

March 31, 1936.

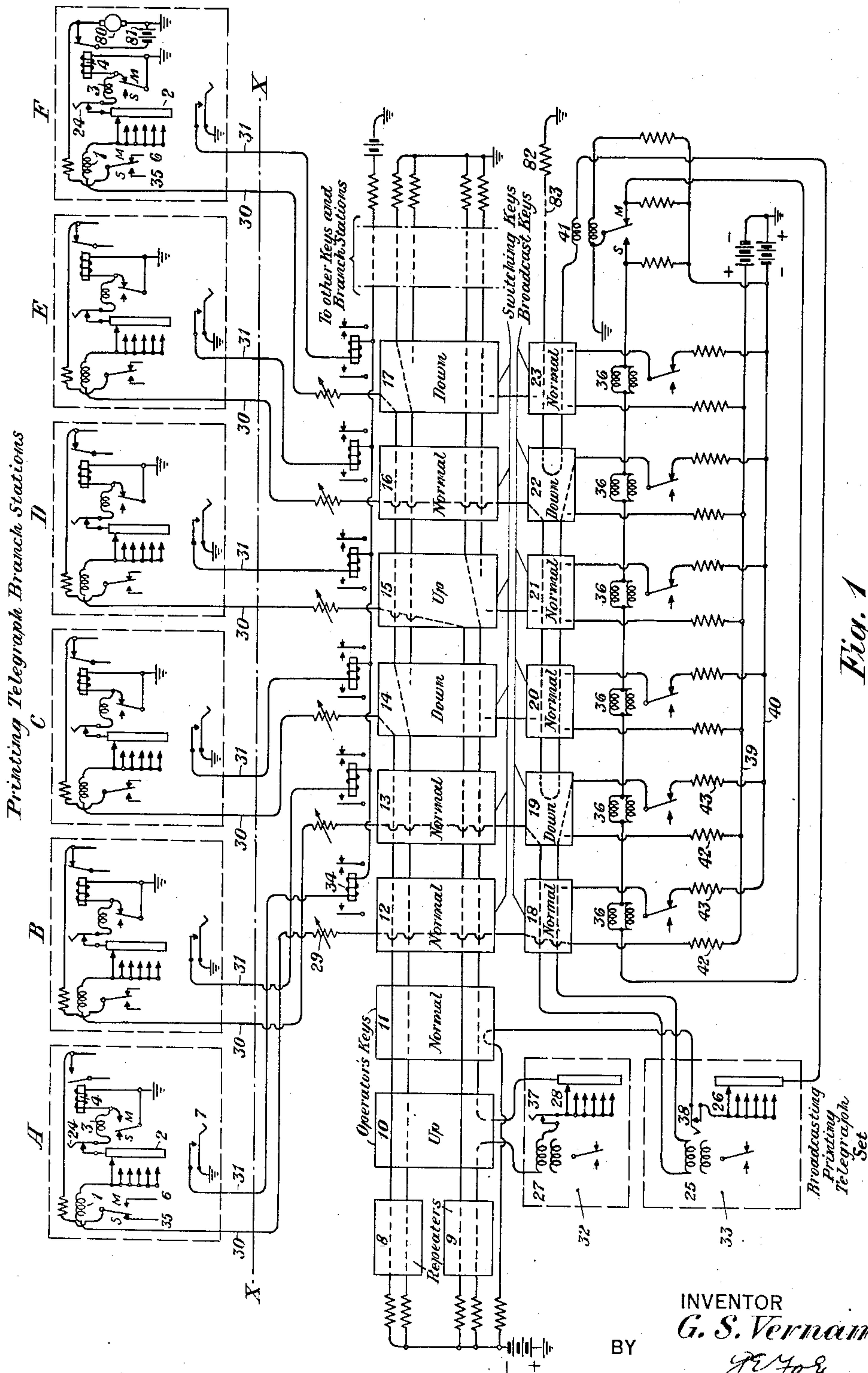
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PRINTING TELEGRAPH EXCHANGE SYSTEM

Filed June 21, 1923

2 Sheets-Sheet 1



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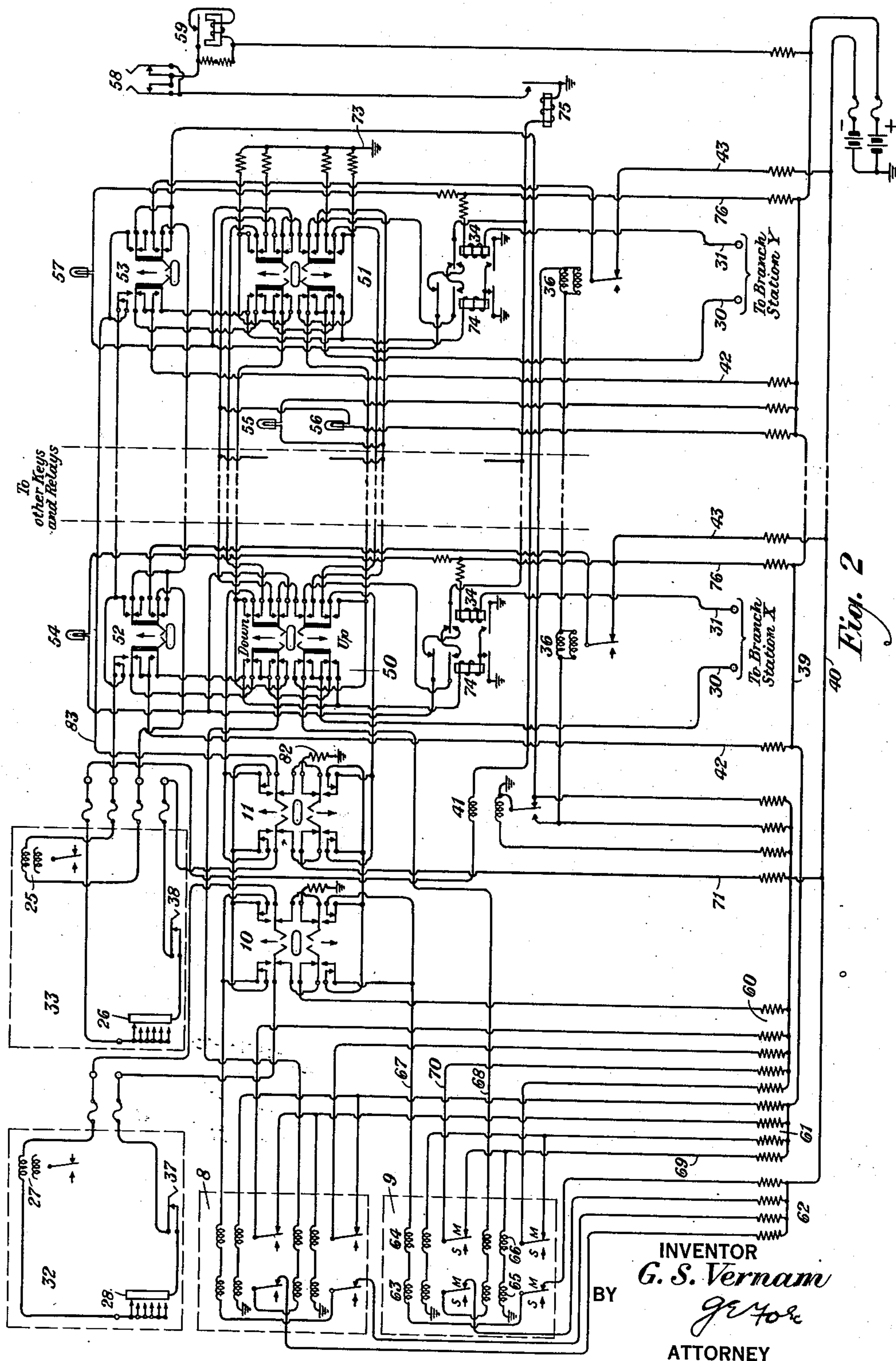
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

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PRINTING TELEGRAPH EXCHANGE
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This invention discloses a printing telegraph exchange system comprising a control station at which a switchboard is located and a plurality of branch stations equipped with printing telegraph sets. By the operation of suitable keys at the switchboard, two-way printing telegraph service may be established between one branch station and any other or between any branch station and the control station. A feature of the exchange consists in provision for simultaneously sending or "broadcasting" messages from the control station to any or all of the branch stations.

The system as shown consists of a switchboard located at the main or control station with lines radiating to the printing telegraph sets at the branch or outlying stations. The switchboard has associated therewith two printing telegraph sets, one of which may be omitted if not required for the traffic to be handled. The switching arrangements are such that any branch station may signal the control station and either of the printers associated with the switchboard may be connected to the branch station line for two-way communication. One of the control station printing telegraph sets associated with the switchboard is so arranged that it may also send simultaneously or "broadcast" to a group or to all branch stations. This broadcasting printer set cannot receive from a branch station while broadcasting, but any branch station may operate a signal on the switchboard and be switched to the other control station printer for two-way communication. This action will not affect the receipt of the broadcast message at the other branch stations.

Two wires are used to connect each branch station with the switchboard; one wire being used for printing and motor control, and the other wire for signaling the switchboard.

The "broadcasting" printer will print a "home record" of all messages broadcast. In addition to the broadcasting feature, this printer may also be used for two-way communication with an individual branch station.

When a connection is established between two branch stations, a telegraph repeater is cut into the circuit at the switchboard. As shown the switchboard is equipped with only two such repeaters, with the result that only two separate communication circuits may be thus simultaneously established. Additional repeaters, together with the necessary switching equipment to establish a greater number of connections simultaneously, could be added if desired. Either control

station printer may monitor on a through connection of this type by the operation of a suitable key on the switchboard.

Line lamps are provided on the switchboard so that any branch station may signal the control station by the operation of a key located at the branch station. These lamps are extinguished when the call is answered at the control station by operation of the proper switching key. After a through call is complete either branch station may give a disconnect signal to the control station. A control feature is provided whereby the printer set motors at a given branch station are running only when another printer set or a repeater at the control station is connected to the branch station in question.

In the drawings, Figure 1 shows in schematic form the exchange system as a whole, including the equipment at the control station as well as the branch stations. The drawing shows only six branch stations but it is to be understood that a greater number of stations with circuits similar to those shown could be added. Fig. 2 shows a wiring diagram of the switchboard and apparatus at the control station. This drawing shows the switching keys for only two branch stations but the wiring for the additional keys of the board is identical with that shown.

Referring to Fig. 1, the branch stations are indicated by the rectangles A to F, inclusive. All equipment below the line XX is located at the control station. The keys on the switchboard are indicated by rectangles 10 to 23, inclusive. The two telegraph repeaters associated with the switchboard are indicated at 8 and 9. The individual printer set at the control station is shown by rectangle 32 and the broadcasting printer by 33.

Referring to branch station F, the only apparatus shown for a printer circuit is that involved in motor and power control and in transmitting and receiving the electrical pulses which operate the printers. For each branch station the operation of printer set motor or motors (there may be one or more depending on the type of printer set) is under control of the control station. This remote control feature is accomplished through the medium of relays 3 and 4 at the branch station. Referring to branch station F, Fig. 1, the armature and back contact of relay 4 constitute part of the circuit containing a source of direct current power 81 and the motor or motors 80 associated with the printer at station F. With relay 4 released, the circuit is completed to operate

motor 80; with relay 4 operated, the circuit is open and the motor 80 is idle.

The operation of relay 4 is controlled by relay 3. Opposite terminals of the winding of relay 4 are connected to the marking contact M and the armature, respectively, of relay 3 as shown on the drawings. Assume now that current supplied from battery at the control station over lead 30 flows through the winding of polar relay 3 in a direction to operate the armature of relay against its spacing contact S. This condition is shown for station A, Fig. 1. For this case, the current supplied over lead 30 will flow into the printer unit through the winding of relay 1, through the printer sending contacts 2, key switch 24, winding of relay 3, and through the winding of relay 4 to ground. The current through the winding of relay 4 holds it operated and hence opens the operating circuit for the printer motor.

Assume now that the direction of current flow in the relay circuit is reversed by connecting battery of opposite polarity to lead 30 at the control station. The reversed current will cause the armature of relay 3 to be operated against its marking contact M. This operation will connect a short circuiting path around the winding of relay 4 as shown for station F, Fig. 1. For this case current supplied over lead 30, station F, will flow through the winding of relay 1, sending contacts 2, switch 24, through the winding, marking contact and armature of relay 3 to ground. The short circuit across the winding of relay 4 causes this relay to release and complete the operating circuit for motor 80, as shown for station F, thus starting up the printer motor.

Relay 1 (see station F, Fig. 1) is the receiving or line relay of the branch station printer. Lead 35 is wired through the receiving contacts to the start magnet, while lead 6 is wired through the receiving contacts to the printer magnets. Battery to operate these relays is supplied to the armature of relay 1 through the back contact of relay 4 from battery 81. The armature of relay 1 thus receives battery, under control of the control station, only while the printer set motor 80 is operating. With the printer motor operating and battery connected to the armature of relay 1, the branch station printer will type up messages in accordance with the electrical pulses flowing through the winding of relay 1 to cause its operation. Relay 1 is equipped with electrical or mechanical biasing means to hold the armature against the spacing contact S, while no current flows through the line winding thereof.

It is obvious that an alternating current source could be substituted for the direct current source 81, by using the proper type of motors, and either by using a single magnet type of printer with the magnet substituted for the relay 1 or by using a motor generator driven from the supply to motor 80 and furnishing direct current from the generator to the printer magnets.

Contacts 2 are the sending contacts of the printer. Normally one contact is closed, as shown. When a key of the keyboard is depressed, it starts the rotation of the sending cams and permits certain contacts of 2 to close momentarily in accordance with the code of the transmitted symbol. Key 24 is the "break" key which is used for transmitting an interruption to the distant station.

Each branch line has associated therewith at the control station a three-position switching key indicated by rectangles 12 to 17, inclusive, respec-

tively, and a two-position broadcast key indicated by rectangles 18 to 23. With both the switching and broadcast keys associated with a given station in the normal condition as shown for station A, positive battery is supplied from lead 39 and through resistance 42 to the branch station over lead 30. This positive current holds the polar relay 3 at the branch station against its spacing contact and hence prevents the printer set motor at the branch station from operating in the manner explained above.

The operation of a switching key connects the corresponding branch station lead 30 to negative battery through one side of a telegraph repeater at the control station as shown for station C. The negative battery reverses the direction of current through the polar relay 3 at the branch station and causes its armature to move against the marking contact M, thus releasing relay 4 and starting up the printer set motor. The operation of a switching key associated with a second branch station in the same direction as that first operated connects the second branch line to the other side of the same repeater. Thus referring to Fig. 1, the operation of keys 14 and 17 to the "down" position connects branch stations C and F in the opposite sides of repeater 8. The negative battery supplied through the repeater starts the motors at both branch stations and thus prepares them for two-way communication. The operation of keys 14 and 17 to the "up" position would merely substitute repeater 9 for repeater 8. Or with keys 14 and 17 operated as shown, the operation of two additional switching keys in the opposite direction, namely "up", would connect the associated branch stations to the second repeater. In this manner two through connections may be simultaneously established.

By providing a second set of switching keys similar to keys 14 to 17, inclusive, and equipping the control station with additional repeaters, four connections could be simultaneously established, or following the same procedure, an even greater number.

If station C called station F, the operation of key 14 "down" would connect the branch station C to the upper winding of repeater 8. The subsequent operation of key 17 "down" would connect station F to the lower winding of repeater 8. If, however, station F had called station C, the operation of key 17 "down" would first connect station F to the upper winding of repeater 8. The subsequent operation of key 14 "down" transfers station F from the upper to the lower winding of repeater 8, at the same time connecting station C to the upper winding. This is merely a matter of convenience in key contact arrangement.

Keys 10 and 11 are three-position operators' keys associated with printers 32 and 33, respectively. By operating key 10 "down" or "up", printer 32 is connected in the upper winding of repeater 8 or 9. The operation of key 11 accomplishes a similar purpose for printer 33. Operation of a switching key in the same direction as the operator's key connects the branch line to the lower winding of the repeater having its upper winding connected to the control station printer. Thus a two-way circuit is established between a control station printer and the branch station. This condition is shown for printer 32 and branch station D. With keys 10 and 15 operated to the up position, branch station D is connected to printer 32 through repeater 9.

The operation of an operator's key in the same

direction with two operated switching keys would connect a control station printer in the circuit connecting two branch stations. In this manner the control station is enabled to monitor on a connection between two branch stations. Thus referring to Fig. 1, the operation of key 10 to the "down" position would connect printer 32 in the lower winding of repeater 8, the latter being already connected between branch stations C and F by operation of switching keys 14 and 17 to the "down" position.

The broadcasting circuit includes the broadcast keys 18 to 23, inclusive, and all of the sending relays 36 individual to the branch stations, a master sending relay 41, and the broadcast printer 33. Normally a circuit is closed from negative battery through the "break" key 38 and sending contacts 26 of printer 33, and through the line or upper winding of relay 41, through the broadcast keys to relay 25, through relay 25 and back through the broadcast keys and through a resistance to ground. The auxiliary winding of relay 41 is connected between negative battery, supplied through a resistance, and ground. Owing to the proportioning of the resistances in series with the respective windings, the current through the line winding of relay 41 is about double that flowing in the auxiliary winding. The current in the line winding holds the armature against the marking contact M, while the current through the auxiliary winding tends to move the armature against the spacing contact S. This latter current supplies the relay with an electrical bias causing the armature to move against the spacing contact each time the current in the line winding is interrupted. The sending contacts 26 of the broadcasting printer will interrupt the current in the line winding of relay 41 and the armature of the relay will obviously follow the signals.

As shown, ground is connected to the armature of relay 41 and negative battery is connected through a resistance to each of the contacts S and M. Across these contacts is a series circuit which includes the operating winding of all the sending relays 36. When the armature of relay 41 is on one contact, one end of the series circuit is grounded and current passes through the string of relays in one direction. When the armature of relay 41 moves to the other contact, the other end of the series circuit is grounded and the direction of current through the relays is reversed. Thus the master relay 41 controls the operation of the individual sending relays 36.

As shown in Fig. 1 for station A, with broadcast key 18 and switching key 12 normal, positive battery is supplied to the branch station over lead 30 holding the printer set motors non-operative as explained above. If now, as shown for station B, the broadcast key 19 is operated, negative battery is supplied from lead 40 through resistance 43, the marking contact and armature of sending relay 36, and through the line winding 25 of the broadcast printer to branch station B over lead 30. The reversal of current through relay 3 at the branch station starts up the printer set motor. The circuit is now in condition for two-way communication between the branch station and the control station. A message transmitted from branch station B to the control station printer 33 will operate the line relay 25 of the broadcast printer and thus cause the received message to be typed up. On the other hand, a message transmitted from printer 33 will cause suitable electrical pulses to be trans-

mitted by means of contacts 26, thus operating relay 41 which in turn causes corresponding operations of all the relays 36. The operation of relay 36 individual to branch station B will interrupt the current supplied to that station through the armature of said relay. The pulses thus transmitted to station B will operate the line relay 1 at the branch station and thus cause the message to be typed. Incidentally it should be noted that since line relay 25 of printer 33 is in series with the branch line, a "home record" will be made of all messages transmitted from the broadcast printer. Restoration of key 19 will again apply positive battery to the branch station lead 30 of station B and stop the printer set motor at that point.

If two or more broadcast keys are operated simultaneously as shown for stations B and E, the circuit is so arranged that line relay 25 of the broadcasting printer is connected in series only with the branch line associated with the lowest numbered key operated, in this case key 19, but the armature of a sending relay 36 will be connected to lead 30 of each branch station having an operated broadcast key. Each broadcast key is equipped with contacts which, with the key operated, will short circuit the connections normally extending from the higher numbered keys to the line relay 25 of the broadcasting set, for the purpose of closing through the branch line circuit to the sending relay for the next higher numbered broadcast key which is operated. The contacts of the highest numbered broadcast key thus operated serve to close through to ground the master relay operating circuit which normally extends through all the broadcast keys to the line relay 25 of the broadcast printer and then back through all the broadcast keys through operator's key 11 indicated by the dashed segment 83, through resistance 82 to ground. This arrangement is clearly indicated in Fig. 1.

It will be noted that the operation of relays 36 will cause the broadcast messages to be transmitted to all branch stations having operated broadcast keys.

It will be seen that except for the branch station associated with the lowest numbered broadcast key which is operated, the operation of the "break" key 24 at a branch station will have no effect on the broadcasting printer. For this reason, if during broadcasting a branch station desires to signal the control station, this may be done by operation of key 7. This signaling feature will be explained below.

Fig. 2 gives a detailed wiring diagram of the switchboard and apparatus associated therewith at the control station, by means of which the various operations discussed above are effected. The manner in which the switchboard functions to establish the various connections indicated on Fig. 1 will be traced in some detail with the aid of Fig. 2. In addition, Fig. 2 will be used to explain the signaling features associated with the switchboard.

In so far as possible, the numbering of the various elements for Fig. 2 is identical with that of Fig. 1. For example, the individual line printer at the control station is numbered 32 in both figures. The broadcast printer is 33. The repeaters are shown at 8 and 9, and the operators' keys at 10 and 11. In Fig. 2, switching and broadcast keys associated with the first and last branch stations only are shown, since the wiring for the omitted keys is identical with that for the two given. The broadcast keys are shown at 52 and 53 and the

switching keys at 50 and 51. The leads 30 and 31 to the two branch stations are labelled X and Y as in the explanation given below they are used to represent any two of the lines shown in Fig. 1.

In the following explanation, statements regarding the operation of operators' keys or switching keys refer to the direction of operation of the key handle. These keys are pivoted in such manner that the handle is above the pivoted axis and the contact arm below. The result is that when a key is operated to the "up" position, the lower key contacts are engaged, and the reverse is the case with the key operated to the "down" position. Thus referring to key 50, Fig. 2, the lower key contacts are labelled "up" and the upper contacts labelled "down" indicating the direction in which the key handle is operated to close the respective contacts.

As shown for station A of Fig. 1, with the switching and broadcast keys normal, positive battery is supplied to the branch station lead 30 from lead 42. This circuit is easily traced on Fig. 2 from lead 42 through normally closed contacts of keys 52 and 50 in order, and out to the branch station over lead 30. With a branch station thus in its idle condition, a call may be initiated at a branch station by operation of the calling key 7, Fig. 1. This connects ground to operate the corresponding relay 34 at the control station as shown in Fig. 1. In Fig. 2 the circuit is traced from positive battery supplied over lead 76 through relay 34 to the branch station over lead 31 and to ground through operated key 7 thereat. Relay 34 thus operates and closes a circuit from battery over lead 76, through lamp 54, upper outer back contact of relay 74, upper front contact of relay 34 and through relay 75 to ground. This lights lamp 54 and furnishes a signal to the control station operator that a call is waiting on the corresponding branch line.

When the operator at the control station operates switching key 50 to its "up" position, the lower key contacts, as shown in Fig. 2, are operated, connecting the branch line to the lower windings of repeater 9. The circuit is traced from negative battery at 62, the marking or M contact and armature of relay 63, through the line windings of polar relays 65 and 66, over lead 68 and through the lower left operated contacts of key 50 to the branch station over lead 30. The negative battery supplied at 62 reverses the direction of current flow in the branch line and hence starts up the motors of the printer at the branch station. The operation of key 50 also extinguishes the line lamp 54 by causing the operation of relay 74 on battery supplied over lead 42 through the non-operated contacts of key 52 and key 50, the lower contacts of which are now operated, through the winding of relay 74 to ground through the lower front contact of relay 34, thus opening the circuit containing lamp 54 at the upper outer back contact of relay 74 to extinguish the lamp. Incidentally, since relay 75 is in the lamp circuit, it will be operated while the lamp is lit and will cause the operation of the buzzer 59, provided key 58 is as shown. With this key operated, the buzzer is disconnected. Relay 74, upon operating, immediately locks to ground through its lower front contact.

The operation of key 10 in the same direction as key 50, in this case "up", will connect the individual line printer 32 in the other winding of repeater 9. The circuit is traced from negative battery at 62, through the marking or M contact and armature of relay 65, through the line

windings of polar relays 63 and 64 over lead 67, through the left contacts of key 10, the lower contacts of which are now operated, into printer 32 through break key 37, the sending contacts 28 and winding of the line relay 27, back through the right contacts of key 10, contacts of key 11, lower right operated contacts of key 50, through the left non-operated contacts of all the remaining switching keys including 51, to ground at 73. A two-way communication circuit is thus established between control station printer 32 and the branch station through repeater 9. This circuit is shown schematically on Fig. 1 for station D and printer 32.

Had key 11 been operated in place of key 10, the broadcasting printer 33 would be substituted for printer 32. With key 11 operated to the "up" position, the circuit is traced from negative battery at 62, through the marking contact and armature of relay 65, through the line windings of relays 63 and 64, over lead 67, lower non-operated contacts of key 10, left contacts of key 11, the lower contacts of which are operated, into printer 33 through key 38, sending contacts 26 and out of printer 33, through the line winding of relay 41, through the lower right non-operated contacts of all the broadcasting keys in succession beginning with 53 and ending with 52, through winding of the line relay 25 of printer 33, back through the broadcasting keys in succession beginning with 52 and ending with 53, and over lead 83, through contacts of key 11, through the lower right operated contacts of key 50, through the left non-operated contacts of all the remaining switching keys, including 51, to ground at 73. In this case it will be noted that messages transmitted to the branch station from printer 33 are sent via repeater 9 and not by means of the sending relay 36. Although the master sending relay 41 and the individual line sending relays 36 are operated by the transmitted pulses, no signals are transmitted by them to the branch stations since the broadcast keys are normal, thus disconnecting the branch lines 30 from the armatures of the corresponding relays 36.

Operation of a branch station switching key to the "down" position will connect the branch station to the lower side of repeater 8. Similarly, operation of key 10 or 11 "down" will connect the corresponding control station printer to the upper winding of repeater 8. The circuits for these conditions will not be traced as they are very similar to those just described for repeater 9.

When switching key 50 is restored to normal, positive battery from lead 42 will again be applied to the branch station lead 30. This will operate polar relay 3 of Fig. 1 against its spacing contact S thus stopping the printer set motors at the branch station.

Restoration of switching key 50 of Fig. 2 also opens the locking circuit of relay 74 which releases. If relay 34 remains operated at this time due to the continued operation of key 7 at the branch station, the line lamp 54 will relight on a circuit from battery on lead 76, through lamp 54, back contact of relay 74, front contact of relay 34 to ground. Lamp 54 will thus remain lighted until key 7 at the branch station is restored, at which time its circuit will be opened by the release of relay 34. If calling key 7 of Fig. 1 is restored before switching key 50 of Fig. 2, relay 34 will release and close a circuit to light the "clear-out" lamp 55. The circuit is traced from positive battery through lamp 55, lower

operated contact of key 50, front contact of relay 74, back contact of relay 34 and winding of relay 75 to ground. The lighting of the "clear-out" lamp furnishes a signal to the control station operator to restore the switching key. If the switching key had been operated to its "down" position, lamp 56 instead of 55 would light. The circuit in such case would be traced from positive battery through lamp 56, upper right operated and lower right non-operated contacts of key 50, front contact of relay 74, back contact of relay 34 to ground through relay 75. Restoration of switching key 50 releases relay 74 which in turn opens the circuit through the "clear-out" lamp, thus extinguishing it.

When the control station printer has been connected to a branch station in the manner explained above, the branch station may request a through connection to some other branch station. This connection may be established by operating two switching keys in the same direction as shown for stations C and F of Fig. 1. The operation of the second switching key will connect the line associated with that key to the repeater loop with which the control printer set is associated, if the called line appears to the right of the calling line on the switchboard. Otherwise the calling line will be transferred to that repeater loop and the called line will be connected to the loop with which the calling line was first associated. The operation of the switching key will also start the motors of the called station so that two-way communication can be carried on between the stations.

Referring to Fig. 2, with key 50 operated to the "up" position, the circuit was traced from negative battery through the lower windings of repeater 9 and out over lead 30 to the branch station. Assume now that switching key 51 is also operated to the "up" position; current from negative battery will flow through the marking contact and armature of relay 65, through the line windings of relays 63 and 64, over lead 67, through the non-operated contacts of keys 10 and 11, through the lower right operated contact of key 51, through the non-operated contacts of the intermediate switch-keys up to 51, through the lower left operated contact of key 51 and out over lead 30 to the called branch station. If key 51 had been operated first to the "up" position, a circuit is traced from battery through the line windings of relays 65 and 66 over lead 68, through the left non-operated contact of key 50, and the non-operated contacts of the intermediate switching keys, through the left operated contact of key 51 to lead 30 thereat. When key 50 is subsequently operated to the "up" position, the circuit through lower windings of repeater 9 and over lead 68 is connected directly to lead 30 of branch station X, through the lower operated contact of key 50. At the same time a circuit is closed from the upper windings of repeater 9 and over lead 67, through keys 10 and 11, through the lower right operated contacts of key 50 and through the intermediate switching keys to key 51, through the left operated contact of key 51 to lead 30 of branch station Y. Thus branch station Y has been transferred from the lower to the upper winding of repeater 9 due to the subsequent operation of key 51.

If the control station desired to monitor on this connection between branch stations X and Y, an operator's key would be thrown in the same direction as the operated switching keys. Thus

with key 10 operated to the "up" position, a circuit would be traced from negative battery at 62, through the marking contact M and armature of relay 65, through the line windings of relays 63 and 64, over lead 67, through the left contacts of key 10, into printer 32 and through "break" key 37, sending contacts 28, and line relay 27, through the right contacts of key 10, non-operated contacts of key 11, lower right operated contacts of key 50, through the left non-operated contacts of the intermediate switching keys in succession, through the left operated contacts of key 51 to lead 30 of branch station Y. The control station printer is thus in series with a branch station connected to one side of the repeater. Messages transmitted between branch stations X and Y will affect relay 27 of printer 32 and thus cause a record of messages transmitted in both directions to be typed up by the control station printer. Also, any messages sent from the control station printer set will be recorded by the printers at both branch stations X and Y.

When the through call is completed, a disconnect signal may be given the control station by restoring the calling key 7, Fig. 1, at the calling station. This releases relay 34, Fig. 2, causing the lighting of the "clear-out" lamp 55 or 56, as explained above. If the calling station fails to give the disconnect signal, the called station may do so by operation and release of the calling key associated with that station. The operation of the calling key at station Y furnishes ground to operate relay 34 from battery or lead 76 and since switching key 51 is operated, relay 74 immediately operates and locks to ground on battery supplied from lead 42. When now the calling key at branch station Y is released, it will in turn release relay 34 leaving relay 74 locked to ground through its lower front contact. Current will then flow from positive battery through clear-out lamp 55, through the lower right operated contact of key 51, through the upper inner front contact of relay 74 and upper back contact of relay 34, to ground through relay 75, thus lighting the clear-out lamp. Restoration of switching key 51 releases relay 74 which opens the lamp circuit at the upper inner front contact of relay 74. If the switching key had been operated to the "down" position, lamp 56 would be involved instead of lamp 55.

At this point it seems appropriate to explain the operation of the telegraph repeaters 8 and 9. When the circuit is idle, the repeater is ready to transmit signals in either direction. When signals are being repeated in either direction, auxiliary arrangements lock the element provided for repeating in the other direction in such manner as to avoid improper operation while at the same time allowing the receiving operator to "break" or interrupt the sender. The polar relays which provide for repeating and effecting the locking features on either side of the repeater have in each case an electrical bias which corresponds to the retractive spring of the usual type of relay. The repeater may therefore be operated by open-and-close signals, i. e., by pulses of current of the same polarity succeeded by intervals of zero current.

Referring to repeater 9, Fig. 2, it will be seen that signals in loop 67 will cause relay 63 to repeat the signals into loop 68, and signals in loop 68 will cause relay 65 to repeat signals into loop 67. When one loop is open, the current in both

loops is interrupted and unless prevented by an auxiliary arrangement, the relay provided for repeating in the opposite direction will operate so as to open the circuit in which the signal originated. Thus the operation of relay 63 to its left or spacing contact opens the circuit of loop 68 which contains relay 65. Normally, this in turn would cause relay 65 to move against its spacing contact thereby opening the circuit of loop 67, and since now both loops would be open, the repeater would thereafter be inoperative. A locking feature must, therefore, be provided for the repeater to hold one repeating relay in its marking position whenever the other is in the spacing position.

Referring to Fig. 1, it will be seen that regardless of the position of the various switching keys, current normally flows through the line windings of the repeater relays from negative battery to ground. Referring to repeater 9 of Fig. 2, this current holds polar relays 63 to 66, inclusive, against their marking contacts M. Opposing current normally about half that in the line windings flows through the auxiliary windings in a direction tending to move the armatures against the spacing contacts S. This current is supplied to the auxiliary windings through resistances 60 and 61. Owing to the larger current in the line windings, the relays normally remain against their marking contacts M.

Assume that loops 67 and 68 are connected to printing telegraph sets by the operation of suitable keys on the switchboard as explained above. While the printer connected to loop 67 is sending, the circuit of this loop from battery to ground will be opened intermittently at the sending contacts of the printer. This will interrupt the current through the line windings of relays 63 and 64, so that the biasing current flowing through the auxiliary windings of those relays will cause the respective armatures to move against the spacing contact S. The operation of relay 63 in this manner will repeat the signal into loop 68 by opening the circuit at the contacts of relay 63. Thus the signal is repeated as desired. It will be noted that the current flowing through the auxiliary windings of relays 65 and 66 consists of the difference of current from negative battery supplied over lead 70 through the marking contact of relay 64, and opposing current from positive battery supplied over lead 69. Resistances 60 and 61 in the respective leads are so proportioned that the current through lead 70 is about double that over lead 69 so that the resultant negative current tends to move the armatures of the relays to the spacing contact. When the current in loop 67 is interrupted as explained above, the operation of relay 64 opens the circuit over lead 70, thus stopping the flow of negative current through the auxiliary windings of relays 65 and 66, leaving only the positive current from lead 69 flowing therethrough. This positive current holds the armatures of 65 and 66 against their marking contacts and thus prevents the circuit over loop 67 from being opened at the contacts of relay 65 during the period that no current is flowing in loop 67. The armatures of relays 65 and 66 are thus locked in their marking positions although the current in the line windings has been interrupted by the operation of relay 63. An exactly analogous operation to that described occurs when the signal originates in loop 68, in which case the operation of relay 66 locks relays 63 and 64 in their marking position. To insure this locking effect,

relays 64 and 66 should be adjusted slightly to spacing as compared to relays 63 and 65. Since the locking feature is not in operation during closed signal elements, i. e., while current flows through the line windings of the relays, it will be clear that the repeater is in condition to transmit a "break" from the receiving to the sending station during the marking pulses of each signal.

Considering now the broadcasting feature of the exchange system, the operation of a first broadcast key 52, Fig. 2, connects negative battery over lead 43, through the armature of sending relay 36, through the right operated contacts of key 52, through line relay 25 of the broadcast printer 33, through the left operated contacts of key 52 and left non-operated contacts of key 50 and out to branch station X over lead 30. Thus the circuit is arranged to broadcast messages to branch station X in accordance with the operation of printer 33. Since the line winding 25 of printer 33 is in series with the branch station line, a "home record" will be made of all messages broadcast.

The operation of a second broadcast key 53 will connect negative battery over lead 43 through the armature of the corresponding relay 36, through the lower right operated contacts of key 53, through the lower right non-operated contacts of the intermediate broadcast keys in succession to key 52 where the circuit is shunted back, through the upper right operated contacts of key 52, and the upper left non-operated contacts of the intermediate broadcast keys in succession to key 53, through the upper left operated contacts of key 53, the left non-operated contacts of switching key 51, and out to branch station Y over lead 30.

Assume again that broadcast key 52 only is operated. The circuit controlled by the sending contacts of the broadcast printer 33 is traced from negative battery on lead 71, through the left non-operated contacts of key 11, into printer 33, through the keys 38 and sending contacts 26, out to printer 33 and through the line winding of master sending relay 41, through the lower right non-operated contacts of the broadcasting keys in succession beginning with 53 and ending at 52, through the upper right operated contact of key 52, and back through the upper left non-operated contacts of the remaining broadcasting keys in succession ending with key 53, back over lead 83, through the right non-operated contacts of key 11, to ground through resistance 82.

Assume now that both broadcast keys 52 and 53 are operated. The circuit for the sending contacts is traced from negative battery on lead 71, through the left non-operated contacts of key 11, into printer 33, through "break" key 38 and sending contacts 26, out of printer 33, through the line winding of relay 41, through the upper right operated contacts of key 53, over lead 83, through the right non-operated contacts of key 11, to ground through resistance 82.

The circuit as traced above for the condition of two operated broadcast keys is shown schematically on Fig. 1 for stations B and E. It will be seen from Fig. 1 that the lowest numbered broadcast key which is operated, namely 19, includes the line relay 25 of broadcast printer 33 in the corresponding branch lead 30. The operation of key 19 also connects the lead from the armature of relay 36 associated with the next higher numbered key which is operated, namely key 22, directly to the lead from branch line 30 associated

with key 22 as shown. Finally, the highest numbered broadcast key which is operated, in this case key 22, connects the lead from the line winding of relay 41 directly to the ground lead 83 as shown.

If any branch station wishes to signal the control station during broadcasting the calling key 7, Fig. 1, at the station is operated and released. Referring to Fig. 2, the operation of the calling key furnishes ground to operate relay 34 as explained above. The operation of relay 34 furnishes ground to operate relay 74 on a circuit from battery on lead 42, through the left operated contacts of key 52, through the winding of relay 74, to ground at the lower front contact of relay 34. When now the calling key at the branch station is restored, relay 34 will release, but relay 74 will remain locked up to ground at its lower front contact. A circuit is thus established to light the line lamp 54. This circuit is traced from battery on lead 76, through lamp 54, right non-operated contacts of key 50, upper inner front contact of relay 74, upper back contact of relay 34 to ground through relay 75. This line signal may be answered at the control station by first restoring key 52 to normal and then by the operation of switching key 50 and operator's key 10 in the same direction. This will connect a repeater between control station printer 32 and branch station X, as explained above. At the same time the release of key 52 disconnects the circuit through the armature of the broadcast sending relay 36 to lead 30, at the right contacts of key 52, so that the broadcast messages are no longer transmitted to branch station X. It will be seen, therefore, that individual communication may now be carried on between printer 32 and branch station X, while printer 33 continues to broadcast to other branch stations. The release of key 52 also extinguishes lamp 54 by opening the locking circuit of relay 74 at the left contacts of key 52. Relay 74 on releasing opens the lamp circuit. If at the end of this individual conversation, key 50 is left operated, the branch station may cause the operation of "clear-out" lamp 55 or 56 by operation and release of the calling key at the branch station. Operation of the calling key will operate relay 34, which in turn will cause the operation of relay 74. The subsequent release of branch station calling key will light the "clear-out" lamp in the manner explained above.

What is claimed is:

1. In a telegraph exchange system in combination, a plurality of branch stations equipped with printing telegraph apparatus, a control station equipped with printing telegraph units, connecting circuits from the branch stations to the control station, means at the control station to connect any branch station with any other branch station or with the control station for printer telegraph communication, additional means at the control station to simultaneously establish a plurality of such connections, said connections constituting a plurality of distinct communication circuits, and means at the control station to simultaneously transmit or broadcast from a printer telegraph unit at the control station to the telegraph apparatus at any or all branch stations.

2. In a telegraph exchange system in combination, a plurality of branch stations equipped with printing telegraph apparatus, a control station equipped with printing telegraph units, connecting circuits from the branch stations to

the control station, means at the control station to connect any branch station with any other branch station or with the control station for printing telegraph communication, additional means at the control station to simultaneously establish a plurality of such connections, said connections constituting a plurality of distinct communication circuits, means at the control station to simultaneously transmit or broadcast from a printing telegraph unit at the control station to the telegraph apparatus at any or all branch stations, and means controlled from any branch station to operate signaling means at the control station to initiate a call, obtain a disconnect thereat or signal the control station during broadcasting thereto.

3. In a telegraph exchange system, in combination, a plurality of branch stations greater in number than two, each equipped with printing telegraph apparatus and motor means therefor, a control station comprising a switchboard, telegraph repeated elements and printing telegraph transmitter and receiver units, connecting circuits from the branch stations to said control station, means at said switchboard to connect a repeater between any two branch stations for printer telegraph communication or to connect a branch station to a control station printer set, means at said control station to simultaneously transmit or broadcast from a control station printer to the telegraph apparatus at any or all branch stations, means controlled from the control station to normally maintain the motor means at each branch station non-operative, means to start said motor means at a branch station upon connection thereto for communication purposes and to maintain said motor means running while thus connected, means controlled from any branch station to operate signaling means at said switchboard to initiate a call or to obtain a disconnect thereat.

4. In a telegraph exchange system, in combination, a plurality of branch stations greater in number than two, each comprising printing telegraph apparatus, motor means therefor, and a control device for controlling the operation of said motor means from a remote point, a control station including telegraph repeater elements and printing telegraph apparatus, connecting circuits from the branch stations to said control station, means at said control station to normally maintain the motor means at each branch station non-operative through the medium of the control device thereat, means to connect a telegraph repeater between any two branch stations or to connect any branch station and the control station for printing telegraph communication and to start the motor means at such branch stations, means to simultaneously transmit or broadcast from the telegraph apparatus at the control station to the telegraph apparatus at any or all branch stations and to start the motor means at such branch stations, means controlled from any branch station to operate signaling means at the control station to initiate a call or to obtain a disconnect at said control station.

5. In a telegraph exchange system in combination, a plurality of branch stations equipped with printing telegraph apparatus, motor means and means for controlling said motor means from a remote point, a control station equipped with printing telegraph transmitter and receiver units and telegraph repeaters, circuit means connecting each branch station to the control station,

means to normally maintain the motor means at the branch stations non-operative, means at the control station to connect a repeater between any two branch stations or to connect any branch station and the control station for printing telegraph communication, means controlled from the control station to start the motor means at the branch stations thus connected, additional means at the control station to simultaneously establish a plurality of such connections, means at the control station to monitor on a connection between two branch stations by connecting a control station printer in said circuit, means controlled from any branch station to operate signaling means at the control station to initiate a call or obtain a disconnect, means at the control station to simultaneously transmit or broadcast messages from a control station printer to any or all branch stations and to start the motor means thereat, means whereby said control station printer prints a home record of messages broadcast, means controlled from any branch station to operate signaling means at the control station during broadcasting thereto, means whereby a second control station printer may communicate individually with said branch station during broadcasting to other branch stations.

6. Means for controlling from a remote point the operation of the motor associated with a printer telegraph unit, comprising in combination, a control circuit extending from the printer unit to the control point, a polarized and a non-polarized relay in series connected to the control circuit at the printer unit, connections from opposite terminals of the non-polarized relay winding to the armature and a contact of the polarized relay, means to normally maintain the armature of said relay electrically free of said contact, means at the control station to apply to said control circuit current of a polarity to operate the armature of said polarized relay against said contact to short circuit said non-polarized relay, and means controlled by said non-polarized relay to apply power to drive said printer unit motors.

7. Means for controlling from a remote point, a motor associated with a printer telegraph comprising in combination, a control circuit extending from the printer telegraph to a control point, relay means connected to the control circuit at said printer telegraph, said relay means being operable in one sense by current of a given polarity and in the opposite sense by current of the opposing polarity, means controlled by said relay means to apply power to drive the printer set motor, means at the control station to apply to said control circuit current of polarity to start or stop said motor as desired through suitable operation of said relay means.

8. Means for controlling from a remote point the operation of the motor associated with a printer telegraph set, comprising in combination, a control circuit extending from said printer set to the control point, a polarized and a non-polarized relay in series connected to said circuit at said printer set, connections from opposite terminals of said non-polarized relay winding to the armature and a contact, respectively, of said polarized relay, means at the control station to apply to the control circuit current of a polarity to operate the armature of said polarized relay against said contact thus connected to short circuit and thus release the non-polarized relay, means at said control station to reverse said

current polarity to operate the polarized relay armature against its opposite contact, thus removing said short circuit from and operating said non-polarized relay, and means controlled by said non-polarized relay to apply power to drive said printer set motors while said polarized relay is actuated in a certain predetermined sense.

9. In a telegraph system in combination a plurality of branch stations, a control station, connecting lines from each branch station to the control station, telegraph means at said stations, a signal control device at each branch station, means actuated upon operation of said signal control device at an idle branch station to operate a line signal at said control station, means at said control station to restore said line signal to normal upon connecting telegraph means to said branch station line, means for said branch station to subsequently operate a disconnect signal at said control station by restoring said signal control device at said branch station, means at the control station to establish a telegraph communication circuit with the telegraph means at an idle branch station, means for said called branch station to operate said disconnect signal at the control station after the establishment of said latter communication circuit by operation and release of the signal control device at said branch station.

10. In a telegraph system in combination a plurality of branch stations, a control station, connecting lines from each branch station to the control station, signal control means at each branch station, switching means individual to each branch station at the control station, means actuated upon operation of said signal control means at an idle branch station to operate a line signal at the control station, means to restore said line signal to normal by operation of the switching means associated at the control station with said branch station, means to operate a disconnect signal at said control station by the subsequent restoration of said operated signal control means, means at the control station under the control of said signal control means to prevent the re-operation of said line signal when said operated switching means is subsequently restored, means to restore said disconnect signal to normal by the subsequent restoration of said operated switching means, means to operate said disconnect signal after operation of the switching means associated with an idle branch station by the subsequent operation and release of the corresponding signal control means thereat.

11. In a telegraph system in combination, a plurality of branch stations, a control station, connecting lines from each branch station to the control station, a first and a second switching device associated with each branch station at said control station, a signal control device at each branch station, means at said control station under the control of said signal control device at an idle branch station to operate a line signal at said control station to initiate a call thereto, means to restore said line signal to normal upon operation of the corresponding first switching device at said control station, means at said control station under the control of the signal control device at the branch station to subsequently operate a disconnect signal at the control station, means to restore said disconnect signal to normal by restoration of said operated first switching device, means at said control station operative after operation of a first switch-

ing device associated with an idle branch station, to initiate a call thereto and under the control of the signal control device at the branch station thus connected to operate said disconnect signal, means at said control station operative after the operation of said second switching device associated with an idle branch station and under the control of the signal control device at the branch station thus connected to operate a line signal at the control station, means to restore said line signal to normal by restoration of said operated second switching device.

12. In a telegraph switching system, in combination, a plurality of branch stations each equipped with printing telegraph apparatus, motor means therefor and means for controlling said motor means from a remote point, a control station equipped with printing telegraph apparatus, telegraph repeaters and a switchboard, connecting lines from each branch station to the switchboard, a plurality of three-position switching keys on said switchboard individual to said branch stations, three-position operators' keys on said switchboard individual to said control station printers, means whereby, with said switching keys normal, current of a certain polarity is transmitted to the branch stations to maintain the motor means at said branch stations non-operative through said remote control means, means whereby, upon operation of any switching key, the current polarity to the corresponding branch station is reversed thus starting the motor means thereat, means whereby, upon operation of any two switching keys in the same direction, a telegraph repeater is connected between the corresponding branch stations for printing telegraph communication, means whereby, upon operation of an additional pair of switching keys in the direction opposite to that of the first two keys operated a second repeater is connected between the branch stations corresponding to said second pair of operated keys, said connection constituting an additional communication circuit distinct from that first mentioned, means whereby, upon operation of an operator's key in the same direction as two operated switching keys, a control station printer may monitor on the connection between the two branch stations thus connected, means whereby upon operation of a switching key and an operator's key in the same direction, the corresponding branch station is connected to the control station for printing telegraph communication therewith, means whereby any branch station may operate signaling means at the control station to initiate a call or obtain a disconnect thereat.

13. In a telegraph switching system, in combination, a plurality of branch stations each equipped with printing telegraph receiving means, motor means and means for controlling said motor means from a remote point, a control station equipped with printing telegraph transmitter and receiver, and relay means associated therewith for broadcasting from said control station printer to any or all branch stations, connecting lines from each branch station to the control station, a switchboard at the control station, a plurality of broadcast keys on said switchboard individual to said branch stations, means whereby, upon operation of one said broadcast key, said broadcast means is connected to said branch station and the receiving unit of the broadcast printer is also connected to said branch station, means whereby, upon operation of a plurality of broadcast keys, said broadcast means

is connected to the corresponding branch stations and the receiving unit of said broadcast printer is connected to one said branch station dependent upon the sequence of arrangement and operation of said broadcast keys, means whereby, with the broadcast keys normal, current of a certain polarity is transmitted to said branch stations to maintain the motor means thereat inoperative through said remote control means, means whereby, upon the operation of any broadcast key, the current polarity to the corresponding branch station is reversed and the motor means thereat are started.

14. In a telegraph exchange system, in combination, a plurality of branch stations each equipped with printing telegraph apparatus and motor means therefor, a control station equipped with printing telegraph transmitters and receivers, relay means associated with one said control station printer for broadcasting from said control station printer to the telegraph apparatus at any or all branch stations, a switchboard at said control station, a plurality of switching keys on said switchboard individual to said branch stations and operators' keys individual to said control station printers for connecting any branch station to any other branch station or to a control station printer for printing telegraph communication, a plurality of broadcast keys on said switchboard individual to said branch stations, means whereby, with the switching and broadcast keys associated with a given branch station normal, current of a certain polarity is transmitted to said branch station to maintain the motor means non-operative, and means whereby, upon operation of either said switching or broadcast key, the current polarity to said branch station is reversed, thus starting said motor means, means whereby, upon operation of any broadcast key, the broadcast means is connected to the corresponding branch station and the receiving unit of the broadcast printer at the control station is connected in the circuit to said branch station, means whereby, upon operation of a plurality of broadcast keys, said broadcast means is connected to the corresponding branch stations and the receiving unit of the broadcast printer is connected in the circuit to one said branch station dependent upon the sequence of arrangement and operation of said broadcast keys, means whereby any branch station during broadcasting thereto may operate a break signal at the control station, and means whereby, upon restoration of the corresponding broadcast key and subsequent operation of the corresponding switching key, said break signal may be extinguished and a second control station printer connected to said branch station for individual communication therewith during broadcasting to the other stations.

15. In a telegraph exchange system, in combination, a branch station and a control station, a circuit extending from said branch station to the control station, a printing telegraph transmitter and receiver and means for controlling the printer motor from a remote point connected to said circuit at the branch station, means at the control station to transmit over said circuit current of a polarity to maintain the printer set motor thereat non-operative through the medium of said remote control means, means at said control station to reverse said current polarity over said circuit, thus rendering the printer set motor at the branch station operative through said remote control means.

16. In a printing telegraph system comprising

a control station, a plurality of branch stations and a plurality of switching means at the control station individual to said branch stations for connecting any branch station with any other branch station, a signaling system therefor comprising in combination, a signal circuit extending from each branch station to the control station, each such circuit terminating at the branch station in a signal control means, and having individual thereto at the control station a first and second relay and a connect signal means, with disconnect signal means common to all said circuits, means whereby any branch station may initiate a call by operation of the signal control means thereat to operate said connect signal means through the consequent operation of the first relay, means at the control station to restore said connect signal means to normal through operation of the second relay consequent upon operation of the switching means associated with said branch station, means for connecting the calling to a called station by operation of a second switching means, means whereby the calling station may terminate said call by release of said signal control means thereat to release said first relay and thus operate a disconnect signal means, means whereby the called station may terminate said call by first operating the signal control means thereat to operate said first and second relays and then releasing said signal control means to release said first relay and operate said disconnect signal, means whereby all signal means including said disconnect signal means are restored to normal upon the subsequent restoration of said switching means.

17. In a printing telegraph system comprising a control station, a plurality of branch stations, switching means at the control station individual to said branch stations for establishing broadcast circuits to broadcast to any or all branch stations and switching means individual to said branch stations, for interconnecting the same, a signaling system for said system comprising, in combination, a signal circuit from each branch station to the control station, each such circuit terminating at the branch station in a signal control means and having individual thereto at the control station a first and second relay and a connect signal means, with disconnect signal means thereat common to all said circuits, means whereby any branch station may initiate a call by operation of the signal control means thereat to operate said connect signal means through the consequent operation of said first relay, means at the control station to restore said connect signal means to normal through operation of the second relay consequent upon operation of the switching means associated with said branch station, means for connecting the calling to a called station by operation of a second switching means, means whereby the calling station may terminate said call by release of the signal control means thereat to release said first relay and operate a disconnect signal means, means whereby the called station may terminate said call by first operating the signal control means thereat to operate said first and second relays, and then releasing said signal control means to release said first relay and operate said disconnect signal, means whereby all signal means including said disconnect signal means are restored to normal upon the subsequent restoration of said switching means, means whereby the control station may broadcast to branch stations having operated broadcast switching means, means whereby during broadcasting to a branch station such station may operate a break signal

at the control station by first operating the signal control means thereat to operate said first and second relays, and then releasing said signal control means to release said first relay and operate said connect signal means, means to restore said connect signal means to normal upon restoration of said broadcast switching means.

18. In a telegraph exchange system, in combination, a plurality of branch stations greater in number than two, each equipped with printing telegraph apparatus, a control station equipped with printing telegraph apparatus, connecting circuits from the branch stations to the control station, means at the control station to connect any branch station with any other branch station or with the control station for printing telegraph communication, and means at the control station to transmit or broadcast from the telegraph apparatus at the control station simultaneously to the telegraph apparatus at any or all branch stations.

19. In a telegraph switching system, in combination, a plurality of branch stations greater in number than two, each equipped with printing telegraph receiving means, a control station equipped with printing telegraph transmitting means, means electrically connecting the branch stations to the control station, means at the control station to transmit or broadcast from the printing telegraph transmitting means at the control station simultaneously to the receiving means at any or all branch stations and non-telegraphic means whereby any branch station may signal the control station during broadcasting thereto.

20. In a telegraph switching system, in combination, a plurality of branch stations, each equipped with printing telegraph apparatus, a control station equipped with a printing telegraph transmitter and receiver, means electrically connecting the branch stations to the control station, means at the control station to transmit or broadcast from the telegraph transmitter at the control station simultaneously to the telegraph apparatus at any or all branch stations, and means whereby individual communication may be established between any one of said branch stations and the control station during such broadcasting to the other branch stations and without interfering therewith.

21. In a telegraph switching system, in combination, a plurality of branch stations, each equipped with printing telegraph apparatus, a control station equipped with a printing telegraph transmitter and receiver, means electrically connecting the branch stations to the control station, means at the control station to transmit or broadcast from the printing telegraph transmitter at the control station simultaneously to the printing telegraph apparatus at any or all branch stations, means whereby any branch station may signal the control station during broadcasting thereto, and means whereby individual communication may be established between such branch station and the control station during such broadcasting to the other branch stations, and without interfering therewith.

22. In a telegraph exchange system, in combination, a plurality of branch stations, each equipped with printing telegraph apparatus, a control station equipped with printing telegraph apparatus, means electrically connecting each branch station to the control station, means at the control station to connect any branch station with any other branch station or with the control station for printing telegraph communication, means at the control station to transmit

or broadcast from the telegraph apparatus at the control station simultaneously to the telegraph apparatus at any or all branch stations, and means whereby individual communication
5 may be established between any one of said branch stations and the control station during such broadcasting to the other branch stations and without interfering therewith.

23. In a telegraph exchange system, in combination, a plurality of branch stations, each equipped with printing telegraph apparatus, a control station equipped with printing telegraph apparatus, means electrically connecting each branch station to the control station, means at
10 the control station to connect any branch station with any other branch station or with the control station for printing telegraph communication, means at control station to transmit or broadcast from the telegraph apparatus at the
15 control station simultaneously to the telegraph apparatus at any or all branch stations, means whereby any branch station may signal the control station during broadcasting thereto, and means whereby individual communication may
20 be established between such branch station and the control station during such broadcasting to the other branch stations, and without interfering therewith.

24. In a telegraph switching system, in combination, a plurality of branch stations greater in number than two, each equipped with printing telegraph apparatus, a control station equipped with a printing telegraph transmitter, means electrically connecting each branch station with
30 the control station, means at the control station to connect any branch station with any other branch station for exclusive telegraph communication therebetween and to transmit or broadcast from the control station transmitter
35 simultaneously to any or all branch station printers and means whereby the control station printer prints a home record of all messages thus broadcast.

25. In a telegraph exchange system, in combination, a plurality of branch stations greater in number than two, each equipped with printing telegraph apparatus, a control station equipped with a printing telegraph transmitter and receiver, means electrically connecting each branch
45 station to the control station, means at the control station to connect any branch station with any other branch station or with the control station for printing telegraph communication, means at the control station to transmit or broadcast
50 from a control station printer simultaneously to the telegraph apparatus at any or all branch stations, and means whereby the control station printer prints a home record of all messages thus broadcast.

26. In a telegraph switching system, in combination, a plurality of branch stations each equipped with printing telegraph apparatus, a control station equipped with a printing telegraph transmitter and receiver, means electrically
65 connecting the branch stations to the control station, means at the control station to transmit or broadcast from the control station printer simultaneously to the telegraph apparatus at any or all branch stations, means whereby any branch
70 station may signal the control station during broadcasting thereto, means whereby individual communication may be established between such branch station and the control station during
75 broadcasting to the other branch stations and

without interfering therewith, and means whereby the control station printer prints a home record of all messages thus broadcast.

27. In a telegraph switching system, in combination, a plurality of branch stations, each
5 equipped with printing telegraph receiving means, a control station equipped with a printing telegraph transmitter and receiver, a circuit connecting each branch station to the control station, means at the control station to transmit or
10 broadcast from the control station printer simultaneously to any or all branch stations, said broadcast means comprising a master sending relay associated with the control station printer and operable in accordance therewith and a plu-
15 rality of sending relays individual to said branch station circuits and operable by said master sending relay, means to connect any or all of said individual sending relays to their respective
20 branch station circuits for broadcasting thereover, and means whereby the control station printer prints a copy of messages thus broadcast.

28. In a telegraph switching system, a plurality of branch stations and a control station, each
25 equipped with printing telegraph apparatus, a circuit connecting each branch station with the control station, switching keys at the control station, one for each branch station circuit, and broadcast means interposed between the control station telegraph apparatus and said switching
30 keys, said switching keys in the normal position closing a series circuit through all the keys and the control station transmitter and receiver units, and any or all of said keys operable to a second
35 position to connect said broadcast means to the corresponding branch station circuits, the control station receiving unit being connected in one of said circuits dependent upon the sequence of arrangement and the operation of the keys, and one
40 of said keys completing an operating circuit for the control station transmitter unit for controlling the operation of said broadcast means.

29. In a telegraph switching system, a plurality of branch stations and a control station, each
45 equipped with printing telegraph apparatus, a circuit connecting each branch station to the control station, switching keys at the control station, one for each circuit, a master transmitting device associated with the telegraph apparatus at the
50 control station, and a plurality of sending relays at the control station individual to said branch stations and controlled by said master transmitting device, any or all of said switching keys being operable to a given position to connect the
55 sending relays to their corresponding branch circuits whereby said telegraph apparatus at the control station may broadcast messages to the branch stations thus connected.

30. Means for controlling from a remote point the operation of a motor associated with a printer
60 telegraph set, comprising in combination, a control circuit extending from said printer set to the control point, a polarized and non-polarized relay in series connected to said control circuit at said printer set, means controlled by said polar-
65 ized relay for normally maintaining said non-polarized relay in its actuated state, means at the control point for applying to said control circuit current of a predetermined polarity to operate said polarized relay in a predetermined sense
70 and release said non-polarized relay, and means controlled by said non-polarized relay for applying power to drive said printer set motors.

31. In a telegraph switching system, in combination, a plurality of stations, each equipped
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with printing telegraph apparatus, means inter-connecting said stations, means at one of said stations for transmitting or broadcasting from the telegraph apparatus at said station simulta-
 5 neously to the telegraph apparatus at any or all of said other stations, means whereby any receiving station may signal the sending station during broadcasting thereto, and means whereby individual communication may be established between
 10 such receiving station and said sending station during such broadcasting to the other receiving stations and without interfering therewith.

32. In a signalling system, a first station, a second station, a signalling line connecting said stations, telegraph apparatus at said first station connected to said signalling line, telegraph apparatus at said second station normally disconnected from said line, the telegraph apparatus at said first station being normally in a non-operating condition, means for normally impressing
 15 current of a predetermined polarity upon said signalling line, means for simultaneously connecting said apparatus at said second station to said signalling line and for reversing the polarity of
 20 the current impressed on said signalling line and means at the first station responsive to the reversal of polarity of said signalling line for starting said telegraph apparatus into operation in preparation for receiving code combinations of
 25 impulses.

33. In a telegraph system, a plurality of outlying stations, a central station, telegraph apparatus at each of said outlying stations, circuit connections between said central station and each
 35 of said outlying stations, means for normally impressing current of a predetermined polarity upon said circuit connections, means at each of said outlying stations responsive to said current of predetermined polarity for maintaining said telegraph apparatus thereat in a normal non-operating
 40 condition, and means at said central station for interconnecting any of said outlying stations and for simultaneously reversing the polarity of the current on one of said circuit connections,
 45 the current responsive means at the corresponding outlying station being responsive to said reversal of polarity for starting the telegraph apparatus thereat into operation.

34. In a telegraph system, a plurality of outlying stations, a central station, circuit connections between said central station and each of
 50 said outlying stations, telegraph apparatus at each of said outlying stations and at said central station, said outlying station apparatus being normally in a non-operative condition, means at
 55 said central station for interconnecting said telegraph apparatus at a plurality of said outlying stations and for reversing the polarity of the current on one of said circuit connections, means
 60 responsive to said reversal for rendering the telegraph apparatus at the corresponding outlying station operative and means at said central station for connecting said telegraph apparatus at
 65 said central station to said telegraph apparatus at any one of said outlying stations.

35. A printing telegraph exchange system comprising a central station, a plurality of subscriber stations, a plurality of normally closed telegraph subscriber lines interconnecting said central station and said subscriber stations, manually operable link circuits at said central station for interconnecting said subscriber stations, means at
 70 each of said subscriber stations for transmitting and receiving impulses and means at said central station for controlling the operation of the trans-

mitting and receiving means at any of said subscriber stations, said means being responsive to the interconnection of any two of said subscriber stations by said link circuits.

36. A printing telegraph exchange system comprising a central station, a plurality of subscriber
 5 stations, a plurality of telegraph subscriber lines interconnecting said central station and said subscriber stations, manually operable link circuits at said central station for interconnecting
 10 said subscriber stations, normally non-operating means at each of said subscriber stations for transmitting and receiving impulses and means responsive to the interconnection of any two of
 15 said subscriber stations by said link circuits and to the disconnection thereof for rendering operative and inoperative, respectively, said transmitting and receiving means at each of said subscriber stations.

37. A printing telegraph exchange system comprising a central station, a plurality of subscriber
 20 stations, a plurality of lines interconnecting said central station and said subscriber stations, manually operable link circuits at said central station for interconnecting said subscriber stations, means at each of said subscriber stations
 25 for transmitting and receiving impulses and normally idle individual motor means for driving each of said transmitting and receiving means, the starting and stopping of said motor means being controlled by the connection and disconnection, respectively, of said stations by the link
 30 circuits at said central station.

38. A telegraph exchange system comprising a central station, a plurality of subscriber stations, a plurality of telegraph subscriber circuits interconnected to said central station and said subscriber stations, means for normally impressing
 35 current of a predetermined polarity on said circuits, link circuits at said central station for interconnecting said subscriber stations, telegraph apparatus at each of said subscriber stations, said telegraph apparatus being normally in a non-operative condition, means controlled by
 40 said link circuits for reversing the polarity in one of said subscriber circuits and means responsive to said reversal of polarity for starting the telegraph apparatus at the corresponding subscriber station into operation.

39. A printing telegraph exchange system comprising a central station, a plurality of subscriber
 50 stations, a plurality of telegraph subscriber lines interconnecting said central station and said subscriber stations, manually operable link circuits at said central station for interconnecting said subscriber stations, means at each of said stations for transmitting and receiving character
 55 signals, a normally non-operating motor at each subscriber station for driving said means, and means directly responsive to the interconnection of any of said subscriber stations by said link circuits and to the disconnection thereof for starting and stopping, respectively, the motors thereat.

40. A telegraph exchange system comprising a central station, a plurality of subscriber stations, a plurality of telegraph subscriber lines interconnecting said central station and said subscriber stations, means at the central station for interconnecting said subscriber stations, automatic telegraph apparatus at each of said subscriber stations, said telegraph apparatus being
 70 normally in a non-operative condition, means for impressing a current of a predetermined polarity on said subscriber lines, means responsive to the interconnection of any of said subscriber stations
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for reversing the polarity on one of said subscriber lines and means responsive to said reversal of polarity for starting the telegraph apparatus at the corresponding subscriber station into operation.

41. A telegraph exchange system comprising a central station, a plurality of subscriber stations, a plurality of telegraph subscriber circuits interconnecting said central station and said subscriber stations, manually operable link circuits at said central station for interconnecting said subscriber stations, telegraph apparatus at each of said stations, said telegraph apparatus being normally in a non-operative condition, control means at each subscriber station for normally maintaining the telegraph apparatus thereat in non-operating condition and means for reversing the polarity of the current on one of said subscriber circuits, the control means at the corresponding subscriber station being responsive to said reversal of polarity for starting the telegraph apparatus thereat into operation.

42. A telegraph switching system including a central station equipped with telegraph apparatus, a plurality of branch stations, each equipped with telegraph apparatus, branch station circuit means extending from each branch station to the central station, a plurality of station keys individual to said branch station circuit means at the central station, means including said station keys whereby a telegraph communication circuit may be established between any two branch stations and whereby said telegraph sending means at the central station may send individually to any said branch station, and means including said station keys whereby said sending means may broadcast to any or all of said branch stations.

43. A telegraph switching system comprising, in combination, a central station equipped with a printing telegraph transmitter and a plurality of branch stations each equipped with a printing telegraph receiver, branch lines extending from each branch station to the central station, a plurality of station keys individual to said branch lines at the central station, means including said station keys whereby said central station printer may send individually to any of said branch station printers, means including said station keys whereby said central station printer may broadcast to any or all of said branch station printers, remote control means including said station keys whereby the printer set motors at a branch station are running only while the corresponding station key is operated, and non-telegraphic signalling means operable during the connection whereby any said branch station may acknowledge to the central station the receipt of a message therefrom.

44. In a signaling system; a first station; a second station; circuit connection between said stations; telegraph apparatus at said first station; a normally stopped motor for operating said telegraph apparatus when in operation; manual means at said second station for controlling the polarity of current on said circuit connection, and polar responsive means at said first station controlled by said manual means for starting said motor.

45. In a signaling system; a first station; a second station; circuit connection between said stations; telegraph apparatus at said first station; a motor for operating said telegraph apparatus when in operation; control means at said second station for controlling the polarity of current on said circuit connection, and polar re-

sponsive means at said first station controlled by said control means for controlling the operation of said motor.

46. In a telegraph system; a first station; a second station; circuit connection between said stations normally having thereon current of a predetermined polarity; normally non-operative telegraph apparatus at said second station; a polar relay at said second station; manually operated means for reversing the polarity of the current in said circuit for operating said polar relay; and means controlled by the operation of said polar relay in response to the reversal of polarity for starting said telegraph apparatus into operation.

47. A printing telegraph system including a plurality of stations, a manually operable link circuit at one of said stations for interconnecting said stations, normally non-operating telegraph apparatus at said stations and means responsive to the connection and disconnection of said link circuit with any distant station for rendering operative and inoperative respectively, the telegraph apparatus at the corresponding distant station.

48. A printing telegraph exchange comprising a control station, a plurality of other stations, a plurality of circuits interconnecting said control station and said other stations, a manually operable link circuit at said control station for interconnecting said stations, printing telegraph apparatus at each of said stations, a normally non-operating motor at each of said other stations for driving the telegraph apparatus thereat, and means responsive to the interconnection of any of said stations by said link circuit and to the disconnection thereof for starting and stopping, respectively, the motors thereat.

49. A telegraph system including a plurality of telegraph stations, communication circuits extending between said stations, telegraph apparatus at said stations, manually operable means for interconnecting the telegraph apparatus at said stations for communication purposes, and means responsive to the operation of said manually operable means for controlling over the communication circuit the starting and stopping of said telegraph apparatus.

50. A telegraph system including a plurality of telegraph stations, telegraph apparatus at said stations, a central exchange point, communication circuits extending between said central exchange point and said telegraph stations, manually operable means at said exchange point for interconnecting said telegraph stations, and means rendered effective by the operation of said manually operable means for controlling over the communication circuit the starting and stopping of said telegraph apparatus.

51. A telegraph system including a main station, a plurality of outlying stations, telegraph apparatus at said stations, circuit means interconnecting said main station and said outlying stations, means manually controlled at said main station for making interconnections between said main station and any of said outlying stations, and means responsive to the interconnections and disconnections for controlling the operation of telegraph apparatus at the corresponding outlying stations, as desired.

52. A telegraph system including a main station, a plurality of outlying stations, telegraph transmitting apparatus at said main station, telegraph receiving apparatus at said outlying stations, communication circuits extending between

said main station and said outlying stations, manually operable means at said main station for interconnecting said main station and any of said outlying stations for communication purposes, and means controlled over the communication circuit by the interconnection of said main station and any of said outlying stations and by the disconnection of said stations for controlling the operation of the telegraph receiving apparatus at said outlying stations as desired.

53. A telegraph system including a central station, a plurality of branch stations, telegraph apparatus at said stations, normally closed communication circuits between said central station and said branch stations, means under the control of an operator at said central station for interconnecting said stations, and means responsive to said interconnection for controlling over the communication circuit the operation of said telegraph apparatus.

54. Means for controlling the operation of printing telegraph apparatus from a remote point comprising, in combination, a control circuit extending from said telegraph apparatus to a control point, relay means associated with said control circuit at said telegraph apparatus, and means at the control point for transmitting over said control circuit current of polarity to render said telegraph apparatus operative or inoperative as desired through the suitable operation of said relay means.

55. In a telegraph system, in combination, telegraph apparatus at one point, a control circuit extending from said telegraph apparatus to a distant control point, and means at said control point for applying to said control circuit current of one polarity to render said telegraph apparatus operative and current of the opposite polarity to render said telegraph apparatus inoperative as desired.

56. In a telegraph system, in combination, an outlying station and a control station, a control circuit extending from said outlying station to the control station, telegraph apparatus at the outlying stations, means associated with said control circuit at the outlying station for controlling the operation of said telegraph apparatus from a remote point, and means at said control station for transmitting over said control circuit current of polarity to render said telegraph apparatus operative or inoperative, as desired, through the suitable operation of said control means.

57. A telegraph system including a plurality of telegraph stations, communication circuits between said stations, telegraph apparatus at said stations, manually operable means for interconnecting the telegraph apparatus at said stations for communication purposes and for impressing current of a predetermined polarity on said communication circuits to control the operation of said telegraph apparatus.

58. A telegraph exchange system including a central station and a plurality of branch stations, circuit means interconnecting said central station and said branch stations, telegraph apparatus at said stations, and manually operable means at said central station for interconnecting said stations for communication purposes and for impressing current on said circuit means to render said telegraph apparatus operative and inoperative, as desired.

59. In a telegraph system, a plurality of outlying stations, a central station, telegraph apparatus at said stations, circuit means interconnect-

ing said central station and said outlying stations, means manually controlled at said central station for establishing communication circuits between said stations, and means responsive to the establishment of said communication circuits for impressing current of a predetermined polarity on said circuit means to control the operation of the telegraph apparatus.

60. In a telegraph system, a plurality of outlying stations, a central station, telegraph apparatus at said stations, interconnecting circuits between said central station and said outlying stations, means for normally impressing current of a predetermined polarity on said interconnecting circuits, and means for establishing communication circuits between said stations and for reversing the polarity of the current impressed on the interconnecting circuits of the stations called to control the operation of the telegraph apparatus.

61. In a telegraph system, a plurality of branch stations, a main station, telegraph apparatus at said branch stations and at said main station, circuit means interconnecting said main station and said branch stations, means at said main station for interconnecting said main station and any of said branch stations, and means controlled by said interconnections for impressing current of a predetermined polarity on the circuit means to control the operation of the telegraph apparatus.

62. In a communication system, a plurality of outlying stations, a central station, apparatus at said central station for transmitting character signals, apparatus at said outlying stations for receiving the character signals, communication circuits between said central station and said outlying stations, means at said central station for interconnecting said central station and any of said outlying stations, and means responsive to said interconnections for impressing current on the circuits of the stations called to start the operation of the receiving apparatus and responsive to the disconnection of said stations to stop the operation of the receiving apparatus.

63. In a communication system, a plurality of outlying stations, a central station, apparatus at said stations for transmitting and receiving character signals, circuit connections between said central station and said outlying stations, means for normally impressing current of predetermined polarity on said circuit connections, and means at the central station for interconnecting said circuit connections and for reversing the polarity of the current thereon for controlling the operation of said transmitting and receiving apparatus.

64. In a telegraph system, a plurality of telegraph stations, circuit means interconnecting said stations, telegraph apparatus at said stations, manually operable means for establishing communication circuits between said stations, means rendered effective by the operation of said manually operable means for impressing current of a predetermined polarity on said communication circuits and means responsive to said current of predetermined polarity for rendering said telegraph apparatus operative.

65. In a signaling system, a first station, a second station, circuit connection between said stations, telegraph apparatus at said stations, means at said first station for normally impressing current of predetermined polarity on said circuit connection, means at said first station for establishing a communication circuit between

said stations, and means at said first station responsive to the establishment of said communication circuit for reversing the polarity of the current to control the operation of said telegraph apparatus.

66. In a printing telegraph system comprising a plurality of printing telegraph subscribers' lines terminating at a central office, manually controllable cord circuits at the central office for connection of any of said subscribers' lines with any central office printing telegraph machine, means responsive to said connection for changing the polarity of the line current, and motor control means at the subscribers' office responsive to said change in polarity of line current.

67. Means for controlling from a remote point the operation of a motor associated with a printer telegraph unit, comprising in combination, a control circuit extending from the printer unit to a control point, polar relay means operatively connected into the control circuit at the printer unit, said relay means having a motor starting condition for starting the motors and being operable to motor starting condition by voltage of a predetermined polarity, and means at the control point for applying voltage of the proper polarity to operate said relay means to motor starting condition.

68. In a telegraph system, a plurality of outlying stations, telegraph apparatus at said outlying stations, a control station, circuit connections between said control station and said outlying stations, a plurality of telegraph transmitting units at said control station, and means at said control station for establishing communication circuits between any one or more of the telegraph transmitting units at the control station and any of said outlying stations and for changing the polarity of the current on the circuit connections extending to the selected outlying stations to control the operation of the telegraph apparatus thereat.

69. In a printing telegraph system, in combination, a telegraph printer, a master relay responsive to signals from said printer, a plurality of relays under the control of said master relay for individually re-transmitting the signals transmitted by said printer, and circuit means associated with each relay of said plurality for receiving the retransmitted signals.

70. A telegraph system including, in combination, a plurality of stations greater in number than three, each equipped with printing telegraph apparatus, means interconnecting said stations, means at one of said stations for transmitting or broadcasting from the telegraph apparatus at said station simultaneously to the telegraph apparatus at any or all of said other stations, and means at any receiving station for sig-

naling the sending station during broadcasting without interfering therewith.

71. In a telegraph system, in combination, a plurality of stations, circuit means interconnecting said stations, connect signal means at a first one of said stations individual to each of the other stations, disconnect signal means at the first station, signal control means at each of said other stations, means at said first station under the control of the signal control means at an idle one of said other stations for operating the connect signal means corresponding to said idle station to initiate a call, means at said first station for restoring said connect signal means to normal upon the establishment of a telegraph communication circuit between such other station and said first station, means at said first station under the control of the signal control means at said other station for operating the disconnect signal means at said first station and for preventing the subsequent re-operation of said connect signal means when said telegraph communication circuit is disestablished upon the termination of the call, means at said first station operative when said first station initiates a call to an idle one of said other stations and upon the establishment of such a telegraph communication circuit to prepare a circuit for the subsequent operation of the disconnect signal means when said other station desires to terminate said call, means at said first station under the control of the signal control means at said other station for completely closing the circuit of and for operating said disconnect signal means, and means at said first station operative upon the disestablishment of the latter communication circuit to restore said disconnect signal to normal.

72. In a telegraph system, in combination, a plurality of stations, circuit means interconnecting said stations, switching means at a first one of said stations for establishing telegraph communication circuits with the other stations, signal control means at each of said other stations, a first relay at the first station individual to each of said other stations and under the control of the signal control means at the corresponding one of said other stations, connect signal means at said first station individual to each of the other stations and under the joint control of said switching means and the corresponding first relay, disconnect signal means at said first station, a second relay at said first station individual to each of said other stations and normally under the joint control of said switching means and the corresponding first relay for controlling the operation of said disconnect signal means, and means for placing said second relay under the exclusive control of said switching means.

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