Jan. 2, 1940. F. S. KINKEAD 2,185,851

SIGNALING SYSTEM

Filed Feb. 11, 1939

FIG. 1

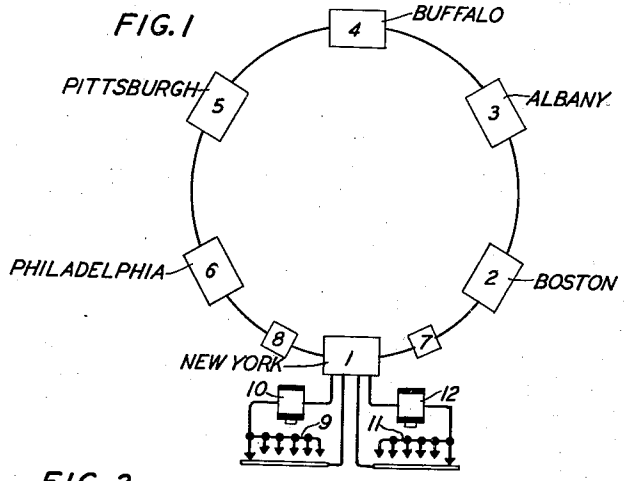
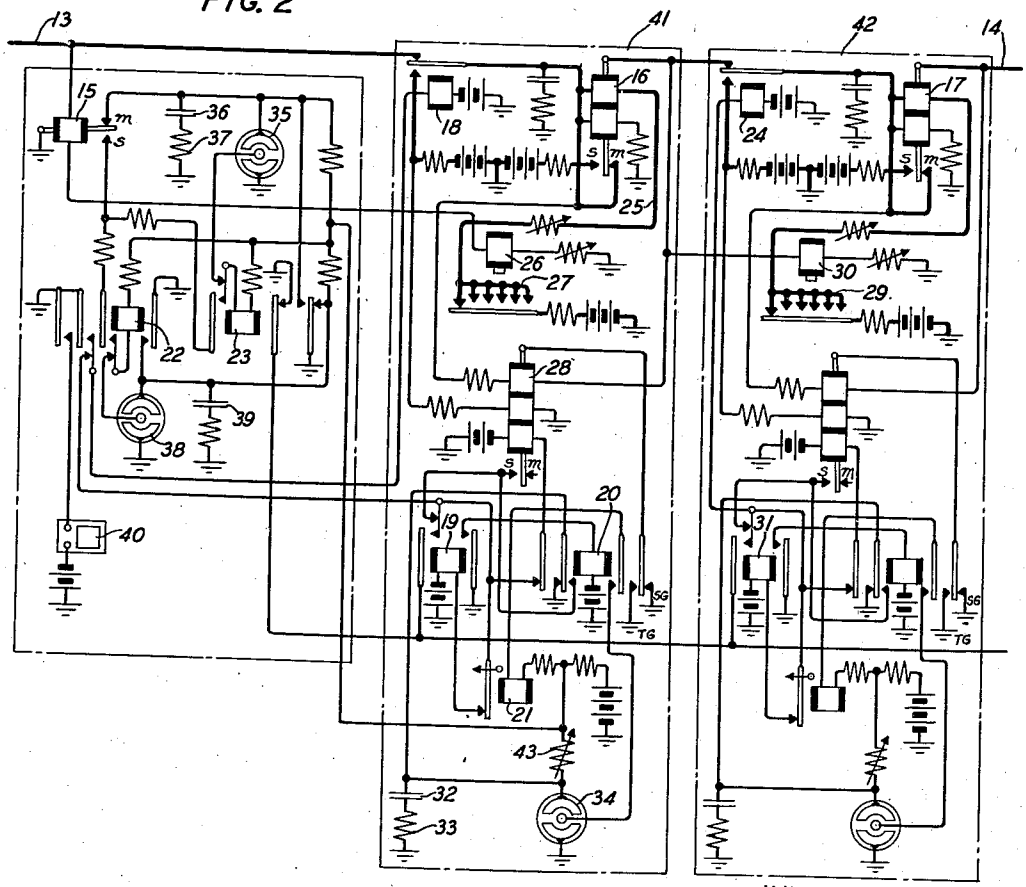


FIG. 2



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SIGNALING SYSTEM

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9 Claims. (Cl. 178—2)

This invention relates to telegraph systems and particularly to systems wherein a common transmission channel is provided for a plurality of stations, any one of which may broadcast messages into said channel for simultaneous reception by all of said stations. The invention is an improvement on the system disclosed in Patent 2,111,685 granted March 22, 1938, to C. R. Walker and is a specific improvement on the system disclosed in the application of Branson et al. filed on even date herewith.

In ring type circuits having even a measurable propagation, time signals transmitted at one point in the ring will traverse the ring and return to such point and since they are not synchronous at the incoming and outgoing terminals of the station forming such point, must be separated. Hence during transmission the normally closed connection between the incoming and outgoing terminals of the station circuit must be opened. Moreover, this open condition must be maintained for a period longer than the propagation time of the ring to prevent closure until after the last impulse has completely traversed the circuit in order to prevent the establishment of a traveling or stray signal which might otherwise continue to traverse the ring indefinitely. Heretofore this open circuit condition has been established manually and according to schedule or automatically under control of a slow-releasing means responsive to signals from the transmitting apparatus at the station. An object of the present invention is to provide improved means having more positive operating characteristics together with less expensive and more widely used standard components. Accordingly, a feature of the invention is a relay in a circuit responsive to signals from the transmitting apparatus which will open the normally closed circuit between the incoming and outgoing terminals and then positively lock up. Thereupon a separate timing arrangement comes into play and which will remain ineffective until transmission has ceased. After an interval which may be adjusted to be longer than the propagation time of the ring, this timing circuit will unlock and release the relay so that the connection between the incoming and outgoing terminals of the station circuit is restored to its normally closed state.

Another object of the invention is to provide improved means to respond to break signals and prolonged open circuit and spacing signals. Accordingly, a timing circuit is provided which is adjusted to respond to break signals and another timing circuit in cascade arrangement therewith is provided to give an alarm in case of an open circuit or extraordinarily long spacing condition.

Another feature of the invention is the use of trigger tube timing circuits making use of sturdy positive action trigger or cold cathode gas-filled tubes in circuits which can be readily and inexpensively adjusted to widely varying time intervals.

In the drawing,

Fig. 1 is a schematic representation of the complete system in which the invention is employed; and

Fig. 2 is a circuit diagram showing the details of a station circuit embodying the present invention.

In Fig. 1 there is shown a ring circuit including rectangles 1, 2, 3, 4, 5 and 6 which represent station circuits at as many different cities, such, for instance, as New York, Boston, Albany, Buffalo, Pittsburgh and Philadelphia. There is also shown in the circuit a rectangle 7 and another rectangle 8 which may indicate repeaters or other time consuming transmission apparatus. To each station circuit at the different points in the ring one or more separate stations may be connected. The pulsing contacts 9 and the magnet 10 represent in the usual form a teletypewriter station. The pulsing contacts 11 and the magnet 12 represent a similar station connected to the same station circuit 1.

In Fig. 2 the transmission line 13 enters the station and the transmission line 14 leaves it. The station circuit shown here comprises three parts, that to the left being the general circuits for the station and the part in the middle and that to the right illustrate the arrangements for two separate subscribers' connections. Under normal conditions the transmission line will be in the marking condition and consequently relays 15, 16 and 17 will be marking. With these relays on their marking contacts, relays 18, 19, 20 and 21 in the middle subscriber's connecting circuit will not be energized and the corresponding relays in the right-hand subscriber's connecting circuit will be in the same condition. Relays 22 and 23 in the master station circuit will also not be energized.

Normally, the circuit is completed from line 13 through the back contact and armature of relay 18, the marking contact and armature of relay 16, the back contact and armature of relay 24, the marking contact and armature of relay 17 to line 14. Marking current flowing in this

line also branches off through a circuit leading through the winding of relay 15 and the winding of selecting magnet 16 of the subscriber's station associated with the broken-line rectangle 41. The subscriber's pulsing contacts 27 of this station also connect to the transmission line through the upper winding of relay 16.

In a similar manner, the selecting magnet of the station represented by broken-line rectangle 42 is connected to the transmission line at a point between the armature of relay 16 and the back contact of relay 24, and the pulsing contacts 29 are connected to the transmission line through the upper winding of relay 17.

In general, the operation of these circuits is as follows: When transmission is being carried on at some remote station the selecting magnets 26 and 30 respond to the pulses flowing over the circuit from incoming conductor 13 to the outgoing conductor 14 and the teletypewriters at the stations represented by broken-line rectangles 41 and 42 respond thereto.

Now suppose that the subscriber at station 41 wishes to transmit. He operates his pulsing contacts 27, whereupon the relay 18 opens the line, leaving the receiving apparatus represented by the magnet 26 connected to the incoming terminal of the station circuit and the transmitting apparatus connected to the outgoing terminal of the station circuit. Thus the pulses sent by the contacts 27 will traverse the entire circuit and will be recorded at all of the teletypewriters around the ring and will finally affect those stations own receiving apparatus represented by the magnet 26. During the transmission of pulses by either of the stations 41 or 42 or by some one of the other stations in the ring or while a steady marking current flows, relay 15 performs no function. Its purpose will be referred to later.

Relay 28, one of which is supplied for each subscriber's line connection, has three windings. The current when flowing through either the upper or lower windings has greater effect than that flowing through the middle winding. Normally, however, with the armature of relay 16 in marking position there is no current through the upper winding since this is short-circuited by the marking contact of relay 16. Also, the same potential is applied to both leads of the lower winding and consequently the middle winding holds the armature to its marking position. When the subscriber opens his station circuit such, for instance, as by operation of the pulsing contacts 27, the armature of relay 16 moves to its spacing contacts. This applies plus battery to the outgoing line, which causes the movement of relay 17 to its spacing position and this in turn applies positive battery to the line 14 to denote a spacing condition beyond. Current now flows from the spacing contact of relay 16 through the upper winding of relay 28, causing its armature to move to its spacing contact. This applies signal ground from the outer right-hand armature of relay 20 to the back contact of the left-hand armature of relay 19 whence ground is extended through the back contact of the middle, left-hand armature of relay 22 to the winding of relay 18 and in parallel therewith through the armature and back contact or relay 21 to the winding of relay 19. Relays 18 and 19 operate and lock in a circuit from ground, the back contact and inner, right-hand armature of relay 23, the left-hand armature and front contact of relay 19 to the same circuit whereover relays 18 and 19 became energized.

Actuation of relay 18 connects steady battery to the marking contact of relay 16 so that the signals from the pulsing contacts of the subscriber's station are on a polar basis and the ring circuit backward toward line 13 is opened.

It should be noted that if a subscriber in the right-hand position, that is subscriber 42, were operating his pulsing contacts, then the relay 17 would respond and vibrate its armature between its spacing and marking contacts in accordance with the operation of the pulsing contacts 29. At the same time relays 24 and 31 would be actuated in a manner similar to the actuation of relays 18 and 19. Relay 24 would cut off the line so that the signals from the pulsing contacts 29 would not go backward to relay 16 but would have to traverse the entire ring circuit.

Actuation of relay 19 causes the operation of relay 20, thereby removing the ground connection from condenser 32. In series with condenser 32 is high resistance 43 which delays the charging of this condenser so that a time interval occurs before the voltage applied to the trigger tube 34 rises high enough to cause a flash-over.

The grid leak resistance 43 is adjustable so that the operation of tube 34 may be adjusted to be slightly greater than the propagation time of the entire ring circuit and since this may be different in different installations, then it is necessary that resistance 43 be on an adjustable nature. For example, if the resistance 43 is made to be 100,000 ohms the delay in the operation of tube 34 may be about .35 second and each 100,000 ohms added to this value will increase the delay by the same amount.

In order to avoid what may be termed "singing," it is necessary to maintain the cut condition at a station after the subscriber has ceased sending until the last spacing signal transmitted has traversed the entire ring. This means that relay 18 shall not be deenergized for a certain definite time interval after the contact of relay 16 is closed. This is achieved in the following manner.

Assume the cut condition to be established as described above. Condenser 32 will be discharged on each spacing signal through the application of ground via the spacing contact on relay 28 and the front contact and inner, left-hand armature of relay 20. When the armature of relay 28 goes to marking, condenser 32 becomes charged through a grid leak resistance 43 and when the voltage in the terminal of trigger tube 34 rises to a predetermined value the tube flashes and applies ground to relay 21, causing relay 21 to be operated. Operation of relay 21 deenergizes relay 19 which in turn removes the ground from relays 18 and 20 which become deenergized. Relay 18 therefore closes the ring circuit and relay 20 is restored to normal, which results in the application of ground to condenser 32 so that it will not be charged. Also, opening the circuit at the inner, right-hand armature of relay 20 causes the tube 34 to be extinguished. The timing of this delay circuit is determined by the value of the grid leak resistance 43 and the capacitance of the condenser 32 as above explained.

Means must be provided to enable any station on the ring to interrupt or break the sending station. This is achieved through relays 15, 23 and

the trigger tube 35 in the following manner. When relay 15 is in operating or when its armature is in the marking position, condenser 36 cannot become charged sufficiently to provide a high-enough voltage to flash the tube 35. When relay 15, however, is held in the spacing position by a break signal (prolonged spacing signal) incoming from another subscriber, tube 35 will flash, putting ground on the circuit through relay 23 which becomes operated. Relay 23 is then locked through its left-hand armature and front contact and the ground on the spacing contact of relay 15. At the same time, ground is applied to the upper terminal of the trigger tube 35 so that this becomes extinguished. Removal of ground from the inner, right-hand armature of relay 23 opens the locking circuit for relays 18, 19 and 20 and these three relays release. The release of relay 18 permits the breaking subscriber's spacing current to be repeated on to the next section, that is, plus battery is applied to both contacts of relay 16. Relay 28 will remain operated. As soon as the break signal has been completed and relay 15 moves to marking, relay 23 which was locked up through the spacing contact on relay 15 will be released.

If it is desired to give an alarm at the central office in the event of line trouble producing a prolonged space, this is achieved through relays 22 and 23 and trigger tube 38. The normal break intervals which actuate relay 23 are not of sufficient time duration to permit trigger tube 38 to be flashed. When a prolonged space occurs removal of ground at the outer, right-hand armature of relay 23 permits the condenser 39 to be charged, raising the voltage sufficiently to flash the tube 38. Application of ground by the actuation of tube 38 causes the operation of relay 22 which locks up through the spacing contact of relay 15, dismissing the tube 38. The outer, left-hand armature of relay 22 applies the ground to any type of alarm signal, here represented by a buzzer 40. A second ground at the middle, left-hand armature and front contact of relay 22 causes the actuation of relay 18 to break the ring and apply marking current to the marking contact of relay 16 so that the subscriber using the pulsing contacts 27 may transmit, if desired. When the trouble condition disappears and relay 15 goes to marking, relays 22 and 23 are deenergized, restoring the circuit to normal. Release of relay 22 restores relay 18 to the control of relays 28, 19 and 20, which is the normal condition.

What is claimed is:

1. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal, transmitting apparatus associated with said outgoing terminal, a relay for opening said normal connection between said terminals and a locking circuit therefor responsive to signals from said transmitting apparatus, and a timing arrangement including a trigger tube for opening said locking circuit and releasing said relay.

2. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal, transmitting apparatus associated with said outgoing terminal, a relay for opening said normal connection between said terminals, means responsive to signals from said transmitting apparatus for operating and locking said relay, a trigger tube for releasing said relay and means responsive to signals from said transmitting apparatus for connecting said trigger tube in a timing circuit, said trigger tube and said timing circuit being arranged to respond a predetermined time after cessation of signals from said transmitting apparatus.

3. In a signalling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal, transmitting apparatus associated with said outgoing terminal, a relay for opening said normal connection between said terminals, means including a locking circuit responsive to signals from said transmitting apparatus for operating said relay and a timing device for releasing said relay comprising a condenser and grid leak charging circuit therefor and a trigger tube responsive to a charged condition of said condenser, said condenser being maintained in a discharged condition by signals from said transmitting apparatus, said charging circuit being adjusted and arranged to charge said condenser to the point of operation of said trigger tube a predetermined time after the cessation of signals from said transmitting apparatus.

4. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal transmitting apparatus associated with said outgoing terminal, a relay responsive to signals from said transmitting apparatus for opening said normal connection between said terminals, a timing arrangement for releasing said relay a predetermined time after cessation of signals from said transmitting apparatus, and a timing device unresponsive to normal signals and responsive to a prolonged signal received over said incoming terminal for releasing said relay, said timing devices each including a condenser, a charging circuit for said condenser, and a trigger tube responsive to said condenser when charged.

5. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal transmitting apparatus associated with said outgoing terminal, a relay for opening said normal connection between said terminals and for conditioning said associated transmitting apparatus for effective transmission of signals into said outgoing terminal, means responsive to signals from said transmitting apparatus for operating said relay, means for locking said relay, a timing means made responsive to signals from said transmitting means by said locking means, said timing means being constructed and arranged to release said relay a predetermined time after cessation of signals from said transmitting means, a second timing means constructed and arranged to be responsive to a prolonged signal received over said incoming terminal for releasing said relay and a third timing means in cascade relation to said second timing means and constructed and arranged to be responsive to an abnormally long signal received over said incoming terminal for operating said relay.

6. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal transmitting apparatus associated with said outgoing terminal, a relay for opening said normal

connection between said terminals and for rendering said transmitting apparatus effective for transmitting signals into said outgoing terminal, means responsive to signals from said transmitting apparatus for operating said relay, a locking circuit for said relay, means responsive to signals from said transmitting apparatus for effectively connecting a first timing circuit to said transmitting apparatus, said first timing circuit operating to release said relay a predetermined time after the cessation of signals from said transmitting apparatus, a second timing circuit responsive to a longer-than-normal signal received over said incoming terminal for releasing said relay and a third timing circuit in cascade arrangement to said second timing circuit and responsive to an extraordinarily long signal received over said incoming terminal for operating said relay and for operating an alarm, said timing circuits each comprising a condenser, a charging circuit therefor, and a trigger tube operable when said condenser attains a charged condition.

7. In a signaling system, a station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal transmitting apparatus associated with said outgoing terminal, means for opening said normally closed connection between said terminals during use of said transmission apparatus and a trigger tube timing circuit for closing said connection a predetermined interval after said use of said transmission apparatus, a trigger tube timing circuit responsive to a break signal for closing said connection and a trigger tube timing circuit responsive to a permanent spacing signal or open circuit on said incoming terminal for giving an alarm.

8. A signaling system comprising a one-way transmission circuit closed upon itself in a ring, a plurality of serially included station circuits and other transmission apparatus all combining to give said ring circuit a definite propagation time, each said station circuit having incoming and outgoing terminals normally connected for through transmission, receiving apparatus connected to said incoming terminal and transmitting apparatus associated with said outgoing terminal, a relay for opening said normally closed connection between said terminals, a locking circuit for said relay, a timing circuit for unlocking and releasing said relay, means responsive to signals from said transmitting apparatus for operating and locking said relay and for effectively connecting said timing circuit to said transmitting relay, said timing circuit being constructed and arranged to unlock and release said relay after a time interval longer than the said propagation time of said ring circuit after cessation of said signals from said transmitting apparatus.

9. A signaling system comprising a one-way transmission circuit closed upon itself in a ring, a plurality of serially included station circuits and other transmission apparatus, all combining to give said ring circuit a definite propagation time, each said station circuit having means for opening the ring thereat during transmission and a trigger tube timing circuit for closing the ring an interval longer than the said propagation time after transmission, a trigger tube timing circuit responsive to a break signal for closing the ring if open thereat and a trigger tube timing circuit responsive to a permanent spacing signal for giving an alarm at that station immediately following the condition causing said permanent spacing signal.

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