C. E. BEACH & H. W. DOUGHTY.

CONTROLLING SYSTEM FOR SIGNALING CIRCUITS.

APPLICATION FILED OCT. 21, 1910.

1,080,246.

Patented Dec. 2, 1913.

4 SHEETS—SHEET 1.

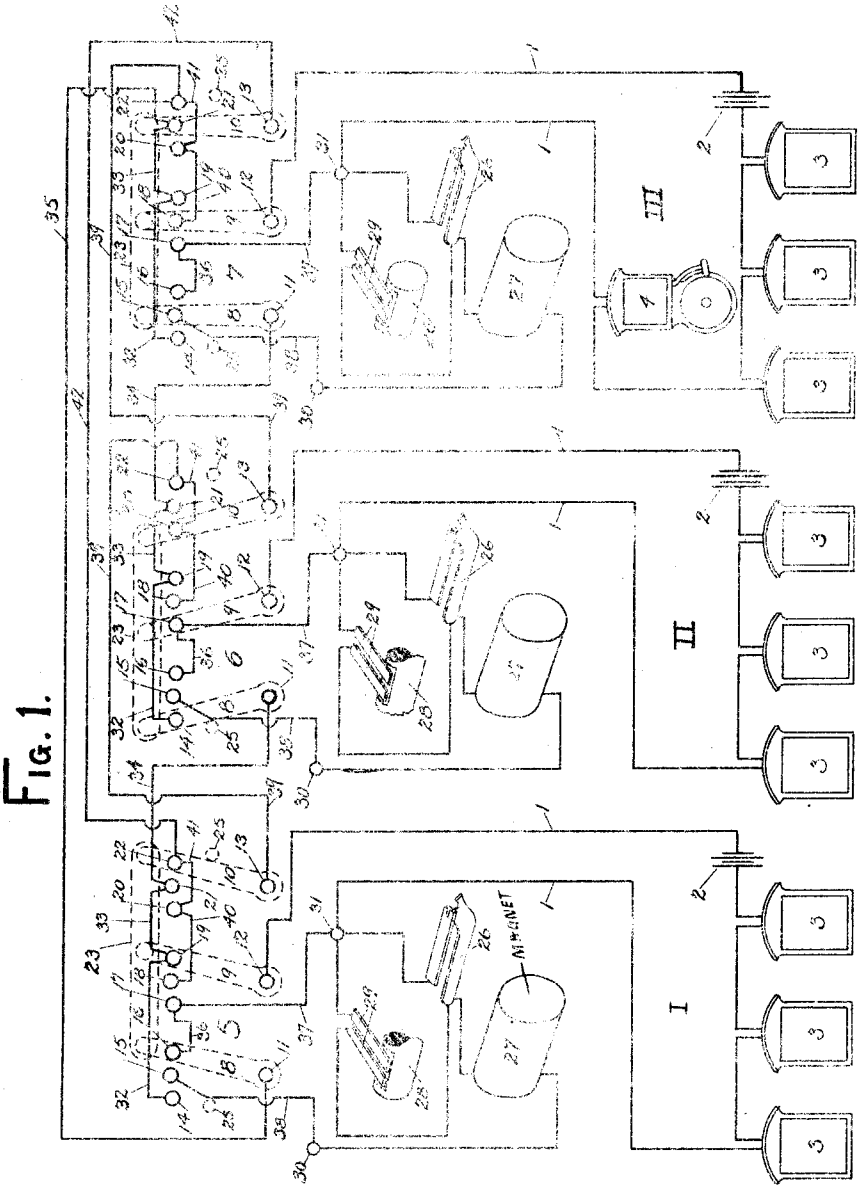


FIG. 1.

WITNESSES:

C. H. Potter.

E. Daniels

INVENTORS

Clarence E. Beach

Herman W. Doughty

by Baynes Townsend & Brickenstein

Attorneys.

C. E. BEACH & H. W. DOUGHTY.

CONTROLLING SYSTEM FOR SIGNALING CIRCUITS.

APPLICATION FILED OCT. 31, 1910.

1,080,246.

Patented Dec. 2, 1913.

4 SHEETS—SHEET 2.

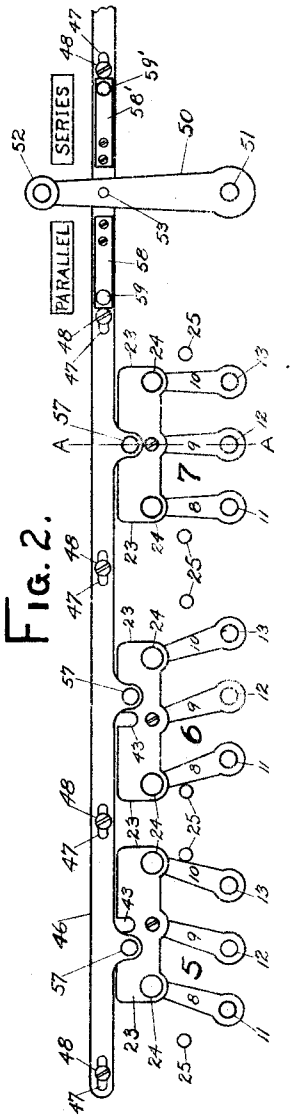


FIG. 2.

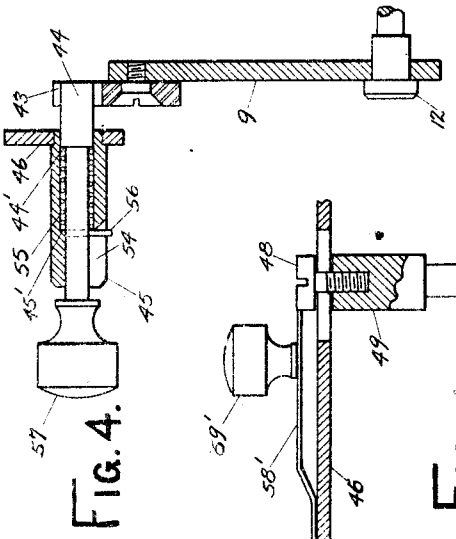


FIG. 4.

FIG. 3.

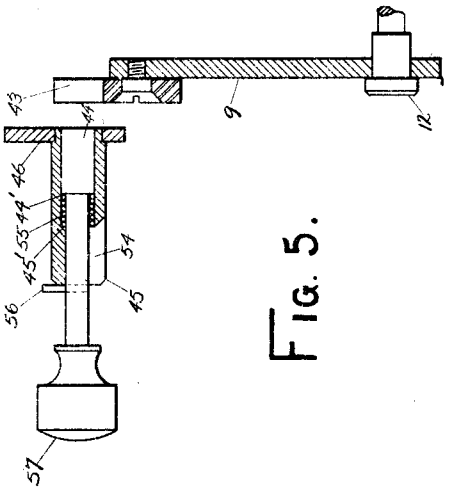


FIG. 5.

WITNESSES:

C. H. Potter

E. Daniels

INVENTOR

Clarence E. Beach

+ Herman W. Doughty

by Byrnes Townsend + Brickenstein

Attorneys

C. E. BEACH & H. W. DOUGHTY.

CONTROLLING SYSTEM FOR SIGNALING CIRCUITS.

APPLICATION FILED OCT. 31, 1910.

1,080,246.

Patented Dec. 2, 1913.

4 SHEETS—SHEET 3.

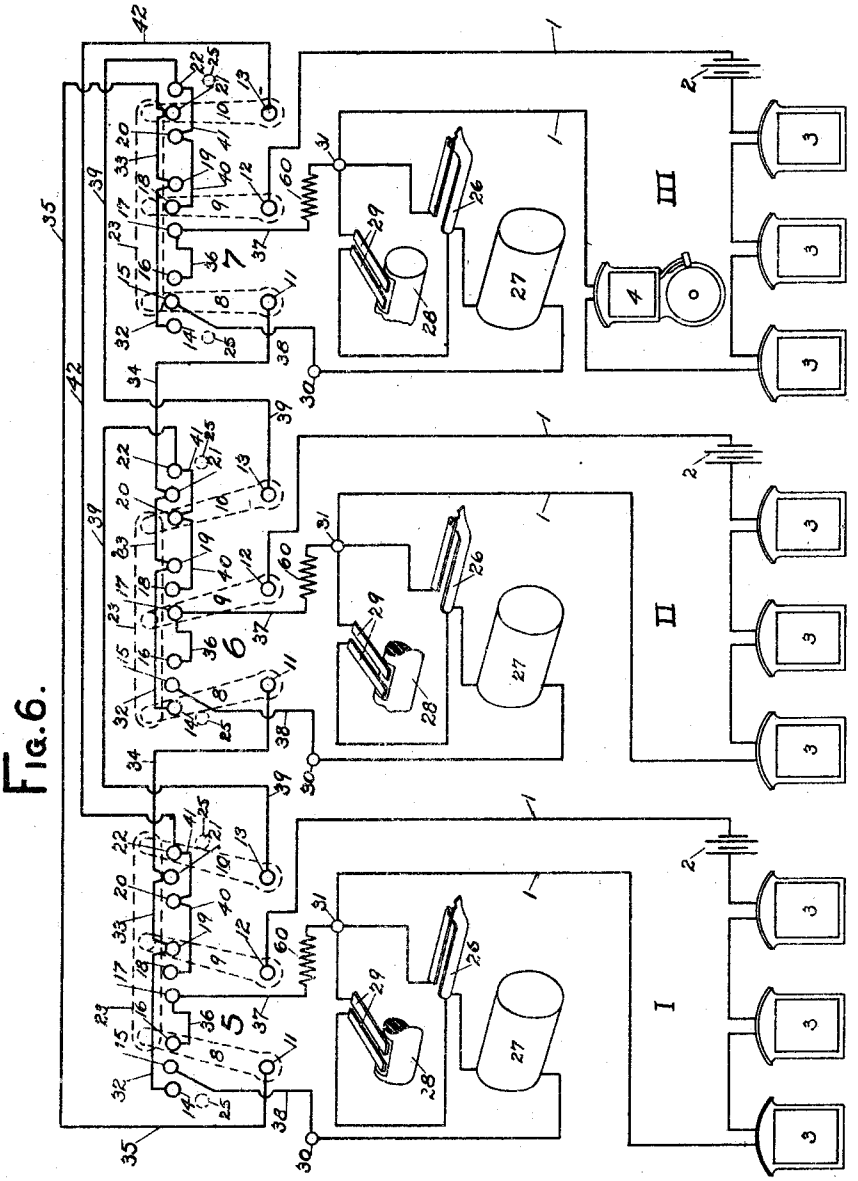


FIG. 6.

WITNESSES:

C. H. Potter.

E. Daniels

INVENTORS

Clarence E. Beach &
Herman W. Doughty
by Byrnes Townsend & Brickenstein
Attorneys

C. E. BEACH & H. W. DOUGHTY.

CONTROLLING SYSTEM FOR SIGNALING CIRCUITS.

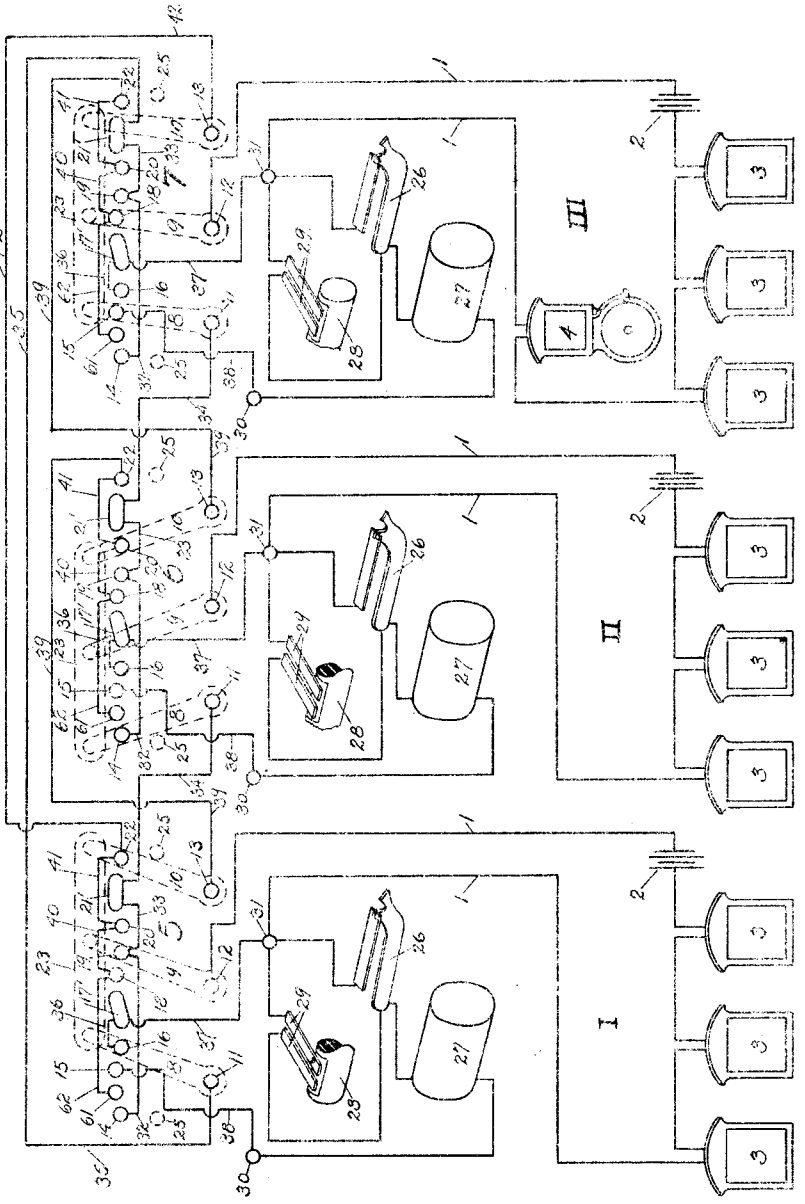
APPLICATION FILED OCT. 31, 1910.

1,080,246.

Patented Dec. 2, 1913.

4 SHEETS—SHEET 4.

FIG. 7.



WITNESSES:

C. H. Cotter

E. Daniels

INVENTORS

Clarence E. Beach,

Herman W. Doughty,

by Byrnes Townsend & Brickenstein

Attorneys

UNITED STATES PATENT OFFICE.

CLARENCE E. BEACH AND HERMAN W. DOUGHTY, OF BINGHAMTON, NEW YORK, ASSIGNORS TO GEORGE O. KNAPP, OF NEW YORK, N. Y.

CONTROLLING SYSTEM FOR SIGNALING-CIRCUITS.

1,080,246. Specification of Letters Patent. Patented Dec. 2, 1913.

Application filed October 31, 1910. Serial No. 589,958.

To all whom it may concern:

Be it known that we, CLARENCE E. BEACH and HERMAN W. DOUGHTY, citizens of the United States, residing at Binghamton, in the county of Broome and State of New York, have invented certain new and useful Improvements in Controlling Systems for Signaling-Circuits, of which the following is a specification.

Our invention relates to the systems of controlling switches frequently employed at the central offices of signaling systems,—such as fire-alarm and police-telegraph systems,—whereby the connections between the various signaling circuits and the signaling instruments provided therefor in the central office are controlled, and certain or all of the signaling circuits are permitted to be connected in one series, or in one or more groups without thereby interrupting any of said circuits.

The objects of our invention are: First, to simplify both the construction and operation of such controlling systems; second, to provide means whereby a defective circuit can be disconnected from its signaling instrument, and at the same time be so isolated from the other circuits that no movement of the controlling switches provided for the other circuits can cause any electrical connection to be established between any of them and such defective circuit; third, to substitute, when needed, a resistance for the magnet of the signaling instrument when a magnet thereof is cut out of the signaling circuit, so as to avoid changes in the strength of the current flowing in the signaling circuits in order that, in the systems to which the invention particularly relates, the proper operation of the non-interfering signaling instruments which require a line current of constant value, may be secured, and the resistance of such circuits, due mainly to the presence of the said magnets may be maintained uniform.

In constructing our invention we provide a gang switch for each signaling circuit, comprising the necessary switch arms, their various contacts, and such wiring as will enable the intended results to be accomplished.

Where the conditions of service make the use of such parts desirable, we also provide a resistance which is automatically included in the circuit whenever the gang switch has been moved to a position where the magnet of the signaling instrument is not included in its signaling circuit, a bar provided with latches whereby any or all of the various gang switches may be engaged and simultaneously operated, and suitable means for automatically locking the bar when it is moved to its normal position and permitting said bar to be released for movement to one of its abnormal positions without leaving it free to be moved to its other abnormal position.

In order that our invention may be better understood, we show, in the drawings accompanying and forming part of this specification, some of the forms of our controlling system which are suited to be applied to a municipal fire-alarm system using an automatic repeater as the signaling instrument the connection with which is to be controlled, but it is evident that our invention is equally well adapted for use for controlling the connection between signaling circuits and their relays, registers, transmitters or other instruments controlling or controlled by such circuits, and that our invention is as well adapted for use with other classes of signaling circuits as with municipal fire-alarm systems. We, therefore, do not desire to limit ourselves to the form or arrangement of parts shown in the drawings and hereinafter described to facilitate the clear understanding of our invention, as various changes in form and arrangement, and the insertion or omission of various parts may be made without departing from the spirit of our invention, as defined by the appended claims.

In the drawings forming part of this specification like numerals of reference denote the same parts throughout.

Figure 1 represents a diagrammatic view of a signaling system controlled in accordance with our invention; Fig. 2 is a front elevation of a switchboard equipped with the controlling switches shown in Fig. 1; Fig. 3 represents an enlarged section of a portion of Fig. 2; Fig. 4 represents a section on the line A—A of Fig. 2 with the bolt in position to engage the yoke of the gang switch; Fig. 5 represents a section of the parts shown in Fig. 4 with the bolt withdrawn; Fig. 6 represents a diagrammatic view of a modification of the signaling system shown in Fig. 1; and Fig. 7 represents a diagram-

matic view of another modification of the signaling system shown in Fig. 1.

Referring to Fig. 1—1, 1, 1, represent the line wires of circuits I, II, and III, 2, 2, 2, represent the batteries for said circuits, and 3, 3, 3, represent signal transmitting or signal boxes included in said circuits which, as will be understood from the following description, may be of a non-interfering type requiring for their proper operation a substantially uniform line current strength. One or more gongs or other signal-receiving instruments may be provided in said system, as 4 shown included in circuit III.

The gang switches 5, 6, and 7, provided for circuits I, II, and III each comprise the switch arms 8, 9, and 10, which are mounted on the pivots 11, 12, and 13, respectively, and the contact points 14, 15, 16, 17, 18, 19, 20, 21, and 22, which are so spaced and constructed that when one of the switch arms 8, 9, or 10 is moved from one of said contact points with which it engages to another, such arm will not cease to be in contact with one of such contact points until it is in contact with the other. The yokes 23 are provided and connected to the free ends of the said switch arms, and the knobs 25 (Fig. 2), are provided for limiting the travel of said switches.

The circuit controllers 26, magnets 27, cylinder 28, and brushes 29 form part of the structure of an automatic repeater, based upon that disclosed in the Letters Patent to Francis A. Skelton, No. 569,250, dated December 28, 1897, which repeater forms no part of our present invention, and being well understood by those skilled in this art, we will not here describe it.

The left-hand terminals 30 and the right hand terminals 31 are the terminals of the mechanism representing circuits I, II and III on the repeater and may be connected to such mechanism in any ordinary manner. The parts 26, 27, 28 and 29 of this automatic repeater are, for clearness sake, shown separately for each switch, though in practice only one repeater or equivalent mechanism is used.

One of the line wires 1 of each of the circuits is connected with a corresponding terminal 31 of the automatic repeater, and the other line wire 1 of each of the circuits is connected with corresponding pivot 12.

The contact points 14, 19 and 21 of each of the gang switches 5 and 6 are connected together by the wires 32 and 33, and said contacts are connected by the wire 34 with the pivot 11 of the next gang switch to the right.

The contact points 14, 19 and 21 of gang switch 7 are likewise connected with each other by wires 32 and 33, but inasmuch as there is no gang switch to the right of gang switch 7 in the system shown in Fig. 1, these contact points are connected by the wire 35 with the pivot 11 of the gang switch 5, located at the extreme left of the series.

The contact points 16 and 17, of each of the gang switches 5, 6 and 7, are connected together by the wires 36, and with the corresponding terminals 31 of the repeater by the wires 37, and the wires 38 connect the contact points 15 of each of the gang switches 5, 6 and 7, with the corresponding terminals 30 provided on the automatic repeater.

The contact points 18 and 20 of each of the gang switches 5, 6 and 7 are connected by wires 40, and the contact points 20 and 22 of said switches are connected by the wires 41.

The pivot 13 of the gang switch 5 is connected by wire 39 with the contact point 22, forming part of the gang switch 6, and the pivot 13 of the gang switch 6 is likewise connected by wire 39 to the contact point 22, forming part of the gang switch 7; but the pivot 13 of the gang switch 7,—same being the extreme right-hand gang switch,—is connected by the wire 42 with the contact point 22 forming part of the gang switch 5,—the extreme left-hand circuit.

To apply our invention to a signaling system comprising a different number of circuits from that shown in Fig. 1,—gang switches similar to those shown in Fig. 1 should be provided for each of the circuits, said switches to be connected in a series according to the scheme shown in Fig. 1, with the first and last switches of such series connected in the same manner that equivalent parts of the gang switches 5 and 7 are shown to be connected in Fig. 1; and the connection between switches which are adjacent in such series should be the same as that shown in Fig. 1 for the connection between equivalent parts of the gang switches 5 and 6 or 6 and 7.

In signaling systems employing a transmitting or repeating signaling instrument, as, for instance, that shown in Fig. 1, it is usual to provide switches whereby all the circuits can be simultaneously connected to or disconnected from such instrument, and when so disconnected be either in series with each other, or by use of a separate set of switches be left in parallel with and disconnected from each other, and to provide independent switches whereby any circuit can be disconnected from such instrument, while leaving the others connected thereto. By the use of the system of wiring, shown in Fig. 1, in connection with the mechanism shown in Fig. 2, all of these results are accomplished with the use of the one set of gang switches.

The yokes 23 are provided with notches

43 (see Figs. 2, 4 and 5) adapted to be engaged by the bolts 44, mounted in the sleeves 45 carried by the bar 46.

The bar 46 is provided with slots 47, which slots are of such width as to permit the body of the screw 48 to pass through freely, and of such length as to permit the bar 46 to have the necessary longitudinal travel.

The posts 49 (see Fig. 3) are mounted in suitable relation to the yokes 23, so that when the bar 46 is attached to said posts by means of the screws 48 the travel of the bolts 44 will be coincident with the travel of the notches 43.

The arm 50 is pivoted at 51 and is provided at its free end with the handle 52 and is connected to the bar 46 by the bolt 53.

The sleeves 45 are provided with a recess containing the spring 55, one end of which spring rests against the shoulder 45′ of the sleeve 45, and the other end of said spring 55 presses against the shoulder 44′ formed on the bolts 44 (see Figs. 4 and 5) thus tending to move said bolts into a position where they will engage the notches 43.

A slot 54 is provided in one wall of the sleeves 45, and the pins 56 carried by the bolts 44 are arranged to move in the slot 54, thus providing a limit for the travel of said bolts 44 in the direction of the yokes 23. Said slots 54 are of such length that, when the bolts 44 are fully withdrawn from the path of the notches 43, the pins 56 may be fully withdrawn from the slots 54, and thereupon the bolts 44 may be held out of engagement with the notches 43 by turning said bolts 44 so as to bring the pins 56 out of line with the slots 54 (see Fig. 5); the knobs 57 being provided for the purpose of operating the bolts 44.

The spring catches 58 and 58′ (see Figs. 2 and 3) are provided at their free ends with the operating knobs 59 and 59′ respectively; the spring catch 58 being mounted upon the bar 46 in such relation to the head of one of the screws 48 as to tend to engage therewith whenever it is attempted to move the bar 46 from its normal position (where the engagement of the bolts 44 with the notches 43 would cause the yokes 23 to hold the respective switch arms in engagement with their contact points 15, 18 and 21), to the position where the engagement of said bolts 44 and notches 43 would cause said switch arms to be brought into contact with their corresponding contact points 14, 17, and 20; and the spring catch 58′ is so mounted upon the bar 46 as to tend to engage with the head of one of the screws 48 whenever it is attempted to move said bar 46 from its normal position, hereinbefore described, to the position where, by means of the engagement of the bolts 44 with the notches 43, the various switch arms would be moved so as to cease to rest upon their contact points 15, 18 and 21, and instead, rest upon their contact points 16, 19 and 22.

The spring catches 58 and 58′ are of such form and material that they are sufficiently flexible to permit their free ends being sprung away from the bar 46 by their knobs 59 and 59′, so that the heads of the screws 48 will not obstruct the movement of said catches, and they will thus permit the bar 46 to move longitudinally.

In many signaling systems employing an automatic repeater similar to that represented in Fig. 1, the resistance of the balance of the circuits is so low with relation to the resistance of the repeater magnets, that when sufficient battery power is applied to maintain the proper flow of current when such repeater magnets are included in said circuits, an excessive current will flow in such circuits if their repeater magnets are cut out, and as the action of cutting out said magnets is usually simultaneous with relation to a number of circuits, it is desirable to provide a resistance which will be automatically substituted for that of such repeater magnets in each of said circuits, whenever said magnets have been cut out of their circuits, and for this purpose we provide the resistances 60 (see Fig. 6), said resistances being included in the respective wires 37.

When all the parts are in their normal positions, the bar 46 is locked by the engagement of the free ends of the spring catches 58 and 58′ with their respective screws 48, the bolts 44 are projecting into the notches 43, and the gang switches 5, 6 and 7 are thereby positively held in the position where their respective arms are resting upon the contact points 15, 18 and 21, (see switch 7, Figs. 1 and 2). The course of the current in the various circuits would then be as follows: in circuit I, from battery 2 through wire 1 to pivot 12 of switch 5, through arm 9 to contact point 18 of said switch 5, thence through wires 40, 41 and 42 to pivot 13 of switch 7, through 10 to contact point 21 of said switch 7, thence through wire 35 to pivot 11 of switch 5, through arm 8 to contact point 15 of said switch 5, thence through wire 38 to terminal 30, through mechanism of the automatic repeater representing circuit I to terminal 31, thence through wire 1 and signal boxes 3, 3, 3, of circuit I to the other side of the battery 2 of said circuit I; in circuit II, from battery 2 through wire 1 to pivot 12 of switch 6, through arm 9 to contact point 18 of said switch 6, thence through wires 40, 41 and 39 to pivot 13 of switch 5, through arm 10 to contact point 21 of said switch 5, thence through wire 34 to pivot 11 of switch 6, through arm 8 to con-

tact point 15 of said switch 6, thence through wire 38 to terminal 30, through mechanism of automatic repeater representing circuit II to terminal 31, thence through wire 1 and signal boxes 3, 3, 3 of circuit II to the other side of the battery 2 of said circuit II; in circuit III, from battery 2 through wire 1 to pivot 12 of switch 7, through arm 9 to contact point 18 of said switch 7, thence through wires 40, 41, and 39 to pivot 11 of switch 6, through arm 10 to contact point 21 of said switch 6, thence through wire 34 to pivot 11 of switch 7, through arm 8 to contact point 15 of said switch 7, thence through wire 38 to terminal 30, through mechanism of automatic repeater representing circuit III to terminal 31, thence through wire 1, gong 4, and signal boxes 3, 3, 3 of circuit III.

If it is desired to disconnect all the circuits from the automatic repeater and so connect said circuits together that they will form one series circuit, this can be done by disengaging the spring catch 58', by means of the knob 59' from the head of the screw 48 with which it normally engages, and then moving the arm 50 to the right, by means of the handle 52, and thus moving the bar 46 and the switches 5, 6 and 7, which are connected to said bar 46 by means of the bolts 44 until the respective arms 10 of said switches 5, 6, and 7 have been moved to the right until they are brought against their stop-pins 25 (see switch 5 in Figs. 1 and 2). The course of the current through this system would then be through wire 1 from battery 2 of circuit I, to pivot 12 of switch 5, through arm 9 to contact point 19 of said switch 5, thence through wires 33 and 34 to pivot 11 of switch 6, through arm 8 to contact point 16 of said switch 6, thence through wires 36 and 37 (and through resistance 60 if the system is arranged as shown in Fig. 6) to terminal 31, thence through wire 1, signal boxes 3, 3, 3 and battery 2 of circuit II to pivot 12 of gang switch 6, through arm 9 to contact point 19 of said switch 6, thence through wires 33 and 34 to pivot 11 of switch 7, through arm 8 to contact point 16 of said switch 7, thence through wires 36 and 37 (and through resistance 60 if the system is arranged as shown in Fig. 6) to terminal 31, thence through wire 1, gong 4, signal boxes 3, 3, 3, and battery 2 of circuit III to pivot 12 of gang switch 7, through arm 9 to contact point 18 of said switch 7, thence through wires 33 and 34 to pivot 11 of gang switch 5, through arm 8 to contact point 16 of said gang switch 5, thence through wires 36 and 37 (and through resistance 60 if the system is arranged as shown in Fig. 6) to terminal 31, thence through wire 1 and signal boxes 3, 3, 3 back to battery 2 of circuit I.

If it is desired to disconnect all the circuits from the automatic repeater and leave all of such circuits disconnected from each other, this can be done by disengaging the spring catch 58, by means of the knob 59, from the head of the screw 48 with which it normally engages, and then moving the arm 50 to the left, by means of the handle 52, and thus moving the bar 46 and the switches 5, 6, and 7 until their arms 8 have been moved to the left until they are brought against their stop-pins 25. (see switch 6 in Figs. 1 and 2). The course of the current through each of the circuits would then be from battery 2, through wire 1 to pivot 12 of the gang switch representing such circuit, through arm 9 to contact point 17, thence through wire 37 (and through resistance 60 if the system is arranged as shown in Fig. 6) to terminal 31, thence through wire 1, signal boxes 3, 3, 3 (and, in case of circuit III, through gong 4) back to battery 2.

If it is desired to simultaneously disconnect all the circuits from the automatic repeater and then again connect all but a certain defective circuit or circuits with the repeater, for reasons which are well understood by those skilled in this art, this can be quickly and conveniently done by disengaging the spring catch 58, by means of the knob 59, from the head of the screw 48 with which it normally engages, and then moving the arm 50 to the left, by means of the handle 52, until the switch arms 8 of the gang switches 5, 6, and 7 have been moved to the left until they are brought against their stop-pins 25, then withdraw the bolt 44 of such circuit or circuits as it is desired to leave disconnected and turn such bolts 44 so that their pins 56 will not be in line with the slots 54, and the bar 46 may then be returned to its normal position, and thereby return all switches to their normal position which were not disconnected from the bar 46.

When the arm 50 has been moved to one of its abnormal positions, it may be rapidly returned to its normal position without fear of moving it past its normal position, as its motion will be arrested when it reaches its normal position by the engagement of either the spring catch 58 or 58' with a corresponding one of the slots 57.

If it is desired to operate one of the gang switches without moving any of the others, this can be done by first withdrawing the bolt 44 provided for actuating such gang switch, and then moving such switch by means of one of the knobs 59 provided therefor.

The positions of the gang switches as pictured in Fig. 1 are such as they would be if the section of the automatic repeater representing circuit I had been cut out or added, circuit II was in such defective condition that it had been disconnected from the automatic repeater, and circuit III was in working condition, the path of the current being as follows: In circuits I and III, from

battery 2 through wire 1 of circuit I to pivot 12 of gang switch 5, through arm 9 to contact point 19 of said switch 5, thence through wires 33 and 34 to pivot 11 of gang switch 6, through arm 8 to contact point 14 of said switch 6, thence through wires 32, 33 and 34 to pivot 11 of gang switch 7, through arm 8 to contact point 15 of said switch 7, thence through wire 38 to terminal 30 of the automatic repeater, through the repeater mechanism representing circuit III to terminal 31, thence through wire 1, gong 4, and signal boxes 3, 3, 3 to battery 2 of circuit III, thence through wire 1 to pivot 12 of gang switch 7, through arm 9 to contact point 18 of said switch 7, thence through wires 40, 41 and 39 to pivot 13 of gang switch 6, through arm 10 to contact point 20 of said switch 6, thence through wires 41 and 39 to pivot 13 of gang switch 5, through arm 10 to contact point 22 of said switch 5, thence through wire 42 to pivot 13 of gang switch 7, through arm 10 to contact point 21 of said switch 7, thence through wire 35 to pivot 11 of gang switch 5, through arm 8 to contact point 16 of said switch 5, thence through wires 36 and 37 (and through resistance 60 if the system is arranged as shown in Fig. 6) to terminal 31, thence through wire 1, signal boxes 3, 3, 3 back to battery 2 of circuit I. In circuit II, from battery 2 through wire 1 to pivot 12 of gang switch 6, through arm 9 to contact point 17, thence through wire 37 (and through resistance 60 if the system is arranged as shown in Fig. 6) to terminal 31, thence through wire 1 and boxes 3, 3, 3 back to battery 2 of said circuit II.

It will be seen from the foregoing that, when the gang switches are in their normal positions, each circuit is subjected to the control of two of said gang switches and is connected with the automatic repeater, so that, if one or more of said gang switches are moved to their right-hand or series positions, the circuits represented by such switches will be disconnected from the automatic repeater and included in the circuits represented by the switches located immediately to the right of the switches so operated; or, if the gang switch located at the extreme right is so operated, the circuit it represents will be included in the circuit represented by the switch located at the extreme left; and if any one or more of said gang switches are moved to their left-hand or parallel positions, the circuits represented by such switches will no longer be subject to the control of any other of said gang switches, and no electrical connection with the other circuits can be established between any circuit represented by a gang switch which is standing in its left-hand or parallel position, by means of any other of the gang switches.

It will also be seen that if a gang switch is moved to its right-hand or series position at a time when the next gang switch to its right stands in its left-hand or parallel position, the circuit represented by the gang switch which is in its series position will be connected in series with the circuit represented by the nearest gang switch, if any, which is not standing in its left-hand or parallel position, and which is located to the right of the gang switch so standing in its series position.

It will further be seen that if there are no gang switches standing in other than their parallel positions, located to the right of a gang switch which is standing in its series position, the circuit represented by the gang switch which is so standing in its series position will be connected in series with the circuit represented by the gang switch, if any, which is not standing in its parallel position and is located farthest to the left of the switch so standing in its series position.

In using the gang switches represented by Figs. 1 and 6, if all of the gang switches are in their normal positions, and a fault develops upon one of the circuits, as, for instance, the line wire of circuit II becoming crossed with some foreign circuit, if the gang switch 6 is moved to its parallel position for the purpose of disconnecting such faulty circuit II from the automatic repeater, during the movement of said switch 6 from its normal to its parallel position, there would be a point in its travel where said circuit II would be placed in electrical connection with circuit III and thus tend to develop a fault on said circuit III.

The path as so provided between circuits II and III would be from one of the wires 1 of circuit II, to terminal 31 and thence through wire 37 to contact point 17 and arm 9 of switch 6, or from the other wire 1 to pivot 12 and through arm 9 of said switch 6, or both, to contact point 18, (switch arm being in contact with points 17 and 18 at the same time) thence through 40 to contact point 20; then either through switch arm 10 to contact point 21 of said gang switch 6, thence through wire 34 to pivot 11 of gang switch 7, through arm 8 to contact point 15 of said switch 7, thence through wire 38 to terminal 30, through the mechanism of the automatic repeater representing circuit III to terminal 31 and one of the wires 1 of circuit III; or else through said switch arm 10 of gang switch 6 to its pivot 13, thence through wires 39, 41 and 40 to contact point 18 of gang switch 7, through arm 9 to pivot 12 of said switch 7 and thus to the other wire 1 of circuit III.

The modified construction represented by Fig. 7 is such that any of the gang switches may be moved from their normal to their parallel positions, without thereby creating any electrical connection between any circuit

represented by one of the switches so moved and any of the other circuits; the construction represented by Fig. 7 being the same as that represented by Fig. 6 except in the following particulars: First,—A contact point 61 is provided in the path of each of the switch arms 8 between its contact points 14 and 15, said contact point 61 is connected to contact point 18 of the same gang switch by the wire 62, and the distance between such contact points 14 and 15, and the total travel of each gang switch is correspondingly increased. Second,—Each contact point 17 is omitted, and in its place an extended or double contact 17′ is provided and so located in the path of each switch arm 9 that, while any gang switch is moved from its normal position to the position where its switch arm 8 rests upon its contact point 61, its switch arm 9 will remain in electrical connection with wire 37 of the circuit represented by such gang switch. Third, Each contact point 21 is omitted, and in its place an extended or double contact 21′ is provided and so located in the path of each of the switch arms 10 that, while any gang switch is moved from its normal position to the position where its arm 8 rests upon its contact point 61, its switch arm 10 will remain in electrical connection with the wire 34 leading to the pivot 11 of the next gang switch in the series. It will thus be seen that any one of the gang switches represented by Fig. 7 may be moved from its normal to its parallel position without thereby establishing any electrical connection between the circuit represented by the switch so moved and any of the other circuits, for the reason that in so moving any such gang switch there is no electrical connection established between its wire 40 and the wire 34 leading from its contact point 21′ to the pivot 11 of the next gang switch in the series, at any time when said wire 40 is in electrical connection with the circuit represented by the switch so moved.

The means employed to permit rapid return of the switch arms to their normal position without over-running and for locking the switch arms in normal position are herein described for the purpose of clearness, but such means are not herein claimed, being the subject of a claim in our divisional application No. 784, 225, filed August 11, 1913.

We are aware that, prior to our present invention, controlling systems have been used which have been made with a gang switch for simultaneously controlling the connection between each of a number of circuits and their respective signal responsive instruments, and switches for each of such circuits whereby any of such circuits may be taken from the control of the gang switch; and we are further aware in constructing some of such gang switches provision was made whereby the individual switches comprising such gangs could be separately operated. We therefore do not claim such combinations broadly; but

What we claim is:

1. The combination of a series of signaling circuits each comprising a battery and signal transmitting devices and signal-receiving mechanism, switching devices for each circuit, and connecting circuits between said switching devices, each such switching device being so arranged that in one position it disconnects the signal-receiving mechanism from its circuit, in a second position connects its circuit in series with some other circuit, or in a third position connects its circuit with the signal receiving mechanism and permits its circuit to be connected with circuits controlled by other similar switches.

2. In a signal-controlling system, the combination with a circuit including a signal-receiving device and a signaling circuit, of a switching device comprising three sets of contacts, each set containing a number of contact points, a circuit including points in each set, a circuit connecting a point of the first set with a point of the second set and with one side of the signaling and signal-receiving circuits, a circuit connecting a second point of the first set with the other side of said signal-receiving circuit, a circuit connecting a point of the second set with two points of the third set, three switch arms having a common actuating means and each adapted to engage one set of contacts, one of said arms being connected to the other side of the signaling circuit, and circuit connections for the other two arms.

3. In a signal-controlling system, the combination with a circuit including a signal-receiving device and a signaling circuit, of a switching device comprising three sets of contacts, each set containing a number of contact points, a circuit including points in each set, a circuit connecting a point of the first set with a point of the second set and with one side of the signaling and signal-receiving circuits, a circuit connecting a second point of the first set with the other side of said signal-receiving circuits, a circuit connecting a point of the second set with two points of the third set, three switch arms having a common actuating means and each adapted to engage one set of contacts, one of said arms being connected to the other side of the signaling circuit, circuit connections for the other two arms, and means whereby any given circuit may be cut off without establishing connection with the other circuits.

4. In a signal-controlling system, the combination with a signal receiving device of a number of signaling circuits connected thereto, of a gang switch for such signaling circuit, each such switch comprising three

switch arms, sets of contact points arranged to be engaged by such arms, a circuit connecting contact points in each set with a switch arm in an adjacent gang switch, a circuit connecting a point of the first set with a point of the second set and with one side of the signaling and signal-receiving circuit, a circuit connecting a third point of the first set with the other side of said signal-receiving circuit, a circuit connecting a point of the second set with two points of the third set and with a second switch arm in an adjacent gang switch, the remaining switch arm of each set having its pivot connected to the other side of its signaling circuit.

5. In a signal-controlling system, the combination with a signal-receiving device of a number of signaling circuits connected thereto, of a gang switch for each signaling circuit, each such switch comprising three switch arms, sets of contact points arranged to be engaged by such arms, a circuit connecting contact points in each set with a switch arm in an adjacent gang switch, a circuit connecting a point of the first set with a point of the second set and with one side of the signaling and signal-receiving circuit, a circuit connecting a third point of the first set with the other side of said signal-receiving circuit, a circuit connecting a point of the second set with two points of the third set and with a second switch arm in an adjacent gang switch, the remaining switch arm of each set having its pivot connected to the other side of its signaling circuit, and mechanism arranged to operate the gang switches simultaneously or separately.

6. In a signaling system, the combination with a circuit normally including a battery, signaling devices and an electromagnetic device, of a switching device having means for disconnecting said electromagnetic device from the circuit and substituting therefor a resistance sufficient to maintain normal flow of current.

7. In a signaling system, the combination with a circuit normally including a battery, signaling devices and an electromagnetic device, of a switching device having means for disconnecting said electromagnetic device from the circuit and separate means for substituting therefor a resistance sufficient to maintain normal flow of current.

8. In a signaling system two or more circuits each including a battery and signaling devices, an electromagnetic device, switching devices connected to the terminals of each circuit, said switching devices having interrelated connections and means constructed and arranged to disconnect the electromagnetic device to substitute therefor a resistance sufficient to maintain normal flow of current and to connect said circuit in series with another circuit.

9. In a signaling system two or more circuits each including a battery, signaling devices, and an electromagnetic device, such as a recorder, switching devices connected to the terminals of each circuit, said switching devices having interrelated connections and means constructed and arranged to disconnect the electromagnetic device, to substitute therefor a resistance sufficient to maintain normal flow of current, to disconnect this circuit while so arranged from other circuits of the system, or to connect the so-arranged circuit in series with another circuit.

10. A signaling circuit including a battery, signaling boxes, an electromagnetic recording device in combination with a switch controlling two current paths, one including the recorder and the other a resistance to maintain normal flow of current under constant potential, a second similar signaling circuit and switching mechanism for placing the first circuit in series with the second.

11. A signaling circuit including a battery, signaling boxes, an electromagnetic recording device in combination with a switch controlling two current paths, one including the recorder and the other a resistance to maintain normal flow of current, a series of similar signaling circuits and switching connections for placing the first circuit in series with either of the other circuits.

12. In a signaling system a circuit including a battery, signaling devices and an electromagnetic device, such as a recorder, a pair of connected switch arms connected to the terminals of said circuit, a current path, containing a resistance sufficient to maintain normal flow of current for shunting said electromagnetic device, leading to contacts arranged to be engaged by either switch arm, and switching connections whereby said circuit can be placed in series with another circuit.

13. A system comprising a series of signaling circuits, each circuit comprising a battery and signaling devices, an electromagnetic device, a gang switch for each circuit and interrelated connections between said switches whereby are formed three branch circuits controlled by each switch, viz., one branch for excluding the electromagnetic device and closing the circuit on itself, a second branch circuit including the electromagnetic device and extending to switches of other circuits whereby the circuit may be connected in series with said other circuits and the third branch circuit for excluding the electromagnetic device and putting said circuit in series connection with switches of other circuits.

14. A system comprising a series of signaling circuits, each circuit comprising a battery and signaling devices, an electromagnetic device, a gang switch for each circuit and interrelated connections between

said switches whereby are formed three branch circuits controlled by each switch, viz., one branch for excluding the electromagnetic device, substituting therefor a resistance sufficient to maintain normal flow of current and closing the circuit on itself, a second branch circuit including the electromagnetic device and extending to switches of other circuits whereby the circuit may be connected in series with said other circuits and the third branch circuit for excluding the electromagnetic device, substituting therefor a resistance sufficient to maintain normal flow of current and putting said circuit in series connection with switches of other circuits.

15. A system comprising a series of signaling circuits, each containing a battery and signaling devices, an electromagnetic device, a gang switch for each circuit and interrelated connections between such switches whereby are formed branch circuits controlled by each switch, viz., one in which the signaling circuit is disconnected from any other circuit, and another in which said signaling circuit is independent of other circuits but in condition to have any other circuit put itself in series with it and the electromagnetic device.

16. A system comprising a series of signaling circuits, each containing a battery and signaling devices, an electromagnetic device, a gang switch for each circuit and interrelated connections between such switches whereby are formed branch circuits controlled by each switch, viz., one in which the electromagnetic device is excluded, a resistance sufficient to maintain normal flow of current substituted and the signaling circuit is disconnected from any other circuit, and another in which said signaling circuit is independent of other circuits but in condition to have any other circuit put itself in series with it and the electromagnetic device.

17. A system comprising a series of signaling circuits, each containing a battery and signaling devices, an electromagnetic device, a gang switch for each circuit and interrelated connections between such switches whereby are formed branch circuits controlled by each switch, viz., one in which the signaling circuit is disconnected from any other circuit, and another in which said signaling circuit is in condition to put itself in series with any other circuit which is not itself disconnected from its associated electromagnetic device.

18. A system comprising a series of signaling circuits, each containing a battery and signaling devices, an electromagnetic device, a gang switch for each circuit and interrelated connections between such switches whereby are formed branch circuits controlled by each switch, viz., one in which the electromagnetic device is excluded, a resistance sufficient to maintain normal flow of current substituted and the signaling circuit is disconnected from any other circuit, and another in which it is in condition to put itself in series with any other circuit which is not itself disconnected.

19. A system comprising a series of signaling circuits, each containing a battery and signaling devices, an electromagnetic device, a gang switch for each circuit and interrelated connections between such switches whereby are formed branch circuits controlled by each switch, viz., one in which the signaling circuit is independent of other circuits but in condition to have any other circuit put in series with it and said electromagnetic device, and another in which it is in condition to put itself in series with any other circuit which is not disconnected from its associated electromagnetic device.

20. A system comprising a series of signaling circuits, each containing a battery and signaling devices, an electromagnetic device, a gang switch for each circuit and interrelated connections between such switches whereby are formed branch circuits controlled by each switch, viz., one in which the signaling circuit is independent of other circuits but in condition to have any other circuit put in series with it and said electromagnetic device, and another in which the electromagnetic device is excluded, a resistance sufficient to maintain normal flow of current substituted and the signaling circuit is in condition to put itself in series with any other circuit which is not disconnected from its associated electromagnetic device.

21. In a signaling system, the combination of a plurality of signaling circuits, each containing a battery, signaling instruments and an electromagnetic device, switching devices for connecting any one of said signaling circuits in series with any other and circuit connections controlled by said switches whereby in connecting one signaling circuit in series with another the electromagnetic device of the first named circuit will be excluded from the circuit and a resistance sufficient to maintain normal flow of current substituted therefor.

22. In a signaling system, the combination of a plurality of circuits each normally including a battery, signal transmitting and signal receiving devices, switching devices connected to the terminals of each circuit, said switching devices having interrelated connections and means constructed and arranged for connecting a signaling circuit in series with another and substituting for the receiving instrument of the first named circuit a resistance sufficient to maintain normal flow of current.

23. In a signaling system, the combination of two or more circuits each normally including a battery, signaling devices and an electromagnetic device, switching devices connected to the terminals of each circuit, said switching devices having inter-related connections, and means constructed and arranged to connect any circuit in series with another through a resistance substituted for its corresponding electromagnetic device, said resistance being sufficient to maintain normal flow of current.

24. In a signaling system, the combination of a plurality of circuits each normally including a battery, signaling boxes and an electromagnetic device, and switching devices adapted in their operation to interconnect said circuits in series relation and to substitute a corresponding resistance for the electromagnetic device of that circuit which is so connected with another, said resistance being such as to maintain normal flow of current.

25. A signaling circuit including a battery, signaling boxes and an electromagnetic device, in combination with a second similar signaling circuit, a switching device and circuit connections controlled thereby adapted to connect one circuit in series with the other and to substitute a resistance for the electromagnetic device of the first named circuit to maintain a normal flow of current in the two circuits, under the combined potential of their batteries.

26. A signaling circuit including a battery, signaling boxes and an electromagnetic device, in combination with a plurality of similar signaling circuits and a switching device, and circuit connections controlled thereby for connecting said first circuit in series with either of the others and substituting a resistance for the electromagnetic device of the said first circuit to maintain a normal flow of current in the circuits so connected, under the combined potential of their batteries.

27. In a signaling system, a circuit including a battery, signaling devices, and an electromagnetic device, a switching device having a pair of coöperating arms connected to the terminals of said circuit, a second and similar circuit adapted to be connected in series with the first, resistances corresponding to the electromagnetic devices and circuit connections with the switch contacts whereby the operation of the switch arms to connect one circuit in series with the other, substitutes for the electromagnetic device of the first circuit its corresponding resistance.

28. A system comprising in combination, a plurality of signaling circuits, each including a battery, signaling devices and an electromagnetic device, a gang switch for each circuit, and inter-related connections between said switches, said connections being adapted to form three paths under the control of the switches, viz., one path excluding the electromagnetic device and completing the circuit on itself, a second path including the electromagnetic device and extending to switches of other circuits whereby said circuit may be connected in series with any other, and a third path including a resistance which is substituted for the electromagnetic device when the circuit including the latter is connected in series with any other signaling circuit.

29. A system comprising in combination, a plurality of signaling circuits, each including a battery, signaling devices and an electromagnetic device, a gang switch for each circuit and inter-related connections between said switches, said connections forming three paths adapted to be controlled by the operation of each switch, viz., a resistance path excluding the electromagnetic device and completing a signaling circuit on itself; second, a path including the electromagnetic device and extending to switches of other circuits whereby the circuit may be connected in series with any of said other circuits, and third, a resistance path excluding the electromagnetic device and adapted to connect the circuit in series relation with the switches of other circuits.

30. A system comprising in combination, a plurality of signaling circuits, each containing a battery, signaling devices and an electromagnetic device, a gang switch for each circuit, and inter-related connections between such switches forming complete circuits controlled by each switch, one of said circuits being disconnected from any other signaling circuit, and another circuit independent of the other signaling circuits, but adapted to have any of said circuits connected therewith in series.

31. A system comprising in combination, a series of signaling circuits, each containing a battery, signaling devices and an electromagnetic device, a gang switch for each circuit and inter-related connections between said switches, forming complete circuits controlled by each switch, one of said circuits containing a resistance corresponding to the electromagnetic device and being disconnected from any other circuit, and another circuit independent of the others but adapted to have any other circuit connected in series therewith.

32. A system comprising in combination a plurality of signaling circuits, each containing a battery, signaling devices and an electromagnetic device, a gang switch for each circuit and inter-related connections between said switches constituting complete circuits controlled by said switch, one constituting a signaling circuit disconnected from any other, and another a signaling circuit adapted to be connected in series with

any other signaling circuit not disconnected from the system.

33. A system comprising in combination a plurality of signaling circuits, each normally containing a battery, signaling devices and an electromagnetic device, a gang switch for each of said circuits and inter-related connections between said switches constituting complete circuits controlled by each switch, one of said circuits including a resistance in place of the electro-magnetic device but disconnected from any other circuits, and another adapted to be connected in series with any signaling circuit not disconnected from the system.

34. A system comprising in combination, a plurality of signaling circuits, each normally containing a battery, signaling devices and an electromagnetic device, a gang switch for each circuit and inter-related connections between said switches, constituting complete circuits controlled by each switch, one of said circuits forming a signaling circuit independent of other circuits, but in condition to coöperate with any other signaling circuit that may be connected therewith, and another circuit in condition to cooperate with any other signaling circuit not disconnected from the system with which it may be connected in series.

35. A system comprising in combination, a plurality of signaling circuits, each normally containing a battery, signaling devices and an electromagnetic device, a gang switch for each circuit and inter-related connections between said switches constituting complete circuits controlled by each switch, one of said circuits forming a signaling circuit independent of the others and in condition to coöperate with any other signaling circuit that may be connected in series therewith, and another including a resistance in place of the electromagnetic device and in condition to coöperate with any other signaling circuit with which it may be connected in series.

36. In a signaling system, the combination with a repeater, of a series of signaling circuits, each circuit including a battery and signaling devices and connected to the repeater, and a corresponding series of gang switches, each gang switch comprising mechanically connected switch arms 8, 9, 10, and contacts 14, 15, 16, 17, 18, 19, 20, 21, 22, said arm 8 arranged to engage contacts 14, 15, 16 and having its pivot connected to connected contacts 14, 19 and 21 of an adjacent switch of the series, contact 15 connected in series with the repeater to one side of the battery, contact 16 connected to contact 17 which is directly connected to the same side of the battery, said arm 9 having its pivot connected to the other side of the battery and arranged to engage contacts 17, 18, and 19, contact 18 connected to contacts 20 and 22 and to the pivot of arm 10 of the next gang switch to the left in the series, and arm 10 arranged to engage contacts 20, 21 and 22 and having its pivot connected with contact 22 of the next gang switch to the right in the series.

37. In a signaling system, the combination with a repeater, of a series of signaling circuits, each circuit including a battery and signaling devices and connected to the repeater, and a corresponding series of gang switches, each gang switch comprising mechanically connected switch arms 8, 9, 10 and contacts 14, 15, 16, 17, 18, 19, 20, 21, 22, said arm 8 arranged to engage contacts 14, 15, 16 and having its pivot connected to connected contacts 14, 19 and 21 of an adjacent switch of the series and contact 15 connected in series with the repeater to one side of the battery, contact 16 connected to contact 17 which is directly connected to the same side of the battery, and a resistance sufficient to maintain normal flow of current in such direct connection, said arm 9 having its pivot connected to the other side of the battery, and arranged to engage contacts 17, 18 and 19, contact 18 connected to contacts 20 and 22 and to pivot of arm 10 of the next gang switch to the left in the series, and arm 10 arranged to engage contacts 20, 21, 22 and having its pivot connected with contact 22 of the next gang switch to the right in the series.

38. In a signaling system, the combination of a series of signaling circuits, connected to a repeater, each circuit including a battery and signaling devices, a gang switch for each circuit having circuit connections directly connecting each side of the battery to the switch and one side of the battery through the repeater to the switch, said gang switches having inter-connected circuits and contacts constituting means whereby each gang switch can (1) complete and dissociate its own circuit from the system and from the repeater while maintaining closed circuit relations with adjacent gang switches, (2) can connect its own circuit with the repeater and permit any other gang switch in series position to connect its signaling circuit with the repeater, and (3) can disconnect from the repeater its own signaling circuit and connect it to said repeater through any other gang switch in normal position.

39. In a signaling system, the combination with a repeater, of a series of signaling circuits, each circuit including a battery and signaling devices and connected to the repeater, and a corresponding series of gang switches, each switch comprising mechanically connected switch arms 8, 9, 10, and contacts 14, 15, 16, 17, 18, 19, 20, 21, 22; said arm 8 being arranged to engage contacts 14, 15, 16 and being connected to contacts 14,

19, 21 of a second switch in the series, contact 14 being connected to contacts 19 and 21 and to arm 8 of a third switch in the series, contact 15 being connected in series with the repeater to one side of the circuit, contact 16 being connected to contact 17 and directly to the same side of the circuit; said arm 9 being arranged to engage contacts 17, 18, 19 and being connected to the other side of the circuit, contact 18 being connected to contacts 20 and 22 and to arm 10 of said second switch in the series; and said arm 10 being arranged to engage contacts 20, 21, 22 and being connected to contacts 18, 20, 22 of said third switch in the series.

40. In a signaling system, the combination with a repeater, of a series of signaling circuits, each circuit including a battery and signaling devices and connected to the repeater, and a corresponding series of gang switches, each gang switch comprising mechanically connected switch arms 8, 9, 10, and contacts 14, 15, 16, 17, 18, 19, 20, 21, 22; said arm 8 being arranged to engage contacts 14, 15, 16 and being connected to connected contacts 14, 19 and 21 of a second switch in the series, contact 14 being connected to contacts 19 and 21 and to arm 8 of a third switch in the series, contact 15 being connected in series with the repeater to one side of the circuit, contact 16 being connected to contact 17 and through a resistance sufficient to maintain normal flow of current to the same side of the circuit; said arm 9 being arranged to engage contacts 17, 18, 19 and being connected to the other side of the circuit, contact 18 being connected to contacts 20 and 22 and to arm 10 of said second switch in the series; and said arm 10 being arranged to engage contacts 20, 21, 22 and being connected to connected contacts 18, 20 and 22 of said third switch in the series.

In testimony whereof, we affix our signatures in presence of two witnesses.

CLARENCE E. BEACH.
HERMAN W. DOUGHTY.

Witnesses:
W. R. GOUDY,
E. V. STOODLEY.