July 3, 1934. G. A. LOCKE 1,965,421

DISCONNECT SIGNAL

Filed May 19, 1932 4 Sheets-Sheet 1

FIG. 1

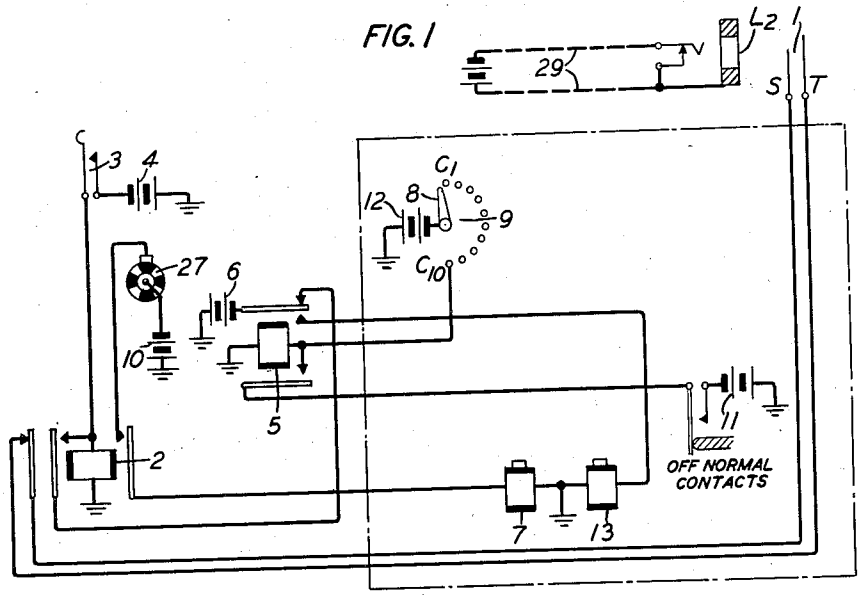
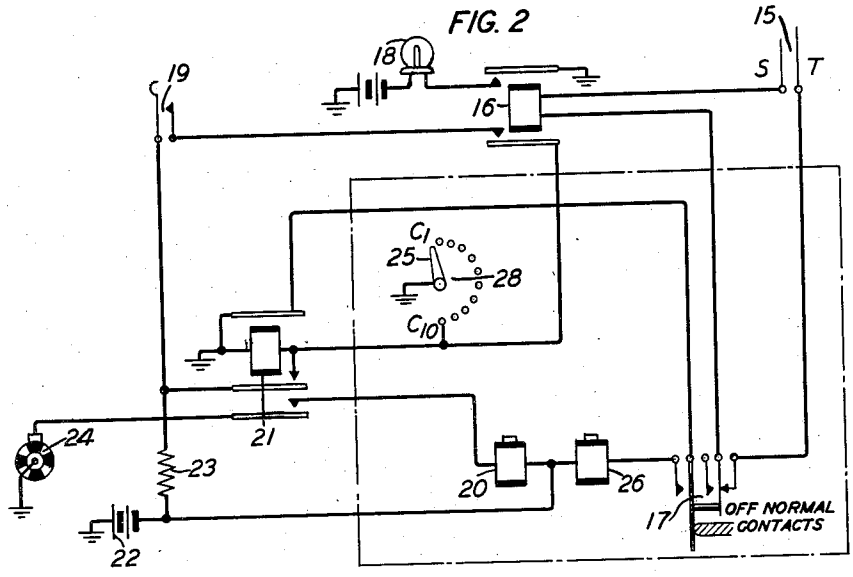


FIG. 2



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July 3, 1934. G. A. LOCKE 1,965,421

DISCONNECT SIGNAL

Filed May 19, 1932 4 Sheets-Sheet 2

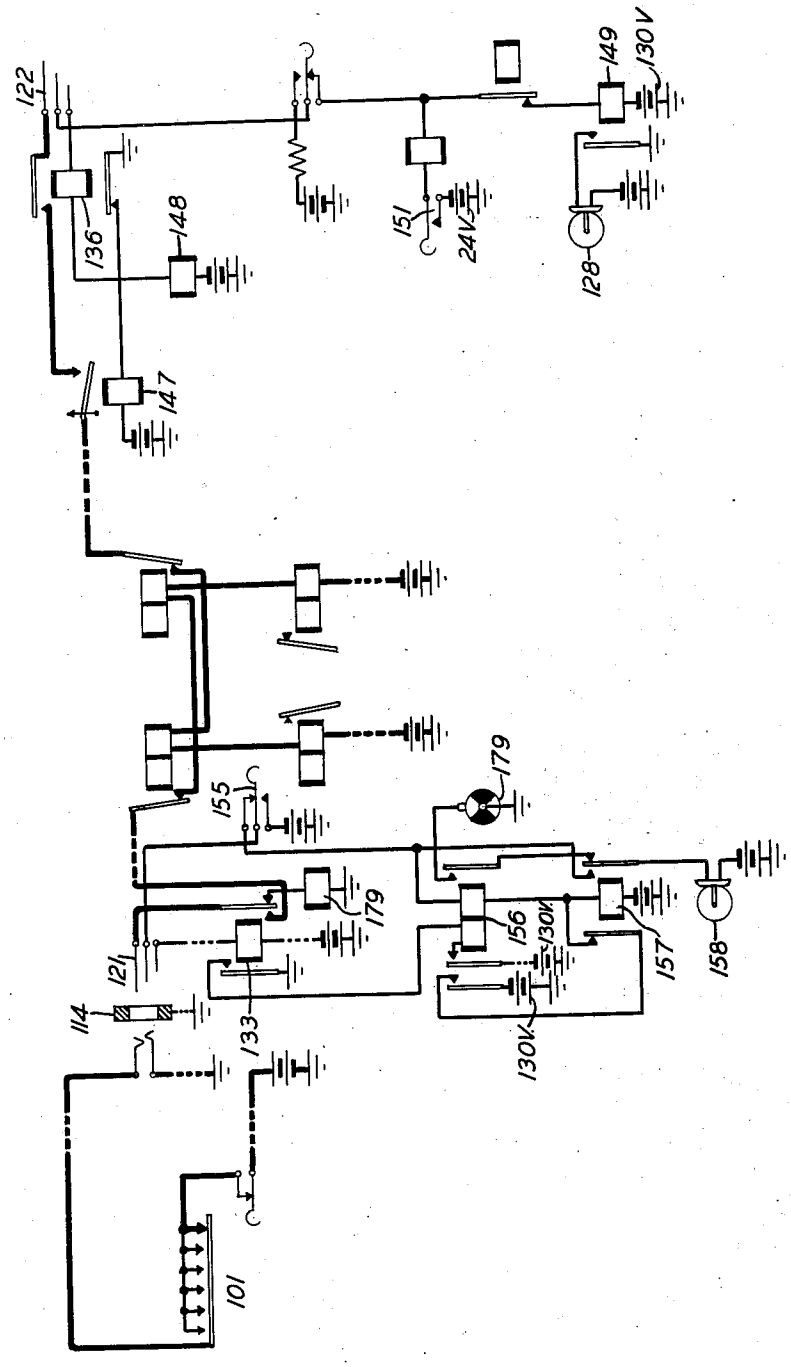

FIG. 3

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DISCONNECT SIGNAL

Filed May 19, 1932 4 Sheets-Sheet 3

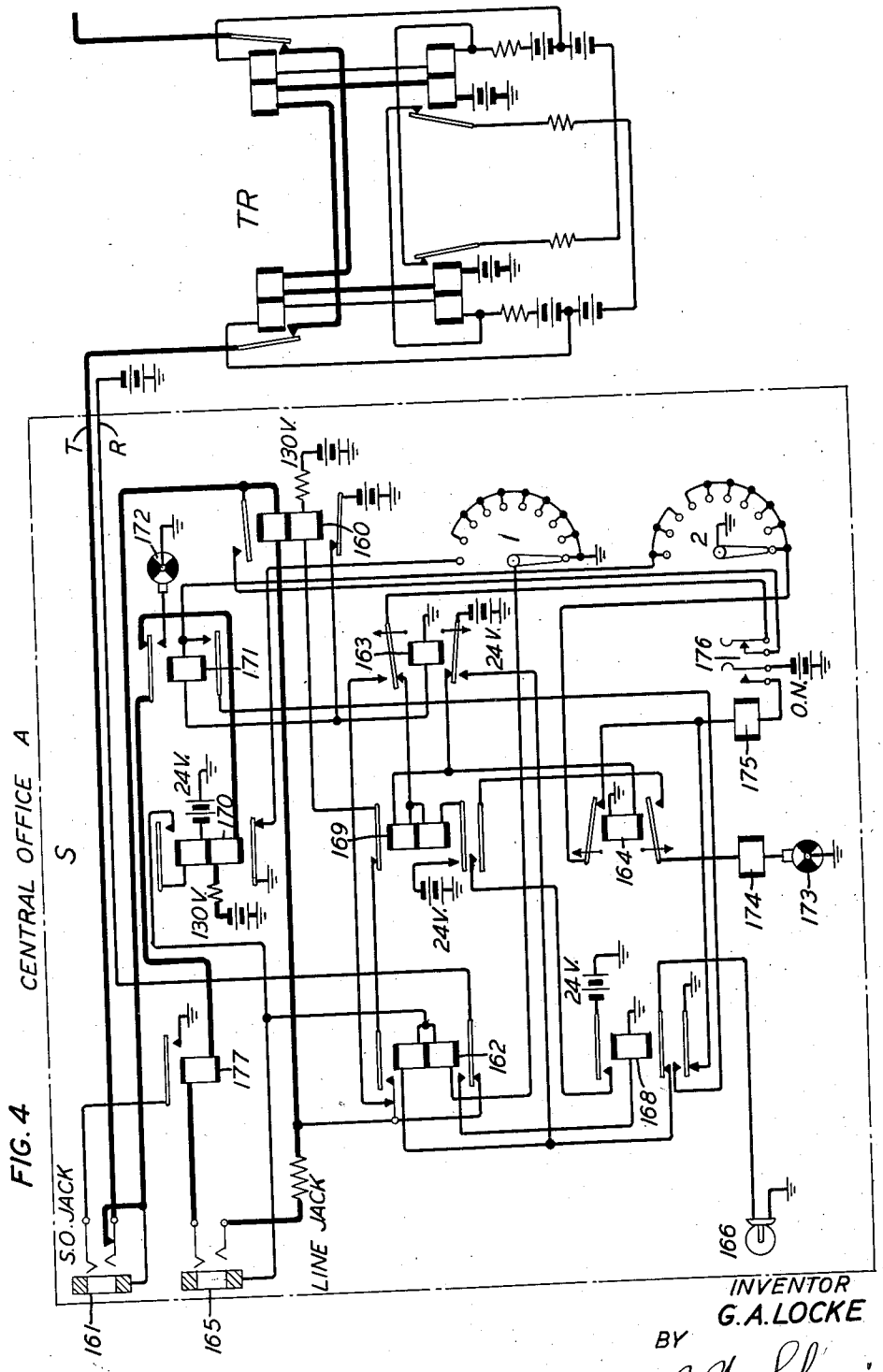

FIG. 4

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DISCONNECT SIGNAL

Filed May 19, 1932 4 Sheets-Sheet 4

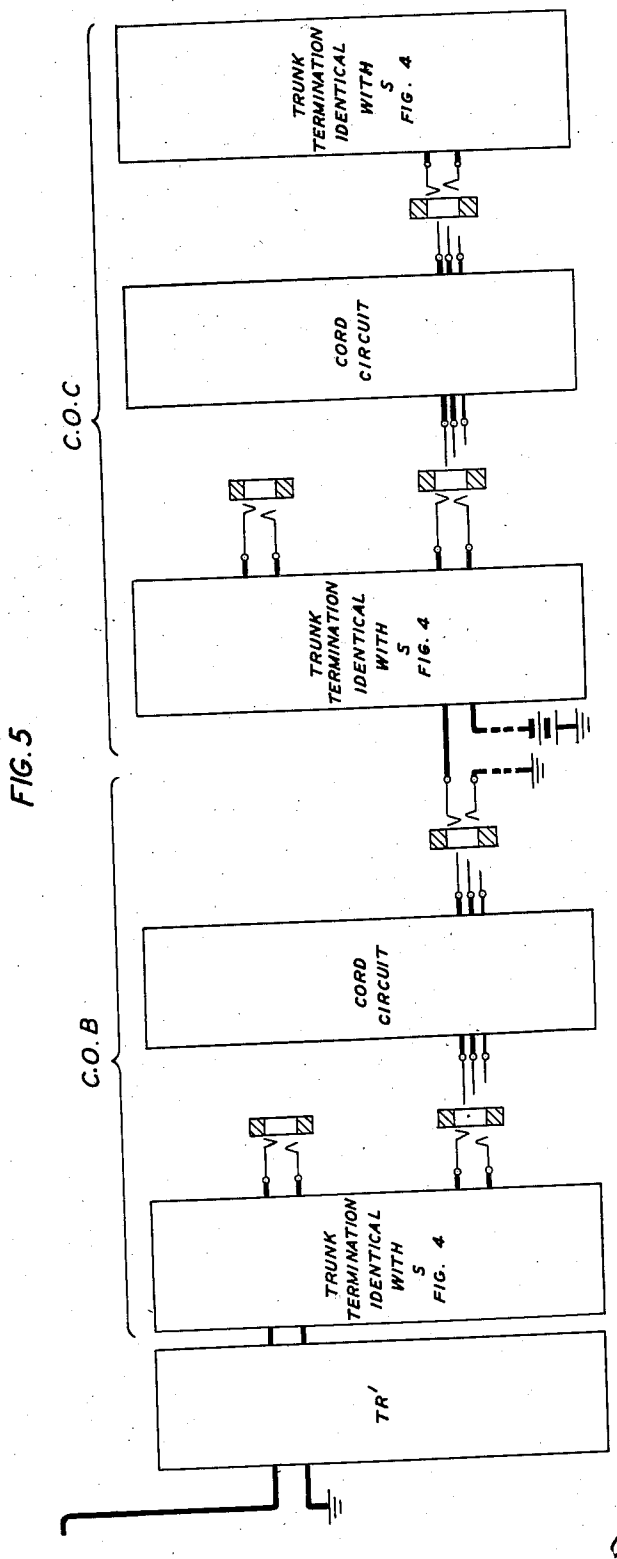

FIG. 5

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Patented July 3, 1934

1,965,421

UNITED STATES PATENT OFFICE

1,965,421

DISCONNECT SIGNAL

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Application May 19, 1932, Serial No. 612,226

7 Claims. (Cl. 178—2)

This invention relates to transmission systems and one of its general objects is to provide means for conveniently and effectively controlling a circuit condition for a predetermined interval of time. A more specific object is the provision of convenient and effective circuit arrangements for transmitting a disconnect signal over a telegraph circuit comprising several exchanges or switching points in tandem.

Telegraph systems in which two subscribers or operators are connected over long toll lines which in turn are connected at an intermediate exchange or repeater point, are known in the art. Assume, for example, a system in which two communicating persons, whom we may conveniently designate as subscribers, are located in New York and San Francisco, and are connected by a telegraph circuit which extends from the New York subscriber through the New York exchange over a trunk line to Chicago, then through a Chicago exchange over another trunk line to a San Francisco exchange and thence to a San Francisco subscriber. The toll lines may be of any known type and comprise telegraph or other repeaters. In communicating back and forth the subscribers employ the usual signaling impulses and furthermore, either subscriber may send a "break-in" signal of the usual kind which will ordinarily last for a few seconds or less. The usual disconnect signals by which the subscriber at New York notifies his local operator that he has terminated his communication would not give a disconnect signal to the Chicago operator, for example. This might result in tying up an expensive trunk line for some time until a Chicago operator monitored on the circuit to determine whether it was still busy. The giving of such disconnect signals is the problem with which the present invention deals.

This problem is solved by an arrangement which among other things transmits an open signal of relatively long duration, for example, ten seconds, although some other period, as for example, twenty seconds, might be used. The giving of a signal by opening the line for such a long period of time for example a period of ten seconds, will be spoken of herein as giving a ten-second disconnect signal.

A convenient manner of giving such a ten second disconnect signal involves the use of a selector arrangement which may be started into rotation by a special circuit condition. The actuation of this selector opens the circuit for the required time of ten seconds and thereafter the selector is restored to its normal position. Meantime, however, the disconnect signal has been given over the telegraph trunk line to the operator at a distant exchange.

Various systems embodying the broad principles of the invention may be devised and embodiments thereof are found in Vernam Patent 1,804,548, issued May 12, 1931 and in Locke-Kinkead application, Serial No. 459,684, filed June 7, 1930, the complete system of which the present applicant was one of the joint inventors. This present application is a continuation in part of applicant's application Serial No. 479,856, filed September 5, 1930. Applicant claims the benefit for priority purposes of each and every of the above mentioned patents and applications to whatever extent such benefit is legally obtainable.

Fig. 1 illustrates schematically a circuit arrangement for transmitting an open signal of ten seconds duration over a manual telegraph exchange system of the type disclosed in the Vernam U. S. Patent 1,804,548;

Fig. 2 comprises a modification of Fig. 1 and contains a supervisory lamp for indicating to the operator the initiation and the termination of the open signal; and

Figs. 3, 4 and 5 taken together illustrate features of the invention in connection with such portions of a telegraph system comprising manual exchanges as are necessary for an understanding of the invention.

Fig. 3 illustrates a subscriber's line circuit and a cord circuit of the exchange at which said line circuit terminates;

Fig. 4 illustrates one termination of a trunk which extends from the exchange comprising the cord circuit of Fig. 3 to a distant exchange; and

Fig. 5 illustrates in a diagrammatic manner additional central offices or exchanges connected by trunk lines extending to the final trunk termination located at the exchange adjacent the distant subscriber.

When an operator at a switchboard of a manual telegraph exchange system of the type disclosed in the Vernam patent, supra, desires to transmit an open signal of ten seconds duration over a circuit connecting two telegraph subscribers in communication with one another, the plug 1 of a cord circuit (Fig. 1) will be inserted into the L_2 jack, see Fig. 7 of U. S. patent to Vernam 1,804,548, May 12, 1931, of the busy trunk circuit. Since the trunk circuit and its associated apparatus may be of conventional type only the jack L_2 and telegraph line 29 are shown in the drawings. Current normally flowing over the communication circuit 29 will now flow over the S conductor

of plug 1 through the break contacts of relay 2 and back over the T conductor of plug 1. When, now the operator momentarily operates non-locking key 3, a circuit is completed from battery 4 through the winding of relay 2 to ground operating relay 2. Relay 2 in operating will lock up on a circuit traced over its left make contact, through the upper break contact of relay 5 to battery 6. The relay 2, in operating, opens the plug circuit at the contacts of relay 2, thus opening the communication circuit 29 which is connected in series with the plug circuit. The operation of relay 2 also completes a circuit to operate stepping magnet 7 on a path traced from battery 10 of interrupter 27 through the make contacts of relay 2, through the winding of stepping magnet 7, to ground. Interrupter 27 is of a well known type and is adapted to alternately open and close the stepping magnet circuit at approximate one second intervals. The first operation of magnet 7 will advance brush arm 8 of selector 9 one step and automatically close "off normal" contact 11, thus preparing a circuit which will be closed to lock relay 5 up when relay 5 operates. Stepping magnet 7 will advance brush arm 8 at one second intervals in response to the impulses transmitted by interrupter 10. When the brush arm of the selector makes contact with contact C—10 an interval of ten seconds will have elapsed and a circuit will be closed to operate relay 5 over a path traced from battery 12 through arm 8 and contact C—10, through the winding of relay 5 to ground, operating relay 5. Relay 5, in operating, locks up on battery through its make contact and through "off normal" contact 11, and also opens the holding up path for relay 2 which releases. The operation of relay 5 will now close a circuit to operate release magnet 13 which will function to restore selector 9 to its normal position and thereby open "off normal" contact 11. This path is traced from battery 6 through the upper make contact of relay 5 to ground through the winding of release magnet 13, operating 13. The opening of contact 11 will release relay 5 and restore the circuit to normal. The release of relay 2, as hereinbefore described, will reclose the communication circuit through plug 1. The communication circuit will now have been opened for an interval of 10 seconds between the T and S conductors of plug 1.

Fig. 2 is a modification of Fig. 1 and includes a supervisory lamp for indicating to the operator the opening and closing of the circuit. When plug 15 is inserted into a busy communication circuit for the transmission of the open signal, a circuit will be traced to operate relay 16 on a path traced from T of the plug through the "off normal" contacts 17, through the winding of relay 16 to S of the plug operating relay 16. The operation of relay 16 connects battery to light lamp 18, and prepares a circuit through the lower contacts of the relay to operate relay 21. When now, the operator momentarily operates non-locking key 19, a circuit is completed from battery 22 through resistance 23, operated contacts of key 19, lower front contact and armature of relay 16 and through the winding of relay 21 to ground. Relay 21 thereupon operates and immediately locks up to battery through its lower inner armature and front contact. The operation of relay 21 closes an operating circuit for the stepping magnet 20 of selector switch 28. This circuit is traced from battery 22 through the winding of magnet 20, lower outer front contact and armature of relay 21 to ground through interrupter 24. Interrupter 24 is adapted to alternately open and close its circuit for approximate one second intervals. The first operation of stepping magnet 20 will advance brush arm 25 of selector switch 28 to contact C—1 and automatically actuate off normal contacts 17 thus opening the communication circuit and releasing relay 16, which in turn causes lamp 18 to be extinguished. Selector switch 28 will now continue to step around in a manner hereinbefore described in connection with Fig. 1.

It will be noted that during the entire period that the selector switch is being stepped around, the circuit is opened between the T and S conductors of plug 15. Lamp 18 thus remains extinguished and a break signal is continuously transmitted over the trunk circuit to the distant end. When the selector switch reaches contact C—10 which is reached at its 10th step ground on the brush arm thereof will short-circuit the winding of relay 21 and cause its release. The release of relay 21 will close a circuit from ground on its upper break armature and contact through the off normal contacts 17, through the winding of release magnet 26 to battery 22, operating magnet 26 which in turn will restore selector switch 28 to normal and release off normal contacts 17. The restoring to normal of contacts 17 will reclose the communication circuit, causing relay 16 to reoperate and light lamp 18 as an indication to the operator that the break signal has been transmitted, whereupon she disconnects plug 15 from the L_2 jack of the trunk.

The duration of the transmitted signal may be changed at will by employing interrupters which are adapted to open and close a circuit according to any predetermined time interval desired or by varying the number of contacts on the rotary selector so that the brush arm takes more or less time to complete its travel.

The proper functioning of the circuit may be made to depend, in other arrangements, upon the automatic operation of a relay instead of the manual operation of a non-locking key.

Reference will now be made to the system of Figs. 3, 4 and 5. In this system a subscriber's instrument 101 is connected over a line to a jack 114 at a central office. The central office comprises a cord circuit certain elements of which are disclosed in Fig. 3, which cord circuit terminates in an answering plug 121 and a calling plug 122, which for the making of calls through distant exchanges or central offices will be plugged through the line jack 165 of a telegraph toll or trunk line. The trunk line comprises trunk terminating equipment generally designated as S which is connected to the trunk telegraph channel proper for terminal repeater TR. At the opposite end of the trunk line is another terminal repeater TR' and other trunk terminating equipment similar to S at the central office B which in turn is connected to the similar trunk line to the central office C whereat the trunk line is equipped with trunk terminating apparatus similar to S including a line jack 165.

If we should assume a circuit set up through the exchanges A, B and C connecting two subscribers for communication, each subscriber may send a disconnect signal to shut down not only his own set but also the distant subscriber's set by sending two shift signals on his printer equipment. Certain mechanism located in the subscriber's printer may also, in accordance with the usual practice, act to open the motor control circuits by sending or reception of such two shift

or other special signals. It is fully described in the application of Locke-Kinkead supra, how the sending of this special signal or the operation of a special key with which the subscriber is provided will produce a disconnect signal at his local exchange to inform the operator that communication has ceased.

In such case, however, no disconnect signal will be received as a result of the operations of either subscriber at an intermediate exchange such as the central office B and it is the purpose of the following description to describe the apparatus and method of operation whereby a disconnect signal is produced at the central office B by the operator at the central office A or by the operator at the central office C. It is to be understood that the manner of producing this disconnect signal over a telegraph trunk line is of general application in telegraph switching systems and its utility is not limited to situations in which three or more central offices are included in the circuit or situations in which the disconnect signal is given by a terminal central office to an intermediate central office.

The system about to be described comprises certain essential elements of the Locke-Kinkead system taken from their application previously referred to, and it is to be understood that full disclosure of said Locke-Kinkead application forms a part hereof to the same extent as though it were bodily incorporated herein.

For the connections, the cord circuit which is partially disclosed in Fig. 3 is employed. The same connecting cord functions equally well for connections over toll lines and the apparatus and operations involved in completing and disconnecting a circuit over such a toll line will now be described.

The circuit connection of one termination of a trunk circuit is shown in Fig. 4. It is only necessary to show the termination of the trunk circuit at one central office since it is identically terminated at each office between which it extends. Other central offices are connected by trunk circuits similarly terminated.

Referring to the drawings of Fig. 4 it will be noted that the equipment in box "S" is novel to the present invention whereas the terminal repeater units TR (Fig. 4) and TR' (Fig. 5) comprise standard telegraph equipment which, of itself, is known in the art. As illustrated, a telegraph channel connects both terminal repeaters, each of the latter in turn being connected to central offices A and B. The repeater unit may be of a known type such as disclosed in U. S. Patent 1,479,430, to J. M. Fell, dated January 1, 1924. Several repeaters may be used in tandem between the terminal repeater stations. Such case may occur when the length of line is very long. It is understood, of course, that metallic, open wire differential duplex, two-way polar, or carrier telegraph repeaters may be used. U. S. Patent 1,469,259 to B. P. Hamilton October 2, 1923 discloses a carrier telegraph arrangement which may be used in this circuit.

The call is initiated in the same manner as for a local connection. It may be assumed that the subscriber has signaled the central office and that the operator at the central office has responded by connecting her set to the jack of the calling subscriber's line through a cord circuit and has obtained the necessary information in regard to the called station. The operator has learned that the connection is to be completed over a toll line.

It is to be noted, at this time, that relay 160 of the toll line terminating equipment is normally operated on a circuit from positive battery in the telegraph repeater over the tip of the circuit, then through the contact of service observing jack 161, upper winding of relay 160, lower break contact of relay 162, back over the ring of the circuit to negative battery at the repeater. Relay 160, in turn, operates relay 163 from battery on the lower make contact of relay 160 to ground through the winding of relay 163. Relay 164 is also operated on a circuit from battery on the lower make contact of relay 163 to ground through the winding of relay 164. Relays 160, 163 and 164 are, therefore, normally held up.

After the operator has received the number of the called subscriber and learned that it is necessary to complete the call over a toll line, she inserts the calling cord into a toll line jack indicated as idle by the idle line indicator. The idle line indicator is a circuit well known in the telephone art and is, therefore, not shown on the drawings, since those skilled in the art would readily understand its application to the circuits disclosed. When calling plug 122 of the cord circuit is inserted in jack 165 a circuit is completed from ground on bank 1 of the selector wiper 1, through one winding of relay 162, sleeve of jack 165, over the sleeve of plug 122, through windings of relays 136 and 148 in the cord circuit, to operate relays 136 and 148 in the cord circuit and relay 162 in the toll line circuit. Relay 168 will then operate on a circuit from battery on the ring of the repeater, lower make contact of relay 162 to ground through the winding of relay 168. As heretofore described, in connection with a local call, relay 136 in the cord circuit, in operating, releases relay 147. Relay 147 is designed to be slow in releasing and a short interval of time of the order of slightly less than one second will elapse before the relay finally releases and closes the tip of the cord through to the repeater circuit TR. The interval of time during which the tip is kept open by slow release relay 147 is utilized to cause a calling signal on the toll line which is automatically given when a calling plug is inserted in a line jack. The open tip caused by the insertion of plug 122 causes relay 160 in the toll circuit at the distant central office "B" to release which in turn releases relay 163. The release of relay 163 also releases relay 164 at office "B". Relay 163 is designed as a slow release relay and the interval of time during which the tip of the cord circuit is kept open is made just long enough to allow relay 163 to release. The release of relays 160 and 163 at "B" will prepare a locking down circuit for relay 160 which may be traced from one side of the upper winding of relay 160 through the upper break contact of relay 160, upper break contact of relay 163, upper normal break contacts of relay 162 to the other side of the upper winding of relay 160. The lower winding of relay 160 is connected to ground through negative battery which prevents the battery from interfering with the transmission of signal impulses when connected to the line because it is connected to meet negative battery in the repeater TR. Relay 163 in releasing lights lamp 166 from battery on the lower break contact of relay 163 through the lower break contact of relay 168 to ground through lamp 166, thus lighting the line lamp at office "B" indicating to the operator at that office that office "A" is calling. The battery which lights line lamp 166 is also used to make the sleeve of the line jack 165 busy through the secondary winding of relay 162. The upper and lower windings of relay 162 are connected in opposition to prevent

the operation of the relay on a circuit from ground on selector 1. Relay 163 as heretofore mentioned, is a slow release relay so designed that slight pulses on the toll line will not give a false call, also that it will not be affected by printer signals or by a momentary withdrawal of the plug from the toll line jack.

The operator at central office "B" answers the call by inserting the answering plug of a cord circuit into the jack. Battery is present on the sleeve of the plug and on the ring of the plug while the tip of the plug is connected to ground through the winding of busy test relay 178. The insertion of the answering cord operates relay 162 in the toll line circuit from battery on the sleeve of the cord, through the winding of relay 162 to ground on selector 1. Sleeve relay 133 in the cord circuit also operates and applies negative battery to the tip of the cord. The operation of relay 162 will open the short-circuit around the primary winding of relay 160 and will complete a circuit to cause current to flow through the secondary winding of relay 160. Relay 160 will not operate at this time, since its windings are differentially connected and the flow of current in the primary and secondary windings act to oppose one another. The operation of relay 162 causes the operation of relay 168 on a circuit from negative battery over the ring from the repeater TR, lower make contact of relay 162 to ground through the winding of relay 168. The operation of relay 168 extinguishes lamp 166 by opening its lighting circuit. The operator at "B" then answers from her printer. These printer signals will not affect relay 160 since fluctuations in current due to the signals passing through both windings of relay 160 will affect the windings equally thus keeping the relay unoperated. When, however, the operator at office "A" replies, the circuit through the primary winding of relay 160 will be opened while current will still flow in the secondary winding of relay 160, thus causing the operation of relay 160 at office B. Relay 160, in turn, operates relay 163 which applies battery to operate relay 164. A circuit is now closed to operate relay 169 from battery on the lower make contact of relay 163, primary winding of relay 169 to ground on the lower outer make contact of relay 168, thus operating relay 169 and locking it up over battery through its lower inner make contact and secondary winding. The operation of relay 169 opens the circuit through the secondary winding of relay 160 allowing relay 160 to follow the printer signals. Relays 163 and 164 will remain operated during the printer impulse interval due to the slow release feature of relay 163.

Incidentally, at this point, it is well to bring out the fact that the insertion of the calling plug at originating office "A" causes the operation of relays 162 and 168 at "A" as hereinbefore described. The open tip caused by the slow release relay 147 in the cord circuit opens the operating path for relay 160 at the originating office "A" and relay 160 will release. However, since relay 163 is a slow release relay, a path is closed to operate relay 169, before relay 163 finally releases, on a circuit from battery on the lower break contacts of relay 163, winding of relay 169 to ground on lower outer make contact of relay 168. Relay 169 locks up over its own lower inner make contact. Relay 163 then finally releases and releases relay 164. When slow release relay 147 in the cord circuit finally releases, the tip of the cord is closed through and relay 160 reoperates, in turn, causing the reoperation of relays 163 and 164. The remaining details of the toll line circuit follow in a manner identical with that outlined for office "B".

It will be noted that if the operator at "B" removes her plug from the incoming trunk line circuit before receiving signals from office "A" that lamp 166 at office "B" will not be extinguished but will relight as an indication to the operator at "B" that the incoming call has not been answered. Upon reception of signals over the trunk from "A", lamp 166 at "B" will be extinguished as described hereinbefore.

The operator at central office "B" may then proceed in a similar manner to extend the call to central office "C".

If the connection is set up as previously described, an operator may simply pull her cord out of the toll line jack. This releases relay 162 in the toll circuit which restores the ring circuit to the tip, releases relay 168, which in turn releases relay 169. In accordance with this mode of operation the operator takes cognizance of a single lighted lamp as an indication to disconnect a toll circuit. Relays 160, 163 and 164 remain operated.

This manner of restoring a trunk circuit to normal is convenient and simple whenever a communication path is established over a single trunk circuit between two terminating central offices. However, if a built up communication circuit is established through several central offices and over several trunk circuits the operator at the through or intermediate office will not receive any disconnect indication whenever an operator at a terminating office simply pulls her cord out of the toll line jack. A ten second disconnect signal is therefore provided for indicating to the operator at the through or intermediate office that a subscriber has disconnected.

To send a ten second disconnect signal the operator at any central office which receives the calling subscriber's disconnect signal depresses non-locking key 151 in the cord circuit which is connected to the toll line jack. The resulting disconnect signal will automatically appear on all offices connected to the communication circuit. The operation of the non-locking key will apply 24 volt negative battery to the ring side of plug 122. Current now flows over the ring side of plug 122 which could not flow before because negative 130 volt battery was applied to both ends of the circuit. Relay 170 will therefore operate on circuit from 130 volt battery through its secondary winding, upper normal break contact of relay 171, through the winding of relay 177 to 24 volt negative battery on the ring of the plug. Relay 170 will lock up over its primary winding and upper make contact to ground on selector 1 through the winding of relay 162. The operation of relay 170 will remove the ground from its lower break contact from the tenth contact of selector bank 1. The operator will now remove the plug from the toll line jack circuit. Relays, 160, 163 and 164 will release since the removal of the plug opens the tip of the toll line circuit and releases relay 160 and opens the original operating circuit of relay 170. Relays 162, 168 and 169 will remain operated. A circuit is now closed for rotary magnet 174 through the break contact of relay 164, make contacts of relays 169 and 168 to battery. Rotary magnet 174 will be stepped around by interrupted ground 173 at the rate of one step per second, which is the rate of interruption for 173. When the wiper of selector 1 reaches the tenth contact the operating circuit for relays 162 and 170, which was heretofore closed, will now be opened, thus caus-

ing their release, in turn releasing relays 168 and 169. When relay 162 releases, battery over the tip of the loop from the repeater TR is reapplied to relay 160 causing it to operate, in turn, operating relays 163 and 164. Relay 168, in releasing, applies ground from its lower outer break contact through the winding of "release relay" 175 to battery through off normal contacts 176, the left contacts of which have been closed and the right contacts opened due to the selector being off normal. The selector will now return to normal. The circuit has, therefore, been opened for ten seconds and then closed.

It will be noted that the ten second disconnect signal may be transmitted over the answering cord also, by depressing non-locking key 155 in the answering side of the cord circuit whenever the answering plug is inserted in the toll line trunk circuit. This closes the ring of the answering plug to ground. Key 155, however, will not be used for this purpose in the circuit description herein described.

The above description of the disconnect feature applies to the transmission of the disconnect signal. The reception of a disconnect signal over the toll line is somewhat different.

To receive a disconnect signal, assume that the line is opened at the distant end by the depression of the non-locking key and the removal of the plug from the trunk circuit. At the near end relays 160, 163 and 164 will release but relays 162, 168 and 169 will remain operated because the plug at the near end is still in the toll line jack. Rotary magnet 174 will now function as hereinbefore described and will advance the selector. When the position of the wiper on bank 2 reaches the eighth point it will apply ground to relay 171. When the wiper of the selector reaches the tenth point, the ground for the winding of relay 162 will then be obtained from the lower break contact of relay 170 through the wiper of tank 1. The selector will remain this way until the line closes. When the line does close relays 160, 163 and 164 will operate. Relay 160 in operating will operate relay 171 from battery on its lower make contact through the winding of relay 171 to ground on bank 2. In operating, relay 171 will lock up on its lower make contact to ground from the lower outer make contact of relay 168. Relay 171 in operating transfers the ring circuit of the plug, which traces a path through line jack 165 and the winding of relay 177, to interrupted ground 172 on the upper inner make contact of relay 171. This circuit will flash the lamp 128 in the cord circuit over the ring of jack 165 at the rate of 60 flashes per minute. The circuit for the flashing lamp is traced from interrupted ground 172 in the toll circuit, ring of calling plug 122 (assuming that plug 122 is in jack 165 which will occur at the calling office) key 150, upper break contact of relay 138, through the winding of relay 149 to battery, operating relay 149 at intervals. Relay 149 applies ground from its upper inner make contact to light lamp 128 whenever relay 149 operates. If answering plug 121 is inserted in the toll line jack instead of plug 122, as at the called office, the interrupted ground will trace a path over the ring of cord 121, key 155, one winding of relay 156, winding of relay 157 to battery operating relays 156 and 157. Relay 156 will lock up on a circuit traced from negative 130 volt battery, lead T, normal contacts of operator's key 196, lead N, lower inner make contacts of relay 156, one winding of relay 156 to ground on the upper inner make contact of relay 133. The operation of relay 157 connects supervisory lamp 158 to the ring circuit through the upper make contact of relay 157, lighting lamp 158. When the interrupted ground 172 from the toll circuit flashes off for a slight interval, relay 157 will release and then lock down on a path traced from 130 volt negative battery on the upper inner make contact of relay 156, lower inner break contact of relay 157 through the winding of relay 157 to 130 volt negative battery on the other side of the winding. Lamp 158 will then be connected to an interrupted ground 179 which will flash 0.5 second on 0.5 second off on a path traced from the upper outer make contact of relay 156, upper outer break contact of relay 157 to battery through lamp 158. In the case of the answering plug, the flashing will originate in the cord circuit while in the case of the calling plug, the flashing originates in the toll line circuit and is transmitted to the cord lamp through the ring of the jack and plug.

Each operater observing the flashing lamp will pull the plug associated with the lamp out of the jack, or, if preferred, she may connect her teletypewriter machine to the circuit in the manner described in the Locke-Kinkead application mentioned and challenge on the line in order to verify that it is idle before disconnecting. A disconnect signal once appearing before an operator will continue until she takes cognizance thereof and disconnects the cord circuit from the associated trunk jack or otherwise suitably responds to the disconnect signal.

What is claimed is:

1. A telegraph system comprising a line connecting two exchanges and over which two telegraph subscribers may be connected for communication, means at each subscriber's station for transmitting impulses over said line and for opening said line to "break in" upon the other station when the operator thereat is transmitting and supervisory apparatus at one of said exchanges under the control of an operator for opening said line and for automatically closing it again after a predetermined interval after said opening which is long relative to the interval of any individual open circuit interval occurring during communication between said telegraph subscribers.

2. In a telegraph exchange system, a device for transmitting an open signal over a normally closed telegraph circuit for a predetermined interval of time, said device comprising normally closed contacts with means for serially connecting said contacts in a closed telegraph circuit, automatic switching means manually operable start means therefor, said switching means being responsive to current controlled by the operable start means for setting said switching means into operation to open said serially connected contacts for a predetermined time interval to transmit a break signal over said telegraph circuit, and an indicator associated with said device to indicate the reclosure of said contacts upon termination of said break signal.

3. A telegraph system comprising a plurality of central offices connected over trunk lines, each office being connected to the next adjacent over a trunk line for telegraph communication, arrangements at a central office whereby the trunk line extending to an adjacent office may be opened for a relatively long time as compared to the duration of printer impulses and break signals, and devices at the adjacent office responsive to said relatively long opening of said line to give a positive disconnect signal, said devices being

unresponsive to give a disconnect signal to shorter periods of opening said line.

4. In a telegraph communication system extending through exchanges, an arrangement for giving a supervisory signal at an exchange remote from the point from which the signal is to be given, comprising contacts connected with the telegraphic communication circuit, and devices for operating said contacts to change the condition of said circuit for a definite period of time comprising a stepper switch, an instrumentality for starting said stepper switch into operation, connections whereby said contacts change the condition of said line at the beginning of said operation, and connections whereby after the execution of a definite number of steps said contacts restore said line to its original condition.

5. A system in accordance with claim 4, including means for causing said stepper switch to step at an accurately predetermined rate.

6. A telegraph system including two or more toll lines, each toll line terminating in toll line terminating equipment including relays and a selector, a station for interconnecting said toll lines including an operator's cord circuit, said relays and selector being functionally unresponsive to normal printing telegraph impulses transmitted over said lines and cord circuit, said cord circuit including a telegraph repeater, a key and a disconnect signal circuit at said cord circuit, devices operable by said key to transmit to a distant terminal of a connected toll line a timed circuit condition longer than a printer impulse, said cord circuit repeater functioning to repeat said condition to the next adjacent toll line, and said selectors at each toll line termination stepping to energize said disconnect signal circuit at the cord circuit thereat upon the operation of said key.

7. A telegraph toll line circuit comprising a plurality of toll line equipments, telegraph transmission circuits therebetween, each toll line equipment including a stepping selector, a timing device for each stepping selector, an operator's key, a relay controlled to open said line upon the operation of said key and devices operable upon the opening of said line to cause all of said stepping selectors to step off-normal correspondingly, and a supervisory signal circuit energized upon the arrival of one of said stepping selectors to a particular off-normal position.

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