E. H. LONG.

SIGNALING SYSTEM.

APPLICATION FILED DEC. 6, 1911. RENEWED AUG. 11, 1913.

1,185,919.

Patented June 6, 1916.

2 SHEETS—SHEET 1.

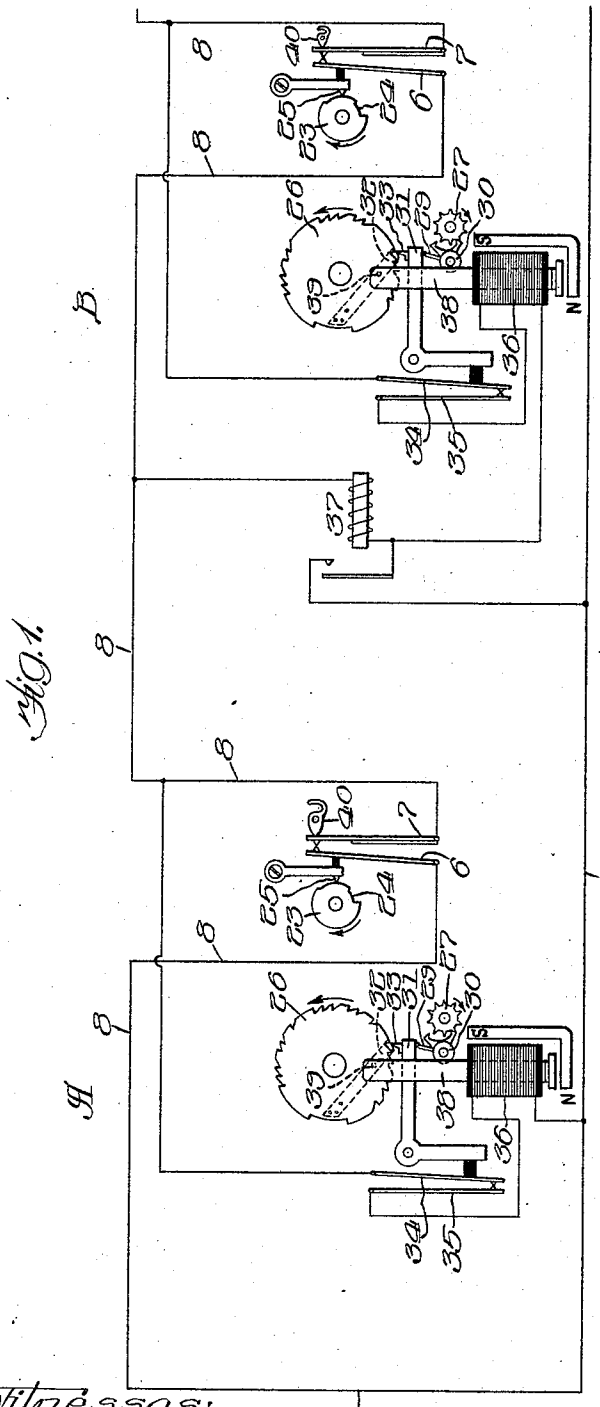


Fig. 1.

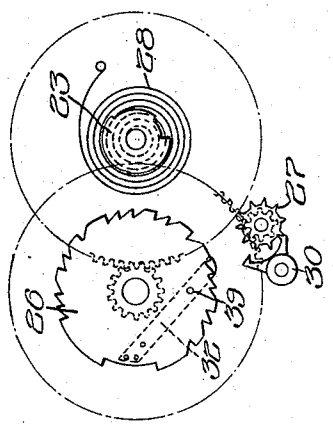


Fig. 2.

Witnesses:
Jno. H. Nelson Jr.
Edwin D. Nelson

Inventor:
Edward H. Long.
By G. L. Gragg Atty.

THE COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

E. H. LONG.

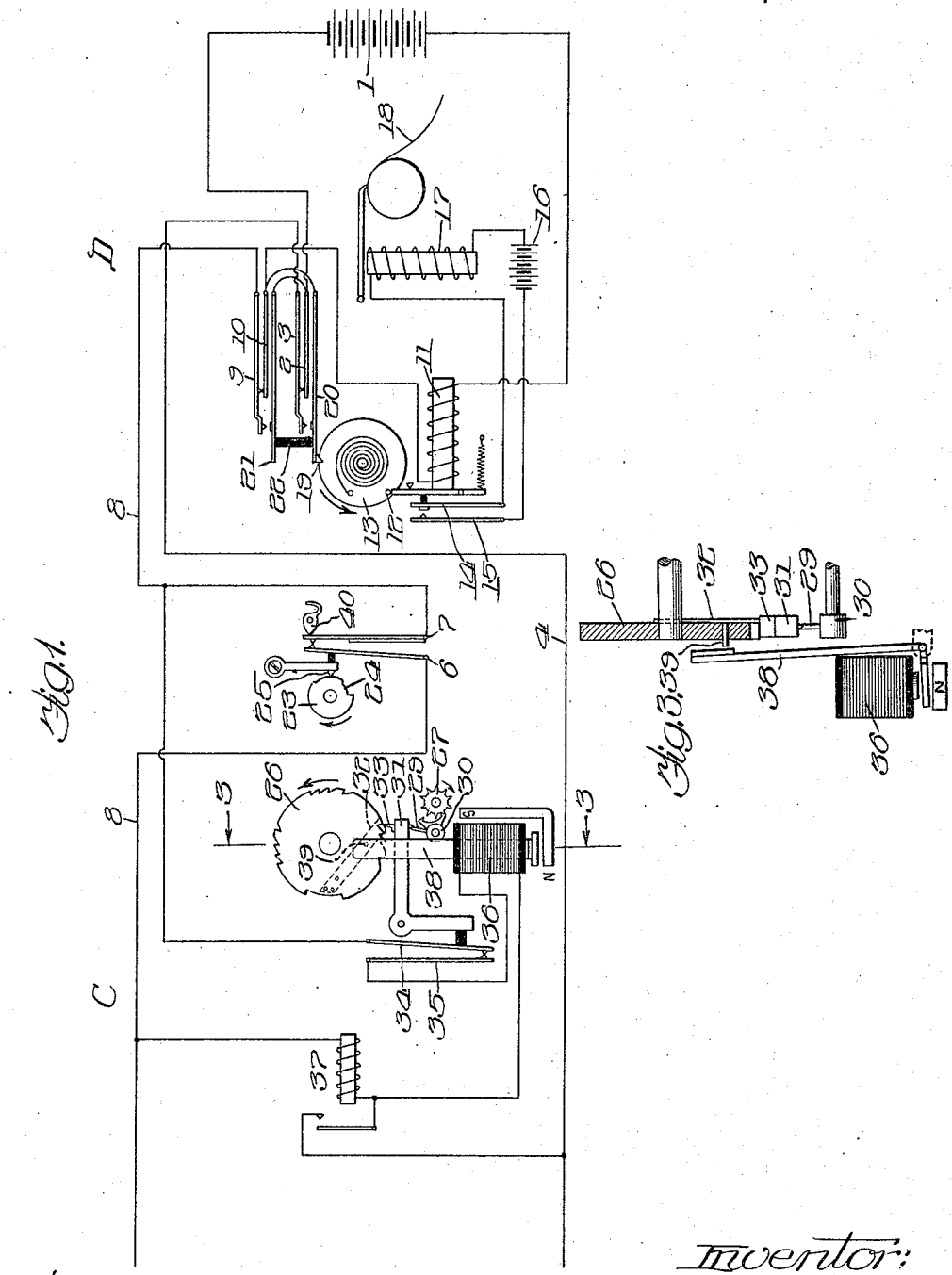
SIGNALING SYSTEM.

APPLICATION FILED DEC. 6, 1911. RENEWED AUG. 11, 1913.

1,185,919.

Patented June 6, 1916.

2 SHEETS—SHEET 2.



Witnesses:
Jno. H. Nelson Jr.
Edwin B. Nelson

Inventor:
Edward H. Long.
By G. L. Gregg
Atty.

THE COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EDWARD H. LONG, OF OAKLAND, CALIFORNIA.

SIGNALING SYSTEM.

1,185,919. Specification of Letters Patent. Patented June 6, 1916.

Application filed December 6, 1911, Serial No. 664,305. Renewed August 11, 1913. Serial No. 784,249.

To all whom it may concern:

Be it known that I, EDWARD H. LONG, a citizen of the United States, residing at Oakland, in the county of Alameda and State of California, have invented a certain new and useful Improvement in Signaling Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to signaling systems and has several objects and advantages in view, the prime object of my invention being to avoid the transmission of interfering signals over the line circuit and to prevent signaling stations later seeking the line from interfering with the use of the line by a station which has appropriated the line.

My invention has for its further object the provision of means for preventing false signals at the receiving station.

My invention finds a most useful embodiment in fire alarm or watch call systems, though it is not to be limited to such systems.

The specific embodiment of my present invention, to which I do not limit myself, is an improvement upon the system shown in my application Serial No. 497,840, filed May 24, 1909.

My invention will be fully explained by reference to the accompanying drawings showing the preferred embodiment thereof, but to which I do not wish to be limited, and in which drawings—

Figure 1 is a diagrammatic view of my improved system; Fig. 2 is a view, somewhat diagrammatic, illustrating a portion of the signal sending mechanism that may be used at a transmitting station; and Fig. 3 is a view, somewhat diagrammatic, also illustrating a portion of such signal transmitting mechanism.

Like parts are indicated by similar characters of reference throughout the different figures.

The system of circuits illustrated in Fig. 1 includes three transmitting stations A B C and one receiving station D which may be a fire alarm station. A source of current 1, preferably a storage battery, is located at the receiving station end of the line and current flows therefrom normally in a uniform direction. I speak of the battery 1 as being located at the receiving station end of the line meaning that it is interposed between the transmitting stations and apparatus at the receiving station. When the apparatus is idle, the polarity of the battery with reference to the line is predetermined and constant. Assuming the line to be idle, circuit may be traced from the upper pole of the battery 1 through the normally engaged contact springs 2, 3, the line side 4, the conductor 5 at the end station A, the normally engaged contacts 6 and 7 at station A, similar contacts 6 and 7 at station B, and similar contacts 6 and 7 at station C, the contacts 6 and 7 at the different stations being in serial relation with each other and being serially included in the line side 8, thence to the normally engaged contact springs 9 and 10 through the winding of the line magnet 11 back to the battery 1. The line magnet 11 is thus normally energized, its armature being normally positioned below a pin 12 carried by a spring motor operated wheel 13, the engagement of the pin 12 with the armature of the magnet 11 serving to hold the wheel 13 from rotation, for a purpose to be stated. The magnet 11, when thus normally energized, also serves to separate a contact 14 from a contact 15, these contacts 14 and 15 constituting terminals of a local circuit which includes a local battery 16 and the recorder operating magnet 17 employed for the purpose of printing signals upon a suitably operated tape 18. The battery 16 may supply other signal devices such as audible signal devices with current when desired and as is well understood.

The wheel 13 is provided with a notch that receives the nose 19 carried by a contact spring 20, whereby this contact spring, by its own resilience, is normally removed from engagement with the contact spring 3. The contact spring 20 is mechanically connected with a contact spring 21 by means of a distance piece 22, the resilience of this spring 21 coöperating with the resilience of the spring 20 normally to maintain the spring 20 out of contact with the spring 3 and also normally to maintain the spring 21 out of engagement with the contact spring 9. The contact springs 2 and 21 are permanently connected with one pole of the battery while the contact springs 10 and 20

are permanently connected with the other pole of the battery. Whenever the line circuit is opened, in a manner to be described, the magnet 11 becomes deënergized so that its armature is removed from engagement with the pin 12 whereupon the wheel 13 is allowed to rotate, the cam or nose 19 then being raised so as to ride upon the periphery of the wheel 13, the springs 20 and 21 being elevated during the time the cam 19 rides upon the periphery of the wheel 13 so that the springs 20 and 21 are brought into connection respectively with the springs 3 and 9 whereby the normal direction of flow of battery current no longer obtains, such current flow being reversed. The construction of the pole changing switch that includes the elements 2, 3, 9, 10, 20 and 21 is such that the springs 20 and 21 are engaged with the springs 3 and 9 in order to separate these springs 3 and 9 from their contacts whereby the circuit through the line relay 11, which is the initial signal receiving relay, is not broken by the mere operation of the pole changing switch, the relay 11 being preferably included upon the battery side of the pole changing switch. In this way a false operation of the recording magnet 17 is avoided when the current flow in the line is changed. In the arrangement illustrated the electromagnetic responsive device 11 is included in a momentarily established local circuit that includes the line battery and while the electromagnetic responsive device is preferably interposed between the pole changing switch and the line battery, I do not wish to be limited to that arrangement.

Hitherto the line relay 11 has been included on the line side of the pole changing or circuit changing switch located at the receiving station. The circuit changing switch, in reversing the battery connection with the line, momentarily deprives the line of current so that any apparatus on the line side of the pole changing switch, as such apparatus was hitherto arranged, would be deprived of current, whereby the line relay 11 would be falsely operated if it were upon the line side of the pole changing switch, a result which I avoid by locating the line relay upon the battery side of the pole changing switch. I consider it to be broadly new with me in any manner to prevent the effective response of the line relay 11 when the line circuit is open upon changing the current condition of the line, irrespective of the location of such relay or responsive device in the line circuit and irrespective of the particular agency that may be employed to prevent the responsive device from effectively responding.

As I have equipped the system, the battery is reversed for the purpose of preventing stations from appropriating the line portion that intervenes between the receiving station and a transmitting station that has appropriated the line, but I do not wish to be limited to the employment of a reversal of current for this purpose.

I will now describe the operations which ensue when a signaling system appropriates the line and I will assume that one of the intermediate signaling stations, station B, has taken the line as I will thereby be able readily to explain the manner in which a station between station B and the receiving station and stations beyond the signaling station B may be prevented from appropriating the line until the signaling operations which have been initiated at the station B have been completed. The party at station B will turn the wheel 23 in a counterclockwise direction by means of a handle so as to place the left hand end of the cam slot 24 in engagement with the nose of the rider 25. The rider 25 is carried by the contact spring 6 and the relationship of the contact springs 6 and 7 is such that the descent of the rider 25 into the cam slot 24 will be sufficient to cause the separation of the contacts 6 and 7. The cam wheel 23, the character wheel 26, and the escapement wheel 27 are connected by a train of gears that preferably permit the wheel 27 to run sixty times as fast as the wheel 23, and the wheel 26 to run six times as fast as the wheel 23. The one who transmits the signal, in turning the cam wheel 23, winds up a spring 28 so as to place this spring in readiness to operate the aforesaid train of gearing and cause the character wheel 26 to turn in a counterclockwise direction for the purpose of transmitting characteristic signals to the receiving station D to enable the attendant at this station to determine which signaling station it is that is sending in the signals. The spring motor 28 will not, however, operate at any station if signals are being transmitted from any other station, the spring motor 28 then being withheld from operation at any stations later seeking the line by means of a detent 29 fixed upon the escapement shaft 30, this detent at each later seeking and each idle station being engaged by one end of a bell crank lever 31 through the depressing action exerted upon this end of said bell crank lever by the normally positioned edge of the free end of a leaf spring 32 upon the nose 33 carried by the bell crank, the spring 32 being mounted upon the back of the wheel 26. Under the assumption which has been made, that the line is free to be appropriated by the signaling station B, the free end of the spring 32 at station B is deflected, by electro-magnetic mechanism to be described, so as to leave engagement with the nose 33 and permit the horizontal branch of the bell crank lever to rise thereby allowing the escapement to oscillate and permit the train of gearing to operate, the

contact spring 34, by its resilience, pressing the nose 33 toward the character wheel 26. The spring 28 so operates upon the train of gears that the character wheel 26 rotates in a counter-clockwise direction, the nose 33 rising and falling as it is maintained in engagement with the teeth of the character wheel by the spring 34. A contact 35 is normally in engagement with the spring 34, the contacts 34 and 35 both serving to establish one side of the line circuit during the time the contacts 6 and 7 are separated, these latter contacts being separated during the time that the rider 25 is in engagement with the cam groove or slot 24, which time of engagement is sufficient to allow the character wheel to cause the transmission of one complete signal known as the watchman's signal. During the time the contacts 6 and 7 are separated the contacts 34 and 35, which the contacts 6 and 7 previously shunted, are included directly in circuit, the contacts 34 and 35 being included in serial relation with the winding of a polarized magnet 36 and a relay 37 in the same side of the line circuit. Under the assumption that the line is initially idle when the watchman at station B endeavors to send in his signal, current from the battery 1 flows in normal direction which is such that the polarized magnet 36 may respond when the contacts 6 and 7 are first separated to cut in the contacts 34 and 35, the relay 37, and the magnet 36 and while the cutout switch comprising the contact switches 6 and 7 desirably shunt the elements 35, 36, 37 in order to cut them out, I do not wish to be limited to a switch for cutting out these elements 35, 36 and 37 that shunt the same. The armature 38 of magnet 36 will, when energized, press upon a pin 39 and cause this pin to deflect the free end of the leaf spring 32 out of engagement with the nose 33 upon the bell crank lever 31 with the results which have been previously described, it being understood that the contacts 34 and 35 are normally in engagement so that energizing current may be passed through the polarized magnet 36 just as soon as the contacts 6 and 7 are separated. The nose 33, riding upon one complete set of signal causing teeth of the character wheel 26, the set shown at the bottom of the wheel, will permit the spring 34 to move away from its companion contact 35 to break circuit through the magnet 11 as often as the nose 33 descends into a tooth space, to produce the characteristic signal upon the tape 18, or upon any other suitable signal receiver at the receiving station D.

I will now describe the manner in which a signal-station farther removed from the receiving station D than the station B which has appropriated the line, is prevented from interfering with the appropriation of the line by the station B and the signals which are transmitted to the receiving station from the transmitting station B. This result is accomplished by the relay 37, and its armature, at the nearer station B. The armature switch of the relay or magnet 37 is light and is tuned to a high rate of vibration, while the electro-magnetic responsive devices 36 are comparatively sluggish in their operation so that the slight impulses that pass through the relays 37 to cause these relays to close their armature switch contacts will not be sufficient to operate the sluggishly operating electro-magnetic responsive devices 36 at stations beyond. It is to be understood that I do not limit myself to electro-magnetic responsive devices 36 whose armatures are comparatively sluggishly moved, but that I use the term "sluggish" in the sense that the ultimate work performed by the magnet 36 (which work is the disengagement of the spring 32 from the nose 33) occurs at an appreciable time after a relay 37 receiving current at the same time with the magnet 36 closed its armature switch. The armature switch of magnet 37 at station B, by the rapidly intermittent closure of its contacts, causes current mainly to flow from station B directly to the line side 4 at this station, the circuit which is effective for enabling the operation of the line relay 11 terminating at the signaling station B, such circuit being traceable, in part, from the contact 35 through the contact 34, the winding of the polarized magnet 36, the armature switch of the magnet 37, the line side 4 to the line relay 11 at the receiving station D. It will be observed that the last station upon the line, station A, does not include a relay 37 since the function of such relay is to prevent stations beyond the signaling stations from interfering with the line. The watchman, or other operator, at station A may, however, set the apparatus at station A to enable it to appropriate the line when the signaling from station B has been completed. This is done by turning the cam wheel 23 at station A in a counter-clockwise direction to bring the rider 25 into engagement with the cam groove 24. When a set of character signals has been transmitted from station B to the receiving station D, the rider 25 engages the intermediate dwell of the cam wheel 23 to bring the contacts 6 and 7 into engagement whereby the contacts 34 35 and the magnets 36 37 serially related with the contacts 34 and 35 are shunted out of circuit so that the armature switch of relay 37 at station B no longer serves to divert current from the station A.

When the rider 25 at station B engages the intermediate dwell of the cam wheel 23, the wheel 13 at the receiving station D has reached its normal position, whereupon the contact springs 2 and 10 are reëngaged with the contact springs 3 and 9 so that current

may flow from the battery 1 in proper direction to operate the polarized magnet 36 at station A. It may be said, in passing, that the equipment at each of the stations at A, B, C is similar with the exception that the most remote station A does not require the magnet 37, and the parts at these stations which have similar functions are given similar characters of reference, it therefore being unnecessary to describe in detail the operation which occurs at each signaling station. When the contacts 34 and 35 are initially separated at the signaling station B, circuit through the magnet 36 at station A is opened (which is also the case with stations between the signaling station and the receiving station) so that no station can, during the separation of the contacts 34 and 35 at a signal transmitting station, receive current for its magnet 36 whereby interference is further guarded against.

I will now describe the means by which a station that intervenes between a signaling station and the receiving station D is prevented from appropriating a line and interfering with the signals that are being transmitted. For the sake of illustration, either of the stations A or B may be considered the signaling station that has appropriated the line, but inasmuch as station B was previously assumed as being the one which had appropriated the line, such assumption will be continued. The instant the line has been appropriated at station B, such appropriation occurring only upon the separation of the contacts 34 and 35 as will be understood by the previous description, the connection of the battery 1 with the line has been reversed owing to the movement of the wheel 13 at station D. If now the intervening station C should attempt to appropriate the line by effecting separation of the contacts 6 and 7 in the manner which has been described, current of the wrong direction for the operation of the magnet 36 at station C will flow through such magnet so that the switch contacts 34 and 35 at station C will not be separated whereby the signaling circuit extending to the station B and including the contacts 34 and 35 at station C is not disturbed. If the rider 25 at station C has been engaged with the cam dwell 24, the apparatus at station C will be set into operation just as soon as a set of character signals have been transmitted from the station B to the receiving station D, that is when the wheel 13 at the receiving station D has been returned to normal to permit of the reëngagement of the contact springs 2 and 10 with the contact springs 3 and 9 in the manner and for the purpose which was described in connection with station A. The apparatus is so arranged and is of such a nature that the contacts 34 and 35 at a station from which signals are being transmitted will remain apart during their first separation until the normal connection of the battery with the line has been removed so as to prevent any magnet 36 at other stations from being energized, when such other stations seek the line, during the interval of time when the battery is being changed from its normal connection with the line preparatory to its reversal.

If it should be desired to send in any extraordinary signal such as a fire alarm signal, suitable equipment may be employed for modifying the ordinary "watchman's" signal, such modification usually residing in multiplying such signal. To this end the normally stationary contact 7 may be made resilient and may be held normally stationary by means of a cam 40, which cam may be re-positioned when the extraordinary signal is to be transmitted so as to permit the contact spring 7, by its own resilience, to become separated from the contact 6 whereby the associate character wheel is permitted to turn until the rider 25 engages the outermost dwell of the cam wheel 23 whereupon the contact spring 6 is again brought into engagement with the contact spring 7 to shunt the magnet 36 and permit the character wheel 26 to stop when the detent 29 is brought into the relationship shown at station B. If it should happen that the signaling party at station C, or station A, should separate his contacts 6 and 7 after the first separation of the contacts 34 and 35 at station B and before the reversal of the battery current at the receiving station, then the party at station A or C cannot appropriate the line or interfere with the signals which are being sent from station B because the working circuit of the polarized relay 36 of the station seeking the line would be open at the contacts 34 and 35 at station B. To this end the nose 33 is adapted immediately to enter a tooth space when the associate magnet 36 has been operated so that the contacts 34 and 35 may be separated as soon as possible to prevent a station later seeking the line from appropriating the line or interfering with the signals that are being transmitted over the line.

As the equipment is preferably organized the relays 37 are quick acting relays, while the magnets 36 operate sluggishly in comparison to the relays 37. By this arrangement any relay 37, which closes its contact before the magnet 36 at any station beyond such relay disengages its associate spring 32 from the bell crank nose 33, will by virtue of such closed contact deflect sufficient current from such magnet to prevent its energization thereby to prevent such magnet from permitting the sending of signals from its station, to avoid the transmission of interfering signals from the stations of said relay and magnet. It is apparent that it is possible for the relay 37 at one station

to close its contacts after the relay at a station farther removed from the receiving station D has closed its contacts in a manner to appropriate the line, but inasmuch as the magnet associated with the nearer relay 37 that is later to act, operates with comparative sluggishness the magnet 36 at the farther station will have had opportunity to open the line at the farther station thereby to deprive the magnet 36 and the relay 37 at the nearer station of current so that interference will again be prevented. It will be observed that the armature switch of each relay 37 is connected between the winding of such relay and the side 4 of the line circuit so that such armature switch, when its contacts are closed, does not include the winding of the relay but rather excludes such winding so that the armature switch may have its contacts disengaged immediately following their closure. If the armature of relay 37 were connected at a point between the winding of the relay and the side 8 instead of at a point between the relay and the associate magnet 36, the armature of the relay would be locked immediately upon the initial energization of such relay, in which latter event the apparatus at a station beyond the station of such relay 37 (which apparatus had been operated at such time as to cause its spring 32 to be disengaged from the nose 33 before the opening of the associate contacts 34 35 and just when the closure of the contacts of the armature switch of relay 37 occurred at the nearer station) would be sending in its signal while the farther station would have its character wheel set into operation without sending in any signal, owing to the shunt connection established by the armature of relay 37 at the nearer station. In the proper operation of the system which is arranged for by means of my invention, the station nearer the receiving station would have the operation of its character wheel delayed until after the signals had been fully sent from the farther station, this result being due to the relative circuit arrangements of the relays 37 and their armature switches, and also to the fact that the magnet 36 of the nearer station does not have opportunity to release its associate character wheel as a consequence of the momentary initial closure of the contacts of the associate relay, the apparatus at the nearer station operating after the apparatus at the farther station has operated owing to the continued closure of the contacts 34 and 35 or the contacts 6 and 7 at the farther station after the apparatus at the farther station has performed its signal sending function at which time the battery at the receiving station has been restored to normal circuit relation with the line. I am thus enabled to permit both stations to send in their signals in succession instead of allowing one of the stations to lose its signal.

While I prefer to employ a polarized magnet and to change the circuit condition of the line by reversing the direction of the battery current for the purpose which has been described, yet I do not wish to be limited to the employment of polarized magnets, nor to the reversal of battery current.

While I have herein shown and particularly described the preferred embodiment of my invention it is obvious that changes may readily be made without departing from the spirit of my invention and I do not therefore desire to be limited to the precise details of construction and circuit arrangement shown, but

Having thus described my invention I claim as new and desire to secure by Letters Patent the following:

1. A signaling system including a transmission line extending from transmitting station to a receiving station; a source of current in closed circuit with the line, an electro-magnetically controlled pole changing switch whose operation is governed at the transmitting stations for reversing the polarity of the current in the line and which pole changing switch includes switch members connected with the battery terminals, these switch members having normal and alternate contacts, the alternate contacts being engaged with said switch members before the normal contacts are disengaged; and an electro-magnetic responsive device at the receiving station interposed between the source of current and the pole changing switch.

2. A signaling system including a transmission line extending from transmitting stations to a receiving station; a source of current in closed circuit with the line; an electro-mechanical switching device for changing the current condition of the lines; and an electro-magnetic responsive device at the receiving station in circuit with said source of current, said switching device being provided with means for maintaining flow of current through said responsive device when operating to change the current condition of the line and which responsive device is responsive to changes in the current condition of the line after the operation of the said switching device to change the current condition of the line.

3. A signaling system including a transmission line extending from transmitting stations to a receiving station; a source of current in closed circuit with the line; an electro-mechanical switching device for changing the current condition of the line; and an electro-magnetic responsive device at the receiving station in circuit with said source of current; there being means for

maintaining flow of current through said responsive device when the switching device operates to change the current condition of the line and which responsive device is responsive to changes in the current condition of the line after the operation of the said switching device to change the current condition of the line.

4. A signal system including a transmission line extending from transmitting stations to a receiving station; a source of current in closed circuit with the line; an electro-mechanical switching device for changing the current condition of the line; and an electro-magnetic responsive device at the receiving station in circuit with said source of current, there being means for including said source of current and said electro-magnetic responsive device in closed circuit when the switching device operates to change the current condition of the line and which responsive device is responsive to changes in the current condition of the line after the operation of the said switching device to change the current condition of the line.

5. A signaling system including a transmission line extending from transmitting stations to a receiving station; a source of current in normally closed circuit with the line; an electro-mechanical switching device for changing the current condition of the line; and an electro-magnetic responsive device at the receiving station in circuit with said source of current, there being means for preventing effective response of the electro-magnetic responsive device when the switching device operates to change the current condition of the line and which responsive device is responsive to changes in the current condition of the line after the operation of the said switching device to change the current condition of the line.

6. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current; and relays at the signal transmitting stations which operate quickly as compared with the effective operation of the said electro-magnets, the switch of each relay, when its station is sending signals, serving to shunt current from the electro-magnets of the distant stations.

7. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current; and relays at the signal transmitting stations which operate quickly as compared with the effective operation of the said electro-magnets and which relays at the signal transmitting stations also receive current from said source of current, the switch of each relay, when its station is sending signals, serving to divert current from the electro-magnets of the other stations.

8. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current, these electro-magnets being included in one side of the line circuit; and relays at the signal transmitting stations which operate quickly as compared with the effective operation of said electro-magnets and which relays at the signal transmitting stations are included in series with said electro-magnets and the side of the line in which said electro-magnets are included, said relays having switches for connecting the sides of the line circuit at stations from which signals are being transmitted to prevent the passage of sufficient current to operate the electro-magnet or electro-magnets at stations beyond the station from which signals are being transmitted.

9. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current, these electro-magnets being included in one side of the line circuit; and relays at the signal transmitting stations which operate quickly as compared with the effective operation of said electro-magnets and which relays at the signal transmitting stations are included in series with said electro-magnets and the side of the line in which said electro-magnets are included, said relays having switches for connecting the sides of the line circuit at stations from which signals are being transmitted to prevent the passage of sufficient current to operate the electro-magnet or electro-magnets at stations beyond the station from which signals are being transmitted, the connections that are establishable by the switches of the relays between the line sides excluding the windings of such relays.

10. A signaling system including a transmission line extending from a signal receiv-

ing station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current; relays at the signal transmitting stations which operate quickly as compared with the effective operation of the said electro-magnets, the switch of each relay, when its station is sending signals, serving to divert current from the electro-magnets of the other stations, said electro-magnets being responsive to the current normally upon the line; and means at the receiving station for effecting change in the current condition of the line to which current condition said electro-magnets are not responsive, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to change the normal current condition of the line to prevent stations later seeking the line from appropriating the line.

11. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current; relays at the signal transmitting stations which operate quickly as compared with the effective operation of the said electro-magnets and which relays at the signal transmitting stations also receive current from said source of current, the switch of each relay, when its station is sending signals, serving to divert current from the electro-magnets of the other stations, said electro-magnets being responsive to the current normally upon the line; and means at the receiving station for effecting change in the current condition of the line to which current condition said electro-magnets are not responsive, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to change the normal current condition of the line to prevent stations later seeking the line from appropriating the line.

12. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting device at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current, these electro-magnets being included in one side of the line circuit; relays at the signal transmitting stations which operate quickly as compared with the effective operation of said electro-magnets and which relays at the signal transmitting stations are included in series with said electro-magnets and the side of the line in which said electro-magnets are included, said relays having switches for connecting the sides of the line circuit at stations from which signals are being transmitted to prevent the passage of sufficient current to operate the electro-magnet or electro-magnets at stations beyond the station from which signals are being transmitted, said electro-magnets being responsive to the current normally upon the line; and means at the receiving station for effecting change in the current condition of the line to which current condition said electro-magnets are not responsive, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to change the normal current condition of the line to prevent stations later seeking the line from appropriating the line.

13. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current, these electro-magnets being included in one side of the line circuit; relays at the signal transmitting stations which operate quickly as compared with the effective operation of said electro-magnets and which relays at the signal transmitting stations are included in series with said electro-magnets and the side of the line in which said electro-magnets are included, said relays having switches for connecting the sides of the line circuit at the station from which signals are being transmitted to prevent the passage of sufficient current to operate the electro-magnet or electro-magnets at stations beyond the station from which signals are being transmitted, the connections that are establishable by the switches of the relays between the line sides excluding the windings of such relays, said electro-magnets being responsive to the current normally upon the line; and means at the receiving station for effecting change in the current condition of the line to which current condition said electro-magnets are not responsive, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to change the normal current condition of the line to prevent stations later seeking the line from appropriating the line.

14. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmit-

ting stations; a source of uni-directional current in normally closed circuit with the line; signal transmitting devices at the signaling stations including polarized electro-magnets for governing their operation; a switch at each of said signal transmitting stations for governing the circuit relation of the polarized electro-magnets at the other transmitting stations and adapted when operated at a signal transmitting station to prevent the magnets at other transmitting stations from being effectively operated; and means at the receiving station for reversing the direction of current in the line, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to prevent stations later seeking the line from appropriating the line.

15. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of uni-directional current in normally closed circuit with the line; signal transmitting devices at the signaling stations including polarized electro-magnets for governing their operation; a switch at each of said signal transmitting stations in circuit with the aforesaid source of current and serving to include said source of current in circuit with electro-magnets at other signaling stations, the switch at each station being adapted when operated at a signaling station to exclude the electro-magnets at other stations from circuit with said source of current; and means at the receiving station for reversing the direction of current in the line, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to prevent stations later seeking the line from appropriating the line.

16. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of uni-directional current in normally closed circuit with the line; signal transmitting devices at the signaling stations including polarized electro-magnets for governing their operation; a switch at each of said signal transmitting stations in circuit with the aforesaid source of current, these switches at the signaling stations being serially related with the electro-magnets at the different stations and with said source of current, these switches having their operation controlled by the electro-magnets at the same stations therewith and operating to open the circuit in which they are included when their associate electro-magnets are energized thereafter to exclude said electro-magnets from circuit with said source of current whereby the electro-magnets at other stations than the station from which signals are being transmitted are prevented from operation; and means at the receiving station for reversing the direction of current in the line, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to prevent stations later seeking the line from appropriating the line.

17. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of uni-directional current in normally closed circuit with the line; signal transmitting devices at the signaling stations including polarized electro-magnets for governing their operation and supplied with current from said source of current; relays at the signal transmitting stations which operate quickly as compared with the effective operation of the said electro-magnets, the switch of each relay, when its station is sending signals, serving to divert current from the electro-magnets of the other stations; and means at the receiving station for reversing the direction of current in the line, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to prevent stations later seeking the line from appropriating the line.

18. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of uni-directional current in normally closed circuit with the line; signal transmitting devices at the signaling stations including polarized electro-magnets for governing their operation and supplied with current from said source of current; relays at the signal transmitting stations which operate quickly as compared with the effective operation of the said electro-magnets and which relays at the signal transmitting stations also receive current from said source of current, the switch of each relay, when its station is sending signals, serving to divert current from the electro-magnets of the other stations; and means at the receiving station for reversing the direction of current in the line, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to prevent stations later seeking the line from appropriating the line.

19. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of uni-directional current in normally closed circuit with the line; signal transmitting devices at the signaling stations including polarized electro-magnets for governing their operation and supplied with current from said source of current, these electro-magnets being included in one side of the line circuit; relays

at the signal transmitting stations which operate quickly as compared with the effective operation of said electro-magnets and which relays at the signal transmitting stations are included in series with said electro-magnets and the side of the line in which said electro-magnets are included, said relays having switches for connecting the sides of the line circuit at stations from which signals are being transmitted to prevent the passage of sufficient current to operate the electro-magnet or electro-magnets at stations beyond the station from which signals are being transmitted; and means at the receiving station for reversing the direction of current in the line, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to prevent stations later seeking the line from appropriating the line.

20. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of uni-directional current in normally closed circuit with the line; signal transmitting devices at the signaling stations including polarized electro-magnets for governing their operation and supplied with current from said source of current, these electro-magnets being included in one side of the line circuit; relays at the signal transmitting stations which operate quickly as compared with the effective operation of said electro-magnets and which relays at the signal transmitting stations are included in series with said electro-magnets and the side of the line in which said electro-magnets are included, said relays having switches for connecting the sides of the line circuit at stations from which signals are being transmitted to prevent the passage of sufficient current to operate the electro-magnet or electro-magnets at stations beyond the station from which signals are being transmitted, the connections that are establishable by the switches of the relays between the line sides excluding the windings of such relays; and means at the receiving station for reversing the direction of current in the line, there being means at the signaling stations for operating the said means at the receiving station upon appropriation of the line to prevent stations later seeking the line from appropriating the line.

21. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in closed circuit with the line; signal transmitting devices at the signal transmitting stations including electro-magnets governing their operation and which are operatively responsive to the current normally flowing in the line; means at the receiving station for changing the current condition of the line to render said electro-magnets unresponsive to current flowing in the line, there being means at each signaling station serving, when its station is a transmitting station, to operate the means at the receiving station when the transmitting station has appropriated the line for the purpose of changing the current condition of the line to prevent other stations from interfering with the line during its appropriation; and means at each transmitting station operating, when its station has initially appropriated the line, to prevent the magnets at the other stations from responding during the normal current condition of the line that exists prior to the change effected in such current condition by the station that has appropriated the line.

22. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of uni-directional current in closed circuit with the line; signal transmitting devices at the signal transmitting stations including polarized electro-magnets governing their operation and which are responsive to the current normally flowing in the line; means at the receiving station for changing the direction of current in the line to render said electro-magnets unresponsive to current flowing in the line, there being means at each signaling station serving when its station is the transmitting station to operate the means at the receiving station when the transmitting station has appropriated the line for the purpose of changing the direction of current in the line to prevent other stations from interfering with the line during its appropriation; and means at each transmitting station operating, when its station has initially appropriated the line, to prevent the magnets at the other stations from responding during the normal current condition of the line that exists prior to the reversal of the current direction in the line that is effected by the station that has appropriated the line.

23. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of uni-directional current in closed circuit with the line; signal transmitting devices at the signal transmitting stations including polarized electro-magnets governing their operation and which are responsive to the current normally flowing in the line, these magnets being serially included in the line circuit; means at the receiving station for changing the direction of current in the line to render said electro-magnet unresponsive to current flowing in the line, there being means at each signaling station serving when its station is the transmitting station to operate the means at the receiving station when the transmitting station has appropriated the line, for the

purpose of changing the direction of current in the line to prevent other stations from interfering with the line during its appropriation; and means at each transmitting station operating, when its station has initially appropriated the line, to open the line circuit through the magnets to prevent the magnets at the other stations from responding during the normal current condition of the line that exists prior to the reversal of current direction in the line that is effected by the station that has appropriated the line.

24. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation; and means at each of said signal transmitting stations including line connected electro-magnets for operating the same and serving when operated instantly to shunt the current from distant stations.

25. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electromagnets for governing their operation; and a switch at each of said signal transmitting stations in circuit with the aforesaid source of current, these switches at the signaling stations being serially related with the electro-magnets at the different stations and with said source of current, these switches having their operation controlled by the electro-magnets at the same stations therewith and which electro-magnets operate instantly to open the circuit in which they are included and associate electro-magnets which are energized to shunt from circuit with said source of current the electro-magnets at distant stations than the station from which signals are being transmitted.

26. A signaling system including a transmission line extending from a signal receiving station to a plurality of signal transmitting stations; a source of current in normally closed circuit with the line; signal transmitting devices at the signaling stations including electro-magnets for governing their operation and supplied with current from said source of current, said electro-magnets being responsive to the current normally upon the line, means operated upon by the signal transmitting devices to transmit signals and instantly operated by an electro-magnet at a signal transmitting station instantly to deprive nearer stations of current to prevent them from being effectively operated; and means at the receiving station for effecting change in the current condition of the line, when appropriated at a transmitting station, to which current condition said electro-magnets are not responsive.

In witness whereof, I have hereunto subscribed my name this 1st day of December A. D. 1911.

EDWARD H. LONG.

Witnesses:
H. B. GRIFFITH,
EDWARD A. HOLMAN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents Washington, D. C."