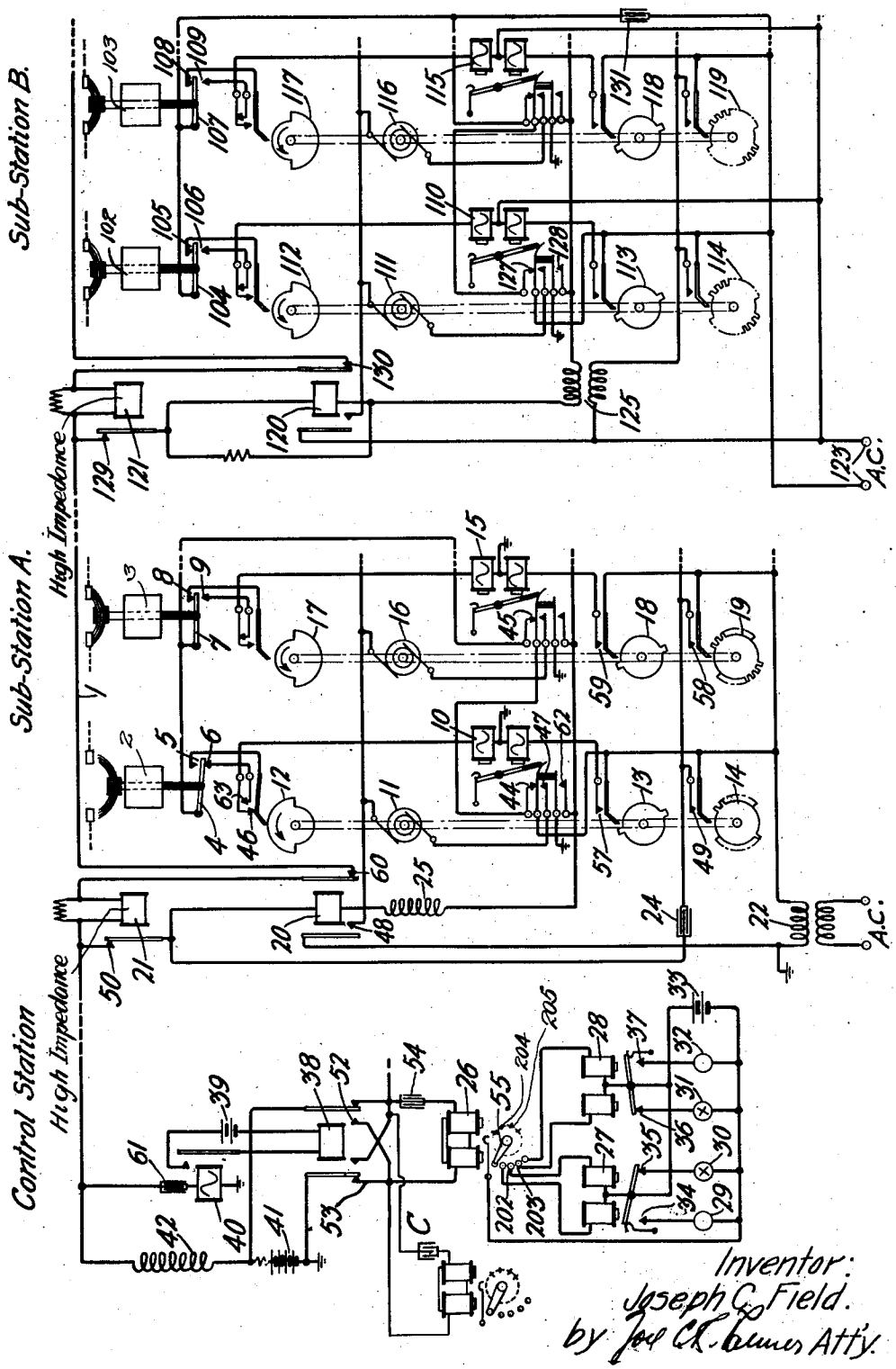
Nov. 17, 1925. 1,562,210

J. C. FIELD

SIGNALING SYSTEM

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SIGNALING SYSTEM.

Application filed October 7, 1921. Serial No. 506,163.

To all whom it may concern:

Be it known that I, JOSEPH C. FIELD, a citizen of the United States, residing at Orange, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Signaling Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to signaling systems, and particularly to such systems whereby indications may be transmitted automatically from one point to another.

It is common practice to employ signaling systems in conjunction with remotely controlled electrical apparatus such as, for example, semaphores or power switches, in order that the position of each piece of apparatus may readily be determined at the distant central office. In such systems it is highly important that the position of each apparatus be reported distinctly at the control station and that means be provided to prevent the signals interfering with each other. The method heretofore employed in systems of this type has been to provide a plurality of lines, one for the signaling means associated with each switch. The present invention, however, relates to systems containing a number of separate substations, each of which contains a plurality of switches, all connected with the central station by a single line.

It is an object of the invention to provide means whereby the position of a plurality of distantly controlled switches may be indicated automatically at a distant station.

A further object of the invention is to provide interlocking means which, in case a plurality of switches are operated simultaneously, insures that a distinctive answer-back signal is received at the central office from each switch operated, none of the answer-back signals being confused with the others.

It is a further object of the invention to provide means for obtaining a positive lock-out between two or more signaling means operating at the same time at a given substation.

Another object of the invention is to provide means for obtaining a lock-out between two or more signaling means operating at the same time at different substations.

Another object of the invention is to provide means whereby a plurality of signals transmitted at the same time from different substations will be received at the central station in the order of their proximity to the central station.

Still another object of the invention is to provide means whereby a plurality of signals transmitted at the same time from a single substation will be received at the central station in succession.

Other objects and features of the invention will appear from a consideration of the following description taken in conjunction with the accompanying drawing and the appended claims.

The drawing shows diagrammatically one embodiment of the invention, the reference letters A and B indicating a plurality of substations shown connected with a central control station C by means of the line wire 1. A plurality of semaphores or power switches 2 and 3 are located at the substation A, and a plurality of similar switches 102 and 103 are located at the substation B, these switches being controlled by manual operation or by any suitable remote control system, not shown in the drawing. The power switch 2 carries a contact 4 which is connected to a source of current supply, and is designed to engage with one or the other of contacts 5 and 6 allotted to this particular switch. The switch 3 carries a corresponding contact 7, adapted to engage with either of contacts 8 or 9. At substation B, the switch 102 is provided with a contact 104, adapted for engagement with either of contacts 105 and 106; while the switch 103 is provided with a contact 107 and associated contacts 108 and 109. Whether the contact 5 or 6 is engaged by switch contact 4, depends upon the position of the power switch 2. Similarly, the position of the switch 3 determines the position of its contact 7 with respect to its associated contacts 8 and 9, the same condition holding true for switches 102 and 103 at the substation B. The power switches are merely provided with additional contacts so that, upon the opening or closing, a circuit will be completed for effecting the operation of indicating mechanism as will be hereinafter described.

Associated with the power switch 2 is a mechanical locking relay 10 having two windings, a motor 11, and a cam shaft driven by the motor, equipped with three

cams, 12, 13 and 14, of insulating material. The power switch 3 has associated with it a corresponding relay 15, a motor 16, and a cam shaft equipped with cams 17, 18 and 19. Similarly, the power switch 102 has associated with it a relay 110, a motor 111, and cams 112, 113 and 114; while the switch 103 is provided with relay 115, motor 116, and cams 117, 118 and 119. Each substation on the line is provided with a relay similar to that shown at 20 in substation A, and at 120 in substation B, the operation of any of these relays, as hereinafter described, serving to break the signaling circuit of all the substations beyond. A line relay 21 is provided at station A and a similar line relay 121 is provided at station B, the operation of either of these relays serving to break the signaling circuit of its respective substation, the purpose of which will be hereinafter described. The relays 21 and 121 are of relatively high impedance in order to prevent the passage of alternating current therethrough. A resistance is provided in shunt of each of these relays for the passage of the alternating current. It is desired to prevent the passage of alternating current through these relays, since when direct current is passing through either one, so that it is operated, as hereinafter described, the passage of alternating current through it might release it and permit signals from its station to be impressed on the line and hence impress false pulses on the receiving apparatus at the central station. In the embodiment shown in the drawing the apparatus at station A is shown as operated from a source of alternating current supply, through the secondary of a transformer 22, while the apparatus at substation B is shown as operated from a separate source of alternating current 123. At substation A, the alternating current is shown connected to the line through the condenser 24 and retardation coil 25; and at substation B, the alternating current is shown operating through the transformer 125.

A plurality of selectors 26 are located at the central control station. These selectors are provided with code settings and are preferably of the type disclosed in Patent No. 1,343,256, granted to J. C. Field, June 15, 1920, but any other well known selector may be employed. Each selector 26 is adapted to control the operation of a pair of mechanically locking relays 27 and 28, the armatures of each of which control the circuits of a pair of electric lamps. It is customary to employ only four contacts in the type of selector herein described, and hence each selector is adapted to control the lighting of only four lamps, corresponding selectors being connected in parallel therewith to control the operation of other such lamps. Two lamps are required to indicate the position of a given power switch, one for the open and one for the closed position. For the sake of clearness, only the indicating apparatus for the substation A has been shown, the lamps 29 and 30 serving to indicate the position of the switch 2, and lamps 31 and 32 for indicating the position of the switch 3. One or the other of each of these pairs of lamps is normally lighted, current being supplied thereto by a battery 33, through the armatures of the relays 27 and 28, respectively, and either of the contacts 34 or 35 on the one hand, and either of the contacts 36 or 37 on the other. Thus, the attendant at the control station, by observing the lamp that is lighted, is informed of the position of any given switch. In practice, it is preferred to have the lamps 29 and 31 green, and the lamps 30 and 32 red. The lighting of a red lamp informs the attendant that a certain power switch is closed, while the lighting of a green lamp will indicate that a particular switch has been moved to the open position. The lighting of these lamps will be hereinafter described in detail. The selector 26, controlling the lamp circuits, is operated by a pole-changer 38, which, in turn, is operated by current from a battery 39 upon the operation of a relay 40. A battery 41 supplies current to operate the selectors 26 at the central station and also supplies current to the line 1 to operate the relays 20 and 120 at the various substations. The relay 40 is operated by the alternating current from any substation A or B, upon a change in the position of any power switch, as hereinafter described, the passage of the alternating current to the local direct current circuit being prevented by the retardation coil 42.

Since only the indicating lamps for substation A have been shown in the drawing, the following description will be largely directed to that station. The power switch 2 is considered to be open, the red indicating lamp 30 at the central station being lighted, as shown in the drawing. When the switch 2 is closed, contact 4 is moved into engagement with contact 5 completing an energizing circuit for the relay 10 which may be traced from the secondary of the transformer 22, through the contacts 44 and 45 of the relays 10 and 15, respectively, contacts 4 and 5 of the power switch, and an associated contact 46, through the uppermost winding of the relay 10 to ground. Since the relay 10 is of the mechanically locking type, it is retained in its operated position. Upon operating, the armature of the relay 10 opens the contact 44, cutting off the source of current to the relay 15 and all other similar relays at the same substation, not shown in the drawing. The operation of the relay

10 likewise closes the circuit of the motor 11 extending from source of current 22, contact 47 of the relay 10, through the motor 11, contact 48 of the relay 20, which is closed upon the operation of the mechanically locking relay 10, as hereinafter described, and thence to ground. As the motor shaft rotates, cam 14 closes the contact 49 twice in rapid succession, sending two series of alternating current impulses to the line 1 causing relay 40 to be energized and deenergized twice over a circuit extending from source of current 22, contact 49, condenser 24, armature and contact 50 of relay 21, condenser 61, through the winding of relay 40, to ground. Each energization of relay 40 causes it to attract its armature, completing a circuit for relay 38 extending from one side of battery 39, through the winding of relay 38, armature and contact of relay 40, to other side of battery. Each complete operation of the pole changer 38 energizes the operating winding of the selector 26 twice with currents of opposite polarities supplied by the battery 41 through contacts 52 when the relay 38 is energized and through contacts 53 when the said relay is deenergized. In this way, each closure and each subsequent opening of the contact 49 by the cam 14, operates the selector 26 once, serving to advance the brush 55 around one step. Since in the present case, two impulses have been sent across the line by the closing of the contact 49 at station A, the selector 26 will receive four pulses, the first three impulses advancing the arm 55 three steps to close the local circuit of the right hand winding of the mechanically locking relay 27 through the selector contact 202. This circuit extends from the positive side of battery 33 through right hand winding of relay 27, contact 202, selector brush 55, pin 204 on the selector wheel, catch spring 56 to the negative side of battery 33, thus energizing the right hand winding of relay 27. During the stepping operation of the selector, contact between catch spring 56 and the pins, such as 204, is made for only about .005 second, which is not long enough to cause the operation of the relays, such as 27 or 28. Contacts 202, 203, etc. are spaced about the selector wheel in accordance with the particular code setting of the selector. Cams 14, etc. are arranged so that the last impulse sent is longer than those preceding it. This long impulse fully charges condenser 54, so that no current is thereafter permitted to flow through the selector windings. Its operating armature, therefore, returns to normal, permitting catch spring 56 to engage pin 204 and hold the wheel in position, while the corresponding winding of relay 27 is energized as explained above. When the long pulse is discontinued, that is, when contact 49 is broken through the continued rotation of cam 14, relay 40 is deenergized, which in turn deenergizes pole changer 38, closing contacts 53, advancing the selector wheel one step, and throwing the catch spring 56 out of engagement with pin 204, thereby permitting the selector wheel with the brush, etc. to return to its unoperated position, as more fully explained in the patent mentioned before. This energization of the relay 27, described above causes the armature to be drawn over to the contact 34, opening the contact 35. The opening of the contact 35 breaks the local circuit of the lamp 30, extinguishing the lamp, at the same time establishing a circuit which may be traced from one side of battery 33, lamp 29, contact 34, and the armature of the relay 27, back to the other side of battery, thus lighting the lamp 29. The lighting of the lamp 29 informs the attendant at the central station that the power switch 2 at the substation A is in the normal or open position. Upon the completion of one-half a revolution, cam 13 closes contact 57 at the station A, establishing a circuit extending from source of current 22, contact 57, through the lowermost winding of the relay 10 to ground. This operation of relay 10 restores its armature to the position shown, breaking the motor circuit through the contact 47, thus stopping the motor 11. The cams 12, 17 and all similar cams are adapted to control the respective relay energizing circuits. The circuit previously traced for the relay 10, for example, extends either through switch contacts 4, 5 and 46 or else through contacts 4, 6 and 63. The cam 12 is so mounted on the cam shaft of the motor 11 that it is in the up position shown in the drawing when the switch contact 4 is down, and at rest in the down position when the contact 4 is up, in both cases breaking the circuit of the relay 10. When, however, the switch contact 4 is moved up against the contact 5 while the cam 12 is up, the energizing circuit of the relay 10 will be completed through contacts 4, 5 and 46. The signaling mechanism will then operate and finally the motor 11 will stop with the cam 12 in the down position, cutting off the energizing current to the relay 10 and preventing its continuous operation. When this operation is completed, the cam 12 will be down, and the contact 4 will, of course, still be up. When the contact 4 is next moved down, manually or otherwise, the energizing circuit of the relay 10 will be completed through contacts 4, 6 and 63, and when the motor 11 finally stops, the cam 12 will have returned to the up position. The operation of cams 17, 112 and 117 and their associated switch contacts is similar to that of the cam 12.

When the signaling mechanism associated with the switch 2 has completed the opera-

tion described above, any other relay, such as the relay 15, at the substation A, can operate if the contact on the power switch has been closed in the meantime. The operation of the relay 15 is similar to the operation of the relay 10 described above, the opening of the contact 45, in this case, cutting off current to the relay 10 as well as to all other similar relays in this substation. The power switch 3 is closed, as shown in the drawing, and the lamp 31 is lighted. Upon the operation of the contact 7 of the switch 3, the motor 16 starts in the manner described in connection with switch 2 above. Three series of impulses will be sent across the line by the closure of the contact 58 by the cam 19, the circuit being traceable from the source of current 22, through contact 58, condenser 24, armature and contact 50 of relay 21, condenser 61, and the winding of the relay 40, to ground. The selector switch 26 at the central station advances, step by step, until the arm 55 comes to rest against the contact 203, completing a local circuit for the right hand winding of relay 28, causing it to move its armature into engagement with contact 37, lighting the lamp 32, in the manner described above. Upon the final opening of the contact 58 by the cam 19, the selector brush 55 will be advanced another step from which position it will drop back to its starting position. After the final operation of the contact 58 by the cam 19, the cam 18 momentarily closes the contact 59, establishing a circuit from the source of current 22, through contact 59, through the lowermost winding of the relay 15, to ground. The relay 15 then operates to break the motor circuit in the manner described above.

The lock-out of all substations except the one transmitting a signal is accomplished as follows: The operation of any relay, such as 10 or 110, at any substation on the line, completes a circuit from battery 41, coil 42, contact 50 or 129, as the case may be, through relay 20 or 120 and through contact 62 or 128 to ground, operating, as the case may be, the relay 20 or 120 and at the same time causes the operation of all the relays 21, 121, etc., at any substation which may lie between the transmitting station and the central control station. For example, the operation of the relay 110 at substation B, which breaks the circuit of its corresponding relay 115 through the contact 127 also completes the circuit of the relay 120 through the closure of the contact 128, the circuit being established from the source of battery 41, through coil 42, through relay 21 and the resistance in shunt therewith contact 60 of relay 20, contact 129, winding of relay 120, secondary of transformer coil 125, contact 128 to ground, thus operating relays 21 and 120. The operation of relay 120 breaks the contact 130, interrupting the line 1 and thus cutting off all substations beyond the station B. Potential from source of alternating current 123 is impressed upon the line 1 when the code wheel contacts are engaged, thus closing the primary winding of transformer 125 through the secondary winding of transformer 125, resistance 101, since the winding of relay 120 offers too great an impedance to the passage of alternating current therethrough, armature of relay 121, contact 129, contact 60, resistance in shunt of the relay 21 at the substation A since the winding of relay 21 offers too great an impedance to the passage of alternating current, condenser 61, winding of relay 40 to ground, thus operating the relay 40. It will thus be seen that an alternating current is superimposed on the direct current from the battery 41 on the line conductor 1. The operation of relay 21 by the direct current from battery 41 opens contact 50, thus preventing an energization of relay 20 and interrupting the circuit for motor 11 or 16, although one break in this circuit may be closed through the contacts of relays 10 or 15 by an operation of power switches 1 or 2 at substation A. Similarly the operation of any relay 10 or 15 at a time when the line is clear will lock out all substations between station A and the central station. Either of these relays in operating also causes an operation of relay 20 over a circuit established from battery 41, coil 42, contact 50, winding of relay 20, coil 25, and contact 62 to ground, opening contact 60 and cutting off the substation B and all other substations beyond it. It will thus be seen that the various relays 20 and 120 can be operated at only one substation at a time, and the motors at any of the other substations are prevented from starting until the corresponding relay 20 or 120, as the case may be, at the substation last operated is released. A condenser, such as is shown at 131 may be provided at each substation on the line for the purpose of taking up the spark caused by the operation of the mechanical locking relays.

What is claimed is:

1. In a signaling system, a central station and a plurality of remote stations joined by a common line conductor, a plurality of devices at each remote station, a plurality of means, each controlled by one of said devices, respectively for signaling said central station over said common line conductor, means controlled by each of said signaling means for preventing the operation of all the other signaling means at the same remote station therewith, and means controlled by each of said signaling means for disconnecting the signaling means at all of said remote stations, other than its own, from said line conductor.

2. In a signaling system, a line, a central station and a plurality of substations connected with said line, a plurality of switches at each substation, a plurality of relays, each respectively controlled by the operation of each such switch, means controlled by each of said relays for signaling the central station over said line, a relay at each substation controlled by the operation of said first mentioned relays for disconnecting from said line circuit said signaling means at all substations between a given substation and the central station, and a relay included in the line at each substation controlled by the operation of the first mentioned relays at substations beyond that at which a given line relay is located for disconnecting their respective signaling means from said line.

3. In a signaling system, a line conductor, a central station and a plurality of substations connected with said line conductor, a plurality of switches at each substation, a plurality of locking relays, each respectively controlled by the operation of each of said switches, means controlled by each of said relays for signaling said central station over said line, a relay at each substation controlled by said locking relays for rendering inoperative the signaling means associated with the locking relays at all substations therebeyond, a relay included in the line at each substation controlled by the locking relays at the substations therebeyond for disconnecting their respective signaling means from said line conductor, a step-by-step device at said central station, means controlled by each of said signaling means for operating said step-by-step device, and means controlled by said step-by-step device for giving an indication of the operation of said switches.

4. In a signaling system, a line conductor interconnecting a central station and a plurality of substations, a plurality of switches at each substation, a plurality of relays each associated with one of said switches and controlled by the operation thereof, means controlled by each of said relays for signaling said central station over said line, said means comprising an electric motor, a cam carried by said motor and means controlled by said cam for impressing electrical impulses upon said line conductor, a step-by-step device at said central station, means controlled by said signaling means for operating said step-by-step device, means controlled by said step-by-step device for giving an indication of the operation of said switches, a second cam associated with each of said motors and operative upon the conclusion of the transmission of signaling impulses for stopping said motor and returning said relays to normal, means at each substation controlled by the relays thereat for rendering inoperative the signaling means at all substations therebeyond, and means controlled by said relays for rendering inoperative the signaling means at all substations between the central station and a given substation.

5. In a signaling system, a line conductor interconnecting a central station and a plurality of substations, a plurality of switches at each substation, a plurality of relays, each controlled by the operation of one of said switches, means controlled by each of said relays for signaling said central station over said line, said means comprising an electric motor and means controlled thereby for impressing impulses upon said line conductor, a selector at said central station, a relay controlled by said motor-controlled means for operating said selector, a plurality of electric lamps controlled by said selector for giving an indication of the operation of said switches, a second cam associated with said electric motor, means controlled by said cam for stopping said motor and returning said relays to normal, a relay at each substation controlled by the operation of the first mentioned relays thereat for disconnecting from said line conductor the signaling means at all substations therebeyond, and a line relay at each substation controlled by the operation of the first mentioned relays at any substation therebeyond for disconnecting the respective signaling means from said line conductor.

6. A signaling system comprising a central station and a plurality of remote stations joined by a common line conductor, signaling means at each of said remote stations connected to said line conductor for signaling said central station over said line conductor, means controlled at each of said remote stations for disconnecting from said line conductor said signaling means at all remote stations nearer said central station, and means controlled at each of said remote stations for disconnecting from said line conductor said signaling means at all remote stations farther away from said central station.

7. A signaling system comprising a common line conductor connecting a central station and a plurality of remote stations, a device at each remote station, a source of alternating current, signaling means connected to said line conductor and controlled by each of said devices for impressing current impulses from said source upon said line conductor to signal said central station, a source of direct current connected with said line conductor, and means controlled jointly by the signaling means at each remote station and by said source of direct current for disconnecting the current impulsing means at all the other remote stations from said line conductor.

8. A signaling system comprising a central station and a plurality of remote stations joined by a common line conductor, a plurality of switches at each of said remote stations, a source of alternating current at each of said remote stations, signaling means connected to said line conductor and controlled by each of said switches for impressing current impulses from one of said sources upon said line conductor to signal said central station, means controlled by each of said signaling means for preventing the operation of all the other signaling means at the same remote station therewith, a source of direct current at said central station, and means controlled jointly by each of said signaling means and by said source of direct current for disconnecting said signaling means at all the other remote stations from said line conductor.

9. A signaling system comprising a central station and a plurality of remote stations joined by a common line conductor, a plurality of switches at each of said remote stations, a source of alternating current at each of said remote stations, signaling means connected to said line conductor and controlled by each of said switches for impressing current impulses from said source upon said line conductor to signal said central station, a source of direct current at said central station, means jointly controlled by each of said signaling means and by said source of direct current for disconnecting from the line conductor said signaling means at all the remote stations beyond a given remote station, and means jointly controlled by each of said signaling means and by said source of direct current for disconnecting from said line conductor said signaling means at all remote stations between the central station and a given remote station.

10. A signaling system comprising a central station and a plurality of remote stations joined by a common line conductor, a plurality of switches at each of said remote stations, a source of alternating current at each of said remote stations, signaling means connected to said line conductor and controlled by each of said switches for impressing current impulses from one of said sources upon said line conductor to signal said central station, means controlled by each of said signaling means for preventing the operation of all the other signaling means at the same remote station therewith, a source of direct current at said central station, means jointly controlled by each of said signaling means and by said source of direct current for disconnecting from said line conductor said signaling means at all the remote stations beyond a given remote station, and means jointly controlled by each of said signaling means and by said source of direct current for disconnecting from said line conductor said signaling means at all remote stations between the central station and a given remote station.

In witness whereof, I hereunto subscribe my name this 4th day of October, A. D., 1921.

JOSEPH C. FIELD.