

July 26, 1927.

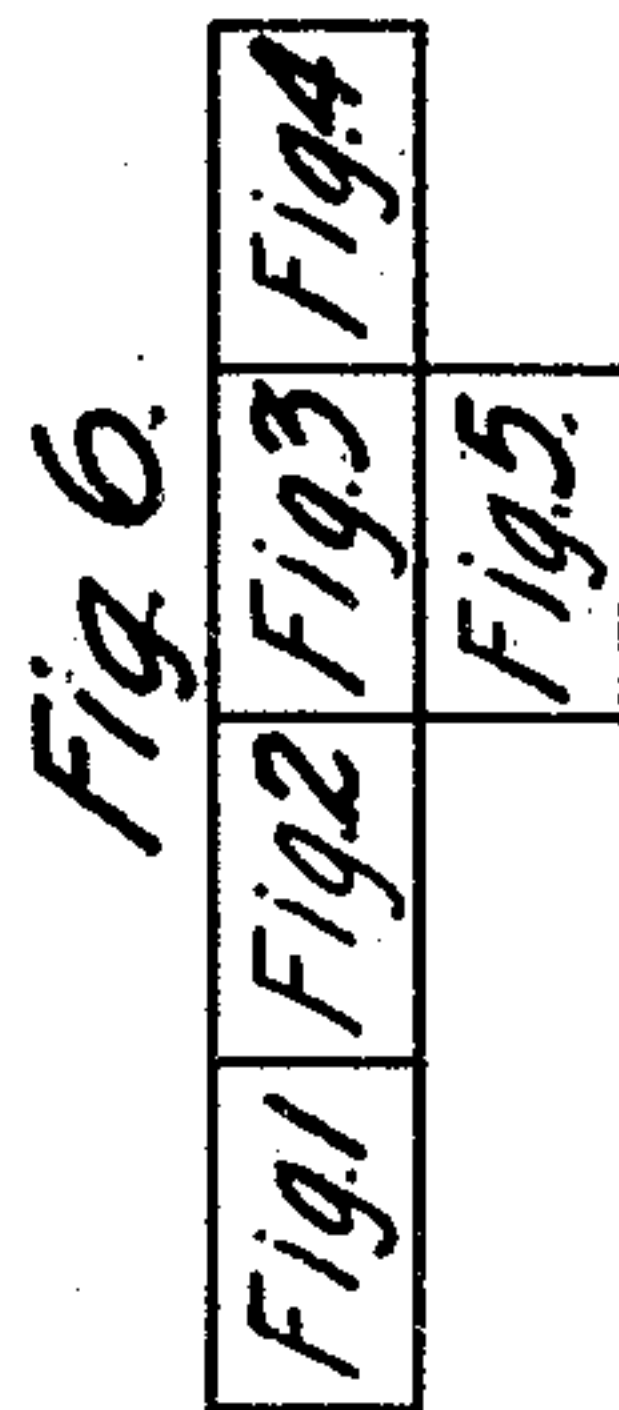
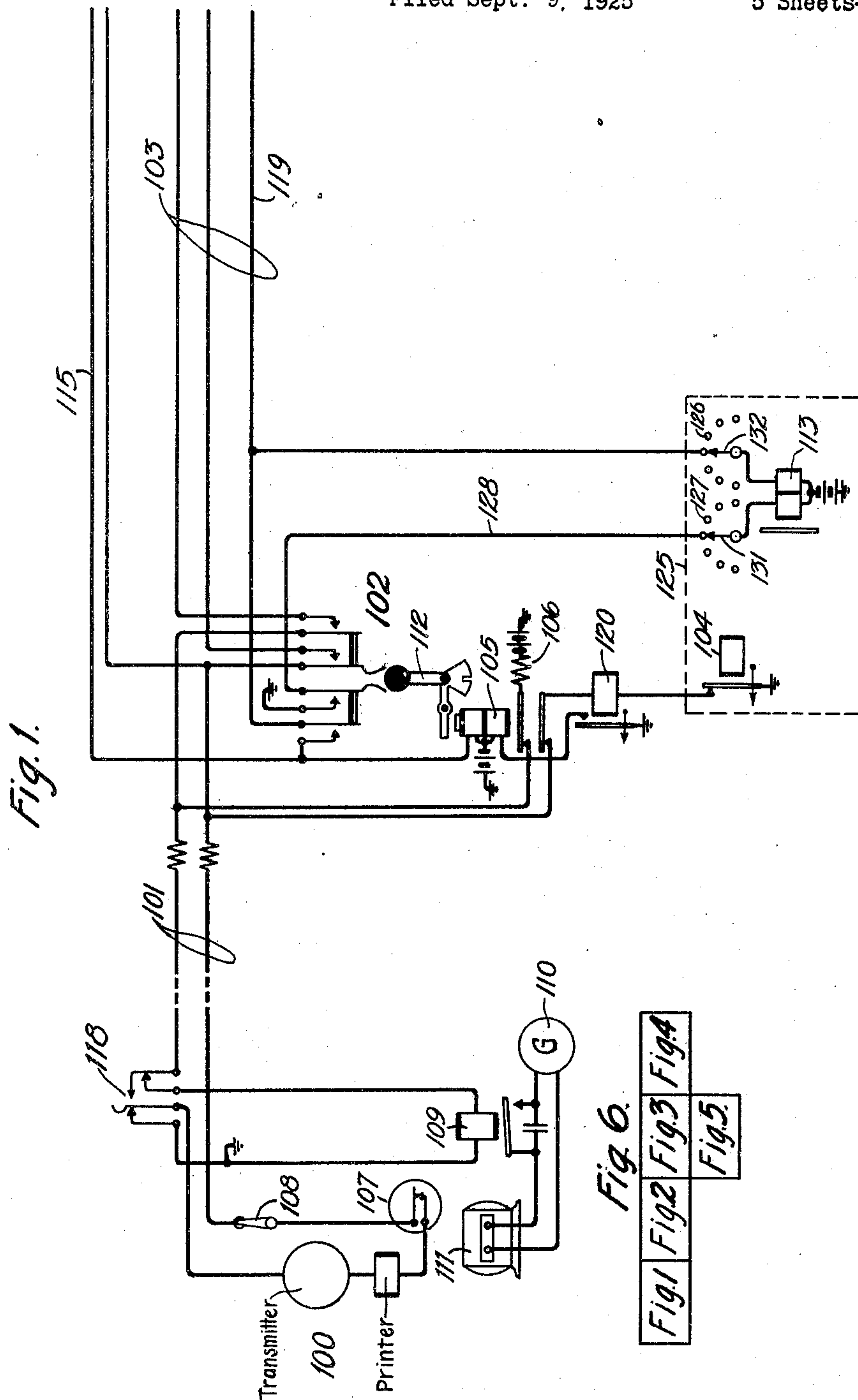
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D. B. PERRY

PRINTING TELEGRAPH EXCHANGE SYSTEM

Filed Sept. 9, 1925

5 Sheets-Sheet 1



Inventor:
Donald B. Perry
J. F. F. Atty

July 26, 1927.

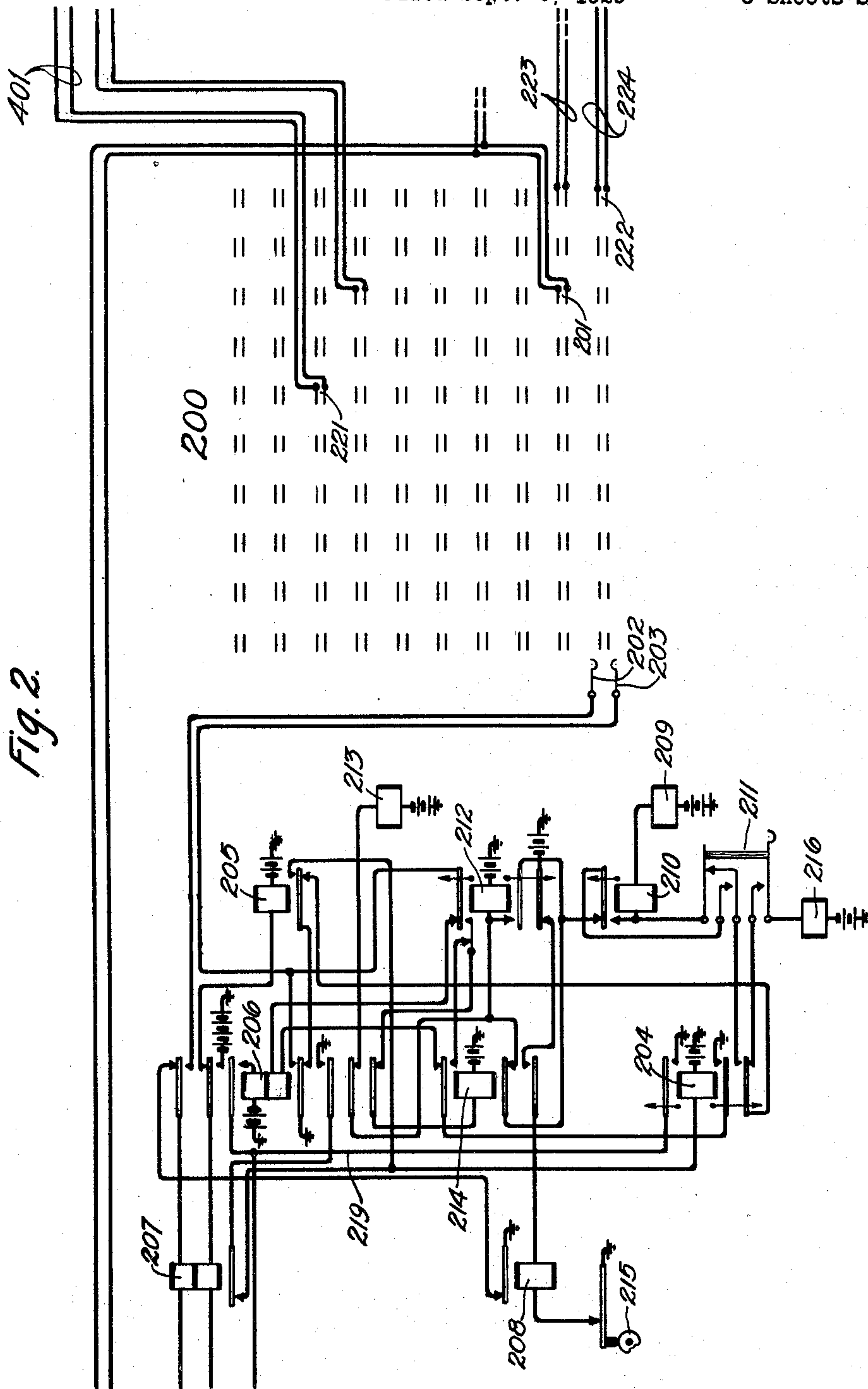
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D. B. PERRY

PRINTING TELEGRAPH EXCHANGE SYSTEM

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Inventor:
Donald B. Perry

by

gc 404

Att'y

July 26, 1927.

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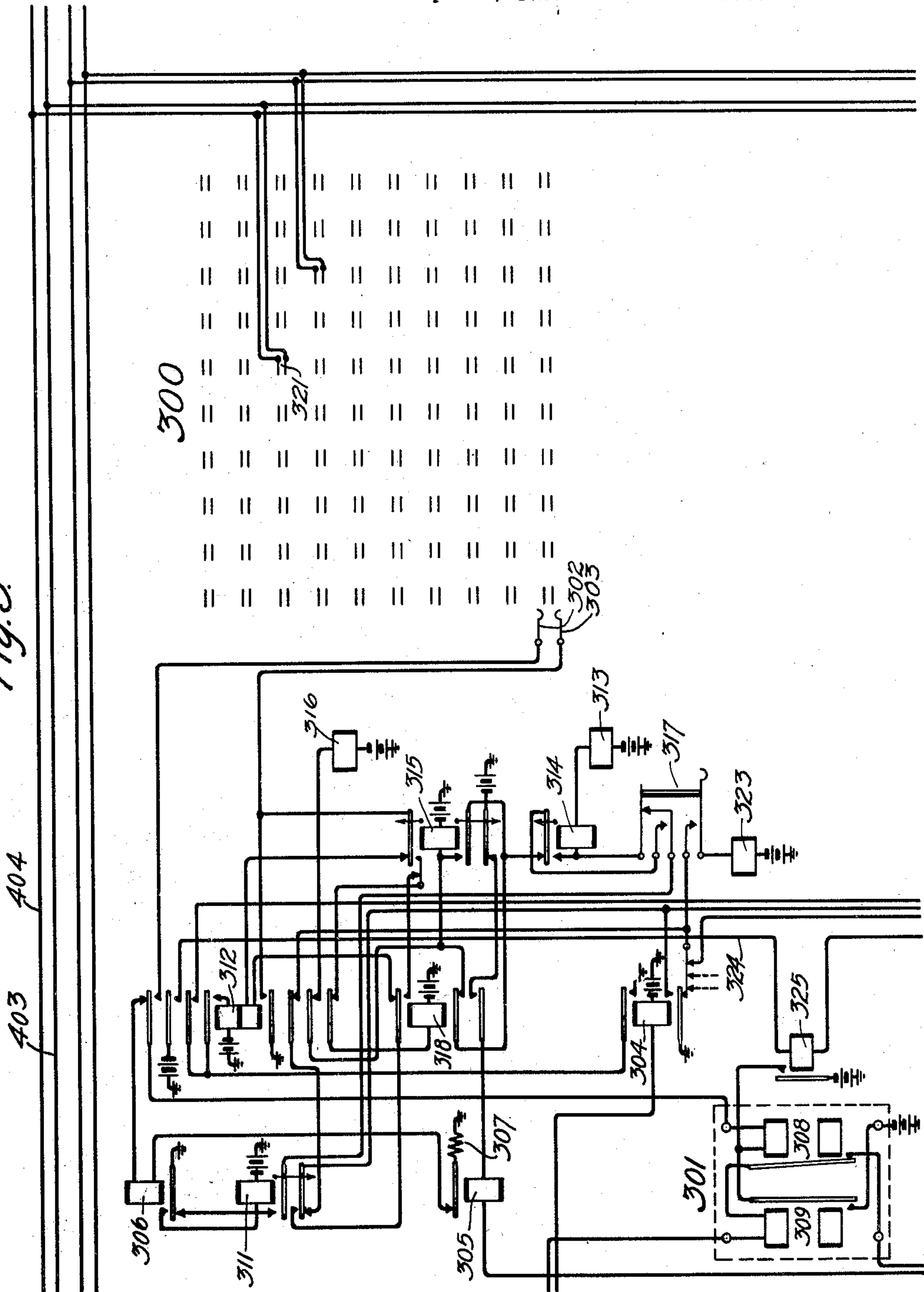
D. B. PERRY

PRINTING TELEGRAPH EXCHANGE SYSTEM

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Fig. 3.



Inventor:
Donald B. Perry

by

George

Atty

July 26, 1927.

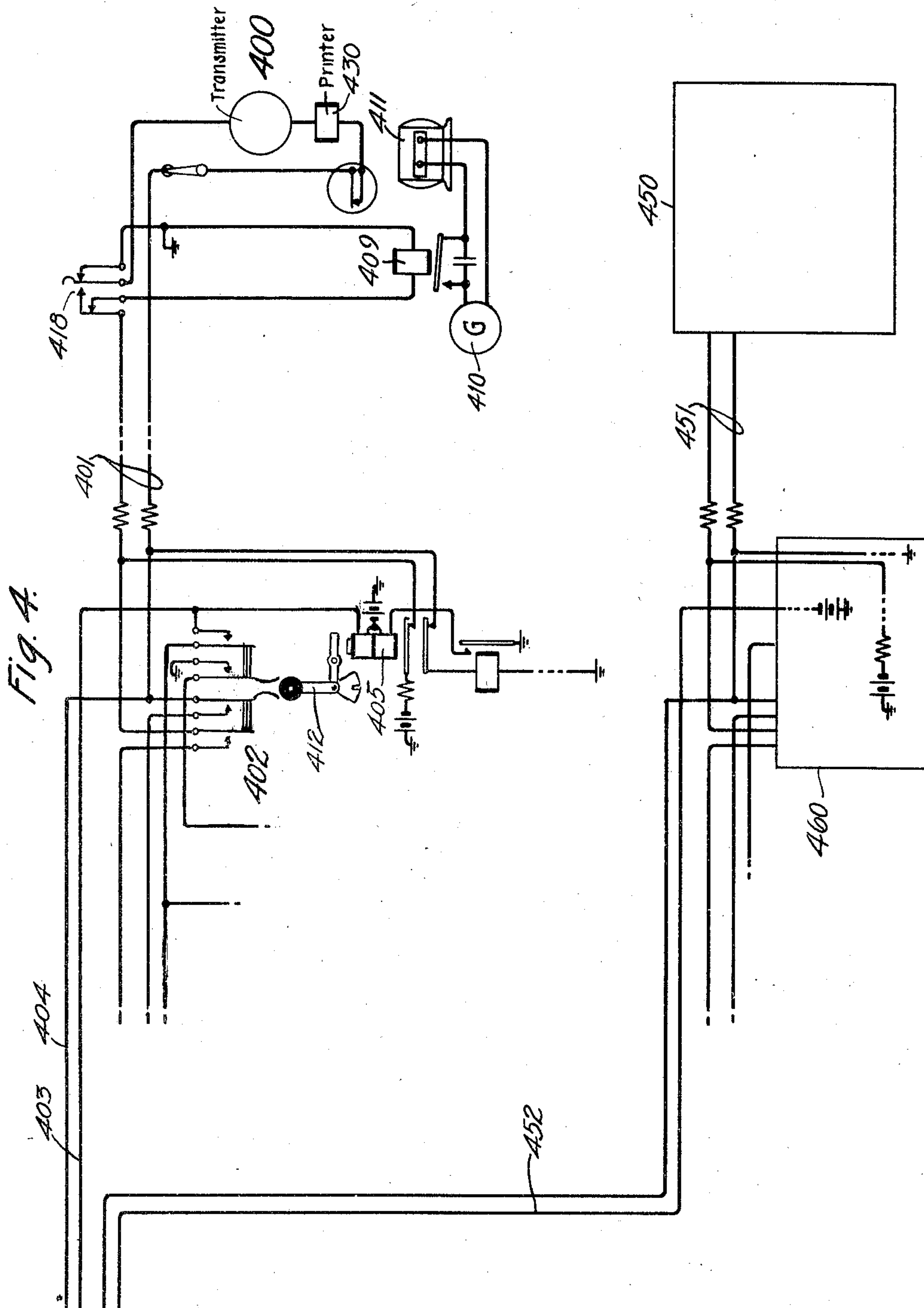
D. B. PERRY

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PRINTING TELEGRAPH EXCHANGE SYSTEM

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Inventor:
Donald B. Perry

by

J. J. H.

Atty

July 26, 1927.

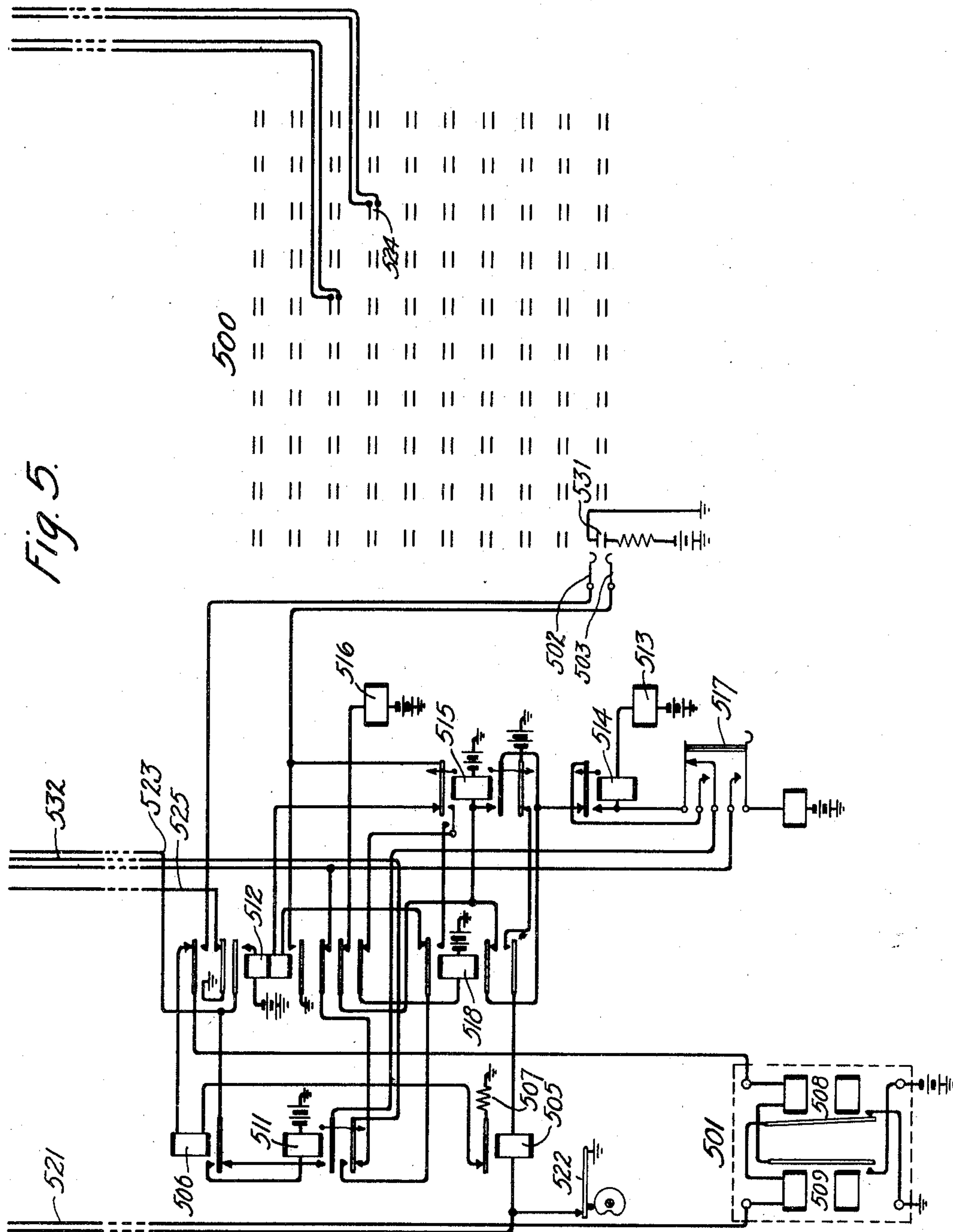
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D. B. PERRY

PRINTING TELEGRAPH EXCHANGE SYSTEM

Filed Sept. 9, 1925

5 Sheets-Sheet 5



Inventor:
Donald B. Perry
by *John* Att'y

UNITED STATES PATENT OFFICE.

DONALD B. PERRY, OF YONKERS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

PRINTING-TELEGRAPH-EXCHANGE SYSTEM.

Application filed September 9, 1925. Serial No. 55,327.

This invention relates to printing telegraph systems and more particularly to telegraph systems wherein automatic switches are employed for the establishment of channels of telegraphic communication.

The invention has for its main object to provide a telegraph exchange system which utilizes automatically and directly operable switches for establishing telegraphic connections, whereby the flexibility and efficiency of telegraph systems are greatly increased.

Heretofore, in printing telegraph systems where each subscriber's station is equipped with motor driven printing mechanism it has been the practice to signal the subscriber at a called station over special circuits before the operation of the printing apparatus thereat, in order that said apparatus might be put in movement.

One of the features of this invention is the provision of means whereby the printing operations at a called station may immediately ensue upon the completion of a connection with said called station, without the manipulation of any switching devices thereat.

Another feature of the invention relates to the means for controlling the printing apparatus driving motors over a communication circuit, thus eliminating the necessity for using extra controlling wires.

A still further feature relates to a telegraph system for establishing so-called "conference" connections, enabling a calling subscriber to directly control the establishment of simultaneous telegraphic connections with a plurality of other stations, whereby the same message may be received at many stations simultaneously.

Another feature of the invention relates to the means for releasing a connector switch when a desired line is busy without releasing the connection, thus permitting a calling station to reoperate the released connector to complete connection with any other idle station.

A still further feature relates to a printing telegraph exchange system wherein a telegraph repeater functions to control the operation of automatic switches and to repeat telegraph signals to a plurality of telegraph receiving devices.

Referring to the drawing, Figure 1 shows

a subscriber's station with the necessary equipment for receiving and sending printed messages including a transmitting and receiving printer with associated driving motor and control circuit therefor. This figure also shows a subscriber's individual line switch and the associated master control switch.

Fig. 2 shows a connector switch in which the called sub-station lines terminate.

Fig. 3 shows a special connector switch which is controlled by a calling subscriber to establish a "conference" circuit. This figure also shows a telegraph repeater for controlling the associated special connector switch, and for repeating telegraph signals to called stations.

Fig. 4 shows a plurality of subscribers' stations with associated apparatus similar to that illustrated in Fig. 1.

Fig. 5 shows another special connector switch and associated repeater circuit similar to corresponding apparatus disclosed in Fig. 3.

Fig. 6 is a diagram showing the manner in which the several figures of the drawing are to be arranged for the purpose of obtaining a unitary disclosure of a preferred form of carrying out the invention.

In the drawing there are illustrated, in comparative detail, two printing telegraph stations, 100 and 400. These stations are connected with the central office by means of the line wires 101 and 401 respectively. At the central station, the lines, as calling lines, terminate in contacts of line switches, for example, switches 102 and 402. The lines also have an appearance, as called lines, in connector switches shown in Figs. 2, 3 and 5, it being understood that each line is multiplied to appear before corresponding sets of terminals in all the connector switches. For example, line 101 is multiplied to appear in terminals 201 of switch 200 and in correspondingly positioned terminals of connector switches 300 and 500.

Extending from each of the line switches are trunks which terminate in the movable contacts of the connector switches. For example, trunk 103 is one of a plurality of trunks which lead from line switch 102. This particular trunk terminates in the brushes 202 and 203 of connector switch 200. It will be understood that as many trunk and connec-

tor switches are provided as traffic conditions may require.

For the purpose of allowing a printed message to be recorded at more than two stations simultaneously, there are provided a number of so-called repeater connectors. Two of these connectors are shown in the drawing, namely, connector 300 and connector 500.

When a subscriber desires to have the same message recorded on several printers at the same time, a special code is dialed which, for convenience of description, may be called the "conference" number. This code is dialed prior to the dialing of impulses corresponding to the numbers of the desired subscribers' stations. The dialing of this code number results in the association of a predetermined number of repeater connectors with the extended line. The number of repeater connectors associated with each conference number may vary as conditions require. The conference circuit comprises a number of single Morse telegraph repeaters, each associated with a connector switch. For example, repeater 301 is associated with, and controls the operation of connector switch 300, while repeater 501 is associated with connector switch 500. The subscriber by means of his dial may cause each repeater connector in succession to operate to associate the printers of any of the other stations with the extended line.

For the purpose of enabling a better understanding to be attained of the operation of the system, a detailed description will first be given of the manner in which a message is recorded at a distant station without the use of a repeater connector. Subsequently hereinafter, a description will be given of the manner in which a subscriber may establish a "conference" circuit to cause his message to be printed simultaneously at a plurality of different stations.

Detailed description.

Let it be assumed therefore that the subscriber at station 100 desires to have a message recorded on printer 430 at station 400. It will be noted that the line 401 from this latter station terminates in the eighth level in connector switches 200, 300 and 500, etc. The subscriber at station 100 operates the switch 118, which at its contacts breaks the energizing circuit of motor control relay 109 which thereupon releases. It is to be noted that relay 109 is normally operated over a circuit traceable from battery through resistance 106 and the lower inner contacts of magnet 105, upper conductor of line 101, right normal contacts of key 118, winding of relay 109, to ground. Relay 109 upon being deenergized, as described, closes its contacts to complete the circuit from the

source of power 110 to operate the printer driving motor 111.

The manipulation of key 118, as mentioned, also completes a circuit from ground at the contacts of relay 104, through the winding of relay 120, lower outer contacts of magnet 105, lower conductor of line 101, normally closed contacts of dial 107, through the printing and transmitting apparatus, make before break contacts of key 118, upper conductor of line 101 to battery at the lower inner contacts of magnet 105. Relay 120 operates in this circuit and closes an obvious circuit for the lower winding of magnet 105, whereby plunger 112 operates the contact set associated with the idle trunk 103. Line switch 102 is of the pre-selector type and is under control of the master switch shown diagrammatically within the rectangle 125. The master switch causes the plunger of each idle line switch to be positioned before sets of contacts corresponding to an idle trunk. Magnet 105 when operated as described, opens the energizing circuit of relay 120, but relay 120 is of the slow-to-release type and is so adjusted as to maintain its armatures attracted until relay 204 operates as hereinafter described, to provide a holding circuit for magnet 105. Simultaneously with the actuation of plunger 112, a circuit is completed from battery through the left winding of relay 113 to ground at the left inner contacts of the line switch. Under control of relay 113, the master switch causes the plungers of other idle line switches to be positioned before the bank contacts corresponding to an idle trunk. Should the trunk succeeding trunk 103, and associated with contacts 126, 127, be busy, the conductor corresponding to conductor 128 is grounded, thus maintaining relay 113 energized. This condition obtains until the brushes 131 and 132 are positioned before the test terminals of an idle trunk, whereupon the absence of ground on the test conductor, thereof, brings about the release of relay 113 and the prevention of further movement of the idle line switch plungers. The operation of plunger 112 also completes a circuit from battery through the winding of the connector line relay 205, upper middle back contacts of relay 206, lower winding of differential relay 207, right inner contacts of the line switch, through the dialing and printing apparatus at the sub-station 100, returning through the make-before-break contacts of key 118, right outer bank contacts of switch 102, upper winding of differential relay 207, uppermost back contacts of relay 206, to ground at the contacts of relay 208. Relay 205 operates in this circuit but relay 207 being differentially wound maintains its armature in its retracted position. A circuit is now closed for the release control relay

204, traceable from battery through the winding of said relay, front contacts of relay 205, to ground at the contacts of relay 206. Relay 204 provides a substitute holding circuit for magnet 105 and grounds the test conductor 115 to render the line 101 busy at the several connector switches. The holding circuit for magnet 105 may be traced from battery through the upper winding of said magnet, left outer bank contacts of switch 102, conductors 119 and 219 to ground at the upper contacts of relay 204. This same ground is extended by means of conductor 115, thence to the multiplied terminals of all the connector switches in which line 101 appears, to render this line busy. A stepping circuit is now prepared and may be traced from battery through the winding of vertical magnet 209, slow-to-release relay 210, uppermost contacts of the off-normal switch 211, lowermost contacts of relay 204, to the back contact of line relay 205.

The subscriber now actuates the impulse sending device 107 to transmit a series of eight impulses corresponding to the level in the connector switches in which the line 401 terminates. At each interruption of the line 101, by the impulse sender 107, relay 205 releases, but relay 204 is so adjusted as to maintain its armatures attracted during the intervals between successive impulses of a series. On the first retraction of the armature of relay 205, the stepping circuit which was partially traced hereinbefore is now completed through the back contact and armature of relay 205, to ground at the back contacts of relay 206. Brushes 202 and 203 are thus raised into cooperative relation with the first level of the associated bank terminals. The original circuit for energizing magnet 209 is broken when brushes 202 and 203 move off normal, but another circuit is prepared for the succeeding impulses of the series. This circuit may be traced from battery through the winding of magnet 209, winding and front contacts of relay 210, middle contacts of the off-normal switch 211, lower outer front contacts of relay 204 to ground as previously traced. When the brushes 202 and 203 move from their normal position, a circuit for release magnet 216 is prepared, but this circuit is not completed so long as relay 204 remains energized.

At the termination of the first series of impulses, relay 205 remains energized for a sufficient interval to bring about the release of relay 210, whereupon the stepping circuit is transferred to the rotary magnet 213. The subscriber now manipulates device 107 to send a series of six impulses corresponding to the row in which line 401 terminates. Each time relay 205 retracts its armature in response to the transmission of an impulse, a circuit is completed from battery through

the winding of rotary magnet 213, back contacts of relay 206, and in parallel therewith from battery through the winding of slow-to-release relay 212, lower inner contacts of relay 214, back contacts of relay 210, middle contacts of the off-normal switch 211, lower outer front contacts of relay 204, back contacts of relay 205, to ground at the contacts of relay 206. Under control of relay 205 and magnet 213, brushes 202 and 203 are moved into cooperative relation with the terminals 221.

At the end of the second series of impulses, magnet 213 deenergizes, but relay 212 being of the slow-to-release type maintains its armatures attracted for a sufficient interval to allow a test to be made of the line 401. For this purpose, a circuit is completed from battery through the winding of relay 214, lowermost contacts of relay 206, upper front contacts of relay 212, brush 203 to the conductor 403 of the line 401. If the line 401 is busy, conductor 403 is grounded in a manner similar to that described in connection with the grounding of conductor 115. Under this condition, relay 214 operates. After an interval, relay 212 releases, but a locking circuit is provided for relay 214, traceable from battery through the winding of said relay, lowermost contacts of relay 206, upper normal contacts of relay 212, upper front contacts of relay 214, to ground at the lower inner contacts of relay 204. The operation of relay 214 opens the stepping circuit to magnet 213 so that succeeding impulses will not affect the position of brushes 202 and 203. At this time also, a circuit is closed from ground through the contacts of the interrupter 215, winding of relay 208, lower front contacts of relay 214, to battery at the contacts of relay 212. Each time that relay 208 operates under control of interrupter 215, the communication circuit hereinbefore traced through the upper winding of differential relay 207 is opened. The interrupter 215 is provided with suitable conducting and insulating segments so arranged that impulses, corresponding to the character "B" are sent over the line 101 to effect the recording of this character on the receiving printer at station 101. The interrupter segments may also be arranged to cause impulses to be sent, corresponding to the word "busy" which may thereupon be recorded on the receiving printer.

The subscriber on recognizing the busy signal, restores key 118 and opens switch 108 for a short interval. The circuit comprising the windings of relays 205 and 207, as hereinbefore traced, is now open. Relay 205 accordingly releases. Relay 205 in turn opens the energizing circuit of release control relay 204 which, after an interval, also releases. When relay 204 releases, a circuit is completed from battery through the wind-

ing of release magnet 216, lower contacts of the off-normal switch 211, lower back contacts of relay 204 and relay 205, to ground at the contacts of relay 206. Under control of the release magnet 216, the brushes 202 and 203 are restored to their normal position whereupon the circuit through the lower contacts of the off normal switch is open and the brushes are brought to rest in their normal position. When relay 204 releases, ground is removed from the conductor 119, resulting in the release of magnet 105 and the withdrawal of the plunger 112 from the associated bank contacts. Relay 204 also opens the holding circuit of relay 214 which thereupon releases. The connector switch and associated relays are thus completely restored to normal. When magnet 105 releases as above described the energizing circuit of relay 109 is closed, and this relay operates to open the motor circuit. The stopping of the motor serves as a signal to the subscriber at station 100 that key 108 may be reclosed.

Should the line 401 be idle when relay 214 is connected to the conductor 403, as hereinbefore described, said conductor is ungrounded and relay 214 remains normal. Accordingly, when relay 212 releases, a circuit is completed from battery, through the upper winding of magnet 405, conductor 403, brush 203, upper back contacts of relay 212, lower winding of relay 206, upper back contacts of relay 214 to ground at the lower inner contacts of relay 204. Relay 206 operates in this circuit and immediately closes a locking circuit for itself traceable from battery, through the upper winding and locking contacts of said relay to ground at the upper contacts of relay 204. However, the current through the upper winding of magnet 405 as above traced, is insufficient to cause the actuation of the plunger 412, but the energization is sufficient to cause the lower armatures of this magnet to be attracted. The opening of the lower inner contacts of magnet 405 opens the normal energizing circuit of the motor control relay 409, which thereupon releases and connects the source of power 410 with the motor 411. The original energizing circuit of relay 204 is opened when relay 206 operates. A substitute holding circuit for the former relay is now completed from battery, through the winding thereof, back contacts of relay 207 to ground at lower front contacts of relay 206. Relay 206 also extends ground through its lower inner contacts to brush 203, thence to conductor 403 to maintain the lower armatures of magnet 405 in their attracted position and to render line 401 busy. Relay 206 in addition disconnects the operating circuit of magnet 213, which is hereby prevented from being affected by succeeding impulses. The busy test relay 214 is also disconnected

at the lowermost contacts of relay 206 to prevent a subsequent false operation thereof. The communication circuit is now completed and extends from telegraph battery at the upper middle front contacts of relay 206, lower winding of relay 207, contacts of switch 102 through the transmitting and receiving apparatus at station 100, returning through front contacts of key 118 to the upper conductor of line 101, contacts of switch 102, upper winding of relay 207, upper outer front contacts of relay 206, brush 202, conductor 404, through the printing apparatus at station 400, thence to ground through the right contacts of key 418. It will be noted that this circuit includes equally both windings of differential relay 207, so that this relay is maintained deenergized regardless of whether the printer signals are open signals or not.

The release of the established connection is completely under control of the subscriber at station 100. When the communication has been completed, this subscriber restores key 118. The upper winding of differential relay 207 is thereby shunted and the lower winding of this relay is energized by means of a circuit traceable from battery at the upper middle front contacts of relay 206, lower winding of relay 206, lower winding of relay 207, contacts of switch 102, through the dialing and printing apparatus at station 100 to ground through the left normal contacts of key 118. Relay 207 thereupon opens its contacts and after an interval brings about the release of relay 204. Relay 204 at its upper contacts breaks the holding circuit of relay 206, which thereupon releases. Relay 206 upon releasing removes ground from the conductor 403, rendering the line 401 idle and causing the deenergization of the upper winding of magnet 405. The lower armatures of this latter magnet are, therefore, retracted, thus closing the normal energizing circuit of control relay 409, whereby motor 411 is brought to rest. Immediately that relay 204 retracts its armatures, a circuit is completed from battery, through the windings of release magnet 216, lower contacts of off-normal switch 211, lowermost back contacts of relay 204 to ground through back contacts of relays 205 and 206. By means of this latter circuit the brushes 202 and 203 are restored to their normal position. When switch 200 is restored to normal, the previously traced circuit for magnet 216 is broken at the lower contacts of switch 211, thus bringing brushes 202 and 203 to rest in their normal position. It will be noted that when relay 204 releases, the holding circuit for magnet 105, which includes the upper winding of said magnet, contacts of switch 102, conductor 119 and contacts of relay 204, is broken when this latter relay releases, thus causing the with-

drawal of plunger 112 from the associated bank contacts. With magnet 105 deenergized the normal operating circuit of relay 109 is completed, and motor 111 is brought to rest.

Establishment of a "conference" connection.

It will now be assumed that the subscriber at station 100 desires a printed message to be recorded at a plurality of separate stations, including station 400 and station 450. For this purpose the subscriber first dials the code 10. It will be understood that the apparatus at station 450 which is represented schematically by a rectangle may be duplicate apparatus to that shown in connection with station 100 and station 400. Similarly, the line 451 connecting station 450 with the central office terminates in the contacts of an individual line switch with its associated control devices, represented schematically by the rectangle 460. This apparatus also may be in duplicate of corresponding apparatus shown in Fig. 1.

From an inspection of Fig. 2, it will be noted that the line 224 leading from terminals 222 and corresponding to the number 10, instead of leading to a called station as does line 401, leads to a series of telegraph repeaters, 301, 501, etc. These repeaters may be of the general type described in U. S. patent to W. E. Athearn No. 774,905 issued Nov. 15, 1904. Reference may be had to this patent for a detailed description of the construction and operation of repeaters 301, 501, etc. It may be pointed out however that the lower windings of the relays 308, 309, 508, 509, etc. are the "holding" windings, and the upper windings are the main or "line" windings. As the external circuit for the left hand "line" windings 309, 509, etc. is normally open at bank contacts 222, while the external circuits of the right hand windings 308, 508, etc. are normally closed, the operation of the repeaters being as described in the Athearn patent, the normal idle condition of these repeaters is such as to maintain the right contacts closed and the left contacts open. There may be as many of these repeaters associated with the "conference" terminals as conditions may require. The drawings show two repeaters, but it will be understood that others may be provided at the points indicated by the dotted portion of the conductors shown in Fig. 5. Furthermore, there may also be provided more than one "conference" number, for example, the dialing of the number 20 will result in the seizure of line 223, which may be associated with a greater or less number of repeaters than are provided when the line 224 is seized.

The sequence of operations when establishing the "conference" circuit is identical with that already described, as far as the

point where the brushes 202 and 203 are positioned on the connector terminals corresponding to the last digit. In this case, since the code 10 is assumed to have been dialed, the motor 111, line switch 102 and connector 200 will be operated as hereinabove described. Accordingly, the brushes 202 and 203 will be brought to rest upon the terminals 222 from which the "conference" line 224 extends. If this line is busy the lower conductor thereof will be grounded, causing the operation of relay 214 and the transmission of a printed busy signal to the calling subscriber in a similar manner to that hereinbefore described. The subscriber on noticing the busy indication may release the connection and dial another conference number, for example 20 resulting in the seizure of conference line 223 if this line is idle.

Immediately that relay 212 releases, after the dialing of the digit zero, a circuit is completed from battery through the winding of release control relay 304, brush 203, upper back contacts of relay 212, lower winding of relay 206, upper back contacts of relay 214, to ground at the lower inner contacts of relay 204. Relays 304 and 206 operate by means of this circuit. Relay 206 also locks by means of its upper winding and locking contacts to ground at the upper contacts of relay 204, and provides a holding circuit for relay 304. Relay 206 also grounds the lower conductor of line 224 to render this line busy. Circuit is now completed from telegraph battery at the upper middle contacts of relay 206, lower winding of relay 207, inner right contacts of switch 102, through the substation printing and dialing apparatus, returning through front contacts of key 118, upper conductor of line 101, upper winding of relay 207, upper outer front contacts of relay 206, brush 202, upper conductor of line 224, upper winding of relay 309, front contacts of relay 308, conductor 521, through the upper windings of intermediate repeater relays corresponding to relay 309, upper winding of relay 509, which is associated with the last repeater of the group, front contacts of relay 508 to ground. It is to be noted that the repeaters are so arranged that normally the lower windings of relays 308, 508, etc. alone are energized to hold the corresponding contacts closed. Since the circuit through the line windings of relays 309, 509 is normally open at the connector bank terminals, should for any reason the contacts of relay 309 be closed a circuit is completed through the line winding of relay 308, winding of relay 306, to ground at relay 305. Under control of this circuit the contacts of relay 308 are closed, and as described in the Athearn patent referred to hereinbefore the holding of relay 309 is shunted causing the

contacts thereof to be opened. The contacts of relay 308 are thus held closed by means of the holding winding of relay 308.

Under control of the previously traced circuit, the armatures of relays 309, 509, etc. are attracted to their front contacts, whereupon a circuit is completed from battery, through the front contacts of relay 309, upper winding of relay 308, uppermost back contacts of relay 312, winding of relay 306, contacts of relay 305 to ground through resistance 307. A similar circuit may be traced comprising the upper winding of relay 508 and the winding of relay 506 to ground at the contacts of relay 505. Under control of these latter circuits the armatures of relays 308 and 508 are respectively held attracted to their front contacts independently of their lower windings. Relays 306 and 506, as well as corresponding relays associated with any intermediate repeaters are energized by means of these last traced circuits. Relay 306 is alone, however, effective at this time and extends ground through its front contact to operate the slow-to-release relay 311. The corresponding circuit for each slow-to-release relay, similar to 311, associated with other connections, while closed at the front contacts of the associated relay, such as 506, is opened at upper front contacts of a relay similar to relay 312 individual to the next preceding connector. A circuit is now prepared for the vertical magnet 313 and the associated slow relay 314 traceable from battery, through the winding of said magnet and said relay in series, uppermost contacts of the off-normal switch 317, lower inner contacts of relay 311, to the back contact of relay 306. The circuits are not in readiness for the reception of the first of the series of impulses corresponding to the first digit, as dialed by the subscriber. In this case it may be assumed that the line 401 is the first line of the desired "conference" group. Accordingly, the subscriber manipulates his dial to transmit a series of 8 impulses. In response to the transmission of the first impulse the circuit hereinbefore traced comprising the telegraph battery at the upper middle contacts of relay 206 and the upper windings of relays 309 and 509, etc., in series is broken whereby these relays are deenergized to cause their armatures to be retracted. The retraction of the armature of relay 309 breaks the circuit, hereinbefore traced, through the winding of relay 306, which thereupon releases and extends ground through its back contact and the front contacts of relay 311, uppermost contacts of switch 317 to battery through the winding of relay 314 and magnet 313 in series. In response to this first impulse the brushes 302 and 303 are positioned before the first level of terminals in switch 300 and

the off-normal switch 317 is operated. Switch 317 while opening the original stepping circuit for magnet 313 closes a substitute circuit therefor, comprising the winding and front contacts of relay 314, the middle contacts of switch 317, front contacts of relay 311, and back contacts of relay 306. Under control of this last circuit and the remaining 7 impulses, as transmitted by the device 107, the brushes 302 and 303 are positioned before the eighth level of terminals in switch 300. At the end of this series of impulses, relay 314 releases and transfers the stepping circuit to the winding of rotary magnet 316 and the slow release relay 315. In response to the transmission of the next series of impulses, in this case six, the brushes 302 and 303 are positioned in cooperative relation with the terminals 321, in which the line 401 terminates. At the end of this series of impulses the line circuit is closed for sufficient time to allow relay 315 to release.

During the interval between the seizure of line terminals 321 and the release of relay 315, and while this latter relay is maintaining its armatures attracted, a test is made of the line 401. If this line is busy, the conductor 403 is grounded in the manner hereinbefore described, and relay 318, connected thereto by means of brush 303, is energized. When relay 315 is released, relay 318 is locked by means of a circuit traceable from battery, through the winding of said relay, lowermost contacts of relay 312, normal contacts of relay 315, upper front contacts of relay 318, outer front contacts of relay 311, to ground at the lower contacts of relay 304. With relay 318 locked, a circuit is completed from ground, through the contacts of interrupter 522, winding of relay 305, outer front contacts of relay 318 to battery at the outer contacts of relay 315. Interrupter 522 is similar in construction to interrupter 215 and comprises conducting and insulating segments arranged in such a manner as to cause telegraphic impulses to be sent through the winding of relay 305 corresponding to the letter "B" or in some cases to the word "busy". If desired a single interrupter as 215 may be provided for both types of connectors. Relay 305, therefore, correspondingly attracts and retracts its armatures in accordance with the arrangement of these segments. Accordingly, the circuit hereinabove traced comprising the winding of relay 306, uppermost back contacts of relay 312, upper winding of relay 308 and the front contacts of relay 309 is opened and closed, resulting in a corresponding release of the armature of relay 308. The contacts of relay 308 in turn control the circuit including the upper winding of relay 309, and the upper winding of differential relay 207, and characteristic impulses

are transmitted to the receiving printer at station 100 in a manner similar to that hereinbefore described. The subscriber noticing the reception of this busy signal, opens key 108. The operation of key 108 opens the circuit hereinbefore described, through the line windings of relay 309 and 509 which thereupon release. Relay 309 in turn releases relay 306. After an interval relay 311 releases in turn releasing relays 318 and 305 to render ineffective further operation of the busy interrupter. Relay 311 also closes a circuit for release magnet 323 traceable from battery, through the winding of said magnet, lower contact of the off-normal switch 317, next to the lower inner contacts of relay 312, outer back contacts of relay 311 to ground at the front contacts of relay 304. Under control of this circuit the magnet 323 restores the brushes 302 and 303 to their normal position whereupon magnet 323 becomes deenergized and the brushes are brought to rest. Relay 304 does not release, however, since it is held operated by means of ground at the lower inner front contacts of relay 206. When the subscriber restores key 108 the circuit comprising the line windings of relays 309, 509, etc., is reclosed, these relays reoperating. Relay 309 operates relays 306 and 311 and the stepping circuit for magnet 313 is prepared as hereinbefore described. The subscriber now proceeds to dial the called number of any other desired station, as a result of which the brushes 302 and 303 are positioned upon the terminals of the line leading to this station and the driving motor thereat is set in operation. These latter operations have been described in detail hereinbefore and repetition at this point is not considered necessary.

Should the line 401 be idle when the terminals 321 are seized by brushes 302 and 303, as hereinbefore described, the conductor 403 will be ungrounded and when relay 315 is releasing, the busy test relay 318 is connected to this conductor, but this relay remains deenergized. Accordingly, when relay 315 releases at the end of the transmission of the digit 6 a circuit may be traced from ground at the lower front contacts of relay 304, lower outer front contacts of relay 311, upper back contacts of relay 318, lower winding of relay 312, upper back contacts of relay 315, brush 303, conductor 403, to battery through the upper winding of magnet 405. By means of this circuit, relay 312 operates, and the lower armatures of the magnet 405 are attracted, resulting in the release of the control relay 409 and the starting in operation of the motor 411. Relay 312 immediately closes a locking circuit under control of the upper contacts of relay 304. Relay 312 also completes a circuit from battery through upper front contacts of said relay, winding of relay 325, to

ground at upper middle back contacts of relay 512. Relay 325 operates and maintains a steady potential at the terminals of relay 308 so that the printer 430 is unaffected by succeeding selective impulses. The stepping circuit is successively transferred to the vertical and rotary magnets associated with succeeding repeater connectors of this "conference" group, and the lines leading to the stations associated with conference number 10 are seized. The intermediate connectors are similar to the connector of Fig. 3 and it is believed further description thereof is not necessary at this point.

It will be remembered that relay 506 is operated at the same time that relay 306 is operated. Accordingly, when relay 312 and corresponding relays of intermediate repeaters have closed their front contacts, a circuit may be traced from battery, through the winding of relay 511, front contacts of relay 506, conductor 523, in series through the next to the upper inner contacts of all the relays similar to relay 312, associated with the preceding connectors, to ground at the upper contacts of relay 304. The stepping circuit may now be traced from battery, through the winding of vertical magnet 513, winding of the slow release relay 514, upper contacts of the off-normal switch 517, inner front contacts of relay 511 to the back contacts of relay 506. Since the line 451 appears in the seventh level of contacts in the connector switches, the subscriber at station 100 manipulates his impulse transmitter to send a series of 7 impulses. In response to the transmission of the first impulse the circuit hereinbefore traced comprising battery at the upper middle contacts of relay 206, the lower winding of relay 207, contacts of the line switch, the apparatus at the sending substation, the upper winding of relay 207 and the windings of relays 309 and 509 in series, is broken. Thus, the energizing circuit of relay 506 is also broken and this relay retracts its armatures, completing the previously described stepping circuit of magnet 513, whereby brushes 502 and 503 are positioned before the first level of contacts in switch 500. The moving off normal of brushes 502 and 503 operates the off-normal switch 517 and the stepping circuit for succeeding impulses may not be traced from battery, through the winding of magnet 513, winding of relay 514 and front contacts thereof, middle contacts of switch 517, front contacts of relay 511 and the back contacts of relay 506, to the grounded conductor 523. Under control of the remaining 6 impulses of this series, brushes 502 and 503 are positioned before the seventh level of bank contacts. At the termination of the series, the line circuit is closed for a period sufficiently long to maintain relay 506 energized and to cause the release of relay 514.

The stepping circuit is thereupon transferred to the rotary magnet 516 and may be traced from battery, through the winding of said magnet, back contacts of relay 512, thence in parallel through the slow-to-release relay 515, inner back contacts of relay 518, back contacts of relay 514, middle contacts of the off-normal switch 517, front contacts of relay 511 to the back contacts of relay 506. The subscriber thereupon transmits a series of 8 impulses, which by means of the back contacts of relay 506 causes magnet 516 to rotate brushes 502 and 503 to the set of terminals 524 wherein the line 451 terminates. At the termination of the transmission of these 8 impulses, relay 515 begins to release and while said relay is releasing, a test is made of line 451. The manner in which this test is made is similar to that already described in connection with the testing of line 401, and repetition thereof is not deemed necessary.

Should the last line of the conference group be busy while all the preceding lines of the group are idle the calling subscriber receives a corresponding busy indication as hereinbefore described. The subscriber may thereupon place the circuits in readiness for communication by opening key 108 which results in the restoration to normal of switch 500 as above described. The subscriber instead of dialing another subscriber's number now dials the blank number 11, whereby brushes 502 and 503 are brought to rest on the terminals 531. When at the termination of the dialing of this number, relay 515 releases, a circuit is completed from battery through brush 503, back contacts of relay 515, lower winding of relay 512, upper back contact of relay 518, lower front contact of relay 511, conductor 532, to ground at the contact of relay 304 associated with the first connector. Relay 512 operates and locks through its upper winding and inner front contact, conductor 523, upper locking contacts of relays similar to relay 512 associated with intermediate connectors, next to the inner upper contact of relay 312 to ground at contacts of relay 304. Relay 512 opens the circuit of "overlap" relay 325 and all similar relays associated with intermediate connectors thus breaking the holding circuit of the line windings of repeater relays 308, 508, etc. The repeaters 301, 501, etc. are now in condition to repeat signal impulses to the respective call stations.

Should line 451, however, be idle when switch 500 was first operated, relay 518 which is connected to the test conductor thereof remains normal and when relay 515 releases, a circuit is completed from battery, through the upper winding of a magnet similar to magnet 405, conductor 452, brush 503, upper back contacts of relay 505, lower winding of relay 512, upper back contacts

of relay 518, outer front contacts of relay 511 to ground at the contacts of relay 304 associated with the first connector. The cut-off armatures of the line switch magnet associated with line 451 are thus attracted, resulting in the starting of the motor at station 450. Relay 512 also operates and completes a locking circuit for itself, which may be traced from battery through the upper winding and locking contacts of said relay, to the grounded conductor 523. When relay 512 operates, it releases relay 325 and corresponding intermediate relays to allow the repeaters 301, 501, etc. to repeat succeeding message impulses to the printers such as 430.

When there are more than two repeater connectors associated with a conference line similar to line 224, all the repeater connectors of the group are equipped similarly to the repeater connector shown in Fig. 3. The repeater connector shown in Fig. 5 has been illustrated as the last of the group associated with line 224. It will be noted that there is no "overlap" relay associated with this connector corresponding to relay 325 associated with connector 300. The purpose of the overlap relay is, as noted hereinbefore, to prevent the switch operating impulses which are delivered to the several repeaters from affecting the printing apparatus on stations which have already been connected with by previously operated connectors until the last connector of the group has been positioned. Obviously, therefore, when relay 512 associated with the last repeater connector operates, it is an indication that all the lines in the conference group have been seized and that the circuits are in readiness for the reception of printer impulses.

The printer impulse repeating circuit may be traced from battery at the upper middle contacts of relay 206, lower winding of differential relay 207, contacts of switch 102, through the printing apparatus at station 100, returning through the upper winding of relay 207, brush 202, upper line winding of repeater relay 309, closed contacts of relay 308, conductor 521, line windings of intermediate repeater relays similar to relay 309, and closed contacts of relay similar to relay 308, line winding of relay 509, to ground at the contacts of relay 508. Under control of the printer impulses relays 309, 509, etc. attract and retract their armatures to repeat the impulse to the respective connected stations. The impulse circuit leading to station 400 may be traced from ground through the left contacts of key 418, printing apparatus at station 400, conductor 404, brush 302, upper outermost front contacts of relay 312, line winding of relay 308 to the armature of relay 309. Similar impulse repeating circuits may be traced to the other connected stations.

What is claimed is:

1. In a telegraph exchange system, a plurality of subscribers' stations, printing telegraph equipment and a source of power therefor at each station, said source being normally disconnected from the associated equipment automatic interconnecting means common to all of said stations, means responsive to the operation of said automatic means for interconnecting one of said stations with another of said stations, means responsive to such interconnection for operatively connecting the power source at said other station with its corresponding printing equipment.

2. In a telegraph exchange system, a plurality of subscribers' stations, printing telegraph transmitting and receiving mechanisms and an impulse sending device at each station, a central office, machine switching apparatus at said central office responsive to the operation of the impulse sender at one of said stations for automatically interconnecting said station with a desired one of the other stations, and means responsive to the establishment of such an interconnection for immediately rendering the printing telegraph equipment at the desired station capable of receiving a printed message from the other station connected therewith.

3. In a telegraph exchange system, a plurality of subscribers' stations, printing telegraph equipment and a source of power therefor at each of said stations, said source of power being normally disconnected from its associated equipment, a central office, automatic switches at said central office, means under control of one of said stations to interconnect said one of said stations with a plurality of other stations, means responsive to such interconnection for immediately operatively connecting the power source at each of said other stations with its corresponding printing telegraph equipment whereby printed messages may be immediately received at each of said plurality of stations, and means effective upon the discontinuance of the interconnection for disconnecting the power sources at said interconnected stations from the associated equipment.

4. In a printing telegraph exchange system, a plurality of subscribers' stations, printing telegraph equipment and driving means therefor at each of said stations, said driving means being normally inert, automatically and directly operable switches for simultaneously interconnecting two or more of said stations, means responsive to the establishment of an interconnection for operating the driving means at certain of the interconnected stations whereby printed messages may immediately be received thereat.

5. In a telegraph exchange system, a plurality of subscribers' stations, printing tele-

graph equipment at each station, a source of power for each equipment normally disconnected therefrom, automatic switches, means under control of any of said stations for causing said switches to operate to interconnect two or more of said stations, and means responsive to the establishment of such an interconnection for operatively connecting the power source at certain of the interconnected stations with their corresponding telegraph equipments.

6. In a printing telegraph exchange system, a plurality of subscribers' stations, printing telegraph equipment and a source of power therefor at each station, said power source being normally disconnected from the associated equipment, a central office, automatic switches at said central office for establishing a plurality of simultaneous communication circuits to said stations, means responsive to the establishment of a communication circuit to a station and operable over said circuit for connecting the source of power thereat with the associated equipment to render said equipment immediately ready to receive printed messages.

7. In a telegraph exchange system a plurality of subscribers' stations, printing telegraph equipment and driving means therefor at each station, said driving means being normally inert, means for establishing a printing communication circuit from one station to any other station and means responsive to such establishment of a connection and operable over the communication circuit for starting the driving means at the connected station in operation.

8. In a telegraph exchange system, a plurality of subscribers' stations, printing telegraph equipment and a source of power therefor at each station, said power source being normally disconnected from the associated equipment, means for establishing a communication circuit from one station to any of the other stations, means responsive to the establishment of such connection and operable over the communication circuit for connecting the power source with the associated telegraph equipment, said means being also responsive to the disestablishment of said connection to disconnect the power source from the associated equipment.

9. In a telegraph exchange system, a calling station, a called station, printing telegraph equipment and driving means therefor at each of said stations, said means being normally inert, a central office, communication lines extending from the stations to the central office, automatic switches at the central office for interconnecting the calling and called stations, and means responsive to the establishment of said interconnection and operable over the communication circuit for immediately rendering operable the driving means at the called station whereby the

associated equipment becomes ready to receive the printed messages.

10. In a printing telegraph exchange system, a calling station, a plurality of other stations, an impulse sending device at each station, a central office, automatic switches at said central office, means under control of the sending device at said calling station for operating certain of said switches to connect said calling station with a first one of said plurality of stations, means for operating other switches to successively establish a connection between said calling station and the remainder of said plurality of stations whereby printed messages may be simultaneously received from said calling station at each of said plurality of stations.

11. In a telegraph exchange system, a calling station, a plurality of called stations, printing telegraph equipment and driving means therefor at each station, said driving means being normally inert, an impulse sending device for each station, central office automatic switches at said central office, means under control of the sending device at the calling station for operating said switches to establish communication circuits in succession between said calling station and said plurality of called stations whereby printed messages from the calling station may be received simultaneously on the equipments at said called stations, and means responsive to the establishment of each communication circuit to a called station for immediately operating the driving means thereat.

12. In a printing telegraph exchange system, a first station, a plurality of other stations, printing telegraph equipment and driving means therefor at each station, a plurality of automatic switches for completing communication circuits to said plurality of stations, means under control of said first station for directly operating one of said switches to establish a communication circuit to one of said plurality of stations, means operable over said established circuit for starting the driving means at said one of said plurality of stations, means under control of said first station for directly operating another of said switches to establish a communication circuit to a second one of said plurality of stations, means operable over said last mentioned established circuit for starting the driving means at the second one of said plurality of stations, and means for simultaneously sending printed messages from said first station over said established circuits to said first and said second stations.

13. In a printing telegraph exchange system, a central office, a calling station, a plurality of called stations, an impulse sending device for each station, a line for each station connecting the same with the central office, a plurality of connector switches at said central office for completing communi-

cation circuits to said called lines, means for automatically extending the calling station line, means responsive to the sending of characteristic impulses from the calling station for associating with said extended line a predetermined number of connector switches, and means under control of the calling station for operating each of said associated connector switches in succession to establish simultaneous communication circuits to a corresponding plurality of called stations.

14. In a telegraph exchange system, a central office, a calling station, a plurality of called stations, an impulse sending device for each station, a line for each station connecting the same with the central office, a plurality of connector switches at said central office for completing communication circuits to said called lines, means for automatically extending the calling station line, means responsive to the sending of a special code of impulses from the calling station for associating with said extended line a predetermined number of connector switches, and means under control of the calling station for operating each of said associated connector switches in succession to establish simultaneous communication circuits to a corresponding plurality of called stations.

15. In a printing telegraph exchange system, a calling station, a plurality of called stations, automatic switches for completing communication circuits to said called stations, means under control of said calling station for extending communication circuits therefrom to one of said automatic switches, means under control of the calling station for directly operating said one of said switches to extend the communication circuit to a particular called station, means effective when said particular station is busy for releasing said switch without releasing the rest of the connection and for allowing the calling station to reoperate said switch to complete a communication circuit to another of said stations.

16. In a telegraph exchange system, a calling station, a central office, a plurality of called stations, a plurality of connector switches at the central office for interconnecting said calling station and said called station, means controlled by the called station for operating a predetermined number of connector switches to establish communication circuits to a corresponding number of called stations, and means effective when one of said stations is busy for allowing the calling station to release the corresponding connector switch without releasing the other connector switches.

17. In a telegraph exchange system, a plurality of printing telegraph subscribers' lines terminating at a central office, automatic switches at the central office for inter-

connecting the subscribers' lines and means associated with certain of said switches for repeating selective impulse and message impulses between the connected lines.

18. In a printing telegraph exchange system, a plurality of stations, means at each station for transmitting selecting impulses and telegraph message impulses, a plurality of automatic switches for establishing communication circuits to said stations, impulse repeating devices associated with certain of said switches, said devices being adapted to repeat selecting impulses from a station to control the operation of automatic switches and also to repeat message impulses to the receiving mechanism at a plurality of stations.

19. In a printing telegraph exchange system, a plurality of stations, printing telegraph transmitting and receiving equipment at each station, a central office, automatic switches at the central office for completing communication circuits between said stations, repeating devices at the central office accessible in common to said stations and adapted to repeat impulses from a sending device to control the operation of said switches and also to repeat message impulses from the telegraph equipment at one of said stations to the telegraph equipments at a plurality of stations.

20. In a printing telegraph exchange system, a calling station, a called station, printing telegraph equipment at said stations comprising message transmitting and receiving mechanisms, an impulse sending device for each of said stations, a switch for automatically extending a calling station line when messages are to be sent thereover, a plurality of connector switches, means under control of the sending device at the calling station for associating with the extended line a predetermined number of connector switches, an

impulse repeating device individual to each of said connector switches and adapted to repeat selecting impulses to control the associated switch and to repeat message impulses to telegraph receiving mechanism at a called station.

21. In a telegraph system, a calling station, a plurality of called stations, a plurality of automatic switches, a device associated with each switch for repeating selective impulses thereto, means for sending from said calling station selective impulses to a first one of said devices to selectively actuate the associated switch, means for sending from said calling station through said first device to a second one of said devices impulses to selectively actuate the switch associated with said second device, and means for rendering said first device unresponsive to the impulses transmitted therethrough.

22. In a telegraph exchange system, a calling station, a plurality of called stations, a plurality of automatic switches, a device associated with each switch for repeating selective impulses thereto and for repeating message impulses to a called station, means for sending from said calling station selective impulses to a first one of said devices to selectively operate the associated switch, means controlled by the calling station for sending selective impulses through said first device to a second one of said devices to selectively actuate the switch associated therewith, and means for temporarily short circuiting the first device while selective impulses are being sent therethrough and for subsequently rendering said first device effective to repeat message impulses to a called station.

In testimony whereof, I have signed my name to this specification this 8th day of September, 1925.

DONALD B. PERRY.