Feb. 28, 1939. J. H. WHEELOCK ET AL 2,149,200

ALARM SIGNAL SYSTEM

Filed June 4, 1934 4 Sheets-Sheet 1

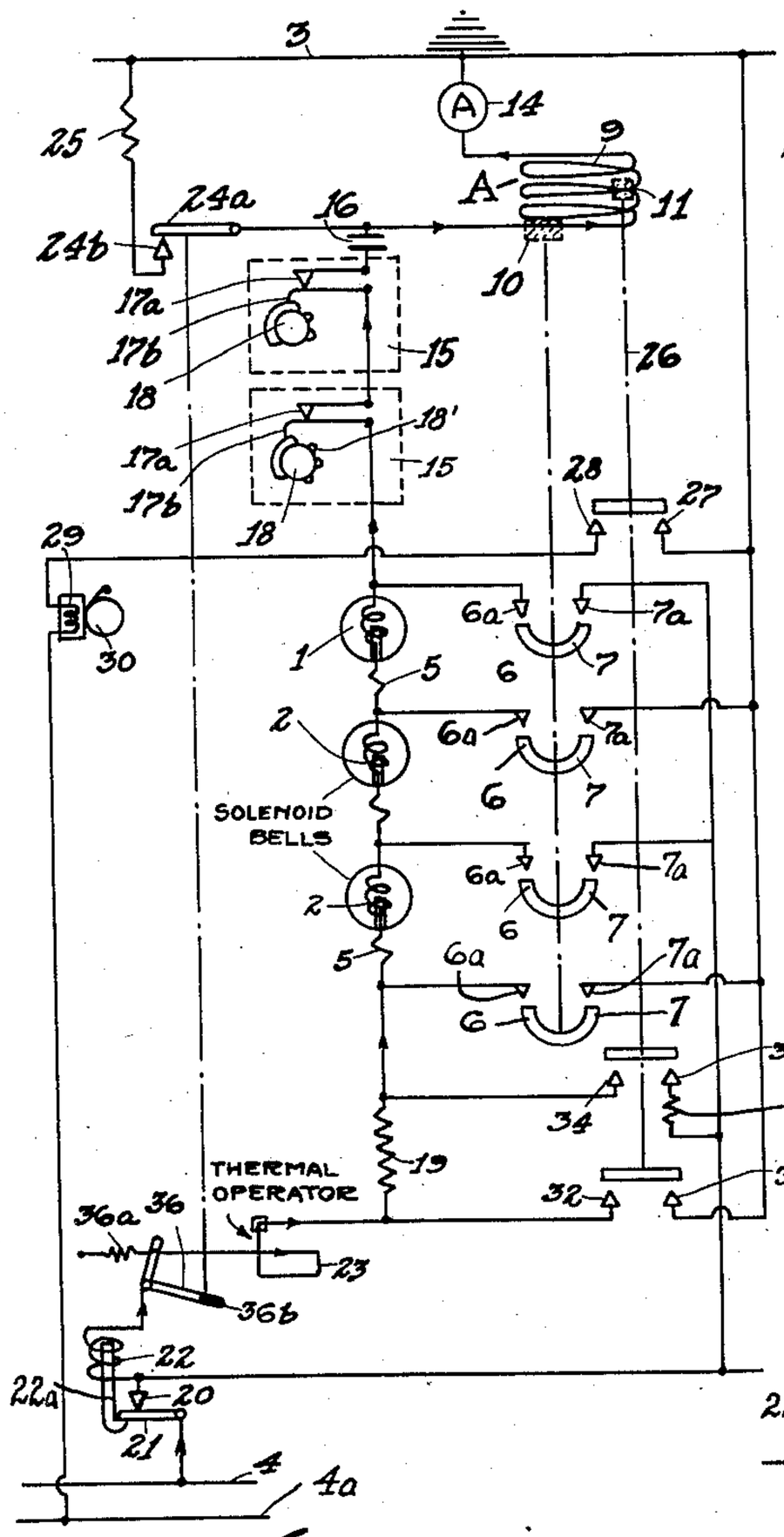

Fig. 1.

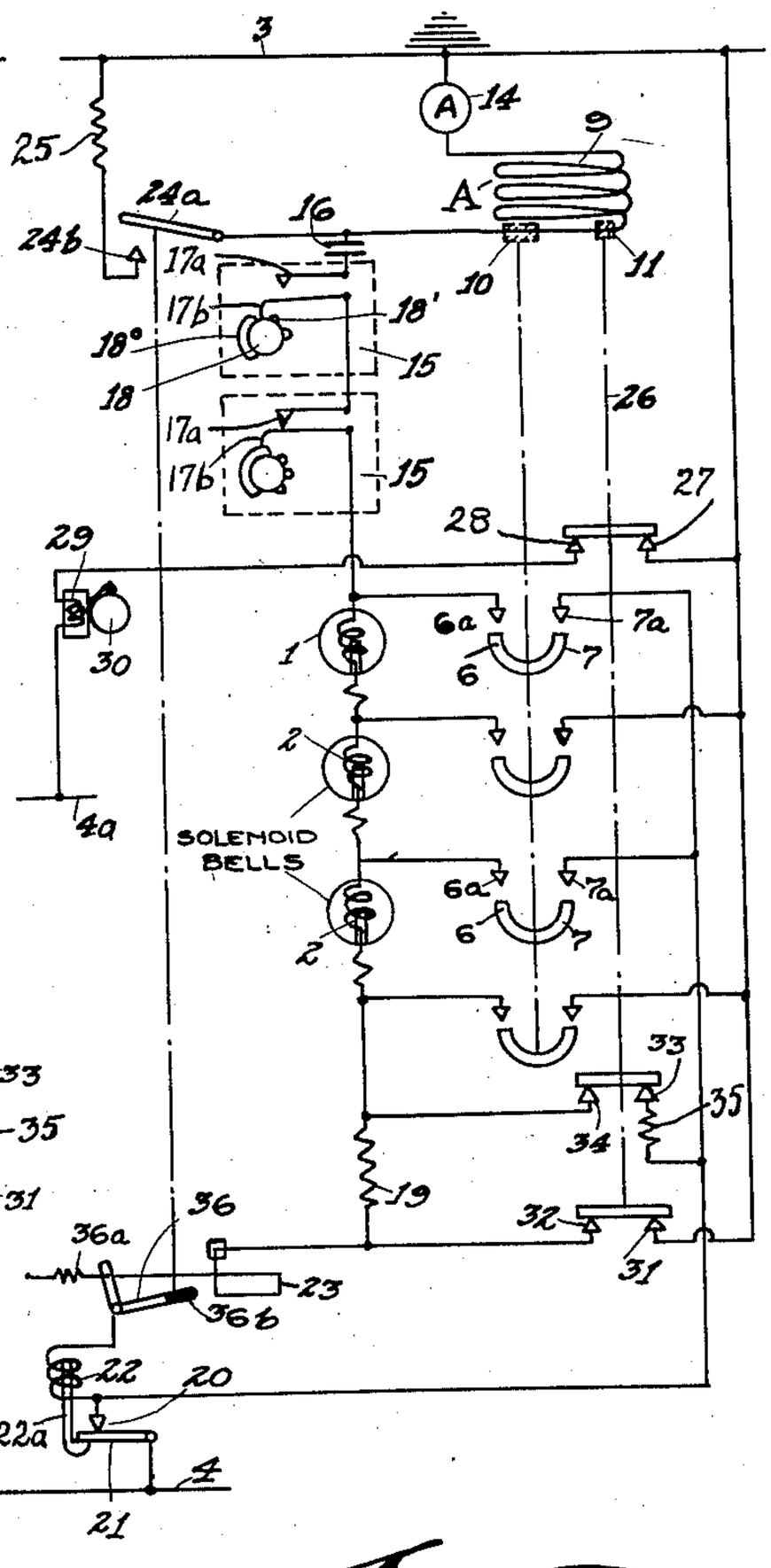

Fig. 2.

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ALARM SIGNAL SYSTEM

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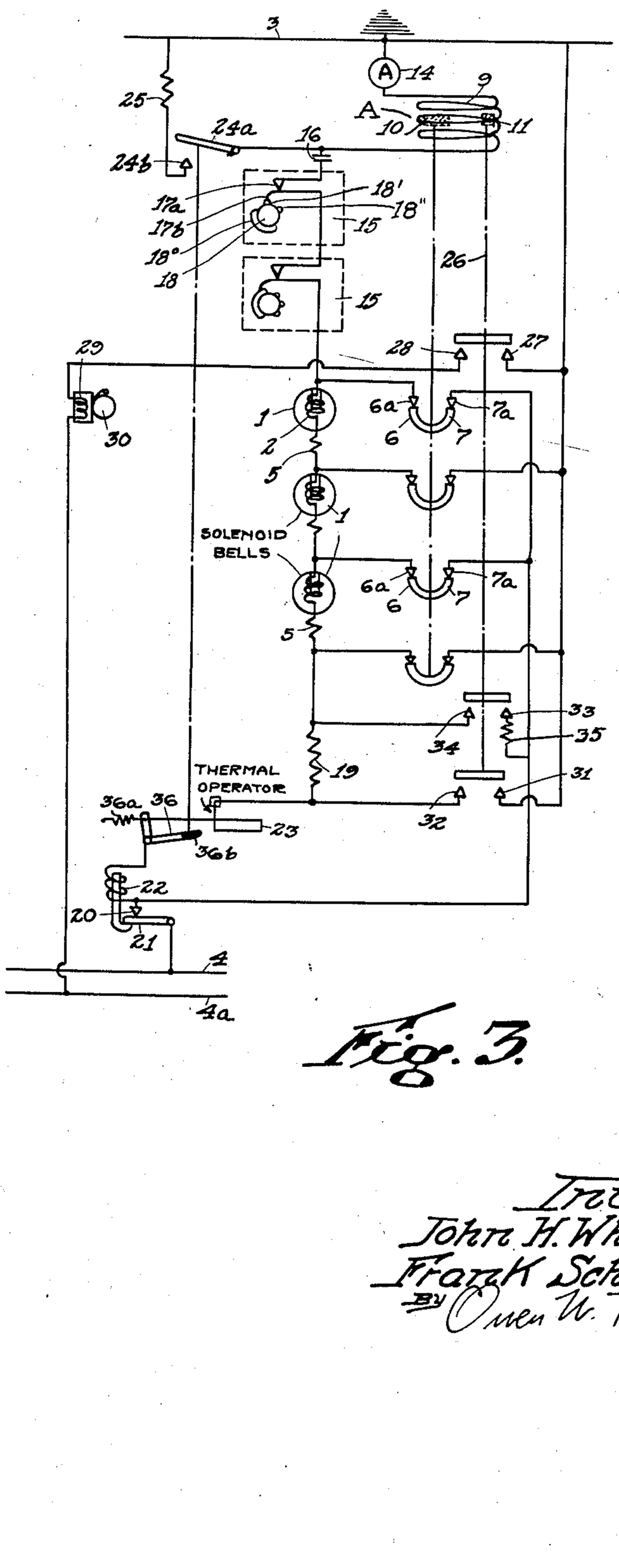

Fig. 3.

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ALARM SIGNAL SYSTEM

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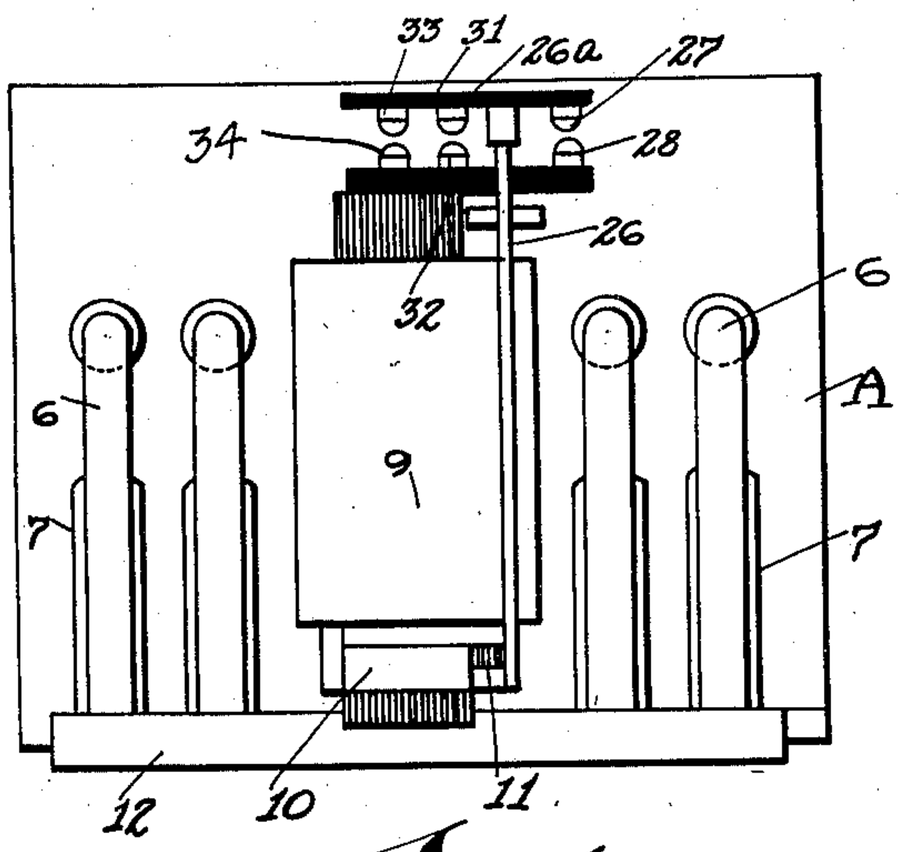

Fig. 4.

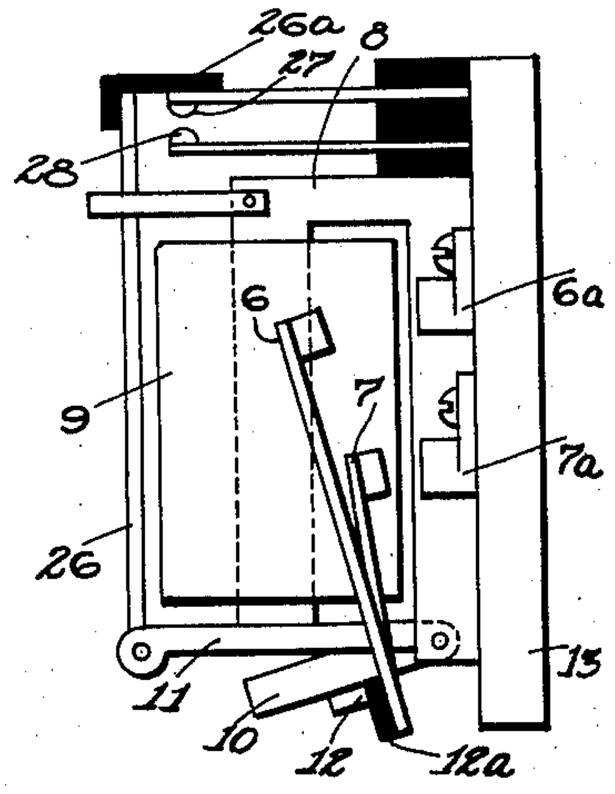

Fig. 5.

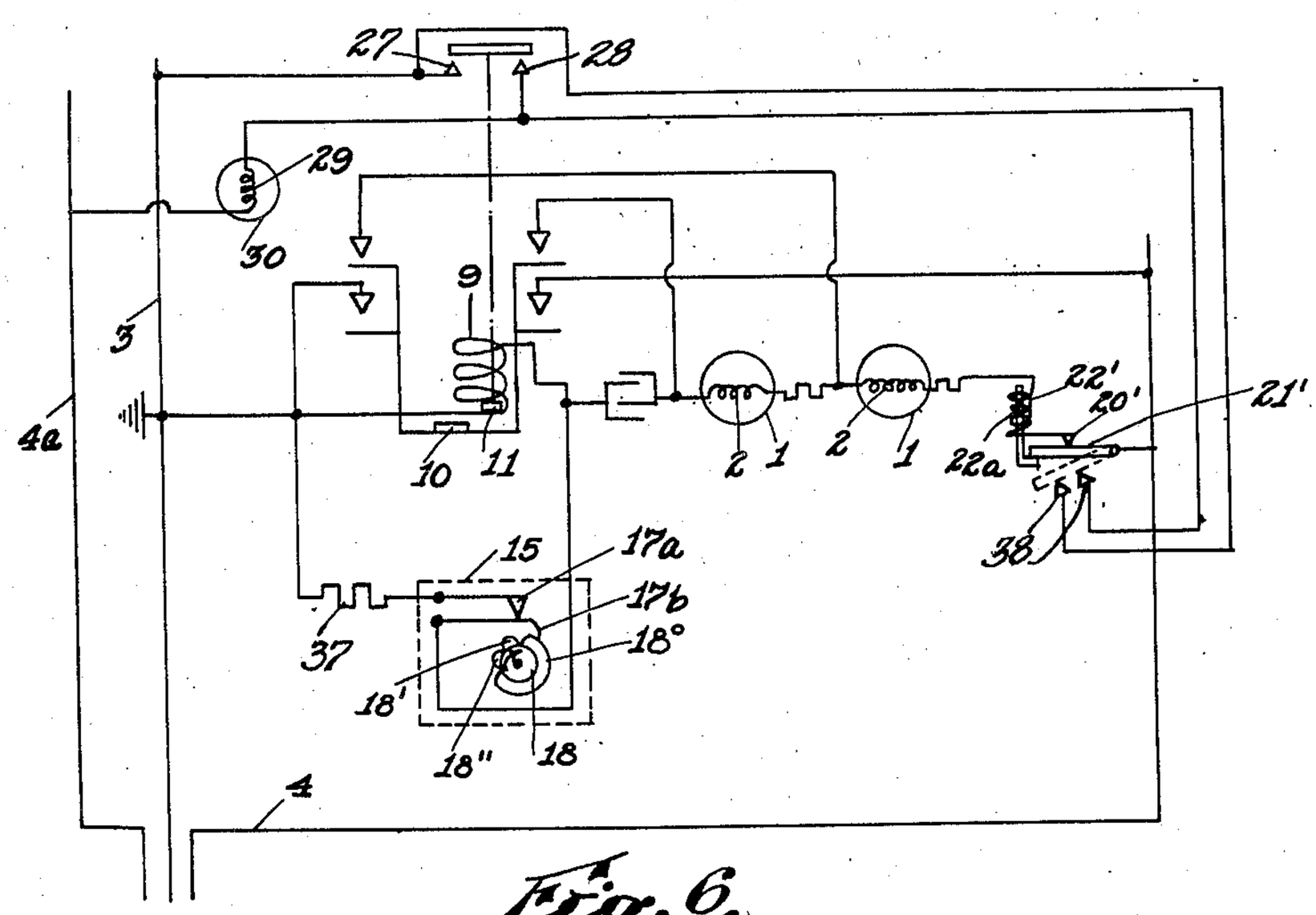

Fig. 6.

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ALARM SIGNAL SYSTEM

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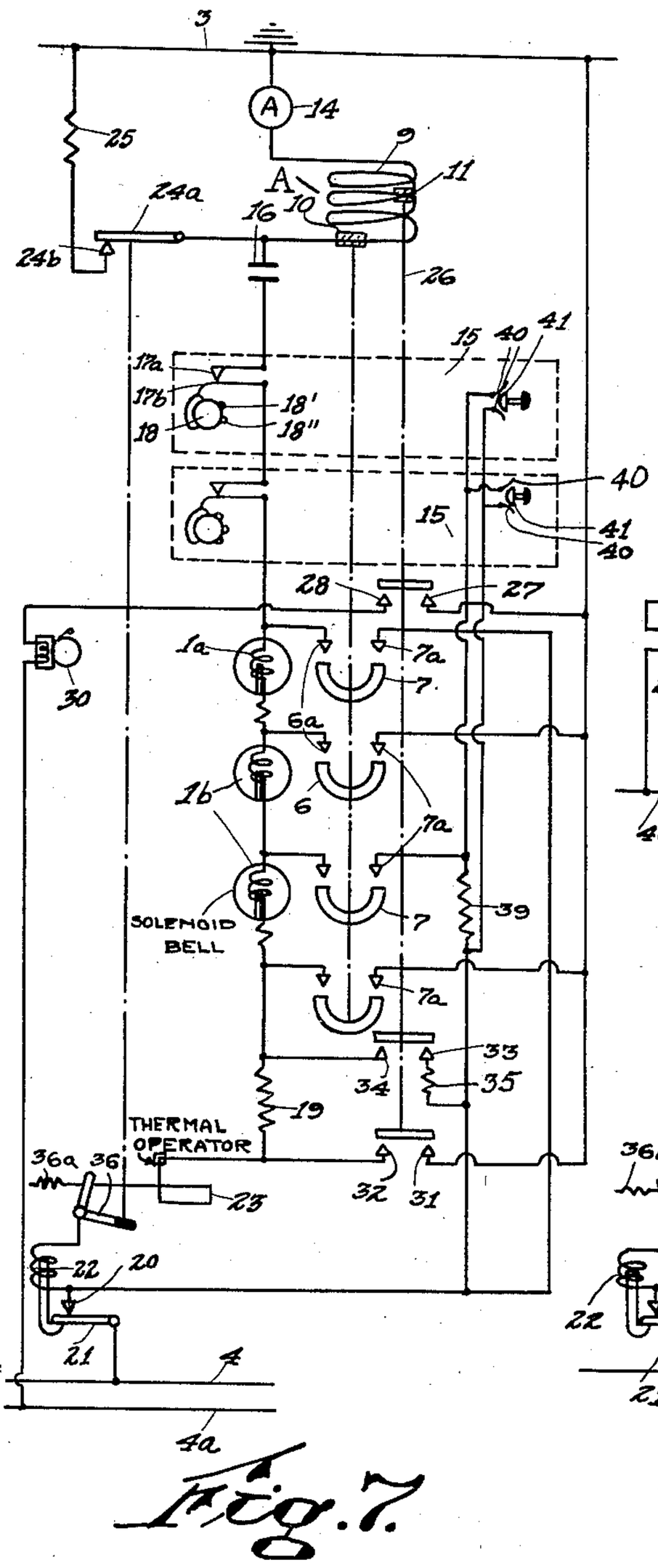

Fig. 7.

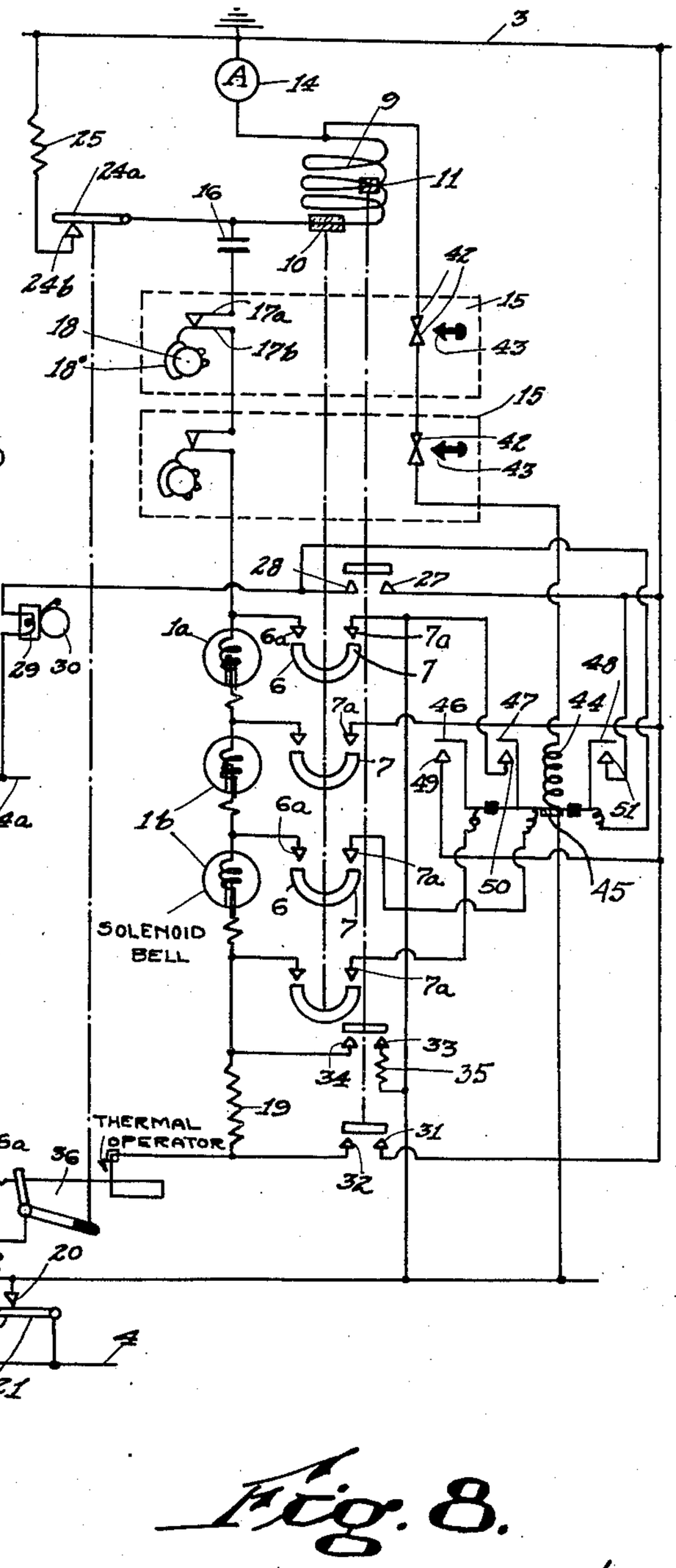

Fig. 8.

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Patented Feb. 28, 1939

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UNITED STATES PATENT OFFICE

2,149,200

ALARM SIGNAL SYSTEM

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Application June 4, 1934, Serial No. 728,812

8 Claims. (Cl. 177—360)

The present invention relates to alarm signal systems, particularly fire alarm systems, employing a number of bells, or other signals, adapted to be sounded, or otherwise operated, in response to the actuation of any one of a number of separate alarm sending stations, such alarm systems being commonly installed in schools, factories, hotels and other large buildings.

In the installation and operation of alarm signal systems, particularly fire alarm systems, certain essential conditions should be met, such as continuous electrical supervision of the various circuits of the system, so that any accidental breaks or grounds in the circuits under control or interruptions to the power supply will immediately be called to attention by the operation of a special trouble signal, distinct from the alarm signals. Furthermore, it is most desirable that the alarm signals should not be sounded upon the occurrence of any of the abnormal conditions mentioned above.

According to the present invention, there is provided an improved alarm signal system characterized by its ability to automatically indicate the occurrence of any abnormal circuit condition without operating the alarm signals, so as to give a false alarm. Furthermore, the system is characterized by the utilization of a single master controller winding, thereby enhancing its simplicity and reliability in operation, and materially reducing the cost of installation and of maintenance. The above and other advantageous features of the invention will hereinafter more fully appear from the following description with reference to the accompanying drawings, in which:

Fig. 1 is a schematic view illustrating the system in its normal inoperative condition, with continuous electrical supervision of the various circuits.

Fig. 2 is a schematic view similar to Fig. 1, illustrating the circuit relations established upon operating one of the alarm sending stations.

Fig. 3 is a schematic view illustrating the sending of the first impulse of an alarm.

Fig. 4 is a view in front elevation, showing the construction of a master circuit controlling device embodied in the system.

Fig. 5 is a view in end elevation of the device shown in Fig. 4.

Fig. 6 is a schematic view, illustrating a modification of the system.

Figs. 7 and 8 are schematic views, similar to Fig. 1, illustrating the invention embodied in a pre-signal and general alarm system.

Like reference characters refer to like parts in the different figures.

Referring first to Fig. 1, the signals 1 which are adapted to be sounded, or otherwise electrically operated in the system, for giving an alarm are shown, for purposes of illustration, as being of the single-stroke solenoid type with each providing an operating winding 2. The windings 2 of the signals 1 are adapted to be connected in sections across the supply mains 3 and 4, with balancing resistors 5 therebetween, by means of a number of pairs of relatively movable contacts 6 and 6*a*, 7 and 7*a*, with such contacts forming part of a master controller generally indicated by the reference character A.

Referring to Figs. 4 and 5, the master controller A comprises a U-shaped magnetic core 8, one leg of which is surrounded by an energizing winding 9, while the lower end of the other core leg supports a main armature 10 and an auxiliary armature 11 movable independently of the main armature on a common pivot. The main armature 10 carries a bar 12 on which are mounted, in pairs, a number of contacts 6 and 7 corresponding to the movable contacts of the several sets of contacts shown in Fig. 1 for controlling energization of the signal windings 2. These contact arms 6 and 7 are insulated from the bar 12 at 12*a* and cooperate with stationary contacts 6*a* and 7*a* mounted on an insulating base 13 carrying the master controller A. Therefore, closure of the main armature 10, in response to energization of the winding 9, is adapted to simultaneously energize the signal windings 2 in sections according to the connection of the several stationary contacts 6*a* to the signal windings 2 and the connection of the other contacts 7*a* to the supply mains 3 and 4.

Referring again to Fig. 1, the winding 9 of the master controller A is shown as having one terminal permanently connected to the supply main 3 through an ammeter 14, while the other terminal thereof is connected in series with a number of alarm sending stations 15, 15 disposed at various locations throughout the system from where it is desired to send an alarm. The stations 15 are also in circuit with the several signal windings 2, with a condenser 16 interposed between the stations 15 and the winding 9 when the supply mains are energized by alternating current. Each sending station 15 provides a pair of relatively movable contacts 17*a* and 17*b*, normally closed, so long as the station is in an inoperative condition and, for purposes of illustration, each station 15 is shown as comprising a contact actuating member 18 in the form of a cam wheel normally sta-

tionary. The function of the cam wheel 18, when rotated, is to open and close the contacts 17*a* and 17*b* to successively interrupt and re-establish the circuit through the stations 15.

Since many different types of sending stations are employed in fire alarm systems, it is unnecessary to further describe the structural details of each station 15, other than to say that normally the position of the cam wheel 18 is such as to maintain the station contacts 17*a* and 17*b* closed while the station is in its inoperative condition. Then, upon operation of the station for the purpose of sending an alarm, rotation of the cam wheel 18 momentarily separates the contacts 17*a* and 17*b*, whereupon engagement of the contacts is re-established, in accordance with the arrangement of the cam projections on the wheel 18. In other words, operation of a sending station 15 results in alternately breaking and remaking the circuit through the station contacts 17*a* and 17*b*, and obviously the cam wheel 18 can be driven through suitable operating mechanism, not shown, so as to send a number of signal impulses through the system for operating the signal windings 2 in accordance with a code, as will be hereinafter described.

With the parts of the system in the condition shown in Fig. 1, that is the normal condition in which the system is prepared to send signals, a continuous circuit is maintained from the lower terminal of the winding 9 through the closed contacts 17*a* and 17*b* of the several stations 15 in series, and from thence to the other supply main 4 through the windings 2 of the signals 1, also in series. Beyond the windings 2 the circuit to the supply main 4 also includes a resistor 19, and the normally closed contacts 20 and 21 of a time delay cut-out device comprising an operating winding 22 in circuit with one of the contacts 20. In passing to the winding 22 the current traverses the thermal element 23 of an automatic interrupter, the function of which will hereinafter appear.

The circuit interrupter of which the thermal element 23 forms a part, comprises a pair of normally closed contacts 24*a* and 24*b*, which are connected in circuit with a resistor 25 between the main 3 and the lower terminal of winding 9, so as to constitute a shunt around the controller winding. The existence of this shunt circuit permits the flow of only a small supervisory current through the winding 9 of the master controller A, as indicated by the small arrows in Fig. 1, which current also traverses the stations 15 and the signal windings 2. As a result, the winding 9 of the master controller is not energized sufficiently to pull up the main armature 10, so that the several pairs of contacts 6 and 6*a* and 7, 7*a* which control the energization of the signal windings 2 remain in an open condition.

The strength of the supervisory current flowing through the winding 9 of the master controller A is sufficient, however, to hold up the auxiliary armature 11, as shown in Fig. 5, and this armature 11 serves for a number of purposes which will next be described. The free end of the auxiliary armature 11 carries a rod 26 extending upwardly in front of the winding 9, and with the armature held up by the supervisory current, an insulating plate 26*a* at the upper end of the rod is held just clear of a resilient contact 27 that is normally spaced from a second stationary contact 28. The contact 27 is connected to the supply main 3, while the other contact 28 is connected to one terminal of the winding 29 of a trouble signal 30, such as a bell, with the other terminal of the winding 29 connected to a third supply main 4*a*. Thus, the circuit of the operating winding 29 of the trouble signal 30 is maintained in an open condition so long as the auxiliary armature 11 is held up by the flow of supervisory current through the winding 9 of the master controller A, and this is the state of affairs illustrated in Fig. 1. Obviously, any interruption in the flow of supervisory current such as would be caused by an accidental break, or ground, in the sending station or signal circuits, immediately results in the dropping back of the auxiliary armature 11, whereupon the pressure exerted by the insulating plate 26*a* at the top of the rod 26 closes the contacts 27 and 28 and energizes the winding 29 of the trouble signal.

As long as any abnormal condition in the system exists which prevents flow of supervisory current, as indicated in Fig. 1, the trouble signal 30 will sound continuously to call attention to the fact that the system is in an inoperative condition. Power is then removed from the system by deenergizing the supply mains 3, 4 and 4*a* before mending the break in the system, or clearing the ground, as the case may be, so that upon resumption of power only the flow of supervisory current through the winding 9 will be resumed. Thereupon the auxiliary armature 11 will move upwardly to the position of Fig. 5 to disconnect the trouble signal 30, without operating the signals 1.

As best shown in Fig. 4, the rod 26, in addition to controlling the contacts 27 and 28, is also adapted to control additional pairs of contacts 31, 32 and 33, 34. These pairs of contacts are similar in construction to the contacts 27 and 28, so that they remain separated so long as the attraction of the auxiliary armature 11 by supervisory current holds the rod 26 up. Upon downward movement of the rod, however, the insulating plate 26*a* causes all three upper contacts 27, 31 and 33 to engage the lower contacts 28, 32 and 34 respectively.

Referring again to Fig. 1, it will be seen that the contact 31 is connected directly to the supply main 3, while the contact 32 is connected to the signal circuit between the resistor 19 and the thermal element 23 in series with the movable contact 21 of the time delay device. The other movable contact 33 is connected to the supply main 4 through the resistor 35, with the stationary contact 34 of this pair connected in the signal circuit between the resistor 19 and the balancing resistor 5 of the last section of signal windings 2. Consequently, when the small armature 11 drops, two things happen in addition to the energization of the trouble signal 30,—namely, the establishment of a circuit directly from the main 3 through thermal element 23 and winding 22 to main 4, independently of the master controller winding 9, and the establishment of a circuit from the main 4 to the terminal of the signal winding circuit farthest removed from the controller winding 9, independently of the winding 22 and thermal element 23.

Let it now be assumed that one of the stations 15 is operated for the purpose of giving an alarm by the system, thereby momentarily opening a pair of station contacts 17*a* and 17*b*, as indicated in Fig. 2. When this occurs, the flow of supervisory current through the winding 9 is interrupted, whereupon the auxiliary armature 11 drops back as indicated, to cause engagement of the several contacts 27, 31 and 33 with the cooperating contacts 28, 32 and 34 respectively. In Fig. 2 such engagement between the contacts is indicated by showing bridging members mov-

able with the auxiliary armature 11. This action operates the trouble signal 30, and in addition causes an increased current to flow through the thermal element 23 and winding 22 through the then closed contacts 31 and 32. One end of the thermal element 23 is anchored, while its other end is connected to a pivotally mounted arm 36, and at ordinary room temperature the tension of the thermal element 23 maintains an insulated tip 36*b* at the free end of this arm 36 below the end of the upper contact 24*a* in the circuit of the shunt resistor 25. As the increased current flows through the thermal element 23, it expands and a spring 36*a* acting on the arm 36 swings the end of the arm upwardly until it lifts contact 24*a* out of engagement with contact 24*b*. The thermal element 23 is so adjusted that the arm 36 separates the contacts 24*a* and 24*b* almost immediately after the small armature 11 drops upon breaking of the box circuit, so that the shunt resistor 25 is removed from the lower terminal of the master controller winding 9 before the station contacts 17*a* and 17*b* are reclosed by rotation of the cam wheel 18 in response to operation of the station, as indicated in Fig. 3.

Upon re-closure of the box contacts 17*a* and 17*b* following the operation of a sending station 15, an increased current flows through the master controller winding 9, due to the removal of the shunt resistor 25 and the previous closure of contacts 33 and 34 which has established a direct circuit to the supply main 4 from the last signal circuit resistor 5. The main armature 10 thereupon pulls up as shown in Fig. 3, to close the several pairs of master controller contacts 6, 6*a* and 7, 7*a* to simultaneously energize the windings 2 of all of the signals 1. This gives the first signal impulse of the code, as determined by the projection 18′ on cam wheel 18 of the station 15 which has been operated. While the closure of the main armature 10 is accompanied by closure of the auxiliary armature 11, the opening of the contacts 33 and 34 as the auxiliary armature 11 reaches its upper position does not interrupt the circuit of the master controller winding 9, owing to the fact that previous closure of the upper pair of master controller contacts 6, 6*a* and 7, 7*a* establishes a holding circuit for the controller winding 9 direct to the supply main 4. Furthermore, opening of contacts 31 and 32 does not affect the open circuit of shunt resistor 25, since the element 23 has only partly cooled and contacts 24*a* and 24*b* are still open, see Fig. 3.

Continued rotation of the cam wheel 18 following the sending of the first signal impulse results in separation of the station contacts 17*a* and 17*b*, whereupon both armatures 10 and 11 drop to open the signal energizing contacts and reclose the several pairs of contacts under the control of the rod 26. In this interval between the first and second signal impulses, during which the master controller winding 9 is entirely deenergized, the re-closure of contacts 31 and 32 again sends current through the thermal element 23, thereby again heating the element 23 and preventing its continued contraction from permitting the arm 36 to re-close the shunt controlling contacts 24*a* and 24*b*. Therefore, upon re-closure of the station contacts 17*a* and 17*b* by projection 18″, the shunt resistor 25 is still out of circuit and a relatively heavy current flows through the main controller winding 9 to again energize all the signal windings 2 and send the second signal impulse. Since the cam wheel 18 shown in the first sending station 15 provides only two cam projections 18′ and 18″, in addition to the holding projection 18°, continued rotation of the cam wheel to close contacts 17*a* and 17*b* by the projection 18°, results in the sounding of only one more signal sequence impulse to complete sending of the signal "three".

Following sending of the signals by the station which has been operated in the manner described above, the station contacts 17*a* and 17*b* are held closed by the projection 18° until the cam wheel 18 comes to rest after one or more complete revolutions with the projection 18° in the same angular position as at the start, as indicated in Fig. 1. This final re-closure of the station contacts by projection 18° pulls up both armatures 10 and 11 and the resulting cooling of element 23 causes closure of contacts 24*a* and 24*b* to reconnect the shunt resistor 25 across the terminals of the controller winding 9. This action occurs only after the contacts 31 and 32 have been opened an appreciable time by the lifting of the rod 26, cooling and contraction of the thermal element 23 serving to swing the arm 36 downwardly to permit the contact 24*a* to reengage the contact 24*b*. Upon this restoration of the circuit of the shunting resistor 25, the current flowing through the winding 9 is reduced to such a value that the main armature 10 falls, while the supervisory current continues to flow through the winding and maintain the system in the condition shown in Fig. 1, preparatory to sending another alarm upon operation of any one of the sending stations 15.

As previously pointed out, it is one of the principal objects of the present invention to provide an alarm system in which the alarm signals will not be operated upon the occurrence of any abnormal circuit condition, so as to sound a false alarm, the invention contemplating the operation of only the trouble signal 30 upon the occurrence of any such condition. For example, should a ground occur in any of the sending stations or in any of the signal circuits, this will have the effect of cutting out the winding 9, since one terminal thereof is grounded through the supply main 3. Furthermore, the resistor 19 between the ungrounded main 4 and the signals 1, will prevent operation of the signals from a ground in any signal circuit. The resulting interruption of the supervisory current through the winding causes the auxiliary armature 11 to drop thereby operating the trouble signal 30 through closure of the contacts 27 and 28. As previously pointed out, dropping of the armature 11 also closes contacts 31 and 32, thereby throwing both the winding 22 and the thermal element 23 across the mains 3 and 4, see Fig. 2.

Assuming that the ground is maintained for any appreciable length of time, the resulting opening of the shunt resistor contacts 24*a* and 24*b* due to expansion of the thermal element 23 will have no effect since winding 9 is grounded out. Furthermore, a sustained ground is followed by functioning of the time delay device to automatically open the contacts 20 and 21. One way of accomplishing this result is by causing the heat generated in the winding 22 which is of relatively low resistance to be conveyed to a bi-thermal latch member 22*a* normally holding the contacts 20 and 21 closed, which member 22*a* upon flexure due to unequal expansion unlatches the contact 21. This separation of contacts 20 and 21 immediately deenergizes the thermal element 23, and its resulting contraction permits reclosure of contacts 24*a* and 24*b* to maintain the

resistor 25 shunted across the terminals of winding 9.

Therefore, upon clearing of the ground following indication thereof by the sounding of the trouble signal 30, the alarm signals will not be sounded to give a false alarm upon re-closure of the contacts 20 and 21 manually. In fact, until the contacts 20 and 21 are re-closed following release of the contact 21 by the latch member 22*a*, the trouble signal will continue to sound to indicate that the system is still in an inoperative condition. Consequently, re-closure of the contacts 20 and 21 has only the effect of restoring the flow of supervisory current through the winding 9 to pull up the small armature 11 and disconnect the trouble signal 30.

Similarly, upon the occurrence of an open circuit in the system, as by breakage of a wire in any of the sending stations or signal circuits, dropping of the small armature 11 will immediately sound the trouble signal 30. This trouble indication is also followed, after a predetermined interval, by automatic operation of the bi-thermal latch member 22*a* to disconnect the thermal element 23 from the supply main 3 in the manner previously described, so that upon repair of the open circuit, the alarm signals will not be sounded upon re-closure of the contacts 20 and 21. Therefore, the net result of the occurrence of any abnormal condition in the system, such as a ground or open circuit, is the energization of the trouble signal 30, which of course may be either audible or visual or both, and is operated without any possibility of the alarm signals being sounded prematurely, either upon occurrence of the abnormal circuit condition or upon remedying the same.

Upon any interruption of the power source supplying the mains 3 and 4, obviously both relay armatures 10 and 11 will fall, but closure of the contacts 31 and 32 has no effect on the thermal element 23, since the power main 3 then is dead. Therefore, upon resumption of the power supplied to the mains 3 and 4, only the small armature 11 will pull up in response to flow of supervisory current, since the shunt resistor 25 has remained across the terminals of the winding 9 during the period of power interruption. Therefore, there will be no premature ringing of the alarm signals to give a false alarm, as a result of any interruption and subsequent resumption of the power source.

Referring now to Fig. 6, there is shown a modification of the system wherein the circuits are simplified, although the modified arrangement does not display quite the same supervision and responsiveness to abnormal circuit conditions, as compared to the arrangement of Fig. 1. In the modified arrangement, like reference characters are applied to the same elements that have been previously described with reference to Fig. 1, and the principal difference between the arrangements of Fig. 6 and Fig. 1 resides in connecting the sending stations 15 across the terminals of the main controller winding 9. A shunt resistor 37 of lower value than the resistance of winding 9 is connected in series with the sending stations 15, so that the current passing through the winding 9 is reduced to a low value, and only the small armature 11 is held up. As a result, the several alarm signal circuits including the windings 2 are supervised, so that any break or ground in these circuits causes the armature 11 to drop and energize the trouble signal 30 through closure of contacts 27 and 28.

Upon operation of a sending station 15, the initial separation of the station contacts 17*a* and 17*b* removes the effect of the shunt resistor 37 from the controller winding 9, so that the increased current flowing through the winding 9 pulls up the main armature 10. This results in the sending of a signal impulse through the system upon energization of the signal windings 2. Continued rotation of the cam wheel 18 of the station 15 which has been operated causes reclosure of the contacts 17*a* and 17*b*, thereby restoring the shunt circuit for the winding 9. When this occurs, the main armature 10 drops to deenergize the signal windings 2 and to place the system in condition for sending another signal impulse. When the station contacts 17*a* and 17*b* again separate, due to continued rotation of the cam wheel, the increased current through the controller winding 9 again draws up the armature 10 to send a second signal impulse, and this action is repeated in accordance with the number of cam projections on the wheel 18.

Thus the signal impulses are sent on the breaking of the circuit between the station contacts, rather than upon the re-closure of the station contacts, as previously described with reference to Fig. 1. As the cam wheel 18 comes to rest with the cam projection 18° holding the station contacts closed, the shunt resistor 37 is restored to the circuit and the main armature 10 remains in its lower position, preparatory to the next operation of the sending station 15. Obviously, the simplified arrangement of Fig. 6 is equally effective with the arrangement of Fig. 1 in the sending of signal impulses, with only somewhat lessened supervision of the circuits of the sending stations 15. That is to say, any breaks in the sending station circuits will give one impulse of the alarm signals, due to the continuous energization of the controller winding 9 with full current.

In order to disconnect the signal circuits from the source following an accidental break in any of the sending station circuits, the operating winding 22′ of a time delay cut-out device is connected between the last signal circuit and the main 4, with its contacts 20′ and 21′ normally held closed by the bi-thermal member 22*a*. Therefore, continued flow of full current through the master controller winding 9 will automatically result in disconnection of the signal circuits from the main 4 upon release of the contacts 20′ and 21′ after the predetermined interval. In order to indicate the existence of such a condition, a pair of spaced contacts 38 are disposed in position to be bridged by the movable contact 21′ of the time delay device upon release of this contact 21′ by the bi-thermal member 22*a*. These contacts 38 are connected in shunt relation with the contacts 27 and 28 under the control of the auxiliary armature 11, so that their closure establishes the circuit of the trouble signal 30 in the same manner as would closure of the contacts 27 and 28. Therefore, any breaks in the sending station circuits will first result in one impulse of the alarm signals, followed by operation of the trouble signal to indicate the abnormal condition, immediately upon functioning of the time delay cut-out device to disconnect the alarm signal circuits from the source.

Referring now to Figs. 7 and 8, there is shown the functioning of the signal system for the sending of a pre-signal in advance of a general alarm, with the system adapted to be operated by a master controller in substantially the same

manner as previously described with reference to Figs. 1, 2 and 3. In Fig. 7, only one section of signals 1*a*, hereafter called the "pre-signals", is adapted to be connected directly to the supply main 4 upon closure of the related contacts 6, 6*a* and 7, 7*a*. The remaining sections of signals 1*b*, hereafter called the "general alarm signals", are normally adapted to be connected to the supply main 4 only through a blocking resistor 39 of such value as to prevent operation of the signals 1*b* upon closure of the particular contacts 6, 6*a* and 7, 7*a* associated with these signals. The pre-signals 1*a* are located at various designated points throughout the system, while the general alarm signals 1*b* are much more widely distributed, and the invention contemplates the operation of the pre-signals 1*a* only, upon actuating any sending station 15 followed by operation of the general alarm signals 1*b*, only in the event that conditions warrant the sounding of a general alarm throughout the system.

To this end, each sending station 15 provides a pair of auxiliary contacts 40 normally open, with the contacts connected in parallel relation across the terminals of the blocking resistor 39. Each pair of contacts 40 has associated therewith a manually operated key 41, indicated as being in the form of a push button, and it is obvious that the bridging of either pair of contacts 40 by either key 41 will provide a shunt circuit around the resistor 39 to the supply main 4.

Assuming now that the signal system is in the condition shown in Fig. 7, that is, with all of the sending station circuits unbroken and with the several pairs of auxiliary stationary contacts 40 open, it is evident that only a small supervisory current will flow through the master controller winding 9 just as previously described with reference to Fig. 1. Assuming next that one of the sending stations 15 is operated for the purpose of sounding an alarm, it is obvious that turning of its cam wheel 18 will result in closure of the master controller contacts 6, 6*a* and 7, 7*a* upon full energization of the winding 9, as the code determining projections 18', 18'' etc. operate the station contacts 17*a* and 17*b*. However, such closures of the contacts 6, 6*a* and 7, 7*a* result in energization of only the pre-signals 1*a*, due to the fact that the flow of energizing current through the general alarm signals 1*b* is restricted by the blocking resistor 39. In other words, normal operation of any one of the sending stations 15 results in only sounding the pre-signals 1*a* as they may be distributed in various locations throughout the system.

Assuming that the pre-signals 1*a* have started to sound in response to the operation of any sending station 15, as described above, the usual procedure in a system of this type is for one or more persons in authority to immediately proceed to the station which has been operated as indicated by the code designation. Then should it be determined that the fire, or whatever emergency has caused operation of the signal, is of such a nature as to warrant the sounding of a general alarm throughout the system, it is only necessary to depress the key 41 of the station which has just been operated, or of any other station in the system, in order to sound a general alarm. Since under ordinary conditions, the particular station initially operated to sound the pre-signals 1*a* has completed at least one round of pre-signals by the time the persons in authority reach this station, the usual procedure for sounding a general alarm is not to operate the key 41 until one or more rounds of the code sequence have been completed, or the station has run down. Then the key 41 is operated to close the contacts 40, followed by re-winding of the station, if necessary. Since closure of the contacts 40 by the key 41 establishes a shunt circuit around the resistor 39 direct to the supply main 4, it necessarily follows that the next succeeding round of signal impulses will operate not only the pre-signals 1*a*, but also all the general alarm signals 1*b* in unison. Upon completion of the sounding of one or more rounds of general alarm signals as desired, release of the key 41 at the station being operated breaks the circuit between auxiliary station contacts 40 and restores the system to its normal condition in which only the pre-signals 1*a* will be operated upon any succeeding actuation of a sending station.

Referring now to Fig. 8, there is shown a modification of the pre-signal system described above, in which the auxiliary contacts provided at the sending stations for the purpose of sending a general alarm are supervised. To this end, each sending station 15 provides a pair of auxiliary contacts 42 which are normally closed, although adapted to be opened by the manual operation of a key 43. The contacts 42 are connected in series with one terminal of a winding 44 of a relay, the other terminal of which is connected directly to the supply main 4. An armature 45 responsive to energization of the winding 44 carries a series of contact arms 46, 47 and 48 insulated from each other, and as long as the winding 44 is energized, these arms are held out of engagement with spaced stationary contacts 49, 50 and 51 respectively.

One stationary contact 49 is connected to the supply main 3, while another stationary contact 50 is connected to the supply main 4, and the corresponding movable contacts 46 and 47, respectively, are connected to the stationary contacts 7*a* leading to the sections of general alarm signals 1*b*. The other pair of relatively movable contacts 48 and 51 of the relay are connected in parallel with the contacts 27 and 28 which control energization of the trouble signal 30.

With the apparatus connected as shown in Fig. 8, the flow of supervisory current through the closed auxiliary station contacts 42 and the winding 44 hold up the armature 45, so that upon the operation of any box station 15, only the pre-signals 1*a* are energized through closure of the two upper pairs of master controller contacts 6, 6*a* and 7, 7*a*. Obviously, closure of the remaining pairs of master controller contacts has no effect on the general alarm signals 1*b*, owing to the fact that contact arms 46 and 47 are held out of engagement with stationary contacts 49 and 50, respectively, by the armature 45. However, upon separation of the auxiliary contacts of the station being operated by the key 43, the resulting deenergization of the relay winding 44 permits the contacts 46, 49 and 47, 50 to engage, thereby connecting the sections of the general alarm signals 1*b* for operation in unison with the pre-signals 1*a*.

Since closure of contacts 48 and 51 serves to establish a closed circuit around the normally open trouble signal contacts 27 and 28, it follows that the trouble signal 30 will be operated upon any break in the circuit of the winding 44. In other words, the trouble signal 30 will be operated upon any break in the supervisory circuit extending through the auxiliary sending station contacts 42, irrespective of whether this

break be caused by accidental means, or by the operation of a key **43** for sending a general alarm.

From the foregoing, it is apparent that by the present invention there is provided an improved supervised alarm signal system of either the presignal or general alarm type characterized by its ability to automatically indicate the occurrence of any abnormal circuit condition, without operating the alarm signals so as to give a false alarm. Due to the utilization of a single energizing winding for the master controller, the simplicity and reliability of the system is greatly enhanced.

We claim:

1. In an electric signalling system, the combination with transmitting stations including normally closed contacts and means for repeatedly opening and closing said contacts upon actuation of a station, signals, a controller having a winding in a closed supervisory circuit including said stations and signals, and signal energizing circuits including normally open contacts operable by said controller, with the flow of supervisory current through said controller winding being insufficient to close its contacts, of means responsive to each successive opening and closing of the circuit through the contacts of an actuated station to increase the energization of said controller winding and cause said controller contacts to close said signal circuits.

2. In an electric signalling system, the combination of a pair of supply mains, one of which is grounded, transmitting stations including normally closed contacts and means for repeatedly opening and closing said contacts upon actuation of a station, signals, and a controller having a winding in a closed supervisory circuit including said station contacts and signals, with one terminal of said winding connected to the grounded main, and signal energizing circuits including normally open contacts operable by said controller, with the flow of supervisory current to said controller winding being insufficient to close its contacts, of a resistor in the supervisory circuit between the ungrounded main and said signals to prevent operation of said signals upon grounding of a signal, with said controller contacts open.

3. In an electric signalling system, the combination with impulse-transmitting stations providing normally closed contacts and means for repeatedly opening and closing said contacts upon actuation of a station, signals, a controller having a winding in a closed supervisory circuit including said station contacts and signals, and signal energizing circuits including normally open contacts operable by said controller, with the flow of supervisory current through said controller winding being insufficient to close its contacts, of means responsive to the opening and closing of the contacts of an actuated station to increase the energization of said controller winding and cause its contacts to close said signal circuits.

4. In an electric signalling system, the combination with impulse-transmitting stations providing normally closed contacts and means for repeatedly opening and closing said contacts upon actuation of a station, signals, a controller having a winding in a closed supervisory circuit including said station contacts and signals, and signal energizing circuits including normally open contacts operable by said controller, with the flow of supervisory current through said controller winding being insufficient to close its contacts, of means responsive to the opening and closing of the contacts of an actuated station to increase the energization of said controller winding and cause its contacts to close said signal circuits, a trouble indicating signal and means responsive to any interruption of the flow of supervisory current through said controller winding to indicate such interruption of the energization of said trouble indicating signal, with said signal energizing circuits remaining open.

5. In an electric signalling system, the combination with impulse-transmitting stations providing normally closed contacts and means for repeatedly opening and closing said contacts upon actuation of a station, signals, a controller having a winding in a closed supervisory circuit including said station contacts and signals, and signal energizing circuits including normally open contacts operable by said controller, with the flow of supervisory current through said controller winding being insufficient to close its contacts, of means responsive to the opening and closing of the contacts of an actuated station to increase the energization of said controller winding and cause closure of its contacts, and means in the energizing circuits of certain of said signals to prevent their operation upon initial closure of said controller contacts.

6. In an electric signalling system, the combination with impulse-transmitting stations providing normally closed contacts and means for repeatedly opening and closing said contacts upon actuation of a station, signals, a controller having a winding in a closed supervisory circuit including said station contacts and signals, and signal energizing circuits including normally open contacts operable by said controller, with the flow of supervisory current through said controller winding being insufficient to close its contacts, of means responsive to the opening and closing of the contacts of an actuated station to increase the energization of said controller winding and cause closure of its contacts, a resistance in the energizing circuits of certain of said signals to prevent their operation upon initial closure of said controller contacts, and additional contacts at the actuated station to cut out said resistance and permit said first-named signals to be energized simultaneously with the other signals upon subsequent closure of said controller contacts.

7. In an electric signalling system, the combination with transmitting stations, including normally closed contacts and means for repeatedly opening and closing said contacts upon actuation of a station, signals, a controller providing normally open contacts and a winding in a closed supervisory circuit including said station contacts and signals, and normally open signal energizing circuits including the open contacts of said controller, with the flow of supervisory current through said controller winding being insufficient to close said controller contacts, of means responsive to the actuation of a station to interrupt the flow of supervisory current through the station contacts and to bring about an increase in the energization of said controller winding and cause its contacts to close said signal circuits.

8. In an electric signalling system, the combination with transmitting stations including normally closed contacts and means for repeatedly opening and closing said contacts upon actuation of a station, signals, a controller providing normally open contacts and a winding in a closed

supervisory circuit including said station contacts and signals, and normally open signal energizing circuits including the open contacts of said controller, with the flow of supervisory current through said controller winding being insufficient to close said controller contacts, of means responsive to the opening and closing of the contacts of an actuated station to interrupt the flow of supervisory current through the station contacts and to bring about an increase in the energization of said controller winding and cause its contacts to close said signal circuits, and means including part of the magnetic circuit of said controller and responsive to any interruption of the flow of supervisory current through said controller winding to indicate the occurrence of a fault in the system, with said signal energizing circuits remaining open.

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