June 5, 1934. G. S. VERNAM ET AL 1,961,407

PRINTING TELEGRAPH SYSTEM

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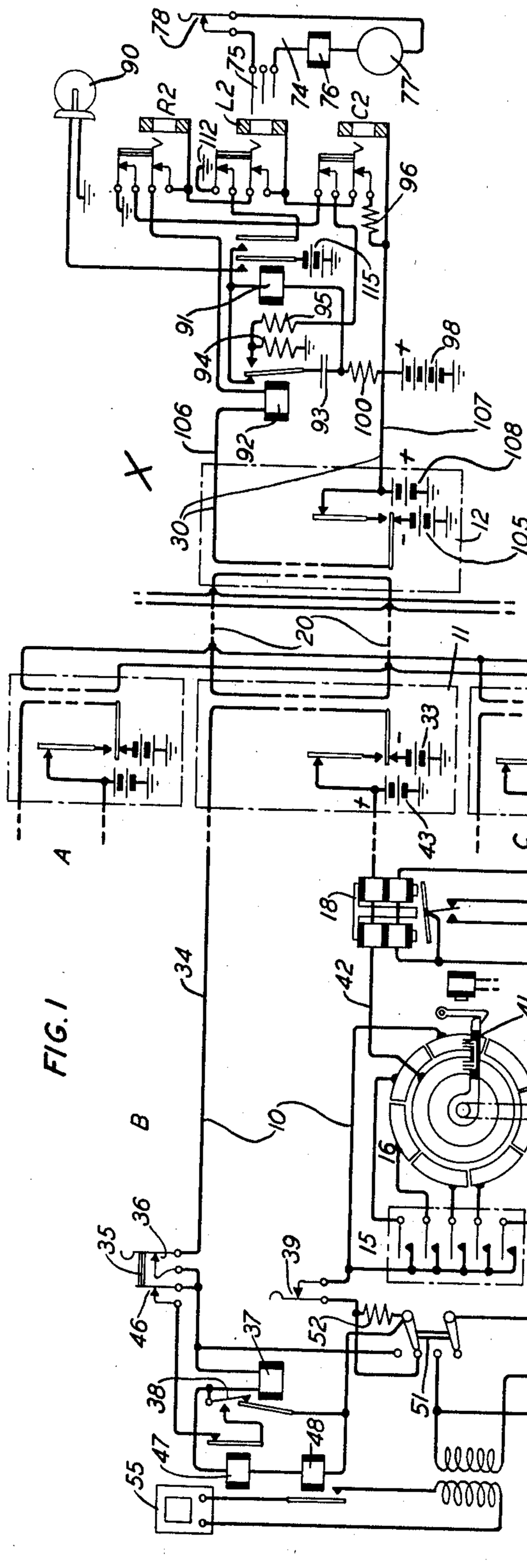

FIG. 1

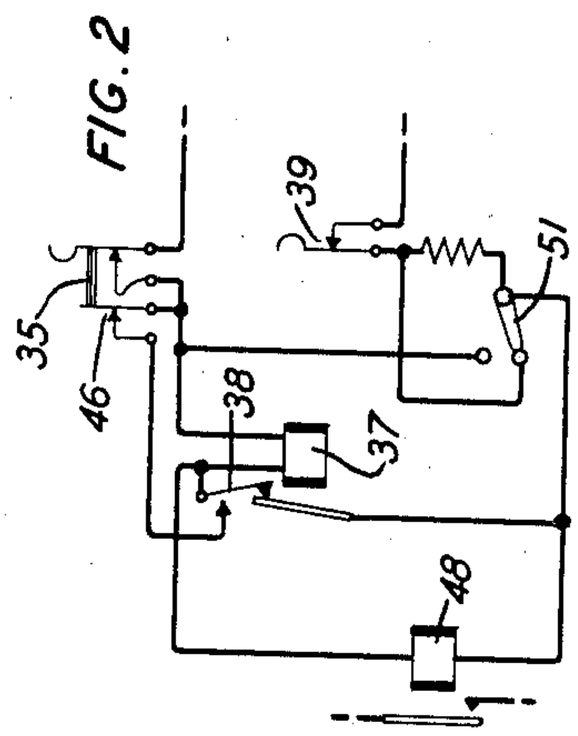

FIG. 2

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PRINTING TELEGRAPH SYSTEM

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10 Claims. (Cl. 178—69.6)

This invention relates to switching systems, and more particularly to such systems as applied to telegraph circuits, and discloses an exchange system applicable prinicipally to the use of printing telegraph equipment, by means of which connections may be established quickly and efficiently for communication purposes between any of a plurality of subscriber's 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.

An exchange system of the type above referred to is disclosed in the patent of G. S. Vernam, No. 1,804,548, granted May 12, 1931. In said prior patent a subscriber's station and a central office are connected thorough a normally open loop, and the subscriber, to initiate a call, may signal the operator by closing the circuit of said loop. Where the distance between the subscriber and the central office is short, the use of a normally open loop is economical. However, when the subscriber's station is removed from the central office by a long distance, it is more economical to connect the subscriber's circuit through a repeater to one channel of an open wire duplex, metallic or carrier frequency circuit. The usual carrier telegraph repeaters necessitates a normally closed loop between the subscriber's station and the first repeater, whereby the operator may signal the subscriber by opening the subscriber's loop.

Accordingly, an object of this invention is to provide a circuit extending between a printing telegraph subscriber's station and a central office, which may include one channel of a multi-channel system. In accordance with this object, both the central office and subscriber's station are connected to a repeater by a normally closed loop. The repeaters may be unattended and are adapted to connect the subscriber's circuit to the operator's circuit over one channel of a metallic, carrier or similar system.

Another object of this invention is to provide a signaling arrangement in a circuit extending between a subscriber's station and a central office whereby either the operator or the subscriber may signal the other for initiating a call, and whereby the subscriber may notify the operator when he has completed a conversation.

In accordance with the above and other objects, this invention comprises a subscriber's circuit normally closed and connected through a repeater to a central office. The subscriber initiates a call by means of a break key, with which he opens the loop for about one second. The opening and subsequent closing of the loop causes a lamp to light in the central office. Conversely, the operator may call the subscriber by means of a similar break key thereby starting a buzzer at the subscriber's station which may continue to vibrate until the subscriber responds by starting his motor. As an alternative arrangement, the buzzer may be energized for only a brief period.

A feature of this invention resides in a relay circuit for actuating the buzzer. The relay is provided with a locking arrangement whereby either the relay or the buzzer may be maintained in a deenergized condition. The relay armature is released upon the receipt of a break signal and is locked in this open position until the subscriber responds by starting his motor. During the time that the relay is locked in its open position and while the loop is closed, current from the loop is effective to actuate the buzzer. When the relay is in its closed position, however, the actuating means for the buzzer is short-circuited.

Another feature of this invention comprises a switching arrangement which permits current to flow normally through a relay which controls the operation of a buzzer, but which disconnects this relay from the loop and substitutes a resistance. The resistance is selected to be of such value that the impedence of the line is the same after the subscriber has answered as before.

Still another feature of this invention is a switching arrangement whereby the subscriber may notify the operator that he has completed a call. According to this arrangement the subscriber sends a break signal of about ten seconds duration. Means are provided to prevent the actuation of the buzzer in response to this break signal.

In the accompanying drawing,

Fig. 1 shows a telegraph system embodying one form of the invention; and

Fig. 2 shows a modified form of part of the circuit and apparatus at the subscriber's station of Fig. 1.

Referring to Fig. 1 an outlying subscriber's station B is connected to a central office or exchange X. At the substation B, telegraph transmitting and receiving apparatus, to be described subsequently, are connected in series with each other to form part of a half duplex loop circuit 10. Another half duplex circuit 30 at the cen-

tral office X is provided with jacks R2, L2 and C2, whereby the operator's telegraph set or other apparatus may be connected at will to form a part of the circuit 30. Circuits 10 and 30 are arranged so that during the time that the subscriber's set is not in use there is a normal flow of current in these two circuits.

A connecting circuit 20 provides a link between the subscriber's circuit 10 and the operator's circuit 30. The connecting circuit 20 transfers impulses or signals from the subscriber's circuit to the operator's circuit and vice versa in such manner that whenever a discontinuity occurs in either circuit 10 or 30 the current in the other circuit will correspondingly be interrupted. The connecting circuit may be any one of a number of types such as open wire, duplex, metallic or carrier frequency. For the purposes of the present invention, connecting circuit 20 will be described as a carrier frequency circuit, employing one channel for station B and other channels for stations A and C respectively.

In order to convert the half duplex direct current impulses to carrier frequency currents and conversely, a repeater 11 and a similar repeater 12 are provided at the respective terminals of connecting circuit 20. For a disclosure of a type of repeater suitable for the purposes of the present invention, reference is made to U. S. Patent No. 1,469,259, to B. P. Hamilton, dated October 2, 1923; and to the Vernam Patent 1,804,548 mentioned above.

Subscriber's apparatus

At the outlying station B is situated the following apparatus: A transmitting distributor 16 operated from a key board transmitter 15; a receiving relay 18; a receiving distributor 21 actuated by the receiving relay 18 and controlling a set of printer magnets 22; a motor 25 for driving distributors 16 and 21; an alarm device 55 responsive to a "break" signal transmitted by the operator at station X; a "break" key 39 for signaling the operator to initiate a call; a "disconnect" key 35 for signaling the operator to interrupt or terminate a call.

Subscriber's circuit

When the subscriber's set is not in use, the position of the apparatus is as illustrated in the accompanying drawing. Under these conditions, the loop circuit 10 is closed and may be traced as follows: Negative battery 33, repeating apparatus at the station 11, conductor 34, disconnect key 35, contact 36, winding of relay 37, contact 38, switch 51, break key 39, transmitting distributor 16, brush 41, conductor 42, main winding of receiving relay 18 and positive battery 43.

Connecting circuit

The carrier circuit 20 connects the subscriber's loop 10 with the operator's loop 30, which, as described subsequently, is normally closed. Carrier currents are transmitted in opposite directions over the line 20, in a manner described in the above identified patent to Hamilton 1,469,259. The result accomplished by the carrier line 20 and the repeating apparatus 11 and 12 is that when both loops 10 and 30 are closed a current flows through both. When either one of the loops is open the current is interrupted in both loops.

Apparatus—Central office

At the exchange X is situated the following apparatus: A repeater jack R_2 for connecting the circuit 20 to another carrier frequency circuit; a listening jack L_2 for connecting the operator's set 74 to the circuit 30; a connecting jack C_2 for connecting the circuit 30 with a direct current loop extending to another subscriber. The functions of the jacks R_2, L_2 and C_2 are substantially the same as those of the jacks bearing corresponding reference characters in the Vernam Patent 1,804,548 mentioned above. Other apparatus at the exchange X include a signal light 90 for notifying the operator that a subscriber wishes to initiate, interrupt or terminate a call; a relay 91 for lighting the lamp 90; a condenser 93 for energizing relay 91 in response to an interruption in the current in the loop 10; and resistances 94 and 95 determining the period of interruption necessary to charge condenser 93 and consequently energize relay 91.

Operator's circuit

The operator's loop 30 is normally closed and is traced as follows: Negative battery 105, repeating apparatus 12, conductor 106, winding of relay 92, non-operated contacts of jacks R_2, L_2 and C_2, resistance 96, conductor 107 and positive battery 108.

Initiation of calls by switchboard operator

When the operator at the exchange X desires to signal the outlying station B she inserts the plug 75 into the jack L_2, thereby connecting her printer set 74 to form a part of the circuit 30. The operator then presses the "break" key 78 thereby transmitting a break signal which may be about one second in duration. Breaking of the circuit 30 interrupts correspondingly the current in the subscriber's loop 10 and deenergizes relay 37. When the operator closes the key 78 current again flows through the loop circuit 10 but takes a different course than formerly. The path taken by the current after the interruption is as follows: Negative battery 33, repeater 11, conductor 34, contact 36, contact 46, break contact and armature of relay 47, break contact and spring 38 of relay 37, windings of relay 47 and 48, switch 51, break key 39, distributor 16, conductor 42, relay 18, and positive battery 43. Thus, the loop 10 includes the windings of relays 47 and 48, instead of relay 37 as normally. The operation of relay 48 closes a circuit for energizing the alarm device 55 during such time as the relay 48 remains energized.

In cases where the outlying station B is always attended, and where it is desired to continue the operation of the alarm device until the attendant answers, relay 47 may be omitted, and the armature and contact for that relay may be short-circuited. This modified form is shown in Fig. 2.

It is sometimes desirable, however, that the alarm continue only for a short interval of time, after the loop circuit 10 automatically restores to its normal position. Where such a mode of operation is desired, the restoring relay 47 is employed in the manner shown in Fig. 1. The purpose of the relay 47 is to remove the short-circuit from the winding of relay 37, which then reenergizes and breaks the circuit through relay 48. To this end, relay 47 is selected to be of the slow operating type, and the armature of relay 47 does not break contact until after relay 40 has

had sufficient time to actuate the alarm device 55.

To answer, the subscriber through the double-pole double-throw power switch 51, thereby starting the motors 25 and 54. Motor 25 drives the brushes of distributors 16 and 21, while motor 54 drives a generator 56 for supplying a biasing current to relay 18. Simultaneously the switch 51 short-circuits relays 37, 47 and 48 and substitutes a resistance 52 in the loop 10 to keep the loop current constant. The subscriber then transmits a signal, by means of the keyboard transmitter 15, which notifies the operator that he has responded to the operator's signal by starting his motor. The operator may then either converse directly with the subscriber, or connect the subscriber B with another calling subscriber through one of the jacks R_2 or C_2, in a manner described in the aforesaid Vernam patent.

Initiating calls at subscriber's station

When the subscriber B starts a call he first throws the switch 51 into operative position thereby starting the motors. Then, he operates the break key 39 to interrupt the current in the loop circuits 10 and 30 for a short period—say one second.

The effect produced at the exchange X by the break signal transmitted thereto will now be described. Since no plug is inserted in jacks R_2, L_2 or C_2 at the exchange X, relay 92 thereat is normally operated over the circuit traced from negative battery 105, repeating apparatus 12, conductor 106, relay 92, non-operated contacts of jacks R_2, L_2 and C_2, resistance 96, conductor 107 and positive battery 108.

Now, relay 92 controls the circuit for operating relay 91, which in turn controls the lighting of lamp 90. Associated with relay 92 are the condenser 93 and the resistance elements 94 and 95. While relay 92 is operated no charge can accumulate on condenser 93 since both terminals thereof are connected to battery 98, one terminal being connected directly thereto through resistance 100, and the other terminal being connected thereto through the winding of relay 91 and the front contact and armature of relay 92. When, however, relay 92 releases, as explained above, due to the reception of the break signal, the upper terminal of condenser 93 will be disconnected from battery 98 at the front contact of relay 92 and in place thereof will be connected to ground through the armature and back contact of the relay and through resistance elements 94 and 95 in parallel. As a result, while relay 92 is released, the condenser 93 will slowly charge up to the potential of battery 98, so that if the break signal is transmitted long enough the condenser will be fully charged to the battery potential when relay 92 is reoperated at the termination of the break signal. The equivalent resistance of elements 94 and 95 in parallel is such that for the circuit described the condenser 93 will be fully charged in about one-half to one second.

After the termination of the break signal, current again flows through loops 10 and 30, causing the reenergization of relay 92. The operation of relay 92 reconnects the winding of relay 91 across the terminals of condenser 93 so that the condenser discharges through the relay winding and operates the same momentarily. As soon as relay 91 thus operates it completes a locking circuit for itself. This circuit is traced from positive battery 98 through the winding, front contact and right-hand armature of relay 91 to ground 112 through non-operated contacts of jack L_2. Relay 91 upon operating, also connects battery 115 to light the lamp 90.

After the lamp 90 has been lighted the operator inserts the plug 75 into the listening jack L_2, communicates with the subscriber B, and establishes a connection to another subscriber, through one of the jacks R_2 or C_2 in a manner more fully described in the Vernam patent mentioned above.

To recall the operator

If during communication with another subscriber, the subscriber B desires assistance from the operator, he operates the disconnect key 35. The operation of this key opens the loop 10 and consequently the loop 30 for about eight and one-half seconds, causing the lamp 90 at the exchange X to light, in a manner to be described subsequently. The key 35 is arranged so that the contact 36 releases after the contact 46, and conversely recloses before contact 46. A key suitable for this purpose is described in U. S. Patent 1,155,640, issued October 5, 1915 to G. Brown. Recalling the operator requires a longer break signal than the one transmitted to initiate a call. The reason for the longer duration of the recall signal is that the condenser 93 charges more slowly when there is a plug inserted in any one of the jacks R_2 or C_2. During the time the subscriber B is communicating with another subscriber a plug is inserted in one of the jacks R_2 or C_2. Under these conditions ground is removed from the resistance 95, so that the condenser 93 can be charged only through the resistance 94.

Terminating a call

At the conclusion of a call, the subscriber B operates the key 35, and at approximately the same time shuts off the printer motors by throwing the switch 51. The operation of the key 35 opens the loop 10 and consequently the loop 30 for about eight and one-half seconds, in the same manner as when the subscriber desires to recall the operator. The contact 46 remains open for a longer period than the contact 36. The purpose of this arrangement is to energize relay 37 before the winding of this relay is short-circuited through the contacts 46 and 38. Thus, improper operation of the buzzer or alarm 55 does not occur whether the power switch be opened before or after the loop is closed. The switchboard operator challenges, and if no response is received, restores the circuit to its original condition by withdrawing the plug 75 from the jack L_2.

What is claimed is:

1. In a communication system, a signal device, a normally closed circuit adapted to be opened momentarily at a remote point, an actuating device for said signal device adapted to be energized by the current in said circuit, a relay in said circuit and adapted when energized to render said actuating device inoperative, and means for locking said relay in a deenergized position by shunting the winding thereof following a break of current in said circuit.

2. In a signaling system, a normally closed loop including a source of current, an alarm relay connected by means of the loop to said source of current, normally operated means actuated by the loop current for disabling the alarm

relay, and means responsive to an interruption of loop current for short-circuiting said disabling means, whereby subsequent closing of the loop energizes the alarm relay.

3. In a signaling system, a normally closed loop including a source of current, an alarm relay adapted to be connected by means of the loop to said source of current, a control relay normally operated by said source of current, said control relay having operated contacts for short-circuiting the alarm relay and non-operated contacts for short-circuiting the control relay, whereby the alarm relay is energized by the source of current in response to the opening and subsequent closing of the loop.

4. A signaling system comprising a local and a remote station connected to each other by a normally closed loop, said local station comprising a signal relay, means responsive to an interruption at the remote station of the loop current and the subsequent closure of the loop circuit for energizing the signal relay, means for transmitting a signal to the remote station by interrupting the loop current, and means for preventing the signal relay from becoming energized in response to the signal transmitted by the local station, said last means comprising a device for short-circuiting the signal relay.

5. A telegraph exchange system comprising in combination a subscriber's telegraph station, a central office connected thereto by one or more circuits, and having means for connecting said subscriber's station with a similar station, means at the subscriber's station and responsive to a temporary break in current at the central office for operating an alarm, means for breaking and reclosing the circuit at the subscriber's station whereby to signal the operator, and circuit control elements for preventing energization of the alarm in response to a break signal transmitted at the subscriber's station.

6. A printing telegraph system comprising a plurality of stations connected by a normally closed loop, one of said stations comprising an alarm relay adapted to be energized in response to the opening and the subsequent closing of the loop, a control relay normally included in said loop circuit and having operated contacts for short-circuiting the alarm relay, a key at said one station for transmitting a break signal to the other station and having means to prevent the energization of the alarm relay before the control relay is reenergized.

7. In a telegraph system, a normally closed circuit including a telegraph set and a relay connected in series, said relay being adapted to actuate a signal device in response to a temporary discontinuity of the current in said circuit, means for rendering said relay and signal device inoperative, said means comprising an impedance element having substantially the same impedance as the relay, and switching means for simultaneously short-circuiting the relay and connecting the impedance element in series with the telegraph set.

8. In a telegraph switching system, in combination, a switchboard and a subscriber's telegraph station, a normally closed loop circuit extending from said station to said switchboard, a signal operating device at said station, and a circuit controlling instrumentality at said station responsive to a temporary interruption and reclosure of the loop circuit for serially connecting said signal operating device in said loop circuit.

9. In a telegraph system, two stations, a communication circuit extending therebetween having a normal condition, a device at one station for changing said normal condition for a brief period of time, a relay at said other station actuated by changing said normal condition for said brief period of time, a source of current and a condenser controlled by said relay whereby said condenser is charged when said circuit is so changed, a device actuatable by the charge on said condenser upon restoration of said relay, said system being further characterized in this, that the connection of an extension circuit to said communication circuit at said other station operates means to vary the charging rate of said condenser whereby change of said normal condition for said brief period of time is insufficient to permit the charging of said condenser whereby the device actuatable by the charge on said condenser discriminates in its response to changes in said normal condition for brief periods of time as to whether said extension circuit is or is not connected to said line.

10. In a telegraph system, a line, a jack at which said line terminates, a condenser, means to charge said condenser upon interruption of said line, a device actuatable by said condenser upon reclosure of said line, a plug for insertion in said jack, and a device actuatable by insertion of said plug in said jack to so change the charging rate of said condenser that the charge on said condenser is effective or ineffective to operate said device upon a given duration of opening said line in accordance with whether said plug is or is not inserted in said jack.

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