Dec. 11, 1945. F. L. CURRIE ET AL 2,390,517

MULTIOFFICE TELEGRAPH SYSTEM

Filed Aug. 2, 1940 5 Sheets-Sheet 1

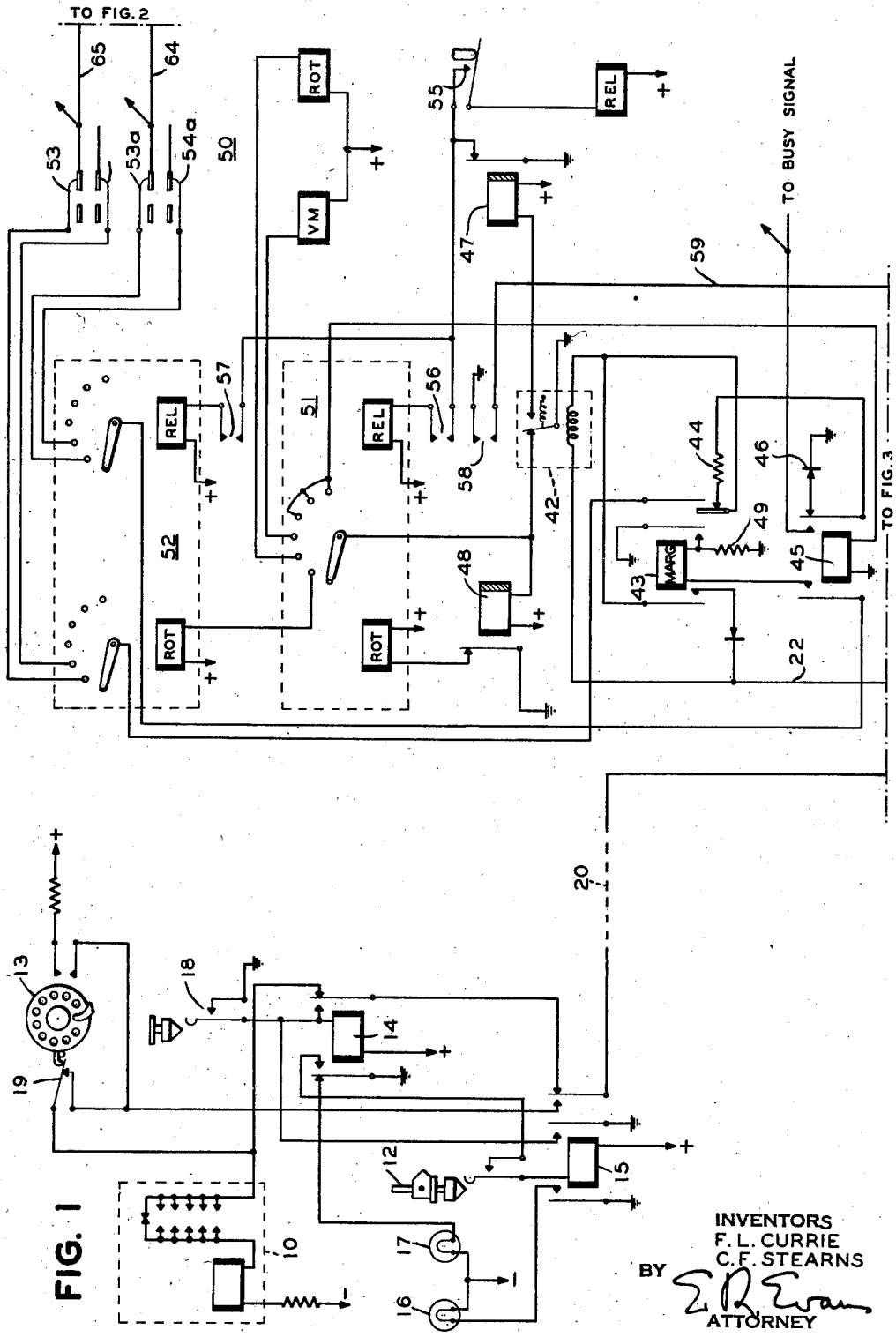


FIG. 1

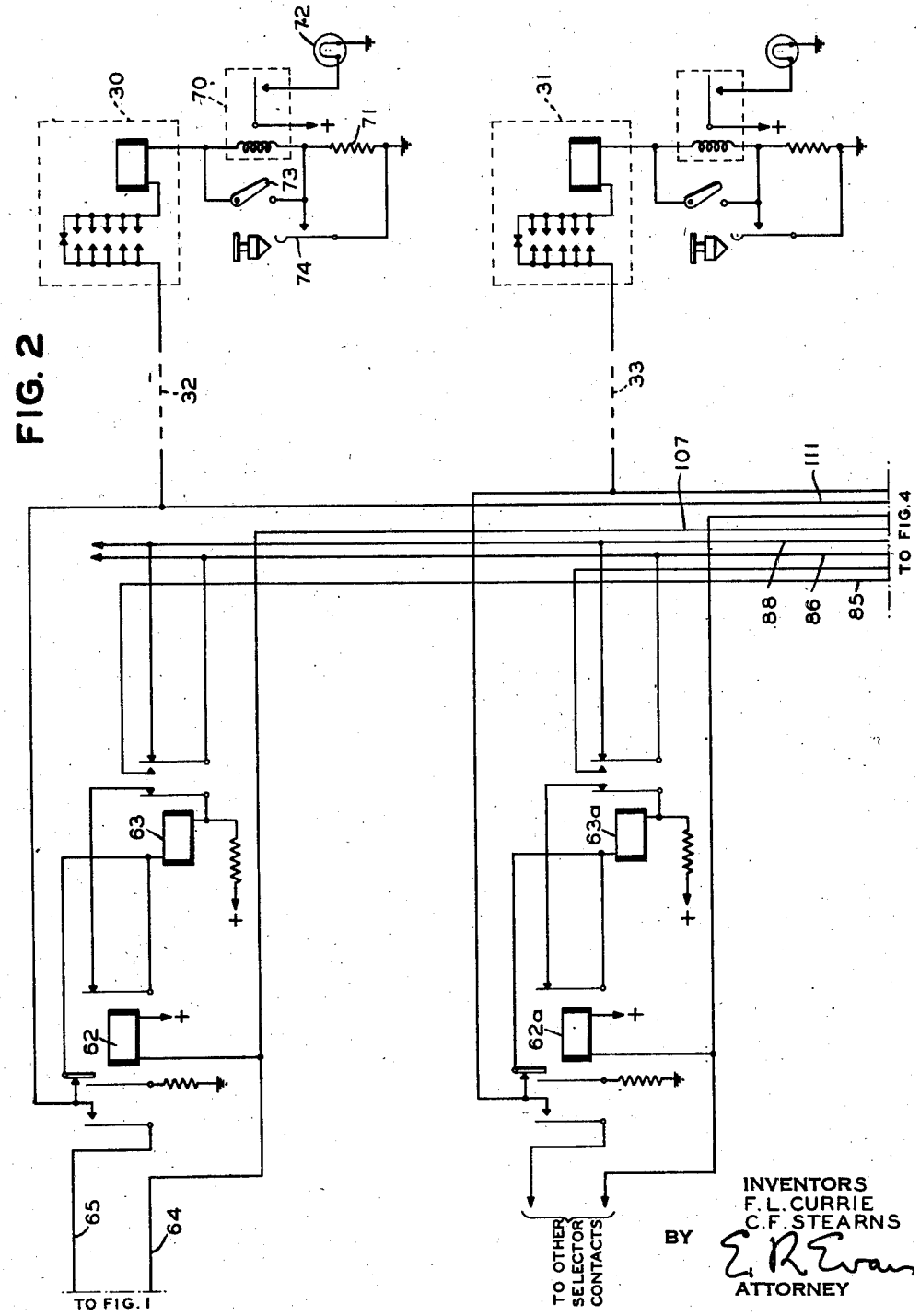
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MULTIOFFICE TELEGRAPH SYSTEM

Filed Aug. 2, 1940 5 Sheets-Sheet 2

FIG. 2



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MULTIOFFICE TELEGRAPH SYSTEM

Filed Aug. 2, 1940 5 Sheets-Sheet 3

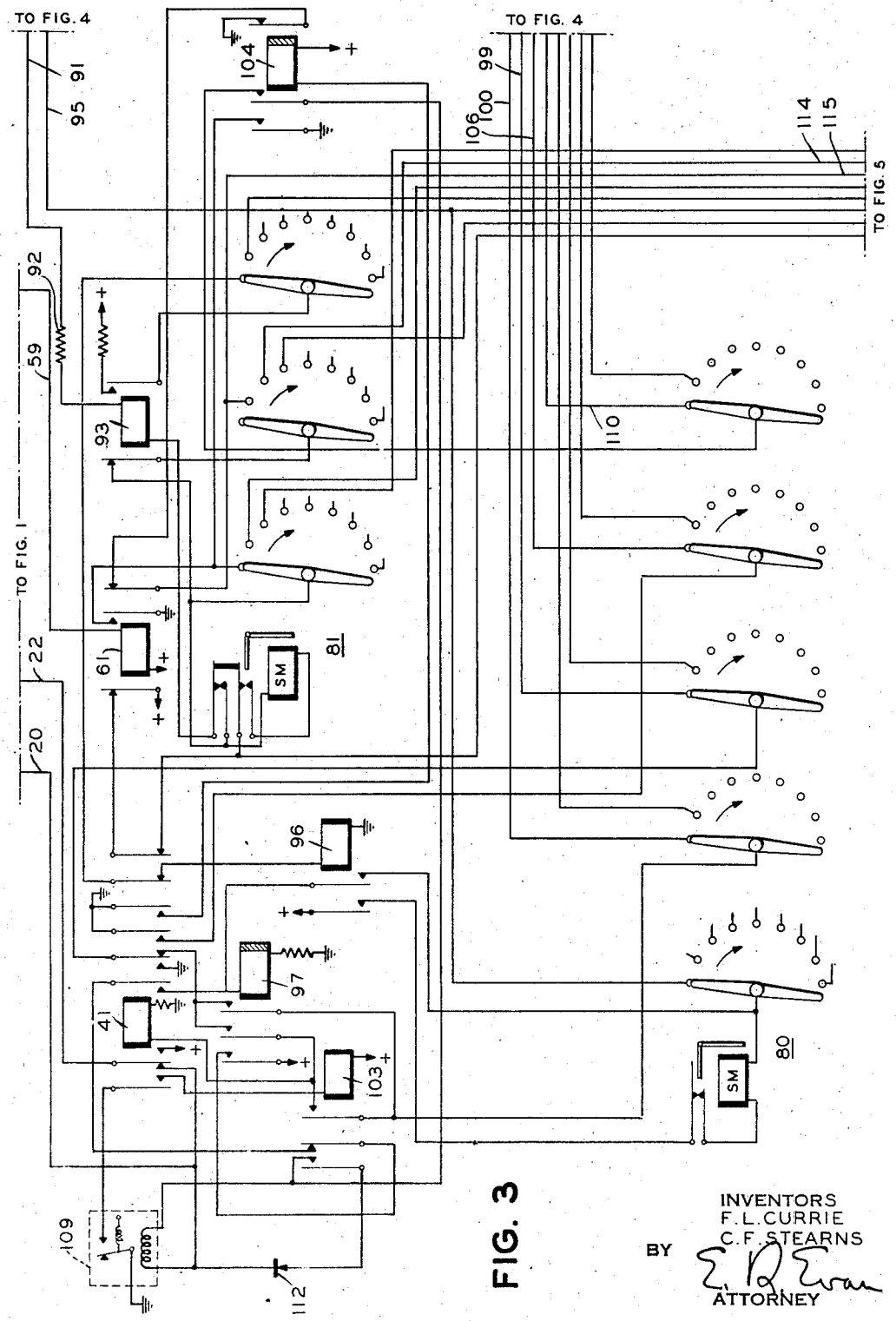


FIG. 3

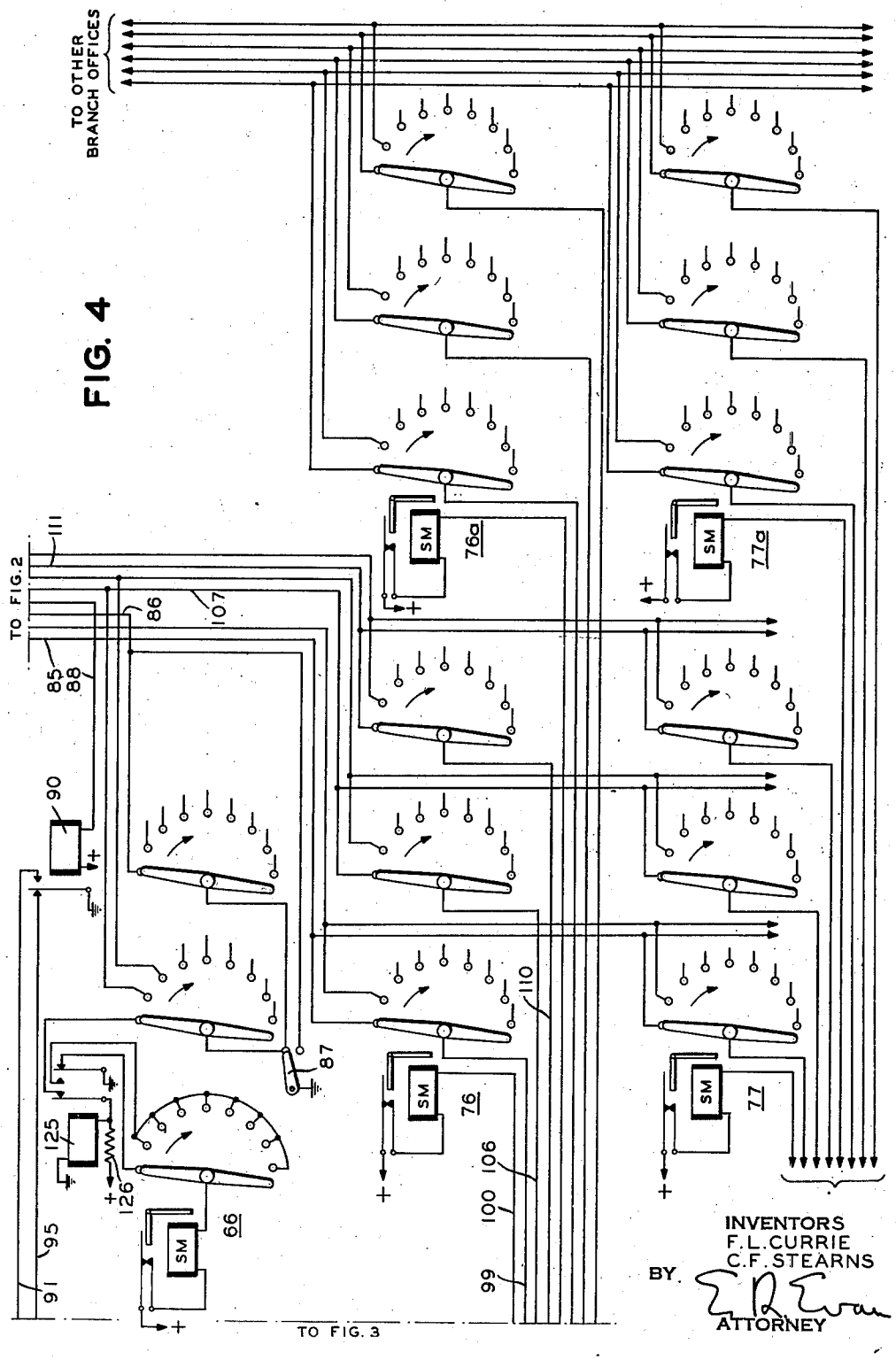
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MULTIOFFICE TELEGRAPH SYSTEM

Filed Aug. 2, 1940 5 Sheets-Sheet 4

FIG. 4



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MULTIOFFICE TELEGRAPH SYSTEM

Filed Aug. 2, 1940 5 Sheets-Sheet 5

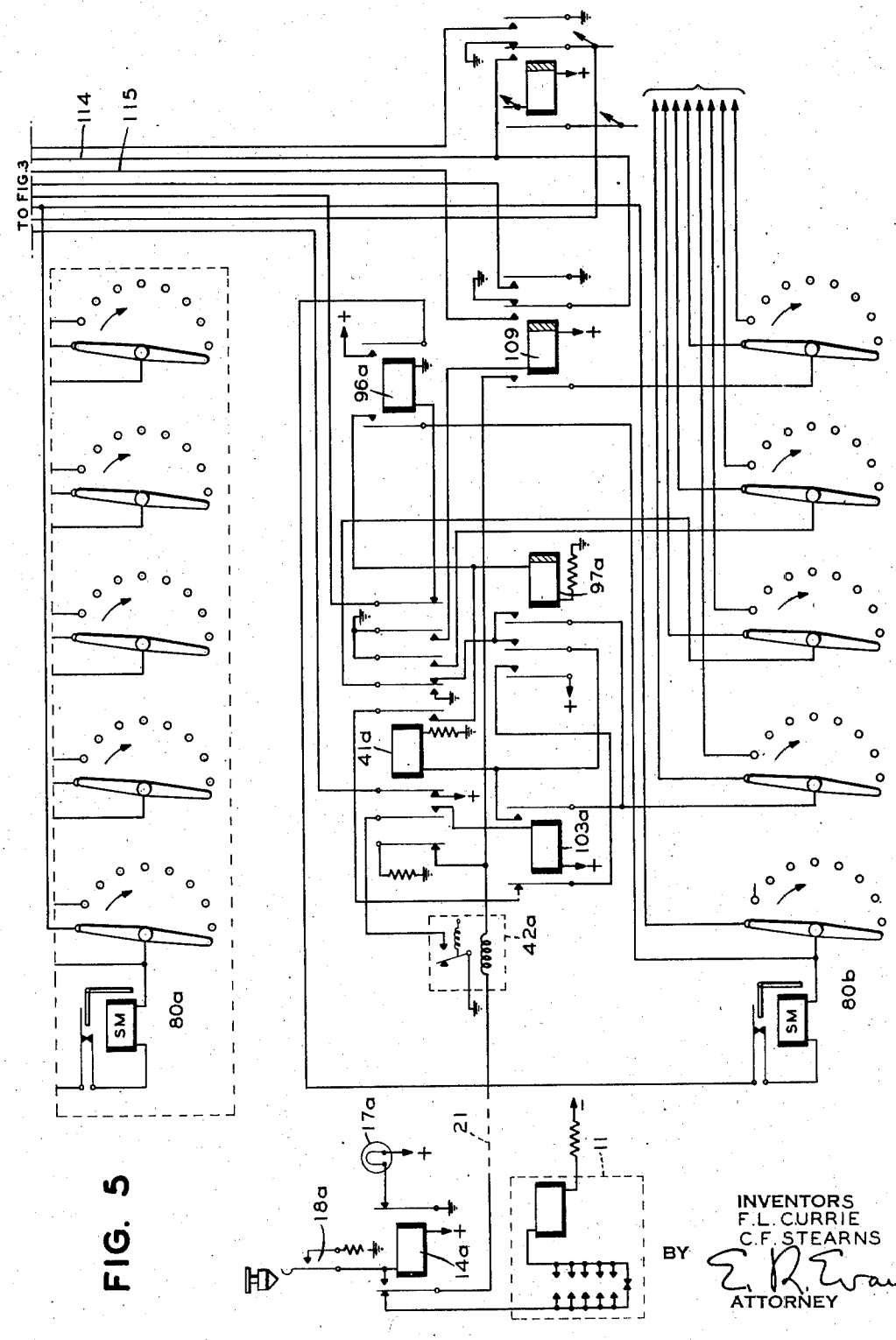


FIG. 5

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UNITED STATES PATENT OFFICE

2,390,517

MULTIOFFICE TELEGRAPH SYSTEM

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Application August 2, 1940, Serial No. 349,716

10 Claims. (Cl. 178—2)

This invention relates in general to printing telegraph systems and more particularly to multi-office systems including a main or central office and a plurality of branch offices or stations.

In the prior patent to Blanton, No. 2,227,121, granted December 31, 1940, is disclosed a system of this general character in which a switching center or office remote from the main office is provided, the switching center being connected through a plurality of separate calling and answering trunks with the main office and through line circuits with the respective branch offices or stations. Switching equipment is provided at the switching center for extending calls from the main office through the calling trunks to any desired branch office, and for extending calls from the branch offices through the answering trunks to the main office. The present invention in one aspect thereof relates to an improvement or modification of the system disclosed in said prior patent, although certain features thereof are not limited to any particular switching system.

A primary object of the present invention is to provide, in a system of the character described, control equipment associated with trunks from the main office to the switching center whereby said trunks may be utilized in extending calls either from the main office to a selected branch office or vice versa.

Another object of the invention is to provide facilities in connection with two-way communication circuits in printing telegraph systems whereby said circuits may be employed not only for the transmission of intelligence signals, but also in selecting calling and called stations to operatively connect the calling stations to the main office and also extend a call from the main office to any desired remote station.

Another object of the invention is to provide in a system embodying a number of trunks from a switching center to the main office, control means whereby the lowest numbered idle trunks are allotted to successive calls whereby the calls are concentrated at the main office in a few operators' positions or even one position when the traffic is light.

A still further object of the invention is to simplify and improve the apparatus employed in switching calls in a system of the character described and to guard against faulty operation as a result of momentary failure of power or other disturbances which cannot be entirely prevented in actual practice.

Other objects and advantages of the invention will appear from the following description of the preferred embodiment thereof shown in the accompanying drawings, the several figures of the drawings when taken together constituting a circuit diagram of a complete system.

Referring to the drawings, printers 10 and 11 at two operators' positions at the main office are associated with trunks 20 and 21 respectively. The trunks 20 and 21 extend to the switching station which, for example, may be located near a group of branch offices or stations of which two are represented by the printers 30 and 31, Fig. 2. Printers 30 and 31 representing two branch offices are connected to the switching center or station by the line circuits 32 and 33. The system is arranged to provide two-way communication between the main office and any of the branch offices or stations. The trunks 20 and 21 represent a number of trunks sufficient to handle the maximum traffic to and from the branch offices but less in number than the total number of branch offices, since the switching equipment at the switching office may connect any main office trunk to any branch office while a call is in progress and release the trunk when the call has been completed. The switching equipment associated with the trunk 20 is adapted for use either in extending calls from the main office to a branch office or in answering calls from the branch office, whereas the trunk 21 is an answering trunk used only in answering calls from the branch offices. This illustrates the flexibility of the system in that only sufficient equipment need be provided for handling the traffic and the number of trunks required is reduced by utilizing certain trunks as both calling and answering trunks. Obviously all of the trunks might be of this type if desired.

In order to initiate a call to a desired branch office, for example, that represented by the printer 30, Fig. 2, the main office operator closes the key 12 and then actuates the impulse transmitter or dial 13 in accordance with the number of the wanted office. Relay 14 is normally locked up in series with the line circuit 20, the circuit including the winding of relay 14, the right hand armature and front contact of said relay, the right hand outer armature and back contact of relay 15, conductor 20, the left hand inner armature and back contact of relay 41, the winding of polar relay 42, the normally closed make-before-break contacts associated with the right hand outer armature of relay 43, resistance 44, the right hand armature and back contact of relay 45, and rectifier 46 to ground. The rectifier 46 being poled to conduct current when its

ungrounded side is connected to positive battery, current flows through the above-described circuit to hold relay 14 energized and to hold the armature of polar relay 42 in engagement with its left hand contact. The armature of relay 42 is biased so that when the polarity of the line circuit 20 is reversed or when no current flows through its winding, said armature will engage the right hand contact of said relay.

When the key 12 is closed as described above, a circuit is closed through the winding of relay 15, the contacts of key 12 and the left hand armature and front contact of relay 14 for energizing relay 15. The energization of relay 15 closes through its inner right hand preliminary make contacts a holding circuit for relay 14, and at its right hand outer armature transfers the line circuit from the winding of relay 14 through the off-normal contacts of the dial 13 and the operating magnet of the printer 10 to negative battery, thus causing a reversal of the polarity of the line conductor 20. A circuit is also closed through the left hand armature and front contact of relay 15 to light the "busy" lamp 16.

Upon the reversal of the potential applied to the trunk 20 the line ccurrent is reduced because of the rectifier 46 in series with the line circuit, and the armature of relay 42 moves into engagement with its right hand contact, thereby closing the circuit of slow release relay 47 and opening the circuit of slow release relay 48. The contacts of relay 42 are connected, as shown, to the operating magnets of the selector switch 50 and the minor switches 51 and 52 to directively control said switches in response to the operation of the dial 13 in substantially the same manner as disclosed in the above-mentioned Blanton patent. When the dial 13 is turned, the off-normal contacts 19 open and remain open until the dial has returned to its normal position. When the dial is released, the dialing contacts transmit a series of positive impulses over the line circuit to operate the armature of relay 42 into engagement with its left hand contact one or more times in accordance with the number dialed. When the line circuit was initially opened, the release of relay 48 closed the circuit of the rotary magnet of the minor switch 51, thereby stepping the wiper of said switch into engagement with its second contact connected to the rotary magnet of the minor switch 52.

Thus, the first number dialed operates the rotary magnet of the switch 52 to step the wipers of said switch into engagement with either their second or third contacts, depending upon the number of current impulses transmitted, and thus select either the upper switch wipers 53 and 53*a* or the lower switch wipers 54 and 54*a* of the selector 50. In this manner an ordinary one-hundred point selector switch 50 may be employed to select more than one hundred and as many as two hundred branch offices or stations.

At the end of the first digit of the number dialed, the release of relay 48 which was operated by the first dialing impulse, recloses the circuit of the rotary magnet of the minor switch 51 and the wiper of the said switch is stepped into engagement with its third contact, thereby closing the circuit through the rotary magnet of the selector switch 50. At the end of the second digit, the wiper of the minor switch 51 takes another step to close the circuit to the vertical magnet of the selector switch 50, and this magnet responds to the third digit dialed. As soon as the selector switch 50 takes its first step, the off-normal contacts 55 are closed, but the slow release relay 47 holds its contacts open during the dialing operation and thus holds open the circuits of the release magnets through the off-normal contacts 55 of the selector switch and the off-normal contacts 56 and 57 of the minor switches 51 and 52 until after the call is released. The off-normal contacts 58 of the minor switch 51 close as soon as the selector switch is seized and connect ground through the conductor 59 for energizing the relay 61 which serves to prevent the answering equipment associated with the trunk 20 from answering any succeeding call from a branch office while the trunk is in use, in a manner to be described below. It will be apparent that this is necessary since the trunk 20 is already busy as it has been seized by an operator at the main office for the purpose of extending a call to a wanted branch office.

The detailed operation of the selector switch and the way in which the busy or idle condition of the called line is tested and the connection made if it is idle are substantially the same as described in the above-mentioned Blanton patent. Reference is therefore made to said patent for a fuller description of these and other details not fully described herein. It may be assumed that the wipers 53 and 53*a* of the selector switch are stepped by the operation of the dial 13 into engagement as shown with the bank contacts which are associated with the branch office printer 30, Fig. 2. It will be noted that after the last digit of a number of the called line has been dialed, the wiper of the minor switch 51 is stepped into engagement with its fifth contact, thereby closing a circuit from positive battery through the winding of relay 48, the wiper of the minor switch 51 and the winding of relay 45 to ground whereupon said relays become energized.

Each branch office or station has associated therewith two control relays corresponding to the relays 62 and 63 individual to the line circuit 32 extending to the selected office. As shown in Fig. 2, a pair of similar relays 62*a* and 63*a* are associated in a similar way with the line circuit 33 to a second branch office. Since the circuits and control equipment of all of the outlying stations are similar, the operation of the system will be clear from a description of the steps involved in extending calls to and from one station. Relay 63 is normally energized in series with the line circuit 32, positive battery being applied to said line circuit through the winding of said relay and the normally closed contacts associated with the left hand inner armature of relay 62. At the branch office a polar relay 70 and resistance 71 are connected in series relation with the printer magnet, the keyboard contacts of the printer 30 and the line circuit. When positive battery is applied to the line circuit 32 at the switching office as described, current flowing through the winding of polar relay 70 holds the contacts of said relay open.

When the selector switch wipers 53 and 53*a* engage the terminals of the called branch office, a circuit is closed from ground through resistance 49, the winding of marginal relay 43, the left hand armature and front contact of relay 45, the right hand wiper of the minor switch 52 which is in engagement with its second contact, switch wiper 53*a*, conductor 64 and the winding of relay 62 to battery whereupon relay 62 becomes energized. The energization of relay 62 interrupts the above-described circuit of relay 63 but maintains said relay energized through a circuit in-

cluding the inner left hand armature of relay 62 to ground. The energization of relay 62 further extends the line circuit from the printer 30 through the left hand outer armature and front contact relay 62, conductor 65, wiper 53 of the selector switch 50, left hand wiper and second contact of the minor switch 52, the right hand outer armature and make contact of relay 43 through the above-described trunk circuit 20 to negative battery at the printer 10 at the main office. Thus, the line circuit is extended from the main office printer 10 to the printer 30 of the branch office and the polarity of the current applied to the polar relay 10 at the branch office is reversed. Therefore, the polar relay closes its contacts in response to said reversal, thereby lighting the "call" lamp 72 in circuit with said contacts. When the attendant at the branch office responds to said call, the switch 13 may be closed to short-circuit the polar relay 10 and extinguish the "call" lamp 72. The printers 10 and 30 are now connected in series relation and two-way communication may be carried on between the main office and the branch office. If the selector switch 50 had been actuated into engagement with other bank contacts, for example, those corresponding to the branch office at which the printer 31 is located, the call would have been extended to said branch office if idle in precisely the same manner as described above, but under the control of relays such as 62*a* and 63*a* associated with such other office.

If the selected branch office were busy when switch wipers 53 and 53*a* engage the bank contacts representing said office, the contact engaged by the wiper 53*a* would have been grounded either through another selector switch similar to the selector switch 50 but individual to another trunk similar to the trunk 20, or the conductor 64 would be grounded by the finder switch which had connected said office for a previous call in a manner to be described. The grounding of the wiper 53*a*, when connection is attempted to a busy line as pointed out in the above-mentioned Blanton patent, prevents the marginal relay 43 connected to ground in series with resistance 49 from operating in the manner described above. Thus, since the relay 43 does not energize when the wanted line has been reached, the line circuit is held open at the outer right hand armature of said relay, and a busy signal is connected to the main office trunk 20 through the normally closed contacts associated with said armature of relay 43 and the right hand armature of the front contact of relay 45. The busy signal may be a code or a series of impulses which operate the printer 10 of the main office to indicate that the wanted line is busy.

At the end of a call, the main office operator restores the key 12, thus releasing relay 15 and transferring the trunk or line circuit 20 from negative battery at the printer 10 to positive battery through the winding of relay 14. The reversal of polarity on the line 20 operates the armature of polar relay 42 in the line circuit into engagement with its left hand contact. When the slow release relay 47 releases its armature, circuits are closed from ground through said armature and back contact and the off-normal contacts of switches 50, 51, 52, to the release magnets of said switches. The switches are thus restored to normal, interrupting the circuits of relays 43, 45, 61, 62 and 63. These relays with the exception of relay 63 are restored to normal, but relay 63 remains locked up through the normally closed contacts of relay 62 in series relation with the line circuit 32 to the branch office or station.

If said branch office or station desires to make a call to the main office, the operator or attendant closes the key 13 to short-circuit the winding of relay 10 and presses one of the keys of the keyboard printer 30. The operation of any of said keys causes a momentary interruption of the line circuit 32 and this releases relay 63 which is in series relation with said line circuit. The inner armature and back contact of relay 63 closes a short-circuit through the right hand armature and back contact of relay 62 around the winding of relay 63 and the latter remains deenergized after the line circuit is reclosed.

The deenergization of relay 63 starts one of the step-by-step finder switches shown in Fig. 4 hunting for the line circuit of the calling branch office. As shown, the finder switches of two main office trunks which have the bank contacts thereof connected to a group of offices including the one referred to above are indicated at 76 and 77, Fig. 4. It is assumed that the number of branch offices exceeds the number of contacts available in the finder switches 76 and 77 and therefore duplicate switches 76*a* and 77*a* are provided for connecting the corresponding trunks to still another group of branch offices or stations. Additional finder switches may be utilized in a similar manner when the number of branch offices exceeds the capacity of the switches shown. A group control switch such as the switch 80, Fig. 3, is employed to select the particular finder switch having access to the calling branch office. Similar group control switches 80*a* and 80*b* of other main office trunks are shown in Fig. 5 in order to show how the contacts and control circuits of the respective switches are operatively connected together. Another step-by-step rotary allotter switch 81 is also provided to preselect the main office trunk and thereby distribute calls from branch offices to idle main office trunks and to insure that each succeeding call is directed to the lowest numbered main office trunk which is idle at the moment. This concentrates the branch office calls in the lowest position or positions of the main office.

The deenergization of relay 63 as described removes ground potential from the first bank contacts of the first levels of switches 76 and 77 to indicate that the call is from the office corresponding to said contacts through a circuit that may be traced from said contacts, through the conductor 85, the outer armature and front contact of relay 63, conductor 86, the third switch wiper of the switch 66 in engagement with its first contact and the switch 87 to ground. The switch 66 is provided for a guard function to be described in detail hereinafter and the wipers thereof normally remain continually in engagement with their first bank contacts. It may be cut out of service when desired by means of the switch 87. When the switch 87 is operated to its alternate position, ground is applied through the conductor 86 to the outer armatures of all of the line relays 63, 63*a*, et cetera.

When relay 63 becomes deenergized as described, the ground is extended through said right hand armature and back contact of said relay, conductor 88 and the winding of relay 90 to battery, whereupon relay 90 becomes energized. The energization of relay 90 closes a circuit from ground through the armature and front contact

of said relay, conductor 91, resistance 92, the winding of relay 93, the interrupter contacts and stepping magnet of the switch 81, the right hand outer armature and back contact of relay 41 and the left hand armature and back contact of relay 61 to battery whereupon relay 93 becomes energized. The energization of relay 90 further removes ground applied through its armature and back contact and the conductor 95 to a bank contact, in this instance the first bank contact, associated with the first switch wiper or the group switches 80, 80*a* and 80*b*, whereby the group control switch associated with the first idle trunk is able to select the particular finder switch, such as 76 or 76*a* of the main office trunk 20 controlling the group of lines in which the call has been initiated.

The switch wipers of the allotter switch 81 are in engagement with their first bank contacts if the main office trunk 20 is idle. As the several trunks to the main office are seized for extending calls between the branch offices and the main office, the wipers of the switch 81 are stepped to direct succeeding calls to idle trunks in a manner to be described. Assuming that the trunk 20 is idle, a circuit is closed upon the energization of relay 93 from battery through the right hand armature and front contact of said relay, the third switch wiper of switch 81 and its first bank contact, the fifth right hand armature and back contact of relay 41 and the winding of relay 96 to ground, whereupon relay 96 becomes energized. Upon the energization of relay 96, a circuit is closed from battery through the outer armature and front contact of relay 96, the interrupter contacts and stepping magnet of the switch 80 and the first wiper of said switch to ground through the contacts of relays corresponding to relay 90 associated with the groups of lines in which the particular calling line is not located. When the wipers of the group control switch 80 reach the position shown in which there is no ground on the bank contact engaged by the first wiper of said switch, relay 97 becomes energized through the inner armature and front contact of relay 96 in series relation with the stepping magnet of said switch, but the current traversing the stepping magnet is reduced to such a value that the switch is not stepped.

Upon the energization of relay 97 a circuit is completed for operating the finder switch 76 to start hunting the trunk contacts of the calling branch office if the switch wipers are not already engaging said contacts. As already described, the deenergization of relay 63 removes ground from the first bank contacts associated with the first switch wipers of switches 76, 77, et cetera. If the switch wipers of switch 76 had been in engagement with other bank contacts, ground on said contacts connected through the first wiper of said switch, conductor 99, the third switch wiper of the switch 80 and its first bank contact, second right hand armature and back contact of relay 41, the inner armature and front contact of relay 97, second switch wiper of switch 80 and its first bank contact, conductor 100 and the stepping magnet and interrupter contacts of switch 76 causes the switch to step until it reaches the contacts of the calling branch office. When the wipers of the switch 76 reach the position shown, a circuit is closed from battery through the stepping magnet of switch 76, conductor 100, the second switch wiper of switch 80 and its first bank contact, the inner armature and front contact, and the middle armature and front contact of relay 97, and the winding of relay 41 to ground, whereupon relay 41 becomes energized and through its second right hand armature and front contact and conductor 99 applies ground potential to the first bank contacts of the first levels of switches 76, 77, et cetera to prevent any other finder switch from seizing the terminals of the line which has been selected by the finder switch 76. The energization of relay 41 interrupts at its fifth right hand armature and back contact the circuit of relay 96 but relay 97 remains locked up through a locking circuit including the inner right hand armature and front contact of relay 41, the middle armature and back contact of relay 103, and the outer armature and front contact of relay 97 to positive battery. The energization of relay 41 also closes a circuit through its fourth right hand armature and front contact from ground through the winding of slow-to-operate relay 104, whereupon relay 104 becomes energized. The energization of relay 41 further interrupts momentarily the line circuit or trunk 20 to the main office at the inner left hand armature and back contact of said relay thereby releasing the normally energized relay 14 at the main office to initiate a call to said office. When relay 14 deenergizes, a circuit is closed from ground through the left hand armature and back contact of said relay for lighting the supervisory lamp 17. Relay 14 further extends the trunk circuit 20 through the right hand armature and back contact thereof and the contacts and operating magnet of the printer 10 to negative battery so that the printer is operatively connected in circuit and the polarity of the source of current connected to the trunk 20 at the main office is changed from positive to negative.

The energization of relay 41 further closes a circuit from ground through the third right hand armature and front contact of said relay, the fourth switch wiper of switch 80 in engagement with its first bank contact, conductor 106, second switch wiper of switch 76 in engagement with its first bank contact, the conductor 107 and the winding of relay 62 to battery, whereupon relay 62 becomes energized. The energization of relay 62 disconnects the branch office line circuit 32 from the winding of relay 63, and opens the short-circuit around the winding of relay 63 whereupon said relay becomes energized through a circuit including the left hand inner armature and make-before-break contact of relay 62, thereby opening the start circuit for the line finder equipment at the outer armature and back contact of relay 63. Relay 90 becomes deenergized and applies ground potential through the conductor 95 to the line terminals of the first level of group control switches 80, 80*a* and 80*b*. The deenergization of relay 90 further opens at its front contact the circuit of relay 93 and relay 93 becomes deenergized. Relay 93 may also be released by the operation of relay 104 as described, since ground potential is connected through the left hand outer armature and front contact of relay 104 to the left hand terminal of the winding of relay 93.

When the polarity of the main office trunk 20 is reversed by the deenergization of relay 14 as above described, the contact of the armature of polar relay 109 having its winding in series with the line circuit is actuated into engagement with its right hand contact, thereby closing a circuit from ground through said contact, the second left hand armature and front contact of relay 41 and the winding of relay 103 to battery, whereupon relay 103 becomes energized. The energization of

relay 103 short-circuits the winding of polar relay 109 through its outer armature and front contact and the rectifier 112, and closes a holding circuit for relay 41 which may be traced through the inner armature and front contact of relay 103, the second wiper of switch 80 in engagement with its first bank contact, conductor 100 and the operating magnet and interrupter contacts of switch 76 to positive battery. The resistance of this winding of relay 41 is sufficiently large to prevent switch 76 from stepping. It will be noted that relay 41 connects positive battery through its inner left hand armature and front contact to the winding of polar relay 42 thus holding its armature in engagement with its left hand contact and maintaining the branch office selector 50 and associated equipment in the idle condition. The main office trunk 20 is now connected through the rectifier 112, the outer armature and front contact of relay 103, the left hand inner armature and front contact of relay 104, the fifth wiper of control switch 80 in engagement with its first bank contact, conductor 110, the third wiper of the finder switch 76 in engagement with its first bank contact, and the conductor 111 to the branch office trunk 32 so that the printers 10 and 30 at the main and branch offices, respectively, are interconnected for two-way communication. The operator at the main office notes the lighting of the lamp 17 and transmits "GA" (go ahead) to the branch office to indicate that the call has been switched through and the branch office operator may commence to send.

At the end of the call the operator at the main office presses the push button or release key 18 whereupon a circuit is closed through the contacts of said key and the winding of relay 14 for energizing said relay. Relay 14 becomes locked up in series relation with the line circuit 20 and positive battery, thus reversing the polarity of said trunk, and opens the circuit of the supervisory lamp 17. The reversal of the polarity of the line or trunk circuit 20 energizes the winding of relay 109 since said winding is not short-circuited by the circuit including the rectifier 112 for this polarity, and the armature of said relay is actuated into engagement with its left hand contact to open the circuit through its right hand contact and the winding of relay 103. Relay 103 becomes deenergized and opens the holding circuit of relay 41 whereupon said relay is released and the finder switch control equipment is restored to the idle condition. The opening of the circuits of relays 62 and 104 at the third and fourth right hand armatures and front contacts of relay 41 causes said relays to be deenergized. Upon the deenergization of relay 104, the main office trunk 20 may be seized for a subsequent call under the control of the allotter switch 81. The release of relay 62 recloses the line circuit 32 from the branch office in series relation with the normally energized relay 63, rendering the branch office available for calls through the switching center.

The allotter switch 81 is provided with driving circuits as indicated including contacts of the respective slow operate relays 104 individual to the respective main office trunks whereby the allotter switch invariably steps to the contacts representing the lowest numbered main office trunk. When the respective trunks are busy, the control relays 104, 104*a*, 104*b*, et cetera, are energized and circuits are closed as shown from the ground through the outer left hand armature and front contact of relay 104 and the outer right hand armatures and front contacts of relays 104*a* and 104*b* to the corresponding bank contacts of the first level of the allotter switch 81, and the lower interrupter contacts and the stepping magnet of said switch for energizing said stepping magnet, whereby the wipers of the switch step over the bank contacts of busy trunks.

In the case of the combined calling and answering trunks, such as 20, the relays 61 operate as described above when the trunk is seized at the main office, and a circuit is closed for stepping the allotter switch 81 as shown at the inner armature and front contact of the relay 61 individual to the trunk 20. On the other hand, if the wipers of the allotter switch 81 are resting upon bank contacts of an idle trunk higher than the first trunk and the first trunk becomes idle, driving circuits are closed for the stepping magnet of switch to step the wipers over both busy and idle trunks back to the first trunk. Similarly, if the switch wipers are in engagement with a trunk higher than the second trunk, and the second trunk becomes idle, the switch wipers will be stepped into engagement with said second trunk if the first trunk is busy. Assume for example that relay 104 is energized indicating that the first trunk is busy, that the switch wipers of the switch 81 are in engagement with their second bank contacts representing the second trunk and the first is released by the main office operator so that it is available for the next call.

Relay 104 becomes deenergized when the trunk circuit is released whereupon a circuit is closed from ground through the right hand armature and back contact of relay 104, the right hand outer armature and back contact of 61, the second wiper of switch 81 in engagement with its second bank contact, left hand armature and back contact of relay 93, stepping magnet and lower interrupter contacts of switch 81, right hand outer armature and back contact of relay 41, and the left hand armature and back contact of relay 61 to battery. The contact of relay 93 just referred to prevents stepping of the allotter switch in case the first trunk is released after relay 93 has operated to cause an idle trunk to be seized. It will be apparent that as the first wiper of the allotter switch engages its bank contacts corresponding to busy trunks, the circuit of the stepping magnet of said switch is closed through the respective bank contacts of the first level of the switch to ground at the armatures and front contacts of relays 104, 104*a*, 104*b*, et cetera. In this manner the allotter switch is stepped over the busy trunks. Assume, however, that relay 104*b* is deenergized indicating that the third trunk is idle, and the first trunk is also idle. In that case another circuit for the stepping magnet is closed through the left hand armature and back contact of relay 93, the second wiper of allotter switch 81 in engagement with its third bank contact, conductor 114, the right hand inner armature and front contact of relay 104*a*, conductor 115, the right hand outer armature and back contact of relay 61 since the first trunk is idle, and the right hand armature and back contact of relay 104 to ground. The additional relays 104 associated with idle trunks are similarly connected to each other and to contacts of the switch 81 to effect the stepping of the switch wipers back to the position shown where the switch stops stepping and thereby preselects the lowest numbered trunk for the next call. Similarly if the first trunk was in use at the moment and the second trunk was idle, the circuit of the stepping magnet to the left hand

outer armature and front contact of relay 104 or the right hand inner armature and front contact of relay 61 will cause wipers of the allotter switch to be stepped to their second bank contacts, even though the switch wipers are in engagement with the contacts of a higher numbered idle trunk, and the second trunk will be preselected.

If the answering trunk 21 is allotted to a call by the allotter switch 81 because of the fact that the previous lower numbered trunk or trunks are in use, the energization of relay 93 as described above subsequent to the initiating of the call from a branch office, will close a circuit through its right hand armature and front contact and the third wiper of the allotter switch 81 for operating relay 96*a* in the same manner as relay 96 is operated when the first trunk was available for the call. The energization of relay 96*a* renders the group control switch 80*b* operative in the same manner as described above in connection with the group control switch 80 associated with the first group. Thereupon one of the finder switches 77, 77*a* would be rendered operative to connect the calling branch office to the switching center. The operation of the control relays associated with the trunk 21 would be effected in substantially the same manner as described above in connection with the control relays associated with the trunk 20. Momentary interruption of the line circuit 21 would release relay 14*a* at the main office whereupon the printer 11 would be connected on the line circuit and relays 42*a* and 103*a* would be operated and the printer 11 connected to the printer at the calling branch office. At the end of the call the operation of the push button or release key 18*a* disconnects the printer 11 from the line, extinguishes the supervisory lamp 17*a* and causes the release of the switching equipment at the switching center in substantially the same manner as described above in connection with the main office trunk 20.

In accordance with another feature of the invention a step-by-step switch 66 is provided to prevent faulty operation in response to failure of power at the switching center. No claims to this feature are presented herein, this feature being claimed in a divisional application. Since it will be apparent that a call is initiated from each branch office by deenergization of the normally energized relays 63, 63*a*, et cetera, and said relays when released close a short-circuit around their own windings, if there is even a momentary power failure resulting from power line failure or other causes, all of the relays 63, 63*a*, et cetera would be released. When power was restored the switching equipment at the switching center would attempt to switch through calls from each of the branch offices of which there may be a considerable number. All of the trunks to the main office would be tied up until each call was answered and released in the usual manner. In order to avoid this difficulty, a relay 125, Fig. 4, is provided which is connected directly across the power terminals and is thus normally continually energized. When a power failure occurs, relay 125 becomes deenergized and closes a short circuit from positive battery through a resistance 126, the inner armature and back contact of relay 125, the second switch wiper of the rotary switch 66, and the contacts of switch 87, to prevent the relay from becoming energized when power is restored to the switching equipment. A circuit is also closed upon the deenergization of relay 125 from ground through the outer armature and back contact and the first wiper of switch 66 in engagement with its first bank contact for stepping said switch as soon as power is restored. As soon as the wipers of switch 66 are stepped into engagement with their second bank contacts, relay 125 becomes energized and closes a stepping circuit for the switch through the first wiper and the remaining bank contacts engaged thereby and the outer armature and front contact of relay 125. In this manner the wipers of switch 66 make one traverse as soon as power is restored to the equipment. The third wiper of switch 66 immediately opens the circuit through the first bank contact thereof which is multipled to the start circuit of the finder switch equipment, thus preventing placing of any calls until the switch returns to normal. Circuits are also closed through the second and third wipers of switch 66 and their respective bank contacts for momentarily operating relays 62, 62*a*, et cetera, thereby removing the short circuits around windings of associated relays 63, 63*a*, et cetera, and permitting said relays to be reenergized in series with the respective line circuits. In this manner the system is restored to an idle or inoperative condition in readiness for placing of subsequent calls from the branch offices in the usual manner.

Various modifications of the embodiment of the invention specifically described above will occur to those skilled in the art and may be made without departing from the scope of the invention as set forth in the appended claims.

We claim:

1. A multioffice telegraph system comprising a main office, a plurality of branch offices or stations, printing telegraph equipment in each of said offices or stations, a switching center remote from the main office for interconnecting said main office with any desired one of said branch offices or stations, a plurality of trunks from the main office to the switching center common to all of said branch offices, line circuits at the switching center to each of the branch offices, means including selective switching equipment at said switching center for extending calls in either direction between the main office and any of the branch offices and means for controlling said switching equipment to connect one of said trunks from the main office to a wanted branch office and at other times to connect the same trunk to any branch office which desires to transmit a message to the main office.

2. A multioffice telegraph system comprising a main office, a plurality of branch offices or stations, printing telegraph equipment in each of said offices or stations, a switching center remote from the main office containing switching equipment for interconnecting said main office with any desired one of said branch office or stations, line circuits from said switching center to each of said branch offices or stations, a trunk from said main office to said switching center, said switching equipment including a selector switch and a finder switch individual to said trunk, means at the main office for directively controlling said selector switch over said trunk to connect said trunk to any desired branch office or station and means at each branch office or station for operating said finder switch to connect a calling branch office through said trunk to the main office when said trunk is idle.

3. A multioffice telegraph system comprising a main office, a plurality of branch offices or stations, printing telegraph equipment in each of

said offices or stations, a switching center remote from the main office containing switching equipment for interconnecting said main office with any desired one of said branch offices or stations, line circuits from said switching center to each of said branch offices or stations, said switching equipment including a finder switch to select the line circuit of a calling branch office or station, means at each branch office or station for initiating a call to the main office and thereby operating the finder switch to connect the calling branch office or station to the main office and means controlled from the main office to render said finder switch inoperative and select a wanted branch office in the case of a call from the main office to said wanted branch office.

4. A telegraph exchange system comprising a main office, a branch office, a trunk terminating at the main office, printing telegraph apparatus at said offices arranged to employ said trunk for communication, a source of current for said trunk at the main office, means at the branch office for momentarily interrupting the flow of current in said trunk to initiate a call to the main office and means including a relay in said trunk circuit at the main office responsive to said momentary interruption for reversing at its contacts the polarity of the source of current connected to said trunk.

5. A telegraph exchange system comprising a main office, a branch office, a trunk terminating at the main office, a source of current for said trunk at the main office, switching means for momentarily interrupting the flow of current in said trunk upon initiating a call from the branch office to the main office, means including a relay at the main office responsive to said momentary interruption for reversing the polarity of the source of current connected to said trunk, means for operating said switching means and means associated with said switching means responsive to restoration of the trunk to its normal or idle polarity for releasing said switching means at the end of the call.

6. A telegraph exchange system comprising two offices, a trunk terminating at one office, means for momentarily interrupting the flow of current in said trunk to initiate a call to said one office, means including a relay at said one office responsive to said momentary interruption for reversing the polarity of the trunk, switching means at said other office associated with said trunk and means for controlling said switching means in response to restoration of the trunk to its normal or idle polarity at the end of the call.

7. A telegraph system comprising a line circuit, a normally energized relay in series relation with said line circuit, means whereby said relay remains deenergized after the circuit thereof has been interrupted by a momentary opening of the line circuit and means including the contacts of said relay for directly controlling the polarity of said trunk.

8. A telegraph exchange system comprising two offices, a trunk terminating at one office, means for momentarily interrupting the flow of current in said trunk to initiate a call to said one office, means including a relay normally in said trunk circuit at said one office responsive to said momentary interruption for reversing at its contacts the polarity of the trunk and means at the other office for detecting the reversal of polarity of the trunk.

9. A telegraph exchange system comprising two offices, a trunk connecting said offices, a path including said trunk which is normally conductive during idle periods, means for momentarily interrupting the flow of current in said trunk to initiate a call to one of said offices from the other office, switching means at said other office associated with said trunk and means at said one office responsive to said momentary interruption of the flow of current in said trunk for controlling said switching means.

10. A telegraph exchange system comprising a main office, a branch office, a trunk terminating at the main office, printers adapted to be interconnected through said trunk, means including a source of current at the main office for impressing potential of one polarity on said trunk during idle periods, means at the branch office for momentarily interrupting the flow of current in said trunk to initiate a call to the main office and means including a relay normally in said trunk circuit at the main office responsive to said momentary interruption for changing at its contacts the character of the potential connected to said trunk to indicate the seizure thereof for communication.

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