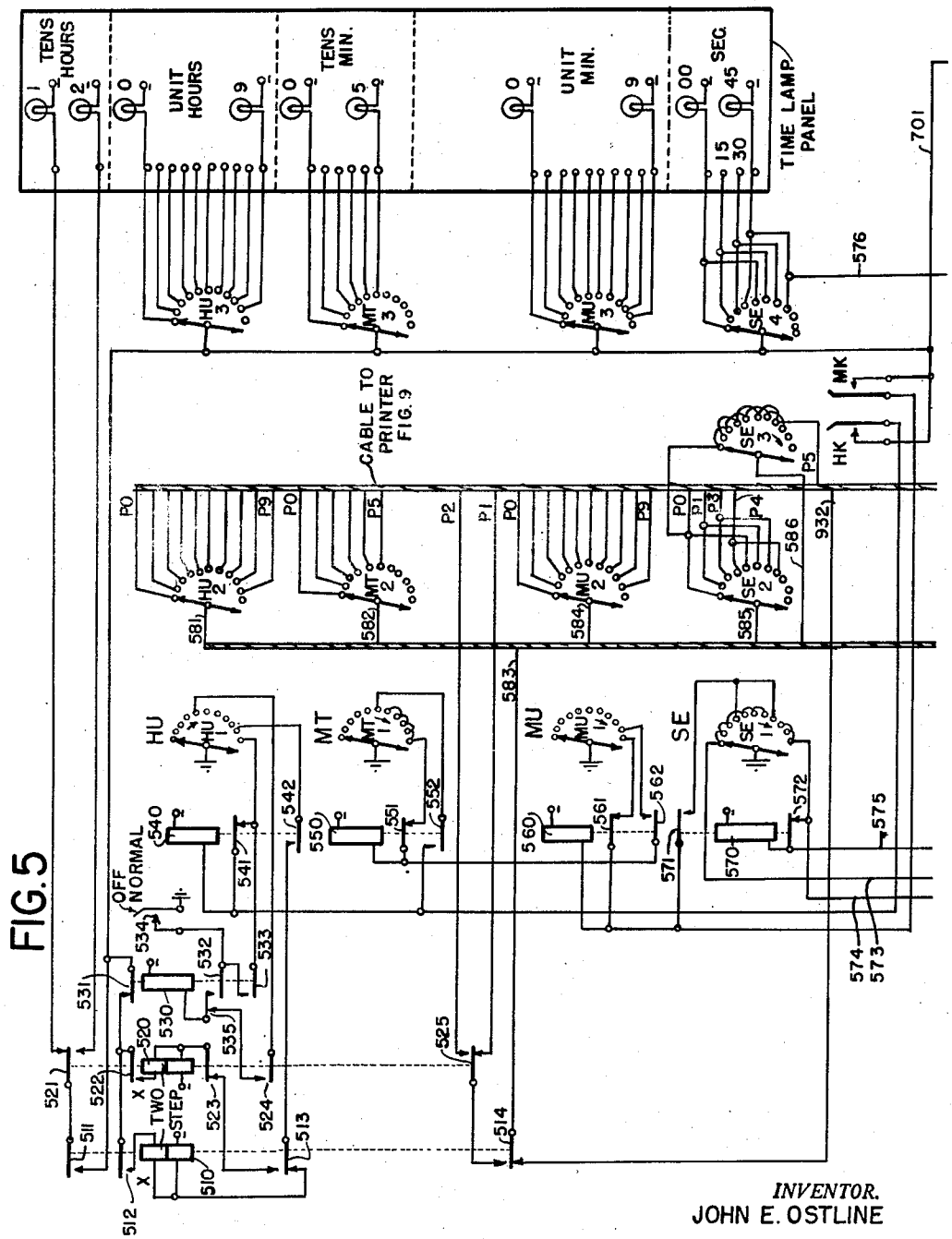

FIG. 5

INVENTOR.
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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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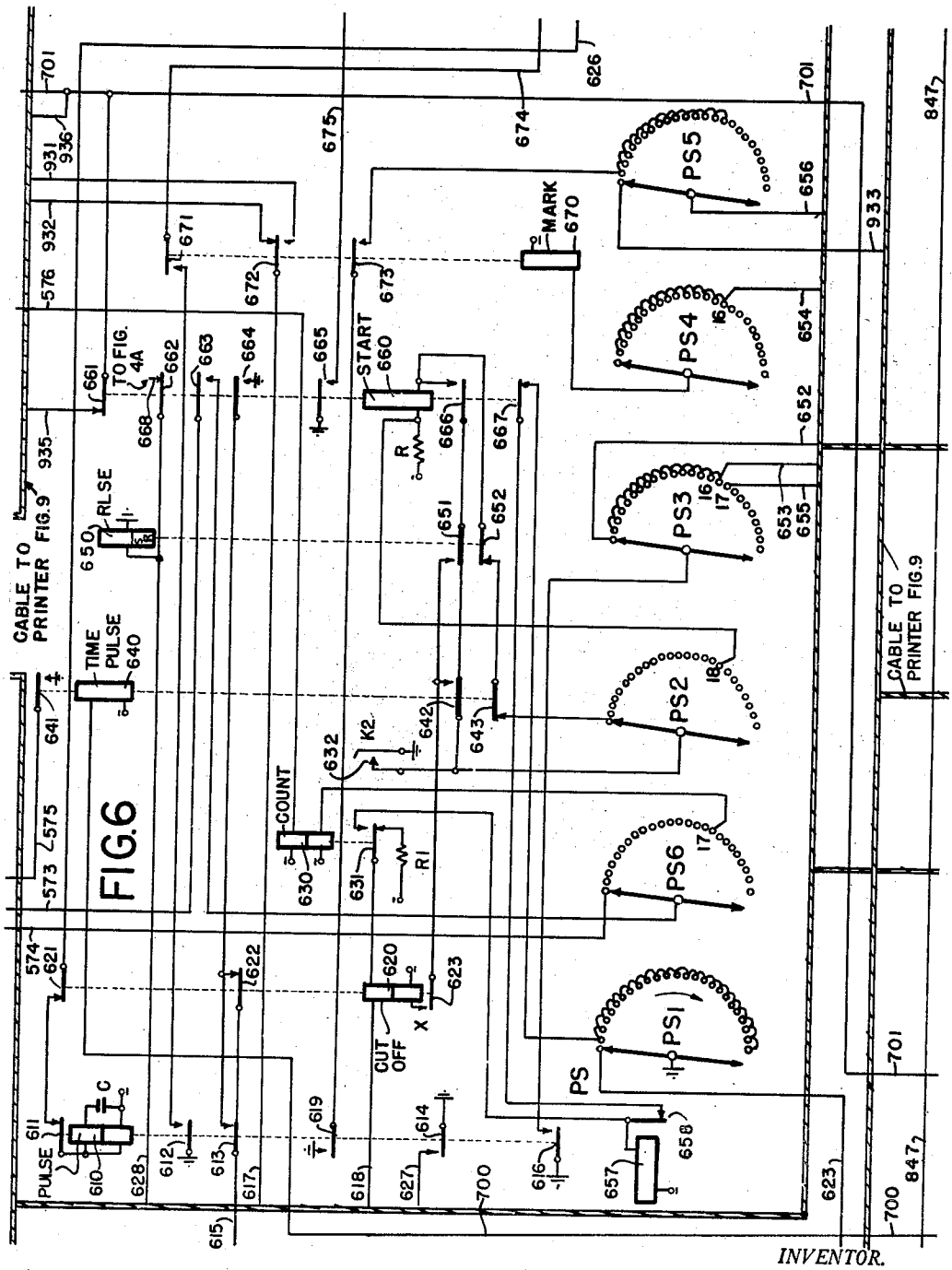

FIG.6

INVENTOR.
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TELEPHONE TRAFFIC RECORDING SYSTEM

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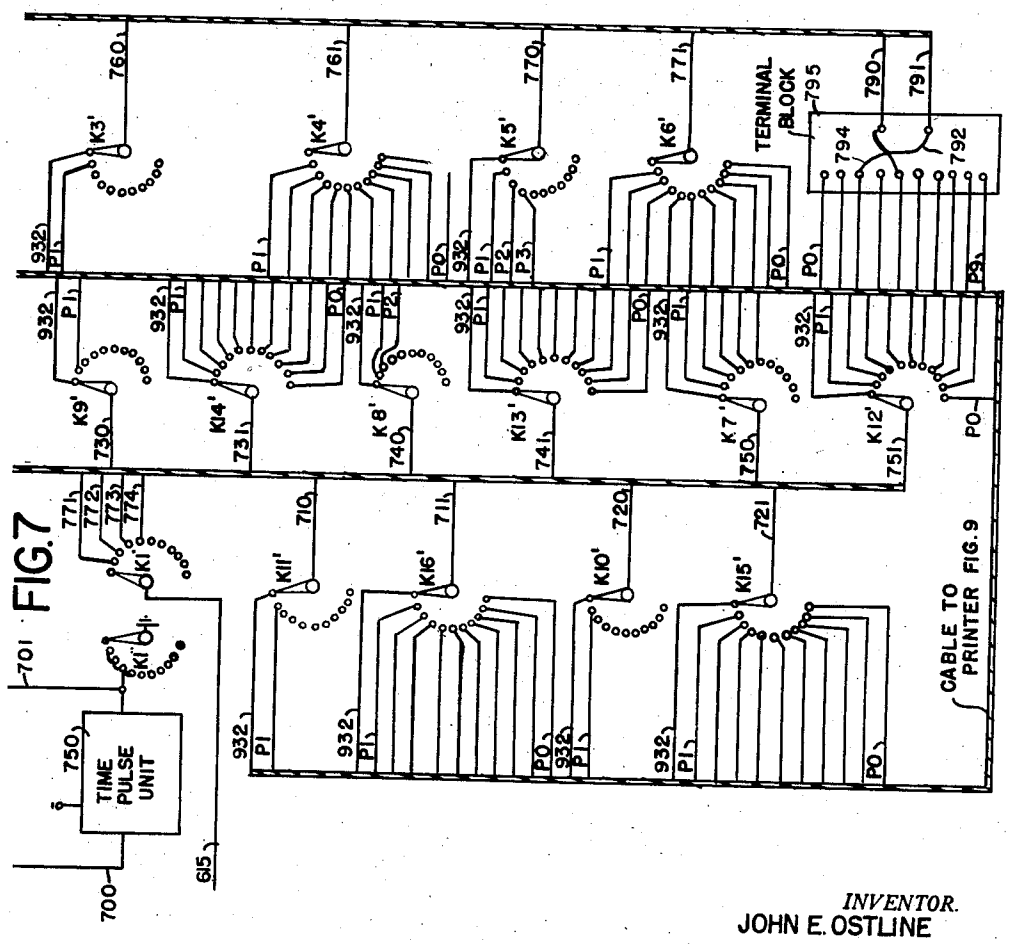

FIG. 7

INVENTOR.
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TELEPHONE TRAFFIC RECORDING SYSTEM

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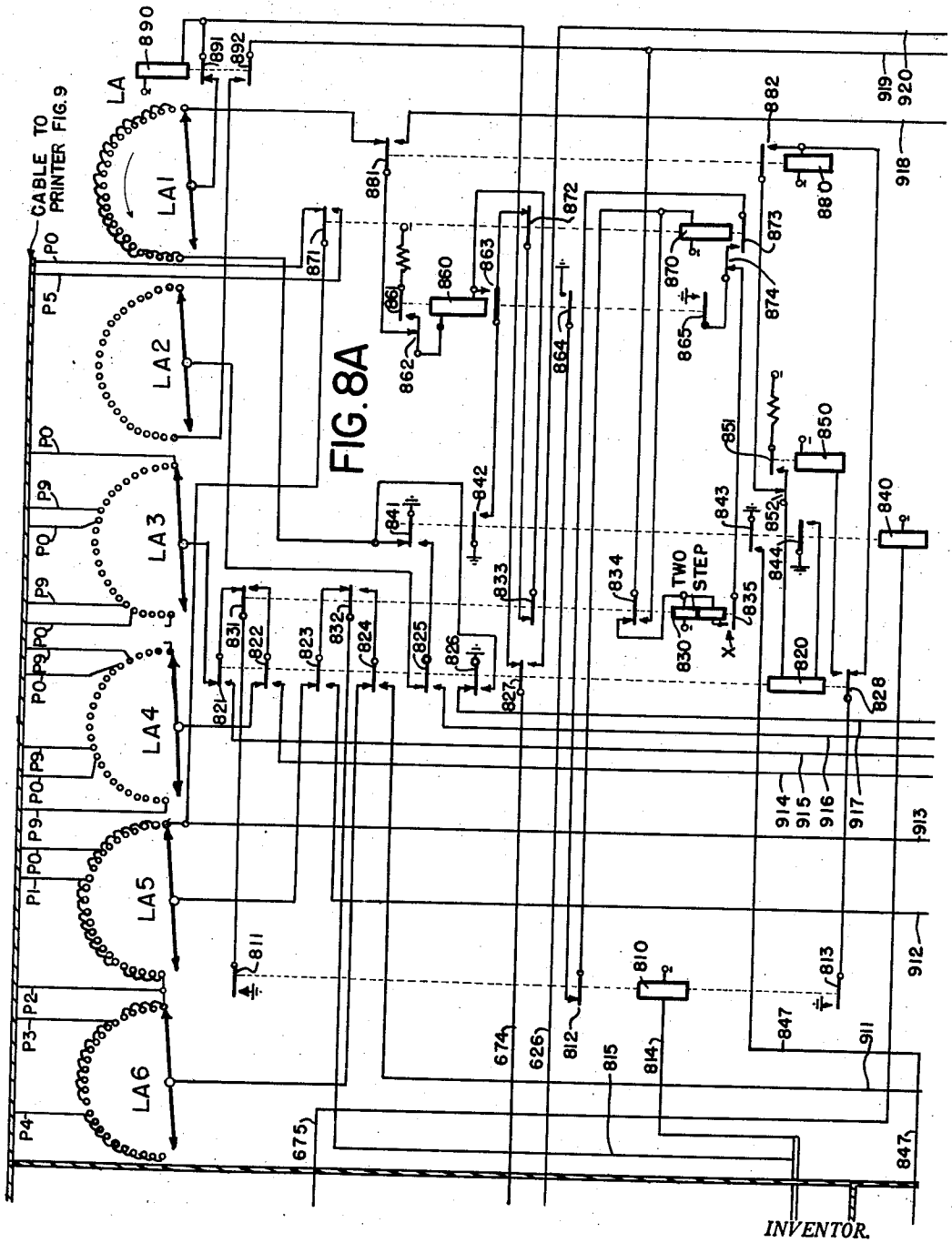

FIG. 8A

INVENTOR.
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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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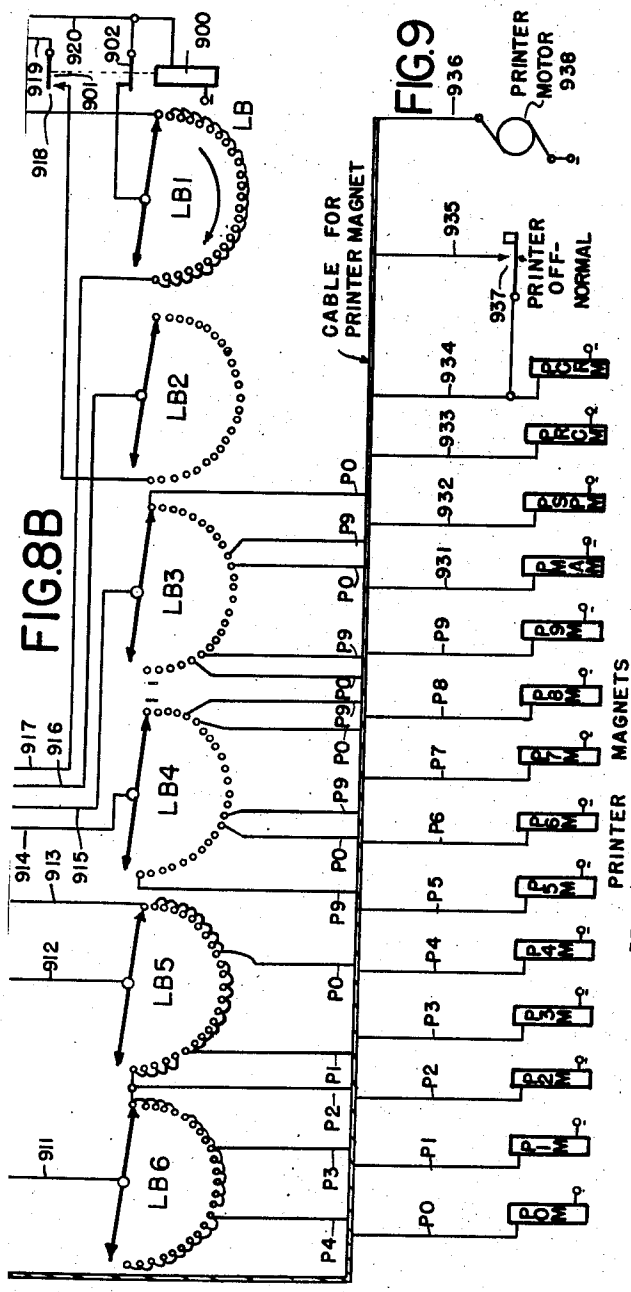

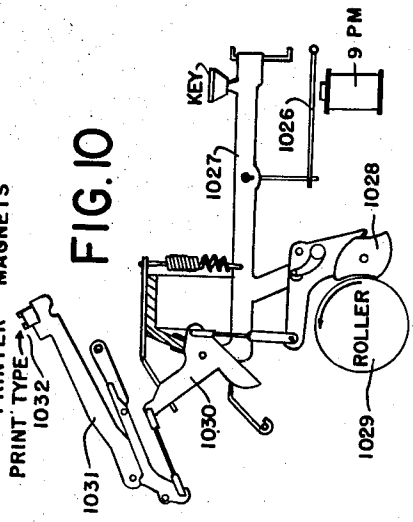

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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

Filed Jan. 22, 1944 16 Sheets-Sheet 14

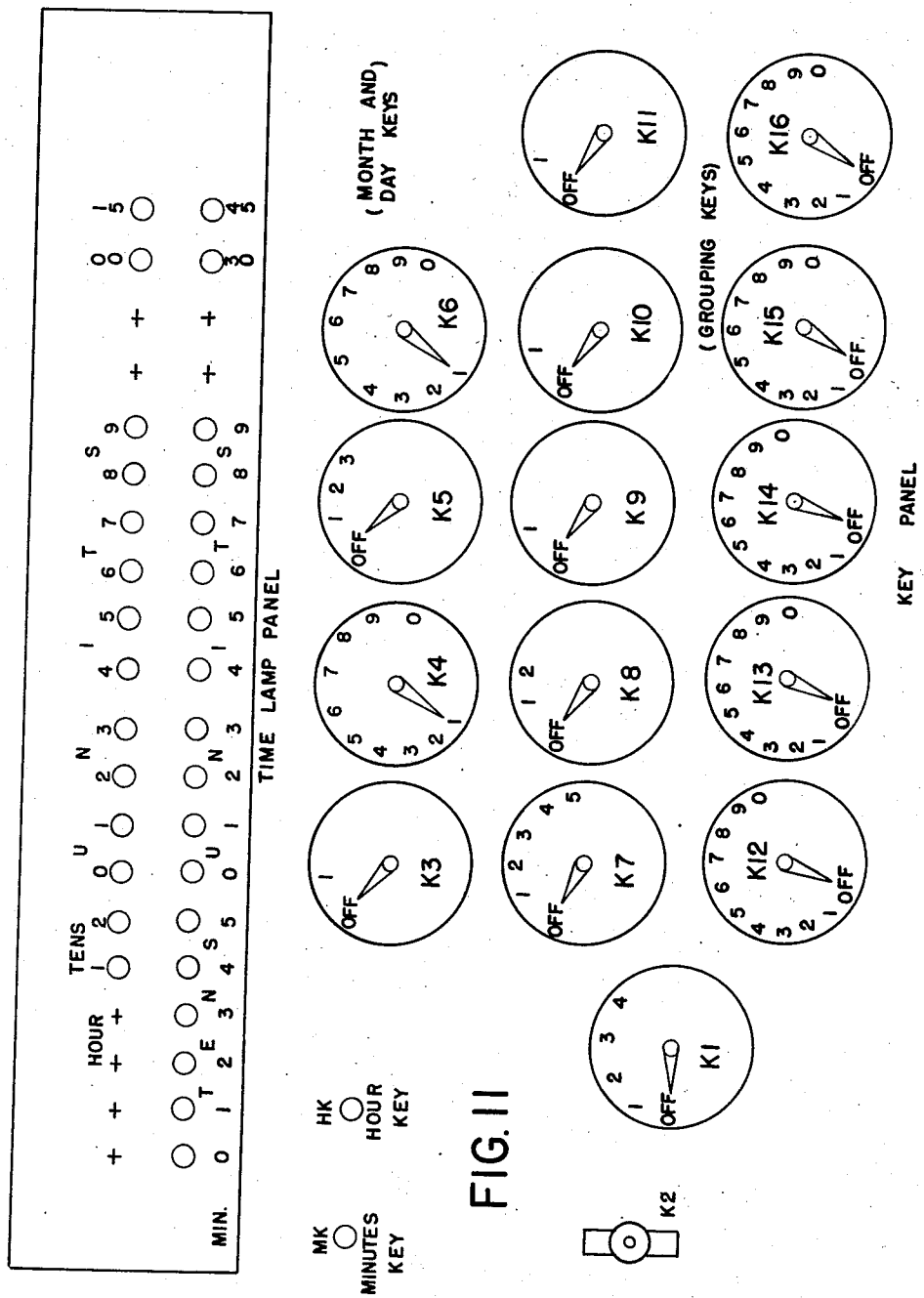

FIG. 11

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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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RECORDING CHART

FIG. 12A

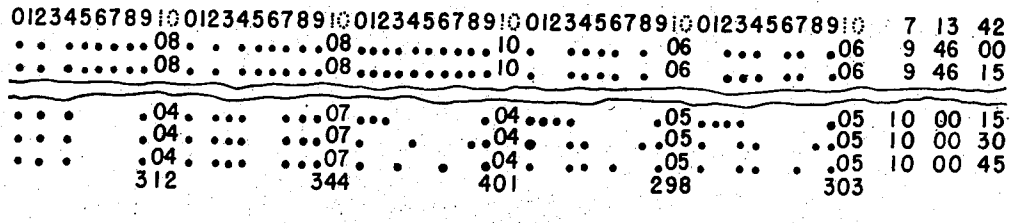


FIG. 12B

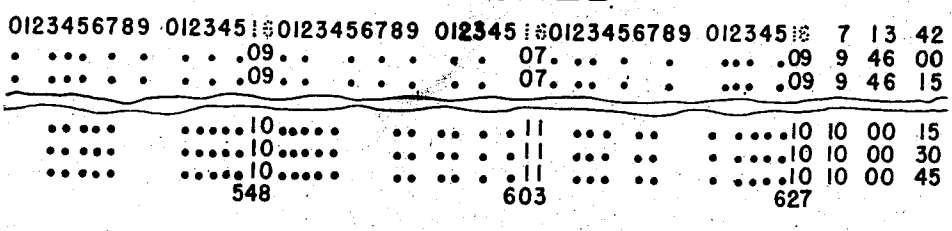


FIG. 12C

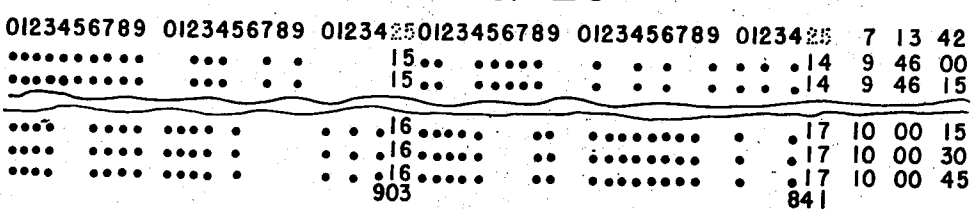
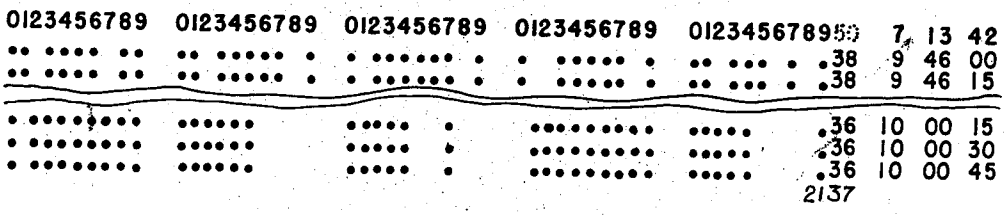


FIG. 12D



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Jan. 22, 1946. J. E. OSTLINE 2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

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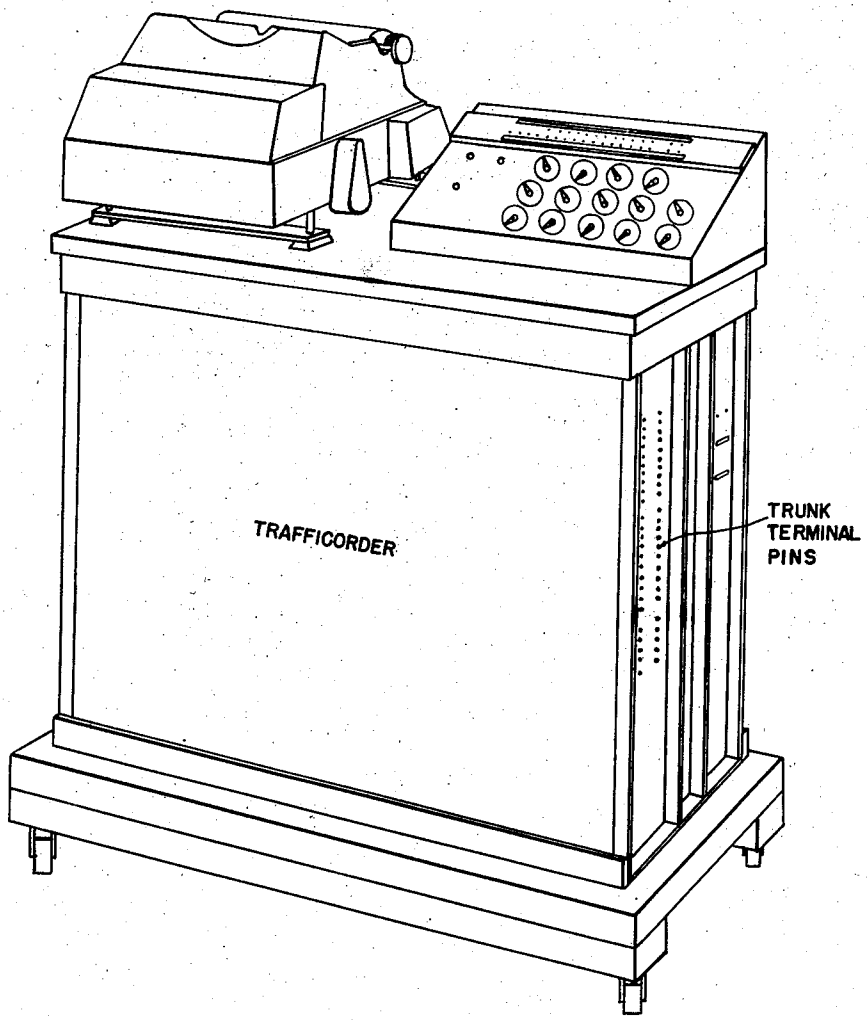
FIG. 13



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Patented Jan. 22, 1946 2,393,403

UNITED STATES PATENT OFFICE

2,393,403

TELEPHONE TRAFFIC RECORDING SYSTEM

John E. Ostline, Chicago, Ill., assignor to Automatic Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application January 22, 1944, Serial No. 519,257

42 Claims. (Cl. 179—8)

The present invention relates in general to traffic recording equipment for telephone, or like, systems and, more particularly, to improvements in apparatus for automatically testing and recording at regular intervals the busy trunks in one or more trunk groups associated with the apparatus.

One of the principal operating and maintenance requirements in automatic telephone systems is that of knowing the volume of traffic for which the trunks and switches are to be provided. As a telephone exchange or network increases in size, or as various classes of traffic change from one period to another, it becomes necessary to add to, subtract from, or re-arrange existing switching and trunk equipment to meet these changing traffic conditions. Therefore, periodic traffic studies become a necessary routine for traffic engineering purposes.

Methods of obtaining information relative to the duration and amount of calls in each trunk and switch group in the busy hour have varied from time to time. The most obvious method is, of course, that of observing the traffic manually by means of a stop watch. It is seldom used, due to the relative slowness with which representative amounts of observations can be accumulated.

Another method of obtaining holding time measurements is by recorders which mechanically and electrically indicate the holding time of each call in a group of switches or trunks during a certain time interval. These recorders, of which there are several types, usually have one common feature consisting of a paper tape moving at a pre-determined speed on which the length and the amount of calls are indicated by means of recording pens. The chief disadvantage with all devices of this type resides in the fact that the records obtained are of no use until considerable time and labor is expended in measuring, interpreting and summarizing the recorded results into fundamental quantities, and even then these results will be influenced by some guess work and errors due to manual interpretations.

In order to overcome the disadvantage and limitations of the foregoing methods, and to make possible a rapid accumulation of fundamental traffic data on a considerable amount of calls, a method referred to as "switch counts" has for a number of years been used. This method consists of placing one or more trunk groups to be studied under manual visual observation by an observer who counts and records at fixed regular intervals the amount of switches held in an operated or busy condition. Such data, when obtained in sufficient quantities, will indicate the average load in any switch or trunk group and by a relatively simple formula the "unit calls" carried by the trunk group can thus be obtained. This figure once having been ascertained, a consultation of standard traffic tables will indicate whether a group needs adjusting or if it is satisfactory for handling the offered traffic.

As in the case of mechanically tape recorded data, this second method of obtaining traffic data by manual observation has a number of disadvantages. The principal one of these is that the human element is always a variable factor and in addition the effectiveness of this method depends upon the frequency and regularity of each "scanning" operation, that is, the counting of busy switches during each period. In order to obtain this information correctly and in order to cover as many trunk groups as possible at the same time, many observers may be required. It is also found desirable to not only record the amount of trunks busy in the group, but also to identify the particular trunks which are busy. This information is desirable in order to determine if the observed "graded" groups are properly distributed or if they need re-adjusting.

It is an object of the present invention to provide an improved unit of apparatus, whereby switch counts are made, added and recorded automatically. This unit of apparatus hereinafter referred to as "Trafficorder," scans each trunk group under observation at regular fixed intervals. The data obtained from each scanning is then stored, analyzed and recorded in printed form comprising numeral characters. This data can, without any further analyzation or prolonged study, be used to ascertain if a trunk group or groups under observation requires any re-adjustment or not.

Another object of the invention is to provide an improved automatic testing and recording apparatus, which is operated to record in printed numerals a printed record designating, or identifying, each trunk and its idle or busy condition at periodic pre-determined timed intervals, the number of trunks in each trunk group and the number of such trunks which are busy at given pre-determined timed intervals, the date and time and the total number of busy trunks in each trunk group for a period of time comprising a

pre-determined number of the periodic timed intervals.

Another object of the invention is to provide equipment for the above apparatus which is automatic in its operation, after it is manually started, and which is flexible in that it can be used for testing and recording a pre-determined number of trunks arranged in one or more groups.

Another object of the invention is to provide circuits and apparatus to print a type written record comprising a "heading," a plurality of periodic trunk recordings, and a total recording. The "heading" comprises numerals and spacings designating the number of trunk groups, the number of trunks in each group, the identity of each trunk in each group and the day, month and year. The periodic trunk recordings comprising successive lines printed at pre-determined timed intervals, each line identifying each busy trunk and designating the number of busy trunks in each trunk group and the time of day. The total recording is printed after the periodic trunk recordings and shows the total sum of the busy trunks in each of the trunk groups during the periodic trunk recording operations.

Further novel features believed to be characteristic of the invention are set forth in the following description and in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the specification taken in connection with the accompanying drawings in which Figs. 1A and 1B illustrate the wiring arrangements of the three scanning switches A1, A2 and A3, and their associated controlling relays 100, 110, 120, the gang group relays GR1 and GR2 and a portion of the storage relays SR. Figs. 2A and 2B, and 3A and 3B illustrate similar scanning switches B1, B2 and B3 and C1, C2 and C3 and their associated control relays; Fig. 3B also diagrammatically represents three adders which are similar to the No. 5 adder shown in Fig. 4B; Fig. 4A illustrates the No. 1 adder and Fig. 4B the No. 5 adder; Fig. 5 illustrates the timing apparatus comprising an hours switch HU, a tens minute switch MT, a units minute switch MU, and a seconds switch SE and their associated relays and a time panel for displaying the time of day; Fig. 6 illustrates the primary switch PS together with its control relays and start key K2. Fig. 7 illustrates the wipers controlled by the manually controlled keys shown in Fig. 11, the time pulse unit 750 and the cross connecting terminal block 795; Figs. 8A and 8B illustrate the two counter switches LA and LB and their associated control relays; Fig. 9 illustrates the wiring arrangement of the record printer and Fig. 10 diagrammatically illustrates the mechanism of the record printer; Fig. 11 shows the time lamp panel, the manually controlled keys comprising the date keys K3, K4, K5 and K6, the grouping keys K7, K8, K9, K10, K11, K12, K13, K14, K15 and K16, the group selecting key K1, the start key K2 and the minutes and hours keys MK and HK; Figs. 12A, 12B, 12C and 12D show in part the kind of recording charts printed by the apparatus; and Fig. 13 shows a perspective view of this unit of apparatus, referred to as a "Trafficorder."

Referring now more particularly to the drawings, the scanning switches are of the well-known rotary switch type which operate their wipers one step in response to the release of their associated stepping magnets. Each scanning switch has six wipers, the first one for controlling the stepping circuits, the second for controlling the circuits and apparatus to print the "headings," such as shown in Figs. 12A, 12B, 12C and 12D, the 3rd and 4th for controlling the circuits and apparatus to print the second and successive lines on the recording charts, the 6th for controlling the circuits to operate the adders to total the number of busy trunk conditions encountered, and the 5th for controlling the circuits and apparatus to print the total busy trunk conditions added by the adders and shown in the last line on each recording chart. Trunk terminal pins 0 to 49, inclusive, shown at the extreme right of Fig. 1B, are cross connected by means of jumpers to the test conductors of the trunks to be tested. The gang group relays GR1 and GR2, when energized, connect these trunk test conductors to test conductors T0 to T49, inclusive. The storage relays SR0 to SR49 are individually connected to corresponding ones of these test conductors and are operated if the corresponding trunk test conductors are grounded due to the corresponding trunks being busy. The test conductors T0 to T49, inclusive, terminate in the bank contacts accessible to the fourth wiper of each scanning switch and these wipers are connected by way of conductor 654 to the primary switch PS (Fig. 6) for controlling Mark relay 670.

The second wiper of each scanning switch has access, by way of its bank contacts, to printer conductors P0 to P9, inclusive, extending by way of a cable to the printer magnets shown in Fig. 9. The second wipers of the scanning switches also have access to conductors extending by way of a cable to Fig. 7 to the wipers of the grouping keys and these scanning wipers are connected by way of conductor 652 to the primary switch PS in Fig. 6.

The third wiper of each scanning switch has access to conductor 617 extending to the primary switch relay group (Fig. 6) and to conductors extending to the counter switches for controlling the operation of the printer. Some of these wipers have access to conductors extending to the time switches shown in Fig. 5. These wipers are connected by way of conductor 653 to the primary switch PS.

The sixth wiper of each scanning switch is connected by way of conductor 656 to primary switch PS and has access to conductors extending to the adders for stepping the adder switches one step for each busy trunk encountered. The fifth wipers of the scanning switches are connected by way of conductor 655 to the primary switch PS and have access to conductors extending to the adders for reading the total added by the adders.

The adders shown in Figs. 4A and 4B, and diagrammatically shown by squares in Fig. 3B, each comprise two rotary stepping switches of the well-known type and a group of control relays. The switches HA and HC are stepped one step for each busy trunk encountered by the scanning switches, while the switches HB and HD are stepped one step for each 100 busy registrations. These switches have access to printer conductors extending in a cable to the printer magnets shown in Fig. 9.

The time switches HU, MT, MU and SE in Fig. 5 are of the well-known rotary type switches which step their wipers on the deenergization of their respective stepping magnets. One wiper of each of these timing switches is connected by way of a cable to the scanning switches shown in

Figs. 1A, 2A and 3A and have access to printer conductors extending by way of a cable to the printer magnets shown in Fig. 9. Another set of wipers of these time switches are connected to the lamps in the time lamp panel for displaying the time of day. Relays 510, 520 and 530 are provided for switching over to the proper tens hour printer conductor. Time switch HU is provided with off-normal springs 534 which are in normal open position when the wipers of the units hour switch HU are in their first position. These off-normal springs close when the wipers of this switch take their first step. The hours key HK and the minutes key MK corresponding to the hours key HK and the minutes key MK shown in Fig. 11 are provided for manually setting the time switches to correspond to the time of day.

Fig. 6 shows the primary switch PS and associated control relays. The primary switch PS is of the well-known rotary type which steps its wipers on the deenergization of its stepping magnet. The start key K2, corresponding to key K2 in Fig. 11, is provided for initiating the operation of the "Trafficorder" after the time switches, the month and day keys, and the grouping keys have been properly set.

Fig. 7 shows a plurality of key wipers controlled by the manually set corresponding keys in Fig. 11 and a time pulse unit 750 which is operative when ground is connected thereto for transmitting time pulses every 15 seconds. The key wipers are connected by conductors extending by way of a cable to the scanning switches and these wipers have access to printer conductors extending by way of a cable to the printer magnets in Fig. 9. The key wiper K1' has access to conductors extending to the scanning switches for controlling certain of the scanning control relays in accordance with the desired groupings of the trunks. A terminal block 795 is shown in Fig. 7 connected to printer conductors extending to the printer magnets and is arranged for cross connection by means of jumpers to conductors extending to the scanning switches for designating the last two digits of the year.

Figs. 8A and 8B show the counter switches LA and LB which are also of the well-known rotary type. The bank contacts of the counter switches are connected by way of printer conductors to the printer magnets of Fig. 9. Fig. 8A shows a group of counter switch control relays for controlling the operation of the counter switches LA and LB.

Fig. 9 shows the printing magnets and driving motor of the record printer and Fig. 10 shows the mechanism associated with one of these printing magnets. This record printer is an electrically driven typewriter and is commonly known as the "Electromatic" printer. Tht "Electromatic" printer comprises a motor driven typewriter such as disclosed in "Product Engineering" for November, 1930, and in "The Story of Electromatic," published by the Electromatic Typewriters, Inc., Rochester, New York. During the time the electromatic printers are in use, the small electric motors for controlling the same are in constant operation and are constantly operating the soft rubber rollers, such as roller 1029, shown in Fig. 10. In order to operate the electromatic printer in this case, magnets P0M to P9M, inclusive, and mark magnet PMA are added to control the key bars. In Fig. 10 magnet P9M operates its armature 1026 to in turn actuate the key bar 1027. This results in bringing the cam 1028 into contact with the rotating roller 1029. Cam 1028 instantly turns through one-half revolution, and in so doing, actuates the type bar 1031 to print the numeral 9. Each cam, such as 1028, is pivoted at one end of a bell crank forming part of the linkage it operates. Normally, a stop holds each cam a few thousandths of an inch out of contact with the roller surface, but when the magnet corresponding to a given cam is operated, a spring forces the serrated surface of the cam against the soft rubber surface of the roller and the two rotate together without slippage. In so doing, the cam pivot and the link to which it is attached are forced away from the roller. It is this motion, for which the motor supplies the power, that actuates the type bar. Since the mechanical construction of the electromatic printer is not part of this invention, it is believed that this general description of its operation will suffice. Any further details regarding the mechanical operation of this type of printer may be had by referring to the aforesaid publications. All the letter type bars of this printer have been removed and only the numeral type bars 0 to 9, inclusive, and one other type bar referred to as the Mark type bar having a small zero for indicating busy trunks remain because only these type bars are used in the present invention. The carriage of the printer moves one step when any type bar is actuated and also steps or spaces when the space magnet PSPM is actuated. The printer is provided with a printer ribbon control magnet PRCM which, when actuated, positions the red ribbon, for printing red characters instead of the usual black characters. The printer also has a carriage return magnet PCRM which, when actuated, restores the carriage to its initial typing position as well as spacing the paper for printing on the spacing the paper for printing on the next line. The printer off-normal springs 937 are normally opened when the carriage of the printer is in its normal position and closes as soon as the carriage moves in its first step. The printer motor 938 is actuated as long as the conductor 936 is grounded.

Fig. 13 shows a perspective view of the portable "Trafficorder" having a box like enclosure for enclosing the equipment comprising the rotary switches and their associated relays. The combined lamp and key panel and the electromatic printer is shown mounted on the top of this unit. Along the righthand side of the enclosure are provided trunk terminal pins to which the test trunks of the trunks to be tested are cross connected by means of jumpers. A pair of battery terminals and a pair of fuses are also shown.

The "Trafficorder" is a unit of apparatus which will collect, analyze and record in printed form all data required to ascertain the volume of traffic carried by each group of trunks under observation. This data is obtained by scanning each connected trunk group for busy trunks every 15 seconds during the busy hour or any other periods for as long a time as may be desired. The "Trafficorder" is arranged to observe traffic on a maximum of fifty trunks which may be grouped as follows: grouping No. 1 for 5 groups of 10 trunks, grouping No. 2 for 3 groups of 16 trunks, grouping No. 3 for 2 groups of 25 trunks, grouping No. 4 for a single group of 50 trunks. The foregoing number of trunks in each trunk group are the maximum, and, if desired, the number of trunks in each trunk group may be less for any group.

After connecting the desired trunks to the trunk terminal pins of the "Trafficorder" and after op-

erating the manual keys of the key panel are set in accordance with the desired trunk grouping, the minutes and hours keys are operated until the lamp panel displays the correct time of day. The start key K2 is then operated to cause certain of the scanning switches, in accordance with the grouping selected, to operate in a series of scanning cycles, or operations. The selected scanning switches, comprising three in number, are operated through a complete scanning cycle every 15 seconds. The first scanning cycle of the scanning switches causes a "heading," such as shown in Fig. 12A to be printed across the record sheet. This "heading" shows the identity number of each connected trunk, the actual number of trunks in each group, the number of groups, and the month, day and year. After this "heading" is printed a second scanning cycle is automatically started and the primary switch PS takes one step to alter the functions performed by these scanning switches. The second and subsequent cycle operations of the scanning switches cause the printing of the second and subsequent lines, such as shown on chart 12A. Each trunk found busy is identified by a mark. The number of busy trunks in each trunk group is counted and this total is printed. The clock time of these cycle operations is also printed. During these cycle operations the number of busy trunks in each trunk group are added in the respective adders and after sixty such cycle operations the totals added by the adders are printed on the chart as shown in the last line of Fig. 12A.

Detail operation

The first operation to be performed by the observer is to connect the test conductors of the trunks to be observed to the trunk terminal pins shown to the right on Fig. 1B. To do this the observer wheels the "Trafficorder" to some distributing frame, or distributing point, and then jumpers only the test conductors of the trunks to be observed to the trunk terminal pins 0 to 49, inclusive, as shown in Fig. 1B. The observer also connects the negative and positive battery bus bars of the exchange battery to the battery terminals on the "Trafficorder."

The next operation is to operate the group selecting key K1 to select a particular grouping. The "Trafficorder" is arranged to observe traffic on a maximum of 50 trunks which can be grouped as follows:

Grouping #1—five groups of ten trunks each,
Grouping #2—three groups of 16 trunks each,
Grouping #3—two groups of 25 trunks each,
Grouping #4—one group of 50 trunks.

The observer now sets the key K1, shown in Fig. 11, to the number corresponding to the desired grouping. The wipers K1′ and K1² (Fig. 7) are associated with the key K1 and are operated to corresponding positions.

Assuming that the key K1 is operated to its #1 position then the wiper K1′ is operated into engagement with conductor 771 in Fig. 7 for the #1 grouping and the associated wiper K1² is operated to ground the conductor 701 and to start the time pulse unit 750. The time pulse unit 750 is a timing device which operates to ground the time pulse conductor 700 every 15 seconds as long as conductor 701 is grounded.

In this case since grouping #1 has been selected, the keys K7, K8, K9, K10 and K11 of Fig. 11 are manually set to their #1 positions and the keys K12, K13, K14, K15 and K16 are set to their "0" positions. This operation of the keys divides the fifty trunks into five groups of ten trunks each. Referring now to Fig. 7, the wipers K7′, K8′, K9′, K10′ and K11′ are each set to their second positions in engagement with the P1 conductor which extends to the #1 printer magnet P1M shown in Fig. 9. It should be mentioned that the wipers such as wiper K7′ is moved at the same time that the key K7 is manually moved by the observer. In the same manner the wipers, which are shown primed, operate at the same time as the correspondingly indicated key. The keys K12, K13, K14, K15 and K16 and their corresponding primed wipers shown on Fig. 7 are each operated to their last positions in engagement with the conductor P0 which extends to the #0 printer magnet P0M shown in Fig. 9.

In response to grounding the conductor 701, the time pulse unit 750 is operated to ground conductor 700 every fifteen seconds or four times per minute. The grounding of conductor 701 also completes a circuit for starting the printer motor 938 over a circuit as follows: from grounded conductor 701 to the printer motor start conductor 936 included in the printer cable which extends to Fig. 9 and thence by way of conductor 936 to the printer motor 938 to battery. The grounding of conductor 701 also completes a circuit for the printer carriage return magnet PCRM if the carriage of the printer is off-normal as follows: from grounded conductor 701, contact 661 of start relay 660, printer off-normal conductor 935 to the printer off-normal contacts 937 and to the winding of the printer carriage return magnet PCRM to battery. The operation of the printer carriage return magnet PCRM will return the printer carriage to its initial typing position as well as advancing the recording sheet one vertical spacing step. Grounded conductor 701 also grounds the HU3, the MT3, the MU3, and the SE4 wipers of the time display switches shown in Fig. 5. Assuming that these wipers at this time are in the position shown in Fig. 5, the grounding of these wipers will complete circuits for the #0 unit hours lamp, the #0 tens minute lamp, the #0 unit minutes lamp, and the #00 seconds lamp shown in the time display panel of Fig. 5.

In the lower portion of Fig. 5 are shown the minute key MK and the hour key HK which are provided for the purpose of directly operating the stepping magnets of the minutes and hours time switches so as to manually set the time display to correspond with the actual time of day the observation is to be taken.

As shown in Fig. 5 the tens minute switch MT and the units minute switch MU are both in 0 position thereby lighting the 0 tens and 0 units minutes lamps. Assuming that the time is 9:45 a. m., the minute key MK is operated forty-five times to operate the stepping magnet 560 of the unit minute switch MU over the following circuit: from grounded conductor 701 thru the spring contacts of the minute key MK and from thence to the winding of stepping magnet 560 to battery. On each deenergization of the stepping magnet 560 the unit minute switch MU operates its wipers MU1, MU2, and MU3 one step. When wiper MU1 reaches its tenth position a circuit is prepared for operating the stepping magnet 550 of the tens minute switch at contacts 562. The next time stepping magnet 560 is energized, the contacts 562 complete a circuit from the grounded wiper MU1 by way of the tenth bank contact to the winding

of stepping magnet 550 and battery. Stepping magnet 550 energizes and positions its pawl preparatory to stepping the wipers of the tens minute switch MT. When stepping magnet 560 deenergizes and opens the circuit to stepping magnet 550 at contacts 562, the magnet 550 deenergizes to step the wipers of the tens minute switch MT one step. When stepping magnet 560 deenergizes it also steps the wipers of the units minute switch MU to step the wipers into engagement with their last set of bank contact. In this position wiper MU1 completes a circuit from ground by way of the last bank contact, contact 561 and thru the winding of stepping magnet 560 to battery. Magnet 560 energizes and at contacts 561 interrupts its own circuit thereby causing the wipers of the units minute switch MU to be stepped to their first positions, or to the positions shown in Fig. 5. Each time the minute unit switch wiper MU1 reaches its tenth position and stepping magnet 560 is thereafter energized, the circuit for stepping magnet 550 of the tens minute switch MT is operated. Since the minute unit switch is operated 45 steps by the operation of the minutes key MK, the unit minute switch MU makes four complete revolutions and each time it reaches its tenth position it completes the previously described circuit for operating the stepping magnet 550.

In order to set the time lamp panel to indicate the correct hour, the hour key HK is operated 9 times. Each operation of the hour key HK completes a circuit for stepping the hour units switch HU by operation of the stepping magnet 540 over the following circuit: from ground by way of grounded conductor 701, make contacts of the hour key HK and thru the winding of the stepping magnet 540 to battery. The wipers of the hour units switch HU are stepped from their first, or "0" position, to their tenth positions after the last deenergization of stepping magnet 540. The hour unit switch HU is now in its tenth position and wiper HU3 completes the circuit for lighting the #9 units hour lamp from grounded conductor 701 and the minute tens switch MT is now in its fifth position to complete a circuit thru the wiper MT3 to the #4 tens minute lamp (not shown) from grounded conductor 701. The minute unit switch MU is now in its sixth position and at wiper MU3 completes a circuit for the #5 units minute lamp (not shown) from grounded conductor 701. The seconds switch SE is in its first position and at wiper SE4 completes a circuit for energizing the "#00" seconds lamp from conductor 701. The lamps in the time lamp panel now display the 9 units hour lamp, the 4 tens minute lamp, the 5 units minute lamp and the "00" seconds lamp to indicate the time as being 9:45 a. m.

As previously stated the time pulse unit 750 grounds conductor 700 every 15 seconds to operate the time pulse relay 640. At contacts 641, time pulse relay 640 completes circuit by way of conductor 575 and thru the winding of seconds stepping magnet 570 to battery. In response to 3 such impulses transmitted by the time impulse relay 640, stepping magnet 570 steps the seconds switch SE into engagement with its fourth bank contact. In this position the wiper SE4 completes a circuit for energizing the #45 seconds lamp by way of grounded conductor 701 to change the lamp display. On the next energization of time pulse relay 640, stepping magnet 570 is again energized and at contacts 571 completes a circuit by way of the grounded SE1 wiper thru the winding of the stepping magnet 560 of the minute units switch MU to battery. The stepping magnets 570 and 560, upon energizing, position their pawls preparatory to the stepping of their respective wipers. In response to the deenergization of the time pulse relay 640, the stepping magnet 570 deenergizes and at contacts 571 opens the circuit to the stepping magnet 560. The wipers of the minute unit switch MU and the second switch SE are operated an additional step. The minutes unit wiper MU3 is now operated to its seventh position to illuminate the #6 units minute lamp while the seconds switch SE has operated its wipers SE4 to its fifth position to illuminate the seconds "00" lamp from grounded conductor 701. In a manner just described the time pulses generated by time pulse relay 640 steps the seconds switch SE by operating the stepping magnet 570 to its eighth position in which position the 45 seconds lamp is illuminated. It should be understood that in the intervening steps of the second switch the 15 seconds lamp and the 30 seconds lamp are successively illuminated in accordance with the set positions of the wiper SE4. On the next energization of stepping magnet 570, contacts 571 again completes the circuit for stepping magnet 560 this time thru the eighth position bank contact of wiper SE1. On the deenergization of the time pulse relay 640, stepping magnet 570 deenergizes and opens the circuit to the stepping magnet 560 thereby causing both the minute unit switch MU and the seconds switch SE to take one additional step. The minute units switch MU is now in its eighth position to display the #8 minute units lamp. In response to the deenergization of stepping magnet 570 and the stepping of the seconds switch SE wipers to their ninth position, a self interrupting circuit is completed for the stepping magnet 570 as follows: grounded wiper SE1 thru the 9th, 10th and last bank contacts accessible thereto, interrupter springs 572 and thru the winding of stepping magnet 570 to battery. The stepping magnet 570 acts in the manner of a buzzer to automatically position the wipers of the seconds switch SE to their first positions or the positions shown in Fig. 5.

In a similar manner, stepping magnet 570 steps the seconds switch SE every fifteen seconds and on each fourth time pulse, operates the stepping magnet 560 to step the minutes unit switch MU. The minutes units switch steps one step every minute. The minutes units switch operates the minute tens switch MT one step every ten minutes as follows: assuming now that the time is 9:49 a. m. and 45 seconds, the minute tens switch MT is in its 5th position, the minutes units switch MU is in its 10th position and the seconds switch SE is in its fourth or eighth position, and the hour units switch HU is in its 10th position. On the next pulse of time pulse relay 640, stepping magnet 570 is energized over conductor 575 and the contacts 571 close the circuit to stepping magnet 560. Stepping magnet 560, upon energizing, at contacts 562 closes the circuit for energizing stepping magnet 550 of the tens minute switch MT. The stepping magnets 550, 560 and 570 position their pawls preparatory to stepping their respective wipers. When the ground time pulse is removed from conductor 575 by the deenergization of time pulse relay 640, the stepping magnet 570 deenergizes to step its wipers and to open the circuit to stepping magnet 560 at contacts 571. Stepping magnet 560, upon deenergizing, steps its wipers to their last posi-

tions and at contact 562 opens the circuit to stepping magnet 550. In its last position, wiper MU1 of the minute unit switch MU completes a circuit by way of contacts 561 and thru the winding of stepping magnet 560 to step the wipers of the minute unit switch MU to their first positions. Stepping magnet 550, upon deenergizing, steps its wipers to its 6th position to illuminate the #5, tens minute lamp instead of the #4 tens minute lamp. The time displayed on the lamp panel is now 9:50::00 seconds.

The time pulses step the second switch SE, the minute unit switch MU, and the minute tens switch MT as previously described, and, at 9:59::45 seconds, the time switches will be in the following positions: the hours units switch will be in its tenth position for displaying the #9 units hour lamp; the minutes tens switch will be in its sixth position for displaying the #5 tens minute lamp; the minute unit switch will be in its tenth position for displaying the #9 units minute lamp and the seconds switch SE will be in its eighth position for displaying the #45 seconds lamp.

On the next time pulse, time pulse relay 640 again energizes and at contacts 641 grounds conductor 575 to again operate the stepping magnet 570, stepping magnet 570 at contacts 571 again closes the circuit to operate the stepping magnet 560. Stepping magnet 560 at contacts 562 close the circuit to operate stepping magnet 550. Stepping magnet 550 at contacts 552 completes a circuit from the tens minute switch wiper MT1 for energizing the stepping magnet 540 of the units hour switch HU. The stepping magnet 540 at contacts 542 completes a circuit from grounded wiper HU1 by way of the tenth bank contact, back contacts 513 and thru the lower winding of two-step relay 510 to battery. Relay 510 is a two-step relay and when energized over its lower winding alone closes only the contacts 512. The closure of contacts 512 completes a circuit from grounded conductor 701 thru back contacts 531 for short circuiting the upper winding of two-step relay 510. Two-step relay 510 is so designed that it will operate its remaining contacts when the short circuit is removed from its upper winding. When relay 640 deenergizes at the end of this time pulse, stepping magnet 570 deenergizes and steps its wipers and opens the circuit to stepping magnet 560 which likewise steps its wipers and opens the circuit to stepping magnet 550. Stepping magnet 550 deenergizes and opens the previously traced circuit to stepping magnet 540 which deenergizes and steps its wipers. At contacts 542 stepping magnet 540 opens the short circuit around the upper winding of relay 510 to permit the two-step relay 510 to close its remaining contacts over a circuit extending from grounded conductor 701, contacts 531 and 512, and to the upper and lower windings of two-step relay 510 to battery. The deenergization of stepping magnet 570 completes a previously described self-interrupting circuit thru its 9th, 10th and last position bank contacts for stepping the seconds switch SE to its first position. The deenergization of stepping magnet 560 completes a self-interrupting circuit by way of the MU1 wiper for stepping the minute unit switch to its first position. The deenergization of stepping magnet 550 completes a self interrupting circuit by way of grounded wiper MT1 thru its 7th, 8th, 9th, 10th and last multiple bank contacts, contact 551 and thru the winding of stepping magnet 550 to battery for stepping the wipers of the minute tens switch to its first position. The deenergization of stepping magnet 540 completes a circuit from grounded wiper HU1 thru its last bank contact, contacts 541 and thru the winding of stepping magnet 540 to battery to step the wipers of the hours unit switch to its first position. The respective switches now display the "0" lamps for their respective time indications. Two-step relay 510, upon energizing, at contacts 511, completes a circuit for energizing the #1 tens hours lamp as follows: from grounded conductor 701, contacts 511, back contacts 521 and thru the #1 tens hour lamp to battery. The time display is now 10 o'clock. At back contacts 513, relay 510 opens its original energizing circuit and at front contacts 513 prepares a circuit for two-step relay 520. At back contacts 514, two-step relay 510 disconnects the printer space conductor 932 from conductor 583 and at its front contacts connects the conductor 583 to the conductor P1 which extends to the #1 printer magnet P1M in Fig. 9.

The time lamp panel is arranged to display the time of day on a 24 hour basis, that is, the hour lamps are arranged to display indications 1 to 12 for indicating the hours up to and including 12:00 a. m., while the numerals 13 to 23 are arranged to indicate the hours after noon from 1 to 11:00 p. m. and when the #0 units hour lamp alone is illuminated, the hour is midnight. In a same manner as previously described, the time switches are operated to display the time of day, and in response to the second revolution of the hour unit switch to its tenth position, wiper HU1 prepares a circuit for operating the two-step relay 520. Wiper HU1 in its tenth position and when stepping magnet 540 energizes on the next time pulse, a circuit is completed from grounded wiper HU1 thru its tenth bank contact, contact 542, front contact 513, contacts 523 and thru the lower winding of two-step relay 520 to battery. Two-step relay 520 is similar to two-step relay 510 and closes only its contacts 522 when relay 520 is energized thru its lower winding alone. When the time pulse is terminated and stepping magnet 540 deenergizes, the two-step relay is energized in its second step over the following circuit: from grounded conductor 701 contacts 531 and 522 and thru the upper and lower winding of relay 520 to battery. Two-step relay 520 is energized thru its second step to operate contacts 521, 523, 524 and 525. The hour unit switch automatically steps to its first position in the same manner as previously described. In its first position, the off-normal springs 534 are opened.

Two-step relay 520, upon energizing in its second step, at back contacts 521 opens the circuit #1 tens lamp and at front contacts 521 completes the circuit for the #2 tens hour lamp as follows: from grounded conductor 701, contacts 511, front contacts 521 and thru the #2 tens hour lamp to battery. At contacts 523, relay 520 opens its original energizing circuit: at contacts 524 prepares a circuit for operating relay 530 and at contacts 525 disconnects the circuit to the P1 lead and connects the P2 lead.

The hour unit switch HU steps one step every hour until the fifth position is reached and in this position a circuit is completed from grounded HU1 wiper, fifth bank contact, contacts 524 and 535, and the winding of relay 530 to battery. Relay 530, upon energizing, at contacts 531 opens the locking circuits of the two two-step relays 510 and 520. At contacts 535, relay 530 opens a point in its original energizing circuit after its locking

circuit is completed thru contacts 532 and the off-normal contacts 534 of the hour unit switch HU. At contacts 533, relay 530 completes a circuit for automatically restoring the hour unit switch to its first position as follows: from ground thru the operated off-normal spring 534, contacts 533 and 541 and thru the winding of stepping magnet 540 to battery. Stepping magnet 540 operates in the manner of a buzzer to step the wipers of the hour unit switch until such time as the off-normal contacts 534 are opened. In response to the wipers of the hour unit switch reaching its first position, the off-normal springs 534 are opened to retain the wipers of the hour unit switch in their first positions. Two-step relays 510 and 520 deenergize and relay 510 at contacts 514 connects the space conductor 932 to conductor 583. At this time none of the tens hour lamps are lighted and the display will consist of only the display of the "0" units hours, the "0" minutes and "00" seconds lamps, and the time is 12:00 p. m.

After setting the time of day the observer will set the keys K3, K4, K5 and K6 (Fig. 11) in accordance with the month and day of the year so as to indicate on the printed record the month and day in which the observation of the trunks were taken. The key K3 is manually set in accordance with the tens digit of the month, the key K4 is set in accordance with the units digit of the month, the key K5 is set in accordance with the tens digit of the day and the key K6 is set in accordance with the units digit of the day. The wiper K3' (Fig. 7) is set to the same corresponding position as key K3, the wiper K4' is set in accordance with the setting of key K4 and in a similar manner wipers K5' and K6' are respectfully set in accordance with the setting of keys K5 and K6. The wipers K3' to K6', inclusive, are set upon the bank contacts which are connected to the conductors extending to the printer magnets to cause the printer to print the month and day in accordance with the setting of these wipers. In the lower portion of Fig. 7, the terminal block 795 is provided with terminal pins for jumpering the tens year conductor 790 and the units year conductor 791 in accordance with the last two digits of the year in which this observation is being taken. The thousands and hundreds digits are not printed by the printer because it is understood that these digits would not be necessary for record purposes.

Recording started

After the observer has jumpered the trunks to be tested and after setting the month and day keys and the desired grouping keys in accordance with the desired grouping, and has operated the hour key and minute key to cause the time lamp panel to display the correct time of day, the observer will operate the start key K2 to start the recording operation. In response to the operation of the start key K2 in Fig. 6, start relay 660 is energized over the following circuit: from grounded springs 632 of the start key K2, wiper PS2 in its first position, contacts 643 and 652 thru the winding of start relay 660 and the resistance R to battery. Start relay 660 energizes over the above circuit and at contacts 666 completes a locking circuit to grounded start spring 632 of key K2. At contacts 661, start relay 660 disconnects the grounded conductor 701 from the printer off-normal conductor 935; at contacts 662 opens a point in the release conductor 668 extending to Fig. 4A; at contacts 664 grounds the hold conductor 615 by way of contacts 622 to prepare holding circuits for the storage relays; at contacts 665 completes a circuit extending by way of conductor 675 for energizing relay 840; and at contacts 667 opens a point in the self restoring circuit for returning the primary switch PS back to its first, or normal, position. At contacts 663 start relay 660 completes a circuit for automatically stepping the second time switch SE of Fig. 5 into either its fourth or eighth position. Assuming that wipers of the second switch SE are resting in the position shown in Fig. 5, a circuit may be traced for automatically stepping the wipers to their fourth positions as follows: from grounded wiper SE1 thru the first bank contact, conductor 573, contacts 663, wiper PS6 of the primary switch PS, first position bank contact engaged by wiper PS6, conductor 574, contacts 572 and thru the winding of stepping magnet 570 to battery. Stepping magnet 570 is automatically operated over wiper SE1 and its multipled bank contacts to interrupt its own circuit to cause the wipers to be advanced into engagement with their fourth bank contacts.

The grounding of hold conductor 615 by contacts 664 of start relay 660, grounds the group selecting wiper K1' which is now in engagement with its second bank contact to thereby ground conductor 771 which extends by way of the cable to Fig. 1A and thence thru the windings of relays 100, 110 and 120 in multiple to battery. Relays 100, 110 and 120 operate over this circuit. Relay 120, upon energizing, at contacts 121 prepares circuits for operating the gang group relays GR1 and GR2 shown to the right of Fig. 1B; at back contacts 122 disconnects the wiper A11 of the scanning switch A1 from the #2 release conductor 628 and at front contacts 122 prepares a point in the stepping circuit for stepping magnet 130 of switch A1. At contacts 123, relay 120 closes a shunt around the interrupter contacts 131 of stepping magnet 130 in addition to preparing a stepping circuit for the stepping magnet; at contacts 124 opens a point in the stepping circuit to magnet 130 to maintain the switch A1 in its last position and at front contacts 124 prepares a circuit to the stepping magnet 130 to step this switch from its first position. Relay 110, upon energizing, at contacts 111, shunts the interrupter springs 141 of the stepping magnet 140 of scanning switch A2 in addition to preparing another stepping circuit for this magnet. At back contacts 112 relay 110 opens a point in the stepping circuit for the last position bank contact of wiper A21 and at front contacts 112 prepares the stepping circuit for magnet 140 of switch A2. Relay 100, upon energizing, at back contacts 101 opens a point in the restoring circuits of the switches A2 and A3 and at front contacts 101 closes a point in the transfer circuit for transferring the circuit from the switch A1 to A2. At front contacts 102 relay 100 closes a point in the transfer circuit to transfer the restoring circuit from switch A2 to switch A3 and at back contacts 102 opens a point in the restoring circuit to stepping magnet 150. At contacts 103, relay 100 shunts the interrupter spring 151, at back contacts 104 opens the stepping circuit for the last position bank contact of wiper A31 and at front contacts 104 prepares a circuit for stepping magnet 150.

When the second time switch SE was operated to its fourth position in response to the operation of the start relay 660, the following circuit is completed for energizing relay 630 as follows: from grounded conductor 701 thru the

wiper SE4 in its fourth position, conductor 576 and thru the upper winding of relay 630 to battery. A similar circuit is also completed for relay 630 in eighth position of wiper SE4. Relay 630, upon energizing, at back contacts 631 disconnects battery thru resistance R1 from the upper winding of the cut-off relay 620 and substitutes the battery extending thru the winding of the primary switch stepping magnet 657.

Relay 840, upon energizing in response to the operation of start relay 660, at back contacts 841 removes one of the ground connections to the multipled bank contacts accessible to the wiper LA1 and at front contacts of 841 connects ground to the LA2 wiper. At contacts 842 relay 840 completes a circuit extending from ground by way of contacts 842, 872, 833 thru the winding of relay 860, contacts 862, back contacts 881, first bank contact engaged by wiper LA1 and said wiper, interrupter, contacts 891 and thru the winding of stepping magnet 890 to battery. Relay 860 is operated over this circuit but the stepping magnet 890 due to the high resistance of relay 860, does not energize. At contacts 843, relay 840 grounds the common locking conductor 847 extending to the adders shown in Fig. 4A, Fig. 4B and diagrammatically shown in Fig. 3B. At contacts 844 relay 840 prepares a point in the energizing circuit of relay 820. Relay 860, upon energizing, at contacts 861 completes a locking circuit thru its winding to grounded contact 842 over a portion of its initial energizing circuit. After closing this locking circuit the contacts 862 are opened to open the circuit extending to the stepping magnet 890. At contacts 865 relay 860 prepares a point in the locking circuit for relay 830 and 870 and at contacts 864 grounds conductor 626 for energizing the pulse relay 610.

The circuit for energizing pulse relay 610 may be traced as follows: from grounded contact 864, conductor 626, contacts 621 and 611, and thru the upper and lower winding of the pulse relay 610 to battery. In this circuit to the pulse relay 610, current first flows thru the upper winding and thru the condenser C to negative battery until the condenser is charged. The charging current thru the upper winding of the pulse relay 610 does not operate the relay but after the condenser C is fully charged the current will then flow thru the lower winding to battery thereby causing the operation of pulse relay 610. After operation of the pulse relay 610, the said relay at contacts 611 opens a point in its own energizing circuit but the relay does not immediately deenergize because the charge on the condenser C will be dissipated thru the two windings of the pulse relay 610 thereby holding this relay in energized position for a period of time dependent upon both of the capacity of the condenser C and the resistance in the discharge circuit which includes the two windings of the pulse relay 610. With the proper condenser capacity coupled with the proper resistances of the windings of the pulse relay 610, this relay is arranged to operate and release periodically to transmit impulses at a standard rate of approximately 12 pulses per second.

Before proceeding with the detailed description of the scanning and printing operation, it is believed advisable to describe in detail the type of record which is automatically printed by the printer.

Figs. 12A, 12B, 12C and 12D show the four different types of records printed by the printer in accordance with the different groupings of the trunks as determined by the setting of the group keys on the key panel.

Fig. 12A shows a portion of a printed record for grouping #1. The top line of Fig. 12A is called the "heading" and indicates the grouping of the trunks and the month, day and year in which the trunk observations were made and the recording chart printed. This top line shows five groups of ten trunks each and each group is numbered "0" to "9," inclusive, followed by the number 10 to indicate the number of trunks in the respective groups. This number 10 is shown dotted in order to indicate that this number is printed in red ink on the chart. Of course, any trunk group could be less than ten if desired, in which case the group number would be printed in red in place of the number 10. The digits 7, 13 and 42, shown at the right of the top line, indicates respectively the 7th month, the 13th day and the year of 1942. Read from left to right in the first group of ten trunks, the digit "0" indicated arbitrarily the first trunk in this group; the digit "1" indicates the second trunk in this group; the digit "2" indicates the third trunk in this group, and etc. This "heading" and the numbering of the trunks in the respective groups is made to enable the record to show which of the trunks were in actual use at the time the record was printed. If desired, the observer may also write on the printed record any desired information needed to properly identify the particular trunks under observation.

The first line directly below the "heading" of Fig. 12A shows a printed dot, or a "mark," directly under the digit "0" to indicate that this particular trunk, or the first trunk in the first group of ten trunks is busy. Similar dots, or "marks," are made for all busy trunks, such as shown directly under the digits 2, 4, 5, 6, 7, 8 and 9 in the first group of ten trunks. A total of eight trunks are busy in this group. The digits "08" directly under the dotted (red) number 10 of the "heading" is printed to indicate that eight trunks are busy in this first group. In a similar manner the 2nd, 3rd, 4th and 5th groups of ten trunks indicate particular trunks which are busy and the total number of such busy trunks in each trunk group.

Digits 9 46 00 indicate the time in hours, minutes and seconds that this first line of the "heading" was printed, or 9:46 a. m. The second, third and other lines in a similar manner indicate the particular trunks and the total number of busy trunks in each trunk group and the time the record was printed. The circuits and apparatus are arranged to automatically make 60 scannings, or readings, and to print 60 such lines during a 15 minute period after which the total of the number of trunks in each trunk group is printed. The digit 312, shown directly below the total column, indicate that for this 15 minute period a total of 312 trunks in the first group of trunks were busy. In a similar manner, the digits 344, 401, 298 and 303 indicate, respectively, that 344 trunks were busy in the second trunk group, that 401 trunks were busy in the third trunk group, that 298 trunks were busy in the fourth trunk group, and that 303 trunks were busy in the fifth trunk group.

Figs. 12B, 12C and 12D show printed recording charts similar to the recording chart shown in Fig. 12A but for larger trunk groups. In Fig. 12B there is shown three trunk groups of sixteen trunks each. In the first line or "heading" of Fig. 12B the digits "0" to "9," inclusive, indicate

the first ten trunk lines of the first trunk group and the next digits "0" to "5," inclusive, arbitrarily indicate the 11th to 16th trunks in this first trunk group. The dotted (red) number 16 indicates that there are 16 trunks in this first trunk group. The second and third trunk group are similarly indicated and the last digits 7, 13 and 42 indicate the month, day and the year. The lines directly below this "heading" indicates which of the various trunks are busy and the total number of such busy trunks in the respective groups, as well as the time of day in hours, minutes, and seconds that such a recording was printed. The numbers 548, 603 and 627 indicate the total number of busy trunks in the three respective groups. Fig. 12C shows a recording chart for two groups of twenty-five trunks and Fig. 12D shows a recording chart for the trunk group of fifty trunks. Since the printed record shown in Figs. 12C and 12D are similar to that shown in Fig. 12A, it is believed that these figures will be easily understood and need not be described in detail.

Pulse relay 610, upon energizing as previously described, at contacts 612 prepares a point in the circuit for stepping magnet 890 of the counter switch LA. At contacts 613, pulse relay 610 shunts contacts 622 to maintain ground on hold conductor 615. At contacts 619, relay 610 prepares a circuit for grounding the multipled bank contacts accessible to wiper PS5 of the primary switch PS. At contacts 614 relay 610 grounds the step conductor 627 which extends to Fig. 1A for the purpose of stepping the scanning switches. The contacts 616 of relay 610 grounds conductor 652 extending to wiper A12 (Fig. 1A) by way of wiper PS3 and its first bank contact.

The pulse relay 610 transmits ground pulses over step conductor 627 and conductor 652 at the rate of 12 pulses per second. The first ground pulse on step conductor 627 completes a circuit for energizing stepping magnet 130 of switch A1 while the ground pulse on conductor 652 is ineffective because wiper A12 is on its first bank contact. The circuit for energizing stepping magnet 130 may be traced as follows: from grounded contacts 614 of the pulse relay 610, stepping conductor 627 included in the cable extending to Fig. 1A, conductor 627, front contacts 122, wiper A11, first bank contact engaged by wiper A11, front contact 124, contacts 123 and through the winding of stepping magnet 130 to battery. Stepping magnet 130 energizes over the above traced circuit and positions its pawl preparatory to stepping the wiper of switch A1 and opens its interrupter contacts 131. When pulse relay 610 deenergizes at the end of the first pulse, ground is removed from stepping conductor 627 and conductor 652. The disconnection of ground from stepping conductor 627 causes the deenergization of stepping magnet 130 to step the wipers of switch A1 to their second position in engagement with their second bank contacts. Wiper A11 prepares a new pulsing circuit for stepping magnet 130 and wiper A12 prepares a circuit for operating the P0M printer magnet over conductor P0. The second operation of pulse relay 610 again grounds stepping conductor 627 and conductor 652. Stepping magnet 130 is now energized over the following circuit: from grounded stepping conductor 627, front contacts 122, wiper A11 in engagement with its second bank contact, through the multipled bank contacts, contacts 123 and through the winding of stepping magnet 130 to battery. Ground on conductor 652 completes a circuit for operating printer magnet P0M as follows: from grounded contacts 616, wiper PS3 and its first bank contact, conductor 652 included in the cable extending to Fig. 1A, wiper A12 in engagement with its second bank contact, conductor P0 included in the cable to the printer shown in Fig. 9 and from thence through the winding of printer magnet P0M to battery. Printer magnet P0M operates over the above traced circuit and actuates its associated key lever, such as 1027, to cause a serrated cam, such as cam 1028, to engage the constantly rotating roller 1029 thereby causing the operation of the printer to type the digit "0" and to space the paper one step in the usual manner. When the pulse relay 610 deenergizes ground is removed from conductors 652 and 627 to cause the release of the printer magnet P0M and the release of stepping magnet 130 to step the wipers of scanning switch A1 another step.

The third operation of pulse relay 610 again grounds conductors 627 and 652 to again energize the stepping magnet 130 and to operate printer magnet P1M over the following circuit: from grounded contacts 616, wiper PS3 in engagement with its first bank contact, conductor 652, wiper A12 in engagement with its third bank contact which is connected to conductor P1 included in the cable to the printer and through the winding of printer magnet P1M to battery The operation of printer magnet P1M prints the digit "1" in the usual manner. In the same manner as just described the stepping magnet 130 is operated in response to successive ground pulses on stepping conductor 627 to step the wipers of switch A1 step-by-step over their bank contacts into engagement with their 25th bank contacts. The second bank contact accessible to wiper A12 is connected to conductor P0 and the third bank contact also accessible to wiper A12 is connected to conductor P1 (not shown) for operating printer magnets P0M and P1M as previously described for printing the digits "0" and "1." In a similar manner, successive bank contacts are connected to successive conductors extending to successive printer magnets to print the digits "2" to "9," inclusive. For example, conductor P9 is connected to the 11th bank contact and when wiper A12 is stepped to its 11th bank contact and conductor 652 is grounded by pulse relay 610 the printer magnet P9M is operated over conductor P9 to print the digit "9."

When the wiper of the switch A1 steps into engagement with their 12th bank contacts, a circuit for operating the printer ribbon control magnet PRCM may be traced as follows: from grounded wiper PS1 in engagement with its first bank contact, conductor 623, twelfth bank contact accessible to wiper A16 and said wiper, conductor 656, wiper PS5 in engagement with its first bank contact, conductor 933 included in the printer cable and through the winding of the printer ribbon control magnet PRCM to battery. The printer ribbon control magnet operates and positions the combination black and red typewriter ribbon so as to switch from black to red ribbon so that thereafter the operation of any digit printer magnet will type a red digit as long as the printer ribbon control magnet is energized. When conductor 652 is grounded with wiper A12 in engagement with its 12th bank contact, a circuit for operating printer magnet P1M may be traced as follows: from grounded conductor 652, wiper A12 in engagement with its 12th bank contact, conductor 710 included in the cable

extending to Fig. 7, key wiper K11' in engagement with its second bank contact, printer conductor P1 and through the winding of magnet P1M to battery. Since the printer ribbon control magnet is operated at this time the operation of printer magnet P1M causes the digit "1" to be printed in red. Printer ribbon control magnet PRCM is also maintained energized with the wipers of switch A1 in engagement with their 13th bank contacts over the previously traced circuit, this time including the 13th bank contact and wiper A16. When conductor 652 is grounded with wiper A12 in engagement with its 13th bank contact a circuit is completed for operating printer magnet P0M as follows: from grounded conductor 652, wiper A12 in its 13th bank contact, conductor 711, key wiper K16' in engagement with its last bank contact, printer conductor P0 and through the winding of the printer magnet P0M to battery. The operation of magnet P0M causes the digit "0" to be printed in red at this time.

Printer ribbon control magnet PRCM deenergizes in response to wiper A16 stepping from its 13th to its 14th bank contact to switch the typewriter ribbon back so that subsequent operations of the printer magnets will print the corresponding digits in black. Thus far the printer has printed the "heading" for the first group of ten trunks, which includes the digits "0" to "9," inclusive, in black and trunk group total, or "10," in red.

In the same manner as just described switch A1 steps its wipers over its 14th to 23rd bank contacts to again type the digits "0" to "9," inclusive, in black. For example, when conductor 652 is grounded by pulse relay 610 with wiper A12 in engagement with its 14th bank contact, a circuit is completed over the printer conductor P0 for operating the printer magnet P0M to print the digit "0" after which the wiper steps their 15th bank contact to complete the circuit for operating printer magnet P1M to print the digit "1" when conductor 652 is again grounded. In a similar manner the successive digits are printed for successive steps of switch A1. When the wipers of switch A1 reach their 24th bank contacts a circuit is again completed for operating the printer ribbon control magnet PRCM as follows: from grounded wiper PS1 and its first bank contact, conductor 623, 24th bank contact, and wiper A16, conductor 656, wiper PS5 and its first bank contact, conductor 933 and through the winding of magnet PRCM to battery. Magnet PRCM again positions the red ribbon to cause the next two digits to be printed in red. When conductor 652 is grounded with wiper A12 in engagement with its 24th bank contact the circuit is completed for operating printer magnet P1M as follows: from grounded conductor 652, wiper A12 and its 24th bank contact, conductor 720, key wiper K10' in engagement with its second bank contact, printer conductor P1 and through the winding of magnet P1M to battery. Magnet P1M is operated over this circuit to print the digit "1" in red.

When the wipers of switch A1 reach their 25th position the control and operating circuits are switched to switch A2. Printer ribbon control magnet PRCM is now held over the following circuit: from grounded wiper PS1, conductor 623, first bank contact and wiper A26, 25th bank contact and wiper A16, conductor 656, and thence over the previously traced circuit to magnet PRCM to battery. The grounding of conductor 652 operates the printer magnet P0M to print the digit "0" in red as follows: from grounded conductor 652, wiper A12 and its 25th bank contact, wiper A22 and its first bank contact, conductor 721, key wiper K15' in engagement with its last bank contact, printer conductor P0 and through the winding of printer magnet P0M to battery. The printer has now printed the "heading" for the second group of trunks.

The grounding of stepping conductor 627 now completes a circuit for operating stepping magnet 140 of switch A2 as follows: from grounded stepping conductor 627, front contact 122, wiper A11 and its 25th bank contact, front contact 101, wiper A21 and its first bank contact, front contact 112, contacts 111 and through the winding of stepping magnet 140 to battery. Stepping magnet 140 positions its pawl preparatory to stepping the wipers of the switch A2. When pulse relay 610 deenergizes and removes ground from stepping conductor 627, stepping magnet 140 releases and steps the wipers of switch A2 into engagement with their second bank contacts. Wiper A26 opens the circuit to the printer ribbon control magnet which deenergizes. Wiper A22 prepares a point in the circuit for operating printer magnet P0M over conductor P0 and wiper A21 prepares a new stepping circuit for stepping magnet 140.

On the next energization of pulse relay 610 conductors 652 and 627 are again grounded. The printer magnet P0M is now operated over the following circuit; from grounded conductor 652, wiper A12 and its 25th bank contact, wiper A22 and its second bank contact, printer conductor P0 and through the winding of printer magnet P0M to battery. Magnet P0M is operated to print the digit "0." Stepping magnet 140 is now energized over the following circuit from grounded stepping conductor 627, front contacts 122, wiper A11 in engagement with its 25th bank contact, front contacts 101, wiper A21 in engagement with its second bank contact and the multipled bank contacts, contacts 111 and through the winding of magnet 140 to battery. In the same manner as just described stepping magnet 140 is energized and deenergized over stepping conductor 627 to step the wipers of switch A2 step-by-step until the wipers are in engagement with their 25th bank contacts. The ground pulses on conductor 652, in a manner similar to that described for switch A1, successively completes circuits for printer magnets P1M to P9M through wiper A22 on the third to the eleventh successive bank contacts. When wiper A26 is in engagement with its 12th and 13th bank contacts a circuit is completed for operating the printer ribbon control magnet PRCM as follows: from grounded wiper PS1 and its first bank contact, conductor 623, through the 12th and 13th bank contacts and wiper A26, 25th bank contact and wiper A16, conductor 656, wiper PS5 in engagement with its first bank contact, conductor 933 and through the winding of the printer ribbon control magnet PRCM to battery. When wiper A22 is in engagement with its 12th bank contact a circuit is completed, when conductor 652 is grounded, for operating printer magnet P1M as follows: from grounded conductor 652, wiper A12 and its 25th bank contact, wiper A22 and its 12th bank contact, conductor 730, key wiper K9' in engagement with its second bank contact, printer conductor P1 and through the winding of printer magnet P1M to battery. Since the printer ribbon control magnet is operated at the time printer magnet P1M is operated, the

digit "1" is printed in red. When wiper A22 is in engagement with its 13th bank contact a circuit is completed, when conductor 652 is grounded, for operating printer magnet P0M to print the red digit "0" as follows: from grounded conductor 652, wiper A12 and its 25th bank contact, wiper A22 and its 13th bank contact, conductor 731, key wiper K14' in engagement with its last bank contact, printer conductor P0 and through the winding of printer magnet P0M to battery. The printer ribbon control magnet is released when the wipers of switch A2 are stepped to their 14th bank contacts. The printer has now printed the "heading" for the third group of trunks.

Wiper A22 successively engages its 14th to 23rd bank contacts thereby completing a circuit each time conductor 652 is grounded to successively operate printer magnets P0M to P9M to print the digits "0" to "9," inclusive, in a manner similar to that previously described. Wiper A26 in its 24th and 25th positions completes the circuit for operating the printer ribbon control magnet to position the red ribbon as follows: from grounded wiper PS1, conductor 623, through the 24th bank contact and wiper A26, and also through the first bank contact and wiper A36, the 25th bank contact and wiper A26, when the wiper A26 is respectively in its 24th and 25th positions, and thence over the previously traced circuit including the conductor 656, wiper PS5 and conductor 933 through the winding of printer ribbon control magnet to battery. Wiper A22 in its 24th position completes a circuit for operating printer magnet P1M as follows: from grounded conductor 652 through the wipers A12 and A22 in engagement with its 24th bank contacts, conductor 740, key wiper K8' in engagement with its second bank contact, printer conductor P1 and through the winding of the printer magnet P1M to battery. Wiper A22 in its 25th position completes a circuit for operating printer magnet P0M from grounded conductor 652 through wipers A12 and A22 in their 25th positions, wiper A32 in its first position, conductor 741, key wiper K13' in its last position, printer conductor P0 and through the winding of printer magnet P0M to battery. The last two digits "1" and "0" are printed in red since the printer ribbon control magnet is energized at this time. The printer has now printed the "heading" for the fourth group of trunks.

The wipers of switch A2 remain in their 25th position and transfer the operating and control circuits to switch A3. The next ground pulse on stepping conductor 627 operates stepping magnet 150 to position its pawl preparatory to stepping the wiper of switch A3 as follows: from grounded stepping conductor 627, front contacts 122, wiper A11 and its 25th bank contact, front contact 101, wiper A21 and its 25th bank contact, front contact 102, wiper A31 and its first bank contact, front contacts 104, contacts 103 and through the winding of stepping magnet 150 to battery. When ground is disconnected from conductor 627 stepping magnet 150 deenergizes and steps the wipers of switch A3 into engagement with the second bank contacts. Wiper A31 prepares a new step circuit for stepping magnet 150, wiper A32 prepares a new circuit for printer magnet P0M and wiper A36 opens the circuit of the printer ribbon control magnet which deenergizes to shift the typewriter ribbon from red to black. When pulse relay 610 grounds conductors 627 and 652, stepping magnet 150 is energized to position its pawl preparatory to stepping the wipers of switch A3 and printer magnet P0M is operated to print the digit "0" in the "heading" for the first trunk in the fifth or last trunk group. The circuit for energizing stepping magnet 150 now extends from grounded step conductor 627 over the previously traced circuit to wiper A31 and through the multipled bank contacts and contacts 103 to the winding of magnet 150 and battery. The circuit for operating printer magnet P0M may be traced from grounded conductor 652 through wipers A12 and A22 in their 25th positions, wiper A32 in its second position, printer conductor P0 and through the winding of printer magnet P0M to battery. Successive pulses on the stepping conductor 627 step the wipers of the switch A3 through to their 24th position by operating the stepping magnet 150 over the previously traced circuit. Wiper A32 in successive engagements with the second to the eleventh bank contacts completes circuits, when conductor 652 is grounded, for successive printer magnets P0M to P9M over printer conductors, such as P0 and P9, to print the digits "0" to "9," inclusive, in black for the fifth group of trunks. Wiper A36 in engagement with its 12th and 13th bank contacts completes circuits for operating the printer ribbon control magnet PRCM as follows: from grounded wiper PS1 and its first bank contact, conductor 623, 12th and 13th bank contacts, wiper A36 and thence through the wipers A26 and A16 to conductor 656, wiper PS5 and conductor 933 to the winding of printer ribbon control magnet PRCM to battery. Magnet PRCM again positions the red ribbon so that the next two digits will be printed in red. Wiper A32 in engagement with its 12th bank contact completes a circuit for operating printer magnet P1M when conductor 652 is grounded as follows: from grounded conductor 652 through wipers A12 and A22 and their 25th bank contacts, wiper A32 in engagement with its 12th bank contact, conductor 750, key wiper K7' in engagement with its second bank contact, printer conductor P1 and through the winding of the printer magnet P1M to battery. Printer magnet P1M is again operated to print the digit "1" in red. Wiper A32 in engagement with its 13th bank contact completes a circuit for operating printer magnet P0M when conductor 652 is grounded as follows: from grounded conductor 652 wiper A12 and its 25th bank contact, wiper A22 in its 25th bank contact, wiper A32 and its 13th bank contact, conductor 751, key wiper K12' in engagement with its last bank contact, printer conductor P0 and through the winding of the printer magnet P0M to battery. Magnet P0M again operates and prints the red digit "0." Wiper A36 in engagement with its 14th bank contact opens the circuit to the printer ribbon control magnet to position the black ribbon so that the remaining digits will be printed in black. Wiper A32 in engagement with its 14th bank contact completes a circuit when conductor 652 is grounded for operating the printer space magnet PSPM to cause the printer to space the carriage one step as follows: from grounded conductor 652, through wipers A12 and A22 in their 25th positions, wiper A32 in engagement with its 14th bank contact, through the multipled contacts to printer space conductor 932 included in the cable to the printer and through the winding of the printer space magnet PSPM to battery. Wiper A32 in engagement with its fifteenth bank contact completes a cir-

cuit when conductor 652 is grounded for operating the printer space magnet PSPM since the key K3, for designating the tens digits of the month, is set to its "off" or space position. This circuit may be traced as follows: from grounded conductor 652 over the previously traced circuit to wiper A32 and its 15th bank contact, conductor 760, key wiper K3' in its first position, printer space conductor 932 included in the cable to the printer and through the winding of the printer space magnet PSPM to battery. Wiper A32 in engagement with its 16th bank contact completes a circuit when conductor 652 is grounded for operating printer magnet P7M for printing the units digits "7" indicating the month, since key K4 has been moved to number "7" position and the key wiper K4' has been moved to engage with printer conductor P7 extending to the magnet P7M. The circuit for energizing printer magnet P7M extends from ground conductor 652 over the previously traced circuit including wipers A12, A22 and A32, conductor 761, key wiper K4' in engagement with its 9th bank contact, printer conductor P7 included in the cable to the printer and through the winding of printing magnet P7M to battery. Wiper A32 in engagement with its 17th bank contact completes the previously traced circuit, when conductor 652 is grounded, for operating the printer space magnet PSPM to cause the printer to space the carriage one step. Wiper A32 in engagement with its 18th bank contact completes a circuit by way of grounded conductor 652 for operating printer magnet P1M to print the day tens digit "1" since the key wiper K5' is in engagement with the printer conductor P1 as follows: from ground conductor 652 over the previously traced circuit to wiper A32 and its 18th bank contact, conductor 770, key wiper K5' in engagement with its second bank contact, printer conductor P1 included in the cable to the printer and through the winding of printer magnet P1M to battery. Wiper A32 in engagement with its 19th bank contact completes a circuit from grounded conductor 652 for operating printer magnet P3M to print the day units digit "3" as follows: from grounded conductor 652 over the previously traced circuit to wiper A32 and its 19th bank contact, conductor 771, key wiper K6' in engagement with its 5th bank contact, printer conductor P3 included in the printer cable and through the winding of printer magnet P3M to battery. Wiper A32 in engagement with its 20th bank contact completes the previously traced circuit when conductor 652 is grounded for again operating the printer space magnet PSPM to space the carriage. Wiper A32 in engagement with its 21st bank contact completes the circuit when conductor 652 is grounded for operating printer magnet P4M to print the year tens digit "4" as follows: from wiper A32 grounded by conductor 652, over the previously traced circuit, conductor 790 connected to the terminal pin in the terminal block 795, jumper 794, jumpered to the terminal pin connected to the printer conductor P4 included in the printer cable and through the winding of printer magnet P4M to battery. Wiper A32 in engagement with its 22nd bank contact completes a circuit when conductor 652 is grounded for operating printer magnet P2M to print the year units digit "2" by way of conductor 791 extending to the terminal block 795, jumper 792 connected to printer conductor P2 included in the printer cable and through the winding of printer magnet P2M to battery. Wiper A32 in engagement with its 23rd bank contact completes a circuit when conductor 652 is grounded for operating the printer carriage return magnet PCRM by way of printer carriage return conductor 934 included in the printer cable and through the winding of the printer carriage return magnet PCRM to battery. The printer carriage return magnet operates and returns the carriage to its initial printing position as well as automatically spacing the paper one vertical step preparatory to printing the second line.

Wiper A32 in its 24th position completes a circuit when conductor 652 is grounded for operating cut-off relay 620 and stepping magnet 657 of the primary switch PS in series by way of conductor 618 extending through the upper winding of cut-off relay 620, front contacts 631, and through the winding of stepping magnet 657 to battery. Stepping magnet 657 energizes over the above traced circuit and positions its pawl preparatory to stepping the wipers of the primary switch PS. Cut-off relay 620, upon energizing the above traced circuit, at contacts 621 opens the circuit to pulse relay 610 to momentarily stop the pulsing operations of the pulse relay. At contacts 622 relay 620 disconnects ground from the hold conductor 615 to release relays 100, 110 and 120, providing the pulse relay 610 is not energized at this time. At contacts 623 relay 620 temporarily completes a locking circuit for its lower winding from ground spring contacts 632 of starting key K2 and contacts 642 because the time pulse relay 640 is energized at this time. Pulse relay 610, in deenergized position, at contacts 613 disconnects ground from the hold conductor 615 to open the circuit of relays 100, 110 and 120 to cause the release of these relays. At contact 614 relay 610 disconnects ground from the stepping conductor 627 to step the wipers of switch A3 to their 25th positions. At contacts 616 relay 610 disconnects ground from conductor 652 to open the original energizing circuit of cut-off relay 620 and stepping magnet 657. Stepping magnet 657 deenergizes and steps the wipers of the primary switch PS into engagement with their second bank contacts. Wiper PS1 prepares a self-restoring circuit for the primary switch PS, and wiper PS6 disconnects the last three multipled bank contacts accessible to wipers SE1 from connection with the first, second, third, fifth, sixth and seventh multipled contacts also accessible to wiper SE1. Wiper PS2 opens the initial energizing circuit of start relay 620 which is now held over its own locking circuit. Wiper PS3 prepares circuits for transmitting pulses by the way of its multipled contacts and conductor 653. Wiper PS4 connects the Mark relay 670 to its multipled bank contacts and to conductor 654. Wiper PS5 disconnects the printer ribbon control conductor 933 and prepares a circuit for connecting ground pulses to conductor 656 for controlling adding switches.

Relays 100, 110 and 120 deenergize and the latter relay completes a circuit for energizing stepping magnet 130 in series with the release relay 650 as follows: from ground through the winding of release relay 650, conductor 628 included in the cable extending to Fig. 1A, back contacts 122, wiper A11 and its 25th bank contact, a back contact 124, interrupter contacts 131 and through the winding of stepping magnet 130 to battery. Release relay 650 at contact 651 completes a cir-

cuit for maintaining cut-off relay 620 energized through its lower winding from grounded start key K2. Stepping magnet 130 energizes and at its own contacts 131 interrupts its own circuit to cause the wipers of switch A1 to be stepped to their normal or first positions. Wiper A11 in its first position completes a circuit for energizing stepping magnet 140 in series with the release relay 650 as follows: from ground through the winding of release relay 650, conductor 628, back contacts 122, wiper A11 in its first position, back contact 101, wiper A21 and its 25th bank contact, back contacts 112, interrupter contacts 141 and through the winding of stepping magnet 140 to battery. Stepping magnet 140 energizes and interrupts its own circuit at contacts 141 to cause the wipers of switch A2 to restore to normal in engagement with their first bank contacts. Wiper A21 in engagement with its first bank contact completes a circuit for energizing stepping magnet 150 in series with release relay 650 as follows: from ground through the winding of release relay 650, conductor 628 and over the previously traced circuit through wipers A11 and A21 now in its first position, and thence by way of back contacts 102, wiper A31 and its 25th bank contact, back contacts 104, interrupter contacts 151 and through the winding of stepping magnet 150 to battery. Stepping magnet 150 interrupts its own circuit to step the wipers of switch A3 back to their normal or first positions. Release relay 650 is a slow-to-release relay and therefore has maintained its armature in operated position during the time the scanning switches A1, A2 and A3 are being restored to their first positions. Shortly after the switch A3 has been restored to its first position release relay 650 deenergizes.

In the preceding description the scanning switches A1, A2 and A3 have completed one complete revolution and have printed the first line or "heading," shown in Fig. 12A. When time pulse relay 640 is deenergized by the time pulse unit 750, relay 640 at contacts 641 disconnects ground from conductor 575 to deenergize the stepping magnet 570 to step the seconds switch SE to its first position as previously described. At contacts 642 relay 640 opens the locking circuit of cut-off relay 620 which now deenergizes. Cut-off relay 620 at contacts 621 again completes the circuit for pulse relay 610, and at contacts 622 again grounds the hold conductor 615 for re-energizing relays 100, 110, and 120 over conductor 771 and key wiper K1'.

Relays 100, 110 and 120 energize to again prepare the stepping circuits to the stepping magnets of the scanning switches A1 to A3, inclusive. Pulse relay 610 again operates in the manner set forth to transmit pulses at the rate of 12 pulses per second.

Pulse relay 610, upon energizing, at contacts 611, interrupts its own circuit as before; the contacts 612 prepares the stepping circuits to the stepping magnets of the counter switches; the contacts 613 again shunts contacts 622; the contact 614 again grounds the stepping conductor 627 for the purpose of stepping the scanning switches A1, A2 and A3. At contacts 619, relay 610 prepares the circuit for controlling the No. 5 adder in Fig. 4B. At contacts 616, relay 610 first completes the circuit for operating the gang group relays GR1 and GR2. Stepping magnet 130 is energized over the same circuit as previously described and positions its pawl preparatory to stepping the wiper of switch A1.

Gang group relays GR1 and GR2 are energized over the following circuit: from grounded contacts 616, wiper PS3, over the multipled bank contacts, conductor 653, wiper R13 (Fig. 1) and first bank contact, contacts 121 of relay 120, conductor 126, and through the winding of the group relays GR1 and GR2 in multiple to battery. Group relays GR1 and GR2 connect each test lead of all connected trunks to a corresponding storage relay such as the SR relays with the result that the SR relays corresponding to busy trunks are operated from ground on the corresponding test leads. Each SR storage relay, upon energizing, locks to the hold conductor 615 and maintains ground on the corresponding test leads extending to the scanning switches.

When the pulse relay 610 deenergizes, ground is removed from stepping conductor 627 to cause the scanning switch A1 to step one step. Wiper A11, upon stepping into engagement with its second bank contact prepares a new stepping circuit for stepping magnet 130 by way of its multipled contacts. Wiper A13, in response to stepping to its second bank contact opens the circuit extending to the gang group relays GR1 and GR2 thereby restoring these relays. Wiper A13 also prepares the circuit for operating the printer space magnet or the printer mark magnet. Wiper A14 completes a circuit for operating the Mark relay 670 if the trunk corresponding to conductor T0 was busy when the gang group relays were operated. Wiper A16 prepares a circuit for operating the stepping magnet 485 of the number 5 adder. The gang group relays GR1 and GR2 deenergize in response to the first step of switch A1, but the storage relays SR, which were operated over the grounded test leads of the busy trunks, are thereafter maintained in operated position from grounded hold conductor 615.

It will be assumed that the trunk line connected to trunk terminal pin "0," shown to the extreme right on Fig. 1B, was busy when group relay GR1 operated, in which case ground on the test lead conductor of this trunk is extended by way of the upper contacts of group relays GR1 to conductor T0 and thence to the winding of the corresponding storage relay SR0 to battery. Storage relay SR0 operates, and through its own make contacts locks itself to grounded conductor 615. In addition storage relay SR0 at its make contacts connects the grounded hold conductor to the test lead T0 which is connected to the second bank contact accessible to wiper A14. Since this first trunk line was busy the corresponding test lead T0 is grounded and therefore a circuit for energizing the Mark relay 670 may be traced as follows: from the grounded test lead T0, second bank contact and wiper A14, conductor 654 extending to Fig. 6, through the multipled bank contacts and wiper PS4 and through the winding of Mark relay 670 to battery. Mark relay 670, upon energizing, at contacts 671, prepares a circuit for operating stepping magnet 890 of the counter switch LA. At back contacts 672 relay 670 disconnects the printer space conductor 932 extending to the printer space magnet and at front contacts 672 connects the mark conductor 931 extending to the printer mark magnet PMAM. At contacts 673 Mark relay 670 prepares a circuit for operating the No. 5 adder.

On the next energization of pulse relay 610, contacts 612 completes the circuit for operating stepping magnet 890 of the counter switch LA as follows: from grounded contact 612, contacts 671, conductor 674, back contacts 827 and through the

winding of stepping magnet 890 to battery. At contacts 619 relay 610 completes the following circuit for operating stepping magnet 485 of the number 5 adder switch HC as follows: from grounded contact 619, contacts 673, second bank contact and wiper PS5, conductor 656, wiper A16 and its second bank contact and associated multipled bank contacts, back contacts 163, conductor 358, included in the cable extending to the Fig. 4B, and through the winding of stepping magnet 485 to battery. At contacts 614 the stepping conductor 627 is again grounded to energize the stepping magnet 130 of switch A1 and at contacts 616 a circuit is completed for operating the printer mark magnet PMAM as follows: from grounded contacts 616, wiper PS3 and its second and associated multipled bank contacts, conductor 653, wiper A13 in engagement with its second bank contact, conductor 617 extending through the cable to Fig. 6, front contacts 672, printer mark conductor 931 extending to the printer in Fig. 9 and through the winding of printer mark magnet PMAM to battery. Stepping magnet 890 of counter switch LA, upon energizing over the above traced circuit, positions its pawl and operates its contacts preparatory to stepping the wiper of the counter switch LA. Stepping magnet 485 of the No. 5 adder switch HC, upon energizing over the above traced circuit, positions its pawl preparatory to stepping the wipers of switch HC and operates its interrupter contacts 486. Stepping magnet 130 of the scanning switch A1 is again energized over its previously traced circuit. The printer mark magnet PMAM operates the printer to print a mark, or dot, below the first digit "0" as shown in Fig. 12A directly below the "heading." This dot, or mark, directly below the digit "0" in the first group of trunks in the "heading" indicates that this particular trunk was busy during the time the gang group relay GR1 was operated.

Pulse relay 610, upon deenergizing, at contacts 612 opens the circuit to the counter stepping magnet 890 to step the wipers of the counter switch LA to their second positions. At contacts 619, relay 610 opens the circuit of the adder stepping magnet 485 to step the wipers of the added switch HC one step. At contacts 614 relay 610 opens the circuit to the stepping magnet 130 of the scanning switch A1 to cause this switch to take one step, and at contacts 616 opens the circuit to the printer mark magnet PMAM.

Wiper A14 in engagement with its third bank contact tests over conductor T1 to determine if the second trunk line was busy at the time the gang group relays GR1 and GR2 were energized. If the second trunk, corresponding to test lead T1 was busy then the associated storage relay SR1 (not shown) is locked operated to grounded hold conductor 615 and this same ground on conductor 615 extends over conductor T1 to the third bank contact accessible to wiper A14 to cause the operation of the Mark relay 670. However, in the present case the second trunk line was not busy and therefore T1 is not grounded and the Mark relay is not energized. In the same manner as just described, wiper A14 on successive steps successively tests the test conductors T2 to T8 (not shown) and T9 to determine if the corresponding trunks were busy. The trunks which were busy will have their corresponding test conductors connected to grounded hold conductors 615 to cause the operation of the Mark relay 670.

Wiper A14, in its 14th to 23rd positions, successively tests for ground on test conductors T10 to T19, inclusive, for determining the operation or non-operation of Mark relay 670. After scanning switch A1 reaches its 25th position, then wiper A24 of scanning switch A2 tests for ground on test conductors T20 to T39, inclusive, in a similar manner to control the operations of Mark relay 670.

After switch A2 reaches its 25th position, then wiper A34 of scanning switch A3 tests for ground on test conductors T40 to T49, inclusive, in a similar manner to control the operation of Mark relay 670.

In the same manner as previously described, pulse relay 610 transmits ground pulses over stepping conductor 627 to step the scanning switches A1, A2 and A3 in the order named to their 25th positions.

Wiper A13 in its second to 11th positions and in its 14th to 23rd positions completes a circuit each time pulse relay 610 is energized to either the printer space magnet PSPM or to the printer mark magnet PMAM, dependent upon the operated or non-operated condition of Mark relay 670. If the corresponding trunk at this particular step is busy, Mark relay 670 will be operated to cause the energization of the printer mark magnet PMAM when the pulse relay 610 is next energized. The printer mark magnet PMAM is therefore operated in the manner previously described to print a dot, or mark, under the digit in the "heading" of Fig. 12A corresponding to each busy trunk. If the corresponding trunk at any particular one of the steps is not busy then the printer space magnet PSPM is operated to space the printer carriage, since the mark relay is not operated when the pulse relay 610 is next energized. The circuit for energizing the printer space magnet PSPM is as follows: from ground contacts 616, wiper PS3 and its multipled bank contacts, conductor 653, wiper A13 and its respective multipled bank contacts, conductor 617, back contacts 672, printer space conductor 932 and through the winding of printer space magnet PSPM to battery. The circuit for energizing the printer mark magnet PMAM is as follows: from grounded contacts 616 over the previously traced circuit for operating the printer space magnet and conductor 617, front contacts 672, printer mark conductor 931 and through the winding of printer mark magnet PMAM to battery.

In a similar manner wiper A23 in its second to eleventh positions and in its 14th to 23rd positions completes circuits for either the printer space magnet PSPM or the printer mark magnet PMAM, dependent upon the operated or non-operated condition of Mark relay 670 over a similar circuit now including wiper A13 and its 25th bank contact.

After switch A2 reaches its 25th position the circuit for controlling the printer space magnet PSPM and the printer mark magnet PMAM is controlled by wiper A33 in its second to 11th position in accordance with the operated condition of Mark relay 670. From the foregoing, it will be seen that for each busy trunk the printer mark magnet PMAM is operated to mark this trunk as being busy and that the printer space magnet PSPM is operated to space the carriage one step without marking, if the corresponding trunk is not busy.

Each time the pulse relay 610 is energized, when Mark relay 670 is energized, a circuit is completed for the stepping magnet 890 of counter switch LA as follows: from grounded contacts

812, contacts 671, conductor 674, back contacts 827, and through the winding of stepping magnet 890 to battery. Counter switch LA therefore takes one step for each busy trunk encountered by wiper A13 in its second to 11th positions to count the number of busy trunks in the first trunk group. Also, each time the pulse relay 610 energizes when Mark relay 670 is energized, a circuit is completed for operating the stepping magnet 485 of adder switch HC as follows: from grounded contacts 619, contacts 673, multipled bank contacts and wiper PS5, conductor 656, wiper A16 and its multipled bank contacts, back contacts 163, conductor 358, and through the winding of stepping magnet 485 to battery. Adder switch HC therefore takes one step for each busy trunk encountered by wiper A14 in its 2nd to 11th positions to add the number of busy trunks in the first trunk group.

Wiper A13 in its 12th and 13th positions completes circuits for causing the printer to print the total number of busy trunks encountered in the first trunk group. This total, since only eight of the trunks were busy, is 8 and the digits "0" and "8" are printed directly after the marks indicating the number of busy trunks for the first group of trunks in the first line under the "heading" as shown in Fig. 12A. Wiper A12 in its 12th position completes a circuit for energizing printer magnet P0M to print the digit "0" as follows: from grounded contacts 616, wiper PS3 in engagement with its multiplied bank contacts, conductor 653, wiper A13 in engagement with its 12th bank contact, conductor 152, back contacts 162, conductor 815 included in the cable extending to Fig. 8, back contacts 832, back contacts 823, wiper LA5 in engagement with its 9th bank contact, through the associated multipled bank contacts to printer conductor P0, extending through the printer cable to the printer in Fig. 8 and through the winding of the printer magnet P0M to battery. Wiper A13 in its 13th position completes a circuit for energizing relay 810 as follows: from ground contacts 616 over the previously traced circuit, through wipers PS3 and A13, 13th bank contacts engaged by wiper A13, conductor 153, back contacts 161, conductor 814 included in the cable extending to Fig. 8 and through the winding of relay 810. Relay 810, upon energizing over the above traced circuit, at contacts 811 completes a circuit for operating printer magnet P8M to print the digit "8" as follows: from grounded contacts 811, back contacts 831 and 821, wiper LA3 in engagement with its 9th bank contact and printer conductor P8 (not shown) included in the printer cable, and through the winding of printer magnet P8M to battery. At contacts 813, relay 810 completes a circuit for energizing relay 880 as follows: from grounded contacts 813, back contacts 828 and through the winding of relay 880 to battery. Relay 880, at contacts 881 opens a point in the initial energizing circuit of stepping relay 860 as well as preparing a new circuit for relay 860. At contacts 882, relay 880 prepares a circuit for energizing 820 in series with relay 880, when relay 810 deenergizes. Relay 820 is now short circuited over the following circuit from ground by way of contacts 844, through the winding of relay 820, contacts 852 and 882, back contacts 828 to ground at contacts 813. When wiper A13 steps to its 14th position relay 810 deenergizes. Relay 810, upon deenergizing, at contacts 811 opens the circuit to printer magnet P8M and at contacts 813 opens the previously traced short-circuit around the winding of relay 820 which now energizes in series with relay 880 as follows: from ground by way of contacts 844, winding of relay 820, contacts 852 and 882, and through the winding of relay 880 to battery.

Relay 820, upon energizing over the above traced circuit, transfers the operating and control circuits from counter switch LA to counter switch LB for counting the number of busy trunks in the second group. At contacts 821 relay 820 switches the control circuit from wiper LA3 to wiper LB3 for the total units digit. At contacts 822 relay 820 switches the circuit from wiper LA4 to wiper LB4 for the total units digit. At contacts 823 and 824 relay 820 switches circuits from wipers LA5 and LA6 to wipers LB5 and LB6 for the total tens digit. At back contacts 826 relay 820 disconnects ground from conductor 917 and at front contacts 826 connects ground to the multipled bank contacts accessible to wiper LA1 of the counter switch LA. At contacts 827 relay 820 transfers the stepping circuit from counter switch LA to counter switch LB. At back contacts 828 relay 820 opens the original energizing circuit of relay 880 and at front contacts 828 prepares a circuit for operating relay 850. Counter switch LA is now restored to normal position over the following circuit: from ground by way of front contacts 826, through the multipled bank contacts, and wiper LA1, interrupter contacts 891 and through the winding of stepping magnet 890 to battery. Stepping magnet 890 operates in the manner of a buzzer to interrupt its own circuit at interrutper contacts 891 to step the wipers of the counter switch LA back to their normal or first positions as shown in Fig. 8.

Wiper A14 in engagement with its 14th to 23rd bank contacts tests for busy trunks in the second trunk group as previously described to cause the operation of the Mark relay 670 which controls circuits at front contacts 672, for operating the printer mark magnet PMAM to print the busy marks, or dots, for the busy trunk in the second trunk group in a manner similar to that described for the first trunk group. However, in this case the counter switch LB is operated to count the total number of busy trunks in the second trunk group because relay 820 is now operated. The circuit for operating counter switch LB may be traced as follows: from grounded contacts 612, contacts 671, conductor 674, front contacts 827, and through the winding of stepping magnet 900 of the counter switch LB to battery. The counter switch LB is operated one step each time the Mark relay 670 and the pulse relay 610 are concurrently energized.

Wiper A16 in engagement with its 14th to 23rd bank contacts completes a circuit over conductor 348 for operating the stepping magnet of the No. 4 adder in a manner similar to that described for operating the stepping magnet 485 of the No. 5 adder switch.

Wiper A13 in engagement with its 24th bank contact completes a circuit for operating printer magnet P0M to print the digit "0" corresponding to the tens digit of the total number of busy trunks in the second trunk group. Since only eight trunks were busy in this group, the counter switch LB was operated only eight steps and therefore the digits "08" will be printed. The circuit for operating printer magnet P0M may be traced as follows: from grounded contacts 616, wiper PS3 and its second bank contact, conductor 653, wiper A13 in engagement with its 24th bank contact, conductor 152, back contacts 162,

conductor 815 included in the cable extending to Fig. 8, back contacts 832, front contacts 823, wiper LB—5, through the multipled bank contacts to printer conductor P0 and through the winding of printer magnet P0M to battery. Wiper A13 in engagement with its 25th bank contact completes a circuit for operating relay 810 as follows: from grounded contacts 616, wiper PS3 and its multipled bank contacts, conductor 653, wiper A13 and its 25th bank contact, wiper A23 and its first bank contact, conductor 153, back contacts 161, conductor 814 included in the cable extending to Fig. 8 and through the winding of relay 810 to battery. Relay 810, upon energizing over the above traced circuit, completes a circuit for operating printer magnet P8M over the following circuit: from grounded contacts 811, back contacts 831, front contacts 821, conductor 915, wiper LB3, in engagement with the bank contact terminating the printer conductor P8 (not shown), and through the winding of printer magnet P8M to battery. Printer magnet P8M operates and prints the digit "8" which corresponds to the units digit of the total number of busy trunks in this trunk group. At contacts 813 relay 810 completes a circuit by way of front contacts 828 for operating relay 850. Relay 850, upon energizing, at contacts 851, closes an obvious circuit for maintaining relay 820 in operated position and at contacts 852 opens the circuit of relay 880 which now deenergizes.

The scanning switch A2 is now operated step-by-step as previously described, and when wiper A23 steps into engagement with its second bank contact, the circuit of relays 810 is open and this relay deenergizes. At contacts 811 relay 810 opens the circuit to printer magnet P8M and at contacts 813 opens the circuit to relay 850 which also deenergizes. Relay 850 at contacts 851 opens the circuit to relay 820. Relay 820 releases when its circuit is open by relay 850 and transfers the control and operating circuit from counter switch LB back to counter switch LA. Counter switch LB restores to normal over a circuit including back contacts 826, conductor 917, multipled bank contacts and wiper LB1, interrupter contacts 902 and the winding of magnet 900.

Wiper A23 in engagement with its second to 11th bank contacts operates the printer space magnet PSPM, or printer mark magnet, PMAM, as previously described, to mark the busy trunks in the third trunk group. The Mark relay 670 is operated once each time a busy trunk is encountered to operate the counter switch LA as previously described. Wiper A26 in engagement with its second to 11th bank contacts completes circuits for operating the stepping magnet of the No. 3 adder over conductor 338 in a manner similar to that described for stepping magnet 485 of the No. 5 adder. Wiper A23 in engagement with its 12th bank contacts completes a circuit for operating the printer magnet P1M to print the digit "1" since the counter switch LA has been operated ten steps because all ten trunks in the third trunk group were busy. This circuit may be traced as follows: from grounded contacts 616, wiper PS3 and its multipled bank contacts, conductor 653, wiper A13 in the engagement with its 25th bank contact, wiper A23 in engagement with its 12th bank contact, conductor 152, back contacts 162, conductor 815, back contacts 832 and 823, wiper LA5 in engagement with its 11th bank contact, printer conductor P1 and through the winding of printer magnet P1M to battery. The operation of the printer magnet P1M prints the tens digit "1." Wiper A23 in engagement with its 13th bank contact completes a circuit for operating relay 810 over a portion of the circuit just previously traced and extending from the 13th bank contact over conductor 153, back contacts 161, conductor 814, and through the winding of relay 810 to battery. Relay 810 energizes and at contacts 811 completes the following circuit for operating printer magnet P0M as follows: from grounded contacts 811, back contacts 831 and 821, wiper LA3 in engagement with its 11th bank contact, printer conductor P0 and through the winding of printer magnet P0M to battery. At contacts 813 relay 810 completes the previously traced circuit for energizing relay 880. The printer magnet P0M prints the digit "0" corresponding to the units digit for the total number of busy trunks in the third group. Relay 880 energizes and at contacts 882 prepares a circuit for energizing relay 820, but this latter relay does not energize at this time because its winding is short-circuited.

When wiper A23 steps to its 14th position relay 810 deenergizes to open the circuit of the printer magnet P0M at contacts 811. At contacts 813 relay 810 opens the short circuit from around the winding of relay 820 with the result that relay 820 now energizes in series with relay 880. Relay 820 energizes and again transfers the operating and control circuits from counter switch LA to counter switch LB. At front contacts 826, relay 820, also completes the previously traced circuit for restoring the wipers of the counter switch LA to their normal or first positions.

Wiper A24 in engagement with its 14th to 23rd positions tests for busy trunks in the fourth group to control the operation of Mark relay 670 as previously described, while wiper A23 controls the operation of the printer space magnet PSPM, or the printer mark magnet PMAM. Counter switch LB is operated in the manner previously described to count the number of busy trunks in the fourth group of trunks. Wiper A26 in engagement with its 14th to 23rd bank contacts completes circuits for operating the stepping magnet of the No. 2 adder over conductor 487 in a manner similar to that described for stepping magnet 485 of the No. 5 adder. Wiper A23 in engagement with its 24th bank contact completes a circuit for operating printer magnet P0M to print the total tens digit "0" since only six trunks were found busy in the fourth group in a manner apparent from the foregoing description. Wiper A23 in its 25th position completes a circuit similar to that previously traced for energizing relay 810. Relay 810 energizes and at contacts 811 completes the circuit for operating printer magnet P6M by way of back contacts 831 and 821, wiper LA3, in engagement with the bank contact terminating the conductor P6 and through the winding of the printer magnet P6M to battery. Printer magnet P6M is operated to print the total units digit for this group of trunks. At contacts 813 relay 810 completes the circuit for energizing relay 850 by way of front contacts 828. Relay 850 energizes and at contacts 851 completes a circuit for energizing relay 820 by way of contacts 844. At contacts 852 relay 850 opens the circuit of relay 880, which deenergizes.

Scanning switch A3 is now operated step by step as previously described and when wiper A33 steps into engagement with its second bank contact relay 810 deenergizes. At contacts 811 relay

810 opens the circuit to the printer magnet P6M and at contacts 813 opens the circuit of relay 850 which deenergizes to in turn open the circuit of relay 820. Relay 820, upon deenergizing, transfers the controlling and operating circuits from counter switch LB to counter switch LA in the manner previously described. Counter switch LB is restored to normal over a circuit including back contacts 826, conductor 917, the multipled bank contacts and wiper LB1, interrupter springs 902 and magnet 900. Counter switch LA operates one step each time Mark relay 670 is operated as previously described to count the number of busy trunks in the fifth trunk group.

Wiper A33 in its second to 11th positions operates the printer space magnet PSPM or the printer mark magnet PMAM as previously described to mark the busy trunks on the chart for the fifth group of trunks. Wiper A36 in engagement with its second to 11th bank contacts completes circuits for operating stepping magnet 425 of the No. 1 adder over the following circuit: from grounded contacts 619, contacts 673, multipled bank contacts and wiper PS5, conductor 656, through wipers A16 and A26 in their 25th positions, wiper A36 through the multipled bank contacts accessible thereto, conductor 427 included in the cable extending to Fig. 4A and to the winding of stepping magnet 425 to battery. Stepping magnet 425 of the No. 1 adder switch HA takes one step for each encountered busy trunk in the fifth group of trunks to add the total number of busy trunks in this trunk group for a fifteen minute period of time.

Wiper A33 in engagement with its 12th bank contact completes a circuit for operating printer magnet P0M as follows: from grounded contacts 616, wiper PS3 and its multipled bank contacts, wipers A13 and A23 in engagement with their 25th bank contacts, wiper A33 in engagement with its 12th bank contact, conductor 815, back contacts 832 and 823, wiper LA5, printer conductor P0 and through the winding of printer magnet P0M to battery. Printer magnet P0M is operated to print the tens total digit for the fifth group of trunks. Wiper A33 in engagement with its 13th bank contact completes a circuit for operating relay 810 over conductor 814 and a portion of the circuit just previously traced. Relay 810 at contacts 811 completes the circuit for operating printer magnet P6M as follows: from ground by way of contacts 811, back contacts 831 and 821, wiper LA3 in engagement with the bank contact terminating printer conductor P6 and through the winding of printer magnet P6M to battery. Printer magnet P6M operates to print the units total digit for the fifth group of trunks. At contacts 813 relay 810 completes the previously traced circuit for operating relay 880. Relay 880 at contacts 882 prepares the circuit for energizing relay 820. Wiper A33 in its 14th position completes the circuit for operating the printer space magnet PSPM as follows: from grounded contacts 616 over the previously traced circuit including wipers PS3, A13, A23 and A33, 14th bank contact, the multipled bank contacts of wipers A33, A23 and A13, conductor 617, back contacts 672, printer space conductor 932 and through the winding of printer space magnet PSPM to battery. The printer space magnet operates to space the printer carriage one step in the usual manner. Wiper A33 in its 15th position completes a circuit for operating the printer space magnet PSPM over the circuit provided for printing the tens hour digit: from grounded contacts 616 over the previously traced circuit to wiper A33, conductor 583, included in the cable extending to Fig. 5, back contacts 514, printer space conductor 932 and through the winding of the printer space magnet PSPM to battery.

Wiper A33 in engagement with its 16th bank contact completes a circuit for operating one of the printer magnets in accordance with the units hour digit as determined by wiper HU2 of the hour switch HU. Since the time is 9:46 a. m., wiper HU2 will be in engagement with its next to last bank contact and a circuit for operating printer magnet P9M may be traced as follows: from ground at contacts 616 over the previously traced circuit including conductor 653 and wipers A13, A23 and A33, conductor 581 included in the cable extending to Fig. 5, wiper HU2, in engagement with the bank contact terminating the printer conductor P9 and through the winding of the printer magnet P9M to battery. Printer magnet P9M is operated to print the units hour digit on the chart shown in Fig. 12A. Wiper A33 in engagement with its 17th bank contact completes the previously traced circuit for operating the printer space magnet PSPM to again space the printer carriage one step. Wiper A33 in its 18th position operates the printer magnet P4M to print the tens minute digit as follows: from grounded wiper A33 and its 18th bank contact, conductor 582, included in the cable extending to Fig. 5, wiper MT2 in engagement with its fifth bank contact, printer conductor P4 and through the winding of printer magnet P4M to battery. Wiper A33 in engagement with its 19th bank contact completes a circuit for operating printer magnet P6M to print the units minute digit by way of conductor 584, wiper MU2 and its 7th bank contacts, printer conductor P6 and through the winding of printer magnet P6M to battery. In position 20 wiper A33 again completes the circuit for the printer space magnet PSPM to again space the printer carriage one step. Wiper A33 in its 21st position completes a circuit for printing the tens seconds digit in accordance with the setting of the seconds switch SE. This circuit may be traced as follows: from grounded wiper A33 and its 21st bank contact, conductor 585, wiper SE2 in engagement with its first bank contact, printer conductor P0 and through the winding of printer magnet P0M to battery. Printer magnet P0M is operated to print the tens digit "0" for indicating the time in seconds. Wiper A33 in engagement with its 22nd bank contact completes the circuit to print the units second digit in accordance with the setting of the switch SE. This circuit may be traced from grounded wiper A33, conductor 586, wiper SE3, in engagement with its first contact, printer conductor P0 and through the winding of the printer magnet P0M to battery. Magnet P0M is operated to print the units second digit shown in Fig. 12A. Wiper A33 in engagement with its 23rd bank contact completes a circuit for operating the printer carriage return magnet PCRM as follows: from grounded wiper A33 and its 23rd bank contact, printer carriage return conductor 934 included in the cable extending to the printer and through the winding of the printer carriage return magnet PCRM to battery. The printer carriage return magnet is operated in the well known manner to return the carriage to its original printing position and to space the recording chart one vertical step. Wiper A33 in engagement with its 24th bank contact completes a circuit for energizing relay 620 as follows: from

grounded wiper A33 in engagement with its 24th bank contact, conductor 618 included in the cable extending to Fig. 6, through the upper winding of relay 620, back contacts 631 and resistance R1 to battery. Relay 620, upon energizing over the above traced circuit, at contacts 621 opens the circuit to pulse relay 610 which deenergizes. At contacts 622 relay 620 opens one of the points in the circuit for grounding hold conductor 615 and at contacts 623 completes a locking circuit for itself as long as the time pulse relay 640 is energized. Pulse relay 610 deenergizes and at contacts 612 opens the circuit for operating the counter switches; at contacts 613 disconnects ground from hold conductor 615 to cause the release of the operated storage relays SR and relays 100, 110 and 120. At contacts 614 relay 610 opens the circuit to stepping magnet 150, which steps wipers of switch A3 to their 25th positions; at contacts 616 opens the original energizing circuit of relay 620 and at contacts 619 opens the circuit for controlling the operation of the adder.

The counter switch LA is restored to its normal position in the same manner as previously described when wiper A33 stepped from its 13th position to open the circuit of relay 810 which thereupon removed the short circuit from around relay 820 to permit this relay to energize in series with relay 880.

The storage relays SR deenergize when relay 620 is operated to disconnect ground from the test leads, such as T0 to T49, inclusive. Relays 100, 110 and 120 likewise deenergize when ground is removed from hold conductor 615 and relay 120 at back contacts 122 operates the stepping magnet 130 and the release relay 650 in series as previously described to step the wipers of switch A1 to its first position. Release relay 650 at contacts 651 maintains relay 620 locked to grounded contacts 632 of key K2. Relays 100 and 110 at back contacts 101 and 112, with wiper A11 and its first position, operates the stepping magnet 140 in series with release relay 650 as previously described to step the wipers of switch A2 to their first position. Wiper A21 in its first position operates stepping magnet 150 in series with release relay 650 as previously described to step the wipers of switch A3 to their first positions.

The printer has now printed the second horizontal line shown in Fig. 12A and has returned the carriage to initial typing position and has positioned the paper another vertical step preparatory to printing the third horizontal line. At the end of this particular time period, time pulse unit 750 disconnects ground from conductor 700 to release relay 640. Time pulse relay 640 at contacts 641 releases the stepping magnet 570 of the seconds switch SE to step the wipers of the seconds switch into engagement with their second bank contacts. At contacts 642 relay 640 opens the locking circuit of relay 620 which deenergizes. Relay 620 deenergizes and at contacts 621 recloses the circuit to operate the pulse relay 610. At contacts 621 relay 621 again grounds the hold conductor 615 to re-operate relays 100, 110 and 120 and to prepare locking circuits for the storage relays SR as previously described.

Relay 120 at contacts 121 prepares the circuit to re-operate the gang group relay GR1 and GR2 by way of conductor 653, wiper PS3, and contacts 616 when the pulse relay 610 is first operated. Relays 100, 110 and 120 prepare circuits to step the scanning switches A1, A2 and A3 through another cycle of operation. Pulse relay 610 now operates and transmits pulses as before to first re-operate the gang relays GR1 and GR2 to cause the storage relays SR, corresponding to the busy trunks, to energize and lock to the hold conductor 615 and then to cause the counter switches LA and LB to count the number of busy trunks in each trunk group, to cause the printer to record, by a mark, each busy trunk and the number of the busy trunks in each trunk group, to cause each adder switch individual to each trunk group to total the number of busy trunks and to finally cause the printer to print the time of day.

In case the same trunks are still busy in their respective trunk groups, then the circuits previously traced are identical and the recording for the third line of chart Fig. 12A is the same as previously described, except for the time of day. Since this recording was made fifteen seconds later, the time recorded is also fifteen seconds later. At the end of this time period, the time pulse unit 750 releases the time pulse relay 640 to cause the seconds switch SE to take another step and to release relay 620. Relay 620 again grounds the hold conductor 615 and again completes the circuit for pulse relay 610.

In the same manner as previously described, pulse relay 610 re-operates the switches to cause the printer to print line 4 of Fig. 12A. At the end of this recording and when time pulse relay 640 deenergizes the seconds switch SE is stepped to its fourth position. In this position wiper SE4 completes a circuit for energizing relay 630 as follows: from grounded conductor 701, wiper SE4 in engagement with its fourth bank contact, conductor 576 and through the upper winding of relay 630 to battery. Relay 630 is energized whenever wiper SE4 reaches its fourth or eighth positions so that a circuit will be completed for stepping magnet 657 of the primary switch PS when the scanning switch A3 reaches its 24th position. This circuit may be traced as follows: from grounded contacts 616, wiper PS3 in engagement with its multipled bank contacts, conductor 653 included in the cable extending to Fig. 1A, wiper A13 in engagement with its 25th bank contact, wiper A23 in engagement with its 25th bank contact, wiper A33 in engagement with its 24th bank contact, conductor 618 extending to Fig. 6 through the upper winding of relay 620, front contacts 631 and through the winding of stepping magnet 657 to battery. This circuit is only completed after each fourth cycle operation of the scanning switch A3. The primary switch PS therefor takes one step for every fourth cycle of the scanning switch, or once every minute, since one cycle operation of the scanning switches consumes approximately fifteen seconds and each scanning operation is initiated upon the release of the time pulse relay 640 which is released every fifteen seconds.

The operation continues as described to make successive scannings and recordings such as indicated in Fig. 12A. After 60 such scannings, or cycles, have been made the total in each of the adders for the respective trunk groups are recorded by the printer. After the last scanning operation of the scanning switches for testing and marking the busy condition of the busy trunk lines in the respective groups, the primary switch PS is stepped from its 16th position to its 17th position to cause the printer to record the total number of busy trunks totalled by the respective trunk group adders.

It will be remembered that the primary switch PS takes one step for each fourth cycle operation of the scanning switches and therefore on the last,

or 60th, scanning operation the circuit for relay 630 is completed as follows: from grounded conductor 701, wiper SE4 in engagement with its fourth bank contact, conductor 576 and through the upper winding of relay 630 to battery. Now when wiper A33 engages its 24th bank contact on this last scanning operation relay 620 and stepping magnet 657 of primary switch PS are energized in series in the same manner as previously described. When pulse relay 610 deenergizes, magnet 657 also deenergizes and steps the wipers of the primary switch PS into engagement with their 17th bank contacts. At the end of this time pulse period, relay 640 deenergizes to step the wipers of the seconds switch SE to their fifth position in which position a circuit is completed for relay 630 as follows: from grounded wiper SE1 in engagement with its fifth bank contact, conductor 573, contacts 663, wiper PS6 in engagement with its 17th bank contact, and through the lower winding of relay 630 to battery. Wiper PS4 of the primary switch has opened the circuit extending to the Mark relay 670 to prevent the operation of this relay on the subsequent cycle operation of the scanning switches. Wiper PS5 now engages open bank contacts so that no further pulses will be transmitted to the adders. Wiper PS3 of the primary switch has stepped from in engagement with conductor 653 and is now in engagement with the bank contact terminating conductor 655, thereby switching the pulsing circuit from wipers A13, A23 and A33 to wipers A15, A25 and A35.

In the same manner as previously described, relay 620 deenergizes at this particular time pulse period and relay 610 is re-operated to cause the scanning switches to rotate through another cycle of operation. During this cycle of operation the wipers A13, A14, A16, A23, A24, A26, A33, A34 and A36 are ineffective and wipers A15, A25 and A35 are effective to operate the printer in accordance with the totals registered on the respective trunk group adders.

Before describing how the printer is operated in accordance with the totals registered on the adders, a detailed description of the operation of the adders will be given. It will be remembered that the No. 5 adder (Fig. 4B) was operated over wiper A16 and conductor 358 each time the Mark relay 670 was energized by a busy trunk during the time wiper A14 was testing trunk test conductors T0 to T9, inclusive. In a similar manner the No. 4 adder, the No. 3 adder, the No. 2 adder and the No. 1 adder were successively controlled over conductors 348, 338, 487 and 427, respectively, in response to the successive testing of the test trunks T10 to T49 by the wipers A14, A24 and A34.

Referring to Fig. 12A, it will be seen that the first time the first group of ten trunks was tested on the second cycle operation of the scanning switches that there were eight busy trunks in this trunk group therefore eight impulses were transmitted over conductor 358 to operate stepping magnet 485 of the No. 5 adder eight steps. In a similar manner eight pulses were transmitted to the No. 4 adder over conductor 348, ten pulses were transmitted to the No. 3 adder over conductor 338, six pulses were transmitted to the No. 2 adder over conductor 487, and six pulses were transmitted to stepping magnet 425 of the No. 1 adder over conductor 427.

Stepping magnet 485 of the No. 5 adder operates the wipers of switch HC one step for each pulse transmitted thereto corresponding to a busy trunk in the first group of trunks. When 24 pulses have been transmitted to switch HC by a plurality of scanning operations of the scanning switches, wiper HC2 is in engagement with its 25th bank contact. When magnet 485 is energized preparatory to stepping the wipers in their 25th step, a circuit is completed for two-step relay 400 as follows: from grounded contacts 487, wiper HC2 in engagement with its 25th bank contact, contacts 483, back contacts 405 and through the lower winding of two-step relay 400 to battery. Relay 400 closes only its first step contacts 404 when relay 400 is energized over its lower winding alone. At contacts 404, relay 400 completes a short circuit around its upper winding from grounded contacts 487 over the previously traced circuit and from thence through its upper winding, contacts 404, contacts 492, contacts 481 and to conductor 847 which is grounded at contacts 843 of relay 840. Two-step relay 400 is so designed that it will close only its first step contacts 404 as long as its upper winding is short circuited. In response to the termination of the 25th pulse transmitted over conductor 358, stepping magnet 485 is deenergized to step the wipers of switch HC into engagement with their first bank contacts. In response to the deenergization of magnet 485, the short circuit around the upper winding of two-step relay 400 is opened with the result that relay 400 now energizes through its second step over the circuit previously traced from grounded conductor 847 and through the upper and lower windings of relay 400 in series to battery. At contact 401 relay 400 switches the tens conductor 350 from wiper HC5 to wiper HC6. At contacts 402 relay 400 switches the units conductor 351 from wiper HC3 to HC4. At contacts 403 relay 400 opens a point in the circuit to relay 470 and at back contacts 405 opens its original energizing circuit and at front contacts 405 prepares a point in the circuit for operating two-step relay 490.

Wiper HC2 reaches its 25th back contact in its second operation as a result of 49 impulses being transmitted over conductor 358. Two-step relay 490 is operated in its first step when magnet 485 is energized as follows: from grounded contacts 487, wiper HC2 in engagement with its 25th bank contact, contacts 483, front contacts 405, back contacts 494, and through the upper winding of two-step relay 490 to battery. Relay 490 operates in its first step over this circuit to close only contacts 493. The lower winding of two-step relay 490 is now short circuited over a circuit extending from grounded conductor 847, contacts 481 and 493 and through the lower winding over two-step relay 490 to ground over the previously traced circuit at contact 487. Two-step relay 490 is similar to the previously described two-step relay 400 and will not energize fully through its second step until such time as the two windings of this relay are energized in series. When magnet 485 deenergizes the short circuiting ground at contacts 487 is removed with the result that this relay energizes through its second step in response to the removal of this short circuit. At contacts 491 relay 490 prepares a point in a circuit for relay 470. At contacts 492 relay 490 opens the circuit of relay 400 which accordingly deenergizes. At back contacts 494 relay 490 opens its original energizing circuit and at front contacts 494 prepares a point in the circuit for two-step relay 480. Relay 400, upon deenergizing, at contacts 401 and 402 switches the tens and units con-

ductors 350 and 351 back to wipers HC5 and HC3. At back contacts 405 relay 400 prepares a point in its initial energizing circuit. At contacts 403 relay 400 completes a circuit for energizing relay 470 over the following circuit: from grounded conductor 847, contacts 491 and 403 and through the winding of relay 470 to battery. At contacts 471 to 475, inclusive, relay 470 switches the normal connections extending from the bank contacts from printer conductors P0 to P4, inclusive, to the printer conductors P5 to P9, inclusive, extending to printer magnets. At contacts 476 relay 470 completes a locking circuit for itself by way of contacts 481 and grounded conductor 847, and at contacts 477 prepares a circuit for the upper winding of relay 400.

When No. 5 adder receives its 75th pulse and wiper HC2 is in engagement with its 25th bank contact the previously traced circuit for operating relay 400 in its first step is again completed. In response to the termination of the 75th pulse, wiper HC2 is stepped from in engagement with its 25th bank contact into its first bank contact and magnet 485 removes the short circuit from the upper winding of relay 400 to permit this relay to operate in its second step. Relay 400 at contacts 401 and 402 again switches the tens and units conductors 350 and 351 and at front contacts 405 prepares a point in the circuit for relay 480.

In response to the 99th pulse, the wiper HC2 is stepped into engagement with its 25th bank contact for the fourth time. In response to the 100th pulse magnet 485 completes the circuit for energizing relay 480 as follows: from ground by way of contacts 487, wiper HC2 and its 25th bank contact, contacts 483, front contacts 405 and 494, and through the winding of relay 480 to battery. Relay 480 is energized to first close contacts 482, thereby completing a locking circuit for itself. At contacts 481 relay 480 opens the circuits of relays 400, 490 and 470. At contacts 484 relay 480 completes a circuit for energizing the stepping magnet 495 of switch HD. Relay 400, upon deenergizing, again transfers the tens and units leads 350 and 351 as previously described. Relays 490 and 470 likewise deenergize and the latter relay at contacts 471 to 475, inclusive, transfers certain of the printer conductors. In response to the termination of the 100th pulse magnet 485 deenergizes to step the wipers of switch HC and to open the locking circuit of relay 480 which now deenergizes. At contacts 484 relay 480 opens the circuit to the stepping magnet 495 thereby causing the deenergization of this stepping magnet and the stepping of the wipers of switch HD one step. All of the relays of the No. 5 adder and the wipers of the switch HC are now in their normal position, or their first positions, as shown in the drawings, and the only change is that the switch HD has taken one step. From the foregoing description it will be seen that the switch HD takes one step for each 100 pulses transmitted to the No. 5 adder.

The circuit for re-energizing relay 400 in its first step is again completed, in response to the 125th pulse at which time wiper HC2 is in engagement with its 25th back contact for the fifth time. On the 125th step of switch HC the short circuit is removed from the upper winding of relay 400, whereupon the relay 400 is operated through its second step. In response to the 150th pulse and when wiper HC2 engages its 25th bank contact for the sixth time the relay 490 is operated in its first step and on the 150th step of wiper HC2 relay 490 is operated in its second step. Relay 400 deenergizes when relay 490 energizes. When relay 400 deenergizes, the circuit is again completed for energizing relay 470 by way of contacts 491 and 403. In response to the 175th pulse with wiper HC2 in engagement with its 25th bank contacts, relay 400 is again energized in its first step and on the 175th stepping of switch HC relay 400 is operated through its second step. In response to the 200th pulse with wiper HC2 in engagement with its 25th bank contact, the circuit for operating relay 480 is again completed. Relay 480 is operated to cause the release of relays 400, 490 and 470 as previously described. Relay 480 deenergizes in response to the termination of the pulse to magnet 485. Relay 480 at contacts 484 releases stepping magnet 495 to cause the wipers of the switch HD to take their second step. The relays of the No. 5 adder are now in normal position. The wipers of the switch HC are now in engagement with their first or normal bank contacts, while the wipers of the switch HD are now in engagement with their third bank contacts. In the same manner as just described, the wipers of the switch HC and the relays in the No. 5 adder are operated to total the number of busy trunks in the first trunk group encountered by the scanning switch A1.

The No. 2, the No. 3 and the No. 4 adders are identical to the No. 5 adder and are operated in a similar manner to record the total number of busy trunks encountered by the scanning switches during their cycle operations and the testing of the test trunk conductor T10 to T39, inclusive.

The No. 1 adder, shown in Fig. 4A, is substantially the same as the No. 5 adder, shown in Fig. 4B, with the exception that the No. 1 adder is of larger capacity and will total up to as many as 4,999 registrations. The switch HA of the No. 1 adder is operated in the same manner as the switch HC of the No. 5 adder and the switch HD of the No. 1 adder is operated in the same manner as the switch HD of the No. 5 adder. The two-step relays 440 and 430, and relays 420 and 410 correspond respectively to the relays 400, 490, 480 and 470 of the No. 5 adder. These relays also operate in the same manner as described for the No. 5 adder. The No. 1 adder has an additional two-step relay 450 which is used for switching over the hundreds and thousands conductors 439 and 438. The switch HB, in the same manner as described for switch HD of the No. 5 adder, is operated one step for each 100 registrations. Switch HB will therefore reach its 25th bank contact when a total of 2,400 registrations have been made. In response to 2,500th registration relay 420 at contacts 424 operates magnet 455 and magnet 455 at contacts 457 completes a circuit for operating relay 450 in its first step as follows: from grounded contacts 457, wiper HB2 in engagement with its 25th bank contact, contacts 454, and through the lower winding of relay 450 to battery. Relay 450 is energized in its first step to close only contacts 453 over this circuit. The contacts 453 now complete a short circuit through the upper winding of two-step relay 450 until magnet 455 deenergizes to remove this short circuit. On the termination of the 2,500th registration magnet 455 deenergizes and removes the short circuit from around the upper winding of relay 450 at contacts 457. Two-step relay 450 now energizes through its second step over a circuit including grounded conductor 847, contacts 453, and the upper and lower windings in series to

battery. At contacts 451 relay 450 switches the hundreds conductor 439 from wiper HB3 to wiper HB4; at contact 452 switches the thousands conductor 438 from wiper HB5 to wiper HB6 and at contacts 454 opens a point in its original energizing circuit.

Referring now to the recording chart shown in Fig. 12A, it will be seen that there was a total of 312 registrations totaled in the No. 5 adder. Since the switch HD in the No. 5 adder takes one step for each 100 registrations, the wipers of switch HD will therefor be in engagement with their fourth set of bank contacts. The wipers of the switch HC are in engagement with their 13th set of bank contacts and the relays are all in their normal positions since the switch HC has been stepped 312 steps. The wiper HD3 is in engagement with the P3 conductor included in the printer cable and is connected to the P3M printer magnet of the printer. The wiper HC5 is in engagement with its 13th bank contact which is connected by way of back contacts 472 to the printer conductor P1 which is connected to the P1M printer magnet of the printer. The wiper HC3 is in engagement with its 13th bank contact which is connected to the P2 printer conductor extending to the P2M magnet of the printer.

In a similar manner the No. 4, the No. 3, and the No. 2 adders have their wipers positioned preparatory to printing the total number of registrations totaled by these adders. The No. 1 adder has a total of 303 busy trunks and therefore the wipers of the switch HB are in engagement with their fourth bank contacts and wiper HB3 is in engagement with the P3 printer conductor extending to the P3M printer magnet. The wipers of the switch HA are in engagement with their fourth bank contacts. Wiper HA5 is connected by way of back contacts 411 to the P0 printer conductor extending to the printer magnet P0M and the wiper HA3 is in engagement with the printer conductor P3 which is connected to the P3M printer magnet.

Returning now to the time in which the scanning switches A1, A2 and A3 are started on their final scanning cycle operation in order to cause the printer to print the totals registered on the respective trunk group adders, each time pulse relay 610 is energized and deenergized the scanning switches are operated step by step and relay 610 transmits a ground pulse by way of contacts 616, wiper PS3, and conductor 655 extending to wiper A15 in Fig. 1B. Wiper A15 in engagement with its second to tenth bank contacts on successive steps of switch A1 completes circuits by way of grounded conductor 655, wiper A15 and printer space conductor 932 for operating the printer space magnet PSPM nine times to step the printer carriage nine spaces preparatory to printing the total registered in the No. 5 adder. On the next step of wiper A15 into engagement with conductor 359 the following circuit is completed for operating the No. 3 printer magnet P3M as follows: from grounded contacts 616, wiper PS3, conductor 655, wiper A15, conductor 359 extending to the No. 5 adder, wiper HD3, printer conductor P3 and through the winding of the printer magnet P3M to battery. The printer magnet is operated over this circuit to print the digit "3" in the hundreds column. On the next step of wiper A15 into engagement with conductor 350 a circuit is completed for operating the printer magnet P1M as follows: from ground at contacts 616 over the previously traced circuit to wiper A15, conductor 350 extending to the No. 5 adder, back contacts 461, wiper HC5 in engagement with its 13th bank contact, back contacts 472, printer conductor P1 and through the winding of the printer magnet P1M to battery. The printer magnet P1M operates over this circuit to print the digit "1" in the tens column. When wiper A15 steps into engagement with its next bank contact a circuit is completed for operating the printer magnet P2M over the following circuit: from grounded wiper A15, conductor 351 extending to the No. 5 adder, back contacts 402, wiper HC3 in engagement with its 13th bank contact, printer conductor P2 and through the winding of printer magnet P2M to battery. Printer magnet P2M is operated over this circuit to print the digit "2" in the units column.

The wiper A15 in its next nine steps engages the contacts multipled to the printer space conductor 932 to cause the printer to take nine spaces preparatory to printing the total registered in the No. 4 adder. When wiper A15 connects with conductor 349 a circuit is completed for operating the printer magnet P3M over a circuit in the No. 4 adder similar to that described for the No. 5 adder. In a similar manner when wiper A15 engages conductor 340 the printer magnet P4M is operated to print the tens digit. When wiper A15 reaches its 25th position a circuit is completed by way of wiper A25 and conductor 341 to the No. 4 adder and thence through the winding of the printer magnet P4M to battery to print the digit "4" in the units column. The wipers of the switch A1 now remain in their 25th positions and the wipers of the second scanning switch A2 are operated to record the totals in the No. 3 and No. 2 adders in a manner similar to that just described. When the wipers of the scanning switch A2 reach their 25th position the scanning switch A3 is operated. Wiper A35 successively engages the second to ninth multipled bank contacts and completes circuits from grounded contacts 616 over conductor 655 through the wipers A15 and A25 in their 25th positions, wiper A35 and through the multipled contacts to the printer space conductor 932 to operate the printer space magnet PSPM to space the carriage to the point preparatory to print the thousands digit totaled in the No. 1 adder. Wiper A35 in engagement with its 10th bank contact terminating conductor 438 completes a circuit from grounded conductor 655, wipers A15, A25 and A35, conductor 438, back contacts 452, wiper HB5, and multipled bank contact connected to printer space conductor 932 and through the printer space magnet PSPM to battery. The printer space magnet operates the carriage of the printer to space another step. Wiper A35 in engagement with its next bank contact completes a circuit for operating the No. 3 printer magnet P3M as follows: from grounded wiper A35, conductor 439, back contacts 451, wiper HB3, printer conductor P3, and through the winding of printer magnet P3M to battery. The printer magnet P3M is operated to print the digit "3" in the hundreds column. Wiper A35 in engagement with its next bank contact completes a circuit by way of wiper A35, conductor 436, back contacts 441, wiper HA5, back contacts 411, printer conductor P0 and through the winding of printer magnet P0M to battery. Printer magnet P0M is operated over this circuit to print the digit "0" in the tens column. Wiper A35 in engagement with its next bank contact completes a circuit by way of conductor 437, back contacts 442, wiper HA3, printer conductor P3, and through the winding of printer magnet P3M

to battery. Printer magnet P3M operates to print the digit "3" in the units column.

Wiper A35 in engagement with its 4th, 17th, 18th and 19th bank contacts completes a circuit by way of printer carriage return conductor 934 for operating the printer carriage return magnet PCRM to cause the printer to return the carriage to its initial printing position and to space the paper one vertical step in the well known manner. Wiper A35 in engagement with its 20th bank contact completes a circuit for operating relay 620 over conductor 618 and front contacts 631 and through the winding of stepping magnet 657 to battery. Relay 620, upon energizing, at contacts 621 opens a circuit to pulse relay 610, at contacts 622 disconnects ground from the hold conductor 615 and at contacts 623 completes the previously traced locking circuit through its lower winding. Pulse relay 610 deenergizes and disconnects ground from hold conductor 615 to release relays 100, 110 and 120 and the operated storage relays SR as previously described.

After the termination of the pulse over conductor 618, stepping magnet 657 of the primary switch PS deenergizes and steps the wipers of the primary switch to their 18th position. Wiper PS2 completes a circuit for short circuiting start relay 660 as follows: from ground at springs 632 of key K2, wiper PS2 in engagement with its 18th bank contact, the winding of start relay 660, contacts 666 and back to ground at key K2. Start relay 660 deenergizes and at contact 661 completes a circuit over the printer off-normal conductor 935 for operating the printer carriage return magnet through the printer off-normal contacts 937 in case the printer carriage is in an off-normal position. At contacts 662 relay 660 completes a circuit for release relay 650 and for restoring the adder switches to normal positions. At contact 664 relay 660 disconnects ground from hold conductor 615, at contacts 665 disconnects ground from conductor 675 to deenergize relay 840 at contacts 666 opens a point in its own locking circuit and at contacts 667 completes a circuit for restoring the primary switch PS to its normal position. This circuit may be traced as follows: from grounded wiper PS1 through the multipled bank contacts accessible to said wiper, contacts 667, interrupter contacts 658, and through the winding of stepping magnet 657 to battery. Stepping magnet 657 interrupts its own circuit at contacts 658 to step the wipers of the primary switch back to their first or normal positions.

Relays 100, 110 and 120 denergize when ground is removed from the hold conductor 615 and relays 110 and 120 complete the previously traced circuits for restoring scanning switches A1 and A2 to their normal positions. Scanning switch A3 is restored to its normal position over the following circuit: from ground through the winding of relay 650, release conductor 628, back contacts 122, wiper A11 in its normal position, back contacts 101, wiper A21 in its normal position, back contacts 102, wiper A31 in engagement with its multipled bank contacts, interrupter contacts 151, and through the winding of stepping magnet 150 to battery. Stepping magnet 150 interrupts its own circuit at contacts 151 to step to wipers of switch A3 into engagement with their 25th bank contacts at which point a circuit is completed through the 25th bank contact, back contacts 104, and interrupter contacts 151 for stepping scanning switch A3 to its normal or first position.

The circuit for restoring the adders may be traced as follows: from ground through the winding of release relay 650, contacts 662, conductor 668 extending to Fig. 4A, wiper HA1 in engagement with its multipled bank contacts, interrupter contacts 426, and through the winding of stepping magnet 425 to battery. Release relay 650 is energized over the previously traced circuits and at contacts 651 maintains relay 620 locked in energized position and at contacts 652 opens a point in the initial energizing circuit of start relay 660. Stepping magnet 425 of the No. 1 adder is energized in series with release relay 650 over the previously traced circuit and at its interrupter contacts 426 interrupts its own circuit to step the wipers of the switch HA back to their normal or first positions. Wiper HA1 in its first position completes a circuit for energizing stepping magnet 455 in series with release relay 650 by way of the previously traced circuit, including conductor 668, wiper HA1 in engagement with its first bank contact, wiper HB1 in engagement with its multipled bank contacts, interrupter contacts 456, and through the winding of stepping magnet 455 to battery. Stepping magnet 455 interrupts its own circuit at contacts 456 to restore the wipers of the switch HB to their normal or first positions. Wiper HB1 in its first position further extends this restoring circuit for restoring the switches of the No. 2 adder to normal in a manner similar to that just described. The hundreds switch in the No. 2 adder, corresponding to switch HB, completes a circuit when it reaches its normal position over conductor 309 for restoring the switches of the No. 3 adder in a similar manner. The hundreds switch in the No. 3 adder in response to being restored to its normal position completes a circuit over conductor 309' for restoring the switches in the No. 4 adder. The hundreds switch in the No. 4 adder then completes a circuit for restoring the switch HC in the No. 5 adder as follows: from ground through the winding of release relay 650 and conductor 668, through wipers HA1 and HB1 in their normal positions, conductor 409 through the normal positions of the switches in the No. 2 adder, conductor 309, through the normal positions of the switches in the No. 3 adder, conductor 309' through the wipers of the switches in the No. 4 adder and their normal positions, conductor 408, wiper HC1 in engagement with its multipled bank contacts, interrupter contacts 486, and through the winding of stepping magnet 485 to battery. Stepping magnet 485 interrupts its own circuit at contacts 486 to step the wipers of the switch HC to their first or normal positions. Wiper HC1 in engagement with its first bank contact continues this restoring circuit by way of wiper HD1 and its multipled bank contacts, interrupter contacts 496 and through the winding of stepping magnet 495 to battery. Magnet 495 interrupts its own circuit at contacts 496 to restore the switch HD to its normal position. All of the adder switches have now been restored to their normal positions and the circuit through the winding of release relay 650 is opened with the result that slow release relay 650 deenergizes after an interval.

Relay 840 deenergizes when ground in removed from conductor 675 and at contacts 841 grounds the multiplied bank contacts of wiper LA1 to restore the counter switch LA to its normal position. At contacts 842 relay 840 opens the lock-

ing circuit of relay 860 which deenergizes, at contacts 843 disconnects ground from conductor 847 to release any operated relays, such as relays 410, 420, 430, 440 or 450 in the adders which at this time may be locked to this ground. At contacts 844 relay 840 opens the circuits to relays 820 to 880 and release said relays if operated. In case relay 820 was operated then relay 820, upon deenergizing, at back contacts 826 completed the circuit for restoring the counter switch LB to its normal position as previously described. Relay 860, upon deenergizing, at contacts 861, opens a point in its own locking circuit, at contacts 862 prepares its own initial energizing circuit, at contacts 863 opens a further point in its own locking circuit, at contacts 864 disconnects ground from conductor 626 to open a point in the circuit to pulse relay 610, and at contacts 865 opens a point in the locking circuits of either relays 830 or 870 if operated.

All the apparatus including the scanning switches, the counter switches and relays, the printer, the adders and relays, and the primary switch and relays are restored to normal position. In case the release relay 650 deenergizes at a time when pulse relay 640 is still operated then relay 620 is locked energized until such a time as pulse relay 640 deenergizes. At contacts 641 relay 640, upon deenergizing, steps the wipers of the seconds switch SE as previously described. At contacts 642 relay 640 opens the locking circuit of relay 620 which deenergizes, and at contacts 643 completes a circuit for reenergizing start relay 660 to start a new recording operation.

In case the switch room attendant desires to stop the recording operation he may do so at any time by releasing the start key K2 to release start relay 660, which causes the release of the apparatus as previously described. It will now be assumed that a recording, such as shown in Fig. 12B, is now desired for three groups of sixteen trunks each. The key K1 (Fig. 11) is now set to No. 2 grouping to position wipers K1' and K1² (Fig. 7) into engagement with their third bank contacts. Wiper K1' is operated into engagement with the bank contact terminating conductor 772 and wiper K1² grounds conductor 701 and starts the time pulse unit 750. The clock time as displayed on the lamp panel of Fig. 11 is now changed, if necessary, by operation of the minutes key MK and hours key HK. The date keys K3, K4, K5 and K6 are set to the proper date positions if not already so set. The grouping keys are now set in accordance with a proper trunk grouping; that is, keys K7, K8 and K9 are operated to their No. 1 positions. Keys K10, K11, K15 and K16 are operated to their "off positions," and keys K12, K13 and K14 are operated to their No. 6 positions. The operation of keys K7, K8 and K9 to their No. 1 positions operates wipers K7', K8' and K9' (Fig. 7) into engagement with their second bank contacts to connect with printer conductor P1. Wipers K10', K11', K15' and K16' are in engagement with their first bank contacts to connect with printer space conductor 932. Wipers K12', K13', and K14' are moved into engagement with their seventh bank contacts to connect with the printer conductor P6. The printer motor 938 is started over conductors 701 and 938 and the printer carriage is returned to normal, if off-normal. The apparatus is now set in the same manner as previously described to start the recording operation as soon as the start key K2 is operated.

In response to the operation of key K2 start relay 660 is operated as previously described to cause the seconds switch SE to step to its fourth or eighth positions, to ground hold conductor 615, to operate relay 840 and to lock itself in operated position. The grounding of hold conductor 615 by contacts 664 of start relay 660, grounds wiper K1' which now engages its third bank contact to thereby ground conductor 772 which extends to Fig. 2A and through the windings of relays 200, 210 and 220 in multiple to battery. Relays 200, 210 and 220 are similar to and perform the same functions as relays 100, 110 and 120 for scanning switches B1, B2 and B3.

When the seconds switch SE was operated to its fourth position in response to the operation of start relay 660, relay 630 is operated to prepare the circuit for operating stepping magnet 657 of the primary switch PS. Relay 840 operates relay 860 and grounds conductor 847 extending to the adders. Relay 860 locks itself and grounds conductor 626 for operating pulse relay 610 to transmit pulses as previously described. At contacts 614 pulse relay 610 transmits pulses over stepping conductor 627 to step the scanning switches B1, B2 and B3 in a manner similar to that described for scanning switches A1, A2 and A3. The circuit for operating stepping magnet 230 of scanning switch B1 may be traced as follows: from grounded stepping conductor 627, front contacts 222, wiper B11 in engagement with its first bank contact, front contacts 224 and 223, and through the winding of stepping magnet 230 to battery. The circuit for operating stepping magnet 230 through its second to 24th steps may be traced as follows: from grounded conductor 627, front contacts 222, wiper B11 in engagement with its multipled bank contacts, contacts 223 and through the winding of stepping magnet 230 to battery. Wiper B11 in engagement with its 25th bank contact completes a circuit for stepping magnet 240 when conductor 627 is grounded as follows: from conductor 627 front contacts 222, wiper B11 and its 25th bank contact, front contact 201, wiper B21 in engagement with its first bank contact, front contacts 212 and 211, and through the winding of stepping magnet 240 to battery. The circuit for operating stepping magnet 240 and the wipers of scanning switch B2 through their second to 24th steps may be traced as follows: from grounded conductor 627 over the previously traced circuit to wiper B21 and thence by way of the multipled bank contacts and contacts 211 through the winding of stepping magnet 240 to battery. Wiper B21 in engagement with its 25th bank contact completes a circuit for operating stepping magnet 250, when conductor 627 is grounded, as follows: from grounded conductor 627 over the previously traced circuits to wiper B21 in engagement with its 25th bank contact, front contacts 202, wiper B31 in engagement with its first bank contact, front contacts 204 and 203 and through the winding of stepping magnet 250 to battery. The circuit for operating stepping magnet 250 and the wipers of the scanning switch B3 through their second to 24th bank contacts may be traced as follows: from grounded conductor 627 over the previously traced circuit to wiper B31 and thence through the multipled bank contacts accessible thereto and through the contacts 203 and winding of stepping magnet 250 to battery.

The wipers B12, B22 and B32 complete the circuits for causing the printer to print the "heading" shown in Fig. 12B in a manner similar to that described for the scanning switches A1, A2

and A3. Wiper B12 in its 2d to 11th positions completes circuits, on successive steps of the wiper, when conductor 652 is grounded by contacts 616 of pulse relay 610, for operating printer magnets P0M, P1M, P2M, P3M, P4M, P5M, P6M, P7M, P8M and P9M successively over printer conductors P0 to P9, inclusive. Wiper B12 in engagement with its 12th back contacts completes a circuit for operating printer space magnet PSPM as follows: from grounded contacts 616, wiper PS3 in engagement with its first back contact, conductor 652, wiper B12 in engagement with its 12th bank contact, printer space conductor 932 and through the winding of printer space magnet PSPM to battery. The printer space magnet in a well known manner spaces the carriage one step. Wiper B12 in successive engagements with its 13th to 18th bank contacts completes circuits over printer conductors P0 to P5, inclusive, for operating the printer magnets P0M to P5M, inclusive, to print the digits "0" to "5," inclusive.

Wiper B16 in its 19th and 20th positions completes circuits for energizing the printer ribbon control magnet PRCM as follows: from grounded wiper PS1 in engagement with its first bank contact, conductor 623, 19th and 20th bank contacts and wiper B16, conductor 656, wiper PS5 of the primary switch in engagement with its first bank contact, printer ribbon control conductor 933 and through the winding of printer ribbon control magnet PRCM to battery. The printer ribbon control magnet positions the red ribbon on the printer so that the subsequent operations of the printer magnets will print the corresponding digits in red.

Wiper B12 in its 19th position completes a circuit for printing the digit "1" in red as follows: from grounded contacts 616, wiper PS3 and its first bank contact, conductor 652, wiper B12 in engagement with its 19th bank contact, conductor 730 extending to the wiper K9' in Fig. 7, second bank contacts, conductor P1 and through the winding of printer magnet P1M to battery. Wiper B12 in its 20th position completes a circuit for printing the red digit "6" as follows: from ground over the previously traced circuit including conductor 652 and wiper B12 and its 20th bank contact, conductor 731 extending to wiper K14' in Fig. 7, seventh bank contact, printer conductor P6 and through the winding of printer magnet P6M to battery.

Wiper B16 opens the circuit to the printer ribbon control magnet when it steps to its 21st position so that the subsequent digits printed by the printer are printed in black. The "heading" for the first group of sixteen trunks as shown in Fig. 12B, has been printed by the printer. The remaining portion of this "heading" for the second and third groups of sixteen trunks are printed in response to the successive steps by wipers B22 and B32 in a manner obvious from the foregoing description. The digits corresponding to the month, day and year are also printed by the printer during the time wiper B32 is stepping over its 11th to 19th bank contacts. In its 20th position wiper B32 completes the circuit for operating printer carriage return magnet PCRM over conductor 934 to cause the carriage to be returned to the left to its initial printing position and to space the paper one vertical step. The printer has now completed printing the "heading" shown in Fig. 12B.

Wiper B32 in its 21st position completes a circuit over conductor 618 for operating relay 620 and stepping magnet 657 in series as follows: from grounded conductor 652 through wipers B12 and B22 in their 25th positions, wiper B32 in engagement with its 21st bank contact, conductor 618, upper winding of relay 620, front contacts 631 and through the winding of stepping magnet 657 to battery. Relay 620 opens one of the points for grounding hold conductor 615 and at contacts 623 locks itself in operated position. Pulse relay 610, upon deenergizing, at contacts 613 disconnects ground from hold conductor 615 to release relays 200, 210 and 220; at contacts 614 disconnects ground from stepping conductor 627 to step switch B3 another step, and at contacts 616 opens the original energizing circuit of relay 620 and the circuit of stepping magnet 657. Stepping magnet 657 deenergizes and steps the wipers of the primary switch PS one step.

Relays 200, 210 and 220 deenergize and the latter relay at contacts 222 completes a circuit for energizing release relay 650 and stepping magnet 230 in series over the following circuit: from ground through the winding of release relay 650, release conductor 628, back contacts 222, wiper B11 in engagement with its 25th bank contact, back contacts 224, interrupter contacts 231 and through the winding of stepping magnet 230 to battery. Release relay 650, upon energizing, at contacts 651 holds the cut-off relay 620 in energized position through its lower winding. Stepping magnet 230 energizes and interrupts its own circuit at contacts 231 to step the wipers of the scanning switch B1 to their first positions. In this position a circuit is completed for maintaining the slow-to-release relay 650 energized and for energizing stepping magnet 240 as follows: from grounded release trunk conductor 628, back contacts 222, wiper B11 in engagement with its first bank contact, back contacts 201, wiper B21 in engagement with its 25th bank contact, back contacts 212, interrupter contacts 241 and through the winding of stepping magnet 240 to battery. Stepping magnet 240 energizes and interrupts its own circuit to step the wipers of scanning switch B2 to their first positions. In this position a circuit is completed for maintaining release relay 650 in operated position and for energizing stepping magnet 250 in series as follows: from grounded release conductor 628 over the previously traced circuit to wiper B21 now in engagement with its first bank contacts, back contacts 202, wiper B31 in engagement with its multipled bank contacts and through the interrupter springs 251 and the winding of stepping magnet 250 to battery. Wiper B31 steps into engagement with its 25th bank contact over the above traced circuit and completes a circuit by way of back contact 204 and interrupter contacts 251 for stepping the wipers of the switch B3 to their normal positions. The first cycle operation of the scanning switches B1, B2 and B3 has been completed and these switches are now in readiness to start on their second cycle operation in which cycle operation and subsequent ones the busy trunks are marked and totaled on the chart, such as shown in Fig. 12B.

Release relay 650 deenergizes shortly after scanning switch B3 is restored to its first position. When time pulse relay 640 deenergizes, relay 620 deenergizes and the seconds switch SE is stepped an additional step as previously described. Relay 620 releases and at contacts 621 again causes the operation of pulse relay 610 and again grounds hold conductor 615 for reenergizing relays 200, 210 and 220. Relay 610, at contacts 616, com-

pletes a circuit for operating the gang group relays GR1 and GR2 as follows: from ground at contacts 616, wiper PS3 and its multipled bank contacts, conductor 653, wiper B13, contacts 221, and over conductor 126 and through the windings of relays GR1 and GR2 in multiple to battery. Relays GR1 and GR2 connect the test leads of all trunks to corresponding storage relays SR to thereby energize the storage relays corresponding to busy trunks. The operated storage relays lock to grounded hold conductor 615 and connect this ground to their corresponding test leads T0 to T47, inclusive, terminating in the banks accessible to the wipers of scanning switches.

When pulse relay 610 releases and removes ground from stepping conductor 627, stepping magnet 230 deenergizes and steps the wipers of scanning switch B1 in their first step into engagement with their second bank contacts on the initiation of the second cycle operation. The wipers of scanning switches B1, B2 and B3 are stepped in their second cycle operation in the same manner as previously described. Wiper B13 releases the gang group relays GR1 and GR2. Wiper B14 completes the circuit for operating Mark relay 670 in case the first test conductor T0, corresponding to the first trunk in the first trunk group, is grounded. This circuit may be traced as follows: from grounded test conductor T0, wiper B14, conductor 654, through the multipled bank contacts and wiper PS4, and through the winding of Mark relay 670 to battery. Mark relay 670 at contacts 671 prepares a circuit for operating counter switch LA; at contacts 672 prepares a circuit for operating the printer mark magnet PMAM; and at contacts 673 prepares circuits for operating the No. 3 adder.

On the next energization of pulse relay 610 said relay at contacts 612 completes a circuit for operating the stepping magnet 890 of counter switch LA as follows: from grounded contacts 612, contacts 671, conductor 674, back contacts 827, and through the winding of stepping magnet 890 to battery. At contacts 619 pulse relay 610 completes a circuit for operating the stepping magnet of the No. 3 adder as follows: from grounded contacts 619, contacts 673, multipled bank contacts and wiper PS5, conductor 656, wiper B16 and its multipled bank contacts, conductor 338 extending to the No. 3 adder and through the winding of the stepping magnet of the adder switch in the No. 3 adder to battery. At contacts 614, relay 610 completes the circuit for operating stepping magnet 230 of scanning switch B1 and at contacts 616 completes the circuit for operating the printer mark magnet PMAM as follows: from grounded contacts 616, wiper PS3 and its multipled bank contacts, conductor 653, wiper B13 in engagement with its multipled bank contacts, conductor 617, front contacts 672, printer mark conductor 931 and through the winding of the printer mark magnet PMAM to battery. The printer mark magnet prints the mark directly below digit "0" in the "heading" in Fig. 12B to indicate that this trunk was busy during the interval that gang relays GR1 and GR2 were energized. Pulse relay 610, upon deenergizing, opens the circuits of stepping magnet 890 of counter switch LA, of stepping magnet 230 of the scanning switch B1, and the stepping magnet of the adder switch in the No. 3 adder to cause these switches to take one step. Relay 610 also opens the circuit of the printer mark magnet.

Wiper B14 in engagement with its third bank contact tests conductor T1, corresponding to the second trunk, for ground. If the second trunk was busy during the interval gang relays GR1 and GR2 were energized then test conductor T1 will be connected to grounded hold conductor 615 by way of the contacts on the corresponding SR relay. In this case, however, the second trunk was not busy and, therefor the test conductor T1 is not grounded and the Mark relay is not energized. In the same manner as just described wiper B14 successively tests the test conductors T2 to T15, inclusive, to determine if the corresponding trunks were busy. The trunks which were busy will have their corresponding test conductors grounded to cause the operation of Mark relay 670 on the corresponding steps of the scanning switch B1. Wiper B14 in its 21st to 25th positions successively tests for ground on test conductors T16 to T20 for determining the operation or non-operation of Mark relay 670. After scanning switch B1 reaches its 25th position, then wiper B24 tests for ground on test conductors T21 to T40 to control the operations of Mark relay 670. After scanning switch B2 reaches its 25th position then wiper B34 of scanning switch B3 tests for ground on test conductors T41 to T47 to control the operations of Mark relay 670. Wiper B14 in its 12th position, wiper B24 in its 7th position, and wiper B34 in its 2nd position engage dead bank contacts so that no circuit is completed for the Mark relay 670 and therefore the printer space magnet PSPM is operated at the steps of the scanning switches as will be apparent from the detailed description.

Wiper B13 in its 2nd to 8th positions and in its 21st to 25th positions completes a circuit, each time pulse relay 610 is energized, to operate either the printer space magnet PSPM or the printer mark magnet PMAM dependent upon the operated or non-operated condition of Mark relay 670. If the trunk, corresponding to a particular step, is busy Mark relay 670 will be operated to cause the operation of the printer mark magnet. The printer mark magnet is operated to print a mark as previously described for each busy trunk. If the corresponding trunk at any particular one of the steps is not busy then the printer space magnet is operated to space the carriage of the printer one space. This circuit may be traced as follows: from grounded contacts 616, wiper PS3 in engagement with its multipled bank contacts, conductor 653 through the wiper B13 and its multipled bank contacts connected to mark conductor 617, back contacts 672, printer space conductor 932 and through the winding of the printer space magnet PSPM to battery. In a similar manner wiper B23 in its first to 13th, and in its 16th to 25th positions, completes circuits for either the printer space magnet or the printer mark magnet over similar circuits, now including wiper B13 in its 25th position. Wiper B33 in its first to its eighth positions completes circuits for either the printer space magnet or the printer mark magnet over similar circuits now including both wipers B13 and B23.

Each time pulse relay 610 is energized, when Mark relay 670 is energized, a circuit is completed for stepping magnet 890 of the counter switch LA as previously described. The counter switch LA takes one step for each busy trunk encountered by scanning switch B1 in its 2nd to 18th positions to count the number of busy trunks in the first trunk group. Also, each time pulse relay 610 energizes when Mark relay 670 is energized, a circuit is completed for operating the stepping magnet of the No. 3 adder as previously traced.

The adder switch in the No. 3 adder therefor takes one step for each busy trunk in the first trunk group to total the number of busy trunks in this group.

Wiper B13 in its 19th and 20th positions causes the printer to print the total number of busy trunks in the first trunk group. In accordance with the chart shown in Fig. 12B, the total number of busy trunks in the first trunk group is nine and the printer is operated to print digits "0" and "9" in the totals column for the first trunk group because the counter switch LA has taken only nine steps. The circuit for operating the printer to print the digit "0" may be traced as follows: from grounded contacts 616, wiper PS3 and its multipled bank contacts, conductor 653, wiper B13 in engagement with its 19th bank contact, conductor 815, back contacts 832 and 823, wiper LA5 in engagement with its 10th bank contact, printer conductor P0, and through the winding of printer magnet P0M to battery. Wiper B13 in its 20th position completes a circuit for operating relay 810 as follows: from grounded contacts 616 over the previously traced circuit to wiper B13, conductor 814, and through the winding of relay 810 to battery. Relay 810, upon energizing, completes a circuit for operating printer magnet P9M as follows: from grounded contacts 811, back contacts 831 and 821, wiper LA3 in engagement with its 10th bank contact, conductor P9, and through the winding of printer magnet P9M to battery. At contacts 813, relay 810 completes a circuit for operating relay 880 by way of back contacts 828. Relay 880, upon energizing, at contacts 882 prepares the circuit for operating relay 820, which, however, is short circuited at this time. Relay 810 releases when wiper B13 steps to its 21st position and opens the circuit to printer magnet P9M. At contacts 813 relay 810 removes the short circuit from relay 820 with the result that relay 820 now energizes in series with relay 880. Relay 820 transfers the operating and control circuits from counter switch LA to counter switch LB as previously described and restores the counter switch LA.

Wiper B14 in engagement with its 21st to 25th bank contacts, and wiper B24 in engagement with its 1st to 6th bank contacts, and its 8th to 13th bank contacts, tests for the busy trunks of the second trunk group to cause the operation of Mark relay 670 which controls circuits for operating the printer mark magnet PMAM to print the busy marks, or dots, for the busy trunks in the second trunk group. The counter switch LB is operated to count the number of busy trunks in the second trunk group. The circuit for operating the counter switch LB may be traced as follows: from grounded contacts 612, contacts 671, conductor 674, front contacts 827, and through the stepping magnets 900 of counter switch LB to battery. Counter switch LB is operated one step each time Mark relay 670 and pulse relay 610 are concurrently energized.

Wiper B16 in engagement with its 21st to 25th bank contacts and wiper B26 in engagement with its 1st to 13th bank contacts completes circuits over conductor 487 for operating the added switch of the No. 2 adder to total the number of busy trunks in the second trunk group.

Wiper B23 in its 14th position completes a circuit for operating printer magnet P0M to print the digit "0" corresponding to the tens digit of the total number of busy trunks in the second trunk group. Since only seven trunks are busy in the second trunk group, the counter switch LB was operated only seven steps and the digits "0" and "7" will be printed. The circuit for operating printer magnet P0M may be traced as follows: from grounded contacts 616, wiper PS3, conductor 653, wiper B13 in engagement with its 25th bank contact, wiper B23, conductor 815, back contacts 832, front contacts 823, conductor 912, wiper LB5 and its multipled bank contacts connected to printer conductor P0 and through the winding of printer magnet P0M to battery. Wiper B23 in its fifteenth position completes a circuit for operating relay 810 over conductor 814. Relay 810 at contacts 811 completes a circuit for operating printer magnet P7M as follows: from grounded contacts 811, back contacts 831, front contacts 821, conductor 915, wiper LB3 in engagement with the bank contact terminating printer conductor P7, and through the winding of printer magnet P7M to battery. Relay 810 at contacts 813 completes a circuit for operating relay 850 by way of front contacts 828. Relay 850 opens the circuit of relay 880 at contacts 852 to cause the latter relay to release. Relay 810 releases on the next step of scanning switch B2 and opens the circuit to relay 850, which deenergizes. Relay 850 deenergizes and opens the circuit of relay 820 which releases. Relay 820 releases and transfers the operating and control circuits back to counter switch LA and restores the counter switch LB to normal position as previously described. Wiper B23 in engagement with its 16th to 25th bank contacts and wiper B33 in engagement with its 1st to 8th bank contacts operates the printer space magnet PSPM or printer mark magnet PMAM over conductor 617 as previously described to mark the busy trunks in the third trunk group. The Mark relay 670 is operated once each time a busy trunk is encountered to operate counter switch LA as previously described.

Wiper B26 in its 16th to 25th positions, and wiper B36 in its 1st to 8th positions completes circuits for operating stepping magnet 425 of the No. 1 adder as follows: from grounded contacts 619, contacts 673, multipled bank contacts and wiper PS5, conductor 656, wiper B16 and its 25th bank contact, wiper B26 in engagement with its 16th to 25th bank contacts, wiper B36 in engagement with its 1st to 8th bank contacts, conductor 427, and through the winding of stepping magnet 425 of the No. 1 adder switch to battery. The No. 1 adder is operated to total the number of busy trunks in the third trunk group.

Wiper B33 in engagement with its 9th and 10th bank contacts successively grounds conductors 815 and 814 to cause the printer, in accordance with the setting of the counter switch LA to print the digits corresponding to the total number of busy trunks in the third trunk group in a manner obvious from the foregoing description. These digits are the tens, digit "0" and the units digit "9" since only nine trunks were busy in the third trunk group. Relays 880 and 820 are now energized in the relay group associated with the counter switches to release counter switch LA and to transfer the control circuits to counter switch LB.

Wiper B33 in engagement with its 11th, 14th and 17th bank contacts operates the printer space magnet to space the carriage of the printer during the printing of the time of day over the following circuit: from grounded contacts 616, wiper PS3, conductor 653, wipers B13 and B23 in their

25th positions, wiper B33 in its 11th position, 14th and 17th positions, printer space conductor 932, and through the winding of the printer space magnet PSPM to battery. Wiper B33 in engagement with its 12th, 13th, 15th, 16th, 18th and 19th bank contacts operates the printer magnets to print the time of day, which is 9 46 00, or 9:46 a. m. and no seconds, as shown in Fig. 12B. Wiper B33 in engagement with its 20th bank contact completes the previously described circuit extending over printer carriage return conductor 934 for operating the printer carriage return magnet PCRM to return the carriage of the printer to its initial typing position and to space the paper one vertical step. Wiper B33 in engagement with its 21st bank contact completes the previously traced circuit for energizing relay 620 over conductor 618. Relay 620 opens the circuit to pulsing relay 610, opens one of the points grounding hold conductor 615, and locks itself under control of the time pulse relay 640. Relay 610 deenergizes and disconnects ground from hold conductor 615 to release the operated storage relays SR and relays 200, 210 and 220. Relays 200, 210 and 220 complete circuits for operating release relay 650 and for restoring the wipers of scanning switches B1, B2 and B3 as previously described. The second cycle operation of the scanning switches B1, B2 and B3 has been completed and these switches are now ready to start the third cycle scanning operation to cause the printer to print the third line in Fig. 13B. Release relay 650 deenergizes shortly after switch B3 is restored and time pulse relay 640 deenergizes to release relay 620 which recloses a circuit to pulse relay 610 to start the third scanning operation. The gang group relays GR1 and GR2 are re-operated and released as before to lock up the SR relays corresponding to the trunks which are busy at this time period and the scanning switches are started on their third scanning operation as previously described to cause the counter switches LB and LA to alternately count the number of busy trunks. The No. 1, No. 2 and No. 3 adders total the number of busy trunks in the different trunk groups, and the printer prints the third line as shown in Fig. 12B.

The operation continues as described to make successive scannings and recordings, such as indicated in Fig. 12B. The primary switch PS takes one step for each fourth cycle operation of the scanning switches and after 60 such cycle operations the primary switch PS is stepped to its 17th position to cause the scanning switches B1, B2 and B3 to step through another cycle operation to cause the printer to print the number of busy trunks totaled in the respective adders. The scanning switches B1, B2 and B3, in this last cycle operation, control the printer over wipers B15, B25 and B35 for printing the total registered on the No. 1, No. 2 and No. 3 adders in a manner similar to that described for scanning switches A1, A2 and A3.

Wiper B35 in its 11th, 14th, 15th and 16th positions completes circuits by way of printer carriage return conductor 934 for operating printer carriage return magnet PCRM to return the carriage of the printer to its initial typing position. Wiper B35 in engagement with its 17th bank contact completes a circuit for operating relay 620 over conductor 618, contacts 631 and the winding of stepping magnet 657 to battery. Relay 620 opens the circuit of relay 610 and these relays remove ground from hold conductor 615 to release relays 200, 210, 220 and the operated SR relays. Stepping magnet 657 steps the primary switch to its 18th position and wiper PS2 short circuits relay 660 which deenergizes. Relay 660 releases and causes the restoration of the adders. Relay 660 opens a circuit to relay 840 which deenergizes and at contacts 667 completes the circuit for restoring the primary switch PS to its normal position. Relays 200, 210 and 220 complete circuits for restoring scanning switches B1, B2 and B3 to their normal positions. Relay 840, at contacts 841, restores the counter switch LA to its normal position; at contacts 842 releases relay 860; at contacts 843 disconnects ground from conductor 847 to release the relays in adders, and at contacts 844 releases relays 820 and 880, if operated. Release relay 650, relay 620, and time pulse relay 640 deenergize. All of the apparatus, including scanning switches B1, B2 and B3, the counter switches and relays, the printer, the adders and relays, and the primary switch PS and relays are restored to normal and will start on a new recording operation if the key K2 is maintained in operated position.

It will now be assumed that a recording, such as shown in Fig. 12C, is desired for two groups of twenty-five trunks each. Key K1 is operated to its No. 3 position to position the wipers K1′ and K1² into engagement with their fourth bank contacts. Grouping keys K7 and K8 are set to their No. 2 positions, grouping keys K12 and K13 are set to their No. 5 position and all other grouping keys, such as K9, K10, K11, K14, K15 and K16 are set to their "off" positions. The wiper K1² grounds conductor 701 as before to start time pulse unit 750 and to illuminate the display panel. The minutes and hour keys are operated to set the time switches of Fig. 5 to display the proper time, the date keys K3, K4, K5 and K6 are also set in accordance with the month, day and year. The printer motor 938 is started over conductor 701 and 936 and the printer carriage is returned to normal, if off-normal. The apparatus is now set in the same manner as previously described to start the recording operation as soon as the start key K2 is operated.

In response to the operation of start key K2 start relay 660 is operated to operate the seconds switch SE, to ground hold conductor 615, to operate relay 840, and to lock itself in operated position. The grounding of hold conductor 615 grounds conductor 773 by way of wiper K1′ for energizing relays 300, 310 and 320. Relays 300, 310 and 320 are similar to and perform the same functions as relays 100, 110 and 120.

When the seconds switch SE was operated to its fourth position in response to the operation of start relay 660, relay 630 is operated to prepare the circuit for operating stepping magnet 657 of the primary switch PS. Relay 840 operates relay 860 and grounds conductor 847 extending to the adders. Relay 860 locks itself and grounds conductor 626 for operating pulse relay 610 to transmit pulses as previously described. At contacts 614 pulse relay 610 transmits pulses over stepping conductor 627 to step the scanning switches C1, C2 and C3. The circuits for operating the stepping magnets 360, 370 and 380 of the scanning switches C1, C2 and C3, respectively, are similar to those previously described for the A and B scanning switches.

The wipers C12, C22 and C32 complete the circuits during the first cycle operation of the scanning switches for causing the printer to print the "heading" shown in Fig. 12C in a manner similar

to that described for printing the "headings" shown in Figs. 12A and 12B. Wiper C12 in its 2nd to 11th positions completes circuits on successive steps of the wiper when conductor 652 is grounded, for operating printer magnets P0M, P1M, P2M, P3M, P4M, P5M, P6M, P7M, P8M, and P9M, successively, over printer conductors P0 to P9, inclusive. Wiper C12 in engagement with its 12th bank contact completes the circuit for operating the printer space magnet PSPM over conductor 932. The printer space magnet spaces the carriage after printing the digit "9" in the well known manner. Wiper C12 in successive engagements with its 13th to 22nd bank contacts completes circuits over printer conductors P0 to P9, inclusive, for operating the printer magnets P0M to P9M, inclusive, to print the digits "0" to "9," inclusive. Wiper C12 in engagement with its 23rd bank contact operates the printer space magnet to again space the carriage one step. Wiper C12 in engagement with its 24th and 25th bank contacts and wiper C22 in engagement with its first to fourth bank contacts completes circuits over printer conductors P0 to P4, inclusive, for operating the printer magnets to print the digits "0" to "4," inclusive.

Wiper C26 in engagement with its fifth and sixth bank contacts completes circuits for energizing the printer ribbon control magnet PRCM from grounded conductor 623, conductor 656, wiper PS5, and printer ribbon control conductor 933. The printer ribbon control magnet positions the red ribbon so that the next two digits which are printed will be printed in red.

Wiper C22 in engagement with its 5th and 6th bank contacts completes a circuit for operating the printer to print the digits "2" and "5" in red. These circuits may be traced as follows: from grounded contacts 616, wiper PS3 and its first bank contact, conductor 652, wiper C12 in its 25th position, wiper C22 in its 5th position, conductor 740 extending to wiper K8' in Fig. 7, third bank contacts, conductor P2 and through the winding of printer magnet P2M to battery. Wiper C22 in engagement with its 6th bank contact completes a circuit by way of conductor 741, wiper K13' in engagement with its sixth bank contact, conductor P5 and through the winding of printer magnet P5M to battery. The digits "2" and "5" have now been printed in red, as indicated in Fig. 12C.

Wiper C26 opens the circuit to the printer ribbon control magnet when it steps to its seventh position so that the subsequent digits printed by the printer are printed in black. The "heading" for the first group of twenty-five trunks as shown in Fig. 12C has been printed by the printer. The remaining portion of this "heading" for the second group of twenty-five trunks are printed in response to the successive steps by wipers C22 and C32 in a manner obvious from the foregoing description. The digits corresponding to the month, day and year are also printed by the printer during the time wiper C32 is stepping over its 13th to its 20th bank contacts. In its 21st position wiper C32 completes the circuit for operating the printer carriage return magnet PCRM over conductor 934 to cause the carriage to be returned to its initial printing position. The printer has now completed printing the "heading" shown in Fig. 12C.

Wiper C32 in its 22nd position completes a circuit over conductor 618 for operating relay 620 and stepping magnet 657 in series. Relay 620 opens one of the points for grounding hold conductor 615 and locks itself in operation position. Pulse relay 610, upon deenergizing, at contacts 613 disconnects ground from hold conductor 615 to release relays 300, 310 and 320; at contacts 614 disconnects ground from stepping conductor 627 to stepping switch C3 another step: and at contacts 616 opens the original energizing circuit of relay 620 and the circuit of stepping magnet 657. Stepping magnet 657 deenergizes and steps the wipers of the primary switch PS one step.

Relays 300, 310 and 320 deenergizes and the latter relay at contacts 322 completes the circuit for energizing release relay 650 and stepping magnet 360 in series. Release relay 650 at contacts 651 holds the cut-off relay 620 in energized position through its lower winding. Stepping magnet 360 energizes and interrupts its own circuit to step the wipers of scanning switch C1 to their first positions. In this position a circuit is completed for maintaining the slow-to-release relay 650 energized and for energizing stepping magnet 370 to restore scanning switch C2 to its normal position. Release relay 650 now energizes in series with stepping magnet 380 and the latter restores the switch C3 to its normal position. The first cycle operation of scanning switches C1, C2 and C3 has been completed and these switches are now ready to start on their second cycle operation to mark and total the busy trunks.

Release relay 650 deenergizes shortly after scanning switch C3 is restored to its first position. When time pulse relay 640 deenergizes, relay 620 deenergizes and the seconds switch SE is stepped an additional step. Relay 620 deenergizes and at contacts 621 again causes the operation of pulse relay 610 and again grounds hold conductor 615 for re-energizing relays 300, 310 and 320. Relay 610, at contacts 616 completes a circuit for operating the gang group relays GR1 and GR2 as follows: from grounded contacts 616, wiper PS3 and its multipled bank contacts, conductor 653, wiper C13 in engagement with its first bank contact, contacts 321 and over the conductor 126 and through the windings of relays GR1 and GR2 in multiple to battery. Relays GR1 and GR2 connect the test leads of all trunks to the corresponding SR storage relays to energize the storage relays corresponding to busy trunks. The operated storage relays locks to grounded hold conductor 615 and connect this ground to the corresponding test leads T0 to T49, inclusive.

When pulse relay 610 releases and removes ground from stepping conductor 627, stepping magnet 360 deenergizes and steps the wipers of scanning switch C1 in their first step into engagement with their second bank contacts on the initiation of the second cycle operation. The wipers of scanning switches C1, C2 and C3 are stepped in their second cycle operations in the same manner as previously described. Wiper C13 releases relays GR1 and GR2, wiper C14 completes the circuit for operating Mark relay 670 in case the first test conductor T0, corresponding to the first trunk in the first trunk group, is grounded. Mark relay 670 at contacts 671 prepares a circuit for operating counter switch LA; at contacts 672 prepares a circuit for operating the printer mark magnet PMAM; and at contacts 673 prepares circuits for operating the No. 2 adder.

On the next energization of pulse relay 610, said relay at contacts 612 completes a circuit for operating stepping magnet 890 of the counter switch LA. At contacts 619 relay 610 completes a

circuit for operating the stepping magnet of the No. 2 adder as follows: from grounded contacts 619, contacts 673, multipled bank contacts and wiper PS5, conductor 656, wiper C16 and its multipled bank contacts, conductor 487 extending to the No. 2 adder and through the winding of the stepping magnet of the adder switch in the No. 2 adder to battery. At contacts 614 relay 610 completes the circuit for operating stepping magnet 360 of scanning switch C1 and at contacts 616 completes the circuit for operating the printer mark magnet PMAM as follows: from grounded contacts 616, wiper PS3 and its multipled bank contacts, conductor 653, wiper C13 in engagement with its multipled bank contacts, conductor 617, front contacts 672, printer mark conductor 931 and through the winding of the printer mark magnet PMAM to battery. The printer mark magnet prints the mark directly below the digit "0" in the "heading" in Fig. 12C to indicate that this trunk was busy during the interval that gang relays GR1 and GR2 were energized. Pulse relay 610, upon deenergizing, opens the circuits of stepping magnet 890 of counter switch LA, of stepping magnet 360 of scanning switch C1, and the stepping magnet of the adder switch in the No. 2 adder to cause these switches to take one step. Relay 610 also opens the circuit to the printer mark magnet.

Wiper C14 in engagement with its third bank contacts tests test conductor T1, corresponding to the second trunk, for ground. If the second trunk was busy during the interval gang relays GR1 and GR2 were energized then test conductor T1 will be connected to grounded hold conductor 615 by way of contacts on the corresponding SR relay. Assuming that the second trunk is not busy the test conductor T1, not grounded, and therefore Mark relay 670 is not energized. In the same manner as just described wiper C14 successively tests the test conductors T2 to T20, inclusive, and wiper C24 successively tests the test conductors T21 to T24, inclusive, to determine if the corresponding trunks were busy. The trunks which were busy will have their corresponding test conductors grounded to cause the operation of Mark relay 670 on the corresponding steps of these scanning switches. Wiper C24 in its 7th to 16th positions, inclusive, and in its 18th to 24th positions, and wiper C34 in its 1st to 3rd positions, and in its 5th and 9th positions, successively tests for ground on test conductors T25 to T49, inclusive, for determining the operation or non-operation of Mark relay 670. Wiper C14 in its 12th and 23rd positions, wiper C24 in its 17th position, and wiper C34 in its fourth position engaged dead bank contacts so that no circuit is completed for the Mark relay 670 and therefore the printer space magnet PSPM is operated at these steps of the scanning switches.

Wiper C13 in its 2nd to 25th positions and wiper C23 in its 1st to 4th positions, completes a circuit each time pulse relay 610 is energized, to operate either the printer space magnet PSPM or the printer mark magnet PMAM dependent upon the operated or non-operated condition of the Mark relay 670. If the trunk corresponding to a particular step is busy, Mark relay 670 will be operated to cause the operation of the printer mark magnet.

If the corresponding trunk, at any one of the steps is not busy, then the printer space magnet is operated to space the carriage one space. In a similar manner wiper C23 in its 7th to 25th positions, and wiper C33 in its 1st to 9th positions, completes circuits for either the printer space magnet or the printer mark magnet.

Each time pulse relay 610 is energized, when the Mark relay 670 is energized, a circuit is completed for stepping magnet 900 of the counter switch LB. The counter switch LB takes one step for each busy trunk encountered to count the number of busy trunks in the second trunk group. Also, each time pulse relay 610 energizes with mark relay energized, a circuit is completed for operating stepping magnet 425 of the No. 1 adder to cause this adder to total the number of busy trunks in this trunk group as previously described.

Wiper C23 in its 5th and 6th positions causes the printer to print the total number of busy trunks in the first trunk group, and wiper C33 in its 10th and 11th positions causes the printer to print the total number of busy trunks in the second trunk group in a manner obvious from the foregoing description.

Wiper C33 in engagement with its 12th, 15th and 18th bank contacts operates the printer space magnet to space the carriage of the printer during the printing of the time of day as previously described. Wiper C33 in engagement with its 13th, 14th, 16th, 17th, 19th and 20th positions operates the printer magnets to print the time of day. Wiper C33 in engagement with its 21st bank contact completes a circuit over printer carriage return conductor 934 for operating the printer carriage return magnet to return the carriage of the printer to its initial typing position. Wiper C33 in engagement with its 22nd bank contact completes a circuit over conductor 618 for operating cut-off relay 620. Relay 620 opens the circuit of pulsing relay 610, opens one of the points grounding hold conductor 615 and locks itself under control of time pulse relay 640. Relay 610 deenergizes and disconnects ground from hold conductor 615 to release the operated storage relays SR and relays 300, 310 and 320. Relays 300, 310 and 320 complete circuits for operating release relay 650 and for restoring the wipers of scanning switches C1, C2 and C3. Release relay 650 deenergizes shortly after switch C3 is restored and time pulse relay 640 deenergizes to release relay 620 which re-closes the circuit to the pulse relay 610 to start the third scanning operation. The gang group relays GR1 and GR2 are re-operated and released as before to lock up the SR relays corresponding to the trunks which are busy at this time period and the scanning switches are started on their third scanning operation, as previously described. The counter switches LA and LB are alternately operated to count the number of busy trunks in the two trunk groups and the No. 1 and No. 2 adders are operated to total the number of busy trunks in the two trunk groups. During this scanning operation the printer prints the next line as shown in Fig. 12C.

The operation continues as described to make successive scannings and recordings, such as indicated in Fig. 12C. The primary switch PS takes one step for each fourth cycle operation of the scanning switches and after sixty such cycle operations the primary switch PS is stepped to its 17th position to cause the scanning switches C1, C2 and C3 to step through another cycle operation to cause the printer to print the number of busy trunks totaled in the two adders. The scanning switches, in this last cycle operation, control the printer over wipers C15, C25 and C35 for printing the total number of trunks regis-

tered in the No. 1 and No. 2 adders in a manner apparent from the foregoing description.

Wiper C35 completes the circuit over printer carriage return conductor 934 for returning the carriage of the printer to its normal position and in its 18th bank contact completes a circuit over conductor 618 for operating relay 620. Relay 620 releases the operated storage relays SR, the relays 300, 310 and 320 and causes the primary switch to take an additional step to cause wiper PS2 to short circuit relay 660. Relay 660, upon releasing, causes the restoration of the No. 1 and No. 2 adders, opens the circuit to relay 840, and restores the primary switch PS to its normal position as previously described. The release of relay 300, 310 and 320 cause the scanning switches C1, C2 and C3 to restore to normal. Relay 840, upon deenergizing, restores the relays and the counter switches to their normal positions. In the same manner as previously described, release relays 650, relay 620, and time pulse relay 640 deenergize, thereby restoring all of the apparatus to their normal positions. If the key K2 is maintained in operated position a new recording operation as just described will be started.

It will now be assumed that a recording, such as shown in Fig. 12D, is now desired for one group of fifty trunks. The key K1, Fig. 11, is now set to its fourth position to position wipers K1' and K2' (Fig. 7) into engagement with their fifth bank contacts. The key K7 is set to its No. 5 position and the key K12 is set to its No. "0" position. The remaining grouping keys, including keys K8, K9, K10, K11, K13, K14, K15 and K16 are moved to their "off" positions. The time pulse unit 750 is started in operation, the clock time is displayed on the lamp panel and changed if necessary by the operation of the minute and hour keys, MK and HK and keys K3, K4, K5 and K6, if not already set, are set in accordance with the month and day. The apparatus is now set in the same manner as previously described to start the recording operation as soon as the start key K2 is operated.

In response to the operation of key K2 start relay 660 is operated to cause the operation of the seconds switch to its fourth position, to ground the hold conductor 615, to operate relay 840 and to lock itself in operated position as previously described. In response to grounding of the hold conductor 615 by contacts 664 of start relay 660, a circuit for energizing relays 100, 110, 120 and 160 is completed as follows: from grounded conductor 615, wiper K1' in engagement with its fifth bank contact, conductor 774 extending to Fig. 1B, through the winding of relay 160 and through the windings of relays 100, 110 and 120 in multiple to battery. The relays 100, 110 and 120 control the scanning switches A1, A2 and A3 in the same manner as previously described. Relay 160, upon energizing, at back contacts 163, 164, 165 and 166 disconnects the conductors extending to the No. 5, 4, 3 and 2 adders. At the front contacts of these armatures relay 160 completes circuits for controlling the No. 1 adder over conductor 427 so that the No. 1 adder will total the number of busy trunks encountered by wipers A14, A24 and A34, while testing test conductors T0 to T49, inclusive. At back contact 161 and 162 relay 160 disconnects conductors 814 and 815 for controlling the alternate operation of the counter switches LA and LB and at front contacts of these armatures connects up the printer space conductor 932 so as to cause the printer to space the carriage when wiper A13 engages its 12th, 13th, 24th and 25th bank contacts and when wiper A23 engages its 12th, 13th, 24th and 25th bank contacts. The operation of the scanning switches A1, A2 and A3 in their first cycle operation cause the printer to print the "heading" shown in the first line in Fig. 12D. This "heading" is printed in a manner similar to that previously described. Five groups of ten trunks each are printed in the "heading" separated by two spaces. The printer space magnet PSPM is operated to space these trunks in groups of ten as follows: when wiper A12 reaches its 12th position, ground on conductor 652 is connected by way of conductor 710, wiper K11' and printer space conductor 932 to the printer space magnet. A similar circuit is completed by way of conductor 711 and wiper K16' and printer space conductor 932 for operating the printer space magnet. In a similar manner wiper A12 in its 24th and 25th positions completes circuits over conductors 720 and 721 to wipers K10' and K15' for operating the printer space magnet. Wiper A22 in its 12th and 13th positions and in its 24th and 25th positions completes circuits over conductors 730, 731, 740, and 741, wipers K9', K14', K8' and K13', respectively to printer space conductor 932 for operating the printer space magnet. Wiper A36 in its 12th and 13th position completes the previously traced circuit from grounded conductor 623 for operating the printer ribbon control magnet to position the red ribbon as previously described. Wiper A32 in its 12th position completes a circuit from grounded conductor 652 and through the wipers A12, A22 and A32 in series, 12th bank contact, conductor 750, wiper K7' in engagement with its 6th bank contact, printer conductor P5, and through the winding of printer magnet P5M to battery. The tens digit "5" is printed in red. Wiper A32 in engagement with its 13th bank contact completes a circuit over conductor 751, wiper K12' in its last position, printer conductor P0 and through the winding of printer magnet P0M to battery for operating this magnet to print the units digit "0" in red. The red digits "50" indicate a group of fifty trunks. In the same manner as previously described, the digits corresponding to the month, day and year are printed in the "heading."

After the completion of the "heading" the scanning switches A1, A2 and A3 are operated in the same manner as previously described to test for busy trunks on test conductors T0 to T49, inclusive, to cause the counter switch LA to total the number of busy trunks in this group, and to cause the No. 1 adder to total the number of busy trunks encountered by these scanning switches.

Wipers A14, A24 and A34 cause the operation of Mark relay 670 each time a busy test trunk, or grounded test trunk, is encountered and wipers A13, A23 and A33 in corresponding positions cause the operation of the printer mark magnet or the printer space magnet as previously described. Wiper A13 in its 12th, 13th, 24th and 25th positons, and wiper A23 in its 1st, 12th, 13th, 24th, and 25th positions completes circuits for operating the printer space magnet. Wiper A13 in engagement with its 12th bank contact completes a circuit from grounded conductor 653, wiper A13 in its 12th position, conductor 152, front contacts 162, printer space conductor 932 and through the winding of printer space magnet PSPM to battery. In a similar manner wiper A13 in engagement with its 13th bank contact

completes a circuit by way of conductor 153, front contacts 161, printer space conductor 932 and through the winding of printer space magnet PSPM to battery for operating this magnet. From the foregoing it will be seen that relay 160 has altered the circuits so that the printer space magnet is operated between each sub-group of ten trunks when a trunk group of fifty trunks is being tested. Wipers A16, A26 and A36 completes circuits for operating stepping magnet 425 of the No. 1 adder each time the Mark relay 670 is operated. This circuit may be traced as follows: from grounded contacts 619, contacts 673, through the multipled bank contacts and wiper PS5, conductor 656, wiper A16 in engagement with is second to 11th multipled bank contacts, front contacts 163, conductor 427 and through the winding of stepping magnet 425 to battery. Similar circuit are completed over the multipled bank contacts and wipers A16, A26, and A36 through front contacts 164, 165 and 166 and over conductor 427 for operating the stepping magnet 425 of the No. 1 adder. The No. 1 adder therefor is operated to total the number of busy trunks encountered by the scanning switches.

In a manner similar to that previously described, the printer is operated to print the busy marks to identify the trunks which are busy in this group of fifty trunks. When wiper A33 engages its 12th and 13th bank contacts the printer is operated to print the number of trunks counted by the counter switch LA. The counter switch LA is operated in the same manner as previously described, and assuming that 38 of the 50 trunks were busy switch LA was operated 38 steps. The digits 3 and 8 are printed by control of the following circuits: from grounded contacts 616, wiper PS3 in engagement with its multipled bank contacts, conductor 653, wipers A13, A23 and A33 in engagement with its 12th bank contact, conductor 815, front contacts 832, back contacts 824, wiper LA6 in engagement with its 14th bank contact multipled to printer conductor P3 and through the winding of printer magnet P3M to battery. The circuit for operating relay 810 extends from ground over the previously traced circuit to wiper A33 in engagement with its 13th bank contact, conductor 814, and through the winding of relay 810 to battery. Relay 810 at contacts 811 completes the circuit for operating the printer magnet P8M as follows: from grounded contacts 811, front contacts 831, back contacts 822, wiper LA4 in engagement with its 14th bank contact, printer conductor P8, and through the winding of printer magnet P8M to battery.

Wiper A33 in engagement with its 14th to 22nd bank contacts operates the printer to print the time of day in the same manner as previously described. Wiper A33 in engagement with its 23rd bank contact completes a circuit for operating the carriage return magnet over carriage return conductor 934. Wiper A33 in engagement with its 24th bank contact completes a circuit over conductor 618 for operating relay 620. Relay 620 in the same manner as previously described opens the circuit of pulsing relay 610, opens one of the points grounding hold conductor 615, and locks itself under control of the time pulse relay 640. Relay 610 deenergizes and disconnects ground from the hold conductor 615 to release the operated storage relays SR and relays 100, 110, 120 and 160. Relays 100, 110 and 120 complete the previously described restoring circuits for restoring the scanning switches A1, A2 and A3 to normal and for operating release relay 650. After the last scanning switch is restored to normal release relay 650 deenergizes and when time pulse relay 640 deenergizes relay 620 is again released to reclose the circuit to pulsing relay 610 to start the third scanning operation. The gang group relays GR1 and GR2 are re-operated and released as before to lock-up the SR relays corresponding to the trunks which are busy at this time period and the scanning switches are started on their third scanning operation as previously described. The counter switch LB is operated on this cycle operation to count the number of busy trunks in the group. The counter switches LA and LB are alternately operated. The No. 1 adder is also operated to add the number of busy trunks encountered on successive scanning operations.

The operation continues as described to make successive scannings and recordings, such as indicated in Fig. 12D. The primary switch PS takes one step for each fourth cycle operation of the scanning switches and after 60 cycle operations the primary switch PS is stepped to its 17th position to cause the scanning switches A1, A2 and A3 to step through another cycle operation to cause the printer to print the total sum of the number of busy trunks totaled in adder No. 1. In a manner similar to that previously described the printer space magnet is operated to space the carriage step by step until wiper A35 engages its tenth bank contact. The printer space magnet is operated over circuits including wipers A15, A25 and their multiple bank contacts which are connected to printer space conductor 932. Wiper A15 in engagement with its eleventh bank contact completes the following circuit: from grounded contacts 616, wiper PS3 in engagement with its seventeenth bank contact, conductor 655, wiper A15 in engagement with its eleventh bank contact, conductor 359 extending to the No. 5 adder, wiper HD3 in engagement with its first bank contact, printer space conductor 932 and through the winding of printer space magnet PSPM to battery. It will be remembered that the No. 5 adder was not operated when this group of fifty trunks is being tested. Adders 4, 3 and 2 are likewise in their normal positions because only the adder No. 1 is being operated for this single group of fifty lines. Wiper A15 in engagement with its 12th bank contact completes a circuit over conductor 350 to the No. 5 adder and thence by way of back contacts 401, wiper HC5 and its first bank contact, back contacts 471, wiper HD2 in engagement with its first bank contact terminating printer space conductor 932. Wiper A15 in its 13th position completes a circuit by way of conductor 351, back contacts 402, wiper HC3 and its first bank contact, wiper HD2 and its first bank contact to printer space conductor 932. These circuits just traced and similar circuits in the Nos. 4, 3 and 2 adders are completed over conductors 349, 340, 341, 339, 330, 331, 499, 497 and 498.

According to chart Fig. 12D the No. 1 adder has totaled 2137 busy trunks. The switch HA therefore has taken 2137 steps and its wipers are now in engagement with their 13th bank contacts. Since switch HB takes one step for each 100 registrations this switch has therefore taken 21 steps and its wipers are in engagement with its 22nd bank contacts. Relay 440 is operated at this time since the switch HA has completed its 85th revolution and has operated part way on its 86th revolution. The circuit for printing

the 1000's digit "2" may be traced as follows: from grounded contacts 816, wiper PS3 in engagement with its 17th bank contact, conductor 655, through wipers A15 and A25 in their 25th positions and wiper A35 in engagement with its 10th bank contact, the thousands conductor 438 extending to the No. 1 adder in Fig. 4A, back contacts 452, wiper HB5 in engagement with its 22nd bank contact, printer conductor P2, and through the winding of printer magnet P2M to battery. The circuit for printing the hundreds digit may be traced over the previously traced circuit to wiper A35 and thence by way of its 11th bank contact, hundreds conductor 439, back contacts 451, wiper HB3 in engagement with its 22nd bank contact, printer conductor P1 and through the winding of printer magnet P1M to battery. The circuit for printing the tens digit extends from wiper A35 in engagement with its 12th bank contact, tens conductor 436, front contacts 441, wiper HA6 in engagement with its 13th bank contact, back contacts 414, printer conductor P3 and through the winding of printer magnet P3M to battery. The circuit for printing the units digit may be traced from wiper A35 in engagement with its 13th bank contact, units conductor 437, front contacts 442, wiper HA4 in engagement with its 13th bank contact, printer conductor P7 and through the winding of printer magnet P7M to battery.

Wiper A35 in engagement with its 14th, 17th, 18th and 19th bank contacts on successive steps completes a circuit over printer carriage return conductor 934 for operating the printer carriage return magnet to cause the carriage of the printer to be returned to its initial typing position. Wiper A35 in engagement with its 20th bank contact completes a circuit over conductor 618 for operating relay 620. Relay 620 causes the release of the operated storage relays SR, the relays 100, 110, 120 and 160 and causes the primary switch to take an additional step to short circuit relay 660 as previously described. Relay 660 deenergizes and causes the apparatus to be restored to its normal position as previously described in readiness to start a new recording operation.

The counting switches LA and LB are each capable of counting a total of fifty busy trunks. The relay 830 is provided for switching wiper connections so that the counter switches can control the printer to print totals from 25 to 50, inclusive, and relay 870 is provided to enable the counter switches to control the printing of numeral 50 if all the trunks in the group are busy. In order to describe this operation it will be assumed that the wipers of switch LA have been operated into engagement with its 25th bank contacts in response to 24 pulses transmitted to stepping magnet 890. Wiper LA2 in engagement with its 25th bank contact, prepares a circuit for relay 830. When stepping magnet 890 is operated in response to the 25th pulse transmitted thereto a circuit for operating relay 830 in its first step may be traced as follows: from grounded front contacts 841, back contacts 825, wiper LA2 in engagement with its 25th bank contact, contacts 892, bank contacts 834, and through the upper winding of two-step relay 830 to battery. Relay 830 operates only its contacts 835 in its first step thereby closing a short circuit around its lower winding. This short circuit may be traced as follows: from grounded contacts 865, contacts 874, first step contacts 835, through the lower winding of two-step relay 830 and thence by way of back contacts 834 to ground at front contacts 841. On the termination of the 25th pulse transmitted to stepping magnet 890, the stepping magnet deenergizes to step the wipers of the counter switch LA and to open the short circuit around the lower winding of relay 830 at contacts 892. The upper and lower windings of two-step relay are now energized in series from ground at contacts 865 with the result that two-step relay 830 now operates its contacts in their second step. At contacts 831 relay 830 shifts the connections from wiper LA3 to wiper LA4, thereby shifting the units control. At contacts 832 relay 830 shifts the tens control from wiper LA5 to wiper LA6. At contacts 833 relay 830 opens a point in the original energizing circuit of relay 860 which relay, however, is maintained in operated position over its locking circuit and at contacts 834 prepares the circuit for operating relay 870. When the wipers of the switch LA again reach their 25th bank contacts on their second revolution, wiper LA2 prepares a circuit for relay 870. In response to the 50th pulse transmitted to stepping magnet 890 said magnet at contacts 892 completes the circuit for operating relay 870. This circuit may be traced from grounded front contacts 841, back contacts 825, wiper LA2 in engagement with its 25th back contact, contacts 892, front contacts 834 and through the winding of relay 870 to battery. At contacts 872 relay 870 opens another point in the original energizing circuit of relay 860 and at contacts 873 completes a locking circuit for itself from grounded contacts 865 and contacts 812. At contacts 874 relay 870 opens the circuit of relay 830 which deenergizes, and at contacts 871 prepares a circuit extending to printer conductor P5. At the end of the 50th pulse to magnet 890 said magnet at contacts 892 opens the original energizing circuit of relay 870. The deenergization of stepping magnet 890 steps the wipers of the switch LA into engagement with their first bank contact. Relay 830 deenergizes in response to the operation of relay 870. At contacts 831 relay 830 switches the units control back to wiper LA3 so that the units digit "0" will be printed. At contacts 832, relay 830 switches the tens control back to wiper LA5 so as to control the printer over conductor P5 to print the tens digit 5. In case every trunk in the group of fifty trunks are busy, the switch LA takes fifty steps as described to position the wipers as shown in Fig. 8. At the end of this scanning operation, conductor 815 is grounded as previously described and in this case a circuit may be traced for operating the printer to print the tens digit "5" as follows: from grounded conductor 815, back contacts 832 and 823, wiper LA5 in engagement with its first bank contact, front contacts 871, printer conductor P5 and through the winding of printer magnet P5M to battery. When relay 810 is operated the circuit for printing the units digit "0" may be traced as follows: from grounded contacts 811, back contacts 831 and 821, wiper LA3 in engagement with its first bank contact, printer conductor P0 and through the printer magnet P0M to battery. Relay 810 at contacts 812 opens the locking circuit of relay 870 which now deenergizes. The operation from here on is the same as previously described.

Although the operation of the system has been described with reference to tests performed upon lines of a telephone system, it will be understood that the apparatus is equally susceptible of use in testing many other types of apparatus.

While there has been described what is at present considered to be the preferred embodi-

ment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover all such modifications in the appended claims as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks, a record printer, means for operating said printer in response to said preliminary scanning operation of said scanning switches to print characters identifying each trunk in said group, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered by said scanning switches.

2. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks, means for operating said printer in response to said preliminary scanning operation of said scanning switches to print characters identifying each trunk in said group and to print characters designating the total number of trunks in said group, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered by said scanning switches.

3. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks, a record printer, means for operating said printer in response to said preliminary scanning operation of said scanning switches to print characters identifying each trunk in said group, and means for operating said printer in response to each cycle operation of said plurality of successive scanning cycle operations to print characters designating the number of trunks in said group which tested busy during each cycle operation.

4. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks, a record printer, means for operating said printer in response to said preliminary scanning operation of said scanning switches to print characters identifying each trunk in said group, and means for operating said printer in response to each cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered by said scanning switches and to print characters designating the number of trunks in said group which tested busy during each cycle operation.

5. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks, means for operating said printer in response to said preliminary scanning operation of said scanning switches to print characters identifying each trunk in said group and to print characters designating the total number of trunks in said group, and means for operating said printer in response to each cycle operation of said plurality of successive scanning cycle operations to print characters designating the number of trunks in said group which tested busy during each cycle operation.

6. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks, a record printer, means for operating said printer in response to said preliminary scanning operation of said scanning switches to print characters identifying each trunk in said group and to print characters designating the total number of trunks in said group, and means for operating said printer in response to each cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered by said scanning switches and to print characters designating the number of trunks in said group which tested busy during each cycle operation.

7. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means for selectively grouping said trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective grouping means, means for operating said selected group of scanning switches in a preliminary scanning operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test the trunks in said groups, a record printer, means for operating said printer in response to said preliminary scanning operation of said selected group of scanning switches to print characters identifying each trunk in each group, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered by said selected group of scanning switches.

8. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means for selectively grouping said trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective grouping means, means for operating said selected group of scanning switches in a preliminary scanning operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test the trunks in said groups, a record printer, means for operating said printer in response to said preliminary scanning operation of said selected group of scanning switches to print characters identifying each trunk in each trunk group and to print characters designating the total number of trunks in

each trunk group, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered by said selected group of scanning switches.

9. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means for selectively grouping said trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective grouping means, means for operating said selected group of scanning switches in a preliminary scanning operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test the trunks in said groups, a record printer, means for operating said printer in response to said preliminary scanning operation of said selected group of scanning switches to print characters identifying each trunk in each group, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print characters designating the number of trunks in each of said trunk groups which tested busy during each cycle operation.

10. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means for selectively grouping said trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective grouping means, means for operating said selected group of scanning switches in a preliminary scanning operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test the trunks in said groups, a record printer, means for operating said printer in response to said preliminary scanning operation of said selected group of scanning switches to print characters identifying each trunk in each group, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered and to print characters designating the number of trunks in each of said trunk groups which test busy during each cycle operation by said selected group of scanning switches.

11. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means for selectively grouping said trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective grouping means, means for operating said selected group of scanning switches in a preliminary scanning operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test the trunks in said groups, a record printer, means for operating said printer in response to said preliminary scanning operation of said selected group of scanning switches to print characters identifying each trunk in each trunk group and to print characters designating the total number of trunks in each trunk group, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print characters designating the number of trunks in each of said trunk groups which test busy during each cycle operation.

12. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means for selectively grouping said trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective grouping means, means for operating said selected group of scanning switches in a preliminary scanning operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test the trunks in said groups, a record printer, means for operating said printer in response to said preliminary scanning operation of said selected group of scanning switches to print characters identifying each trunk in each trunk group and to print characters designating the total number of trunks in each trunk group, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered and to print characters designating the number of trunks in each of said trunk groups which test busy during each cycle operation by said selected group of scanning switches.

13. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means operative for selectively dividing said predetermined number of trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective dividing means, and means for operating the selected group of scanning switches in a plurality of successive scanning cycle operations to successively and repeatedly test successive trunks in said trunk groups.

14. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means for selectively grouping said trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective grouping means, means for operating the selected group of scanning switches in a plurality of successive scanning cycle operations to successively and repeatedly test successive trunks in said trunk groups, and means for printing a record identifying each trunk which tested busy during said plurality of successive scanning cycle operations of said selected group of scanning switches.

15. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, a plurality of groups of scanning switches, means for selectively grouping said trunks into a variable number of trunk groups, means for selecting the group of scanning switches corresponding to the number of trunk groups selected by said selective grouping means, means for operating the selected group of scanning switches in a plurality of successive scanning cycle operations to successively and repeatedly test successive trunks in said trunk groups, and means for printing a record identifying each trunk which tested busy and for printing a record designating the number of trunks in each of said trunk groups which tested busy during each cycle operation.

16. In a traffic recorder for recording traffic

conditions in a plurality of groups of trunks, scanning switches, means for operating said scanning switches in a preliminary scanning operation and in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks in said groups, a record printer, means for operating said printer in response to said preliminary scanning operation of said scanning switches to print characters identifying each trunk in each group, and means for operating said printer in response to each scanning cycle operation of said plurality of said successive scanning cycle operations to print a character designating a busy trunk each time one is encountered by said scanning switches.

17. In a traffic recorder for recording traffic conditions in a plurality of groups of trunks, a plurality of scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation, for reoperating said scanning switches in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks in said groups, and for thereafter reoperating said scanning switches in a final scanning cycle operation, a plurality of counter switches, means for alternately operating said counter switches to count the number of trunks which test busy in each of said groups in each cycle operation during the said plurality of successive scanning cycle operations of said scanning switches, an adder switch for each group of trunks, means for operating said adder switches to total the number of times a busy trunk in its corresponding group is encountered during said plurality of successive scanning cycle operations of said scanning switches, a record printer, means for operating said printer in response to said preliminary scanning cycle operation to print characters identifying each trunk in each group and to print characters designating the total number of trunks in each group, means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations of said scanning switches to print a character designating a busy trunk each time one is encountered and to print characters corresponding to the operated condition of said counter switches to designate the number of trunks in each trunk group which tested busy during each cycle operation, and means for operating said printer in response to said final scanning cycle operation to print characters corresponding to the operated condition of said adder switches to designate the total number of busy trunks in each trunk group encountered by said scanning switches during said plurality of successive scanning cycle operations.

18. In a traffic recorder for recording traffic conditions on a group of trunks, a plurality of scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation, for reoperating said scanning switches in a plurality of subsequent successive scanning cycle operations to successively and repeatedly test said trunks, and for thereafter reoperating said scanning switches in a final scanning cycle operation, a counter switch, means for operating said counter switch to count the number of trunks which test busy in each cycle operation during the said plurality of successive scanning cycle operations of said scanning switches, an adder switch, means for operating said adder switch to total the number of times a busy trunk is encountered by said scanning switches during said plurality of successive scanning cycle operations, a record printer, means for operating said printer in response to said preliminary scanning operation to print different characters identifying each trunk in said group, means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print characters corresponding to the operated condition of said counter switch to designate the number of trunks in said group which tested busy during each cycle operation, and means for operating said printer in response to said final scanning operation to print characters corresponding to the operated condition of said adder switch to designate the total number of busy trunks encountered by said scaning switches during said plurality of successive scanning cycle operations.

19. In a traffic recorder for recording traffic conditions in a group of trunks, means for automatically printing a series of different value numeral characters, each different numeral character identifying a different trunk in said group, means for automatically testing the trunks of said group successively, and means for printing a mark designating each trunk which tests busy and for associating said marks with said different numeral characters to identify the busy trunks.

20. In a traffic recorder for recording traffic conditions in a plurality of groups of trunks, means for automatically printing a plurality of series of different numeral characters corresponding to said trunk groups and identifying different trunks in each trunk group by different numeral characters, means for automatically testing the trunks of said groups successively, and means for automatically printing a character designating each trunk in each group which tests busy and for associating said last mentioned printed character with said different numeral characters to identify the busy trunks.

21. In a traffic recorder for recording traffic conditions in a plurality of groups of trunks, means for automatically printing a plurality of series of different numeral characters corresponding to the numerical order of the individual trunks in said trunk groups, means for automatically testing the trunks in said group successively, and means for automatically printing a character identifying each trunk in each group which tests busy and for associating said last mentioned printed character with said different numeral characters to identify the busy trunks.

22. In a traffic recorder for recording traffic conditions in a plurality of groups of trunks, means for automatically printing a plurality of series of different numeral characters corresponding to said trunk groups and identifying different trunks in each group by different numeral characters and for automatically printing numeral characters numerically designating the number of trunks in each trunk group, means for automatically testing the trunks of said groups successively, and means for automatically printing a character designating each trunk in each group which tests busy and for associating said last mentioned printed character with said different numeral characters to identify the busy trunks.

23. In a traffic recorder for recording traffic conditions in a plurality of groups of trunks, means for automatically printing a plurality of series of different characters corresponding to said trunk groups and identifying different trunks

in each group by different characters, for automatically printing characters numerically designating the number of trunks in each trunk group, and for automatically printing characters numerically designating the day, month and year, means for automatically testing the trunks of said groups successively, and means for automatically printing a character designating each trunk in each group which tests busy and for automatically printing characters numerically designating the number of busy trunks in each group.

24. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, manual means for selectively grouping said trunks into a plurality of trunk groups for recording purposes, means for automatically printing a plurality of series of different numeral characters corresponding to the selected plurality of trunks in each trunk group and numerically identifying each trunk in each group, means for automatically testing the trunks in said groups successively, and means for automatically printing a character designating each trunk in each group which tests busy and for associating said last mentioned printed character with said different numeral characters to identify the busy trunks.

25. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, manual means for selectively grouping said trunks into a plurality of trunk groups for recording purposes, means for automatically printing a plurality of series of different characters corresponding to the selected plurality of trunk groups, corresponding to the number of trunks in each group, and identifying each trunk in each group, means for automatically testing the trunks in said groups successively, and means for automatically printing a character designating each trunk in each group which tests busy.

26. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, selective means for grouping said trunks into a variable number of trunk groups for recording purposes, and means for automatically printing a variable number of series of different characters corresponding to the variable number of trunk groups selected and for automatically printing characters designating the total number of trunks included in each trunk group after each said series.

27. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, means for selectively grouping said trunks into a variable number of trunk groups for recording purposes, and means for automatically printing a corresponding variable number of series of characters each corresponding to an individual trunk and for automatically printing characters designating the total number of trunks included in each trunk group.

28. In a traffic recorder for recording traffic conditions in a group of trunks, manual means for selectively dividing said group into a plurality of sub-groups, means for testing said sub-groups of trunks successively, and means effective immediately prior to the testing of said sub-groups for making a record identifying each particular trunk, for making a record designating the number of trunks in each sub-group, and for making a record designating the month, day and year.

29. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation, a record printer for printing characters, means for manually selecting characters corresponding to the day, month and year, and means for operating said printer in response to said preliminary scanning cycle operation of said scanning switches to print characters identifying each trunk in said group and to print the characters selected by said manual selecting means designating the day, month and year.

30. In a traffic recorder for recording traffic conditions on a group of trunks, a record printer for printing characters, time switches, means for operating said time switches to select characters corresponding to the hours, minutes and seconds time of day, scanning switches, means for operating said scanning switches in a plurality of successive scanning cycle operations to successively and repeatedly test said trunks, and means for operating said printer in response to each scanning cycle operation of said plurality of successive scanning cycle operations to print a character designating a busy trunk each time one is encountered by said scanning switches and to print characters corresponding to the hours, minutes, and seconds time of day selected by said time switches.

31. In a traffic recorder for recording traffic conditions on a group of trunks, a record printer for printing characters, means for manually selecting characters corresponding to the date, means for selecting characters corresponding to the time of day, scanning switches, means for operating said scanning switches in a preliminary scanning operation, means responsive to said preliminary operation of said scanning switches for operating said printer to print characters corresponding to the date selected by said manual selecting means, means for operating said scanning switches in subsequent scanning cycle operations to test said trunks, and means responsive to said subsequent scanning cycle operations of said scanning switches for operating said printer to print a character designating a busy trunk each time one is encountered and to print characters corresponding to the time of day selected by said selecting means.

32. In a traffic recorder for recording traffic conditions on a group of trunks, a record printer for printing characters, scanning switches, means for operating said scanning switches in a plurality of scanning cycle operations to successively and repeatedly test said trunks in said group, means responsive to said scanning cycle operations of said scanning switches for operating said printer to print a character for each busy trunk and to space said printer one step for each idle trunk encountered by said scanning switches during each cycle operation, and means including said scanning switches and time selecting means for operating said printer to print characters corresponding to the time of day during each scanning cycle operation of said scanning switches.

33. In a traffic recorder for recording traffic conditions on a group of trunks, a record printer for printing different characters, scanning switches, means for operating said scanning switches in a preliminary scanning cycle operation and in a plurality of successive scanning cycle operations to successively and repeatedly test said trunks, means for operating said printer to print different characters identifying each trunk in said group in response to said preliminary scanning operation of said scanning switches, and

means for operating said printer to print a character for each busy trunk in alinement with the printed characters identifying each trunk and to space the printer one step for each idle trunk in response to said plurality of successive scanning cycle operations of said scanning switches.

34. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches for testing said trunks successively in a single cycle operation, means including a primary control switch for operating said scanning switches in a predetermined number of cycle operations, an added switch, means for operating said adder switch to total the number of times a busy trunk is encountered by said scanning switches in said predetermined number of cycle operations, a record printer, and means for operating said printer to print a character designating a busy trunk each time one is encountered by said scanning switches and for operating said printer to print characters designating the total number of busy trunks encountered in said predetermined number of cycle operations of said scanning switches.

35. In a traffic recorder for recording traffic conditions on a plurality of trunks, a record printer, an adder, a counter, scanning switches, means including a first wiper on each scanning switch for controlling the step-by-step operation of said scanning switches in a plurality of successive scanning cycle operations, means including a second wiper on each of said scanning switches for controlling the operation of said printer to print characters identifying each of said trunks in response to the first cycle operation of said scanning switches, means including a third wiper on each of said scanning switches for testing each of said trunks successively in response to successive cycle operations of said scanning switches, a mark relay operated each time a busy trunk is encountered by said third wipers, means including a fourth wiper on each scanning switch for operating said printer to print a character indicating a busy trunk or to space the printer one step for each step of said scanning switches dependent upon the operated or non-operated condition of said mark relay during the successive cycle operations of said scanning switches, means including a fifth wiper on each scanning switch for operating said adder each time said mark relay is operated to total the number of busy trunks encountered by said third wipers, means including a sixth wiper on each scanning switch for controlling said printer to print characters corresponding to the total number of busy trunks added by said adder during said successive cycle operations of said scanning switches, means controlled by said mark relay for operating said counter to count the number of busy trunks encountered by said third wiper in each cycle operation, and means including said fourth wipers for operating said printer to print characters corresponding to the number of busy trunks for each cycle operation of said scanning switches.

36. In a traffic recorder for recording traffic conditions on a plurality of trunks, a record printer, an adder, scanning switches, means including a first wiper on each of said scanning switches for controlling the step-by-step operation of said scanning switches in a plurality of successive scanning cycle operations, means including a second wiper on each scanning switch for controlling the operation of said printer to print characters identifying each of said trunks in response to the first cycle operation of said scanning switches, means including a third wiper on each scanning switch for testing each of said trunks successively in response to successive cycle operation of said scanning switches, means including a fourth wiper on each scanning switch for operating said printer to print a character indicating a busy trunk or to space the printer one step for each step of said scanning switches dependent upon the busy or idle condition of said trunks during the successive cycle operations of said scanning switches, means including a fifth wiper on each of said scanning switches for operating said adder to total the number of busy trunks encountered by said third wipers in said successive cycle operations, and means including a sixth wiper on each scanning switch for controlling said printer to print characters corresponding to the total number of busy trunks added by said adder during said successive cycle operations.

37. In a traffic recorder for recording traffic conditions on a group of trunks, an electric adder comprising a first and a second rotary switch operative step-by-step to a plurality of different positions for numerically designating totals, means for successively testing said trunks, means for operating said first switch one step for each trunk which tests busy, said first switch rotating through a complete revolution and starting in a succeeding revolution in response to predetermined numbers of stepping operations, and means including relays controlled by said first switch on the completion of each revolution for controlling the operation of said second switch to take one step for each fourth revolution of said first switch.

38. In a traffic recorder for recording traffic conditions on a group of trunks, an electric adder comprising a first and a second rotary switch operative step-by-step to a plurality of different positions for numerically designating totals, means for successively testing said trunks, means for operating said first switch one step for each trunk which tests busy, said first switch rotating through a complete revolution and starting in a succeeding revolution in response to predetermined numbers of stepping operations, means including relays controlled by said first switch on the completion of each revolution for controlling the operation of said second switch to take one step for each fourth revolution of said first switch, a record printer, and means for operating said printer to print a record corresponding to the operated positions of said first and second switches.

39. In a traffic recorder for recording traffic conditions on a group of trunks, a test conductor and a storage relay individual to each trunk of said group, means for simultaneously and momentarily connecting each of said trunks to its corresponding test conductor, means for operating each storage relay over its corresponding test conductor in response to said first means in case the corresponding trunk is busy, means for locking the operated storage relays for a predetermined time interval and for connecting a test potential to the test conductors corresponding to the operated storage relays, scanning switches, and means for operating said scanning switches to successively test said test conductors for said test potential.

40. In a traffic recorder for recording traffic conditions on a group of trunks, a test conductor and a storage relay individual to each trunk of

said group, means for simultaneously and momentarily connecting each of said trunks to its corresponding test conductor, means for operating each storage relay over its corresponding test conductor in response to said first means in case the corresponding trunk is busy, means for locking the operated storage relays for a predetermined time interval and for connecting a test potential to the test conductors corresponding to the operated storage relays, scanning switches, means for operating said scanning switches to successively test said test conductors for said test potential, and means for making a record each time said scanning switches encounters a test conductor having a test potential thereon.

41. In a traffic recorder for recording traffic conditions on a group of trunks, scanning switches, means for operating said scanning switches to successively test said trunks, a counter switch, a circuit for operating said counter switch, an adder switch, a circuit for operating said adder switch, a record printer, a circuit for operating said printer, a mark relay having contacts for controlling said circuits, and means for operating said mark relay each time said scanning switches encounters a trunk which tests busy to control said circuits.

42. In a traffic recorder for recording traffic conditions on a predetermined number of trunks, means for selectively grouping all said predetermined number of trunks into a single or a plurality of groups of trunks, scanning switches, means for operating said scanning switches to successively test said trunks, and means operated in response to the operation of said scanning switches for making a record indicating the said grouping arrangement selected by said selective grouping means.

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