

Nov. 21, 1933.

G. A. LOCKE ET AL
TELEGRAPH EXCHANGE SYSTEM

1,936,200

Filed Dec. 4, 1931

4 Sheets-Sheet 1

FIG. 1

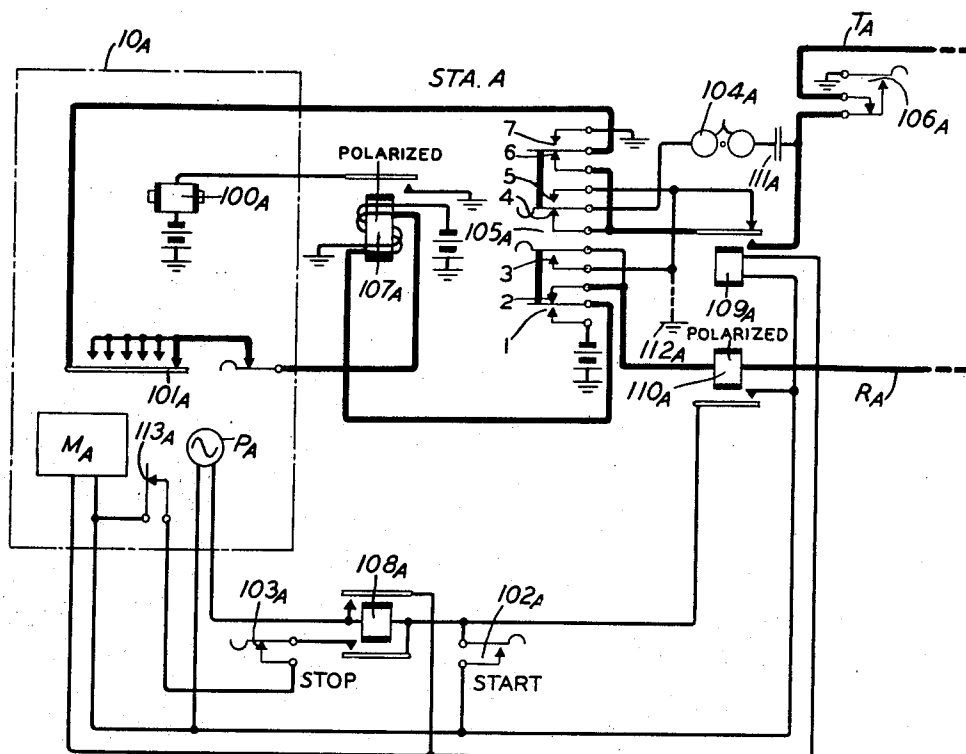
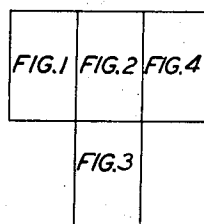


FIG. 5



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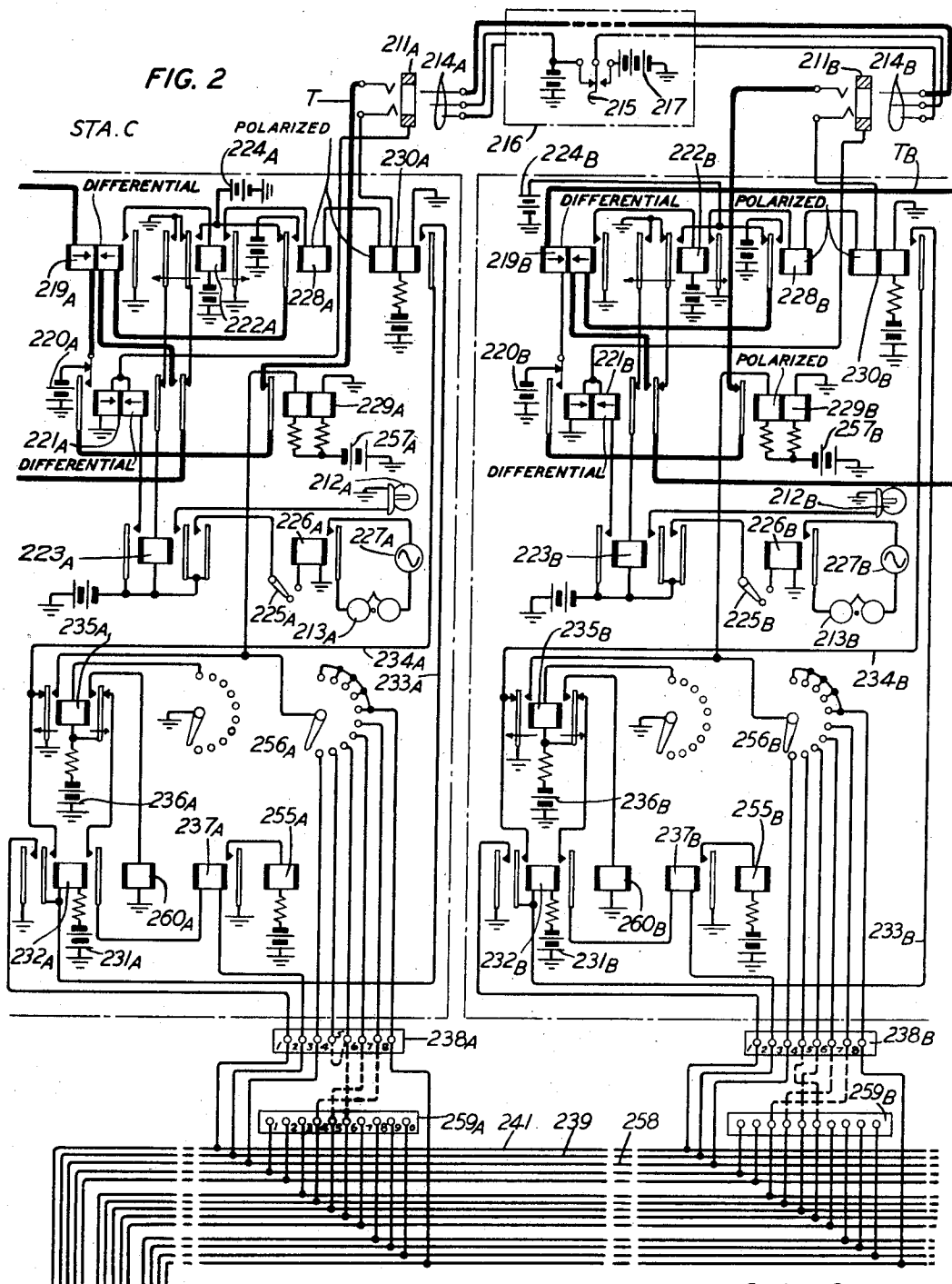
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4 Sheets-Sheet 2



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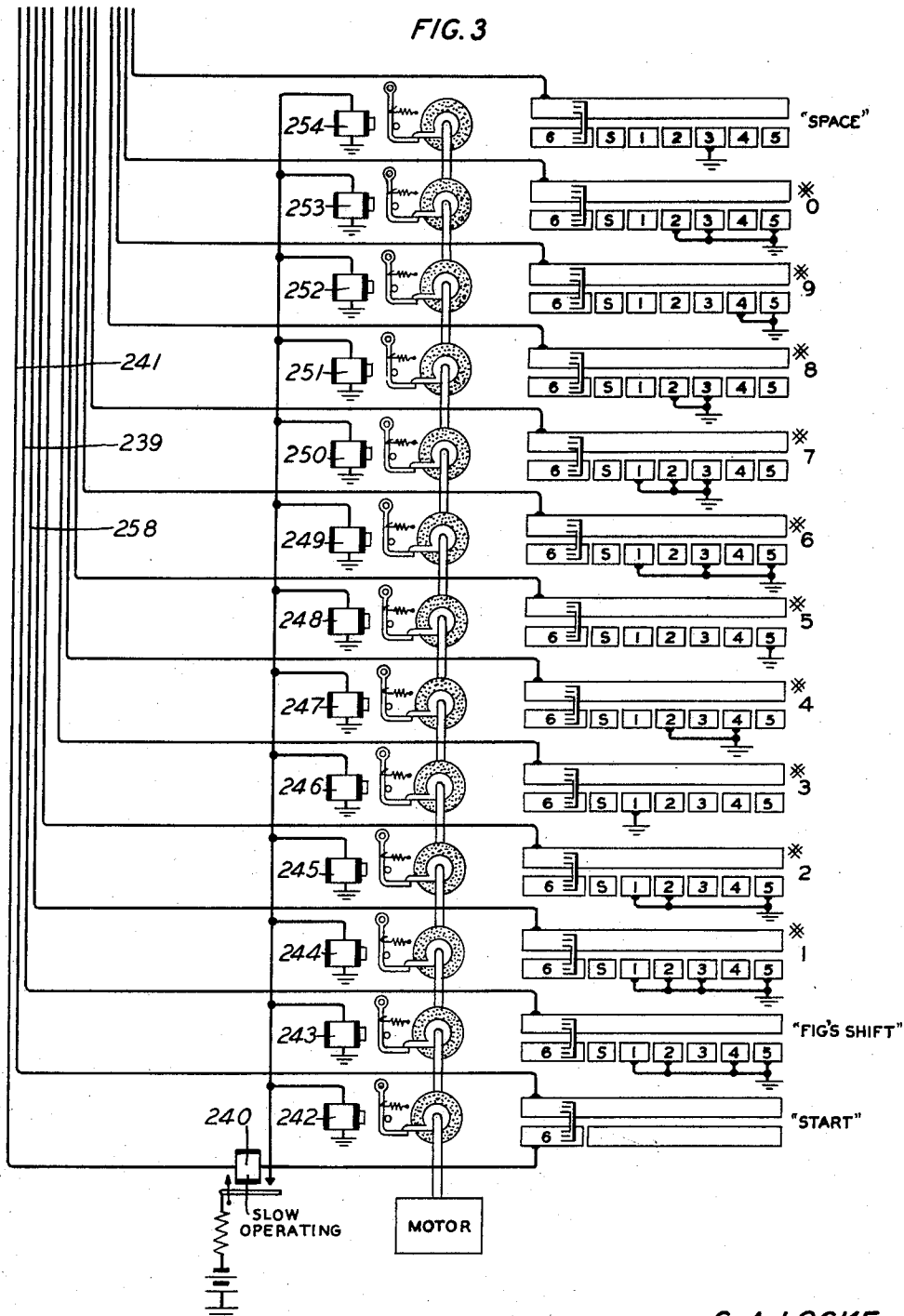
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4 Sheets-Sheet 3



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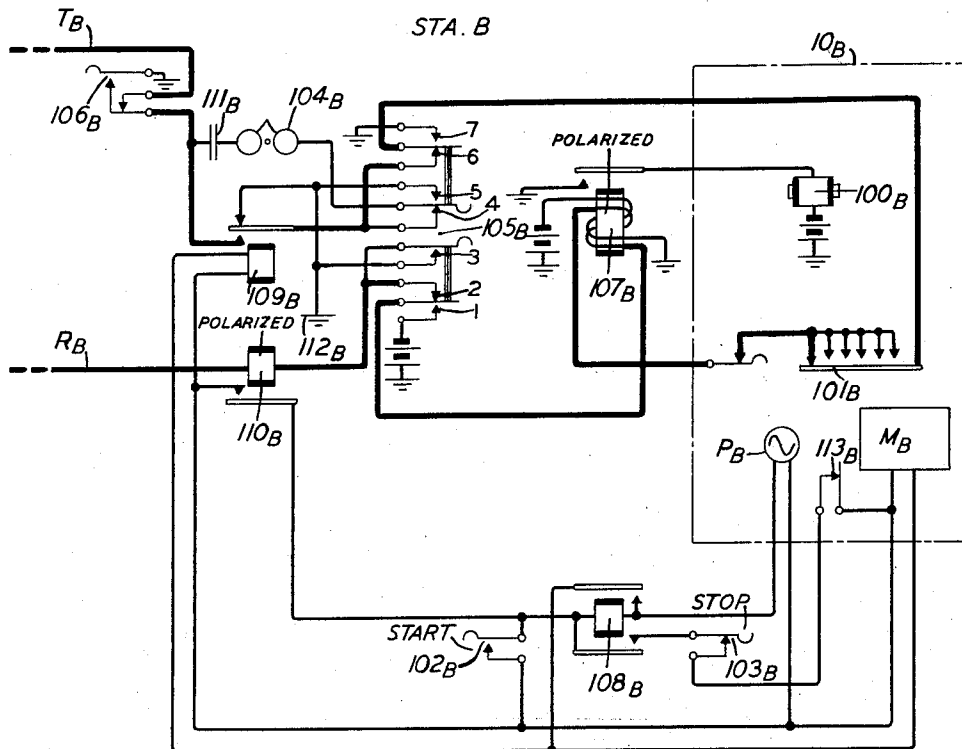
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4 Sheets-Sheet 4

FIG. 4



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UNITED STATES PATENT OFFICE

1,936,200

TELEGRAPH EXCHANGE SYSTEM

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Application December 4, 1931. Serial No. 578,958

10 Claims. (Cl. 178—4)

This invention relates to a printing telegraph exchange system by means of which connections may be established quickly and efficiently for communication purposes between any two of a plurality of subscribers' telegraph stations, and further by means of which such connections are to remain thus established for more or less temporary intervals in accordance with the wishes of the subscribers.

This invention relates to a printing telegraph exchange system which can establish connections between any two of a plurality of subscribers and more particularly to such of those systems which can establish a communication circuit between a calling subscriber and an unattended station circuit.

It is known in the art that in manual telegraph exchange systems means may be provided whereby any telegraph station served by the exchange system may obtain connection with any other substation by signaling the operator at a central office to which the telegraph station is connected. At the central office a special circuit controlled by an "unattended start key" may be provided for the operator to start the driving mechanism at an unattended subscriber's station for receiving communication from a calling subscriber. G. A. Locke and F. S. Kinkead copending application, Serial No. 459,684, filed June 7, 1930, discloses such an arrangement.

It is also desirable in such systems to bring to the attention of the calling subscriber the code number of the unattended station to which the connection is established before starting to transmit a message. Such an arrangement will prove a check on the central office operator and will inform the calling subscriber of the identity of the station to which the connection is established.

Accordingly, a primary object of this invention is to provide a circuit which will transmit from the central office to the calling subscriber a check signal which verifies the code number of the unattended subscriber's station; and moreover the signal may be sent to the calling subscriber in cases where the called station is attended but the calling subscriber wants the identity of the called subscriber verified.

According to the herein described embodiment of the invention, an impulse sender arrangement individual to each subscriber's line circuit is provided at the central office together with a plurality of continuously rotating distributors of the start-stop type. The distributors are common to the impulse sender arrangements and are

arranged to repeat the signals respectively corresponding to the numerical digits constituting the subscriber's station numbers or codes. Each sender arrangement is connected to a line jack circuit in response to a request for a called subscriber's line. The operator at the central office by means of a cord circuit plugs into the jack of the called subscriber's line, operates a special, or unattended station, key in the cord circuit to thereby operate the sender circuit arrangement of the called subscriber's line. The sender circuit of the called subscriber's line is connected by means of a cross-connecting rack or bus-bar to the distributors repeating the signals corresponding to the digits of the called subscriber's line and these signals are repeated in proper order through a repeater in the cord circuit to the calling subscriber's line whereby the calling subscriber is informed that the connection established by the operator is correct. This service is required only when the called subscriber's station is unattended at the time the call is made.

A feature of this invention is the provision for informing a calling subscriber, before a message is transmitted to an unattended station, that the station to which the connection is established is the correct one.

Another feature of this invention is the use of rotary stepper switches for insuring the transmission to a calling subscriber's station of a complete signal for each of the digits of the called subscriber's station code.

Another feature resides in providing a separate stepper switch for each of the subscribers' stations connected to the central office.

Another feature lies in the use of ten continuously rotating distributors common to all the subscribers' stations connected to the central office, wherein the signal combinations corresponding to each of the numbers of the subscribers' stations are stored so that combinations constituting any called number may be selected at will for transmission to a calling station.

Other objects and features will appear in the subsequent detailed description taken in conjunction with the accompanying drawings. A system to which the present invention may be suitably adapted is disclosed in the copending application of G. A. Locke and F. S. Kinkead, supra.

Referring to the drawings:

Fig. 1 shows the circuit diagram of a subscriber's loop circuit at station A. A similar circuit is provided for each of the other subscribers' loop circuits in the system. The system shown

in Fig. 1 includes suitable audible and visible indicating apparatus;

Fig. 2 illustrates in diagrammatic form one of the cord circuits at the central office and in schematic form the equipment at the central office which is individual to each subscriber's line circuit. Only so much of the equipment is shown that is necessary for the satisfactory understanding of the invention. The cord circuit not shown but diagrammatically represented by a block is described in detail in the application of G. A. Locke and F. S. Kinkead, supra;

Fig. 3 shows the storing device which is common to all subscribers' station line circuits terminating in the central office, which is adapted to repeat to a calling subscriber's line whenever desired, signal combinations representing the number of the called station to which the connection is established;

Fig. 4 shows the circuit in schematic form of a second subscriber's station; and

Fig. 5 shows the manner of arranging the sheets of the drawings for a complete understanding of the system herein described.

Apparatus at station A

Referring to Fig. 1 which shows the subscriber's loop circuit at station A, the equipment shown therein comprises a printing telegraph sending and receiving unit 10A. Unit 10A comprises a printer magnet 100A, a set of sending contacts 101A and a suitable motor M_A equipped with a pair of contacts 113A which will open by mechanical means when motor stop signals are sent. External of the printing telegraph set or unit are switch 102A for starting the printer set motor, a stop or break key 103A for stopping the printer set, a ringer or bell 104A whereby the central office may signal the subscriber's station, a test key 105A for testing locally the printer sets while the loop circuit is arranged so that the ringer may be operated from the central office, a flash key 106A for signaling the central office and several relays, the functions of which will be hereinafter described.

Apparatus of the Central Office (station C)

Figs. 2 and 3 constitute equipment at the central office.

In Fig. 2 the tip T_A lead of the loop circuit of station A terminates in jack 211A, one such jack being provided at the central office for each subscriber's station in the system. Each of these jacks has associated therewith a line lamp 212A and an auxiliary bell 213A so that each subscriber may signal the central station whenever a connection to another subscriber's station is desired. A plurality of cord circuits are provided for respectively establishing connections between calling subscriber and called subscriber stations in a manner well known in the manually operated telephone exchange systems. A cord circuit is shown which terminates in answering plug 214A and a calling plug 214B. Each cord circuit includes a repeater represented diagrammatically by block 216. The repeaters are of the single line repeater type which repeat signals in either direction between two interconnected subscriber loop circuits. A detailed disclosure of a repeater unit of this type will not be given in this application since it may be had by referring to the application of Locke-Kinkead, supra. A key such as 215 shown in repeater 216, is provided for each repeater and serves two purposes, namely, to start the printer motor at the unattended station in the

same manner as key 150 shown in Fig. 2 of the Locke-Kinkead application, and to operate the answer-back equipment located at the central office and associated with a called subscriber loop circuit. By means of the answer-back equipment a calling subscriber is informed of the number of the called stations to which a connection has been completed by means of a cord circuit. Key 215 is operated only when the connection between a calling and a called subscriber loop circuit has been completed and the called station is unattended at the time. Key 215 provides an arrangement whereby the calling subscriber is assured that the connection established is correct. The answer-back equipment provided at the central office for each of the subscribers' stations comprises a group of relays and a stepper switch. The equipment shown on the left-hand side of Fig. 2 is associated with subscriber's station A and that shown on the right-hand side is associated with subscriber's station B shown in Fig. 4. As soon as a subscriber's jack is selected to complete a call its associated stepper switch starts operating in response to the operation of the key corresponding to key 215 in cord circuit and repeater 216 and as the switch moves through its first four operated positions, that is, positions Nos. 2 to 5, inclusive, four combinations of impulses corresponding to the numerical digits of the called number in their proper sequence are successively repeated from a source of impulses common to all stations, to the printer set of the calling station. The connections of the contacts of each stepper switch are connected to the common source of impulse combinations through a bus-bar or cross-connecting rack such as those shown at the bottom of Fig. 2.

In Fig. 3 is shown the common source of impulse combinations which comprises thirteen rotary distributors, one for effecting the start of the series of operations of the stepper switch associated with the jack into which the calling end of a cord circuit is inserted, one for transmitting the signal combination effective in operating the "shift to figures" mechanism in the printer typewriter at the calling station, ten for generating signal combinations of the numerical digits of 0 to 9 and one for producing a "space" signal which is utilized for restoring the selected stepper switch to normal immediately after the last digit of the called number has been transmitted to the calling station. These distributors are of the start-stop type but are arranged to operate continuously while the code number of any called subscriber's station is being transmitted to a calling subscriber's station.

Apparatus at station B

The apparatus for station B is shown in Fig. 4 and is identical with that shown for station A in Fig. 1.

Operation of the system

Having briefly discussed the various circuit elements involved in establishing a connection between local subscribers' lines, the manner in which this connection is established will now be described in detail. Referring to Fig. 1, under normal conditions, a circuit may be traced through a bell ringer 104A from the tip side T_A of the loop, over the normally closed contacts of key 106A, condenser 111A, and bell 104A, contact No. 4 of key 105A, back contact of relay 109A to ground 112A. Also, ground is normally connected to the ring side of the loop in a path from ring lead 150

RA through the winding of relay 110A, contact No. 2 of key 105A, one winding of relay 107A, contact 101A of the subscriber's printer set, contact No. 6 of key 105A, back contact of relay 109A to ground 112A. For the purpose of illustration, it is assumed that station A desires to establish a connection to station B. Start switch 102A is operated which closes a circuit from one side of power supply PA, through the winding of relay 108A to the other side of the power supply, causing relay 108A to operate. Relay 108A, in operating, locks up through its lower contact, contact of stop key 103A, motor control contact 113A of the printer. In operating, relay 108A closes a path through its upper contact to start the motor for the printer set and also to operate relay 109A through the same circuit.

The operation of relay 109A opens the bell ringer circuit over the tip lead TA of the loop, removes ground from the ring side RA of the loop and closes the tip and ring leads of the loop through the subscriber's station set to operate relay 219A at the central office. This last circuit is traced from negative battery 220A at the central office, through the right-hand break contact of relay 221A, left-hand winding of relay 219A, the tip side of the loop, normally closed contact of flash key 106A located at subscriber's station A, front contact of relay 109A, contact No. 6 of key 105A, sending contact 101A of the printer set, one winding of relay 107A, contact No. 2 of key 105A, winding of relay 110A, ring side of loop, outer right-hand armature and back contact of relay 221A, inner left armature and back contact of relay 222A to ground. The operation of relay 219A completes a path to operate relay 222A, from ground on the armature and contact of relay 219A to battery through the winding of relay 222A. The operation of relay 222A in turn operates relay 223A. This circuit is traced from ground on the outer left armature and front contact of relay 222A, to the inner right-hand armature and back contact of relay 221A, through the winding of relay 223A, to grounded battery. Incidentally, relay 219A is kept from releasing when relay 222A operates by the substitution of grounded positive battery 224A on the left inner armature and front contact of relay 222A, for the ground on the left inner armature and back contact of relay 222A. This positive battery is now connected over the ring side RA of the loop circuit which may be traced back over the tip lead TA of the loop circuit to grounded negative battery 220A as mentioned hereinbefore. Relay 223A, in operating, lights lamp 212A in a circuit traceable from grounded battery on the inner right armature and contact of relay 223A to ground at lamp 212, indicating to the operator at the central office that the subscriber at station A is calling. If desired, the operation of relay 223 may be made to operate a night alarm bell or buzzer circuit by merely operating switch 225A to connect relay 226A to grounded battery on the outer right armature and contact of relay 223A. With this arrangement, when relay 223A operates, relay 226A will operate to close a circuit containing generator 227A in series with bell 213A. The operation of relay 223A not only lights the line lamp but connects grounded battery at the left armature and contact of relay 223A through the secondary, or right-hand, winding of relay 221A to the sleeve of jack 211A to put a busy indication on the sleeve of jack 211. The secondary winding of relay 221A is connected in opposition to the primary

or left-hand, and helps to prevent relay 221A from operating.

The operator at the central office answers the call by inserting answering plug 214A of the cord circuit selected for use, into jack 211A of the calling subscriber's line. This energizes relay 221A as hereinafter described and thus extinguishes the lamp 212A. The operation of a key designated 196 in Fig. 3 of the drawings of the Locke-Kinthead application, supra, and associated with the selected cord circuit, connects the operator's printer telegraph set to the loop circuit for communication with the subscriber's printer at station A.

Relay 221A is caused to be operated by the operation of a relay 134 not shown in the drawings of the present application but shown in Fig. 2 of the Locke-Kinthead application, supra. The operation of relay 221A opens the operating circuit for relay 223A which releases and, as stated above, extinguishes the lamp 212A. The operation of relay 221A transfers the ring side RA of the loop circuit from positive battery 224A on the inner right front contact of relay 222A to the same positive battery, but through the right front contact of relay 221A, through the right-hand, or secondary, winding of relay 219A, armature and back contact of relay 228A. The operation of the cord circuit repeater in establishing the connection to the central office printer telegraph set is fully described in the Locke-Kinthead application.

The operation of relay 221A removes negative battery 220A from the loop circuit, but another battery of similar polarity is substituted in a circuit which is shown in the Locke-Kinthead application, and is described therein as extending through resistance AA, conductor S, normally closed contact of key 196, conductor M, normally closed contact of key 130, left-hand windings of relays 126 and 125 in series, contact and armature of relay 123, back contact and armature of relay 139, lower inner armature and front contact and upper outer front contact and armature of relay 133 to the tip of plug 121, which corresponds to the tip side of plug 214A of the present application, to complete a circuit over the tip side of jack 211A, contact and armature of relay 229A, the "make" contact of relay 221A, left-hand or primary, winding of relay 219A, tip lead TA and back over the ring lead RA of the loop, outer right armature and front contact of relay 221A, through the right-hand winding of relay 219A, armature and back contact of relay 228A to positive battery 224A. This circuit energizes both windings of relay 219A, the windings of which are wound so as to oppose each other, thereby causing the relay to release and in turn to release relay 222A.

The busy condition on the sleeve of jack 214A, formerly obtained by battery on the left-hand armature of relay 223A, is replaced upon insertion of plug 214A and upon the release of relay 223A, by battery from the sleeve lead of the cord circuit. This battery is furnished by the operation of relay 134 stated above as being shown in Fig. 2 of the Locke-Kinthead application, supra.

The operation of the operating key, not shown but designated 196 in the Locke-Kinthead application, connects the central office printer telegraph set over the answering plug 214A to the printer set at station A. Consequently, communication may now take place between the central office and the subscriber's station A. The word "operator" or "opr" is transmitted from the central office printer set and received in the receiving unit 100A of the printer set at station A.

The subscriber then answers by operating the sender unit 101A to transmit to the central office printer set the code number of the subscriber's station with which a connection is desired. As soon as this information is received in the central office printer set the opposite end, that is, calling plug 214B, of the selected cord circuit is inserted into the jack of the station desired by the subscriber at station A. Assuming that the desired station is station B, the plug 214B is inserted in jack 211B. The insertion of plug 214B into jack 211B of the called subscriber's line causes the operation of relay 221B because grounded battery is connected to the sleeve lead of plug 214B as shown in the Locke-Kinthead application. The tip of plug 214B completes the circuit extending through jack 211B, contact and armature of relay 229B, left "make" contact of relay 221B, left-hand, or primary, winding of relay 219B, tip lead TB of the loop circuit of station B, normally closed contacts of flash key 106B, condenser 111B, bell 104B, contact No. 4 of key 105B, back contact of relay 109B, to ground at 112B. The operation of relay 221B in the line jack circuit will complete a circuit from positive battery 224B, back contact and armature of relay 226B, right-hand winding of relay 219B, right front contact and armature of relay 221B, ring lead RB of the loop circuit to station B, through the winding of relay 110B, contact No. 2 of key 105B, through one winding of relay 107B, sending contacts 101B, contact No. 6 at key 105B, armature and back contact of relay 109B, to ground 112B, thereby operating relay 219B. The operation of relay 219B will operate relay 222B, which in turn will operate supervisory apparatus included in the cord circuit to inform the central office that the loop circuit to station B is completed and that ringing current may be applied to the loop to operate the ringer 104B at station B in a manner described in the Locke-Kinthead application, supra. The ringing current (20 cycle current) will continue to be applied to the line extending to station B until the subscriber answers. While the ringing is being applied relay 219B in the line jack circuit will chatter, but to prevent this chattering from affecting the supervisory guard lamp (not shown but designated at 153 in Fig. 2 of the drawings of the Locke-Kinthead application) in the cord circuit, relay 222B is designed a slow release relay which will not release when 219B chatters. When the subscriber's station B answers, as for example, by depressing the start key 102B, the relays at station B will operate in the same order as those described above in connection with station A whereat the call originated and ground will be removed from the ring side of the loop circuit; the bell circuit over the tip side of the loop circuit will be opened and leads TB and RB of the loop will be closed through the sending unit 101B and the receiving unit 100B of the printer set at station B. In the line circuit the closure of the loop circuit of station B will cause both windings of relay 219B to become energized and relay 219B releases, because of its differential character, in a manner similar to that of relay 219A described above in connection with originating the call.

The release of relay 219B will release relay 222B which will remove ground from the ring side of the cord circuit and thus cause the supervisory guard lamp in the cord circuit to be extinguished. The tip of the calling cord circuit is restored to the repeater circuit and communication may now take place between subscribers through the re-

peater with a printer set connected in the cord circuit at the central office for monitoring the circuits.

The called subscriber may acknowledge the call in some way, as by typing his code number on the printer at station B. This code will be received on the printer sets at both stations A and the central office. This connection is monitored at the central office until subscribers at stations A and B are in satisfactory communication, at which time the restoring key designated 196 in Fig. 3 of the Locke-Kinthead application, supra, is operated to its normal position thereby disconnecting the printer set at the central office from the through connection. The central office printer set is now free to answer other calls.

When the call is completed a disconnect signal may be sent by either subscriber by depressing a stop key 103 which opens the locking circuit for relay 108, causing it to release and thereby open the circuit of the power supply P to the printer motor. Relay 109 will also release and the subscriber's station will return to normal and restore the condition of an open tip lead and grounded ring lead. Relay 219 in the line jack circuit will now reoperate since the ring, or left-hand, winding only of the relay will be energized. Relay 222 will now operate from the contact of relay 219 to apply ground to the ring lead of jack 211 and to the cord circuit. In the case of the calling end of the cord circuit, a supervisory lamp associated with the calling end will light. In the case of the answering end of the cord circuit a supervisory lamp circuit associated with the answering end will light. As soon as the lighting of these lamps is noted at the central office, the cord circuit is disconnected from the jacks of the calling and the called subscribers' lines, thus restoring all equipment to normal.

It should be noted that if the subscriber's printer set is one of certain well known types in common use, either subscriber may send a disconnect signal to shut down, not only his own set but also that of the other station by sending two "shift" signals or one "shift" and one upper case "H" signal on his printer equipment. Certain mechanism located in the subscriber's printer (not shown in the drawings since the printer forms no part of this invention) acts to open the motor control contacts. The opening of the motor control contacts 113 releases relay 108 and has the same effect as opening the stop key 103.

Unattended station

If the operator at the central office rings a called subscriber and the subscriber does not answer, the operator may start the subscriber's set and allow the calling subscriber to send a message to the unattended station. However, before this is done, the operator will send a request to station A asking whether or not the connection with an unattended station is desired. At this time, that is, when both the answering and the calling plugs are, in response to a call from station A to station B, inserted in jack 211A and 211B, respectively, relays 108A and 109A at station A and relays 219A, 221A, 222A, 219B, 221B and 222B at the central office are in operated positions. Assuming that a connection to the unattended station B is desired, the operator operates key 215 in the cord circuit. Key 215, when operated, performs two functions, namely, starts the printer motor at the unattended station in a manner described in the Locke-Kinthead application, supra, and connects grounded positive

battery 217 to the circuit extending over the ring lead of plug 214_B, the ring lead of jack 211_B, through the left-hand winding of relay 230_B, through the winding of polarized relay 228_B, contact and right armature of relay 222_B to ground. Relay 228_B being of the polarized type, operates in response to the positive current from battery 217 and thus applies negative battery through its front contact and armature, through the right-hand winding of relay 219_B, right front contact and armature of relay 221_B to the ring side of the loop circuit of station B, instead of the usual positive battery 224_A. The reversal of polarity on the ring side of the loop circuit of station B operates polarized relay 110_B at station B, which in operating, closes a circuit of relay 108_B in a manner similar to that described above for station A when the start key 102 is depressed. The operation of relay 110_B puts station B in an operating condition by starting motor M_B. Relay 230_B which is normally held in a non-operated position due to the biasing current in its right-hand winding, operates simultaneously with relay 228 and closes a circuit extending from grounded battery 231_B, through the winding of relay 232_B, conductor 233_B, contact and armature of relay 230_B, conductor 234_B to ground at the back contact and left armature of relay 235_B. Relay 232_B operates and locks up in a circuit extending through its left armature and contact, through the contact and left armature of relay 235_B to ground. Relay 232_B in operating, also closes a circuit extending from grounded battery 236_B, right-hand armature and back contact of relay 235_B, contact and right-hand armature of relay 232_B, through the winding of relay 237_B, terminal No. 2 of bus-bar 238_B, conductor 239, continuous ring, brush and short segment of the "start" distributor, through the winding of relay 240, conductor 241, terminal No. 1 of bus-bar 238_B, contact and left outer armature of relay 232_B, to ground. Relay 240, which is of the slow-to-operate type, operates and closes an obvious operating circuit for release magnets 242 to 254. The operation of the release magnet starts the brushes rotating over their respectively associated rotary distributors shown opposite the magnets. Relay 237_B operates and subsequently effects the operation of rotary magnet 255_B. However, it is released as soon as the brush on the "start" distributor passes off the short segment and causes the release of rotary magnet 255_B. The release of magnet 255_B causes the brushes of rotary stepper switch 256_B to simultaneously move in the same phase one rotary step along their respectively associated banks to the first operative contact on the right-hand bank. The right-hand brush in moving onto its first contact closes a circuit extending from grounded battery 257_B, through the left-hand winding of relay 229_B, right-hand brush at its first operative contact of switch 256_B, terminal No. 3 of bus-bar 238_B, conductor 258, continuous ring, brush and segments S, 1, 2, 3, 4 and 5 of the "shift" distributor, the segments being engaged by the brush in the order mentioned, to ground on segments 1, 2, 4 and 5. Relay 229_B, which is normally maintained in a non-operated position by the biasing current continuously flowing through the right-hand winding, operates in the circuit just traced as a vibrating relay, that is, it operates when the brush passes over segments 1, 2, 4 and 5 and releases when the brush passes over the remaining segments. The vibratory operation of relay 228 alternately opens and closes the fundamental circuit which extends from grounded negative battery on the front contact and armature of relay 228 through the right-hand winding of relay 219_B, front contact and outer right-hand armature of relay 221_B, ring lead R_B, through the winding of polarized relay 110_B, contact No. 2 of key 105_B, through one winding of polarized relay 107_B, sending unit 101_B, contact No. 6 of key 105_B, armature and front contact of relay 109_B, normally closed contact of key 106_B, tip lead T_B, left-hand winding of relay 219_B, lower contact and left armature of relay 221_B, armature and contact of relay 229_B, tip spring of jack 211_B, tip of plug 214_A, tip of plug 214_A, tip spring of jack 211_A, contact and armature of relay 229_A, left armature and lower contact of relay 221_A, through the left-hand winding of relay 219_A, tip lead T_A, normally closed contact of key 106_A, front contact and armature of relay 109_A, contact No. 6 of key 105_A, sending unit 101_A, through one winding of polarized relay 107_A, contact No. 2 of key 105_A, through the winding of polarized relay 110_A, ring lead R_A, outer right armature and front contact of relay 221_A, through the right-hand winding of relay 219_A, armature and back contact of relay 228_A, to grounded positive battery 224_A. The direction of current through the winding of relays 107_B and 107_A operates both relays and the alternate opening and closing of the fundamental circuit at the armature of relay 229_B, due to impulses received from the "shift" distributor in Fig. 3, will have a corresponding effect on each of the receiving units or printer magnets 100_B and 100_A. The operation of the printer magnets in response to the "shift" signal causes the type bars of the printer set at each subscriber's station to be shifted to record "figures" or upper case characters.

As the distributor brushes complete a revolution and the brush of the "start" distributor again engages its associated short segment the operating circuit for relay 240 is again momentarily closed to operate the release magnets and to allow the brushes to continue rotating. Relay 237_B, the winding of which is included in the operating circuit for relay 240, also operates momentarily to step the brushes on the banks of switch 256_B to their second contacts. As the distributor brushes continue rotating over segments S, 1, 2, 3, 4 and 5, of their respective distributors, a combination of impulses is transmitted corresponding to the first numerical digit of the called station number. The distributor capable of transmitting numerical signals, may be connected in any desired order to the contacts of the right-hand bank of stepper switch 256_B by means of the cross-connecting rack comprising bus-bars 238_B and 259_B. There is one cross-connecting rack provided for each subscriber's station and the numerical digits corresponding to the digits of a subscriber's station number are connected by means of the contacts on the right-hand bank of the stepper switch associated with the subscriber's station. The system shown herein provides for four numerical digits to a number. Therefore at the beginning of each revolution of the distributor brushes the brushes on both banks of an engaged stepper switch rotates through four steps to complete the transmission of the signal combinations constituting the called station number to both the calling and the called station where the number is typed on the local printer sets. The calling subscriber is informed by these means that the connection established is correct. It is under-

stood that the scope of the invention disclosed herein is not limited to four digits in the subscriber's number but that additional digits, either numerical or letters, may be employed by increasing the number of contacts on the switch banks, if necessary.

Immediately after the transmission of the signal combination for the fourth digit, the "space" distributor is connected to the next or sixth contact of the stepper switch and a "space" signal is then transmitted. The remaining contacts on the switch are connected in multiple with the sixth contact and are likewise connected to the "space" distributor, so that during each of the subsequent revolutions of the distributor brushes, the "space" signal is transmitted. When the brush on the operating bank of the stepper switch reaches the last contact, the brush on the associated bank reaches its last contact, which is connected to a circuit extending from ground on the brush, through the winding of relay 235_B to grounded battery 236_B. Relay 235_B operates, opens the locking circuit for relay 233_B, maintains open the start circuit for the distributors and the operating circuit for the stepping switch, connects ground to the operating circuit for relay 229_B, whereby relay 229_B operates to maintain the fundamental circuit opened and closes an operating circuit for release magnet 250_B which operates and restores both brushes to their normal position. The rotary stepper switches have releasing arrangements, self-interrupting in operation, and are of a type well known in the automatic telephonic art.

As soon as the brushes on the left-hand back of stepper switch 256_B moves off the last contact, relay 235_B releases thereby restoring relay 229_B to its normal position so that the fundamental circuit is now closed and ready to transmit a message from the calling station A to the called station B.

In the arrangement shown in Fig. 2 of the drawings, the stepper switch 256_B is so connected through its associated cross-connecting rack as to receive the transmitted combinations from the distributors Nos. 6, 5, 4 and 3 in the sequence mentioned. Consequently when station B is called and is unattended at the time, the number printed at the printer set of the calling station is 6543 which is the number of station B. Should the station A be called, the number printed at the printer set of the calling station would be 6654 as indicated by the cross-connection at the rack constituted of bus-bars 238_A, and 259_A.

The disconnection between subscribers' stations is accomplished at the conclusion of a message in the manner described in the Locke-Kinthead application, supra.

It will be noted that a special impulse is put upon a called line, in this case, a reversal of polarity, to start the called subscriber's motor, and that the impulse functions to cause transmission from apparatus at the central station of a signal verifying the called subscriber's number. In accordance with the more generic concept of the invention this special impulse may consist of a potential or succession of potentials of different forms suitable to effect the desired result which may or may not perform other functions in the systems. Furthermore, the invention from another generic aspect may assume different forms depending on the particular form of apparatus at the central exchange or of the

form or nature of the link circuits connecting the subscribers.

What is claimed is:

1. A telegraph exchange system for interconnecting at a central office in a plurality of subscribers' lines for communication purposes, characterized in this that the equipment at the central office for repeating back to a calling subscriber's line the code number corresponding to a connected called subscriber's line, comprises circuit means associated with each subscriber's line, a plurality of signal transmitting devices arranged to be selected in any desired combination by any one of said circuit means, and cross-connecting means for connecting one or more of said devices with any one of said circuit means.

2. An answer-back arrangement for a telegraph exchange system comprising a plurality of subscribers' stations, a central office, circuit means located at said central office, individual to each of said stations and connected to the line jack circuit of a called subscriber's station for generating and transmitting back to a calling subscriber the code number corresponding to a connected called subscriber's station, said circuit means being responsive to a single operation of a key for repeating back the called number of the connected called station.

3. In a telegraph exchange system, a central office, subscribers' stations, cord circuits at said central office for interconnecting said subscribers' stations for communication purposes, switching means in each of said cord circuits, circuit means individual to each of said subscribers' stations and controlled by any one of said switching means for answering back, when desired by a calling subscriber, the code number of the station to which a calling subscriber's station is connected.

4. A telegraph exchange system, according to claim 3, wherein the circuit means comprises a rotary stepper switch adapted to be rotated at definite intervals through its successive steps, in response to a single operation of said switching means to thereby cause to be recorded at the calling subscriber's station, the code number of the station to which the calling subscriber is connected.

5. A telegraph exchange system, a central office, subscribers' stations, cord circuits at said central office for interconnecting said subscribers' stations for communication purposes, switching means in each of said cord circuits, selective circuit means individual to each of said subscribers' stations and controlled by any one of said switching means for answering back the code number of the station to which a calling subscriber's station is connected, and a plurality of sources of information at said central office and common to said circuit means, each of said circuit means being automatically arranged to select said sources in various combinations for transmitting to the calling subscriber's station signal combinations corresponding to the code number of a subscriber's station to which the calling subscriber's station is connected when one of said switching means is operated.

6. A telegraph exchange system according to claim 5, wherein the source of information is a plurality of start-stop rotary distributors adapted to operate simultaneously and continuously during the transmission to a calling subscriber's station, of the code number of the station to which the calling subscriber's station is connected.

7. A telegraph exchange system according to claim 5, wherein the circuit means are arranged

to be restored to normal as soon as the calling subscriber's station has received the code number to which the calling subscriber's station is connected and wherein the source of information is adapted to be restored to normal at the same time if all other switching means in the system are in normal position.

8. A telegraph exchange system comprising a central office, loop circuits, a jack at said central office for terminating each of said loops, a plurality of subscribers' telegraph stations respectively included in said loop circuits, a subscriber's station called number transmitting circuits at the central office for each of said loop circuits, cord circuits at the central office, each arranged for interconnecting any two of said loop circuits, switching means in each of said cord circuits for associating the subscriber's station called number transmitting circuit of one of two interconnected stations for transmitting, when said means is operated, the called number of said one station over the loop circuits of the other station to which it is connected.

9. A telegraph exchange system comprising subscribers' lines and interconnecting link circuits having at the central office a source adapted to apply to a subscriber's line a special voltage to set a called subscriber's receiving apparatus into operation and code signal originating means located at the central office, individual to each subscriber's line and controlled by the application of said voltage to send from the central station an indication verifying to the calling subscriber the identity of the called line to which the calling subscriber's line is connected.

10. In a printing telegraph system, a circuit extending between two stations, mechanism individual to each of said stations, located at a point remote from one of said stations, and responsive to a special voltage applied to said circuit at said point to send signaling impulses characteristically adapted to verify the identity of one of said stations to the other of said stations.

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