

Oct. 17, 1933.

O. C. LEVY

1,930,525

SIGNALING SYSTEM

Filed Sept. 14, 1929

11 Sheets-Sheet 1

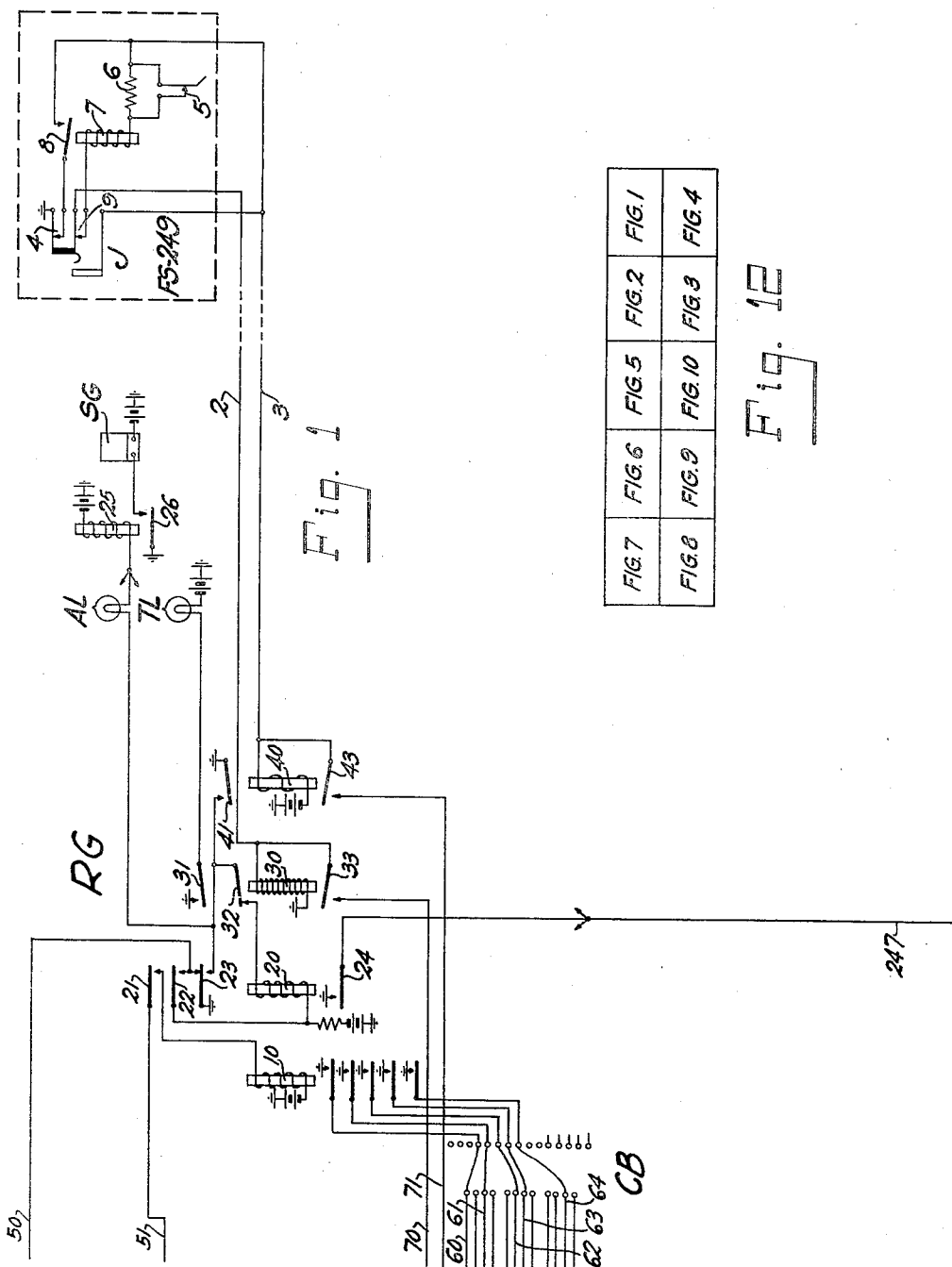


FIG. 7	FIG. 6	FIG. 5	FIG. 2	FIG. 1
FIG. 8	FIG. 9	FIG. 10	FIG. 3	FIG. 4

Fig. 12

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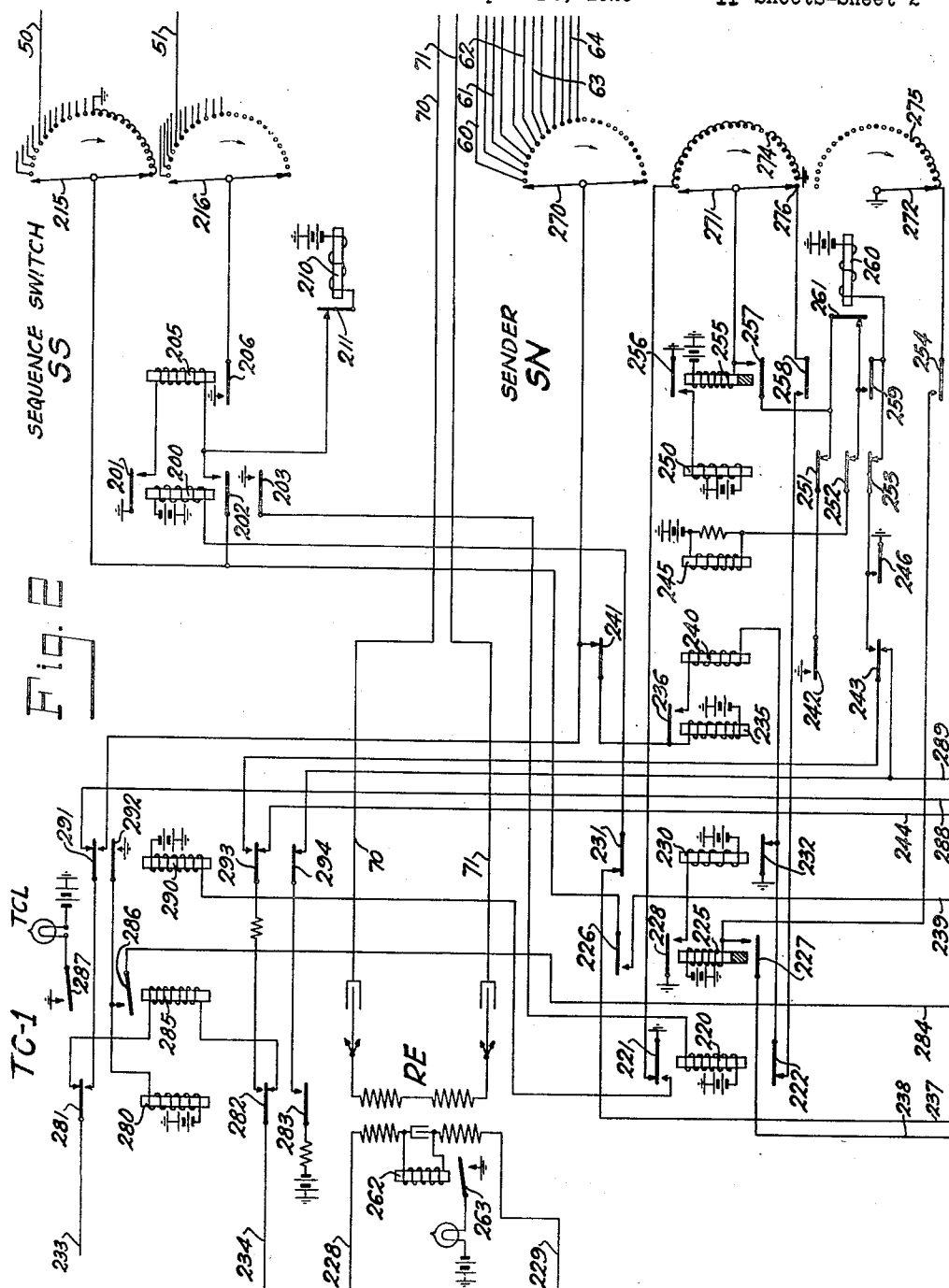
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SIGNALING SYSTEM

Filed Sept. 14, 1929

11 Sheets-Sheet 2



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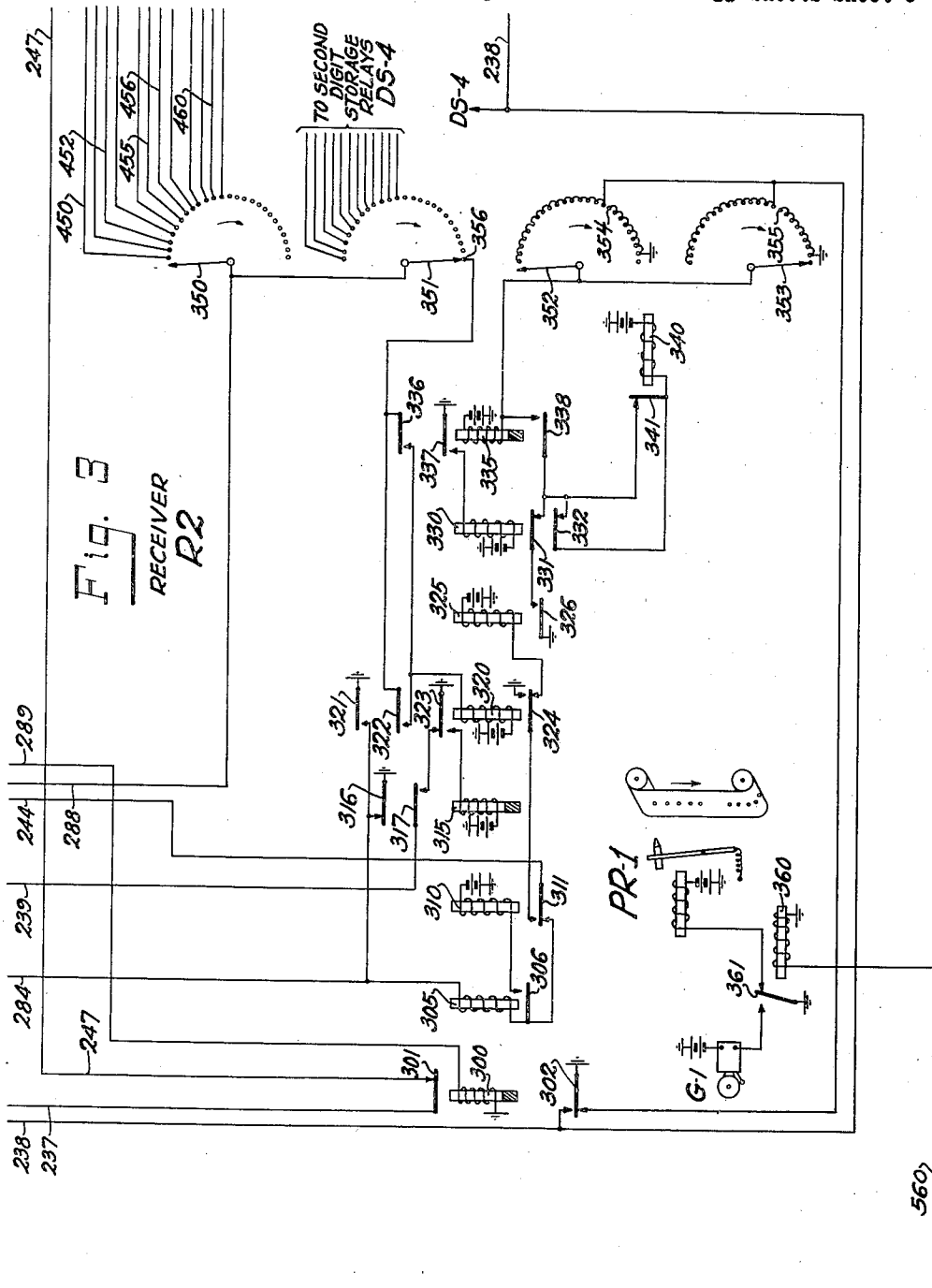
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Filed Sept. 14, 1929

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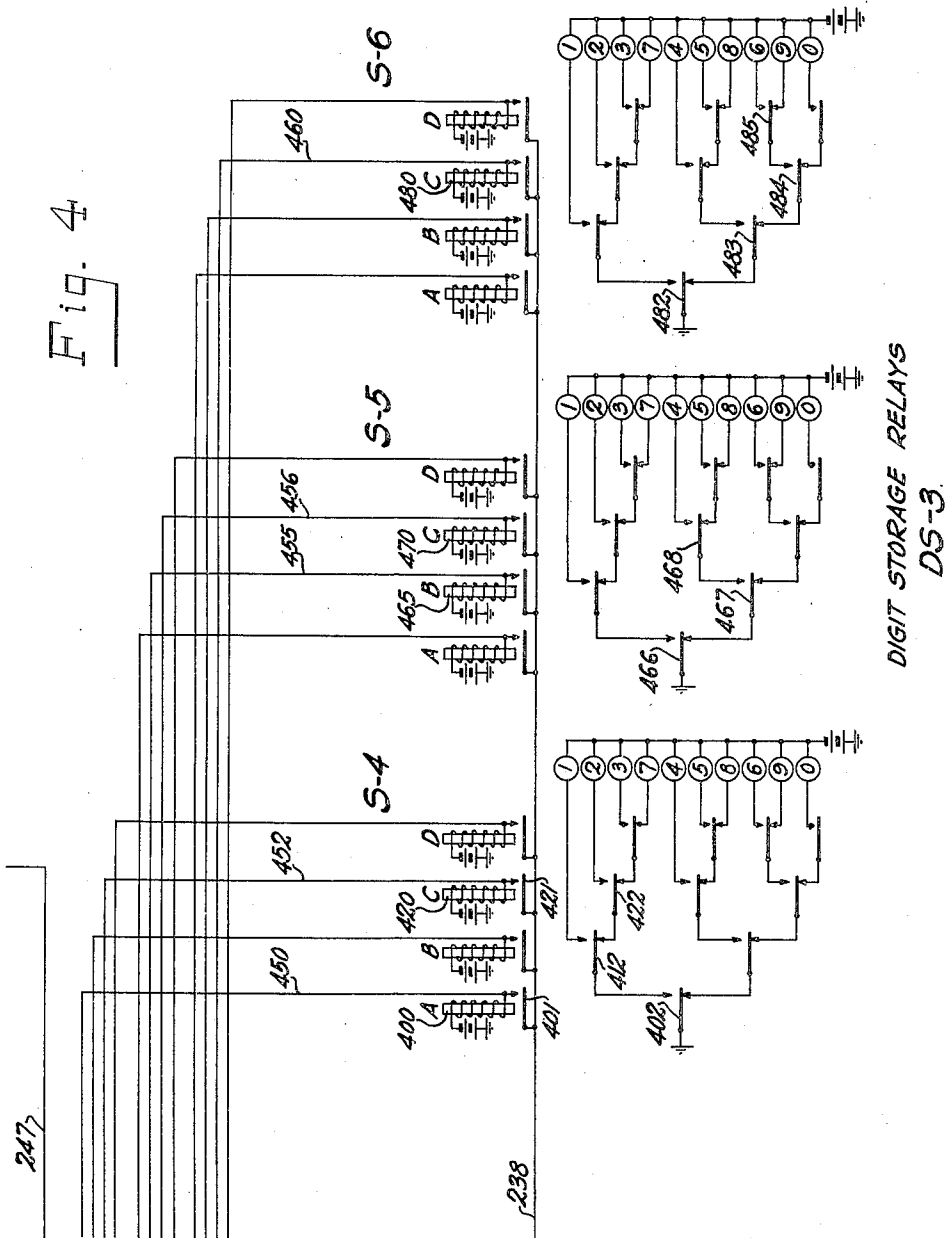
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Fig. 4



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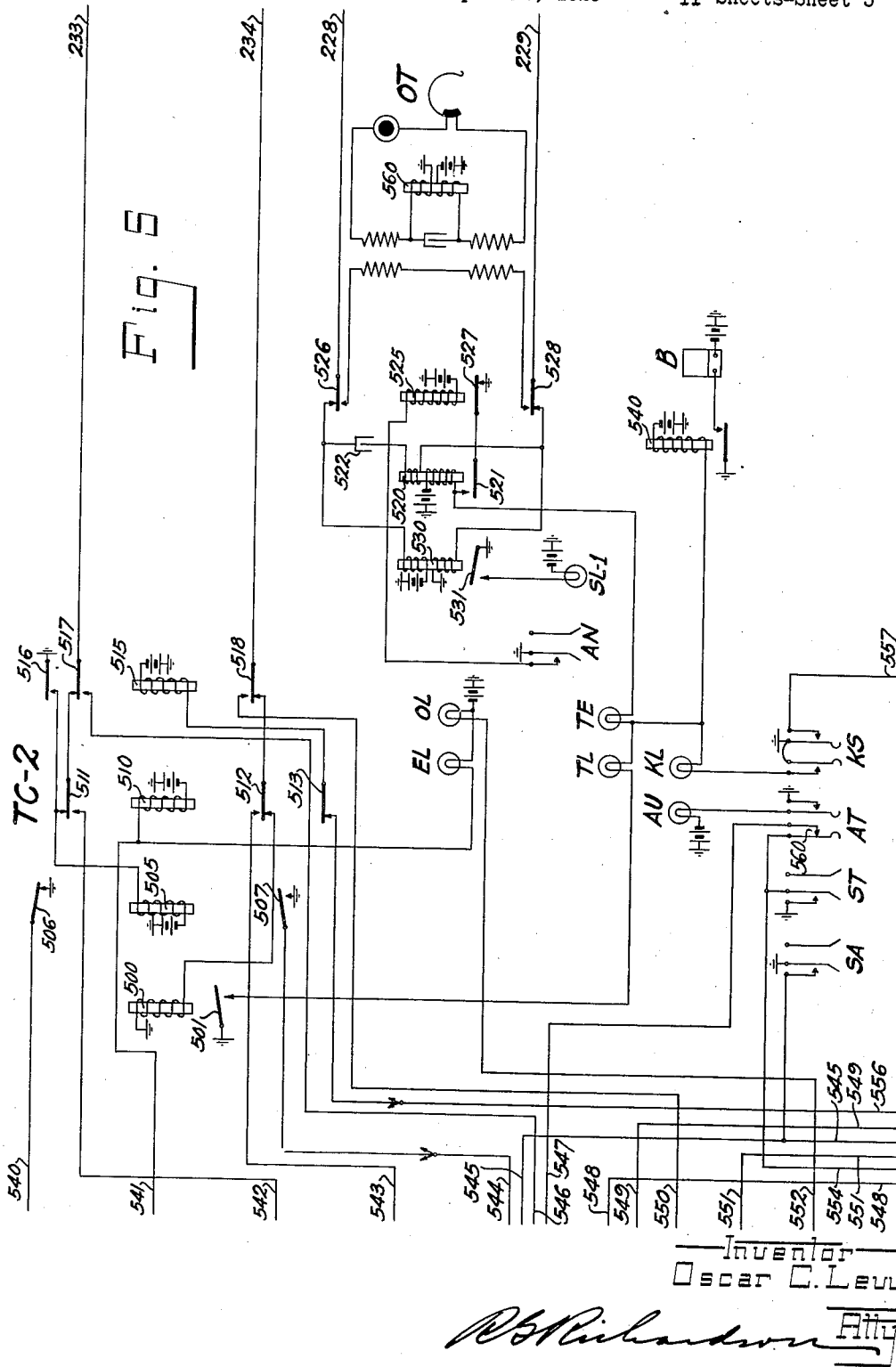
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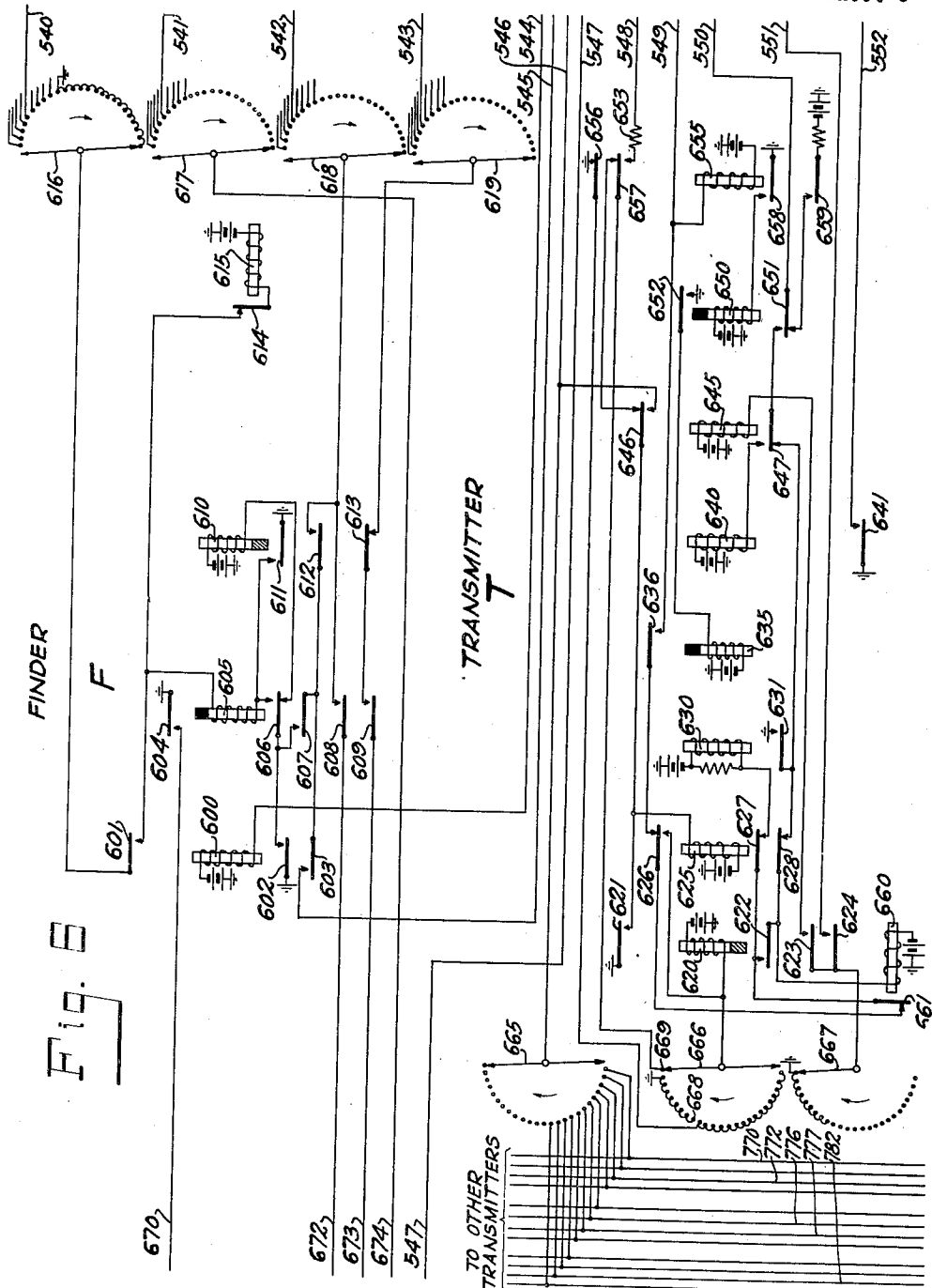
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1,930,525

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Filed Sept. 14, 1929

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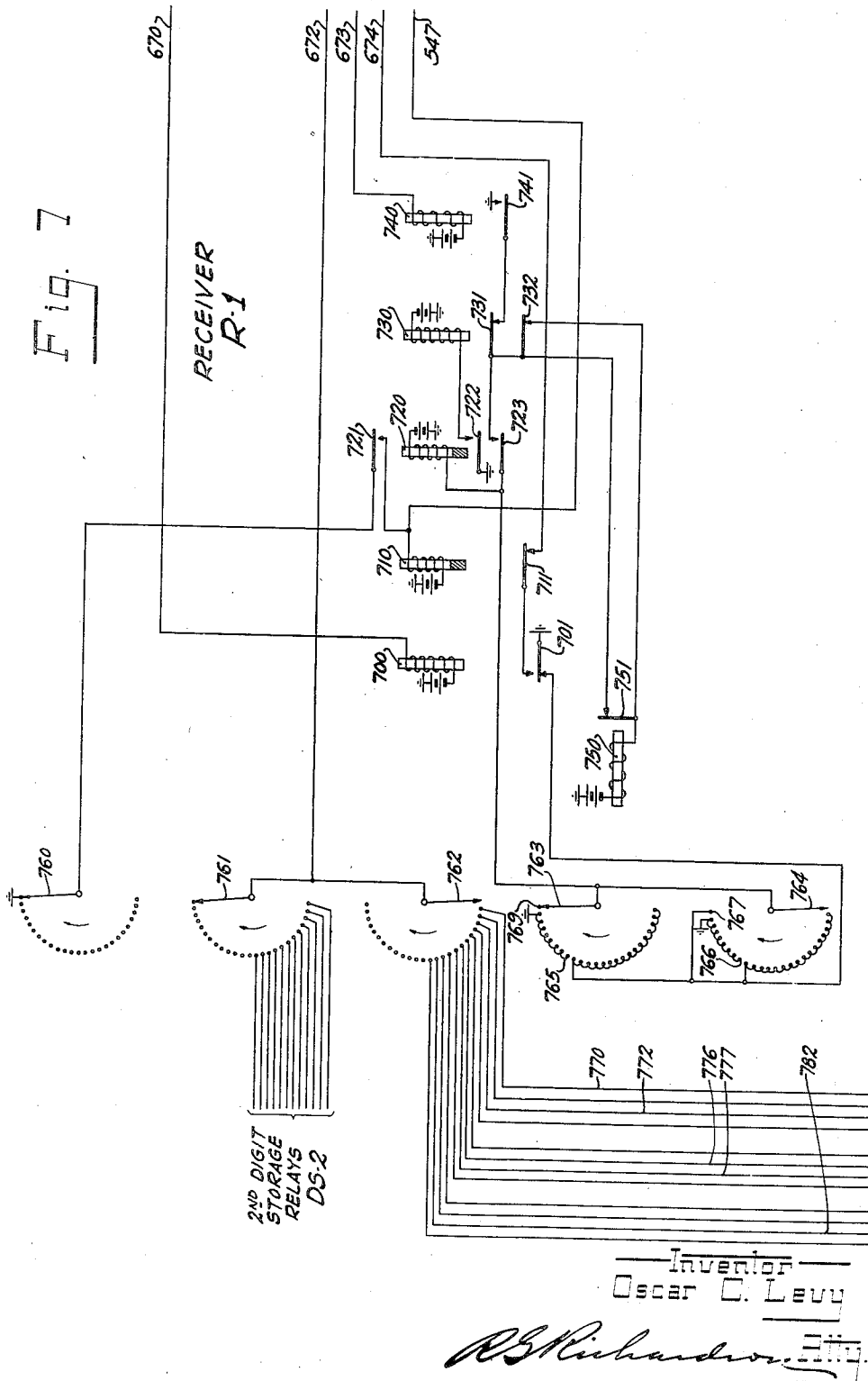
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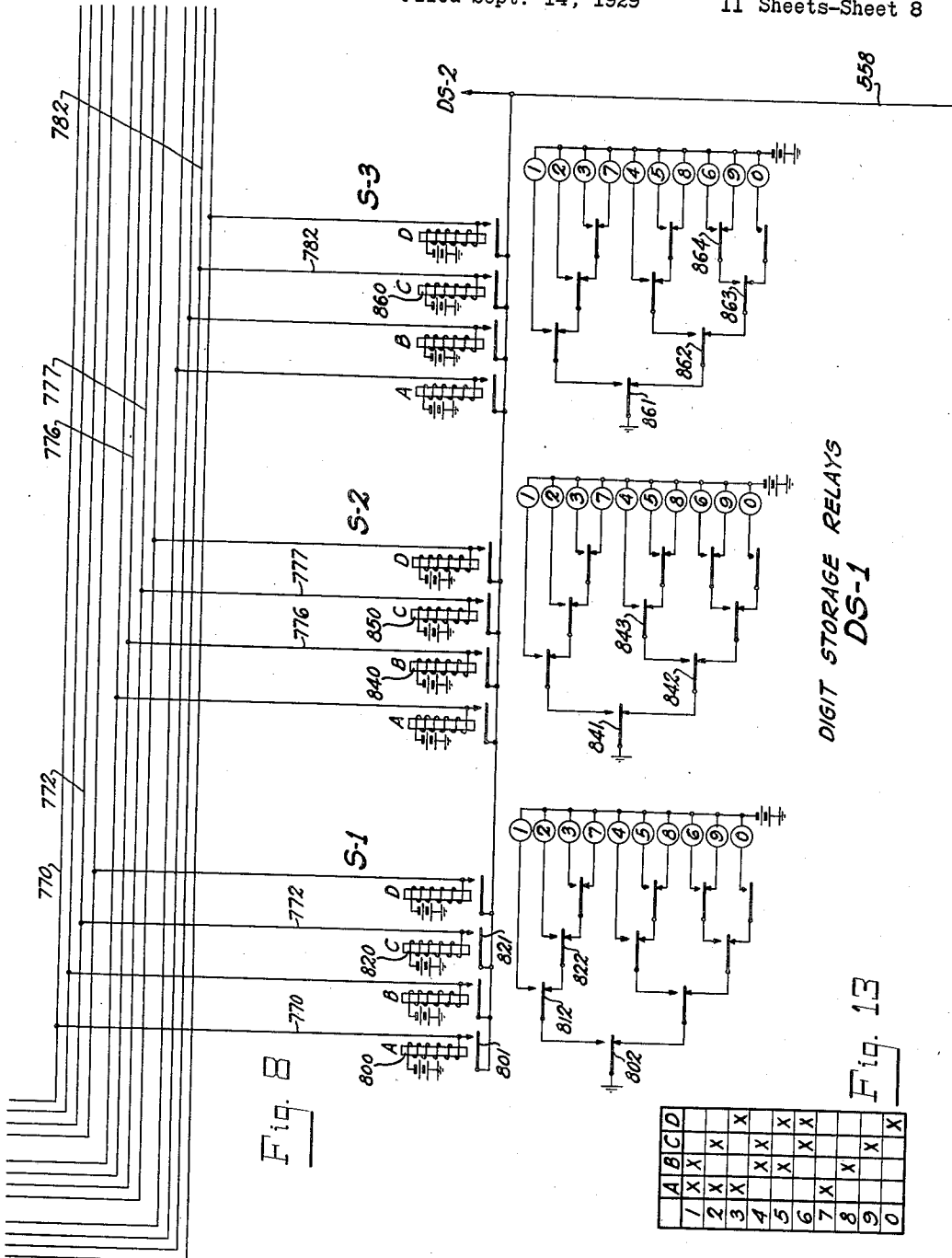


Fig. 8

Fig. 13

DIGIT STORAGE RELAYS
DS-1

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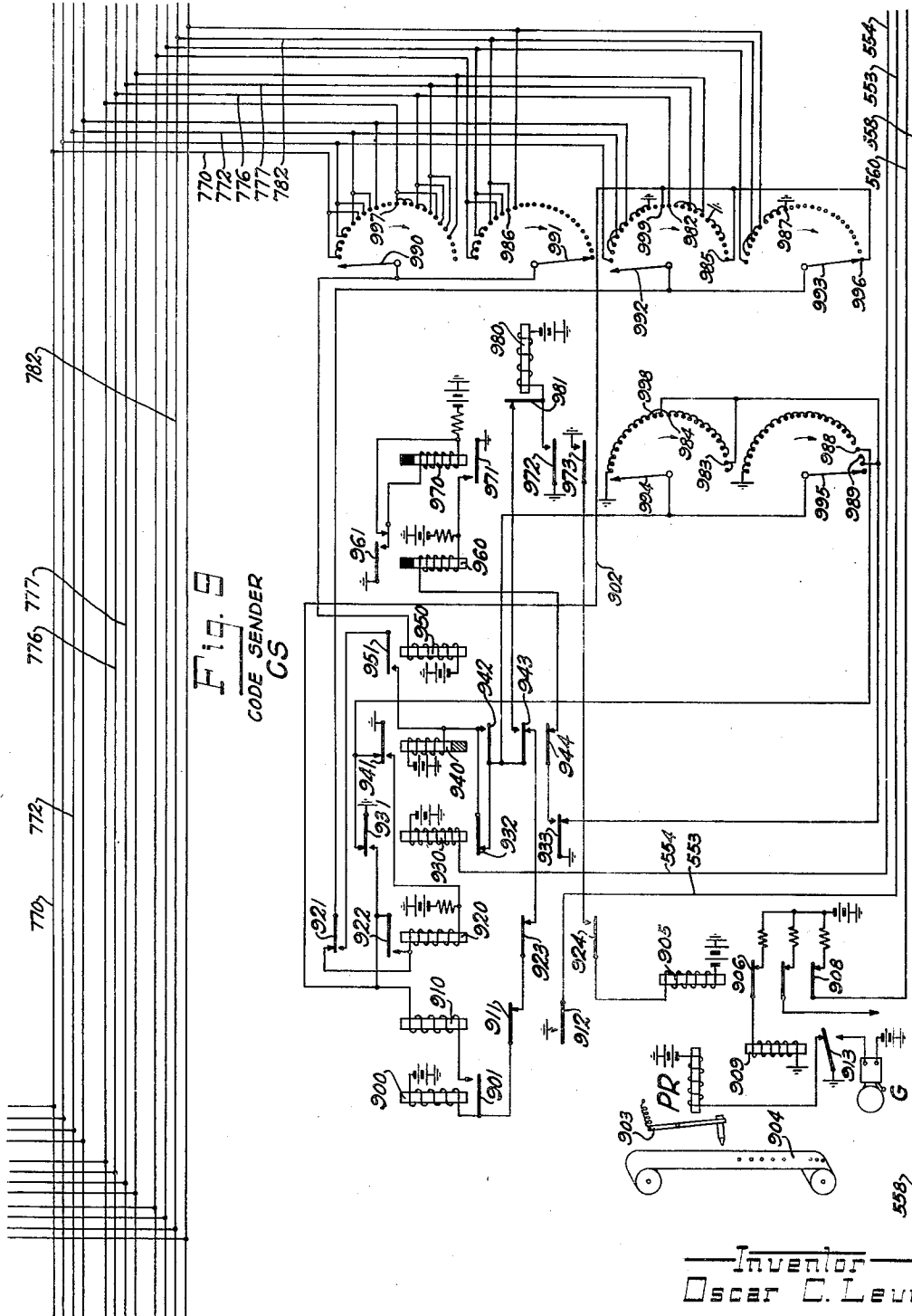
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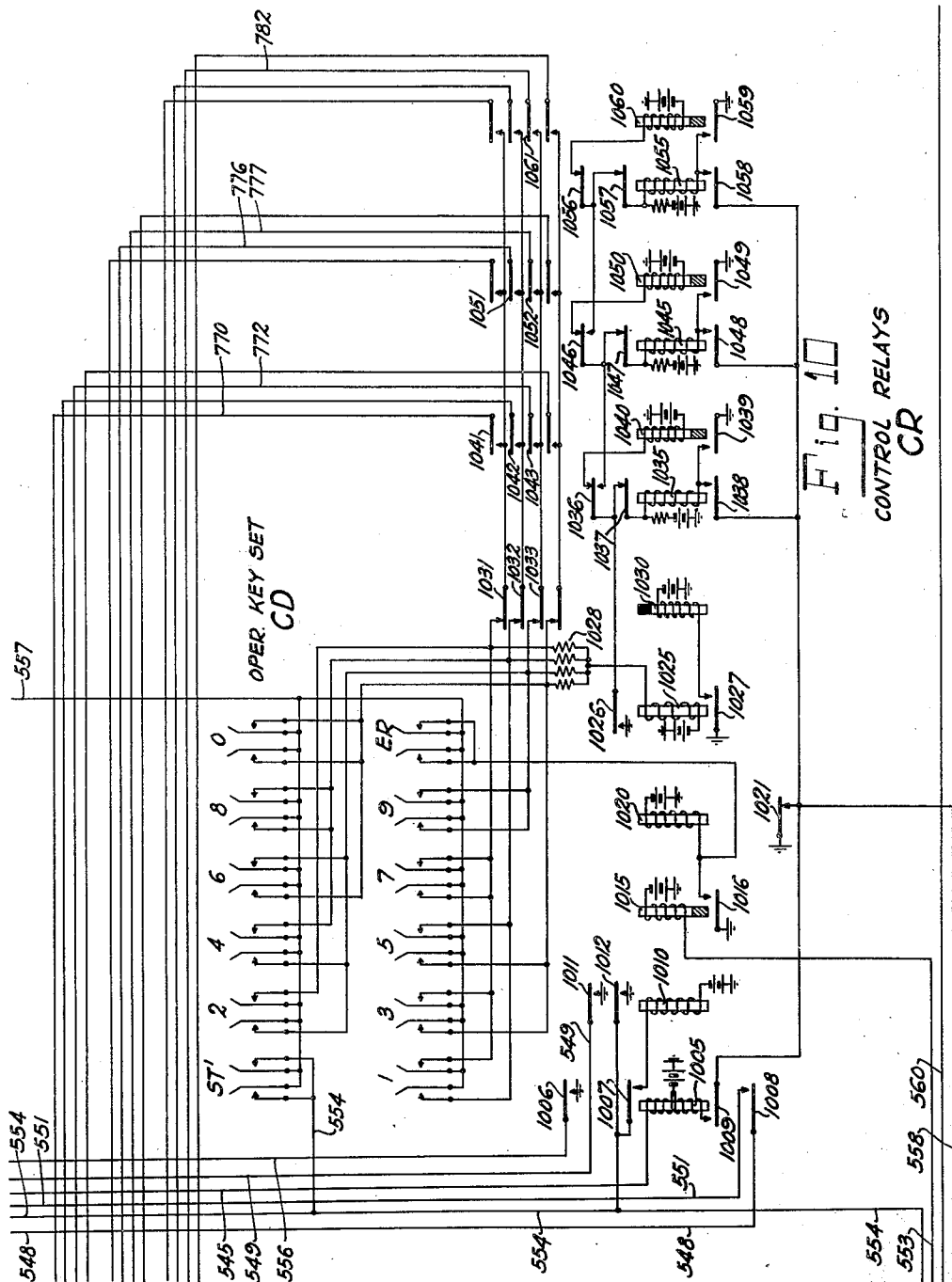
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CONTROL RELAYS
CR

2

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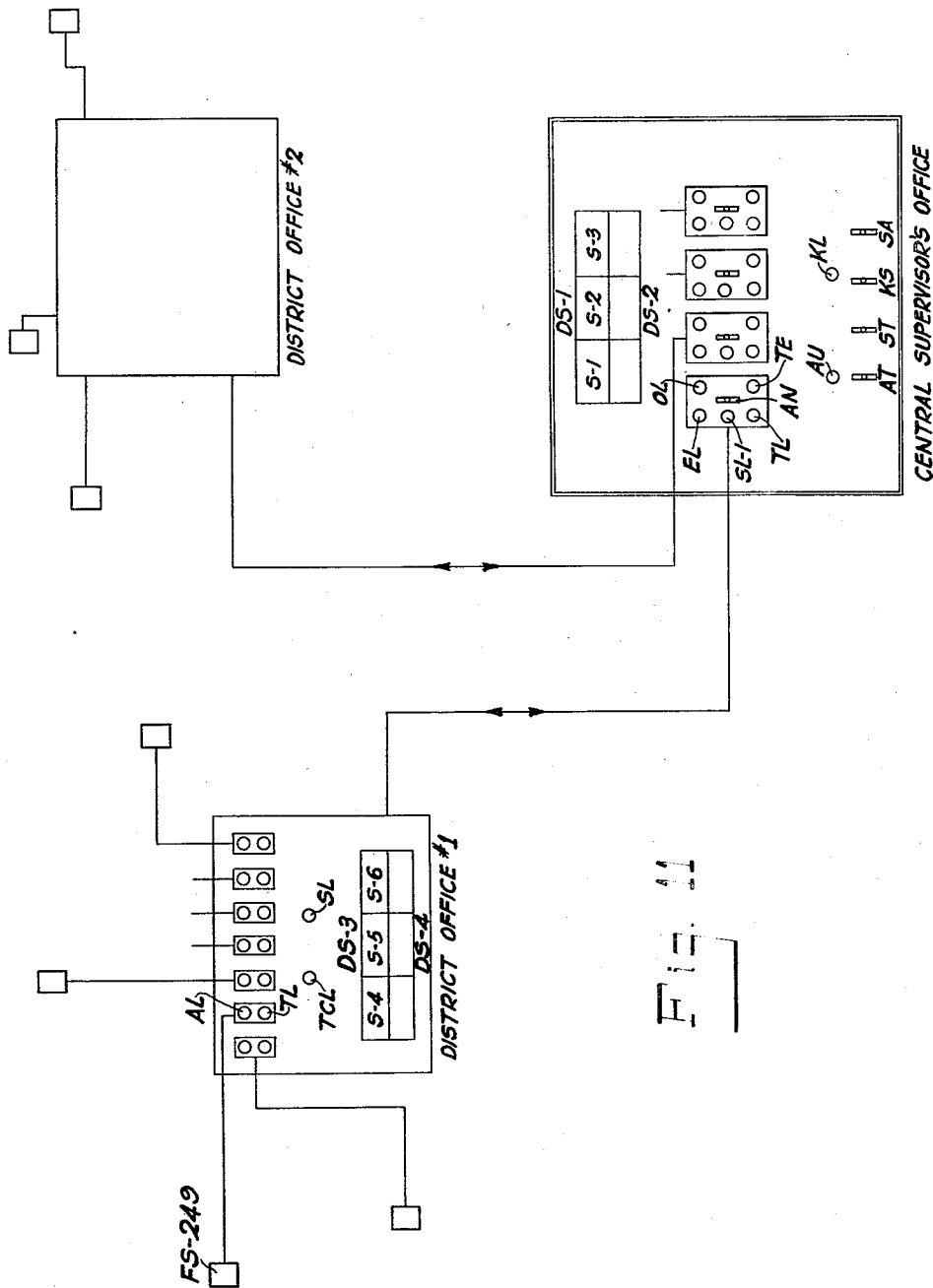


Fig. 11

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UNITED STATES PATENT OFFICE

1,930,525

SIGNALING SYSTEM

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Application September 14, 1929

Serial No. 392,637

9 Claims. (Cl. 177—360)

This invention relates to signaling systems in general, but more particularly to improvements in fire alarm systems, and the broad object of the invention, generally stated, is to design a system wherein fire alarm signals are received and registered at a central location in a faster, more efficient, and reliable manner than heretofore.

A feature of the invention resides in the provision of means in a fire alarm system wherein a signal from an operated fire alarm box is automatically transmitted to a district office, then automatically relayed to a central supervisor's office wherein the signal is displayed on visible lamp panels, and then is automatically retransmitted to the originating district office, and all other district offices, and there displayed on similar lamp panels.

A further feature of the invention relates to means whereby visible display signals are indicated in duplicate in order to check the accuracy of the number of the box from which the signal has been received.

Other objects and features of the invention reside in the design of a system utilizing a minimum amount of apparatus in an efficient manner and to perform all necessary operations automatically. These and other objects and features, not specifically pointed out, will be apparent by referring to the accompanying drawings which together with the detailed description constitute the preferred embodiment of the invention.

The drawings comprising eleven sheets, when laid end to end as indicated in Fig. 12, with their adjoining lines in alignment, diagrammatically illustrate the invention by means of the usual circuit diagrams.

Fig. 1 shows a single fire station FS—249 connected to its associated relay equipment RG at a district office.

Fig. 2 shows a sequence switch SS having access to the relay equipment RG of Fig. 1, and also all other fire stations. The sender switch SN sends out the number of the operated fire station. At the upper left-hand corner there is shown a trunk TC1 extending to a central supervisor's office.

Fig. 3 shows a receiver switch R2, controlled by the sender SN of Fig. 2.

Fig. 4 comprises a digit storage relay group DS3 and their associated contacts which control a group of lamps arranged in a lamp panel.

Except for the fire alarm station FS—249, Figs. 1, 2, 3, and 4 comprise all the equipment associated with a single district office.

Fig. 5 shows various lamps and keys associated

with the equipment at the central office or supervisor's position, together with a group of relays connecting the supervisor's position over a trunk line TC—2 with the district office.

Fig. 6 shows a finder switch F, for seizing the line extending from the district office. The lower part of the figure shows a transmitter switch T, individual to the district office, for transmitting the number of the fire alarm box which is operated.

Fig. 7 shows the receiver switch R—1, which receives the number of the line with which the finder F of Fig. 6 is associated.

Fig. 8 illustrates a set of digit storage relays DS—2 connected to a lamp panel which displays the number of the operated fire alarm box.

Fig. 9 shows the code sender switch CS for translating the code of the operated fire alarm station so as to operate the punch register PR.

Fig. 10 illustrates the control relay group CR and associated relays and also the operator's calling device key set CD, for manually setting up numbers received over "still" alarms or telephone systems to control the digit storage relays of Fig. 8.

Fig. 11 diagrammatically shows the general layout of the complete system as shown in detail on the other drawings.

Fig. 12 shows a general layout of the method of connecting together the different sheets of drawings.

Fig. 13 is a code chart illustrating the order in which the digit storage relays of Fig. 8 and Fig. 4 operate and display a number on the lamp panel.

Referring now particularly to Fig. 11, this drawing diagrammatically illustrates the principles involved in the invention. In the lower right-hand corner there is indicated a central supervisor's position having branch lines associated with a number of district offices of which two are indicated. Each district office, for example No. 1, has a large number of fire alarm boxes or stations connected to it, all of which are in a particular district or area under control of this office. Each fire station, for example FS—249, is connected with the office over a normally closed circuit. Each line has associated with it at the district office, a pair of lamps, one lamp to indicate when an alarm is sounded, and the other to indicate when there is a case of trouble on the line, such as a broken down line or a grounded line. Each district office is equipped with a display panel and has means wherein the operation of a fire alarm box sets in operation certain equipment in the office to seize a trunk line extending

to the supervisor's position. The supervisor's position is equipped with a number of keys and lamps, one such set being shown as connected to the district office No. 1, and also a display panel similar to that in the district office.

In the operation of the system when a fire alarm box, such as FS-249, is operated, the associated alarm lamp is illuminated at the district office No. 1 and equipment at the district office seizes this line and extends this to the supervisor's position where another alarm lamp is illuminated indicating that the alarm is coming from this particular district office. Equipment at the supervisor's position then is set in operation to automatically translate the number of the box and display it on a lamp panel in duplicate, in order to insure that the correct number has been set up. This number is then retransmitted back to the district office in which the call originated and there displayed on a similar lamp panel in duplicate. This number is also sent out by the equipment to all other district offices, terminating in the supervisor's position, so that they will be aware of a fire and know the location of it. It will be noted that the only action required is to merely open the fire alarm line extending from the fire box to the district office and to set up the number in the supervisor's position and to operate all of the equipment.

Facilities are provided whereby "still" alarms may be received over a telephone line at the supervisor's position and there set up on display panels of the position, and also transmitted to each of the district offices. Other facilities provide for connection at the fire alarm box, with the telephone line extending over the fire alarm trunks to the district office and thence to the supervisor's position.

All of the switches disclosed in this invention are of the same general type wherein the wipers are rotated in a forward direction over their associated bank contacts under the influence of a stepping magnet. The direction of rotation of each wiper is indicated on the drawings. Each time this magnet becomes deenergized it advances the switch wipers one step over the bank contacts. A switch of this general type is disclosed in Patent No. 1,693,027, issued November 27th, 1928 to John Erickson.

A detailed description of a regular fire alarm call will now be given. The fire alarm station shown in Fig. 1 and designated FS-249 may be of any well known type of construction such as the "break glass" type or otherwise, wherein a handle is turned and this operates to momentarily open the contacts 5 which are normally closed. Relay 40 and high resistance relay 30 at the district office are normally energized over the line conductors 2 and 3, and through the normally-closed contacts 5. The high resistance shunt 6 is normally shunted out by the contact 5, so that opening the line conductors 2 and 3 at the contact 5 inserts the high resistance 6 across the line. As a result of this relay 40, being of low resistance deenergizes, while relay 30, being of very high resistance, remains energized in series with the shunt 6.

Relay 40 upon deenergizing, at the back contact of armature 41, places ground through the fire alarm lamp AL, through the winding of relay 25 to battery. Relay 25 at armature 26 closes a circuit for the audible alarm signal SG. The ringing of the signal SG informs an attendant at the station house that an alarm has been sent in while illumination of the lamp AL indicates

the particular fire station or location from which the alarm has been sent. At the back contact of armature 41 ground also extends by way of armature 32 and its front contact through the winding of relay 20 and the resistance to battery. Relay 20 upon operating closes a locking circuit for itself extending from ground on armature 23 and its front contact, armature 32 and its front contact, to relay 20. A branch of this circuit extends to the lamp AL so that it remains lighted when relay 40 again energizes due to contacts 5 closing. At front contact of armature 22 a circuit is prepared extending over to conductor 50, while at the front contact of armature 21 a circuit is prepared extending over conductor 51 for the relay 10.

At the front contact of armature 24, relay 20 grounds the start conductor 247 which is common to all the other relay groups RG associated with all the fire alarm stations connected to this district station. This ground extends over conductor 247, through Fig. 4 and Fig. 3, back contact and armature 301, back contact and armature 231 of relay 230, through the winding of relay 200, to battery in the sequence switch SS. Relay 200 upon energizing, operates its armature 201 and places ground to its front contact, through the winding of relay 205, back contact and armature 211, through the winding of rotary magnet 210, to battery. Due to the high resistance of relay 205, the rotary magnet 210 does not energize in this circuit. At the front contact of armature 202 the test wiper 215 is connected to a point between the stepping magnet 210 and relay 205. The bank contacts of the wiper 215 connect to the various relay groups RG associated with all the fire alarm lines in this district, only one of which has been shown connected. All the lines not equipped have their contacts permanently grounded. Ground, therefore, extends from the bank contact upon which wiper 215 is resting through wiper 215, armature 202 and its front contact, to the junction point of relay 205. The other side of this relay is also grounded at armature 201, and it, therefore, is short-circuited. A branch of this circuit extends through armature 211, through the winding of stepping magnet 210, to battery. Magnet 210 energizes and when it operates the contacts 211 it deenergizes, and rotates the wipers 215 and 216 on to their first set of bank contacts. The first contact in the bank of wiper 215 extends to a relay group similar to RG and over a similar conductor 50 to ground, at armature 23 of relay 20 of this other relay group. This ground, therefore, extends back over wiper 215 to again energize the magnet 210 and set the wipers onto the next set of bank contacts. This action continues until the fifth bank contact is reached to which the conductor 50 is connected. In this case the relay 20 has operated to remove the ground from its armature 23 extending over conductor 50 and substituted, therefore, the battery from the relay 20 extending through its front contact and armature 22. Relay 205 is, therefore, no longer short-circuited, but is energized from ground on armature 201 through the relay 205 and then through the winding of stepping magnet 210, to battery. The magnet 210 does not operate in series with relay 205, and the stepping operation of the sequence switch SS is halted, and it remains in its operated position.

At the front contact of armature 206, relay 205 places ground through wiper 216, the fifth contact upon which it is now resting, conductor 51, armature 21 and its front contact, through the wind-

ing of relay 10, to battery. Relay 10 upon operating, places ground on all of its armatures, thereby connecting ground on each of the conductors 60, 61, 62, 63, and 64, extending through the cross connecting block CB to the bank contacts of the sender SN. The cross connecting block CB is provided so that additional fire alarm stations may be connected up, or existing ones removed or changed. The right-hand terminals of the connecting block are connected to other relay groups such as RG, associated with other fire alarm lines under the supervision of this particular district station. These conductors at the terminals are all cross-connected to the left-hand terminals of the block CB in accordance with the number of the fire alarm box. The cross-connection of the wires at the terminal block CB and the connection to the bank contacts of the wiper 270 of the sender S determines the code which is to be transmitted and which is associated with each individual fire alarm line or box, there being one box per line. At the front contact of armature 203 relay 200 places ground on this armature through the winding of relay 220, to battery. Relay 220 upon energizing at the back contact of armature 222 opens a point in the circuit of relay 240 and at the back contact of armature 221 ground is removed from the bank contact of wiper 271 and extended to the front contact of this armature through the winding of relay 290, to battery.

Relay 290 is associated with the group of relays comprising the trunk circuit TC—1, controlling the trunk line comprising conductors 233 and 234 which extends from the district station to the supervisor's office. At armatures 291 and 293, relay 290 transfers the trunk circuit from its back contacts to the front contacts. At the front contact of armature 292 ground is extended through the winding of relay 280 to battery. At the back contact of armatures 281 and 282 of relay 280, relay 285 is removed from the line conductors 233 and 234 over which it has been previously held energized. At the front contacts of these armatures, the trunk line is extended to the armatures 291 and 293 of relay 290. At front contact and armature 283 the battery through the resistance is connected to armature 294 but that contact is now open and this is without effect. As a result of the deenergization of relay 285 its armatures retract, and at armature 287 and its back contact ground is placed through the lamp TCL, to battery, indicating to an attendant at the district station that the trunks 233 and 234 extending to the supervisor's position have been seized.

After the trunk line conductors 233 and 234 have been seized by the apparatus at the district station and extended to the supervisor's position they must be placed in such condition as to receive the number of the fire alarm box that is operated. The trunk lines 233 and 234 terminate in Fig. 5 at the supervisor's position in a pair of relays 500 and 505 in the trunk circuit TC—2. Relay 500 is connected to the lower conductor 234 over armatures 512 and 518 and relay 505 is connected to conductor 233 over armatures 511 and 517. These relays have been normally energized over the trunk line in series with relay 285 of the trunk circuit TC—1. At the time relay 280 operated its armatures 281 and 282, it disconnected relay 285 from the line conductors and thereby permitted relays 500 and 505 to be deenergized. At armature 501 and its back contact relay 500 places ground through the lamp TL,

then through relay 540, to battery. The illumination of lamp TL informs the supervisor at his position, that this trunk is taken into use and is about to receive a fire alarm signal over it. Relay 540 attracts its armature and places ground through the buzzer B, to audibly inform the supervisor of the alarm. Relay 505 upon deenergizing opens the ground circuit from its armature 506 and removes the ground from conductor 540 extending to the bank contact of the finder switch F, in order to mark this trunk in the bank of the finder. Armature 507 closes at its back contact, places ground on the conductor 544 extending to Fig. 6, and through the winding on relay 600, to battery at the finder F.

All of the trunk lines such as TC—2 for example, which are not in use at the present time and are all extended to the bank contacts over which wiper 616 rotate, will have ground placed on them similar to that shown at armature 506. All other trunk lines not equipped or not in use will have their bank contacts permanently grounded. In the instant case the bank contact to which conductor 540 is attached will have ground removed from it at armature 506. At the time relay 600 is operated it closes its front contact on armature 601 and completes a circuit extending from ground on the last bank contact upon which wiper 616 is resting to wiper 616, armature 601 and its front contact, back contact and armature 614, through the winding of stepping magnet 615 to battery. Magnet 615 operates and at the back contact of armature 614 opens its own circuit, and when it deenergizes it advances the wipers 616, 617, 618, and 619 on to the first set of bank contacts. As this set of bank contacts is connected to a trunk not in use at this time, there will be ground fed to wiper 616 and the magnet 615 will again be energized to interrupt its own circuit and upon deenergizing advance the wipers another step. This action continues as long as the wiper 616 rests on bank contacts which are grounded. When the fifth bank contact is reached to which conductor 540 is attached, there will be no ground on this contact, and consequently, the operation of the rotary magnet is stopped.

At the time relay 600 operated, it closed its armature 602 from ground to its front contact, through armature 606 and its back contact, then through the winding of slow-release relay 610, to battery. When slow-release relay 610 has operated, it completes a circuit extending from ground on armature 611 and its front contact through the winding of slow-operating relay 605 to the junction point between the stepping magnet 615 and the wiper 616. At the time the rotary magnet 615 was operating, and the wiper 616 was rotating over the bank contacts, relay 605 was short-circuited on one side of its winding from armature 611 and on the other side from ground and the bank contact over which wiper 616 is rotating. Relay 605 is of such high resistance that stepping magnet 615 cannot operate in series with it when the wiper 616 reaches the bank contact upon which conductor 540 is attached. There will be no ground in this conductor and the rotation of the switch is stopped. Consequently, the relay 605 energizes in series with the stepping magnet 615. When relay 610 operated, it closed its armature 612 on the front contact to close a point in the circuit of wiper 618, and at armature 613 opens a point in the circuit of wiper 619. When slow-operating relay 605 energized it moved its armature 606 from its back contact to its front contact, thereby completing a locking circuit for it—

self extending from ground on armature 602 and its front contact, armature 606 and its locking contact, through the winding of relay 605, then to armature 614, through the winding of relay 615 to battery. At the back contact of armature 606 the circuit for relay 610 is interrupted, and this relay slowly restores its armatures. At armatures 608 and 609 relay 605 switches the trunk through to the receiver R—1 in Fig. 7. At the front contact of armature 607, it completes a circuit extending from ground on armature 602 and its front contact, front contact and armature 607, armature 603 and its front contact, conductor 545, through Fig. 5, then down to Fig. 10, through the winding of relay 1005, to battery. Relay 1005 energizes and at armature 1009 and its front contact completes a locking circuit for itself extending from ground on armature 1021 of relay 1020 through armature 1009 and its front contact. Relay 1005 remains locked in position for a purpose which will be later on explained.

At the time relay 605 is energized, it also closes armature 604 on its front contact and places ground over conductor 670 to Fig. 7, through the winding of relay 700 to battery. Relay 700, therefore, energizes and at armature 701 places ground on its front contact over a circuit extending through armature 711 and its back contact, conductor 674, wiper 617 and the fifth bank contact of this wiper to which conductor 541 is connected, through the winding of relay 510 to battery. A branch of this circuit extends through the lamp EL to battery. The illumination of the lamp indicates to the supervisor that the transmission of the number of the fire alarm station is about to begin. Relay 510 at armatures 511 and 512 switches the trunk conductors onto the front contacts, and at armature 513 holds open the circuit of relay 515.

As a result of the switching through of the trunk conductors 233 and 234, a circuit is momentarily completed extending from ground on armature 602 and its front contact, front contact and armature 607, armature 612 and its front contact (this is a momentary impulse and occurs before relay 610 has a chance to fall back and restore its armatures), wiper 618 and the fifth bank contact upon which it is now resting, conductor 542, front contact and armature 511, in the trunk circuit TC—2, back contact and armature 517, upper trunk conductor 233, armature 281 and its front contact, in the trunk circuit TC—1, armature 291 and its front contact, back contact and armature 241 of relay 240 in the sender SN, then through the winding of relay 235 to battery. Accordingly, relay 235 energizes, and at its front contact and armature 236 completes a locking circuit for itself extending from battery through the winding of relay 235, armature 236 and its front contact, winding of relay 240, back contact of armature 232, to ground. Relays 235 and 240 are, therefore, held energized in series when the ground pulse is removed from the line at armature 612. At the back contact of armature 241, relay 240 opens the original energizing circuit of relay 235.

At the front contact of armature 243, a circuit is prepared extending over the lower trunk conductor 234 for transmitting impulses from the sender switch SN and at the front contact of armature 242 ground is extended through armature 251 and its back contact, armature 261 and its back contact, back contact and armature 252, through the winding of relay 245 to battery, around the high resistance shunt. Relay 245

upon energizing, operates its armature 246 and connects ground to its front contact, armature 253 and its back contact, through the winding of the stepping magnet 260 to battery. A branch of this circuit also extends from ground on armature 246 to its front contact, front contact and armature 243, front contact and armature 293 of relay 290, through the compensating resistance, front contact and armature 282, trunk conductor 234, Fig. 5, armature 518 and its back contact, armature 512 and its front contact, conductor 543, the fifth bank contact of the finder F upon which wiper 619 is now resting, back contact and armature 613, front contact and armature 609, conductor 673 to Fig. 7, to the winding of relay 740 to battery.

Relay 740 will respond to impulses received over this circuit from armature 246. Each time the stepping magnet 260 energizes, it opens the back contact of its armature 261, thereby opening the energizing circuit of relay 245. Relay 245 upon falling back, at armature 246 opens the circuit of stepping magnet 260, and this magnet, each time upon restoring, advances the sender switch wipers 270, 271, and 272 in a forward direction over their associated set of bank contacts. Wipers 271 and 272 are without effect at this time, but wiper 270 which is now standing on the first bank contact completes a circuit extending from ground on the first armature of relay 10, through the cross-connecting block CB, conductor 60, first bank contact of the sender SN, wiper 270, front contact and armature 291, front contact and armature 281, upper trunk conductor 233 extending to Fig. 5, armature 517 and its back contact, armature 511 and its front contact, conductor 542 connected to the fifth bank contact upon which wiper 618 of the finder F is now resting, front contact and armature 608, conductor 672 to a junction point between the wipers 761 and 762 of the receiver R—1 in Fig. 7. Each time wiper 270 picks up ground at its bank contacts, it transmits this ground to the wipers 761 and 762. As soon as the stepping magnet 260 deenergizes, it again closes the circuit for relay 245 which at its armature 246 again extends ground to the stepping magnet 260 and also to relay 740. This interaction between magnet 260 and relay 245 continues for a time as will be further explained.

The wipers 270, 271, and 272 are, therefore, continuously advanced over their bank contacts in a forward direction, and as wiper 270 encounters the bank contacts to which conductors 61, 62, 63, and 64 are connected, ground then will be extended over this wiper from the cross-connecting block CB and the armatures of relay 10 which are all operated. It will thus be seen that each time relay 245 is energized it transmits a ground pulse over the lower trunk conductor 234, to the receiver switch R—1 and the relay 740, energizing and deenergizing this relay alternately. Likewise each time that the wiper 270 encounters one of the grounded bank contacts, it will transmit a ground from the armatures of relay 10 over the upper trunk conductor 233, to Fig. 7 and the junction points between the wipers 761 and 762.

Referring now to the operation of receiver R—1 of Fig. 7, as relay 740 is alternately energized and deenergized from ground over the lower line conductor, it opens and closes the ground at the front contact of armature 741, through the back contact of armature 731 of relay 730, then over two parallel paths to armature and back contact 732, armature 751 and its

back contact, through the winding of the stepping magnet 750, to battery. Accordingly, magnet 750 energizes and when relay 740 falls back it opens its armature spring 741 from the ground thereby permitting the stepping magnet 750 to deenergize. The wipers 760 to 764 inclusive, of the receiver R—1 are, therefore, advanced one step. Wiper 764 steps on to its first bank contact but without closing any circuit due to the fact that the circuit is open at the armature 701 which is operated by relay 700.

Wipers 760, 761, and 763, it will be noted, are now standing on the last one of their bank contacts, while wipers 762 and 764 are resting on their first set of bank contacts. Therefore, when wipers 762 and 764 have advanced one revolution around the set of bank contacts they are resting on the last contact while wipers 760, 761, and 763 will be in a position opposite their first set of bank contacts. Therefore, it requires 50 steps or 360 degrees to make one full revolution and return the wipers to their normal position. Wiper 762 is at present operated and resting on its first bank contact at this time, and the sender SN of Fig. 2 has also advanced the wipers on the first set of bank contacts so that wiper 270 is now resting on the bank contact connected to conductor 60 and this conductor has been grounded by relay 10 in Fig. 1. Consequently, this ground is extended over the line conductor 233, as has been pointed out, and conductor 672, to the junction points between wipers 761 and 762, down through wiper 762 and the first bank contact upon which it is now resting, conductor 770 to Fig. 8, then through the winding of the relay 800 to battery, in the first digit relay group S—1. As soon as relay 800 energizes, it completes a locking circuit for itself through its front contact and armature 801, to ground over a circuit extending over conductor 558 to Fig. 9, to the back contact of armature 1021 to ground at relay 1020 of Fig. 10. When the wiper 762 steps onto the next bank contact, this ground is removed from relay 800 but it remains locked in its energized condition. The next time relay 740 energized and deenergized, the stepping magnet 750 advanced the wipers 760 to 764 to the second set of bank contacts. At this time, however, no circuit is completed through the wiper 762 over conductor 672 from the sender SN and its wiper 270, because this wiper is now resting on a bank contact to which a conductor is attached, which has not become grounded by relay 10. Consequently, the digit storage relay B of the group S—1 in Fig. 8, will not be energized. However, when wiper 270 reaches the third bank contact and wiper 762 of Fig. 7 also reaches its third bank contact, ground will be sent over the circuit from conductor 61 through the wiper 762, conductor 772, through the winding of the digit storage relay 820 to battery. At armature 821 and its front contact, relay 820 locks itself to the conductor 558.

This simultaneous and synchronous operation of the sender switch SN of Fig. 2 and the receiver switch R—1 of Fig. 7, continues and each time the wiper 270 encounters a bank contact which is grounded by one of the conductors 60, 61, 62, 63, and 64 which corresponds to the code number of the operated fire alarm box, this ground is transmitted through wiper 762, and the conductors 770, 772, 776, 777, and 782 have each become grounded and have consequently, operated relays 800 and 820 of the group S—1 for the first digit of the number of the fire alarm

box, relays 840 and 850 of the group S—2 for the second digit, and relay 860 of group S—3 for the third digit. Each of these relays remain energized and locked to conductor 558 after the ground has been removed from wiper 762.

Referring now to Fig. 13, this represents a code chart diagram illustrating the numbers displayed whenever any of the relays A, B, C, and D of the groups S—1, S—2, and S—3 are operated in combination. It will be noted that when relays A and C of a group are energized and operate their armatures, the digit two will be displayed on the lamp panel. When relays B and D are energized, the digit four will be illuminated on the lamp panel, and likewise, when the relay C is energized, the numeral nine will show up on the lamp panel.

Referring to the circuit of Fig. 8, it will be remembered that relays 800 and 820 are held energized and, therefore, a circuit is closed from ground on armature 802 and its front contact, armature 812 and its back contact, armature 822 and its front contact, through the lamp number 2, through to battery. Therefore, the numeral 2 will be displayed at the supervisor's position. These lamps it will be understood, will be arranged in a regular lamp panel so that all displayed numerals will be in consecutive order in three different groups S—1, S—2, and S—3. This operated lamp number 2 constitutes the first digit of the code number. As relays 840 and 850 of group S—2 have been energized, it will be observed by referring to the Fig. 13, that the lamp number 4 will be illuminated, from ground on armature 841 and its back contact, armature 842 and its front contact, armature 843 and its front contact, through lamp 4, to battery. In the third set of relays S—3, relay 860 is operated and consequently digit 9 is displayed, over a circuit from ground on armature 861 and its back contact, armature 862 and its back contact, armature 863 and its front contact, armature 864 and its back contact to lamp 9, to battery. The complete number 249 of the fire station which is operated will, therefore, be displayed before the supervisor and appraise him of the existence of a fire at this particular fire alarm box.

Returning now to the operation of the receiver R—1 of Fig. 7, and the sender SN of Fig. 2, these switches after having set up the numbers on the display panels DS—1 continue to advance their wipers in a forward direction under control of their respective stepping magnets. When the wiper 271 has advanced until it has encountered bank contact 274, it completes a circuit extending from ground multiplied through all the remaining bank contacts after contact 274, through wiper 271, through the winding of slow-release relay 255, to battery. Relay 255 upon energizing closes ground from its armature 256 onto its front contact and through the winding of relay 250 to battery, to operate this relay. At armature 253 and its back contact relay 250 opens the circuit extending to the stepping magnet 260. At the back contact and armature 252 it interrupts the circuit of relay 245 and this relay restores armature 246. At armature 251, relay 250 opens a further point in the circuit of relay 245. When relay 255 became energized it closed armature 257 upon its front contact, completing a circuit extending from ground on the bank contact 274, wiper 271, front contact and armature 257, armature 261 and its back contact, front contact and armature 259, then through the winding of the stepping magnet 260, to battery.

Relay 255 closes the front contacts on armatures 258 and 254 without effect at this time. Consequently, the stepping magnet is again energized. Upon energizing it opens its armature 261 to interrupt its own energizing circuit so that it is now self-interrupting and continues to operate as long as wiper 271 rotates over grounded bank contacts. Wipers 270, 271, and 272 are, therefore, further stepped in a forward direction over their bank contacts. During this stepping interval, however, no further impulses are sent over the trunk conductor 233 to the receiver by way of the wiper 270. In a similar manner no further impulses are sent over the lower conductor 234 to the relay 740 in Fig. 7, and consequently, the further operation of the sender SN does not control the receiver R—1.

Returning now to the operation of the receiver R—1 in Fig. 7, when the wiper 764 of this switch has advanced and is resting on the bank contact 766, the wiper 271 of the sender SN in Fig. 2 will be resting at the same time on bank contact 274; the switches, it will be observed having advanced the same number of steps over their associated bank contacts. The wiper 764 resting on bank contact 766 will have ground connected to it in multiple through all the remaining bank contacts, through the winding of slow-to-release relay 720, to battery. Relay 720 energizes and at armature 722 and its front contact connects ground through the winding of relay 730 to battery. At armature 723, relay 720 prepares the automatic stepping circuit of the magnet 750. At armatures 731 and 732, relay 730 opens the circuit which originally energizes the rotary magnet 750. The energizing circuit for this magnet is now completed over wiper 764 from the grounded bank contacts through armature 723 and its front contact, then through the back contact and armature 751, through the winding of stepping magnet 750, to battery. Each time this magnet energizes it interrupts its own circuit at armature 751 and it falls back, thereby further advancing the wipers 760 to 764, inclusive, over their bank contacts. When the wiper 764 reaches its last bank contact 767, the stepping operation is momentarily halted, due to the absence of ground on this contact.

In the sender SN, when the wiper 271 reaches the bank contact 276, there will be no ground on this contact, and the stepping magnet 260 no longer operates. Slow-acting relay 255 likewise has its circuit interrupted at this point and it deenergizes, restoring all of its armatures. At armature 256, it opens the circuit of relay 250 and allows it to fall back and this restores its armatures 251, 252, and 253. At armature 259 relay 255 opens the self-interrupting circuit of the stepping magnet 260. The circuit of the sender SN is now in the same condition as it had been previously when the fire alarm signal first came in, and when the sender was at normal, likewise, in the receiver R—1 of Fig. 7 a similar action has taken place. When wiper 764 reaches the bank contact 767 ground will no longer be transmitted through the wiper 764 to hold up relay 720, and a branch of this circuit to operate stepping magnet 750. Consequently, relay 720 slowly deenergizes. This relay is so adjusted and arranged that it will restore its armatures before the slow-release relay 255 of sender SN, in order to keep these switches in synchronism. At this time, it will be observed, that the wiper 272 of the sender is positioned opposite the first contact in the bank instead of the last one as it was

in its normal position; also in the receiver R—1, the wipers 760, 761, and 763 will be positioned opposite their first set of bank contacts instead of the last set and the wipers 762 and 764 will be positioned one step away from their last set of bank contacts.

The sender SN of Fig. 2 is again operated as it had been in the first instance to send out the same code number to the receiver R—1 and control its operation. The wipers 270, 271, and 272 are again advanced in a forward direction over their bank contacts due to the action of the stepping magnet 260. Each time that relay 245 energizes it sends a ground pulse from armature 246 and its front contact over conductor 234, through the winding of relay 740 of the receiver R—1, to battery. Accordingly, relay 740 again follows the energization and deenergization of the relay 245 causing the stepping magnet 750 to advance the wipers 760 to 764 over their bank contacts in a forward direction as has been described before. The wiper 270 of the sender SN also rotates over its bank contacts and picks up the ground from conductors 60, 61, 62, 63, and 64 from the operated relay 10 and transmits these grounded pulses over the upper line conductor 233 to the junction point between wipers 761 and 762; but in this instance, however, instead of being transmitted through the wiper 762 which is now rotating away from the bank contacts, they will be transmitted through the wiper 761 and its bank contacts upon which it is now rotating. These bank contacts are connected to a second digit storage relay group DS—2 to which similar equipment is connected, as that shown in Fig. 8. In a similar manner as before, these relays such as 810 and 820 for the first digit, 840 and 850 for the second digit, and 860 for the third digit, are energized so that these relays operate and display the number 249 of the fire alarm box in a similar manner as had been done on the first lamp panel. This lamp panel is a duplicate of the first and arranged immediately above it and the duplicate transmission is an indication to the supervisor at the desk that the correct signal has been received. If a different number is displayed on the second digit storage relay group DS—2 from that which has been shown on the first one DS—1, he will know that there has been an error somewhere, or that the equipment is not functioning properly.

When wiper 271 reaches its bank contact 274, it again completes the circuit through the winding of slow-release relay 255. This relay upon energizing closes its armature 256 and completes the circuit for relay 250. Relay 250 operates its armatures and allows relay 245 to be deenergized and opens its armature 246 so that no further ground pulses will be sent over the trunk line to operate the relay 740 in Fig. 7, and so that the sender SN will have no further control over the receiver R—1. Relay 255 at its armature 257 completes a circuit from ground at bank contact 274, wiper 271, front contact and armature 257, armature 261 and its back contact, front contact and armature 259, through the winding of the stepping magnet 260, to battery. At armature 261, magnet 260 interrupts its own circuit, and further operates the wipers 270, 271, and 272 until wiper 271 reaches its bank contact 276 upon which there is no ground. Accordingly, relay 255 deenergizes and prevents further rotation of the switch, which is now in its initial normal position. Previous to this, however, the wiper 272 engaged the bank contact 275, and it com-

pleted a circuit extending from ground on wiper 272, bank contact 275 is multiple with all remaining bank contacts, armature 254 and its front contact, through the winding of slow-release relay 225, to battery. This relay energizes for a purpose which will be explained later on.

In the receiver R—1 of Fig. 7, the stepping magnet 750 has been alternately energized and deenergized, during this period, over the circuit extending from ground on bank contact 765, wiper 763, through the winding of slow-release relay 720, to battery. This relay energizes as before and completes a circuit at armature 722 for relay 730 which operates its armatures 731 and 732 to remove the control of the stepping magnet 750 from the relay 740. At armature 723 and its front contact, relay 720 completes the self-interrupting circuit for the stepping magnet 750. Ground is now extended from grounded bank contacts 765 through which the wiper 763 is rotating, armature 723 and its front contact, back contact and armature 751, through the winding of the stepping magnet 750, to battery. The stepping magnet interrupts its own circuit to step the wipers 760 to 764, inclusive, further over their bank contacts. When wiper 763 reaches its bank contact 769 no further ground is available for the stepping magnet 750. Accordingly, this magnet deenergizes. Slow-release relay 720 likewise falls back slowly and at its armature 722 opens the circuit of relay 730 which restores its armatures. However, before relay 720, which is slow to release, completely restores its armatures, a circuit is completed extending from the grounded contact upon which wiper 760 is now resting, armature 721 and its front contact, through the winding of relay 710, which is slow to release, to battery. Relay 710 energizes and opens its armature 711. Another branch of this ground circuit extends over conductor 547 through Fig. 6, through the contact 560 of the automatic transmission key AT, Fig. 5, over conductor 554 to a junction on one side of the circuit extending to armature 1007 and its front contact of relay 1005, which it will be remembered was locked energized, through the winding of relay 1010, to battery. The other junction extends through the code sender CS of Fig. 9, over conductor 554, through the winding of relay 930, to battery. This is in order to start the operation of the code sender CS, which switch is arranged to translate the code number set up on the digit storage relay group DS—1 of Fig. 8, and translate this into numerical digits which are suitable for operating the punch register PR, as will hereinafter be explained.

After relay 930 of code sender CS and relay 1010 of Fig. 10 are energized, relay 720 of Fig. 7 has completely released its armatures, and at front contact and armature 721 opens the original circuit of relay 710, but this relay remains held up over its other circuit. When relay 710 energized at its back contact and armature 711, it opened a circuit extending from ground on armature 701 and its front contact, armature 711 and its back contact, conductor 674, wiper 617 of the finder F, conductor 541 to the relay 510 of the trunk circuit TC—2, to battery. Relay 510 falls back and disconnects the trunk conductors 542 and 543 from its armatures 511 and 512. At armature 513, it closes the circuit of relay 515 and this relay energizes from ground on armature 1006, Fig. 10, conductor 556 which is common, back contact and armature 513, through the winding of relay 515, to battery. Relay 515,

upon energizing switches the trunk conductors 233 and 234 to the conductors 546 and 550. At the front contact of armature 516 it places ground on relay 505, permitting this relay to again energize, so that at its armature 507 it removes ground from its back contact which was previously extended over conductor 544 to relay 600 of the finder F. Accordingly, relay 600 deenergizes and at grounded armature 602 and its front contact it opens the locking circuit for relay 605, and this relay deenergizes and releases its armatures. At armatures 608 and 609, relay 605 opens the trunk extending to receiver R—1 in Fig. 7. Relay 740, therefore, deenergizes. The release of the sender SN, the finder F, and the receiver R—1, has now taken place. The trunk circuits TC—1 and TC—2 are also now in condition for retransmitting the received number.

The system has now been operated to receive the fire alarm number and display it in duplicate at the supervisor's position. The action which is now to take place is for the transmitter T, Fig. 6, to be operated, and the code sender CS in Fig. 9 to operate the printing register PR, so as to leave a permanent indication of the number of the fire alarm box which has been operated. The transmitter operates to send out impulses over the trunk circuit extending to the originating district station represented by Figs. 1, 2, 3, and 4, and to transmit these pulses into the receiver R—2 of Fig. 3, and operate the digit storage relay group of Fig. 4, to display the number of the operated fire alarm box at this district station which is the station connected to the particular alarm box which has sent in the alarm. In addition to the transmitter T, which is individual to the trunk extending to this particular district office, the other transmitters connected to the multiple conductors in the bank of wiper 665, transmit this same fire alarm number to all the other district stations connected to the supervisor's position, and operate receivers similar to R—2 of Fig. 3 and there display the numerals of the operated fire alarm box. This is to appraise all fire engine companies at the district office controlled by the supervisor's position, that that particular box has been operated and they will know from the number displayed, whether they are or are not required to respond to this fire call. The transmission of the number back to the originating district office is an indication to the attendant at this office that the signal has been properly transmitted to the supervisor's office and has also been properly transmitted back to the district office.

It will be remembered, that when the sender SN had completed its operation and the wiper 272 is at its normal position, the relay 225 was operated. At its armature 228 it places ground over its front contact to energize relay 230, and at its front contact and armature 227 closes a locking circuit for itself extending over conductor 238 to ground on the front contact of armature 302. Relay 230 at its back contact and armature 232 removes ground from relay 240 which was held energized in series with relay 235. These two relays, accordingly, release and restore their armatures. At the back contact of armature 231, relay 230 opens the circuit extending over the start conductor 237 to relay 200 of the sequence switch SS, thereby permitting this relay to restore. At the front contact and armature 201 relay 200 opens a circuit of relay 205 and this relay upon restoring removes ground from the front contact of armature 206 extending over

wiper 216 and its conductor 51 through armature 21 and its front contact to relay 10, to battery. Relay 10 upon deenergizing removes ground from all of its armatures extending to the bank contacts of the sender SN. At the front contact of armature 203, relay 200 removes ground from the circuit of relay 220 so that this relay likewise restores. At the front contact of armature 221 relay 220 removes ground from the circuit of relay 290 and this relay then restores to normal, thereby closing the line conductors 233 and 234 on its back contacts 291 and 293, so as to connect the trunk with the receiver R—2 of Fig. 3 preparatory to receiving the impulses sent over this trunk from the transmitter T. At the front contact of armature 292, relay 290 opens a point in the circuit of relay 280, but its circuit is maintained through the back contact and armature 286 of relay 285, over conductor 284, to Fig. 3 and to the back contact and grounded armature 316 of relay 315.

It will be remembered, that the relays of the storage relay group DS—1 of Fig. 8, had been energized and were held locked up to their own locking contacts to conductor 558, which maintains ground for these relays and also on conductors 770, 772, 776, 777, and 782. The operation of the transmitter T and its control over the receiver R—2 of Fig. 3 is somewhat similar to the operation of sender SN which controlled the receiver R—1. This will now be explained. At the time relay 1010 of Fig. 10 was operated due to its circuit being closed from the wiper 760 in Fig. 7, it placed ground on its front contact and armature 1011 over conductor 549 through Fig. 5, through the winding of relay 655 of the transmitter T, to battery. Relay 655 upon operating at armature 658, places ground on its front contact through the winding of relay 650 to battery. Armatures 656 and 657 are without effect at this time. Relay 650 is slow to operate and, therefore, relay 655 closes a circuit extending from battery and resistance on armature 659 and its front contact, back contact and armature 651, conductor 550 which is common to all other trunk circuits TC—2, front contact and armature 518, trunk conductor 234, armature 282 and its front contact, trunk compensating resistance, armature 293 and its back contact, conductor 244 of Fig. 3, armature 311 and its back contact, through the winding of relay 305, then over to back contact and armature 316 of relay 315 to ground. Consequently, relay 305 received a momentary impulse before relay 650 of the transmitter is fully operated. Relay 305 upon operating, closes a locking circuit for itself at its front contact and armature 306 in series with relay 310 to battery, and the ground on armature 316. This starts to prepare the operation of the receiver R—2.

Relay 650, has during this interval, become operated and at its grounded front contact and armature 652 completes a circuit extending to slow-to-operate relay 635, and after a short interval this operates its armature 636 to its front contact. This completes a circuit which extends from ground on armature 1011 of relay 1010 over conductor 549 and which ground also energizes relay 655, and transfers this ground through armature 636 and its front contact, back contact and armature 626 of relay 625, back contact and armature 661 of the stepping magnet 660, armature 627 and its back contact, through the winding of relay 630 to battery, and around the shunt resistance of this relay. Relay 630

upon operating, closes ground from its front contact to armature 631, back contact and armature 628, through the winding of the stepping magnet 660, to battery. Upon operating, stepping magnet 660 opens its armature 661 from its back contact, thereby interrupting the circuit of the relay 630 which falls back and opens its front contact and armature 631 to deenergize the stepping magnet 650. The relay 630, and the stepping magnet 660, therefore, alternately energize and deenergize each other, and the stepping magnet rotates the wipers 665, 666, and 667 in a forward direction over their bank contacts, each time it is deenergized. Each time the relay 630 energizes it also places ground to its front contact and armature 631, over another circuit extending through back contact and armature 647, front contact and armature 651, conductor 550, front contact and armature 518, over the lower trunk conductor 234, armature 282 and its front contact, armature 293 and its back contact, conductor 244, armature 311 and its front contact on relay 310, armature 324 and its back contact, through the winding of relay 325, to battery. Relay 325, therefore, operates and follows the impulses delivered to it from ground on armature 631 of relay 630. When relay 325 operates it places ground over a circuit from armature 326 and its front contact, armature 331 and its back contact, back contact and armature 332, through the winding of the stepping magnet 340 to battery. Each time the stepping magnet 340 energizes and deenergizes under control of impulsing relay 325, it advances the switch wipers 350, 351, 352, and 353 in a forward direction over their associated bank contacts.

From the foregoing it will be seen that the transmitter T and the receiver R—2 operate in synchronism to rotate their wipers the same number of steps. In the transmitter T when the stepping magnet 660 has energized and deenergized once, the wiper 665 will be resting on its first bank contact to which conductor 770 is connected. This conductor extends down to Fig. 9, and then over to Fig. 8 to front contact and armature 801 of relay 800, to ground on conductor 558, which is maintained on this conductor. This ground extends back over this circuit, through wiper 665, conductor 546, to Fig. 5, front contact and armature 517, upper trunk conductor 233, armature 281 and its front contact, armature 291 and its back contact, conductor 288 to Fig. 3, wiper 350 and its first bank contact on which it is now resting, conductor 450 to Fig. 4, through the winding of relay 400 to battery. Relay 400 is in the digit storage relay group S—4, and is one of the relays of the first digit of the number. Relay 400 energizes and at its front contact and armature 401 locks up itself to ground which is maintained on conductor 238 extending back through Fig. 3, through the front contact and armature 302 of relay 300 to ground. When wiper 665 of the transmitter T reaches the third bank contact to which conductor 772 is attached, another ground pulse will be received from relay 820 of Fig. 8 and this will be transmitted over the previously traced circuit over the trunk conductor 233 to wiper 350 and its third bank contact, conductor 452, through the winding of relay 420 to battery. Relay 420 energizes, and at its front contact and armature 421 locks itself up to grounded conductor 238. Relay 400 and relay 420 are, therefore, held energized and at their armatures illuminate the lamp number 2, over a circuit extending from ground on armature 402 and its front contact, armature

412 and its back contact, armature 422 and its front contact, through the lamp 2, to battery. By referring to the code chart diagram of Fig. 13, it will be understood how other numerals may be displayed.

The receiver R—2 and the transmitter T continue to advance their wipers under the synchronous operation of both rotary stepping magnets, and each time the wiper 665 encounters bank contacts upon which the remaining conductors 776, 777, and 782 are connected, ground will be fed over these conductors from the digit storage relay group DS—1, through the wiper 665 and thence over the upper trunk conductor 233, to the wiper 350, and as wiper 350 passes over its bank contacts, the conductors 455 and 456 will each be grounded in turn, resulting in the energization of relays 465 and 470 of the group S—5, which upon energizing, will display the numeral 4 over a circuit from ground at armature 466 and its back contact, armature 467 and its front contact, armature 468 and its front contact, through the lamp 4 to battery. When the wiper 350 grounds the bank contact upon which conductor 460 is connected, the relay 480 of the group S—6 operates and locks to the ground on conductor 238 and displays the numeral 9, over a circuit extending from ground at armature 482 and its back contact, armature 483 and its back contact, armature 484 and its front contact, armature 485 and its back contact, through the lamp 9 to battery.

The complete number of the operated fire station FS—249 has now been displayed at all the district stations. This numeral has been displayed only once on the lamp panels at the district stations and as a double precaution and to take care of any errors that may be in the equipment and that might exist, it is transmitted a second time another lamp panel. This takes place in a manner similar to that in which sender SN transmitted the number twice to the receiver R—1 of Fig. 7, and displayed it at the supervisor's office on two separate lamp panels.

When the wiper 352 reaches the bank contact 354, it will pick up the ground multiplied through all the remaining contacts, through the wiper 352, through the winding of slow-release relay 335, to battery. Relay 335 energizes and at its front contact and armature 337 places ground through the winding of relay 330 to battery. Relay 330 energizes and operates its armatures 331 and 332 to cut off the original energizing circuit for stepping magnet 340. At armature 336 and its front contact relay 335 prepares a circuit which is without effect at this time because the wiper 351 is rotating away from its bank contacts. At front contact and armature 338 relay 335 completes another circuit for the stepping magnet 340 which extends from the grounded bank contact over which wiper 352 is now traveling, through the front contact and armature 338, back contact and armature 341, through the winding of the stepping magnet 340, to battery. When magnet 340 energizes it opens its own circuit at armature 341 so that it energizes and deenergizes as long as there is ground on the wiper 352. When this wiper reaches its last bank contact, ground will no longer be present. Accordingly, the stepping operation is stopped and relay 335 slowly deenergizes and opens the circuit of relay 330 at its front contact and armature 337. When this relay restores its armatures 331 and 332, it places the stepping circuit in condition to again receive impulses by way of the relay 325 from its grounded armature 326. At this time the wipers 350 and

352 are stationed on their last bank contacts, while wipers 351 and 353 are positioned opposite their first set of bank contacts. The wiper 351 is now in a position to receive the grounded impulses from the digit storage relay group DS—1 over the trunk conductor in place of the wiper 350.

In the transmitter T of Fig. 6, a similar action has taken place. Wiper 666 upon reaching its bank contact 668 will find ground on this bank contact, which is multiplied through all the remaining bank contacts, and extend this ground through its own wiper 666, through the winding of slow-release relay 620, to battery. Relay 620 energizes and at its front contact and armature 621 places ground through the winding of relay 625 to battery. Relay 625 upon operating, opens the armatures 627 and 628 from their back contacts, interrupting the circuit for relay 630 and the stepping magnet 650. Relay 620 operates its armatures 623 and 624 without effect at this time, due to the fact that wiper 667 is now rotating away from its set of bank contacts. At front contact and armature 622, however, it completes a circuit extending from the grounded bank contact 668, wiper 666, front contact and armature 626, back contact and armature 661, front contact and armature 622, then through the winding of the stepping magnet 660, to battery. The stepping magnet energizes and opens its armature 661 to break its own circuit. Accordingly, the stepping magnet energizes and deenergizes, as long as there is ground through the bank contact over which wiper 666 is operating. When the wiper reaches its bank contact 669 which is not grounded, relay 620 has its circuit open and it slowly falls away. At armature 621 it interrupts the circuit of relay 625 which thereupon releases its armatures. Relay 630 is, therefore, again energized as it has been originally over a circuit extending from battery through the winding of this relay, back contact and armature 627, armature 661 and its back contact, armature 626 and its back contact, armature 636 and its front contact, to conductor 549 which it will be remembered extended to ground on front contact and armature 1011 of relay 1010 in Fig. 10. Relay 630, therefore, again energizes and at its front contact and armature 631 completes the circuit for the stepping magnet 660, and this in turn upon operating at its armature 661 interrupts the circuit for the relay 630. This action continues as the wiper 665 is again rotated over the bank contacts to which it has access, and as the ground has remained on the conductors 770, 772, 776, 777, and 782 extending from the operated digit storage relay group DS—1, this ground will be again sent over the wiper 665, the upper trunk conductor 233, then over conductor 288 to the wiper 351. A branch of the circuit from ground on armature 631 extends over conductors 550, 234 and 228 to relay 325, so that this relay controls stepping magnet 340 to step the wipers of the receiver R—2 as before in synchronism with the transmitter T.

The bank contacts of the wiper 351 are connected to conductors leading to a group of digit storage relays DS—4 which are an exact duplicate of that shown in Fig. 4, and these various conductors are grounded from wiper 665 in a similar manner as were the conductors to which wiper 350 had access. Accordingly, the numeral 249 is displayed by these relays on the lamp panel DS—4 which is a duplicate of the first one. During this time, the number 249 of the operated fire alarm box remains displayed on the lamp panel

at the supervisor's office in both of the duplicate lamp panels DS-1 and DS-2. At all the district offices, the duplicate lamp panels likewise display the number due to the fact that the transmitter T has transmitted this number not only over the trunk lines connected to the originating district office, but to all offices in this system. This was possible because the conductor 556 is common to all relays similar to 515 connected to other trunk circuits, and the conductors 546 and 550 are common to all other trunks, such as 233 and 234 extending to other district offices. As the wiper 353 encounters its bank contact 355, it will pick up ground through the remaining bank contacts in multiple and extend this ground through the winding of slow-release relay 335, to battery. Relay 335 upon operating, closes a circuit for relay 330 from the front contact and armature 337. Relay 330 operates and opens the previous energizing circuit for the stepping magnet 340 and a self interrupting circuit is then completed for the magnet from ground over which wiper 353 is rotating, front contact and armature 338, back contact and armature 341, through the winding of magnet 340 to battery. Magnet 340 energizes and at armature 341 and its back contact interrupts its own circuit, thereby further advancing the wipers until the last bank contact is reached by wiper 353 upon which there is no ground. The circuit for the stepping magnet 340 is then permanently open and likewise the circuit of relay 335 is open and this relay slowly restores its armatures. At armature spring 337 and its front contact it interrupts the circuit of relay 330 which in turn allows its armatures to fall back. Wiper 351 is at this time positioned on its bank contact 356 and prepares a circuit extending over this wiper 351, bank contact 356, armature 336 and its front contact, through the winding of relay 320, to battery. This circuit is completed before relay 335 fully restores and is completed from the transmitter T over conductor 288 as will be pointed out hereinafter.

The further operation of the transmitter T will now be explained. As the wiper 666 reaches its bank contact 668 it encounters ground thereon and this will again energize the slow-release relay 620 and when this relay energizes it will complete the circuit for relay 625 from ground on armature 621. At armature 622, relay 620 completes the self-interrupting circuit for the stepping magnet 660 which interrupts its own circuit each time it energizes. The wipers 665, 666, and 667 are therefore, further advanced over their bank contacts as long as wiper 666 picks up ground. At front contact and armatures 623 and 624, relay 620 completes a circuit at this time extending from ground through the multiple connected bank contacts of wiper 667 and then over two paths through these armatures; one path extending through the winding of relay 645 to battery, and the other path extending over conductor 551 for a purpose which will be hereinafter pointed out. Relay 645 at its armature 647 and its front contact, closes a circuit from battery through the winding of relay 640, front contact and armature 651, conductor 550, Fig. 5, front contact and armature 518, lower trunk conductor 234, armature 282 and its front contact, armature 293 and its back contact, conductor 244, armature 311 and its front contact to ground on armature 324 and its front contact. Relay 320 is held operated during the interval that relay 335 falls back. When relay 645 operates its armature 646 and its front contact it completes a circuit extending

from ground on armature 621 and its front contact, armature 646 and its front contact, conductor 546 to Fig. 5, front contact and armature 517, upper line conductor 233, armature 281 and its front contact, armature 291 and its back contact, conductor 288, wiper 351 and the bank contact 356 upon which it is now resting, through armature 322 and its front contact, then to the winding of relay 320 to battery. In this interval relay 335 has fallen back and relay 320 is, therefore, held energized to its own locking contact and armature 322 independent of relay 335 over the above circuit. Relay 640 when it was operated by relay 645 places ground from its armature 641 on its front contact over a circuit extending over conductor 552 to Fig. 5 through the lamp OL, to battery. The illumination of this lamp indicates to the supervisor that the transmission of the fire alarm number, which has been received, has been completed and sent successively to all the district offices in the system. After the number has been transmitted, certain of the relays remain operated while the switches themselves are in their normal position.

In the meantime, while the retransmission has taken place, the code sender CS, Fig. 9 has operated as will now be explained. The purpose of the code sender is to translate the coded digit into a decimal digit, suitable for operating a printing recorder PR which punches a series of holes in a paper tape corresponding to the number of the operated fire alarm box so as to leave a permanent record of this number at the supervisor's position and also at the district offices. It will be remembered, that when wiper 760 reached its grounded contact, of the receiver R-1, it transmitted this ground over a circuit extending to the relay 1005 of Fig. 10. This relay energized and locked to its armature 1009 when relay 720 deenergizes, and completed a circuit at its contact 1007 for relay 1010. At armature 1012 relay 1010 closed a locking circuit for itself and a branch of this circuit extends over conductor 554 through Fig. 9 to the code sender CS, and through the winding of relay 930 to battery. At armature 931 relay 930, upon operating places ground on its front contact through a circuit extending over conductor 902, bank contact 996, wiper 993, armature 921 and its back contact, through the winding of relay 920, and the resistance, to battery. At the front contact and armature 922, relay 920 closes a locking circuit for itself extending to armature 931, and remains energized. At armature 923 it opens a point in the circuit of relay 900 and at its front contact and armature 924 prepares a circuit for operating the printer recorder PR. Relay 930 at its grounded armature 933 places ground through its front contact, armature 944 and its back contact, through the winding of slow-to-operate relay 960 and the resistance, to battery. After a short interval relay 960 operates and places ground from its armature 961 on to its front contact, through the winding of slow-to-operate relay 970 and the resistance to battery. Relay 970 slowly operates and places ground from its armature 971 to its front contact to short circuit relay 960. Relay 960 upon falling away opens grounded armature 961 from its front contact and at its alternate contact short circuits relay 970. This alternate energization and deenergization and the short circuiting of each other continues with relays 960 and 970 as long as ground is maintained at armature 933. Each time relay 970 energizes, it places ground from its front

contact to its armature 973, to front contact and armature 924, through the winding of relay 905 to battery. Each time relay 905 operates, it opens its back contacts from its armatures 906 and 908 which connect to all the printing recorders in the district offices and to the supervisor's office. At armature 906 it opens a circuit through relay 909, and this relay at armature 913 places ground to its back contact through the alarm bell or gong G. This gong follows the impulses to sound the number of the fire alarm box and audibly informs the supervisor of this number. At the front contact of armature 913 the circuit extending to the printing magnet PR is interrupted, and this magnet deenergizes back each time, allowing its armature 903 to punch a hole in the moving tape 904 for each impulse. A series of these holes corresponds to the number of the operated fire alarm box. It may be stated that this printing recorder PR is of the usual type and is shown only diagrammatically. At armature 908 the line 560 connecting the district office is opened over a circuit to Fig. 3, thence through the winding of relay 360, to ground. At armature 361 and its front contact this relay follows the impulses delivered to it, and operates the printing magnet PR—1, and at the back contact the audible alarm G—1 operates.

Returning again to the operation of relay 970 of the code sender CS, at armature 972 it places ground through its front contact, through the winding of the stepping magnet 980 to battery so that each time relay 970 energizes and deenergizes the stepping magnet likewise energizes and deenergizes and rotates the wipers 990, 991, 992, and 993 in a forward direction over their associated bank contacts. It will be recalled that when the digit storage relays DS—1 of Fig. 8 were energized to display the numerals of the called fire alarm station, they remained operated and were held up from the locking ground over conductor 558. This ground extended through the locking contacts of these operated relays, and remained on conductors 770, 772, 776, 777 and 782 which extended over to Fig. 9. It is, therefore, seen that the bank contacts of the code sender switch CS which are connected to these conductors will have ground on them. Therefore, when the stepping magnet 980 energizes and then deenergizes, wiper 990 will be resting on its first bank contact which will be grounded from conductor 770. This ground extends over this bank contact, wiper 990 and through the winding of relay 950 to battery. At its front contact and armature 951, relay 950 prepares a circuit for relay 940, but this is not complete at this time, because wiper 992 is resting on a bank contact which is not grounded. During this interval relay 970 has been energized and deenergized once, transmitting one grounded impulse from its armature 973 to operate all of the printing recorders PR and PR—1. When the wiper 990 advances to its second bank contact, it is still multiplied to conductor 770; consequently, relay 950 remains energized.

Wiper 992 upon coming to rest upon its second bank contact, connects the ground which is on conductor 772 and extends it to armature 921 and its front contact, armature 951 and its front contact, through the winding of slow-release relay 940 to battery. Relay 940 operates and at the back contact of armature 944 it interrupts the circuit for relay 960 and this in turn for relay 970, and both of these relays fall back. Relay 970 at armature 972 opens the circuit of

the stepping magnet 980 and at armature 973 the printing recorders. At armatures 942 and 943 and their front contacts, relay 940 prepares another stepping circuit for the stepping magnet 980. At its front contact and armature 941, it places ground to one side of relay 920 so as to short circuit this relay and permit it to restore its armatures. At the front contact of armature 921, it opens the original energizing circuit of relay 940. Before relay 940 restores, however, a circuit is completed extending by way of ground on the multiple connected bank contacts of wiper 994, armature 942 and its front contact, through the winding of relay 940 to battery. Consequently, relay 940 remains locked up to its locking contact 942. A branch of this circuit of wiper 994 extends by way of armature 943 and its front contact, back contact and armature 981, through the winding of stepping magnet 980 to battery. The stepping magnet is thus further energized, and each time opens its own circuit. The printing recorder PR does not receive any pulses during this stepping operation because the circuit is opened through the deenergization of relays 920 and 970. The wipers are, therefore, advanced to their third set of bank contacts. Wiper 990 and its third bank contact receives further ground from the conductor 770, to maintain relay 950 energized. Wiper 992, however, at its third bank contact is connected to a conductor, which has no ground on it. Therefore, the circuits remain in the same position and the stepping magnet 980 again energizes, and as it energizes it opens its own circuit at its armature 981 and deenergizes to advance the wipers on to their fourth set of bank contacts. On the fourth bank contact, wiper 992 connects to conductor 772 which is grounded, but the ground extending over this wiper has no effect on the operation of the relays because relay 920 remains short circuited from the front contact and armature 941 of relay 940. As relay 940 is held energized the stepping magnet 980 continues to receive the ground pulses fed to it from the grounded bank contacts of wiper 994 and the stepping magnet rotates all of the wipers further over their bank contacts, but as the circuit of the printing recorder PR is open at armatures 973 and 924, no further impulses will be transmitted to the recorders. So far only the first digit of the fire alarm box has been transmitted and two punches have been made on the tape 904 indicating the numeral 2. It will, therefore, be understood that in order to operate the printing recorder there must be ground at the same time on both wipers 990 and 992 from the conductors connected to their bank contacts, the wiper 990 operating the relay 950 while wiper 992 operates relay 940, and if there is ground on only one of the wipers the printing recorder will not be operated. As long as wiper 994 rotates over the grounded contacts, it will maintain the relay 940 locked in energized position; therefore, the stepping magnet 980 continues to advance the wipers 990 to 995, across their bank contacts, and regardless of the fact that some of these bank contacts over which wipers 990 and 992 are rotating may be grounded, either alone or both together, they will be without effect on relays 950 and 920. From the above it will be seen that when wiper 990 rested on its second bank contact relay 950 was energized, and at the same time wiper 992 energized relay 940 which locked up and rendered further ground from either of the wipers ineffective over

the remaining ones of the first set of 10 bank contacts.

When the wiper 994 reaches its bank contact 998 ground will no longer be fed over this wiper because the conductor to which this bank contact is connected is open at the back contact of armature 933. Consequently, the circuit extending to the locking armature 942 for the relay 940 is interrupted, and this relay slowly deenergizes. Relay 950 likewise falls back because the wiper 990 is standing on the first of two dead bank contacts. At the front contact of armature 941 relay 940 removes the short circuit from relay 920. At armature 942 it opens its locking circuit, and at front contact of armature 943 opens the stepping circuit for the rotary magnet 980. At the back contact of armature 944, it again completes the circuit extending from ground on armature 933 and its front contact, armature 944 and its back contact, through the winding of the interrupter relay 960 to battery. When relay 970 energizes from armature 961, it closes its grounded armature 972 on its front contact to the stepping magnet 980. This magnet energizes and when relay 970 is short circuited by relay 960 the contacts 972 are open, and the stepping magnet upon deenergizing advances the wipers to the next set of bank contacts.

Wiper 992 is now resting on its bank contact 999 to close a circuit for printing the second digit of the fire alarm box number. This circuit extends from grounded armature 931 and its front contact, conductor 902, bank contact 999, wiper 992, armature 921 and its back contact, through the winding of relay 920 and the resistance to battery. Relay 920 energizes and at its front contact and armature 922 completes the locking circuit for itself extending to the front contact and armature 931 to ground. At armature 924 this relay closes the circuit through to the printing magnet and when relay 970 energizes the printing magnet receives another impulse. The stepping magnet is again energized from ground on armature 972. The wipers advance to the next bank contact so that wiper 994 is now resting on bank contact 984 which is grounded. Wiper 990 at the same time is resting on bank contact 997, while wiper 992 is positioned on the contact 982. Bank contact 997 has no ground connected to it from its conductor and, therefore, no circuit is provided for relay 950 at this time. However, ground will be fed from conductor 776, to the bank contact 982, wiper 992, armature 921 and armature 951, but as the relay 950 is not energized at this time, no circuit will be completed for the slow-release relay 940. The switch then continues to step under the action of the relays 960 and 970 which operate the stepping magnet 980, and each time relay 970 energizes it sends a pulse of current to the printing magnet to mark the tape 904. When wiper 990 reaches the third bank contact after contact 997 it receives ground over conductor 776. This is sent through the wiper 990, through the winding of relay 950 to battery, consequently, this relay energizes again. Wiper 992 at the same time reaches the third bank contact after bank contact 982 and this is connected to conductor 777 which is also grounded. This ground feeds through wiper 992, armature 921 and its front contact, armature 951 and its front contact, then through the winding of relay 940 to battery. During this interval the relay 970 has operated four times and sent four impulses to the printing magnet PR—2 to punch four holes in the tape.

This represents the second digit of the code of the fire alarm number and now the switch steps over the remaining bank contacts without operating the punch register. This is again accomplished by relay 940 energizing and locking itself up over armature 942; at 944 interrupting the circuits for the relay 960 to stop the stepping operation from relay 970, and at front contact of armature 943 closes the circuit for the stepping magnet 980 from ground on the bank contacts which are arranged after bank contact 984, through the wiper 994, armature 943 and its front contact, back contact and armature 981, through the winding of the stepping magnet 980, to battery. Each time this magnet energizes it interrupts its own circuit, and continues to advance the wipers in a forward direction. At armature 941, relay 940 has also short circuited relay 920 so this relay falls back to open a further point in the circuit of the printing magnet PR which is controlled by relay 905. The stepping magnet 980 continues to advance the wipers until wiper 992 is resting on its last bank contact number 985. At this time a circuit is again completed, extending from ground on armature 931 and its front contact, conductor 902, bank contact 985, wiper 992, armature 921 and its back contact, through the winding of relay 920, to battery. Before this has taken place, however, the wiper 994 has reached the bank contact 983, and as there is no longer ground at this bank contact, the relay 940 deenergizes, opening the automatic stepping circuit of the magnet 980, and again preparing the circuit for the interrupter relays 960 and 970; at armature 944 it removed the short circuit from relay 920 so that it again energizes over the above circuit.

The code sender is now in position to transmit the third and last digit of the fire alarm number so that printing register PR can record this number on the tape. As this is the numeral 9, nine impressions will be made on the tape, and as the wipers 990, 992, and 994 leave their last bank contacts, the wipers 991, 993, and 995 will be positioned upon their first set of bank contacts, the other wipers rotating in an arc through which there are no bank contacts. In this position, wiper number 991 is standing on its first bank contact to connect to a wire upon which there is no ground potential. Wiper 993 is likewise standing on a bank contact which has no ground on it. Consequently, relay 950 and relay 940 will not be energized. The stepping action, therefore, takes place under control of the relays 960 and 970 and the printing recorder PR is operated. When wiper 991 reaches its sixth bank contact to which conductor 782 is connected, ground will be fed over the wiper 991 to operate the relay 950 but without effect. Wiper 993, however, when it reaches its sixth bank contact will not encounter the grounded wire; consequently, relay 940 will not be operated and the switch continues to step. When wiper 991 encounters its ninth bank contact 986, to which conductor 782 is connected, there will be ground on this conductor, and relay 950 energizes again. Wiper 993 at the same time encounters grounded contact 987 which is permanently grounded, and operates relay 940 over armature 921 and its front contact, armature 951 and its front contact, through the winding of relay 940, to battery. Relay 940 operates and again cuts off the control of the stepping magnet 980 from relay 970. At armature 973 relay 970 opens the circuit through the printing recorder, which has operated nine times, and at armature

972 opens the self-interrupting circuit of the stepping magnet 980 which receives its ground now from the grounded bank contacts over which wiper 995 is now rotating.

5 Wipers 991 and 996 are at this time rotating over bank contacts to which no wires are connected. When the wiper 995 reaches its bank contact 988, ground will not be present on this bank contact, as armatures 931 and 941 are
10 operated at this time. Consequently, the circuit for relay 940 extending through its front contact and armature 942 is interrupted and this relay slowly restores. The automatic stepping circuit for the rotary magnet 980 extending through
15 armatures 943 and 981 is also interrupted and the magnet comes to rest. When relay 940 restores at armature 944, it completes the circuit for relay 960 from grounded armature 933. This relay in energizing closes the circuit for the slow-
20 to-operate relay 970 and this upon operating again completes the circuit for the rotary stepping magnet 980. The ground on armature 973 is not effective to operate the printing recorder because relay 920 is not operated at this time as its
25 armature spring 924 is opened. The stepping magnet 980, therefore, advances the wipers one step when relay 970 opens its circuit, and wiper 995 is now resting on bank contact 989. However, before wiper 995 leaves its contact 988 after
30 relay 940 has fully restored, a circuit is completed extending from ground, armature 941 and its back contact, bank contact 988, wiper 995, armature 943 and its back contact, back contact
35 and armature 923, back contact and armature 911, through the winding of relay 900, to battery. Relay 900 upon energizing, closes its armature 901 on its front locking contact and holds up in series through the winding of relay 910, front
40 contact and armature 931 to ground. Relay 910 at its armature 911 opens the original energizing circuit of relay 900 and at its front contact and armature 912 grounds the conductor 533 which extends to Fig. 10, through the winding
45 of slow-release relay 1015 to battery. Relay 1015 energizes and at its grounded armature and front contact 1016, completes a circuit extending through the winding of relay 1020 to battery. Relay 1020 energizes and removes ground on its
50 armature 1020 from its back contact. This ground extended through all the locking armatures of the relays which have been held energized from it, including the digit storage relays DS-1 of Fig. 8. As a result of the removal of
55 this locking ground, relay 1005 is deenergized and at its front contact and armature 1007 opens the circuit for relay 1010, and this relay releases its armatures. At armature 1012, ground is removed from conductor 554 extending to Fig. 9, to the winding of the start relay 930 of the code
60 sender. Relay 930, therefore, restores its armatures. At armature 933 it opens the energizing circuit of the relays 960 and 970, and these in turn open the circuit to the stepping magnet 980. At armature 931 the circuit which has held relays
65 900 and 910 energized in series, is interrupted and both of these relays restore. Relay 910 at armature 912 opens the circuit of relay 1015 and this in turn of relay 1020. The wipers 991, 996, and 995 are now positioned on their last set of
70 bank contacts, while the wipers 990, 992, and 994 are positioned one step away from their first set of bank contacts, and the code sender CS has been restored to its normal position. All of the relays have been released and are ready to
75 receive another fire alarm signal.

Referring now to Fig. 10, when relay 1020 opened the ground from its armature 1021, it removed this ground from the conductor 558. This extends through Fig. 9 and is the locking conductor which has held the digit storage re-
80 lays operated. These relays 800, 820, 840, 850, and 860, consequently, release their locking armatures and remove ground from the code conductors 772, 776, 777, and 782. At their other armatures, the illuminated lamps in the lamp
85 panel which in this case shows number 249, are extinguished.

When relays 1005 and 1010 released their armatures they prepared the release of the various switches and other relays concerned in this connection and this will now be explained. At
90 the front contact of armature 1006 ground is removed from conductor 556 which extended over back contact and armature 513 to relay 515. This relay, therefore, releases its armature and
95 connects the trunk conductors 233 and 234 to its back contacts. At front contact and armature 1012 ground is removed from conductor 554; a branch of this circuit it will be remembered, released the relay 930 of the code sender.
100 The other side extends to the automatic transmission key AT, conductor 547 extending through Fig. 6, to the relay 710 of receiver R-1 in Fig. 7. This permits relay 710 to release and close its
105 armature 711 on its back contact, for a purpose which will be later described. At armature 1011, ground is removed from conductor 549 extending through Fig. 5 to relay 655 of the transmitter T. Relay 655 deenergizes and releases its armatures
110 and at armature 658 it opens the circuit of slow-to-pull-up relay 650. Relay 650 in turn upon restoring at armature 652, opens the circuit of relay 635. Relay 635 upon restoring opens its armature from front contact 636.

Relay 1005 at its front contact and armature
115 1008 opens the circuit which extended from ground on the last bank contact upon which wiper 667 of the transmitter T is resting, armature 624 and its front contact, relay 620 being
120 operated at this time, conductor 551 through Fig. 5, the front contact and armature 1008, conductor 548, resistance 653, front contact and armature 657, bank contact 669 and wiper 666, through the winding of slow-release relay 620 to
125 battery. A branch of this circuit extends through front contact and armature 626, back contact and armature 661, front contact and armature 622, through the winding of the stepping magnet 660 to battery, but due to the high
130 resistance of the resistance 653, the stepping magnet 658 will be prevented from operating. Relay 620, consequently, releases its armatures and at armature 621 it removes ground which has held up relay 625 and this relay restores. The transmitter T now has been completely re-
135 stored to normal and all of its relays are deenergized.

With relays 510 and 515 at normal the trunk conductors 233 and 234 at the supervisor's position will again be connected through to relays
140 500 and 505, and these are energized and held in operated position as soon as the trunk circuit TC-1 is restored to normal, as will now be explained. As relay 620 of the transmitter T has been restored, ground has been removed
145 from armature 621 which has extended over conductor 546 and upper trunk conductor 233, conductor 288 to the receiver R-2 of Fig. 3, and then through wiper 351, bank contact 356 to relay 320. When this was removed, relay 320 deener-
150

gized and released its armatures, and at armature 323 opens a circuit of slow-release relay 315, but before the relay fully restores and closes its armature 316, ground is removed from armature 5 spring 321 over conductor 284, armature 286 and its back contact, to relay 280. Relay 280, therefore, deenergizes, and as soon as it releases its armatures 281 and 282, it closes the circuit for relay 285 over the trunk conductors 233 and 234. Relay 285 at its armature 286 opens a further point in the circuit of relay 280 before relay 315 has completely deenergized and placed ground on conductor 284 at its armature 316. However, before relay 315 closes its armature 316 on its back contact, the circuit extending through relay 305 and 310 in series is interrupted, and both of these relays restore their armatures. Also at this time before relay 315 fully restores, and before it opens its armature 317 from its front contact, a circuit extends from ground on armature 323 and its back contact, front contact and armature 317, conductor 239, front contact and armature 226 of relay 225, through the sequence switch SS, wiper 215 and the bank contact to which conductor 50 is connected, through front contact and armature 22 of relay 20, through the resistance to battery. Consequently relay 20 is short circuit and it restores its armatures. When relay 280 deenergized, it opened its front contact from its armature 283, and removed the battery extending to armature 294 and conductor 289, to ground at relay 300. Consequently, relay 300 deenergizes and restores its armatures. At front contact of armature 302, it removes the ground extending over conductor 238 to the digit storage relays of Fig. 4, resulting in the release of relays 400, 420, 465, 470, and 480, which upon releasing their armatures wipe out the numbers which have been displayed on the number panel. This action also takes place in the duplicate panel DS-4. At armature 302 relay 300 also removes ground from the conductor 238 to armature 227 and its front contact, and through the winding of relay 225 to battery. This relay, therefore, slowly restores its armatures as this is a slow-release relay. After a time at its armature 228 it removes ground from its front contact which maintained relay 230 operated, and this relay upon restoring closes its back contact onto its armature 231. The receiver R-2 is now in its normal position as in the sender SN and the sequence switch SS, while the trunk lines 233 and 234 between trunk relay groups TC-1 and TC-2 is restored to its normal state.

Referring now to Fig. 1, it will be remembered, that relay 20 was short circuited. At its armature 24 and its front contact it removes ground from the start conductor 247, thereby opening another point of this circuit which has originally been opened at armature 301 of relay 300. At the back contact of armature 23, it restores ground to the conductor 50, to mark this line idle in the sequence switch SS. At armature 22 it removes the short circuit from this relay, while at the front contact of armature 23 it opens its original locking circuit and extinguishes the lamp AL.

The complete fire alarm signal 249 has now been transmitted as described in the foregoing explanation and all the equipment at the district offices and at the supervisor's position has been restored to normal. If it is necessary at any time to know which fire alarm box has sent the num-

ber, the supervisor at the central office, or the supervisor at the district office, merely counts the number of punches on the various punch registers. The complete operation from the time of the sending in of the alarm at the fire station to the operation and release of the complete apparatus is done instantly, the time required for any number being approximately 5 seconds.

It will be seen that it is merely necessary to momentarily open the contacts 5 at the fire box to send in the alarm and have the number completely recorded at all the district offices in the system. The complete operation is entirely automatic and without the aid of any operator or supervisor at either the district stations or at the supervisor's position; no attention being necessary except for the supervisor to note the number of the alarm which is being received and to dispatch the necessary fire-fighting apparatus to this particular location. At the district office this is done instantly, immediately upon the illumination of the alarm lamp AL which informs the operator of the exact location of the fire. She does not have to wait before the number is transmitted to the supervisor and then retransmitted back to the district office and displayed on the display panel, although this is done almost instantly. This is merely to serve as a check that the number has been correctly received. In addition this retransmission to all the other district offices serves as an indication that there is a fire in the district controlled by the district office No. 1, and that these other fire houses must be held in readiness to respond to any additional fire alarms which may be sent to the first district.

In certain instances there may be a large fire in a district wherein there are no fire alarm boxes available without going a long way to reach one of them, and this may be too late. In this case, the person will call up the telephone operator over the regular telephone system and she will relay the call over to the supervisor, who will in turn transmit the number of a "dummy" or a real fire box signal to the various district offices. This is usually known as a "still alarm", and in this system the operator at the supervisor's position has provisions for transmitting an alarm of this type. For this purpose, therefore, the operator's key set CD shown in Fig. 10 is provided. This has a number of keys numbered from 1 to 0, an error or a wipe-out key ER, and a start key ST'. The operator in receiving a "still" alarm, will operate these keys in accordance with a number of a fire alarm box that may be in the vicinity of the fire, or some other number which would indicate at the district offices the location of the particular fire. The setting of the keys of the operator's key set CD will, transmit the number to the digit storage relays DS-1 at her position and likewise to all the district stations, and set up the number on the display panels in duplicate as before. In receiving a call of this type, the first act of the operator is to operate the "still" alarm key SA, Fig. 5. The operation of this key places ground on conductor 545, extending to Fig. 10, and through the winding of relay 1005, to battery. At its front contact and armature 1009 this relay locks up to the back contact and ground on armature 1021. At the front contact of armature 1007 it completes the circuit for relay 1010 and this relay upon operating its armatures at armature 1012 completes the locking circuit for itself extending from armature 1012 and grounded front contact, armature 1007 and its front contact, to

relay 1010. At armature 1006, ground is fed over conductor 556 to energize relay 515. This relay upon operating moves its armatures and switches the trunk conductors 233 and 234 to the transmitter T of Fig. 6. At armature 516, relay 515 maintains relay 505 in its operated position. The operation of relay 515 results in the deenergization of relay 500. Relay 500 at its armature 501 completes the circuit for the lamp TL, which indicates to the supervisor that the trunk TC—2 has been taken into use. All other trunks will also have their associated trunk lamp illuminated from the commoned conductors extending from the transmitter T. A relay similar to relay 285 of each trunk circuit TC—1 is, therefore, deenergized; and when this relay falls back, due to the energization of relay 515, and closes its back contact on its armature 286, it completes the circuit at armature 286 for relay 280, over conductor 284, to back contact and armature 316 to ground. Relay 280 upon energizing, closes the trunk conductors to the receiver R—2 of Fig. 3 which prepares this switch for operation. The operation of relays 1005 and 1010 likewise results in the circuit of the code sender CS being prepared. The operator then closes the key KS resulting in the illumination of the lamp KL to indicate to the supervisor that she has taken her key set into use preparatory to transmitting a number. The operation of relay 540, likewise, results in an audible indication to her of the use of this key set. At the right-hand contact of the key KS ground is connected over conductor 557 in multiple through all various keys of the key set CD, grounding the two main springs of each key. The operator then proceeds to set up the number on the key set CD by depressing the keys in accordance with the number of the box of the fire alarm station, and as she presses each key, the number will be set up on the digit storage relay group DS—1 and the lamp panel to serve as a check to the operator. If, for example, the first digit of the number to be translated is the digit 2, she will operate her key #2. This results in the placing of ground to each side of this key and its contacts from conductor 557, through two resistances indicated at 1028, and through the winding of relay 1025 to battery. The individual resistances in each of the four conductors prevent the ground from feeding to those not grounded. At the front contact of armature 1027, relay 1025 places ground through the winding of the slow-to-operate relay 1030 to battery. At its front contact and armature 1026, it places ground through armature 1036 and its back contact, through the winding of slow-release relay 1040, to battery. Relay 1040 operating, closes its front contact on armature 1039 and places ground through the winding of relay 1035 to battery; but this relay is short circuited on the other end of its winding by ground from armature 1026. At armatures 1041 and 1043, relay 1040 closes a circuit from ground at the key 2 through back contact and armatures 1031 and 1033 of relay 1030, before this has time to fully energize, conductors 770 and 772, which extend to Fig. 8 to the first set of digit storage relays S—1, resulting in the energization of the relays 800 and 820. The operation of these relays results in their being locked up over their front contacts and armatures 801 and 821 to grounded conductor 558. These relays remaining energized and at their other armatures light the lamp 2. When the operator releases her finger from the key 2, thereby opening the contact of this key, relay

1025 restores its armatures, removing the ground from one side of relay 1035 at armature 1026. This permits relay 1035 to operate and at armature 1038 and its front contact lock itself up to ground on armature 1021 and its back contact. In the interval relay 1040 has slowly released its armatures because its circuit was open at armature 1036 of relay 1035. At the front contact of armature 1036, the circuit extending from armature 1026 of relay 1025 when closed is transferred over to the second group of relays for the second digit of the number. Relay 1030 likewise releases and restores its armatures.

The operator next presses the key #4, thereby again energizing relay 1025, and this in turn energizes slow-to-operate relay 1030. Relay 1025 this time closes a circuit from armatures 1026 and its front contact, armature 1036 and its front contact, armature 1046 and its back contact, through the winding of slow-release relay 1050 to battery. Relay 1050 operates and closes its front contacts onto its armatures 1051 and 1052 and the other armatures. The ground from conductor 557 is thereby connected by the key #4, through armatures 1031 and 1033 and their back contacts, armatures 1051 and 1052 and their front contacts, and over conductors 776 and 777, resulting in the energization of the second digit storage group S—2. Relays 840 and 850 of these relays, consequently, energize and lock up to conductor 558, and likewise, at their other armatures cause the illumination of the lamp #4. As soon as the operator releases the key #4, relay 1025 restores and at armature 1027 opens the circuit of relay 1030, but this relay holds its armatures for a slight interval after relay 1025 operates relay 1050, so that the ground from conductor 557 can be sent to the digit storage relays. When relay 1025 restores its armature 1026 it opened the circuit of relay 1050 and also removed the short circuit from relay 1045. Relay 1050 releases very slow so that it completes the circuit of relay 1045 at armature 1049, and this relay locks itself over armature 1048 and at armature 1046 prepares the circuit for relay 1060.

The operator then presses the key #9, resulting in ground being transmitted over conductor 557 to both sides of the key to operate relay 1025. Relay 1025 closes the circuit at armature 1027 for relay 1030 and this after a slight interval will operate its armatures. Relay 1025 at its front contact and armature 1026 closes a circuit through armature 1036 and its front contact, armature 1046 and its front contact, armature 1026 and its back contact, through the winding of slow-release relay 1060, to battery. Relay 1060 operates its armature springs and closes its front contact on armature 1061, resulting in the ground from the key #9 being transmitted over armature 1033 and its back contact, front contact and armature 1061, conductor 782, to the third storage relay group S—3 to operate relay 860. Relay 860 operates and locks its front contact to the grounded conductor 558 and at its other armatures results in the illumination of the lamp 9. When the operator releases the pressure on the key #9, relay 1025 deenergizes, removing ground from its armature 1026 so that relay 1055 is not short circuited and energizes from ground on armature 1059 and its front contact, through the winding of this relay and the resistance to battery. Relay 1055 upon energizing closes its locking front contact and armature 1058 to ground at

armature 1021. At armature 1056 and its back contact the circuit of relay 1060 is opened and it releases its armatures. Relays 1035, 1045, and 1055, therefore, remain locked up to the armature 1021, while the remaining relays in this circuit are released at this time. The number 249 is now displayed at the supervisor's position.

At any time during the setting up of these numerals should the operator make an error, she will know this by noting the numeral which is instantly displayed. In case of an error, she may wipe out this number by depressing the error key ER. This places ground from conductor 557 to both sides of the key, through the winding of relay 1020 to battery. Relay 1020 upon energizing removes ground from armature 1021 and its back contact, resulting in opening the locking circuits extending to relays 1038, 1048, and 1058, and likewise any of the digit storage relays which receive their locking ground over conductor 558 from this back contact. This completely wipes out the number and it may be set up over again by the operator.

After the operator has set up the number satisfactorily, she operates either her start key ST or ST—1, one of these being shown in the operator's key set and the other one in her key panel with the other keys. This places a ground from either of these keys to the conductor 554 which completes a circuit through armature 1007 and its front contact, through the winding of relay 1010 to battery. Relay 1010 at its front contact and armature 1012, completes its locking circuit extending to armature 1007 and its front contact. At the front contact and armature 1011, relay 1010 places ground on conductor 549, through the winding of relay 655 of the transmitter T to start the operation of this transmitter. The ground from the start key ST also extends over conductor 554 to the code sender CS of Fig. 9 resulting in the energization of relay 930 to start the operation of the code sender CS. The transmitter T is then operated as has been previously explained, so that wiper 665 rotates over its associated bank contacts to pick up the various grounds which have been placed on the conductors 770, 772, 776, 777, and 782 by the various digit storage relays of the group S—1, S—2, and S—3. This ground, it will be recalled, has remained on these conductors through the locking up of these various relays from the ground on conductor 558 and now is transmitted over the conductor 546 from the transmitter T, over the trunk conductor 233 of Fig. 5 and all other district offices; then from the trunk circuit TC—1 to the receiver R—2 of Fig. 3, resulting in the operation of this switch extending the ground by way of wipers 350 and 351, over the bank contacts and conductors to the digit storage relay groups DS—3 and DS—4. Relays 400 and 420 of the relay group S—4, relays 465 and 470 of the group S—5, and relay 480 of the group S—6 being thereby energized and locked through their own bank contacts to conductor 238. These relays operate their other armatures and display the numeral 249 as in the first instance.

The code sender CS of Fig. 9, is operated as was previously explained in that it rotates its wipers over the bank contacts to pick up the various grounds from the conductors extending to the digit storage relays DS—1, and translates them into numerical digits suitable for operation of the printing recorder PR at the supervisor's position and likewise over the trunk conductor 560 to the district office and to all other district offices

in a similar manner. After the complete number has been transmitted, the apparatus is all restored to normal position as has been explained before, relay 1020 of Fig. 10 and relay 300 of Fig. 3 being eventually operated and these result in the opening of the locking circuits for the various digit storage relays and complete the release of the apparatus associated with this connection.

It will be noted that in this type of connection it is not necessary to operate the sequence switch SS, because no fire alarm box has been operated; neither was it necessary to operate the finder F of Fig. 6, because no trunk hunting was necessary, while the receiver R—1 of Fig. 7 was also not operated. The equipment is now in readiness to receive another fire alarm signal.

In certain instances, alarms may be received on the display panel at the supervisor's position and the operator at this position may desire for certain reasons to hold up the transmission of the signal of the operated fire alarm box to the district offices. In this case it will remain displayed on her lamp panel until such time as she desires to release it. In this case she will first operate her automatic transmission key AT, which places ground at one contact through the lamp AU, resulting in the illumination of this lamp to indicate visibly to the operator that she has operated this key and that all fire signals will be held up at her position. Operation of this key likewise opens the normally closed contacts 560. This opens a point in the circuit extending over conductor 547, to relay 710 and armature 721 of the receiver R—1, preventing it from transmitting ground at bank contact of wiper 760 to the contact 560 of the automatic transmission key AT and over conductor 554 to relay 1010, which relay it will be remembered, prepares the operation of the transmitter T. The starting circuit of the code sender CS, extending over conductor 554 is likewise not completed and the code sender also does not operate. As a result of this, the transmitter T is not operated when a fire alarm signal is received, and does not transmit the number of a fire alarm box if one has been set up on the digit storage relay DS—1 at the supervisor's position. The transmitter T, the code sender CS, and the sender SN and the digit storage relays DS—3 are not operated and the transmitted number, therefore, remains on the lamp panel until it is cleared by the operator, which occurs when she restores the automatic transmission key AT to normal, closing the circuit through from the receiver R—1 to the transmitter T, and operating the start key ST to energize relay 1010 thereby resulting in the complete operation of the equipment as has been explained.

Referring now to Fig. 1, it will be remembered that the line conductors 2 and 3 extending from the fire station FS—249 to the district station comprise a closed circuit loop including the relays 30 and 40 which are held energized in series over these conductors, and that the normally closed contacts 5 at the fire station are in shunt of the resistance 6. In sending in an alarm, these contacts 5 are momentarily broken, resulting in the insertion of the high resistance 6 in the line, and the deenergization of the relay 40, which transmits the alarm and brings in the alarm signal AL, characteristic of this particular line. Now in case the line conductor 2 should accidentally become open circuited or broken, both relays 30 and 40 would release and restore their armatures. However, at the fire box relay 7 which is normally

held energized in series with these relays likewise restores its armature 8 onto its back contact, thereby closing a circuit extending from ground through the contacts 4, armature 8 and its back contact, conductor 3, through the winding of relay 40, to battery. Relay 40 will, therefore, remain energized while the relay 30 will fall back. At its front contact and armature 32 relay 30 opens a point in the circuit of relay 20 to prevent this relay from energizing. At the back contact and armature 31, it places ground through the trouble lamp TL to battery. The illumination of this lamp indicates to an attendant at the district office that there is some trouble on the line that requires attention, or that there is a break on the line. When the break has been repaired, relays 30 and 7 again energize and place the circuits in their normal condition again.

If the conductor 3 becomes open circuited, both relays 30 and 40 fall back and likewise relay 7. Relay 30 at armature 32 opens a point in the circuit for relay 20 to prevent the transmission of alarm, and at armature 31 lights the trouble lamp TL. At armature 41 relay 40 lights the alarm lamp AL. The attendant at the district office will know when both lamps appear that it is not fire alarm signal that is being transmitted, but that there is some trouble out on the line. If the conductors 2 and 3 are short circuited, relay 7 falls back and places ground across the short circuit to hold up relay 40 and short circuit relay 30, which lights the trouble lamp TL. A permanent ground on either conductors will hold up relay 40 and restore relays 30 and 7 to light the lamp TL.

The trunk conductors extending from each district office to the supervisor's office are likewise arranged so that they will be constantly supervised. In the event that these lines become open-circuited or grounded, there will be an indication of this condition at the district office and at the supervisor's position. Relays 500 and 505 at the supervisor's position and relay 285 at the district office are all energized in series with each other, and in case of a break in this trunk, relay 285 will fall back and at its back contact and armature 287 closes a circuit extending to the lamp TCL to battery. If no number is transmitted over the trunk line to the district office from the supervisor's position, the attendant will know that this is an indication to him of an open line. At the supervisor's position, relay 500 in falling back closes its ground at armature 501 on to its back contact and completes a circuit through the lamp TL, and then through the relay 540 to battery. The illumination of this lamp and the closing of the armature of relay 540 to complete the circuit through the buzzer B serves as an indication to the supervisor, after she waits an interval to see if there is a number being transmitted, that there is trouble on the trunk line extending to the district office. When the trouble has been repaired, relays 500, 505, and 285 will again energize in series with each other and interrupt the circuits extending through their associated lamps.

In case one side of the trunk line comprising conductors 233 and 234 becomes permanently grounded, the relay 500 only falls back and closes the circuit to the lamp TL. The relay 285 may or may not fall back to close the circuit to the lamp TCL, depending upon which trunk conductor has accidentally become grounded.

Should it happen that the attendant or anyone accidentally move the wipers 270, 271, and 272 of

the sender SN and set them on their first set of bank contacts, this would ordinarily throw the switch out of its position so that it would not function correctly. To guard against this condition, when the wiper 271 steps to its first bank contact, ground is connected from grounded armature 221 and the back contact of relay 220, first bank contact on which wiper 271 is resting, through this wiper and the winding of relay 225 to battery. At its armature 256, it closes a circuit through the winding of relay 250 to battery, to energize this relay which upon operating opens its armatures 251, 252, and 253 to prevent this switch from being operated at this time in response to a fire alarm signal. Relay 255 upon operating closes its front contact on to its armature 257 and also its front contact on armature 259, which completes a circuit extending from the ground on armature 221, bank contacts, wiper 271, front contact and armature 257, armature 261 and its back contact, front contact and armature 259, through the winding of the rotary stepping magnet 260 to battery. This magnet energizes and at its back contact and armature 261 interrupts its own circuit which upon falling back again closes its energizing circuit. The wipers are, therefore, moved in a forward direction over their bank contacts. When wiper 271 reaches bank contact 274, it receives ground direct from the grounded back contacts which are connected in multiple and the switch steps further. When wiper 271 reaches bank contact 276 ground is received from armature 232 and its back contact, armature 222 and its back contact, front contact and armature 258 to bank contact 276. As wiper 272 is now opposite its first bank contact, the wipers again rotate over their bank contacts as before. When wiper 272 reaches bank contact 275, ground from this wiper extends to armature 254 and its front contact, to the winding of relay 225 to battery. This relay upon operating, at armature 228 closes the circuit of relay 230 which removes the ground at armature 232 from bank contact 276. Wiper 271 upon reaching contact 276, permanently opens the circuit of relay 255 and this relay restores all other relays at its armatures and the switch is now in its normal position.

A similar action takes place when the wipers 350, 351, 352, and 353 of the receiver R—2 of Fig. 3, are accidentally displaced from their normal position and advanced onto their first set of bank contacts. This completes a circuit extending from ground on armature 302 and its back contact, wiper 352 and its first bank contact, which is connected in multiple through all their remaining contacts up to bank contact 354, then through the winding of the slow-release relay 335, to battery. This relay energizes and at its grounded armature 337 and its front contact, completes a circuit through the winding of relay 330 to battery. This relay upon energizing opens its armatures 331 and 332 from their back contacts to prevent an alarm signal from controlling the switch. Relay 335 at its front contact and armature 338 extends the ground from the wiper 352 through the back contact and armature 341 through the winding of the stepping magnet 340 to battery. This magnet energizes and opens its own circuit at its back contact and armature 341 and upon restoring advances the switch wipers to the next set of bank contacts. This action continues until wiper 352 reaches bank contact 354 when ground will be picked up from the grounded bank contacts instead of from arma-

ture 302. When wiper 352 reaches its last bank contact, ground will no longer be fed through the wiper 352 and relay 355 deenergizes, opening the circuit of the stepping magnet 340, which upon releasing advances the wipers opposite their first set of bank contacts. At this time wiper 353 is positioned opposite its first bank contact, and the ground extending from armature 302 extends through this wiper 353 to again energize relay 335 which in turn energizes relay 340 and the stepping action continues once more. After wiper 353 has reached its last bank contact, and wiper 352 is positioned opposite its first bank contact, the circuit through relay 335 is no longer complete and it restores its armatures and this in turn releases the stepping magnet 340. The switch is now in its normal position ready to receive a fire alarm box signal, and is in the position it was in before it was accidentally moved.

In the receiver R—1 of Fig. 7, a similar action takes place when the wipers are accidentally positioned onto their first set of bank contacts, and it will be obvious how this takes place as the circuits are somewhat similar to the receiver R—2 of Fig. 3. Relay 720 energizing the stepping magnet 750 and this in turn rotating the wipers back to their normal position at which time relay 720 falls back and permanently opens the circuit to the stepping magnet 750.

In case the transmitter T has its wipers accidentally displaced, they will be positioned on their first set of bank contacts, and the wiper 666 will receive ground from its first bank contact which is connected in multiple with other contacts to ground on armature 656 and its back contact. A circuit then is completed, extending from wiper 666 through the winding of the slow-release relay 620 to battery. Relay 620 upon operating, closes a circuit for relay 625 from grounded armature 621 and its front contact. Relay 625 operates its armature 626 and at armatures 627 and 628 prevents interference in the rotation of this switch should any alarm be sent in at this time. The armature 626, completes a circuit from the grounded bank contact, wiper 666, front contact and armature 626, back contact and armature 661, front contact and armature 622, through the winding of the stepping magnet 660 to battery. When magnet 660 energizes it opens its own circuit at its armature 661 and upon falling away each time advances to the wipers in a forward direction. When the wiper 666 is rotated to its bank contact 669, there will be ground on this bank contact extending from ground on armature 621 and its front contact, armature 646 and its back contact, back contact and armature 657 to the bank contact 669, therefore, the circuit to relay 620 remains completed and the stepping magnet is, further energized and continues to step the wiper 666 once more over its grounded bank contacts. During this second rotation, however, wiper 667 reached its grounded bank contacts which are in the last half of its bank and it will place this ground through the wiper 667, armature 623 and its front contact, through the winding of relay 645, to battery. At armature 647 it pulls up relay 640 but this is without any effect on the apparatus. At armature 646 it opens its back contact, thereby interrupting the circuit which extended from ground on armature 621, through to bank contact 669. Consequently, when wiper 666 reaches its bank contact 669, ground will no longer be on this conductor and relay 620, therefore, deenergizes. At armature 623, upon falling back, it opens its circuit of relay 645. The

switch is, therefore, in its normal position once more, ready to receive the number of an operated fire alarm box.

When the code sender CS has its wipers 990 to 994 accidentally displaced and set onto their first set of bank contacts, ground will be fed from the first bank contact to wiper 994, through this wiper to the back contact of armature 932, through the winding of relay 940, to battery. This relay, therefore, energizes and at its armature 943 and its front contact, it extends the ground from all of the multiplied connected bank contacts, to back contact and armature 981, through the winding of the stepping magnet 980 to battery. The wipers are, therefore, automatically rotated over their bank contacts. At its front contact and armature 942, relay 940 remains locked up to these grounded bank contacts. When the wiper 994 reaches the bank contact 998, it receives ground from the back contact, armature 933 to further advancing the switch. This same action takes place when the wiper reaches its bank contact 983, and after this wiper 995 takes the place of wiper 994. When the wiper 995 reaches its bank contact 988, the circuit is complete over armature 931, and when bank contact 989 is reached, it receives ground from armature 933. On the last bank contact, wiper 995 opens the circuit of relay 940, and the switch is again at normal. As the finder switch F and the sequence switch SS have their wipers resting on the last bank contacts used, it is not necessary to restore them when accidentally moved because they have no normal position.

The foregoing descriptions pointed out the condition existing when an ordinary fire alarm call is made. In certain instances it may be desirable in connection with the fire alarm system to establish telephonic communication between the fire alarm station and the district office, or between the district office and the central supervisor's office, or from the fire station direct to the supervisor's position. In this instance suitable provisions are made whereby the regular line connecting each fire box with the district station may be utilized for the purpose of telephoning. Between the district office and the supervisor's office, however, separate telephone trunks are provided in addition to the signaling trunks over which fire calls are transmitted and received. Each fire alarm station, for example, FS—249, is provided with an ordinary telephone jack indicated at J. Each district office which has responded to an alarm somewhere adjacent to this fire station may, therefore, call the district office, or the chief supervisor in case additional apparatus is necessary when they are unable to cope with the fire. For this purpose each fire-engine or piece of fire apparatus is provided with a portable telephone set, comprising the usual receiver and transmitter, and a magneto generator for the purpose of providing ringing current. A few dry cells furnish talking battery for talking purposes. The circuit of the fire station is so arranged that by inserting the plug of the portable telephone into the jack J, it will cut out the fire signaling apparatus. The line to the two relays 30 and 40 which are normally energized, and which likewise control the operation of the signal associated with this fire station, is permanently opened. The telephone line terminates at the district station in the repeating coil RE, through a pair of condensers, and is arranged so that it is accessible at the district station to an attendant thereat, as indi-

cated by the multiple connections and also connected in multiple with all other fire station lines. The other side of the repeating coil RE extends to the trunk line to the supervisor's position, wherein there are suitable provisions for the supervisor to cut in on this trunk and also be signaled from any of the fire stations.

A detailed description of an ordinary telephone call will now be pointed out by referring to Figs. 1, 2, and 5. In making a telephone call over the fire alarm signaling line, the fireman will move his portable telephone to a position in close proximity to the fire station, for example FS-249. He will insert the telephone plug into the jack J, thereby opening the contacts 4 and 9, to cut out the other equipment and extend the conductors 2 and 3 to the portable telephone in series with a condenser which is placed in the portable telephone. The opening of the contacts 4 and 9 isolates the relay 7, the shunt resistance 6, and the fire alarm springs 5 from the telephone circuit. The insertion of the condenser of the portable telephone across the trunk conductors 2 and 3 permits the relays 30 and 40 to become deenergized. At the back contact and armature 31, relay 40 completes the circuit for the trouble lamp TL. At the back contact and armature 41, relay 40 completes the circuit for the alarm lamp AL. The operation and illumination of both of these lamps which are individual to this particular fire station informs the attendant at the district station that a telephone call is about to be made to the supervisor's position. At front contact and armature 32, the circuit of relay 20 is prevented from being completed so that no fire alarm signaling equipment will be operated. The armatures 33 and 43 are resting now on their back contacts and the circuit is extended over conductors 70 and 71 through to the repeater coil RE. The fireman at the portable telephone now proceeds to operate the hand generator, thereby transmitting alternating ringing current over the conductors 2 and 3, armatures 33 and 43 and their back contacts, conductors 70 and 71, through the right-hand winding of the repeating coil RE including the condensers. Then it is fed inductively to the left-hand winding of repeating coil RE, trunk conductors 228 and 229 extending from the district office to the supervisor's position, then over armature 526 and its back contact, ringing condenser 522, upper winding of relay 520, back contact and armature 528, and back over conductor 229. This ringing current will therefore, operate the ringing relay 520 which upon its energization closes a locking circuit for itself through its lower winding extending from its front contact and armature 521 to the armature 527 and its back contact to ground. A branch of this locking circuit of relay 520 extends from ground on armature 527, armature 521 and its front contact, through the lamp TE to battery at relay 540. Relay 540 upon energizing, operates the buzzer B to audibly inform the supervisor of some action which has taken place on the trunk. The illumination of the lamp TE informs the supervisor of the particular trunk this call is being received from. In responding to the illumination of the lamp TE the supervisor operates the "answer key" AN closing ground over this key and its contacts through the winding of relay 525, to battery. Relay 525 upon operating, opens its back contact from its armature 527, resulting in the deenergization of relay 520 and the extinguishing of the lamp TE. At its front contacts and armatures 526 and 528, relay 525 switches

the trunk through to the operator's telephone circuit OT including the battery feed relay 560 which furnishes talking current, and the operator may, therefore proceed to converse with the fireman at the fire station and be advised by him as to the results of any particular fire or whether any additional apparatus is needed. When relay 525 operated and opened its back contacts from its armatures, relay 530 was deenergized, resulting at its armature 531, in the illumination of the signaling lamp SL-1 which informs the operator at this time that this trunk is in use and that she is connected to it. The lamp TE, it will be remembered, was extinguished when she answered the call. At the district station relay 262 falls back and at armature 263 closes the circuit through lamp 263 which informs the attendant of a telephone call over this trunk.

When the conversation has been completed relays 30 and 40 will again energize in series with each other over the lines 2 and 3, and at the same time relays 530 and 262 will energize in series. These last relays being normally energized, hold their armatures operated so that in case the trunk line 228 and 229 extending between the district station and the supervisor's position should at any time become open circuited or one side grounded or short circuited, the attendants at either the supervisor's position or at the district station will be aware of this fact instantly, due to the illumination of either the lamp SL, or SL-1, or both lamps.

From the foregoing it will be seen that a novel type of fire alarm system has been devised wherein there is only one station per line, and where in only one station of a plurality of stations that have been operated at the same time, or one after another, is effective to operate the apparatus to transmit the alarm signal. The remaining stations having their signals stored on their associated relays, for example, relay 20 of the group RG which is individual to each fire station, and as one signal is completed and sent out the next signal will immediately be effective, depending on its position in the bank of the sequence switch SS. This switch, it being recalled, is a switch wherein its wipers remain on the set of contacts which are last used. As this sequence switch SS has only been indicated as having lines connected to 12 fire stations, and those which are not connected are grounded, it will be appreciated that the number of lines may be increased to any amount by merely adding more contacts to the banks of the switch. Similarly the finder switch F may have access to a greater number of trunks extending to district offices than that indicated.

While this invention has been shown as used in connection with a fire-alarm system, it will be understood that it could be utilized equally as well in connection with any other signaling systems such as watchmen's service, police signaling, and supervisory signaling.

What is claimed is:

1. In a fire alarm system, a central office, a plurality of district offices, trunk lines connecting each district office with the central office, fire alarm stations connected to each of said district offices, means in each district office responsive to the transmission of an alarm from one of said fire alarm stations connected thereto for transmitting a coded number characteristic of said station over the trunk line to said central office, means in said central office responsive to the reception of said coded number for displaying it

at said central office, means at said central office responsive to the reception of the complete signal for retransmitting said coded signal to the district offices over said trunk lines, means at each of said district offices for displaying said coded signal, and means at said central office for preventing the transmission of a signal from the district offices to the central office while the signal is being received or retransmitted.

2. In a fire alarm system, a central office, a plurality of district offices connected therewith, fire alarm stations associated with each of said district offices, display signals at said central and district offices, means at each of said fire alarm stations for operating a display signal at its associated district office characteristic of said station, means in said district office responsive to the operation of one of said signals for retransmitting a coded signal corresponding to said fire stations to said central office, means at said central office for operating a display signal thereat in accordance with the coded numeral, and means in said central office responsive to the reception of the complete coded signal for retransmitting said coded signal to all district offices to operate the display signals thereat, means in said district offices for transmitting only one coded signal at a time to said central office, and means in said central office for receiving and retransmitting only one coded signal at a time between said district offices.

3. In a fire alarm system, a central office, a plurality of district offices connected thereto, a plurality of separate fire alarm stations connected to each of said district offices, means at any of said fire alarm stations for transmitting the same signal to its associated district office, means at said district office responsive to the reception of said signal for transmitting a coded signal characteristic of the transmitting station to said central office, means at said central office responsive to the reception of said coded signal for translating said coded signal into a decimal signal, and means at said central office responsive to said decimal signal for indicating the transmitting fire alarm station.

4. In a fire alarm system, a central office, a plurality of district offices connected therewith, fire alarm stations connected with said district offices, signal transmitting means at each of said fire stations, means responsive to the transmission of the signal for one of said fire alarm stations for generating and transmitting a coded signal at said district office characteristic of said transmitting station to said central office, means at said central office responsive to the reception of the complete coded signal for translating the signal into a decimal signal, and means in said central office for transmitting said decimal signal over a separate circuit to all of said district offices for indicating the transmitting fire alarm station.

5. In a fire alarm system, a central office, a plurality of district offices each having a separate connection to said central office, fire alarm stations connected to each of said district offices, means at any of said fire stations for transmitting a signal to its associated district office, means in said district station responsive to the reception of said signal for transmitting a coded number corresponding to said operated fire alarm station to said central office indicating means in said central office and at all said district offices, means at said central office for translating said coded number into a decimal number, and means

for transmitting said decimal number to said district offices and said central office to operate said indicating means thereat in accordance with said decimal number to indicate the operated fire alarm station.

6. In a fire alarm system, a central office, a district office connected to said central office, a plurality of fire alarm stations connected to said district office, means in each of said fire alarm stations for transmitting a signal to the district office, means in said district office for generating and transmitting a coded signal characteristic of only an operated fire alarm station to said central office, means for displaying said coded signal at said central office, means in said district office for displaying said coded signal thereat, means in said central office responsive to the reception of the complete coded signal for automatically retransmitting it to the district station, to display it thereat, and means operative at will at said central office for preventing the automatic retransmission of said coded signal.

7. In a fire alarm system, a central office, a plurality of district offices interconnected therewith, fire alarm transmitting stations connected to each of said district offices, means at a district office responsive to the transmission of an alarm from one of said fire alarm stations for transmitting a coded signal characteristic of said transmitting station to the central office, means at said central office receiver for displaying the coded signal thereat, means in said central office responsive to the reception of the entire coded signal for retransmitting said coded signal to all of said district offices, means at said district offices for displaying said coded signal and means operative at will at said central office for preventing the transmission of said coded signal and for storing the same.

8. In a fire alarm system, a central office, a district office connected to said central office, a plurality of fire alarm transmitting stations connected to said district office, means at said district office responsive to the transmission of an alarm from one of said fire alarm stations for generating and transmitting a coded number corresponding to said fire alarm station to said central office, means at said central office for displaying the coded numeral, means at said central office responsive to the transmission of the entire coded numeral for retransmitting said coded numeral to said district office, means at said district office for displaying said coded numeral, means at said central office for storing the coded signal and subsequently retransmitting the same, and means for giving an indication when the signal is stored.

9. In a fire alarm system, a central office, a district office connected therewith, a plurality of fire alarm stations connected to said district office, means at any one of said fire alarm stations for automatically transmitting a signal to the district office, means at said district office responsive to said signal for generating and transmitting a coded numeral corresponding to said station to said central office, means in said central office to visibly display said coded numeral, means at said central office after the entire coded numeral has been received for automatically retransmitting it to said district office, means to visibly display said numeral at said district office, means at said central office for storing said coded numeral thereat and preventing the automatic transmission thereof, and means for subsequently permitting the retransmission of said stored coded numeral.

OSCAR C. LEVY.