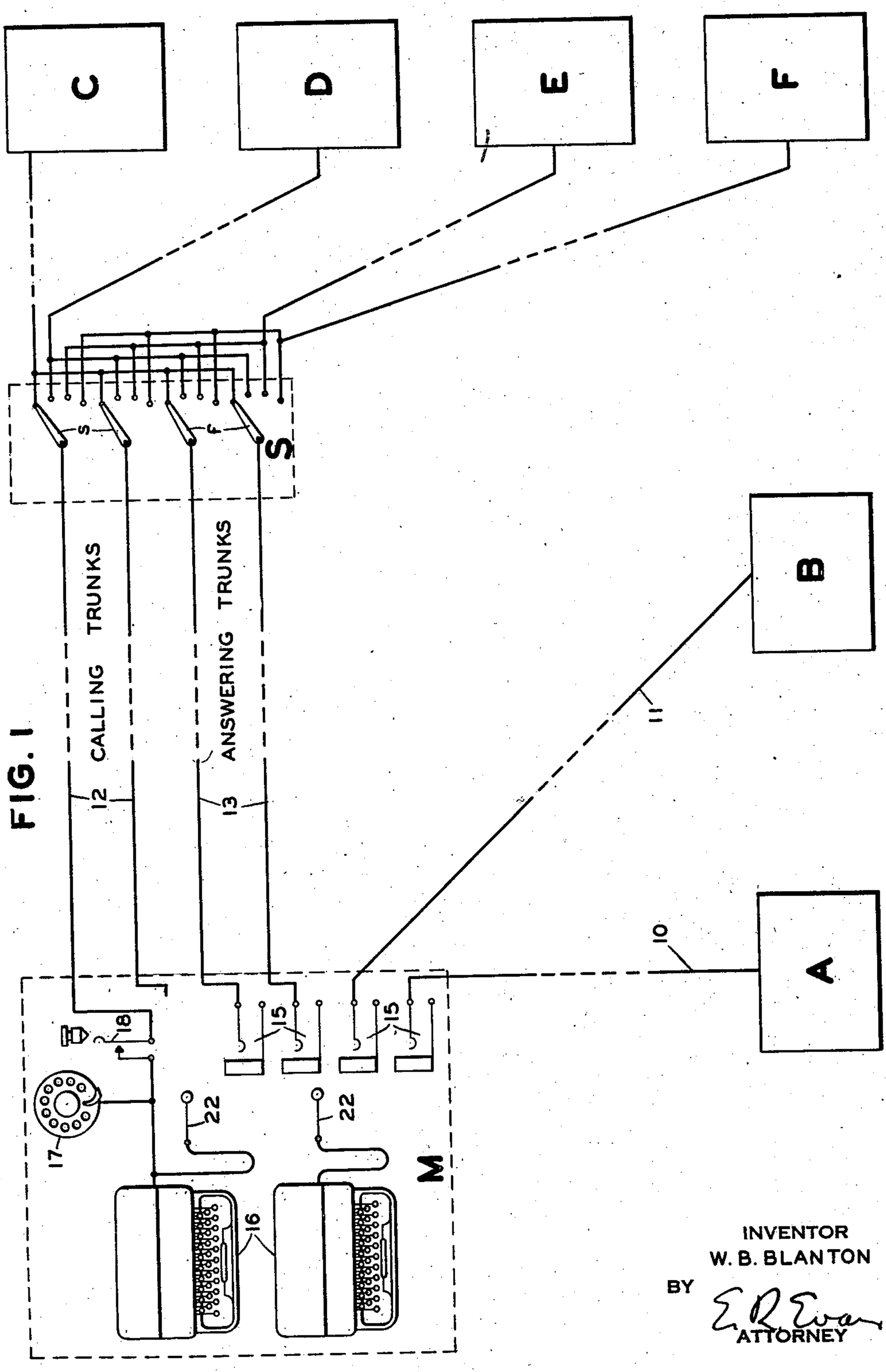
Dec. 31, 1940. W. B. BLANTON 2,227,121

PRINTING TELEGRAPH SYSTEM

Filed March 29, 1938 3 Sheets-Sheet 1

FIG. 1



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PRINTING TELEGRAPH SYSTEM

Filed March 29, 1938 3 Sheets-Sheet 2

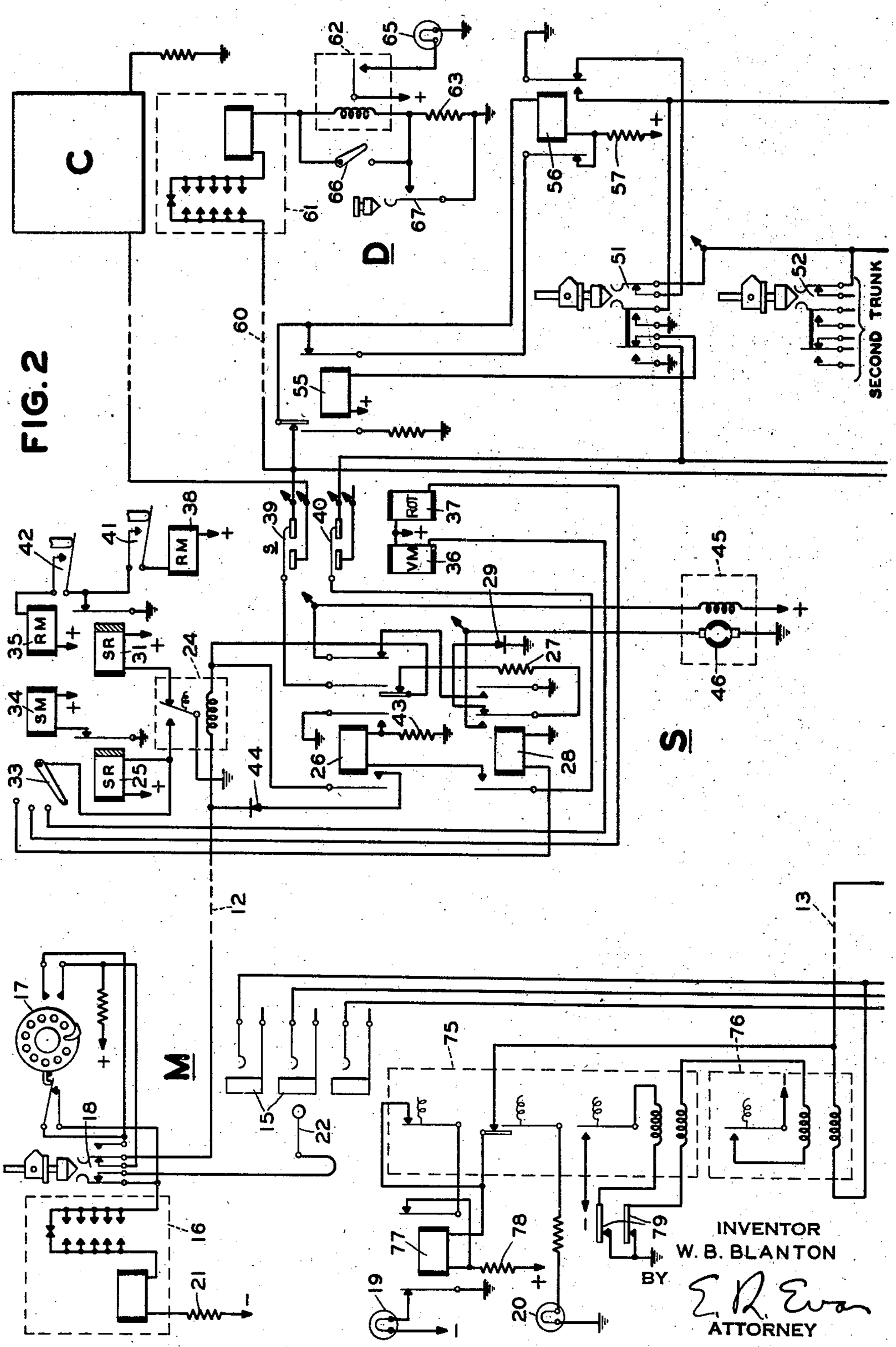

FIG. 2

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PRINTING TELEGRAPH SYSTEM

Filed March 29, 1938 3 Sheets-Sheet 3

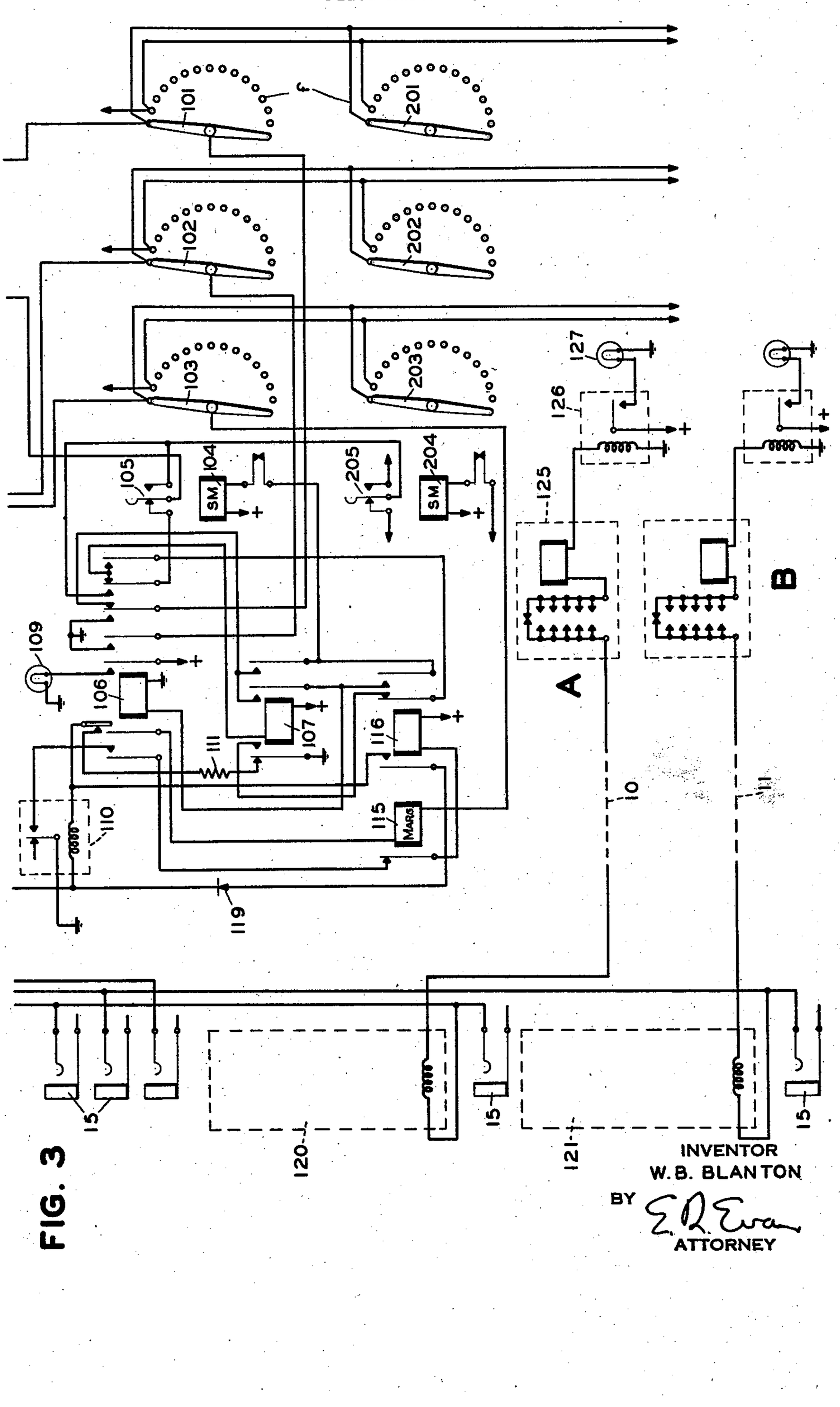

FIG. 3

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UNITED STATES PATENT OFFICE

2,227,121

PRINTING TELEGRAPH SYSTEM

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Application March 29, 1938, Serial No. 198,633

22 Claims. (Cl. 178—2)

This invention relates to printing telegraph systems, and more particularly to multi-office systems embodying a central station and a plurality of branch offices or stations.

The primary object of the invention is to decrease the number of channels or circuits required between the branch offices and the main office or central station of a multi-office system, or to increase the telegraph facilities between outlying branch offices and the central station or main office.

A telegraph system to which the invention is applicable would be one where a considerable number of branch offices or stations are located in a relatively small area remote from the central station, or so located that the installation or maintenance of connecting circuits is difficult or expensive, as for example where a group of branch stations are located on the opposite side of a river or a bay from the central station so that a connecting cable is required. In order to decrease the size of the cable required or to provide for increased facilities as the number of branch offices increases, in accordance with the invention, switching means would be provided in connection with the signaling channels from the central station arranged to connect the signaling channels to a wanted branch station, or in the case of a call from a branch station, to connect the calling station to an idle one of the signaling channels to the central station. In this manner a comparatively large number of branch stations may be operated over a small number of common signaling channels to the central station.

It is an object of the invention to provide a multi-office telegraph system having a switching center for controlling the channels between the respective offices, which switching center may be remote from the central office and all, or all but one, of the branch offices. Since the printers in the printing telegraph system embodying the invention may be used by subscribers or patrons as well as in branch offices of the telegraph company, the term "branch office" is intended to cover a subscriber's or patron's office.

Another object of the invention is to provide a multi-office telegraph system having switching means for connecting the central office to a wanted branch office and vice versa in which some of the branch office lines are used only in calling from the central office and others only in calling from branch offices.

Another object of the invention is to provide a multi-office system of the character described adapted for central offices having a concentrator for selectively connecting operator's printers with calling and called branch offices and preferably a concentrator having terminals of direct lines to branch offices as well as terminals of branch offices connected through the switching center.

Another object of the invention is to provide a multi-office system of the above character having concentrator operator's sets at the central office adapted to be connected either to direct branch-office lines or switching center channels and to provide certain guard features to prevent the operator from sending into switching center channels before connection has been made to a remote branch office and for other purposes.

Another object of the invention is to provide a telegraph system having selector switches to connect to wanted lines, the switches being controlled by current impulses transmitted over the telegraph lines or circuits, and in which the operativeness of the telegraph transmitter depends either upon the prior transmission of selective impulses for setting the selector switch or upon the connection to telegraph receiving apparatus. This feature of the invention prevents an inadvertent attempt to transmit a message before the connection has been extended to the wanted line or office.

Other objects and advantages of the invention will appear from the following description of the system shown on the accompanying drawings wherein

Fig. 1 is a schematic diagram of the preferred embodiment of the invention, and

Figs. 2 and 3 are diagrammatic views of the detailed circuits of the system shown in Fig. 1.

Referring to Fig. 1, a typical system embodying the invention comprises a central station or main office M, a plurality of branch offices or patrons' offices A and B connected by direct line circuits 10 and 11 to the main office, and other branch offices C, D, E and F adapted to be connected to the main office through the switching center S and branch office channels or trunks 12 and 13. It will be apparent that by the provision of selectively operable switches at the switching center S to control the connection of a calling or called branch office to the channels 12 and 13, the number of such channels may be considerably less than the number of branch offices since the latter are not in continual operation. The invention is of particular value therefore where the installation or maintenance of the circuits 12 and 13 is difficult or expensive,

or where additional branch offices are required by the growth of the system in the proximity of the branch offices C, D, E and F, since the additional offices may be placed in service without the installation of additional trunk circuits to the main office.

As shown, the trunk circuits 12 are employed in selecting a wanted branch office from the main or central station and are designated "calling" trunks, whereas the trunk circuits 13 are accessible to calling branch offices and are designated "answering" trunks. The calling trunks 12 terminate at the switching center S in selectors *s* which are controlled from the central station or main office in order to connect a wanted branch office. On the other hand, when one of the branch offices C, D, E or F has a message to send to the central station, the branch office operator transmits a signal as by depressing a key of the printer keyboard whereupon one of the finder switches *f* at the switching center connects the branch office to one of the answering trunks 13 to the main office or central station M.

After a connection is established between one of the branch offices C, D, E or F, and the main office M over either a calling trunk or an answering trunk, two-way communication may be had between the main and branch offices. On the other hand, if the main office places a call for a branch office which is already connected to the main office or has initiated a call thereto, a busy signal is transmitted from the switching center S to the operator who is attempting to call the busy branch office.

At the main office or central station M a concentrator or switchboard represented by the connecting jacks 15 and switchboard plugs 22 may be employed to connect the operator's printers 16 at the main office to any calling or called branch office. As indicated, the concentrator switchboard may include terminals of both direct lines 10 and 11 to branch offices and channels 12 and 13 to the switching center S. Certain of the operator's printers at the main office are provided with a calling dial 17 and a key or switch 18 whereby the printer may be connected to one of the calling trunks 12 and impulses transmitted over the calling trunk for controlling the selector switches *s*. In accordance with another feature of the invention, the selection, control and intelligence signals, and in the case of an attempted call to a busy branch office, the busy signal, are transmitted over a single line conductor. In accordance with a still further feature of the invention provision is made whereby the operator's printer 16 will not function after actuating the key 18 if an attempt is made to transmit message signals over a calling trunk 12 before the dial 17 has been operated or a branch office has been connected by the associated selector switch S.

For a better understanding of the present invention, reference may be had to Figs. 2 and 3 illustrating the detailed circuits of the system shown in Fig. 1. In Fig. 2 is shown the operator's printer 16 associated with one of the calling trunks to the switching center, together with the selector switch individual to said trunk and substations C and D to which connections are made through the switching center. Fig. 3 shows the finder switches for connecting a substation originating a call to the main office M through the switching center, together with two of the branch offices A and B connected by direct line circuits to the main office M.

The apparatus at the main office M includes a concentrator or switchboard for connecting operator's printers to the branch office lines of the type disclosed in the patent to Drake and Blanton, No. 1,804,327 dated May 5, 1931. Reference may be had to said prior patent for a complete description of the main office equipment, certain features of which have been omitted for the sake of simplicity. In general, the concentrator comprises manual switching equipment such as plugs and jacks for connecting any printer to any branch office line to answer calls from branch offices and to originate calls to the branch offices. The terminals of each branch office line are multipled to each operator's position and the system is further provided with a "call" lamp 19 for each line and "busy" lamp 20 for each operator's position, the "call" lamp 19 being lighted when a call is initiated to the main office from a branch office, as for example by the branch office operator momentarily interrupting the line circuit. The line circuits are normally connected to positive battery at the main office until an operator plugs in a printer to originate or answer a call, whereupon the polarity of the line circuit is reversed.

The printer 16 shown in Fig. 2 is arranged to be used in connection with transmission to or from the branch offices A and B (Fig. 3) connected by the direct line circuits 10 and 11 to the main office M and also for transmission of messages through the switching center S to and from the remote branch offices, such as C and D (Fig. 2). The calling trunk 12 shown in Fig. 2 is representative of the several calling trunks provided, the number of which depends upon the peak message load. Since each of the calling trunks is similar to the trunk 12, and the apparatus associated with each of the answering trunks 13 is also similar to that shown, a description of the operation of one calling trunk and one answering trunk will suffice.

Call from main office to branch office

A polarized relay 24 is connected in series relation with the calling trunk 12 to respond to current impulses for controlling the selector *s* transmitted over said trunk. The armature of said relay is provided with mechanical bias as shown, or with electrical bias tending to hold said armature against its right hand contact. The armature of relay 24, however, is held in engagement with its left hand contact by the current traversing the calling trunk 12 when idle and thereby energizes associated relay 25 during this period. The circuit of relay 24 may be traced from positive battery at the main office through the right hand break contacts of the key switch 18, conductor 12, the winding of relay 24, the make-before-break contacts associated with the middle right hand armature of relay 26, resistance 27, the inner right hand armature and back contact of relay 28 and a rectifier 29 to ground. The rectifier 29 is poled to pass the line current flowing when the trunk 12 is connected to positive battery at the main office.

When the operator at the main office desires to initiate a call through the switching center S to one of the branch offices, for example branch office D, the key or switch 18 is operated, it being assumed that the printer 16 is idle and the plug 22 associated therewith is removed from the

switchboard. In any event the cord circuit including the plug 22 is opened at the left hand break contacts of switch 18. Upon the operation of key 18, the above-described circuit of relay 24 is interrupted at the break contacts of said key and a new circuit is established through the right hand make contacts of said key, the off-normal contacts of the dial 17, the contacts and printer magnet of the printer 16 and resistance 21 to negative battery. As a result of the reversal of polarity, the flow of current in the conductor 12 and winding of relay 24 is decreased to a relatively small value by the rectifier 29 and the armature of relay 24 is actuated into engagement with its right hand contact by the retractile spring or bias of said relay.

Upon the release operation of relay 24 the circuit of relay 25 is broken and a circuit is closed through the right hand contact of relay 24 for energizing relay 31, relays 25 and 31 being both of the slow-to-release type. The apparatus at the switching center is now in condition for operation in response to the transmission of selector impulses from the dial 17 at the main office.

It will be noted that a different switching operation, i. e., operation of the key 18, precedes the dialing of a call through the switching center whereas in the case of calls to the branch offices A and B, the operator plugs the connection into a jack representing the wanted office. In the latter instance, the operator may commence transmission immediately or upon the reception of "GA" (go ahead) from the branch office. In order to prevent the operator from proceeding in this manner inadvertently in the case of a call through the switching station, the line circuit is opened in effect by the rectifier 29 until after the number of the wanted station has been dialed. The printer 16 is of the start-stop type, operating in response to rest and marking current impulses and start and spacing impulses of zero current. Thus the printer runs idle while the line current is zero and the operator cannot send until normal line current corresponding to the normal rest condition is established.

Any suitable form of selector switch may be employed in the switching center. For the purpose of explaining the invention, a conventional two-motion step-by-step selector switch is shown having an auxiliary minor switch 33 controlled by a stepping magnet 34 and release magnet 35. The selector switch comprises vertical and rotary stepping magnets 36 and 37, respectively, and a release magnet 38 adapted when energized to permit the restoration of the arms or wipers of the selector switch to normal. The upper switch wiper 39 of the selector is adapted to extend the calling trunk 12 to the line extending to the called branch office and the lower wiper 40 of the selector is arranged to test the busy or idle condition of the called office to guard against the seizure of a busy line. The stationary contacts of the respective selector switches associated with the several calling trunks 12 are multipled together, and in case the called office has already been selected by another operator or a call initiated from said office, the contacts engaged by the test wipers of the other selectors have ground potential thereon which serves to prevent the connection to the busy office in a manner that will be described.

The operation of the selector in response to the actuation of the calling dial 17 is as follows: when relay 25 becomes deenergized as described above, a circuit is closed through the armature and back contact of said relay for energizing the stepping magnet 34 of the minor switch 33, whereupon the movable switch arm of said switch is stepped into engagement with the second contact thereof. When the operator dials the first digit of the wanted branch office D, the off-normal contacts of the dial are opened and the dialing contacts are closed a number of times corresponding to the number dialed. The closure of the dialing contacts of the dial 17 connects positive battery to the calling trunk 12 which at this time is disconnected from negative battery by reason of the opening of the off-normal contacts of said dial, each current impulse from the calling dial 17 thus momentarily energizing the polar relay 24 and actuating the armature thereof momentarily into engagement with its left hand contact. Relay 25 thus becomes reenergized and again opens the circuit of the stepping magnet 34 of the minor switch. However, since relay 25 is a slow-to-release relay, its armature remains attracted during the series of impulses from the calling dial 17 and these impulses are reproduced by the armature of relay 24 through a circuit including the left hand contact of said relay, the switch arm of the minor switch 33 and the vertical magnet 36 of the selector switch so that the wipers of said switch are actuated a number of steps corresponding to a number of impulses dialed by the operator. At the end of the first series of impulses the slow-to-release relay 25 becomes deenergized, reclosing the circuit of stepping magnet 34 to step the wiper of the minor switch 33 to the third contact thereof. Slow-to-release relay 31, however, remains sufficiently energized to maintain its armature attracted during the entire dialing operation.

The operator now dials the second digit of the number of the called office, whereupon the above operations are repeated except that the selective impulses are diverted through the minor switch 33 to the rotary magnet 37 of the selector switch. In this manner the wipers 39 and 40 of the selector switch are actuated into engagement with the terminals corresponding to wanted office D. At the end of the second series of impulses slow-to-release relay 25 again becomes deenergized and again closes the contact of the stepping magnet 34 of the minor switch, whereupon the wiper thereof is actuated into engagement with its fourth contact.

Upon the operation of the minor switch as described, a circuit is closed from positive battery through the winding of relay 25, the minor switch 33 and the winding of relay 28 to ground, whereupon relays 25 and 28 become energized. Assuming that the wanted branch office is idle, the operation of relay 28 closes a circuit from ground through resistance 43, for example of 1000 ohms, the winding of relay 26, left hand armature and front contact of relay 28, the test wiper 40 of the selector s and the associated bank contact, the left hand break contacts of the trunk busying key 51 and the winding of relay 55 to positive battery, whereupon relay 55 becomes energized and relay 26 is sufficiently energized to close its inner right hand armature and preliminary make contact, whereupon the resistance 43 is shunted by the last-mentioned contact and a much larger current flows through the circuit. This increased flow of current causes relay 26 to become fully operated whereupon the calling trunk 12 is connected through the middle

right hand armature of relay 26, the wiper 39 of the selector s to the line 60 extending to the called branch office D. Likewise the relay 26, at its left hand armature and front contact closes a shunt circuit through the rectifier 44 around the winding of polar relay 24. The rectifier 44 is poled so as to oppose the flow of current through this shunt circuit when positive potential is applied to the trunk 12 at the main office, but to offer a relatively low-resistance shunt path around the winding of relay 24 under normal transmitting conditions when negative potential is supplied at the main office. The purpose of this rectifier is to improve the transmission characteristics of the trunk circuit by removing the inductance of the winding of relay 24 from the circuit, while at the same time not to interfere with the signaling and control functions of the system.

The line circuit 60 extending to the branch office D is normally connected through the make-before-break contacts associated with the left hand armature of relay 55, the winding of relay 56 and resistance 57 to positive battery. Relay 56 is thus normally energized, its circuit further including the contacts and printer magnet of the printer 61, the winding of polar relay 62 and resistance 63. When a connection is made as described above to the line circuit 60 through one of the selector switches and relay 55 becomes energized as described above, relay 56 is maintained energized through the left hand armature and make contact of relay 55 to prevent initiating a false call to the apparatus associated with the answering trunks 13. The connection to positive battery through resistance 57, relay 56 and polar relay 62 maintains the contacts of the polar relay 62 open. However, when negative battery is applied through the selector switch s to the line circuit 60 from the main office, the contacts of polar relay 62 are engaged and light the "call" lamp 65. In response to the call the branch office operator closes the switch 66 shunting out the inductance of the polar relay 62, the switch being arranged if desired to start the motor of the printer 61. Alternatively, the driving motor of the printer if not running continuously may be started by the operation of relay 62. The operator at the branch office D now sends "GA" (go ahead) whereupon the main office operator is apprised of the fact that the branch office has answered and transmission proceeds in the usual manner. Since the contacts and operating magnets of the printers 16 and 61 are in series, two-way communication may be had over the trunk 12 and branch office line 60.

At the end of the exchange of business, the main office operator restores the key 18 thereby disconnecting the trunk circuit 12 from the printer and connecting the same to positive battery through the right hand break contacts of the key. The reversal of the current in the line circuit as the result of the reversal of the polarity of the battery connected thereto at the main office causes the armature of polar relay 24 to move against its left hand contact thereby interrupting the circuit of relay 31. Relay 31 becomes deenergized and closes through its armature and back contact, and the off-normal contacts 41 and 42 of the selector switch and minor switch, respectively, circuits for energizing the release magnets 38 and 35 of said switches, whereupon the switches are restored to normal. When the wipers of the selector and minor switches are restored to their normal positions, the off-normal contacts 41 and 42 are opened. The restoration of the minor switch 33 also interrupts the above-described circuit of relay 28 whereupon this relay becomes deenergized and interrupts the circuit of relays 26 and 55 through its left hand armature and front contact. The circuit of relay 55 is also interrupted by the restoration of the test wiper 40 of the selector switch to normal. Relays 26 and 55 are thus deenergized so that all equipment and circuits at the main office and the switching center are restored to normal in readiness for use in establishing another connection.

Upon the deenergization of relay 55, the branch office line circuit 60 is reconnected through the make-before-break contacts associated with the left hand armature of said relay to the positive battery at the relay 56. The polar relay 62 at branch office D is thus operated in such a manner as to open the circuit of the call lamp 65. The operator opens the switch 66 arranged in shunt relation to the relay 62 so that the signaling equipment at the branch office is in readiness to receive another call.

In the above description it was assumed that the branch office D was idle at the moment when the selector switch s connected the calling trunk 12 to the terminals of said branch office. If the branch office D had been busy, the lower bank contact engaged by the test wiper 40 would have been at or near ground potential. In the case of a previous call initiated from the main office through one of the other selectors s, the test bank contact would have been grounded through the left hand armature of a relay corresponding to relay 28 and the winding and right hand inner armature and front contact of the relay corresponding to relay 26. In the case of a previous call initiated from the branch office D, the bank contact would have been grounded at the finder switch f as will be described hereinafter. The bank contact may also be grounded by the busying key 51 in case a branch office circuit is to be disconnected from service during testing or repairs being effected on the branch office circuit.

When the selector switch s is operated to connect to the branch office D when the latter is busy, the ground potential on the test contact which is connected through the test wiper 40 and the left hand armature and front contact of relay 28 to the test relay 26 does not operate relay 26 since this relay is also connected to ground through the resistance 43. Relay 26 thus does not become energized in case an attempt is made to connect to a busy branch office and therefore the calling trunk 12 is not connected through the middle right hand armature and front contact of said relay to the switch wiper 39, but remains connected through the make-before-break contacts associated with said relay, the resistance 27, the right hand inner armature and front contact of relay 28 to the busy signal transmitter 45 having interrupter contacts 46 connected to the front contact associated with the inner right hand armature of relay 28. The transmitting device 45 may be a motor driven commutator arranged to send signaling impulses of any desired character to the printer 16 to indicate that the desired branch office or patron's office is busy. The transmitter may be running continually or started if desired upon the closure of a circuit through the outer right hand armature and front contact of relay 28 and the outer right hand armature and back contact of relay 27 as shown. Thus, if an attempt is made to connect to a busy

branch office, the connection is not effected but the calling operator is signaled that the branch office dialed is busy.

If the operator restores the key 18, the switching center equipment is restored to normal in the same manner as in the case of a completed call described. However, if the operator does not restore the key 18 but waits until the wanted branch office is idle, the connection will be automatically effected between the calling trunk 12 and the branch office when the latter becomes idle. The idle condition of the branch office will be indicated by the removal of ground potential from the lower bank contact associated with the test wiper 40 whereupon test relay 26 will be energized in series relation with the relay 55 as described above in the case of a call to an idle branch office. The energization of relay 26 will interrupt the busy signaling circuit from the busy signal transmitter 45 and will connect the calling trunk 12 through the switch wiper 39 to the called branch office. Subsequent operations of the system will be the same as described above in connection with a completed call to an idle line.

Call initiated from a branch office

Assuming that the driving motor of the printer at the branch office D is running continually or has been started by the operation of a conventional manual starting switch, the branch office operator initiates a call to the main office by pressing any key on the printer, thereby momentarily opening the line circuit 60 extending to the switching center and interrupting the current through series relay 56. As explained above, relay 56 is normally energized when the system is idle, its circuit including the make-before-break contacts associated with the left hand armature of relay 55, the conductor 60 to the branch office, contacts and printer magnet of printer 61, the winding of relay 62 and resistance 63 to ground at the branch office. When relay 56 becomes deenergized as described above, a short-circuit around the winding of said relay is closed through the left hand armature and back contact of relay 55. Thus relay 56 remains deenergized until the circuit has been restored and the short-circuit opened by the operation of relay 55.

Upon the deenergization of relay 56 as described, a start circuit is closed from ground through the right hand armature and back contact of said relay, the right hand break contacts of the key 51, the break contacts of the trunk busying key 105, Fig. 3, the fourth right hand armature and back contact of relay 106 and the winding of relay 107 to battery whereupon relay 107 becomes energized. The respective finder switches *f* are each associated with individual answering trunks 13 to the main office and the foregoing description assumes that the first finder switch comprising movable arms or wipers 101, 102 and 103 and stepping magnet 104 was idle when the call was initiated from the branch office D. If the first finder switch associated with the first answering trunk 13 had been busy, relay 106 would have been energized as will be described hereinafter and the start circuit from the right hand armature and back contact of relay 56 would be transferred from the fourth right hand armature and back contact of relay 106 to the front contact associated with said armature through the break contacts of busying key 205 to the control equipment associated with the second finder switch comprising the wipers 201, 202, and 203 and the stepping magnet 204. A plurality of finder switches are thus provided, one for each answering trunk, sufficient to take care of the maximum number of simultaneous calls from the group of branch offices C, D, etc.

Upon the operation of relay 107 as described above, the left hand armature of said relay opens the circuit including the trunk 13 to the main office to initiate a call to said office. As shown, the trunk 13 is connected through the winding of polar relay 110, the make-before-break contacts associated with the inner left hand armature of relay 106, resistance 111 and the left hand armature and back contact of relay 107, to ground.

The trunk 13 terminates at the main office in signaling and control equipment of any suitable character. As shown in Fig. 2, the control equipment comprises relays 75, 76 and 77, arranged to control the "call" and "busy" lamps 19 and 20, together with interrupter contacts 79 arranged as shown in the above mentioned prior patent to Drake and Blanton. The trunk circuit is normally connected through the make-before-break contacts associated with the middle armature of relay 75, the winding of relay 77 and the resistance 78 to positive battery. The described circuit normally maintains relay 77 energized and because of the connection to positive battery operates the series polar relay 110 at the switching center to maintain the armature thereof in engagement with its left hand contact.

Upon the momentary interruption of the trunk circuit as described, relay 77 becomes deenergized and closes through its right hand armature and back contact and the upper armature and back contact of relay 77 a short circuit around its own winding so that the relay remains deenergized upon the reclosure of the line circuit. The deenergization of relay 77 also closes through its left hand armature and back contact the circuit of "call" lamp 19, whereupon this lamp becomes lighted to indicate to the operator that a call has been received on the trunk 13 from a remote branch office.

When the operator plugs a printer such as the printer 16 into the jack 15 associated with the trunk circuit 13, the trunk circuit 13 is extended through the lower winding of relay 76 to the corresponding jack 15, the plug 22, the left hand break contacts of the key 18, the contacts and printer magnet of the printer 16 and resistance 21 to negative battery, whereupon the polarity of the line current in the trunk circuit 13 is reversed and relay 76 is energized. The energization of relay 76 closes through its armature and front contact, the lower winding of relay 75 and the lower interrupter contact 79 a locking circuit for relay 76 and an operating circuit for relay 75. The energization of relay 75 at its middle armature and front contact opens the above described circuit of relay 77 and closes the circuit for operating the "busy" lamp 20. The energization of relay 75 further closes at its lower armature and front contact a locking circuit for said relay including the upper interrupter contact 79. The operator's printer at the main office is now connected to the calling circuit, but before this connection has been made a finder switch *f* has operated to connect the calling branch office to this main office line circuit in a manner which will now be described.

The bank contacts associated with the wipers

mally grounded by the relays 56 associated with the respective branch office circuits. When, however, a call is initiated from one of the branch offices as described above, ground potential is removed by relay 56 from the bank contact in each of the finder switches, corresponding to the calling branch office. Upon the operation of relay 107, as described above, a circuit is closed from positive battery to the stepping magnet of the first idle finder switch, for example, the stepping magnet 104 of the first finder switch and the interrupter contacts thereof, the outer right hand armature and front contact of relay 107, the third right hand armature and back contact of relay 106, wiper 101 to ground potential, assuming that the wiper 101 is not already in engagement with the bank contact corresponding to the calling branch office. In response to the energization of stepping magnet 104, the switch wipers 101, 102 and 103 are stepped until the wiper 101 reaches the ungrounded contact individual to the calling office, at which time the stepping magnet 104 becomes deenergized and the switch wipers remain in engagement with the bank contacts associated with the calling office.

Upon the energization of relay 107 as described above, a circuit is also closed from positive battery through the stepping magnet 104 of the finder switch, the outer right hand armature and front contact of relay 107, the inner right hand armature and front contact of said relay and the winding of relay 106 to ground. However, as long as wiper 101 of the finder switch is stepping over grounded contacts the winding of relay 106 is short circuited and the relay is not energized. However, as soon as the wiper 101 reaches the contact associated with the calling branch office which is not grounded, relay 106 becomes energized. The outer right hand armature and the front contact of relay 106 are adjusted to engage before any of the other contacts of said relay are made or broken and a circuit is thus closed from battery through the winding of relay 107, the outer right hand armature and front contact of relay 106, the inner right hand armature and back contact of relay 116 and the left hand armature and front contact of relay 107 whereby the latter relay is maintained energized in spite of the fact that this original circuit is broken at the fourth right hand armature and back contact of relay 106. The energization of relay 106 through its fourth right hand armature and front contact transfers the start circuit through the busying key 105 to the control equipment associated with the second finder switch through the break contacts of the second busying key 205. Hence the second finder switch will be started to hunt for the next branch office that initiates a call through the switching center to the main office M. This connection will be established in the same manner as described above in connection with the call initiated in the branch office D through the first finder switch. The energization of relay 106 also interrupts at its third right hand armature and back contact the above described circuit between the wiper 101 of the finder switch and the stepping magnet 104, and at the front contact associated with said armature connects ground potential to the wiper 101 so that the bank contact multiple with which said wiper is engaged is grounded and will not be selected by another finder switch. The energization of relay 106 also grounds through its second right hand armature and front contact, and the wiper 102 of the finder switch and its associated bank contact the test contacts of the selector switches S at the switching center to cause a busy signal to be transmitted to the main office if the main office operator attempts to call the branch office D which has initiated a call to the main office.

The inner right hand armature and front contact of relay 106 closes the circuit of busy lamp 109 which may be disposed adjacent the trunk busy key 105 to prevent a repairman from cutting the trunk control equipment out of service by operating said key when the trunk is in use.

The energization of relay 106 further closes through its inner left hand armature and front contact, a circuit for extending the main office trunk 13 through the winding of marginal relay 115, the wiper 103 of the finder switch and its associated bank contact and the branch office trunk 60 to the calling branch office D. The transmission circuit is thus completed between the calling and called offices as soon as the main office operator plugs the printer 16 into a jack associated with the answering trunk 13. The marginal relay 115 however does not operate on normal line circuit.

The energization of relay 110 as described above, closes a circuit from ground through the armature of relay 110, the right hand contact thereof, and left hand outer armature and front contact of relay 106, the armature and back contact of relay 115 and the winding of relay 116 to battery, whereupon relay 116 becomes energized. The energization of relay 116 closes a shunt circuit through the left hand armature and front contact thereof and the rectifier 119 around the winding of polar relay 110. The purpose of this shunt circuit around the winding of the polar relay which is in series relation with the transmission circuit, is the same as the corresponding circuit described above in connection with the polar relay 24. However, relay 110 is not biased, and the armature thereof remains in engagement with either contact when the current through its operating winding is made and broken so long as the polarity of the current is not reversed.

The outer right hand armature and front contact of relay 116 are adjusted to close before any of the other contacts of said relay are closed or broken. A circuit is thus closed initially from the winding of relay 106 through the outer right hand armature and front contact of relay 116 and the winding of stepping magnet 104 for holding relay 106 energized. However, the current flowing in this circuit on account of the resistance of the winding of relay 106 is not sufficient to energize the stepping magnet 104. Upon the energization of relay 116 as described, the circuit of relay 107 is interrupted at the right hand inner armature and back contact of relay 116, whereupon the relay 107 becomes deenergized.

The printers 16 and 61 at the main office and branch office, respectively, are now interconnected for two-way communication through the wiper 103 of the finder switch *f*. After the exchange of business between the respective offices, the operator at the main office will disconnect her cord circuit by withdrawing the plug from the jack 15, whereupon positive battery is again connected to the answering trunk 13 upon the deenergization of relays 75 and 76 and the apparatus at the switching center S and main office M is restored to normal. Likewise the branch office operator may operate the marginal relay 115 by closing the key 67, to release the finder switch 103 and restore the apparatus at the switching center

to normal. If the main office operator disconnects the printer 16 first, the reversal of polarity of the battery connected to the trunk 13 causes the armature of polar relay 110 to be actuated into engagement with its left hand contact, thereby opening at the right hand contact of said relay the energizing circuit of release relay 116. Relay 116 becomes deenergized and opens at its outer right hand armature and front contact the energizing circuit of relay 106, whereupon said relay becomes deenergized.

The deenergization of relay 106 at its fourth right hand armature transfers the start circuit back to the winding of relay 107 so that the first finder switch will respond to the next call initiated from one of the branch offices. Likewise, the restoration of the second right hand armature of said relay removes ground potential from the wiper 102 of the finder switch, from the winding of relay 55 and from the test contacts in the test banks of the selector switches *s*. Thus the branch office line will no longer test busy if an attempt is made to connect thereto from one of the calling trunks 12. Relay 55 becomes deenergized and opens at its left hand armature and front contact the circuit of relay 56, but said relay remains energized through the make-before-break contacts associated with the left hand armature of relay 55 in series relation with the printer 61 and relay 62 at the branch office D.

The switching equipment at the switching center is thus restored to normal when the operator at the main office disconnects the printer 16 from the answering trunk 13. The disconnection of the printer 16 as described also disconnects the negative battery at the printer from the operating winding of relay 76 and upon the opening of the lower interrupted contact 79 relay 76 becomes deenergized. The interrupter contacts 79 are opened successively and intermittently, thereby intermittently opening the locking circuits of relays 75 and 76. Therefore, after relay 76 has become deenergized, as described, the upper interrupter contact 79 opens the locking circuit of relay 75 and this relay becomes deenergized. Upon the deenergization of relay 75 the circuit of the busy lamp 20 is opened at the middle armature and front contact of said relay, but relay 77 remains energized through the make-before-break contacts associated with said armature in series relation with the answering trunk 13 and the winding of relay 110 at the switching center. In this manner, the control equipment associated with the concentrator at the main office is also restored to normal when the operator withdraws the plug 22 from the jack 15 as described above.

If the branch office operator closes the key 67 before the main operator restores the switching equipment at the switching center to normal, the marginal relay 115 in series relation with the line circuit is operated by the increased line current when the resistance 63 is short-circuited. Upon the energization of relay 115 the circuit of release relay 116 is broken at the armature and back contact of relay 115 whereupon the control equipment at the switching center associated with the finder switch *f* is restored to normal in the same manner as described above in connection with the release of the equipment from the main office. Thus the branch office is released from the connection and made available for a call from another operator at the main office even if the operator who has been connected with the branch office fails to disconnect the main office printer promptly from the branch office line circuit.

In the case of calls to or from the branch offices A and B the operation of the system is essentially the same except that the main office operator plugs one of the printers 16 into a jack 15 individual to the wanted branch office A or B and, therefore, does not dial the number of the wanted office as in the case of a call to the branch offices connected through the switching center *s*. The line circuits 10 and 11 extending to the branch offices A and B terminate at the main office in control equipment associated with the concentrator and designated by the reference characters 120 and 121, each of which is similar to the control equipment shown in Fig. 2 associated with the trunk 13. Thus the lines 10 and 11 are normally connected to positive battery at the main office when the lines are idle, the polarity of the line current being reversed when the main office operator plugs the printer 16 in circuit. The polar relay 126 at the branch office in series with the printer 125 responds to the reversal of polarity thereby lighting the "call" lamp 127. At the end of the exchange of business, the main office control equipment is restored to normal as described above in connection with the apparatus associated with the trunk 13.

In order to initiate a call from one of the branch offices A or B, the branch office operator momentarily interrupts the line circuit as by pressing any key on the printer keyboard. The interruption of the line current initiates a call to the concentrator and lights the "call" lamp 19 in the same manner dsecribed above in connection with the initiation of a call over the answering trunk 13. When the main office operator plugs the printer 16 into the jack associated with the lighted "call" lamp 19, the printer magnets and contacts of the printers 16 and 125 are in series relation so that two-way communication can be carried on over the line circuit.

The foregoing detailed description of a system embodying the invention is merely for the purpose of explaining the invention. The system shown and described above may be modified in various ways without departing from the scope of the invention.

I claim:

1. A printing telegraph system comprising a central station, a plurality of branch stations, printing telegraph equipment of the current-impulse type at said stations, a plurality of signaling channels terminating at said central station, switching means remote from the central station and responsive to current impulses for connecting certain of said channels to any of said branch stations, means including the connected ones of said channels for controlling said switching means from the central station whereby said certain channels are employed for both selecting and signal transmission purposes, other switching means for connecting idle ones of said signaling channels to calling branch stations and means at the branch stations for controlling said other switching means to effect connections between calling branch stations and the central station.

2. A printing telegraph system comprising a central station, a plurality of branch stations, printing telegraph equipment at said stations, an intermediate switching station, signaling channels between said switching station and each of the other stations, switching means at the switching station for connecting central station channels to branch station channels, means for transmitting controlling impulses over a central sta-

tion signaling channel to operate said switching means to connect a branch station channel to said central station channel, means for controlling said switching means from a calling branch station to connect the channel extending to said branch station to an idle central station signaling channel and means operative after such connections have been completed at the intermediate switching station for operating the printing telegraph equipment at the connected stations over the same channels employed for setting up the connection.

3. A printing telegraph system comprising a central station, a plurality of branch stations, printing telegraph equipment at said stations, a plurality of signaling channels terminating at said central station and common to each of said branch stations, means for impressing a potential of one polarity upon a signaling channel to seize the same switching means for extending said channels to the branch stations and means at the central station to control said switching means to select a wanted branch station, said last mentioned means including means for impressing controlling impulses of opposite polarity upon the seized channel.

4. A printing telegraph system comprising a central station, a plurality of branch stations, printing telegraph equipment at said stations, a plurality of signaling channels terminating at said central station and common to each of said branch stations, switching means for extending said channels to the branch stations and means including said printing telegraph equipment at the branch stations to control said switching means to connect a calling branch station to an idle channel to the central station.

5. A printing telegraph system comprising a central station, a plurality of branch stations remote from said central station, printing telegraph equipment at said stations, a switching station common to said branch stations and remote from said central station and switching means at said switching station for connecting said central station and any of said branch stations, said switching means including a polarized impulse relay responsive to impulses transmitted from the central station.

6. A printing telegraph system comprising a central station, a plurality of branch stations remote from said central station, printing telegraph equipment at said stations, a switching station common to said branch stations and remote from said central station, switching means at said switching station for connecting said central station and any of said branch stations, and means for controlling said switching means from either said central station or said branch stations depending upon the origin of a call, said means for controlling the switching means from the central station including a polarized impulse relay arranged to respond to impulses of opposite polarity from the normal line polarity.

7. A printing telegraph system comprising a central station, a plurality of branch stations, a plurality of trunks or channels terminating at said central station, a source of signaling current of one polarity, means for connecting the same to said trunks or channels, switching means associated with said trunks or channels and remote from said central station and means for disconnecting said source of current from the line and for transmitting current impulses of opposite polarity for controlling said switching means to interconnect said central station with any of said branch stations through said trunks or channels.

8. A printing telegraph system comprising a central station, a plurality of branch stations, a plurality of trunks or channels terminating at said central station, selective switching means associated with said channels, means including said switching means for interconnecting said central station and any one of said branch stations, said means including impulse-transmitting means at the central station for transmitting impulses over said channels, and means for rendering a printer at the central station inoperative upon initiating a call from said last mentioned station until after said impulse-transmitting means has been operated to control the selective switching means.

9. A printing telegraph system comprising a central station, a plurality of branch stations, a plurality of trunks or channels terminating at said central station, selective switching means at the other terminals of said trunks or channels for extending said trunks or channels to any of the branch stations, impulse-transmitting means at the central station for controlling said switching means, printing telegraph equipment at said central station and branch stations, and means for rendering said trunks or channels initially inoperative for the transmission of printer signals and operative only after a predetermined operation of the selective switching means.

10. A printing telegraph system comprising a plurality of stations, a plurality of trunks or channels between said stations, printing telegraph equipment at said stations, selective switching means controlled over said trunks or channels for interconnecting said stations for operation, means for controlling said switching means over said trunks or channels and means for preventing the transmission of printer signals over said trunks or channels prior to the transmission of impulses for controlling said switching means.

11. A printing telegraph system comprising a plurality of stations, printing telegraph equipment at said stations, selective switching equipment for interconnecting said stations, means for controlling said selective switching equipment from a remote station, said means including a relay, and means for short-circuiting the winding of said relay after the operation of the selective switching means.

12. A printing telegraph system comprising a central station, a plurality of branch stations, a plurality of trunks or channels terminating at said central station, selective switching equipment associated with each of said channels remote from said central station for connecting any of said channels with any of said branch stations and means for controlling said switching equipment from said central station, said means including an impulsing device utilizing a potential having a polarity opposite to that employed for normal printer operation.

13. A printing telegraph system comprising a central station, a plurality of branch stations, a plurality of trunks or channels terminating at said central station, printing telegraph equipment at said stations, selective switching equipment associated with each of said channels remote from said central station, means for impressing a normal line condition upon any of said channels, means for impressing a second line condition upon said channels for communi-

cation purposes, and means for controlling said switching equipment, said last named means including an impulse transmitter arranged to reverse said line conditions and periodically interrupt said normal line condition.

14. A printing telegraph system comprising a central station, a plurality of branch stations, a plurality of trunks or channels terminating at said central station, selective switching equipment associated with each of said channels remote from said central station, means for impressing upon said channels different line conditions comprising a positive potential, a negative potential and a zero potential, means for controlling said switching equipment from said central station, said switching equipment including a relay, and means for rendering said relay responsive to only one of said line conditions.

15. A printing telegraph system comprising a plurality of stations, selective switching equipment for interconnecting said stations, a plurality of trunks or channels terminating at one of said stations, means for controlling the operation of said switching equipment from said one station, said means including any of said channels, means for effecting printer communication over any of said signaling channels, means for releasing said switching equipment from said one station, said means including said signaling channel and means for utilizing said signaling channel to provide an indication at said one station of the busy condition at one of said branch stations to which connection has been attempted.

16. A printing telegraph system comprising a central station, a plurality of branch stations, a plurality of trunks or channels terminating at said central station, switching equipment associated with each of said channels remote from said central station, and means including printing telegraph equipment at each of said branch stations for controlling said switching equipment from any of said branch stations to connect a calling branch station to said central station.

17. A printing telegraph system comprising a central station, a plurality of branch stations remote from said central station, a plurality of trunks or channels terminating at said central station, selective switching equipment associated with said channels for extending any one thereof to any of said remote branch stations, a plurality of branch stations having direct connection with said central station, printing telegraph equipment at each of said stations, and means for connecting the printing telegraph equipment of said central station alternatively for communication with any of said branch stations.

18. A printing telegraph system comprising a central station, a plurality of branch stations, a plurality of trunks or channels terminating at said central station, selective switching equipment associated with each of said channels remote from said central station, said equipment including means responsive to a reversal of the normal trunk polarity for directively controlling and releasing said equipment, and printer means responsive to interruptions of the normal trunk polarity for communicating between the central station and the connected branch station.

19. A printing telegraph system comprising a plurality of stations including a central station and branch stations remote therefrom, a plurality of trunks or channels terminating at said central station, selective switching equipment remote from said central station for extending any of said channels to any of said remote branch stations, means for controlling said switching equipment from any of said stations, a plurality of other branch stations adjacent said central station, a plurality of individual trunks or channels directly connecting said adjacent branch stations with said central station, printing telegraph equipment at all of said stations, and means for grouping all of said channels at the central station to afford the telegraph equipment of said central station access to the telegraph equipment of direct-connected branch stations and the branch stations connected through said switching equipment.

20. In a printing telegraph system, a transmitting circuit, printing telegraph equipment for transmitting and receiving printer signals over said circuit, a selector switch for extending said circuit to any desired one of a series of terminals, means for impressing signaling current of one polarity on said circuit and means for impressing controlling impulses of opposite polarity upon said circuit for stepping and releasing said selector switch whereby the transmission of printer signals does not effect the operation of the selector switch.

21. In a printing telegraph system, printing telegraph equipment, a line circuit, selective switching means associated with said line circuit for connecting the same to any desired one of a series of terminals, said selective switching means including a polarized relay connected to the line circuit, means including the printing telegraph equipment for impressing printer signals of one polarity upon the line circuit, means for impressing controlling impulses of opposite polarity upon the line circuit and means including said polarized relay responsive to said impulses of opposite polarity for controlling the selective switching means.

22. In a printing telegraph system, a plurality of offices, printing telegraph equipment at said offices, a line circuit extending from one of said offices, a selector switch associated with said circuit having a plurality of bank contacts and a movable switch member for engaging the same, means including said selector switch for initiating a call over said line circuit from said one of said offices to the printing telegraph equipment at a selected one of the other offices, means for controlling said selector switch including means for impressing controlling impulses of one polarity on said circuit to control the stepping of said switch by said impulses transmitted over the line circuit and means for impressing code signalling impulses of opposite polarity on said circuit for effecting signalling, said selector switch being responsive solely to said impulses of the first-mentioned polarity.

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DISCLAIMER

2,227,121.—*William B. Blanton*, Merrick, N. Y. PRINTING TELEGRAPH SYSTEM. Patent dated December 31, 1940. Disclaimer filed July 3, 1943, by the assignee, *The Western Union Telegraph Company*.

Hereby enters this disclaimer to claims 1, 2, 3, 4, 5, 6, 7, 11, 13, 15, 16, and 18 of the patent.

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