Jan. 11, 1927. 1,613,685

G. S. VERNAM ET AL

PRINTING TELEGRAPH EXCHANGE SYSTEM

Filed Nov. 10, 1923 2 Sheets-Sheet 1

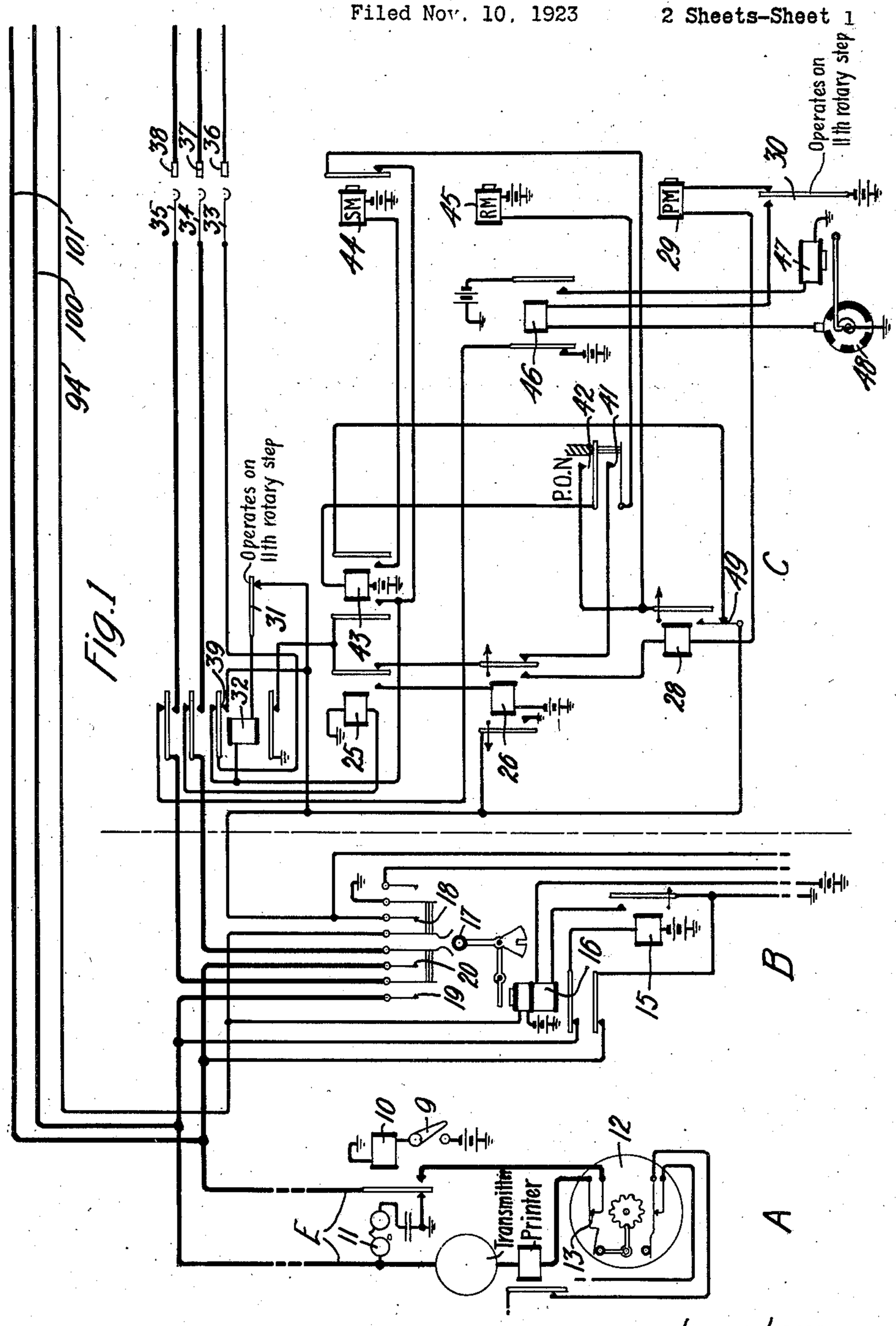

Fig. 1

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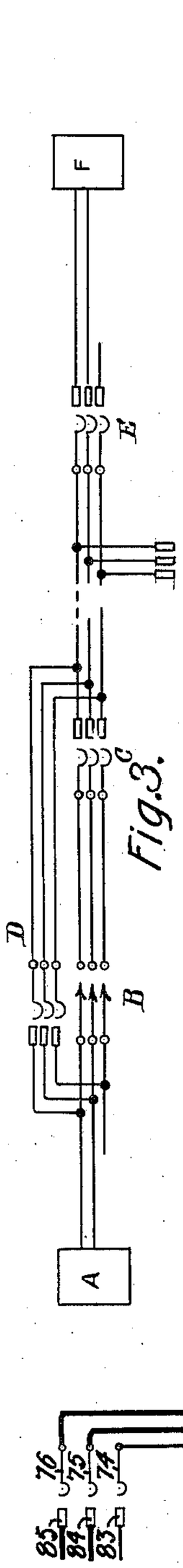

Fig. 3.

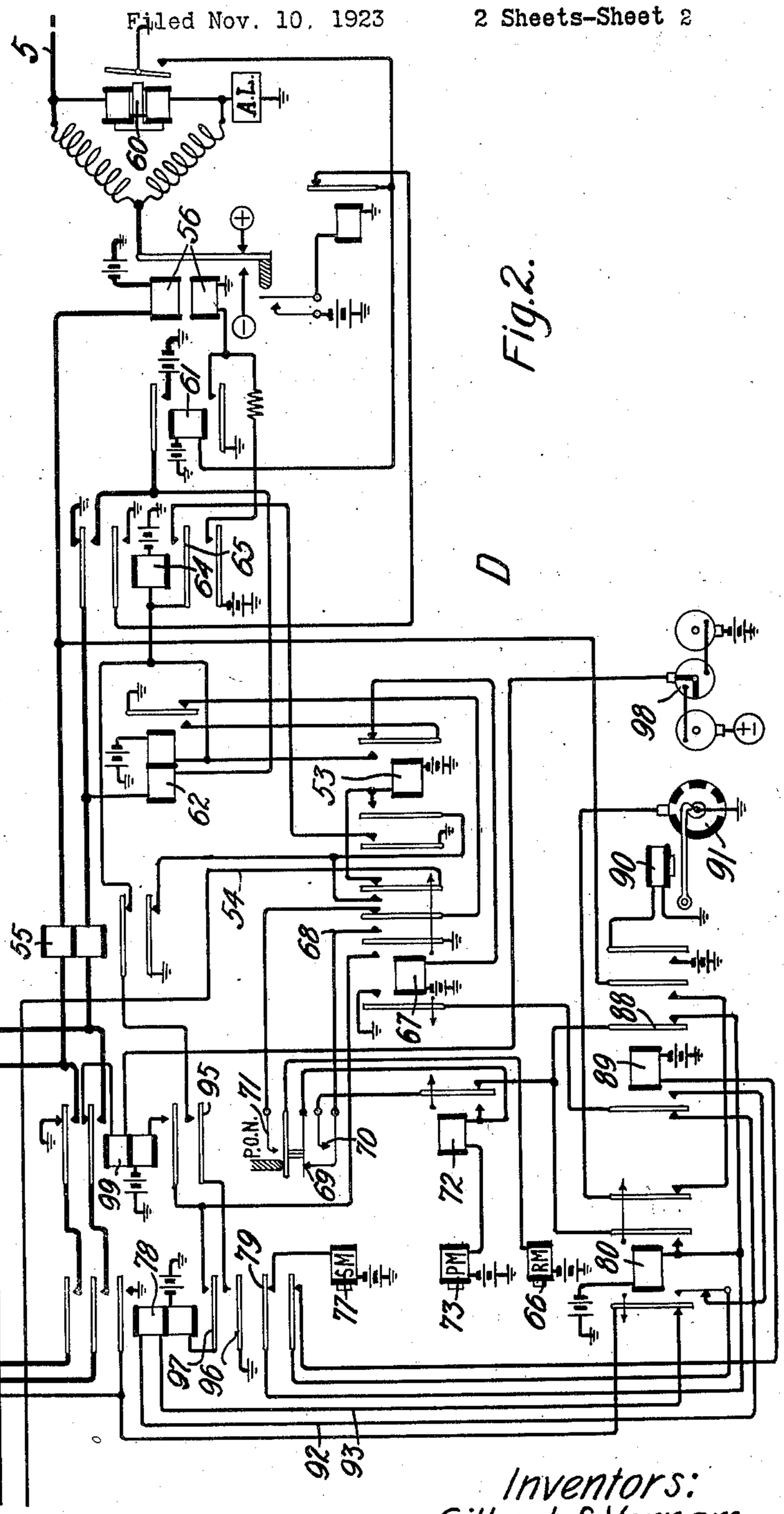

Fig. 2.

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UNITED STATES PATENT OFFICE.

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PRINTING-TELEGRAPH EXCHANGE SYSTEM.

Application filed November 10, 1923. Serial No. 674,010.

This invention relates to printing telegraphy and particularly to machine switching printing telegraph exchange systems.

An object of the invention is a machine switching telegraph system which is capable of extending the line of a printing telegraph subscriber over a telegraph line equipped with duplex apparatus to a printing telegraph subscriber located in a distant city and which functions to extend the connections in either direction over said telegraph line between said subscribers.

In the preferred form, the invention contemplates the provision of a machine switching telegraph exchange system, which may be operated to selectively connect, over a telegraph line equipped with duplex apparatus, the lines of two printing telegraph subscribers who may, after the completion of the connection, converse telegraphically. To facilitate and expedite the operation of the system, machine switching apparatus is designed to be capable of completing connections in either direction, thereby providing both incoming and outgoing service on the same line conductor. In addition to the above mentioned provision, following the completion of the connection by the machine switching apparatus, relay means are operated for converting the system from full duplex to half duplex operation.

Referring to the drawings, the apparatus associated with one end of a telegraph line is shown when Figures 1 and 2 are placed end for end with Fig. 2 at the right of Fig. 1. It is of course understood that similar equipment is associated with the other end of the line for completing the desired connections. Fig. 3 is a schematic illustration of a system comprising a plurality of stations.

In the drawings, there is shown a printing telegraph subscriber's station A which may be located, for example, in New York and whose line E may be connected to one of a plurality of telegraph lines 5 through suitable machine switching apparatus such as a line switch B, a selector switch C and a connector switch D. The arrangement of the apparatus in this manner makes it possible for a printing telegraph subscriber located in one city to automatically establish a telegraph connection over a telegraph line with a subscriber located in a distant city.

Each of the printing telegraph subscriber's stations is provided with an impulse sending device and printing telegraph equipment, the latter comprising the usual transmitter and receiving printer for performing their respective functions.

A better understanding of the invention may be had from the following description when considered in conjunction with the accompanying drawings, wherein one embodiment of the invention is illustrated.

Referring first to Fig. 3, there is illustrated a calling station A having a line leading to the central office and terminating in the line switch B. The line switch B has access to trunks leading to the selector switch C, which in turn has access to outgoing telegraph lines extending to a distant central office and there terminating in connector switches such as the switch E. Connector switches E have access to local telegraph lines leading to stations such as the called station F. The connector switch D in the first office is also illustrated.

Assume for the purpose of illustration that the subscriber at station A located at New York desires to communicate telegraphically with a subscriber located in Pittsburgh. The subscriber at station A desiring to establish such a connection would operate switch 9 which causes the energization of switching relay 10. The switch 9, in addition to causing the energization of the relay 10, may also be utilized for connecting the power circuit with the printer apparatus. For the sake of clearness, this part of the system has not been shown. Switching relay 10 disconnects the call bell 11 from in bridge of the line conductors E and connects the transmitter, printer and impulse sending device 12 in series therewith. When the front contact of relay 10 is closed, an energizing circuit is established for line relay 15 of the line switch B. The circuit of this relay may be traced from grounded battery, through the winding of relay 15, uppermost armature and contact of cut-off relay 16, ring conductor of the line E, transmitter and printer in series contact 13 of the impulse sending device 12, armature and front contact of relay 10, lowermost contact and armature of cut-off relay 16 to ground. The line relay 15 in closing its contact establishes an energizing circuit

for cut-off relay 16, which opens at its contacts, the energizing circuit of relay 15 but inasmuch as this relay is slow-to-release, it does not release its armature until the energization of relay 26 associated with the selector switch C is energized for establishing a locking circuit for the cut-off relay 16. The cut-off relay 16 in energizing, also moves plunger 17 to a position where contacts 18, 19 and 20 are closed.

Upon the closure of contacts 19 and 20, an energizing circuit is established for line relay 25. This circuit may be traced from grounded battery, left-hand back contact and armature of relay 46, uppermost contact and armature of switching relay 32, contact 19 of line switch B, ring conductor of the line E, the transmitter and printer in series, contact 13 of the impulse sending device 12, armature and front contact of relay 10, tip conductor of the line E, contact 20 of the line switch B, upper middle armature and back contact of relay 32, and the winding of line relay 25 to ground. Line relay 25 in energizing, establishes an energizing circuit for slow-to-release relay 26 extending from grounded battery, through the winding of relay 26, front contact and armature of relay 25, and the lowermost contact and armature of relay 32 to ground. Relay 26 in closing its right-hand front contact, conditions an energizing circuit for the series relay 28 and the vertical magnet 29. Relay 26 also completes the locking circuit for the cut-off relay 16 extending from grounded battery, through the upper winding of cut-off relay 16, contact 18 of the line switch B, and the left-hand armature and contact of relay 26 to ground. As previously stated, line relay 15 is of the slow-to-release type and remains operated after its energizing circuit is opened at the uppermost contact and armature of cut-off relay 16, and until relays 25 and 26 have been energized to maintain cut-off relay 16 energized, after which line relay 15 releases its armature. Cut-off relay 16 now depends for its energization on the maintenance of the ground connection at the left-hand armature of relay 26.

The subscriber at station A may now operate the impulse sending device 12 for transmitting a series of impulses characteristic of the first digit of the called subscriber's line. This digit identifies the city in which the called subscriber is located. Due to the operation of the impulse sending device 12, the contact thereof will be opened and closed, thereby causing the deenergization and energization of line relay 25 which thereupon vibrates its armature between its front and back contacts. On each closure of the back contact, an energizing circuit for the series relay 28 and the vertical magnet 29 is closed. This circuit may be traced from grounded battery, through switching element 30 which is operated only after the selector switch has taken 11 rotary steps, winding of vertical magnet 29, winding of series relay 28, right-hand front contact and armature of slow-to-release relay 26, back contact and armature of relay 25, and the lowermost contact and armature of relay 32 to ground. The series relay 28 and the vertical magnet 29 are thereupon energized, the vertical magnet moving the wiper shaft, upon which the wipers 33, 34 and 35 are mounted, to the level in the bank of contacts allotted to the particular digit dialed, as for example, contacts 36, 37 and 38. On the first vertical step of the wiper shaft, off-normal contacts 41 and 42 are closed, thereby conditioning the energizing circuits for the interrupter relay 43 and the release magnet 45.

Upon the energization of relay 28 which as previously described is energized at the same time as vertical magnet 29, the interrupter relay 43 will be energized following the upward movement of the wiper shaft over a circuit which extends from grounded battery, through the winding of interrupter relay 43, off-normal contact 42, armature and contact of relay 28 and the left-hand armature and contact of relay 26 to ground. Following the closure of the left-hand contact of relay 43, a locking circuit is established therefor, extending from grounded battery, through the winding of interrupter relay 43, off-normal contact 42, armature and contact of stepping magnet 44, left-hand contact and armature of relay 43 and the lowermost armature and contact of switching relay 32 to ground.

When the series of impulses ends, that is, impulses produced by the first operation of the impulse sending device 12, line relay 25 is again energized, thereby maintaining relay 26 energized. Owing to this operation, the series relay 28 is deenergized, closing the circuit of stepping magnet 44. The energizing circuit of stepping magnet 44 may be traced from grounded battery, through the winding of stepping magnet 44, right-hand contact and armature of interrupter relay 43, contact 49 and the left-hand armature and contact of relay 26 to ground. It is to be noted here, that the interrupter relay 43 depends for its energization on the ground established at the lowermost armature and contact of switching relay 32, while the stepping magnet 44 depends for its energization on the closure of the left-hand front contact of relay 26. The stepping magnet 44 now operates to move the wipers 33, 34 and 35 through one horizontal step or in other words, on to the first set of contacts. If the telegraph line which is connected to this set of contacts is free, there will be an absence of ground on the wiper 33. However, if the telegraph line happens to be busy, there will be a ground

connected to this particular wiper. Assume the latter to be the case. This ground on the bank contact 36 is now connected through wiper 33, and an armature and back contact of relay 32, to the contacts of the stepping magnet 44 and the interrupter relay 43. Near the end of its stroke, the stepping magnet 44 opens its contact thereby opening the locking circuit of interrupter relay 43. Accordingly, relay 43 is deenergized opening the energizing circuit of stepping magnet 44. Stepping magnet 44 now closes its back contact, closing an energizing circuit of interrupter relay 43 to the wiper 33 and the bank contact 36. At this time, interrupter relay 43 depends solely upon the wiper 33 for a circuit because its own circuit to ground at the relay 32 is opened. If wiper 33 rests on a grounded contact, the interrupter relay 43 will again energize and again cause the energization of stepping magnet 44, causing it to rotate the wipers to the next set of contacts. So long as the wiper 33 finds ground, the interrupter relay 43 and the stepping magnet 44 will vibrate.

During this time, the switching relay 32 has had a ground on each end of its winding; therefore, it remains deenergized. When the wiper 33 engages an ungrounded contact, as for example 36, the interrupter relay 43 fails to energize. Switching relay 32 immediately energizes over a circuit extending from grounded battery, through the winding of relay 43, switch member 31 which is operated only after the switch has taken ten rotary steps, and the left-hand armature and contact of relay 26 to ground. Due to the establishment of the circuit just traced, switching relay 32 is energized but relay 43 remains inert. Switching relay 32 extends the sleeve conductor through the wiper 33, contact 36, conductor 54, right outer armature and back contact of relay 67 to battery through the winding of relay 53 which operates and locks as hereinafter described. A locking circuit for switching relay 32 is established upon its operation extending from grounded battery, winding of relay 43, off normal contact 42, armature and contact of magnet 44, winding of relay 32, switch member 31, front contact and armature 39 of relay 32, wiper 33, contact 36, right outer armature and back contact of relay 67, locking contacts of relay 53, and the lowermost contact and armature of relay 55 to ground. The release of switching relay 32 is now under the control of the differential relay 55 which is not operated at this time. Switching relay 32 operates, disconnecting line relay 25, and extends the subscriber's line E through the contacts 37 and 38 by the wipers 34 and 35 to the telegraph line 5. It also removes at its lowermost armature to ground connection through which the series relay 28 and the vertical magnet 29 were previously energized, thereby preventing the actuation of these relays. Prior to the deenergization of relay 26, a locking circuit is established for out relay 53 extending from grounded battery, through the widing and middle contact and armature thereof and the lowermost contact and armature of differential relay 55 to ground, thereby connecting this ground with the sleeve conductor, through the contact 36 and wiper 33 for maintaining cut-off relay 16 and switching relay 32 energized independent of relay 26, which releases shortly after the deenergization of relay 25.

If all of the telegraph lines connected to contacts corresponding to 37 and 38 in the selected level are busy, the wiper 33 will be unable to find an ungrounded set of terminals. The wipers therefore will take 11 rotary steps. At this point in the operation, operating members 30 and 31 will be operated cutting off the switching relay 32 and the vertical magnet 29 and closing an energizing circuit for busy relay 46. The energizing circuit for busy relay 46 extends from grounded battery, operating member 30, and front contact thereof, winding of busy relay 46 and the conducting segments of the interrupter 48 to ground. The interrupter 48 is provided with suitable conducting and insulating segments so that upon its rotation, characteristic impulses will be transmitted due to the energization and the deenergization of the busy relay 46 to cause the operation of the receiving printer for recording a symbol designating that the called line is busy. The energization of busy relay 46 closes at its right-hand contact and armature an energizing circuit for release magnet 47 which controls the release of the interrupter 48. The interrupter 48 is of the start-stop type inasmuch as the printer equipment at the station A is also of this type, it being necessary in such systems to transmit a starting impulse for releasing the printer mechanism, at the subscriber's station.

If an idle telegraph line is seized, and upon the closure of the two uppermost contacts of switching relay 32, a circuit is established for pole changer relay 56. This circuit may be traced from grounded battery, through the upper winding of the pole changer relay 56, upper winding of differential relay 55, contact 37, wiper 34, upper middle contact and armature of switching relay 32, contact 20 of the line switch B, tip conductor of the line E, armature and front contact of relay 10, contact 13 of the impulse sending device 12, printer and transmitter in series, contact 19 of line switch B, uppermost armature and front contact of switching relay 32, wiper 35, contact 38, lower winding of differential relay 55, and

the uppermost armature and back contact of duplex relay 64 to ground. On the closure of the circuit just traced, pole changer relay 56 is operated for impressing on the telegraph line 5 a marking impulse. At the opposite end of the telegraph line 5, this marking impulse flows through a receiving relay similar to relay 60 for causing the closure of its contact. On the closure of the contact controlled by relay 60, an energizing circuit is established for control relay 61 extending from grounded battery, through the winding of control relay 61 and the contact and armature of relay 60 to ground. Control relay 61 establishes an energizing circuit for line relay 62 extending from grounded battery, through the upper contact and armature of relay 61, left-hand winding of line relay 62 and the uppermost armature and back contact of relay 64 to ground. Line relay 62 is energized over the circuit just traced and completes the energizing circuit for the release relay 67 which is of the slow-to-release type and which prepares an energizing circuit for the series relay 72 and the vertical magnet 73, the series relay 72 and the vertical magnet 73 which will be energized upon the closure of the back contact of line relay 62 in response to the further operation of the impulse sending device 12 by the subscriber A. The release relay 67 also connects ground from a back contact of relay 55, through one of its front contacts and the contact 36 which is multipled to corresponding contacts of other selector switches similar to C, thereby making this particular set of contacts busy and preventing the seizure of this line circuit by wipers which may be operated by another subscriber who desires to establish a connection over the telegraph line 5.

When the subscriber A dials the tens digit, pole changer relay 56 is operated in accordance with such operation for transmitting impulses over the telegraph line 5 to operate receiving relay 60 located at the opposite end of this line, whereby line relay 62 vibrates its armature and establishes alternately the circuit through the winding of release relay 67 and through the contacts of the release relay 67 for the series relay 72 and the vertical magnet 73. The release relay 67 remains energized as does the series relay 72 but the vertical magnet 73 is quick acting and follows the impulses and lifts the wiper shaft upon which the wipers 74, 75 and 76 are mounted. The series relay 72 operates on the first impulse and remains energized to the end of the series of impulses impressed on the vertical magnet 73. On the first upward movement of the wiper shaft, contacts 70 and 71 are closed, while contact 69 is opened. The closure of contact 70 extends the energizing circuit of the vertical magnet 73 through the armature and front contact of series relay 72 while the closure of contact 71 prepares an energizing circuit for release magnet 66. Inasmuch as the release relay 67 and the series relay 72 are at this time energized, the movement of the wiper shaft produces no change.

When the impulses cease, line relay 62 remains energized, thereby maintaining release relay 67 energized but series relay 72 is accordingly deenergized. The impulse circuit is now transferred to the stepping magnet 77. When the subscriber dials the last digit, line relay 62 again vibrates sending pulsations through the stepping relay 80 and the stepping magnet 77 in parallel. The energizing circuit of each of these devices may be traced from grounded battery, through their windings, contact and armature 88 of busy relay 89, back contact and armature of series relay 72, off-normal contact 70, right-hand middle front contact and armature of release relay 67, and the back contact and armature of line relay 62 to ground. The stepping magnet 77 rotates the wipers 74, 75 and 76 over the bank of contacts in which contacts 83, 84 and 85 are located. To these contacts, there are connected conductors 94, 100 and 101, which extend to subscriber's station A or similar stations, and for the purpose of illustration, it should be assumed that these conductors extend to another subscriber's station. No interference with other connected lines is caused due to the movement of the wipers 74, 75 and 76 over the back of contacts as the line wipers are opened at the contacts of switching relay 78.

During the rotation of wipers 74, 75 and 76, the wiper 74 may pass over one or more busy lines, the corresponding contacts of which are grounded through the lower armature and contact of differential relay 55 if busy as a result of an outgoing call or through the innermost upper armature and front contact of relay 78 if busy as a result of an incoming call. Busy relay 89 may be energized while passing over such contacts, but this will not interfere with the stepping magnet 77 as the circuit for this magnet is controlled through the contacts of the stepping relay 80 which remains energized and holds the circuit closed until the last series of impulses has been received. When this occurs, the stepping relay 80 will also be released and if the called for line is not busy, busy relay 89 will be released due to the absence of ground on the contact to which the wiper 74 is now connected.

If the called line is not busy, wiper 74 connects battery to the upper winding of switching relay 78, which is energized over a circuit extending from battery, upper winding of cut-off relay 16, conductor 94, contact 83, wiper 74, left-hand armature and back contact of stepping relay 80, upper

winding of stepping relay 78, extreme left-hand back contact and armature of busy relay 89, and the left-hand armature and front contact of release relay 67 to ground. Following the closure of the contacts of switching relay 78, a locking circuit therefor is established from grounded battery, through the lower winding and armature 97 and front contact thereof and the right-hand innermost front contact and armature of relay 67 to ground. Ground is also connected to the wiper 74 due to the energization of the switching relay 78 making the called line busy. Relay 78 also opens the circuit of the stepping magnet 77 and the busy relay 89.

The wipers 75 and 76 are now closed through the upper winding of the ringing cut-off relay 99 and the source of ringing current 98. Ringing current will now be transmitted intermittently through the upper winding of ringing cut-off relay 99, wiper 75, contact 84, conductor 100, call bell 11, and associated condenser to ground. The call bell at the subscriber's station will thus be operated for advising such subscriber that some one desires to communicate with him telegraphically and that his printer set should be connected with the line. The called for subscriber will thereupon actuate a switch corresponding to 9 causing the energization of the switching relay which connects the printer set with the line. The ringing cut-off relay 99 is designed so that it will not operate on the ringing current, but when the subscriber responds to the call by the operation of switching relay corresponding to relay 10, direct current will be permitted to flow through the upper winding of the ringing cut-off relay 99 over the circuit traced for the ringing current except in place of passing through the call bell, it will pass through the transmitter, printer and contact 13 of the impulse sending device and back over the line to ground at the uppermost back contact of relay 99. Ringing cut-off relay 99 in operating, disconnects the source of ringing current from the line and establishes a locking circuit for itself extending from grounded battery, through the lower winding, front contact and armature thereof and the right-hand innermost front contact and armature of release relay 67 to ground. It also removes the ground connection from the tip conductor and establishes a holding circuit for line relay 62 and an energizing circuit for duplex relay 64. The circuits of these relays may be traced from grounded battery, through the connected winding, uppermost contact and armature of differential relay 55, contact and armature 95 of ringing cut-off relay 99 and the contact and armature 96 of relay 78 to ground. The purpose of holding line relay 62 is to prevent its operation upon the printer or "break" signals and the false release of the connector switch D. Due to the energization of the duplex relay 64, the ground connection on the lower winding of the differential relay 55 is disconnected and the battery at the upper armature and contact of relay 61 is substituted therefor. When the called for subscriber responds by connecting the printer equipment with the line conductors individual to his station, the pole changer relay associated with the incoming end of the telegraph line 5 will be operated for transmitting over this line a marking impulse. This impulse, upon being received at the outgoing end of the telegraph line 5, operates receiving relay 60 which completes an energizing circuit for control relay 61 extending from grounded battery, winding of relay 61 and the contact and armature of relay 60 to ground. Relay 61 closes at its upper contact an energizing circuit for line relay 62 which may be traced from grounded battery, upper contact and armature of relay 61, left-hand winding of relay 62 and the uppermost armature and contact of duplex relay 64 to ground. Relay 53, associated with the outgoing end of the telegraph line 5, being at this point in the operation energized a circuit is completed for locking up relay 62 and causing the energization of duplex relay 64. The energizing circuit of duplex relay 64 may be traced from grounded battery, winding thereof, right-hand front contact and armature of relay 53 and the front contact and armature of relay 62 to ground. Upon the energization of the duplex relay 64, a locking circuit therefore is established from grounded battery, winding thereof, armature 65 and front contact, and the extreme left-hand contact and armature of relay 53 to ground. Duplex relay 64 also disconnects the ground from its uppermost armature and connects battery thereto through the upper armature of control relay 61, whereby differential relay 55 is prevented from operating. There is also established, upon the energization of relay 64, a locking circuit for control relay 61.

A channel of communication is now established between the subscriber located at New York and the subscriber located at Pittsburgh and the transmission of messages between these two stations may now be commenced. In many cases, however, it would first be necessary for the other subscriber located at Pittsburgh to operate his transmitter for the transmission of suitable symbols to the subscriber at New York to advise such subscriber of the connection and that the subscriber at Pittsburgh is in readiness to receive any messages which the subscriber at New York may desire to transmit.

Should the called for subscriber's line be busy, busy relay 89 will be energized over a circuit completed through the wiper 74, and the contact 83 to which ground under these conditions will be connected. Busy relay 89 opens at its left-hand back contact and armature the energizing circuit of switching relay 78 thereby preventing the energization of this relay. Likewise, the energizing circuits of stepping relay 80 and stepping magnet 77 are opened when relay 80 releases after the last dial impulse and consequently, the stepping magnet cannot be actuated by any further dialing or printing impulses which might be sent from station A. There is also completed due to the energization of the busy relay 89, an energizing circuit for release magnet 90 of the interrupter 91, which is similar to that described in connection with the interrupter 48 and which controls the operation of the pole changer relay 56. On the operation of the interrupter 91, pole changer relay 56 is caused to move its armature in accordance with the segments arranged on the interrupter 91 for transmitting impulses over the telegraph line 5 which operate relay 60 and which control the operation of control relay 61 for transmitting to the calling station impulses characteristic of a symbol which designates that the line is busy. These impulses will effect the operation of the receiving printer at the calling subscriber's station for designating to such subscriber that the called for line is busy and that the call should be abandoned.

When the connection is completed, the release of the connector switch D is controlled jointly by both stations. If the called station disconnects first, differential relay 55 will operate over the tip side of the line circuit. The operation of the differential relay 55 opens the energizing circuit for the line relay 62 and the duplex relay 64 which are thereupon deenergized. When the duplex relay 64 releases, the line relay 62 will immediately operate again. The circuit is now completed from ground at the upper back contact and armature of relay 64 through the left-hand winding of relay 62 and the upper armature and contact of relay 61 to battery. The energization of relay 62 prevents the connector switch D from releasing until the calling station disconnects. When the calling station disconnects, the pole changer relay 56 at that end of the line is caused to resume its normal position and accordingly transmits a spacing signal which causes the restoration of the receiving relay and the control relay 61 to normal. Relay 62 is thereby released and after a short interval, release relay 67 will be deenergized, thus causing the energization of release magnet 66 and the restoration of the connector switch D to its normal position.

If the calling subscriber disconnects first, the selector switch will be released at the calling end and a spacing impulse will be transmitted as previously described to release the receiving relay 60 and control relay 61. The line relay 62 and the duplex relay 64 will remain locked up through the upper contact and armature of differential relay 55, and the contacts and amatures of relays 99 and 78. When the called station disconnects, the differential relay 55 will operate and release the line relay and duplex relay and thereby release the connector switch D restoring it to its normal condition. When the calling subscriber disconnects the printer equipment from the line E, differential relay 55 operates and removes the ground connection through which the switching relay 32 was held energized. Switch relay 32 is thereupon deenergized and opens at its contacts the circuits extending to the wipers 33, 34 and 35 and closes at its lowermost armature and contact the circuit of the release magnet 45. This circuit may be traced from grounded battery, winding of release magnet 45, off normal contact 41, right-hand back contact and armature of relay 26, back contact and armature of relay 25 and the lowermost contact and armature of relay 32 to ground. Release magnet 45 is operated over the circuit just traced and restores the selector switch C to normal. The cut-off relay 16 is also deenergized at this time, whereupon contacts 18, 19 and 20 are open, due to the withdrawal of the plunger 17. The system may now be used for the extension of the lines individual to the printing telegraph subscribers to other printing telegraph subscribers' lines as may be desired.

Although the invention has been disclosed and described with reference to a particular circuit arrangement, it is of course obvious that various modifications may be made without departing from the spirit and scope of the present invention.

What is claimed is:

1. In a telegraph system, a plurality of telegraph stations each provided with a receiving printer and transmitter, a two-way telegraph line, and selectively operable switching mechanism associated with each end of said line and under the control of said stations whereby connections may be extended in either direction over said line between said stations.

2. In a telegraph system, a plurality of telegraph stations each provided with a receiving printer and transmitter, a two-way telegraph line terminating at each end in a selectively operable switch for extending connections from said line to a desired telegraph station, other selectively operable switches for extending connections from said stations to said telegraph lines, and means associated with each telegraph station for

controlling said switches whereby connections may be extended in either direction over said line between said stations.

3. In a telegraph system, a plurality of telegraph stations each provided with a receiving printer and transmitter and located at remote points, local telegraph lines for each of said stations, telegraph lines equipped for duplex operation extending between said remote points, and selectively operable switches associated with each end of said last mentioned lines and under the control of said stations whereby connections may be extended in either direction over said duplex telegraph line between said local telegraph lines.

4. In a telegraph system, a plurality of telegraph stations each provided with a receiving printer and transmitter, a two-way telegraph line, switching means associated with each end of said line and under the control of said stations whereby connections may be extended in either direction over said line between said stations, and means operated following the setting of said switching means for preventing its release on the normal operation of said telegraph transmitter.

5. In a telegraph system, a plurality of telegraph stations each provided with a receiving printer and transmitter, a telegraph line equipped for duplex operation, switching means associated with each end of said line and under the control of said stations whereby connections may be extended in either direction over said line between said stations, and means operated following extension of said lines for automatically changing said system from full duplex to half duplex operation.

6. In a telegraph system, a plurality of telegraph stations each provided with a receiving printer and transmitter, a telegraph line, switching means under the control of any of said stations for extending connections over said line to any desired one of said stations, and means operated when said line is found busy to effect the transmission of characteristic impulses to the calling station whereby said receiving printer is operated to record the busy condition of said line.

7. In a telegraph system, a plurality of telegraph stations each provided with a receiving printer and transmitter, a telegraph line, switching mechanism under the control of one of said stations for extending the connection over said line to any desired one of said stations, and means controlled jointly by the connected stations for causing the release of said switching mechanism.

8. In a telegraph system, a plurality of telegraph stations each provided with a receiving printer and transmitter, a telegraph line and switching mechanism associated with each end of said line and under the control of said stations whereby a connection may be extended in either direction over said line between said station, and relay means under the joint control of the connected station for effecting the release of said switching mechanism.

In testimony whereof, we have signed our names to this specification this 8th day of November, 1923.

GILBERT S. VERNAM.
DONALD B. PERRY.