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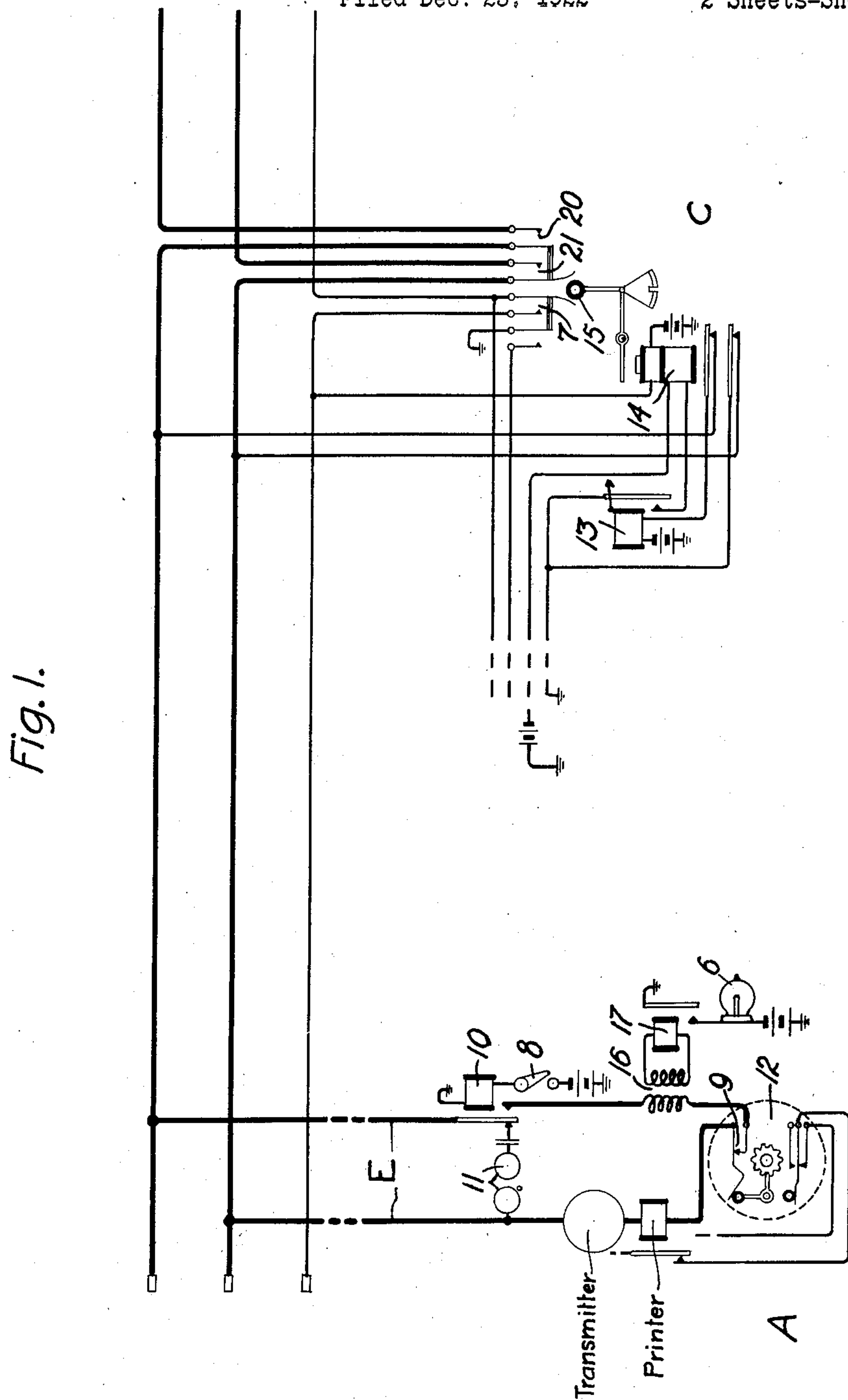
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R. D. PARKER ET AL

PRINTING TELEGRAPH EXCHANGE SYSTEM

Filed Dec. 23, 1922

2 Sheets-Sheet 1



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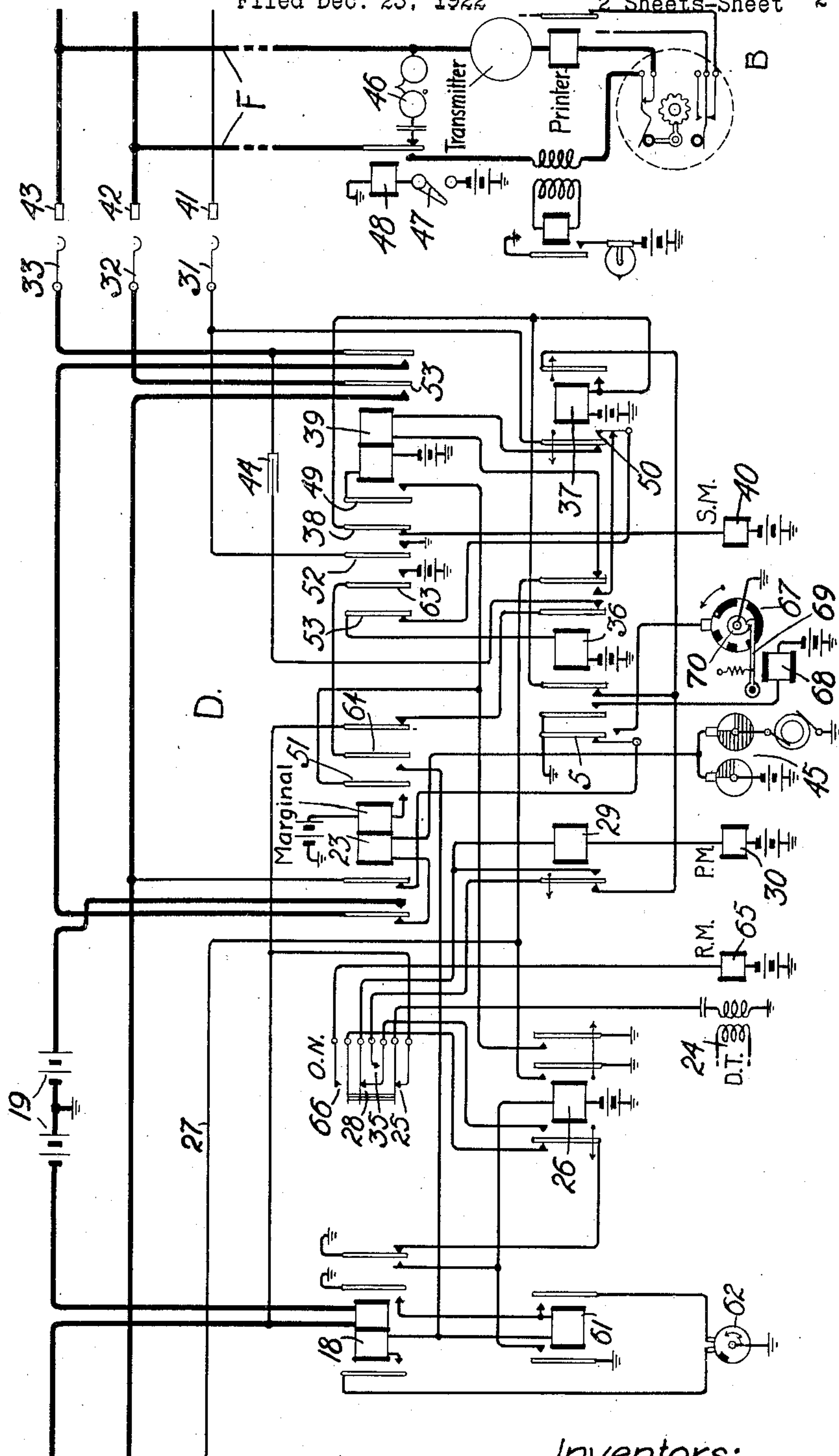
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2 Sheets-Sheet 2

Fig.2.



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UNITED STATES PATENT OFFICE.

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PRINTING-TELEGRAPH EXCHANGE SYSTEM.

Application filed December 23, 1922. Serial No. 608,775.

This invention relates to printing telegraph systems, and particularly, to a machine switching telegraph exchange system.

Its object is a printing telegraph system which is flexible and one wherein a printing telegraph subscriber may establish automatically a connection with another printing telegraph subscriber.

In accordance with the preferred form of the invention there is provided a plurality of printing telegraph subscribers' stations equipped with printing telegraph apparatus and impulse sending apparatus which are connected with a central office where machine switching apparatus is located. The machine switching apparatus comprises selector switches of the step-by-step type which respond to the operation of the impulse sending apparatus at the subscribers' stations and which in responding extend the calling subscriber's line to the called for subscriber's line in accordance with the operation of said impulse sending apparatus. Located at each of the subscribers' stations there is also arranged in the subscriber's loop circuit, indicating means for indicating to the subscriber the proper time for dialing and the period when ringing current is being applied to the called for line.

Referring to the drawing a complete system is shown diagrammatically when Figs. 1 and 2 are placed end to end with Fig. 1 on the left of Fig. 2.

In the drawing there are shown two printing telegraph subscribers' stations A and B whose lines E and F, respectively, extend to a central station where a line switch C and a selector switch D are located. It is understood, of course, that many other lines similar to E and F extend from similar subscribers' stations to the central office, and so for convenience, but two of the lines are shown in the present case. Each of the printing telegraph subscribers' 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, taken in connection with the accompanying drawings which illustrate one embodiment of the invention,

Assume for the sake of illustration that the subscriber A desires to communicate telegraphically with the subscriber B. The subscriber A accordingly operates the switch 8 for closing the operating circuit of switching relay 10. The switch 8 may also function to close the operating or power circuit of the printing telegraph equipment which for the sake of clearness has been shown diagrammatically. The operation of switching relay 10 disconnects the call bell 11 from the line conductors extending to the central office and connects the tip conductor with the impulse sending device 12, the printer and the transmitter. The closure of the circuit at the contacts of relay 10 completes an energizing circuit for line relay 13, the circuit of which may be traced from grounded battery, through the winding of relay 13, uppermost armature and contact of cut-off relay 14, thence over the line to the subscriber's station through the front contact of switching relay 10, contact 9 of the impulse sending device 12, the printer and transmitter in series and over the line to the central station and through the lowermost contact and armature of cut-off relay 14 to ground. Line relay 13, in operating, closes at its contact an operating circuit for cut-off relay 14. Cut-off relay 14 is thereupon energized and opens at its lowermost contact the operating circuit of line relay 13 and moves plunger 15 to a position where contacts 7, 20 and 21 are closed. Relay 13 being of the slow release type, does not release until relay 26 has operated as described later. At the closure of contact 20, a circuit including the negative terminal of battery 19 and the right-hand winding of relay 18 is completed. Relay 18 is energized over a circuit extending from grounded battery 19, right-hand winding of relay 18, through contact 20 and thence over the line to the subscriber's station A, through front contact of relay 10, contact 9 of the impulse sending device 12, the printing and transmitting mechanism in series and back over the line through contact 21 and the left inner armature of marginal relay 23 to ground on the back contact of armature 5 of relay 36. At this time the dial tone device 24 is connected to the line through contact 25 of the off-normal switch contact. The current produced by the operation of

the dial tone mechanism passes through contact 20 and then traverses the line through the equipment located at the subscriber's station and the primary winding of transformer 16, back over the line to ground through the left inner armature of relay 23, and armature 5 of relay 36. The primary winding of transformer 16 is designed to be of relatively high impedance to currents of the dial tone and of ringing frequencies, but the choking effect of this impedance is not sufficient to prevent passage of signaling currents produced by the operation of the dial tone and ringing mechanism in sufficient strength to cause the energization of relay 17 by the current thereby induced in the secondary winding of this transformer. The primary winding of this transformer is also designed as not to produce any appreciable distortion in the signals transmitted by the operation of the telegraph transmitter. The current through the primary winding of transformer 16 induces a current in the secondary winding thereof in which there is connected relay 17. Relay 17 is thereby energized for closing its contact and, consequently, causing the lighting of lamp 6. The lighting of lamp 6 indicates to the subscriber that the line switch has been operated and the impulse sending device 12 may now be operated for transmitting impulses characteristic of the number of the called for line. It is understood, of course, that the relay 17 is of a type responsive to currents of very low magnitude, and that preferably the relay 17 should be non-responsive to the lower frequency current impulses produced by the operation of the printing telegraph equipment. Relay 18, in energizing, completes an energizing circuit for relay 26 extending from grounded battery through the winding of relay 26 and the outermost right-hand contact and armature of relay 18 to ground.

Relay 26 connects ground to conductor 27 for locking relay 14 through contacts 7 and its upper winding. As previously mentioned, relay 13 being of the slow release type, remains operated after its circuit has been opened by relay 14 and until relays 18 and 26 have been energized to lock relay 14, after which relay 13 releases.

Relay 26 also prepares locking circuits for relays 23 and 39 and prepares the impulse circuit for the primary magnet PM. The subscriber A now actuates the impulse sending device 12 to send the impulses of the first digit of the designation of the wanted line thereby interrupting the circuit of relay 18. During the operation of the impulse sending device 12 contact 9 is open thereby opening the loop circuit. Upon the first retraction of the outermost right hand armature of relay 18, a circuit is completed from ground through the front contact of relay 26 and off-normal contact 28 closed until after the first primary step of the switch, through the winding of slow-release relay 29 and primary magnet 30 to grounded battery. Magnet 30 is energized in this circuit thereby stepping the brushes 31, 32 and 33 one step in their primary movement and opening contacts 25 and 28 and closing contacts 35 and 66. Relay 29 was also energized and remains energized for a short time after the opening of contact 28. If more than one impulse is transmitted for the first digit, a circuit will be completed on the second and all subsequent retractions of the outermost right-hand armature of relay 18, through the front contact of relay 26, contact 35, armature and front contact of relay 29, winding of relay 29 and the winding of primary magnet 30 to grounded battery. Relay 29 is held energized in this circuit and magnet 30 steps the brushes to the desired level of the terminal bank. At the conclusion of the first series of impulses, relays 18 and 26 remain energized and relay 29 is deenergized. The subscriber A now dials for the second digit of the wanted line designation. Upon the first retraction of the outermost right-hand armature of relay 18, a circuit is completed from ground, armature and back contact of relay 18, front contact of relay 26, contact 35, armature and back contact of relay 29, left-hand contact and armature of relay 36, winding of slow release relay 37 to grounded battery as well as the armature 38 of relay 39 and the winding of stepping magnet 40 to grounded battery. Magnet 40 is energized in this circuit and moves the brushes 31, 32 and 33 into engagement with terminals 41, 42 and 43. Relay 37 is also energized and being slow to release maintains its armatures attracted between impulses. If more than one impulse for the second digit is transmitted, a circuit will be completed upon the second and subsequent deenergizations of relay 18 which may be traced from ground, armature and back contact of relay 18, armature and front contact of relay 26, contact 35, armature and back contact of relay 29, right-hand armature and front contact of relay 37, armature 38 and contact of relay 39, and the winding of stepping magnet 40 to grounded battery. If more than one impulse characterizes the second digit the brushes 31, 32 and 33 will be moved to engage terminals other than those indicated as 41, 42 and 43.

If the selected line is idle a circuit will be completed upon the deenergization of relay 37 extending from battery through the winding of the cut-off relay (not shown), terminal 41, brush 31, left-hand armature and back contact of relay 37, right-hand winding of relay 39, the outermost back contact and armature of relay 36, and the innermost contact and armature of relay 26 to

ground. The cut-off relay (not shown) and relay 39 are energized in the circuit just traced. Relay 39 completes a locking circuit for itself extending from grounded battery, through the left-hand winding, armature 49 and front contact thereof, and the outermost right-hand armature of relay 26 to ground. The ground at the outermost right-hand armature of relay 26 is also connected to armature 51 of marginal relay 23. Relay 39, now being energized, ground is connected to brush 31 through armature 52 to provide busy potential for multiples of the terminal corresponding to 41 on the banks of the other connector switches, and also establishes a short circuit about the right-hand winding of relay 39, but which owing to the establishment of the locking circuit previously traced will be held energized. Upon the energization of relay 39 a circuit is also completed from ground at contact and armature 5 of relay 36, through contact and armature of relay 23, front contact and armature 53 of relay 39, brush 32, terminal 42, armature and back contact of switching relay 48 at the subscriber's station B, call bell 46, terminal 43, brush 33, outermost right-hand armature and contact of relay 39, outermost left-hand armature and back contact of relay 23, left-hand winding of relay 23 to a source of interrupted ringing current 45. The call bell 46 is operated in this circuit, but relay 23 is marginal and will not be operated until the resistance of the ringing circuit is lowered when the call bells 46 are disconnected from the subscriber's line. During the period ringing current is impressed on the line conductors, condenser 44 which has one of its terminals connected with the conductor leading to the brush 33 while the other terminal is conducted through the innermost contact and armature of relay 36, outermost right-hand contact and armature of relay 23 to the conductor which extends through contact 20 of the line switch C and thence to the subscriber's station A, through the primary winding of the transformer 16 and the substation equipment is effective at the time ringing current is applied to the wanted line. Accordingly, a small part of the ringing current passes through this condenser, through the previously enumerated contacts to the calling subscriber's station A. This current in passing through the primary winding of the transformer 16 causes a current to be induced in the secondary winding thereof for causing the operation of relay 17 and the illumination of the lamp 6. Inasmuch as ringing current is intermittently applied to the connected line, the lamp 6 will be operated intermittently for indicating to the subscriber A that ringing current is being applied to the connected line.

The subscriber B hearing the operation of

the call bell 46 operates switch 47 which causes the energization of switching relay 48 and the disconnection of the call bell 46 and the connection of the printing telegraph equipment thereat with the line conductors. At this time relay 23 attracts its armatures completing a locking circuit for itself extending from grounded battery, through the right-hand winding thereof, contact and armature 51 and the outermost right-hand contact and armature of relay 26 to ground. Relay 23, accordingly, remains energized. Relay 23 in attracting its outermost left-hand armature disconnects the source of ringing current 45 from the line conductors and completes the circuit to battery 19 which serves as the transmitting battery for each of the connected subscribers. This relay 23 also opens at one of its right-hand armatures the circuit previously traced for the condenser 44 thus causing the extinction of the lamp 6 which serves as an indication to the subscriber A that the subscriber B has responded to the call and that the printing telegraph equipment thereat is operatively associated with the line conductors through the brushes 31, 32 and 33.

In the operation of the printing telegraph equipment it is important to have the selector switch remain in the selected position although the loop circuit is continually being opened due to the operation of the transmitting equipment and may be opened for a longer time when one of the subscribers desires to interrupt the transmission of the other subscriber and reverse the direction of sending. To take care of this condition, a relay 61 and a slow speed interrupter 62 are operatively connected with relay 18. When relays 39 and 23 are energized a circuit is established from grounded battery through the contact and armature 63 of relay 39, armature 64 and contact of relay 23, winding of relay 61 and the innermost contact and armature of relay 18 to ground, and in parallel from armature 64 and its contact through the left-hand winding contact and armature of relay 18 to ground through interrupter 62. Relay 61 in energizing establishes a holding circuit for relay 26 and also locks itself through interrupter 62. This interrupter is arranged so that on each revolution it momentarily opens the locking circuit first of relay 61 and then that of relay 18.

The subscriber A having noticed that the lamp 6 is no longer operated intermittently may operate his transmitter for transmitting to the station B the desired message. During the operation of the transmitter at station A, relay 18 is held operated most of the time by interrupter 62. It may, however, fall back at the opening of its locking circuit only if an open printer signal occurs at the same time. In case it opens it will be oper-

ated immediately and locked up by the next closed printer signal. This brief open interval even in the case of a break signal should not last long enough to release relay 61 which in the meantime has been held up by the interrupter, as the locking circuit for relay 61 is opened momentarily but not until several seconds after that of relay 18.

Following the communication between the two connected stations each subscriber operates his respective switch for causing the deenergization of the switching relay thereat for disconnecting the impulse sending device and the printing telegraph equipment from the line and connecting the call bell thereto. Under these conditions the line circuit is open for several seconds after which relay 61 is deenergized, and opens at its left-hand contact the holding circuit for relay 26. Inasmuch as relays 23, 39 and the cut-off relay in the line switch circuit (not shown) are all held operated by relay 26, its release opens the connection between the two subscribers' stations. At the same time a circuit for restoring the selector switch is established through the left-hand back contact of relay 26 to the release magnet 65. The energizing circuit for release magnet 65 may be traced from grounded battery, winding of release magnet 65, contact 66, left-hand back contact and armature of relay 26 and the right-hand contact and armature of relay 18 to ground. Release magnet 65 is accordingly energized for restoring the brushes of the selector switch to their normal position in readiness for another setting.

Assuming the line associated with the selected terminals 41, 42 and 43 is busy at the time brushes 31, 32 and 33 come to rest on such terminals, ground potential is present on the test terminal 41 and a circuit is completed from said grounded terminal 41, brush 31, left-hand armature of relay 37, which has not yet been released, contact 50, contact and armature 53 and the winding of relay 36 to grounded battery. Relay 36 in attracting its armatures opens the energizing circuit for relay 39 whereby this latter relay is prevented from energizing and establishing the circuit including the source of ringing current 45 with the connected line. Relay 36 also prepares a locking circuit for itself which is established when relay 37 releases, through contacts 50 and 53. Armature 5 of relay 36 also removes the direct ground connection from the tip conductor extending to the subscriber's station A, through the outermost right-hand armature and contact of relay 23, and substitutes therefor a circuit to ground through the busy interrupter 67. The interrupter 67 is arranged with insulating and conducting segments to transmit to the calling subscriber's station A upon its release a starting

impulse, as is common in systems of the start-stop type, followed by a group of impulses characteristic of the character B and a stop impulse to communicate to such party that the line is busy. In order that the interrupter will be released at the proper moment, it is provided with a stop cam 70, both the stop cam and the interrupter being frictionally mounted on a continuously rotating shaft. Stop cam 70 is normally held against rotation by a latch under the control of a release magnet 68, which is energized upon the energization of relay 36 over a local circuit established by such relay. It is thus seen that upon the energization of relay 36 magnet 68 will be energized and the interrupter 67 released for transmitting to station A impulses for releasing the printer mechanism and recording the character B. The segments of the interrupter 67 may also be arranged for transmitting a series of impulses designating the word "busy". The subscriber A in detecting the printed matter in his printer operates key 8 for opening the energizing circuit of relay 10 which disconnects the substation equipment from the loop circuit and connects the call bell 11 thereto. The system is now restored to its normal condition.

Although the invention has been disclosed and described as applied to a particular type of system, it is understood, of course, that variations may be made without departing from the spirit and scope of the present invention.

What is claimed is:

1. A printing telegraph exchange system comprising a plurality of printing telegraph stations, printing telegraph transmitting and receiving mechanisms at each of the stations, a central office, line conductors connecting the stations to said central office, means at said central office for establishing connections between said lines to permit the transmission of direct current telegraph signals between the connected line conductors, and means associated with said means responsive to the connection thereof with a busy line for transmitting to the calling station impulses for operating said receiving mechanism.

2. A printing telegraph exchange system comprising a plurality of printing telegraph stations, printing telegraph transmitting and receiving mechanisms at each of the stations, a central office, line conductors connecting the stations to said central office, means at said central office for establishing connections between said lines to permit the transmission of direct current telegraph signals between the connected line conductors, and an interrupter associated with said means responsive to the connection thereof with a busy line for transmitting to the calling station impulses characteristic of the

condition of said line, said receiving mechanism being operated in accordance with such impulses for indicating the condition of said line.

5 3. A printing telegraph exchange system comprising a plurality of printing telegraph stations, printing telegraph transmitting and receiving mechanisms and an impulse sending device at each of said stations, a central office, line conductors extending from said stations to said central office responsive to the operation of said impulse sending device for extending automatically a calling line to a called for line, a source of operating current at said central office for said printing telegraph equipment, means for impressing ringing current on the called for subscriber's line, and means responsive to the connection of the printing telegraph equipment with the line of the called for party for disconnecting said ringing current and connecting said source of operating current to the connected lines.

25 4. A printing telegraph exchange system comprising a plurality of printing telegraph stations, printing telegraph transmitting and receiving mechanisms and an impulse sending device at each of said stations, a central office, line conductors extending from each of said stations to said central office, machine switching apparatus at said central office responsive to the operation of said impulse sending device for automatically extending a calling line to a called for line and arranged to permit the transmission of direct current telegraph signals between the connected stations, and means responsive to the connection of the printing telegraph equipment with the line of the called for subscriber and including an interrupting device for maintaining said machine switching apparatus operated during the time said telegraph transmitting mechanism is operated.

45 5. A printing telegraph exchange system comprising a plurality of printing telegraph stations, printing telegraph transmitting and receiving mechanisms and an impulse sending device at each of said stations, a central office, line conductors extending from each of said stations to said central office, machine switching apparatus at said central office responsive to the operation of said impulse sending device for automatically extending a calling line to a called for line arranged to permit the transmission of direct current telegraph signals between the connected stations, a relay operated upon the connection of the printing telegraph equipment with the line at the called for subscriber's station,

and means rendered effective upon the operation of said relay for preventing the release of said machine switching apparatus during the time said telegraph transmitting mechanism is operated.

60 6. A printing telegraph exchange system comprising a plurality of printing telegraph stations, printing telegraph transmitting and receiving mechanisms and an impulse sending device at each of said stations, a central office, line conductors extending from each of said stations to said central office, machine switching apparatus at said central office responsive to the operation of said impulse sending device for automatically extending a calling line to a called for line, and an interrupter rendered effective upon the extension of the calling line for preventing the release of said machine switching apparatus when said transmitting mechanism is transmitting an open impulse longer than would occur through the operation of the impulse sending devices.

75 7. In a printing telegraph system, a plurality of printing telegraph subscribers' stations, a central office, line conductors for each of said stations extending to said central office, means at said central office for establishing connections between said lines as desired, means for applying currents having different characteristics to said lines, a signaling device, a relay for operating said signaling device, and means for including inductively said relay with the line conductors at said subscribers' stations, said inductive means being arranged to permit the operation of said relay only in response to the application of current of certain characteristics.

85 8. A printing telegraph exchange system comprising a plurality of telegraph stations, a central office, transmitting and receiving mechanisms at each of the stations, line conductors connecting the stations to said central office, means at the central office for establishing connections between said lines to permit the transmission of direct current telegraph signals, and means responsive to a busy condition on a called telegraph line for transmitting to the calling station impulses causing the receiving mechanism thereat to print a statement of the busy condition of the called line.

100 In testimony whereof, we have signed our names to this specification this 22nd day of December, 1922.

105 110
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