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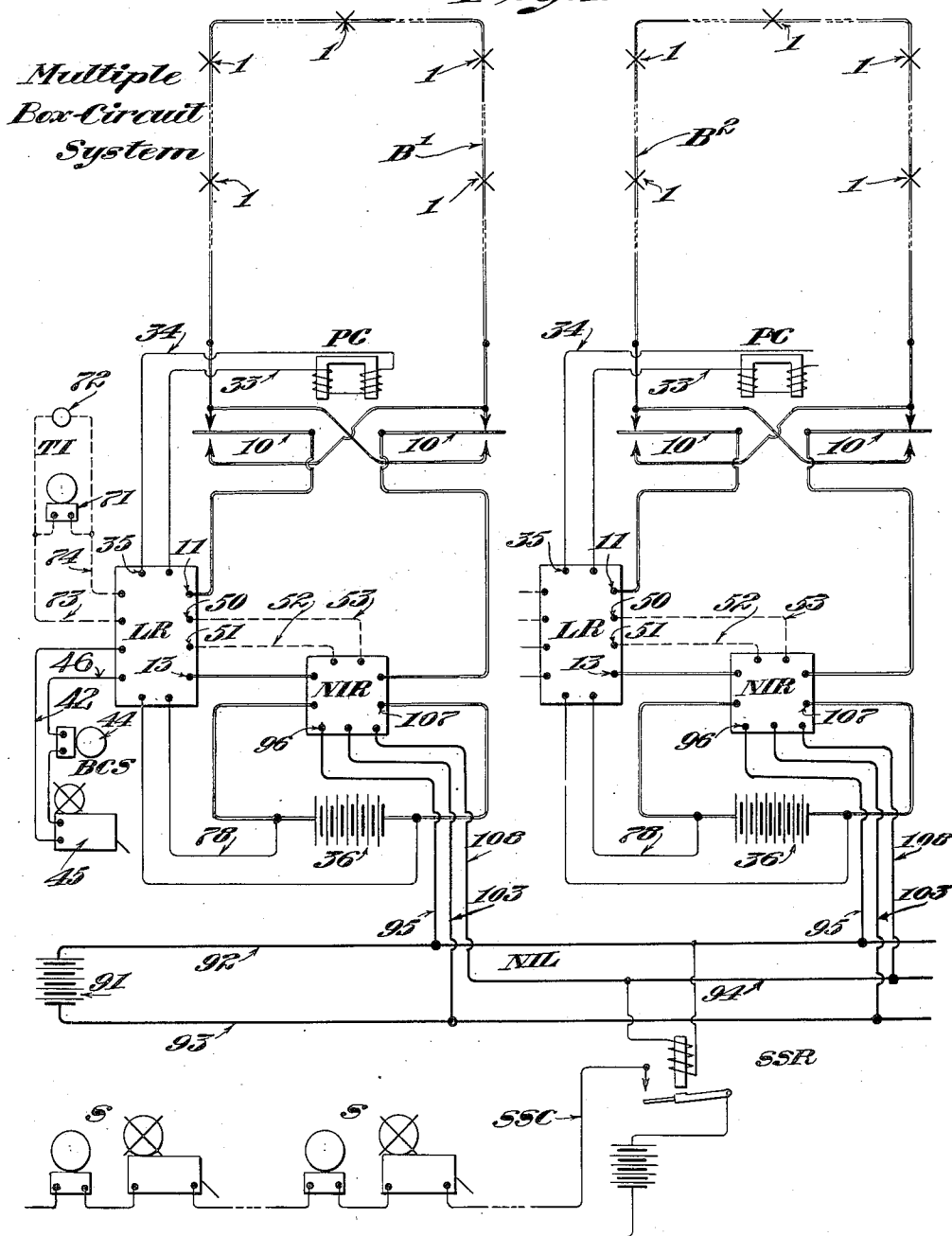
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1,786,524

FIRE ALARM SYSTEM

Original Filed June 23, 1922 7 Sheets-Sheet 1

Fig. 1



Witness
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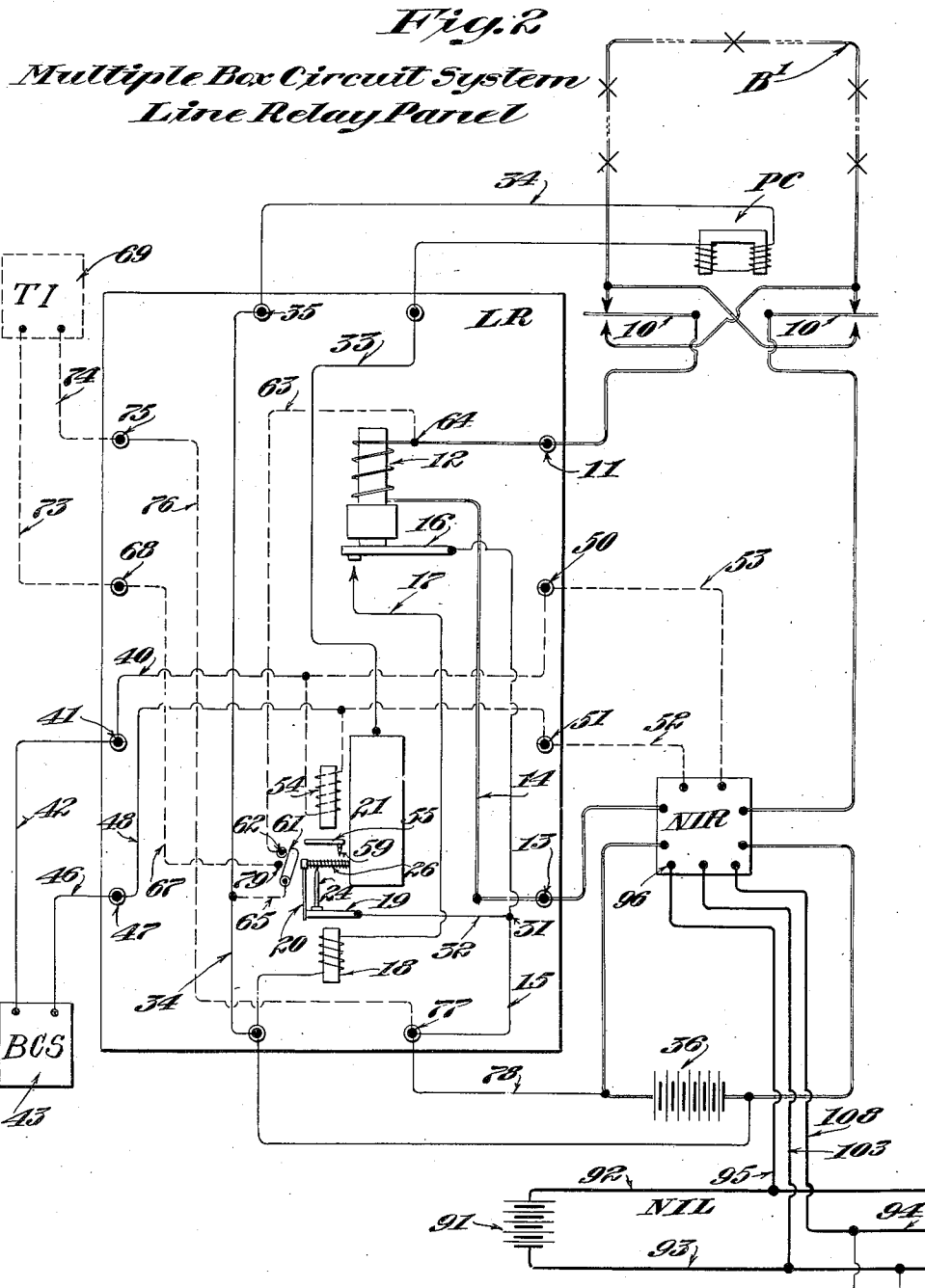
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FIRE ALARM SYSTEM

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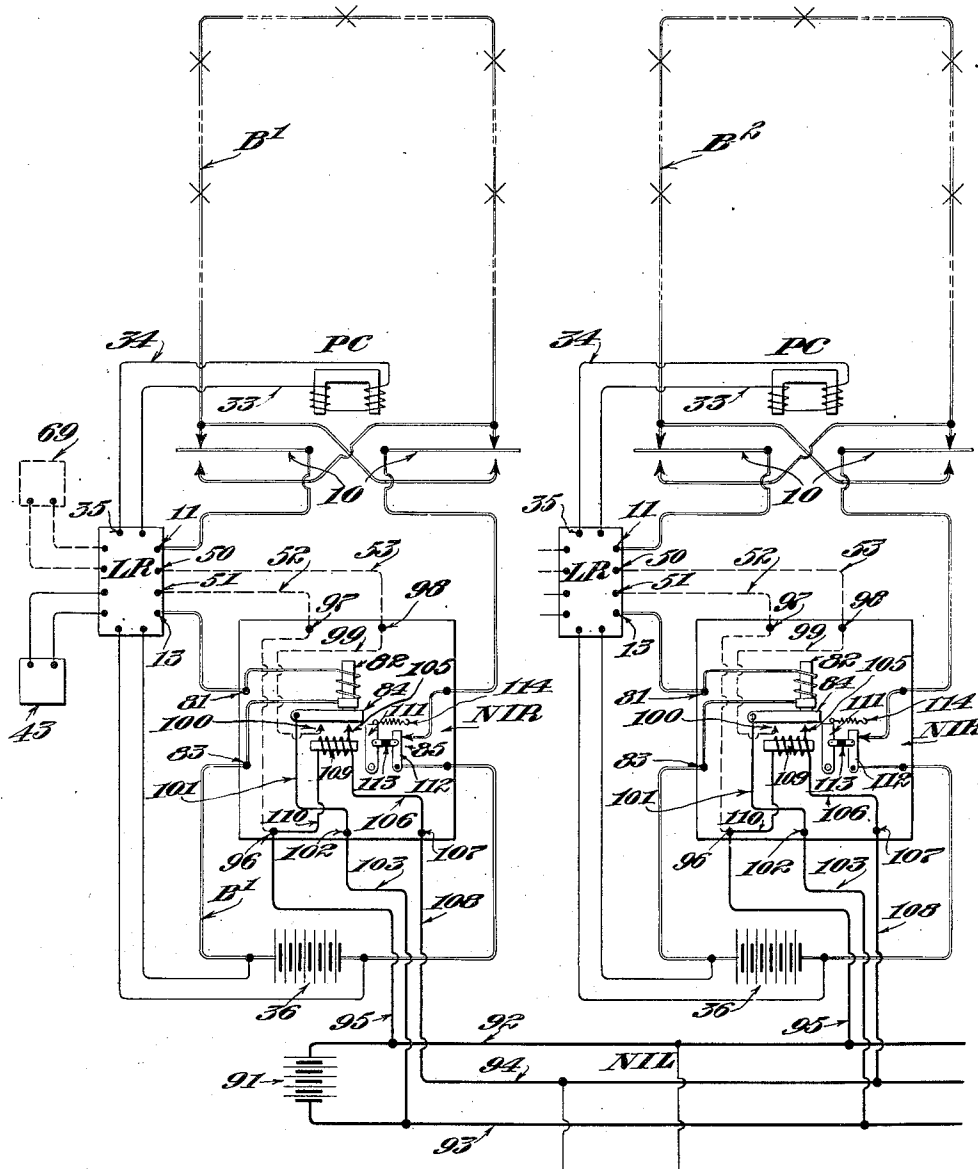
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FIRE ALARM SYSTEM

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Fig. 3



*Multiple Box Circuit System
Non-Interfering Relay Panel*

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FIRE ALARM SYSTEM.

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Fig. 4

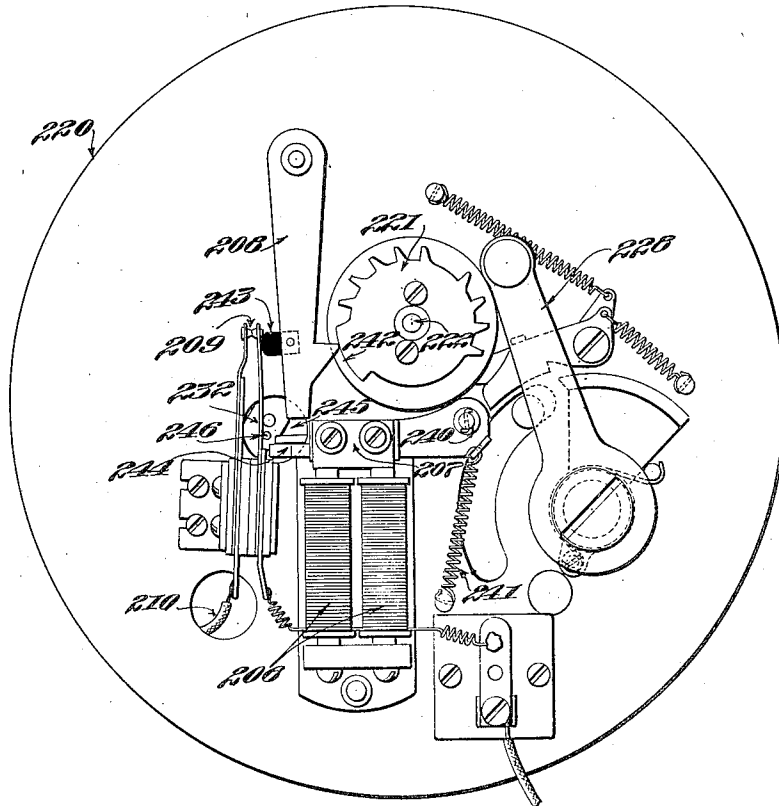
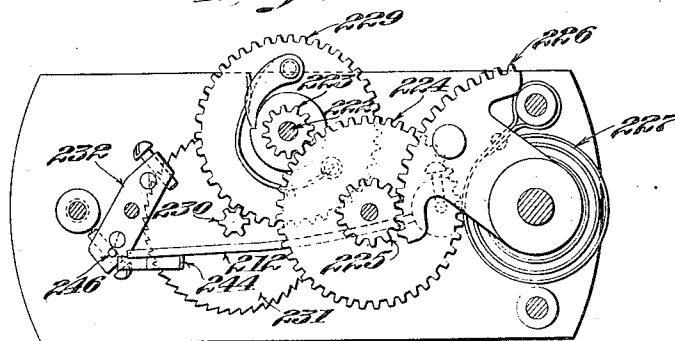


Fig. 7



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FIRE ALARM SYSTEM

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Fig. 5

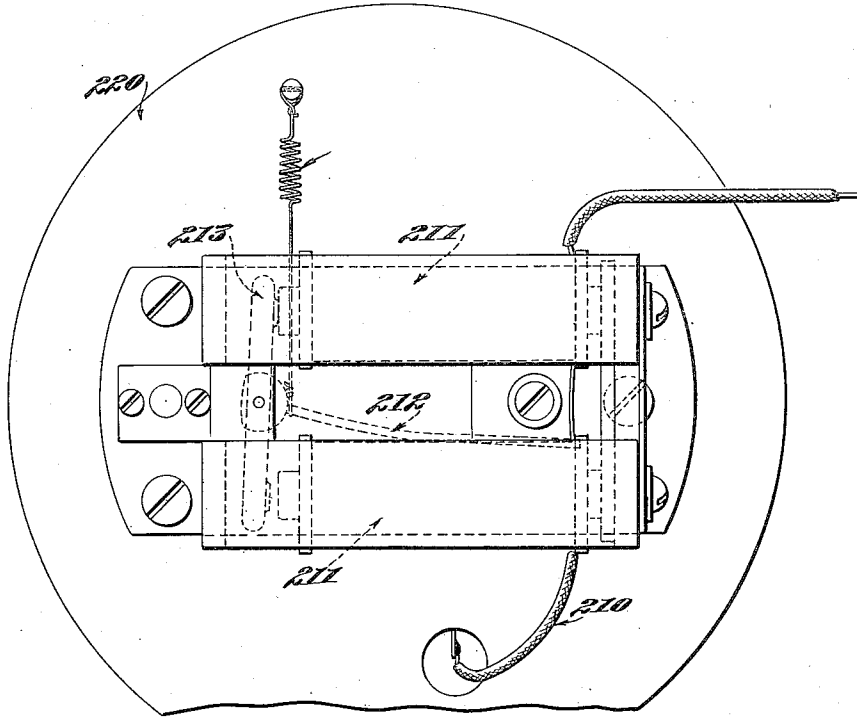
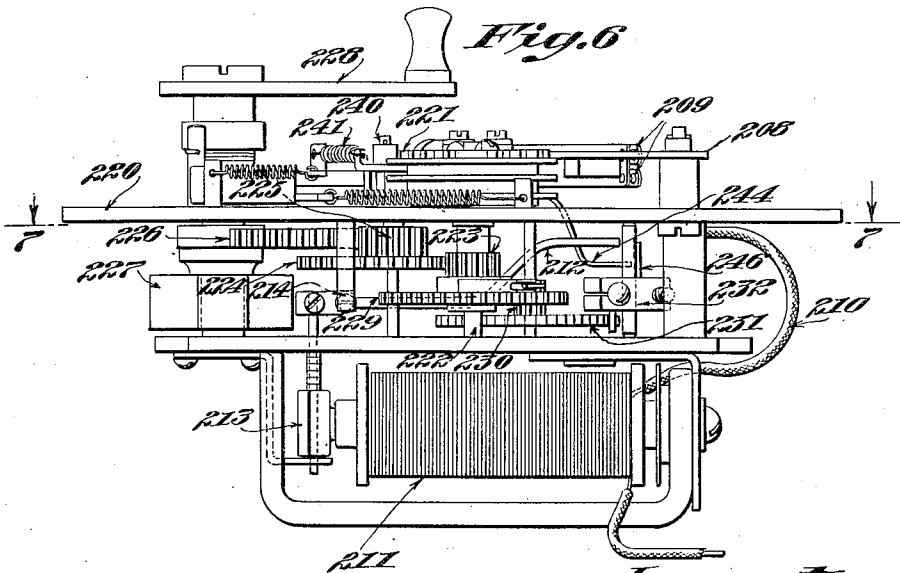


Fig. 6



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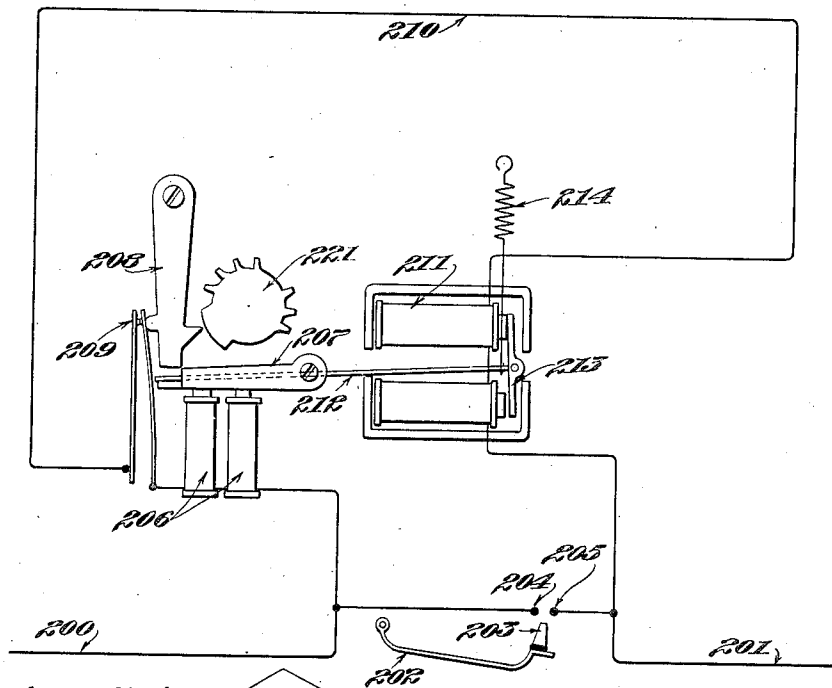
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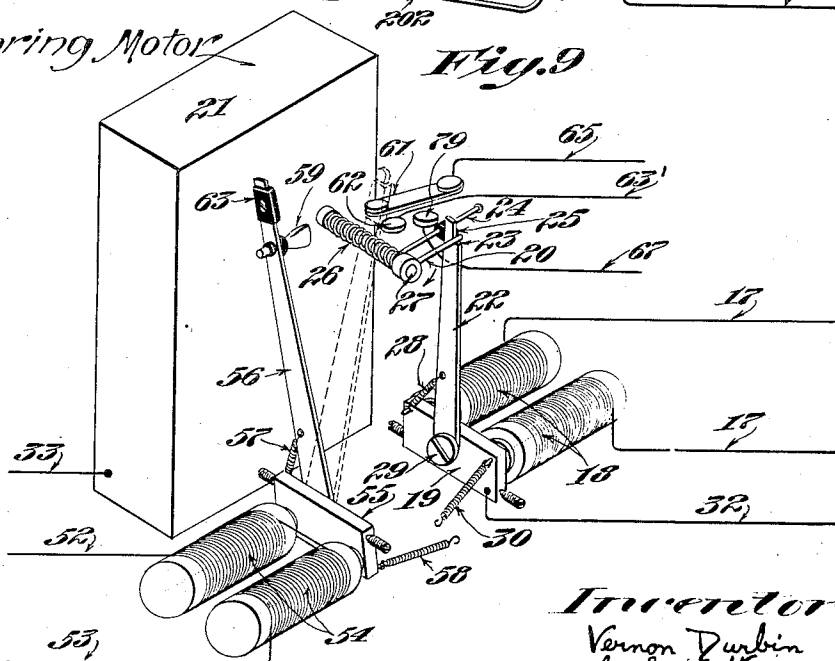
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Fig. 8



Spring Motor

Fig. 9



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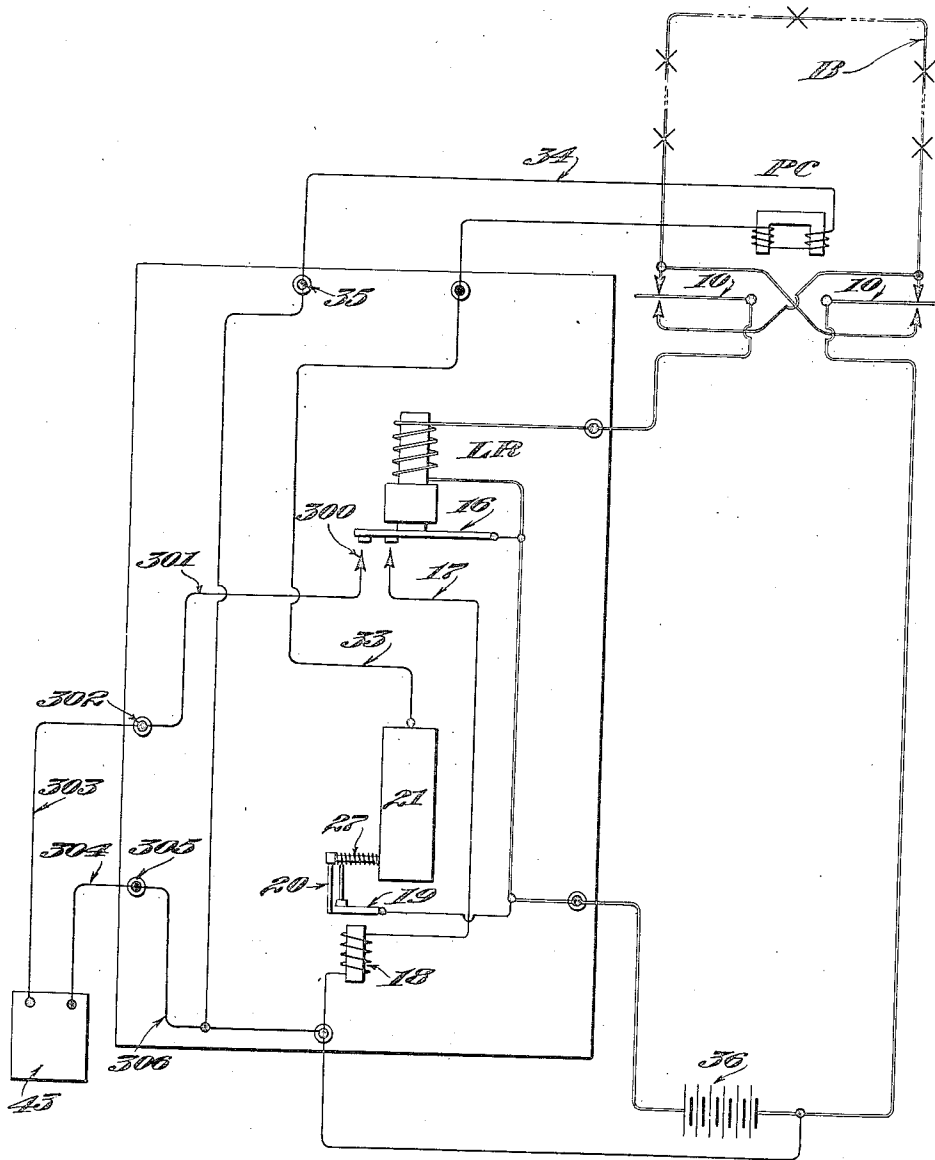
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FIRE ALARM SYSTEM

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Fig. 10
Single Box Circuit System



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UNITED STATES PATENT OFFICE

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FIRE-ALARM SYSTEM

Application filed June 23, 1922, Serial No. 570,393. Renewed May 19, 1928.

The present invention relates to an improvement in fire alarm systems.

The object of the invention is to produce a fire alarm system of simple construction and less expensive than systems now in use. Another object of the invention is to produce a fire alarm system in which the alarm boxes are so constructed and arranged as to be non-interfering and successive in operation. Another object of the invention is to produce a system comprising a plurality of box circuits, or a multiple box-circuit system, which is non-interfering and successive in operation. Other objects of the invention will be set forth in connection with the description of the invention.

To these ends the present invention consists in the fire alarm system and constructions hereinafter described and particularly defined in the claims.

In the accompanying drawings illustrating the preferred form of the invention, Fig. 1 is a diagrammatic plan illustrating the complete system; Fig. 2 is a diagrammatic plan wherein the details of a portion of the system are illustrated; Fig. 3 is a diagrammatic plan of the fire alarm system, giving emphasis to features of construction relating to the securing of non-interfering and successive operation of the box circuits of the system; Fig. 4 is a front elevation of the box mechanism; Fig. 5 is a rear elevation of the same; Fig. 6 is a top plan of the same; Fig. 7 is a section taken on the line 7—7, Fig. 6; Fig. 8 is an illustrative diagram of portions of the box and connections; Fig. 9 is a more or less diagrammatic sketch of the line relay and associated parts, and Fig. 10 is a diagrammatic plan of a single box-circuit fire alarm system.

The preferred embodiment of the invention is described as follows:

Multiple box-circuit system.—The general system is illustrated in Fig. 1. Box circuits B^1 , B^2 , are shown in double lines. All of the apparatus shown is at the central station with the exception of the box-circuits shown at the top of the figure and the station signals shown at the bottom of the figure. The boxes 1 are all alike, and when pulled operate to

send in signals to the central station. Each box circuit is provided at the central station with a line relay LR and associated elements, and a non-interfering relay NIR, which is connected with the non-interfering lines NIL, and operates to prevent the different box circuits from interfering with each other in the sending in of signals. The circuits for preventing interference of the box-circuits with each other are shown in heavy lines. The non-interfering lines NIL are also connected with the station signals S, and operate all of alarm signals at all of the fire houses on the receiving of signals from any box in any circuit. Each box circuit is provided with a pole changer PC, operated by the line relay on the pulling of a box to reverse the polarity of a box circuit. Broadly considered, this may be stated to be a device for abnormalizing the box circuit current, and viewed in such aspect it is immaterial whether it is abnormalized by reversal or in a variety of other ways. When a box in a box circuit is pulled, it breaks the circuit, and the break in the box circuit operates, through means to be described, to de-energize the pole changer PC, which thereupon operates to reverse the polarity of the box circuit. The reversal of polarity of the box circuit operates to prevent any one of the boxes in such box circuit from sending in a signal in a manner which will be described in connection with a description of the box. Thus, whenever a box is pulled, and has gained control of the box circuit, it will begin to send and continue sending the signal of the box to the central station until it has completed the sending in of the signal. After the completion of the signal the pole changer is re-energized, and the polarity of the box circuit is restored to normal, or normalized, whereupon any other box in that line which has been pulled will begin to operate, and the first one of such boxes which gets control of the line will cause the breaking of the box circuit, and the reversal of polarity thereof, and thus prevent the sending in of signals from any other box until it has completed the sending in of its signal. The non-interference of the boxes in one box circuit is controlled by the reversal

of polarity of the line, for when the polarity is reversed no box can send in any signal except the box which first broke the circuit. Each box circuit operates a box circuit signal BCS, so that when a signal is being sent in, the central station apparatus of the box circuit gives a signal audibly and at the same time records it.

Each box circuit is provided with a trouble indicator TI, which sounds a bell and lights an indicator lamp when the box circuit remains open for a length of time greater than that sufficient to send in a signal from a box. The trouble indicator circuits are shown in broken lines. Thus, in case a box circuit line should be accidentally broken, this would result in abnormalizing the circuit, and then, after the lapse of a certain length of time, the box circuit at the central station, through the line relay, would be restored to closed condition, and the trouble indicator TI would ring a bell and light a lamp, and thereby call attention to the out-of-order condition of the box circuit. At the same time this device operates in addition to prevent such open box circuit from interfering with the operation of any other box circuit, so that the accidental breaking of one box circuit will not put the whole system out of commission, but will result only in the putting out of commission of the particular box circuit which is broken. The non-interfering relay NIR is connected with the non-interfering relays of the other box circuits, the arrangement being such that when one box circuit is opened, the non-interfering relay operates a magnet in all the other non-interfering relays of the system to open all the box circuits except that box circuit in which the signal first originated. These non-interfering lines conveniently afford a connection to a station signal relay SSR which makes and breaks the station signal circuit. Thus, when a box circuit begins sending in a signal, the signal is given by the box circuit signal, and in addition the station signal relay impresses these signals upon the station signal circuit SSC, which runs to all the stations in the city, and in each one of those stations gives the signal and records it at those stations.

Thus, it will be seen that each box circuit provides for the separate, successive and non-interfering sending in of signals from each box, and the central station provides for the separate, successive and non-interfering reception of signals from each box circuit as well as the separate, successive and non-interfering sending out of station signals on the station signal circuit.

Box circuit.—Referring to Fig. 2 in which the box circuit is indicated in double lines and the line relay LR is shown with its various connectors wherein the trouble circuits are shown in broken lines, and the non-interfering circuits are shown in heavy lines, we have

the following arrangement: The box circuit B¹ is provided with a pole changer PC, which consists of a magnet, and apparatus for reversal of the polarity of the box circuit. Such apparatus is well known and needs no specific description here. Suffice it to say that the switch members 10, upon the de-energization of the pole changer circuit, move from the position shown in Fig. 2 into contact with the lower contacts of the pole changer, so as thereby to change the polarity of the box circuit B¹. The left hand side of the box circuit is connected at the binding post 11 with the line relay panel. From this binding post the circuit leads to the line relay 12, and thence to the binding post 13, by the wire 14. A tap 15 from the near side of the box-circuit battery leads (through the binding post 77 and connection 78) to the armature 16, and upon the opening of the box circuit B¹, the relay 12 is de-energized and the armature 16 falls, thereby closing the circuit through the wire 17 to the time element relay 18, thereby energizing the latter, and causing it to attract the armature 19. This withdraws the armature 19 out from under the contact pin 20, which is rotated by the spring motor 21, as seen in Fig. 9.

To digress for the moment for the purpose of describing this relay and its mode of operation, it is pointed out that the armature 19 carries the pivoted bar 22, which at its upper end is provided with a shoulder 23 upon which the contact pin 20 rests when the time element relay 18 is de-energized. The upper end of the bar 22 also carries a feed-pin 24, supported on the bar 22 in a block of insulating material 25, the end of which pin engages the screw thread 26 on the rotating shaft 27, driven by the spring motor 21. When the shoulder 23 is withdrawn from under the contact pin 20, a circuit through the spring motor, the contact pin and bar 22 is opened. When the armature 19 is attracted by the relay 18 and the bar 22 is withdrawn from under the contact pin 20, the spring 28 swings the bar 22 on the pivot 29, and thus the pin 24 is moved toward the spring motor box, and then upon the next de-energization of the time relay magnet 18, as when the box circuit begins sending in its signals, the armature 19 being released, the pin 24 is swung into engagement with a screw on the shaft 27. This screw is of such length that the screw will not feed the pin 24 far enough to move the shoulder 23 under the contact pin 20 during the sending in of a signal from a box, but will require a longer time than the sending in of the longest signal to bring such shoulder under the contact pin. The armature is pivoted at the bottom as shown and a spring 30 normally holds the armature away from the magnet and in the position shown in Fig. 9. It is thus seen that the dropping of the armature of the line relay 12 breaks a circuit con-

trolled by the time element relay. This circuit thus broken by withdrawal of the lever 22 from under the contact pin 20 is the pole changer circuit. The pole changer circuit extends from a tap 31 on the wire 15 through the wire 32 to the armature 19 and thus through the contact pin 20 to the frame of the spring motor 21, from which the wire 33 leads to the pole changer PC. The return wire 34 from the pole changer leads to the binding post 35, which is connected to the opposite or far end of the box circuit battery 36 from that to which the left hand side of the box circuit is connected.

Thus, the opening of the box circuit de-energizes the line relay, lets fall its armature, closes the time-element relay circuit, which causes its armature to open the pole-changer circuit, whereupon the box circuit is reversed. The box circuit remains reversed or abnormalized until the sending in of its signal is completed; specifically, it remains reversed until the pole-changer circuit is again closed. The spring motor 21 and the time-element relay 18 act to prevent the closing of the pole-changer circuit by preventing the contact pin 20 from engaging with the shoulder 23 of the bar 22, and thereby closing the pole-changer circuit for a certain length of time. During the sending in of a signal the opening of the box circuit due to such signal sending closes the circuit through the time-element relay magnet 18 and pulls the pin 24 out of engagement with the screw 26, and thereby permits the spring 28 to pull the lever back to its original tripped position. The screw 26 on the spring motor shaft 27 is made of such a length as to prevent the bringing of the shoulder 23 under the contact pin 20 for a length of time greater than the longest interval during the sending in of a signal from the box. When the box ceases to send in signals the energization of the time-element relay magnet 18 ceases, and the feed pin 24 remains in contact with the screw 26, and thereby the lever 22 is swung against the tension of the spring 28 until finally the contact pin 20 engages the shoulder 23 of the lever 22, thereby again closing the pole-changer circuit and restoring the polarity of the box circuit to normal.

In connection with each box circuit there is employed a trouble apparatus which operates on the accidental opening of the box circuit, after the lapse of a certain period of time, permanently to close the portion of the box circuit at the central station, so as to cause such box circuit no longer to operate to affect the receipt of signals from the other box circuits. At the same time, this trouble apparatus lights a lamp and rings a gong, and the light remains lit and the gong continues to ring until the trouble is eliminated or the attendant opens the trouble line. The

trouble circuits, it will be recalled, are shown in broken lines.

While this apparatus is shown as conveniently embodied in a construction employing the same spring motor as the time element relay, it might employ a separate spring motor. The description of this portion of the construction illustrated in Fig. 2 is conveniently inserted at this place because of the identity of the spring motor 21, which serves the two functions, both of reversing the polarity of the box circuit, and of ultimately closing the station portion of the box signal circuit.

To the binding posts 50 and 51 there are connected wires 52 and 53, which lead to the non-interfering relay or relay panel NIR, a description of which will be found at a later place. Suffice to say for the purpose of the present description that the non-interfering relay opens and closes the circuit with which the binding posts 50, 51 are connected, and thus energizes and de-energizes the trouble relay 54. By reference to Fig. 9 again, it will be seen that when the trouble relay 54 is energized, it attracts its armature 55 to which the arm 56 is pivotally attached in a manner similar to that in which the bar 22 is pivotally attached to the armature 19 of the time element relay 18, it being normally pulled in a direction to move it to the left by the spring 57 in the same manner. The armature 55 is pivoted at the top, as shown, and a spring 58 normally holds the armature away from the magnet and in the position shown in Fig. 9. The upper end of the pivoted bar 56 carries a knife 59, which, when the trouble relay 54 is energized, engages the screw thread 26, and thereby feeds the arm along to the right, as shown in Fig. 9, and as it approaches the end of its movement to the right, it engages the switch 61 and moves it to the right into engagement with the contact 62, the arm 56 being provided with an insulated portion 63 adapted to engage the switch 61 for this purpose. The switch point 62 is connected by the wire 63' to the box circuit B¹ at a point 64 above the line relay 12. The switch lever 61 is connected by the wires 65 and 34 with the binding post 35 connected to the far end of the box circuit battery 36, so that when the trouble relay 54 remains closed for a sufficient length of time to feed the arm 56 over sufficiently far to cause it to engage and move the switch lever 61, this switch is closed and the line relay is re-energized exactly as if the box circuit were closed. Thus the box circuit B¹, although it remains open due to some accident, can no longer interfere with the operation of other box circuits and prevent the receiving of signals from them. At the same time that this trouble circuit is closed, as above described, the switch lever 61 makes contact with the contact 79 which conveys current

by means of the wire 67 to the binding post 68 and thence to the trouble indicator TI, indicated on Fig. 2 as 69. This indicator as shown in Fig. 1 consists of a bell 71 and a lamp 72, the former of which rings and the latter of which remains illuminated until the box circuit connected therewith is repaired or the attendant interferes. The wire 73 leads from the binding post 68 to the trouble indicator TI, and the wire 74 leads to the binding post 75, which in turn is connected by means of the wire 76 with the binding post 77, connected by means of the wire 78 to the near side of the box circuit battery 36.

Each individual box circuit is provided with its own box circuit signal device BCS. For this purpose the connections from the non-interference relay through the wires 52 and 53 are availed of. This relay, as will hereinafter appear in detail, operates upon the making and breaking of the box circuit to break and make the circuit through the trouble relay 54. So a tap wire 40 from the wire leading from the binding post 50 to the trouble relay 54 leads to the binding post 41, from which the wire 42 leads to the box circuit signal BCS, indicated on Fig. 2 as 43, but which comprises, as will be seen by reference to Fig. 1, a bell 44 and permanent record apparatus 45. From the box circuit signal the wire 46 leads to the binding post 47, which is connected by the wire 48 with the binding post 51. Thus, upon every energization of the non-interference relay magnet, the box circuit signal BCS gives and records the signal being made.

In the foregoing description of the connections more directly concerned with the box circuit system, the non-interfering relay NIR has been generally referred to, and it now is convenient to describe its construction and mode of operation in detail.

Referring to Fig. 3, the non-interfering relay is shown so that its construction and mode of operation may be understood. The box circuit line B^1 coming from the binding post 13 is connected to the binding post 81 of the non-interfering relay NIR. From there it runs to the relay proper 82 from which it returns to the binding post 83, and thence passes to the near side of the box circuit battery 36. The relay 82 is provided with an armature 84 normally held in lifted position by the closed box circuit B^1 . When the box circuit is opened, this relay 82 is deenergized and the armature 84 falls. When it falls it performs a number of functions, (1) to close the circuit at contacts 100 and 105 through the trouble relay 54 (Fig. 2) through the medium of the connections 52 and 53, thereby starting up the trouble circuit closer 61 which will operate to close the box circuit in case it does not otherwise close in due course after the sending in of the signal, (2) to close the circuit through the non-interfering relay

panels of all the other box circuits B^2 , etc., and thereby prevent any of them from operating, and (3) to block the opening of the non-interfering switch at 85 in the far, or right hand, side of the box circuit line while such box circuit is sending in a signal.

The non-interfering lines NIL comprise a battery 91, two battery lines 92 and 93 leading therefrom, and a box circuit opener line 94 for convenience laid up with them. The descriptions of the several functions of the non-interfering relay NIR will take the following order. First the trouble arrangement, second the non-interfering arrangement, and third the box-circuit-interference-prevention arrangement.

The trouble arrangement comprises a wire 95 leading from the battery line 92 to the binding post 96, thence to the binding post 97, and through the lines 52 and 53 to and from the trouble relay 54 (Fig. 2), and back to the binding post 98, which in turn is connected by means of the wire 99 with the contact 100 adapted to be engaged by the armature 84 of the non-interfering relay 82. The armature is connected by means of a wire 101 leading to the binding post 102 which is connected by the wire 103 to the battery line 93. Thus when the box circuit B^1 is opened and the relay 82 is de-energized, the falling of the armature 84 makes a circuit through the trouble line and trouble relay, and thus prepares the apparatus to short-circuit the box line, in case the box circuit should remain open for too long a time, and in addition it affords a means for giving the box-circuit signals. It will be seen from Fig. 2 that if the box circuit stays open sufficiently long to allow the trouble relay to actuate the switch 61, a short circuit path for the box circuit is provided, as above described, so that if the box circuit remains open due to any fault therein, such condition is ineffective to actuate any of the apparatus or cause interference with the other circuits.

Coming now to the non-interfering and repeating arrangement. Simultaneously with the fall of the armature 84 of the relay 82 by the opening of the box circuit B^1 the armature 84 makes contact with the contact 105, and thereby leads current to the box-circuit opener line 94 through the wire 106 leading to the binding post 107, connected by means of the wire 108 to the box circuit opener line 94. From 94 at each of the other box circuits the wires 108 lead current to the magnets 109, from which the current leads through the wire 110, binding post 96 and wire 95 to the battery line 92, thus energizing the magnets 109 and attracting the armatures 111, which pull with them the pivoted switch levers 112, and open the far or right hand sides of the box circuit lines at 85. It will be observed that the armature 111 and lever 112 are connected by means

of the insulating link 113 and normally held in position to the right, as shown in Fig. 3, by means of the spring 114. The magnet 109 and its armature 111 constitute a circuit opening relay which is operated on the energization of the non-interference lines by the falling of the armature 84 of the non-interference relay of any one of the box circuits.

This operation opens the box circuit line at 85, and thereby reverses or abnormalizes the polarity in the box circuits B², etc., so that all of such box circuits are prevented from sending in any signals, as will hereinafter be more fully described. It will be observed that the energization of the magnet 109, pulling as it does the armature 111 under the end of the armature 84, prevents that armature from dropping on the opening of such inactive box circuit, and so long as one box circuit is sending in a signal all of the other box circuits are thereby prevented from operating at all. The magnets 109, it will be noticed, are arranged in multiple, and the current is supplied at the contact 105 by the active box circuit.

The box - circuit - interference - prevention arrangement.—The opening of any box circuit will de-energize the relay magnet 82 of that box circuit, and thereby close the circuits through all of the other non-interference magnets 109, thereby opening all other box circuits. The effect of this upon the other box circuits will be to de-energize all their line relays 12, (Fig. 2) reverse the polarities of such circuits, or abnormalize them, and thereby hold them inoperative to send in any signals pending the receipt of the signals from the active box circuit. When the sending in of a signal from a given box circuit is completed, the polarity of such circuit will be reversed by the energization of the pole changer of such circuit, whereupon, the circuit being remade, the non-interfering relay magnet 82 will be again energized, and its armature raised, thereby opening the circuit leading to the several non-interfering magnets 109 in the non-interference relay panels, and permitting the springs 114 to close the far sides of all the box circuits, whereupon any box in any other circuit which has been pulled, or the pulling of a box in any box circuit may re-institute the sending in of a signal.

Signal boxes.—The general system and the box systems have been described, together with their mode of operation, and it now remains to describe the construction and mode of operation of the several boxes which have features of construction for preventing interference between boxes on the same box circuit, and securing successivity of operation of boxes which have been pulled simultaneously. In this connection, the word simultaneously is to be understood as meaning pulled within the time limit of operation of a

box—thus, if a box is pulled, and starts sending in a signal, it gains and holds control of the line until it has completed the sending in of its signal. If another box is pulled during this time, the second box may be said, in a sense, to have been pulled simultaneously with the pulling of the first box, but it will be inoperative, by reason of features of construction presently to be described, to send in a signal until the first box shall have completed the sending in of its signal.

The box is shown diagrammatically in Fig. 8, the line wire 200 leading to the box, and the line wire 201 leading away from the box, and the box being short-circuited by the cover 202, which interposes a connecting plug 203 between the contacts 204 on the line 200, and the contact 205 on the line 201, so that in normal condition, with the box closed, the box is short-circuited out of the box circuit line. The line at this time has a normal direction current, or a normal current, and whenever the cover of one of the boxes is opened, this current passes through the non-interference magnet 206 and causes it to attract its armature 207, thereby holding it in a position below the end of the code lever 208. At this time the code lever is in its left hand position, as shown in Fig. 8, and the signal contacts 209 are closed and the current continues from such contacts through the wire 210 to the polarized magnet 211, which, owing to the normal condition of the current flowing through the box, is of such polarity as to hold the armature 207 of the non-interfering magnet 206 within the effective field of such magnet. This is secured by means of an arm 212 attached to the armature 213 of the polarized magnet, which arm 212 presses on a projection, or finger on the armature 207 of the non-interference magnet, and depresses it into a position within the effective field of the non-interference magnet. When the armature 207 is held depressed, whether by energization of its magnet or by the arm 212, the armature 207 permits the code wheel to turn by virtue of a construction presently to be described.

Now, assume that the box is pulled, by pulling down the lever 228 (see Fig. 4). The immediate effect of this is to cause the code wheel to turn so as to permit the code lever 208 to move to the right, thereby causing its lower end to occupy a position above the end of the armature 207 of the non-interference magnet, and at the same time to open the contacts 209 and thereby break the box circuit. This breaking of the box circuit results first in the de-energization of the polarized magnet, and thereupon the spring 214 raises the arm 212 and withdraws it from contact with the projection on the armature 207. At the same time the non-interference magnet 206 is de-energized by the breaking of the circuit, but its armature cannot rise because the

right hand position of the code lever prevents, so the code wheel continues to turn. These are the operations which take place at the box.

5 Now the central station is caused, by the breaking of a circuit to reverse the connections of the battery to the box circuit and to thereby prepare the box circuit for the reception of reversed current or abnormalization. This immediately follows the operations above described, as soon as the code wheel turns far enough to push the code lever to the left and thereby close the circuit again at the contacts 209. This closure of the box circuit at these contacts initiates the sending in of the signal from the box, and does nothing else because all of the other boxes are held inoperative by reason of the previous opening of the circuit, their armatures 207 having risen under the influence of their springs, thus bringing their ends in front of their code levers 208, in which position they are beyond the effective field of magnetism of their non-interference magnets 206, as a consequence of which they remain in raised position, and although the circuit is opened and closed in the process of sending in the signal from the operating box, such armatures remain stationary and hold their code wheels from motion in a manner above referred to and presently to be more specifically described. This reference to other boxes, of course, is pertinent only to such other boxes as have been cut into the circuit by the opening of their doors.

35 With these general observations on the mode of operation of the box, its specific construction will now be set forth in detail, and the specific operation of its instrumentalities will then be described.

40 Referring to Figs. 4, 5, 6 and 7, the box mechanism comprises a plate 220, which is supported in the box casing in the usual manner. Upon this plate is supported the operating mechanism. The code wheel 221 is supported in the usual manner on the plate 220. The shaft 222 upon which the code wheel is mounted carries a pinion 223, which is driven by the gear 224; to the latter is secured the pinion 225 which is actuated by the segmental gear 226; this gear in turn is driven by the spring 227, which spring is wound up by the pull-lever 228 in the usual manner. The code wheel shaft 222 carries the gear 229 which meshes with the pinion 230, which in turn is attached to the escapement wheel 231. This escapement wheel drives the escapement 232, which acts as a device to regulate the speed of motion of the code wheel 221. When the pull-lever 228 is pulled down and thereafter released, the code wheel starts in motion, and the latter rotates at a rate of speed determined by the escapement 232.

65 The non-interfering magnet 206 is mounted

on the front of the plate 220, and its armature 207 is pivotally mounted on the post 240, being held in raised position by the light spring 241, unless held depressed by the energization of the magnet 206 or otherwise, as will be described. When the code wheel comes to rest, the code lever normally stands with its tooth resting upon the stopping land 242, as shown in Fig. 4, which holds the code lever 208 in left hand position, so that its insulating pusher block 243 holds the contacts 209 closed. With the code lever in the position shown in Fig. 4, that is, in its stopping position, it will be observed that the armature 207 of the non-interfering magnet may, if permitted, rise so that its end will come in front of the lower end of the code lever, and thereby prevent the code lever from moving to the right. When the code lever is moved to the right, its lower end swings over the end of the armature 207 and prevents the latter from rising. The armature 207 is provided with a finger 244, which extends outward from the end of the armature, as shown in Fig. 6, and thence through a hole 245 in the plate 220 and beyond and into the path of a pin 246, projecting from the side of the escapement 232. Thus when the magnet 206 is energized and the armature 207 is held downward, the finger 244 is held below the pin 246, so that the clockwork may operate, and the code wheel may rotate. So, therefore, when the code lever is sending in a signal and moving from left to right to open and close the contacts 209, the armature lever is held down by the code lever when the contacts 209 are separated, that is to say, when the box circuit is open. Then when the code lever moves to the left and closes the contacts 209, this energizes the non-interfering magnet 206, and holds the armature 207 down so that it cannot rise while the code lever is in the left hand position. With this arrangement the sending in of a signal by the box is accomplished, the code lever holding the armature 207 down while the circuit is open, and the magnet holding the armature down when the circuit is closed, and the rotation of the code wheel being permitted by the holding down of the armature by either the one or the other means. The polarized magnet 211 is provided with an armature 213, which is shown in normal position in Fig. 8. This armature is provided, as has been stated, with the arm 212 which extends from the armature to a position above the finger 244. Now when the current passing through the polarized magnet is direct, or normal current, the arm 212 is held depressed, as shown in Fig. 8, and this holds the armature 207 down in the field of the non-interfering magnet 206. Upon the pulling of the box the box circuit is broken by reason of the fact that the code lever moves to the right and drops off the stopping land 242 of

the code wheel. Upon the breaking of the box circuit the polarized magnet 211 is de-energized, and the spring 214 lifts the arm 212 so that it no longer operates to prevent the armature 207 of the non-interference magnet from movement, but as the armature is held down by the code lever at this time, the code wheel is permitted to continue to rotate. The opening of the box circuit operates at the central station to cause the pole changer to operate, thereby reversing the box circuit connections, then as soon as the code wheel moves far enough for a tooth to push the code lever to the left and thereby close the contacts 209, reversed, or abnormal current flows through the box circuit and prevents the non-interference magnet of any other box from operating to depress its armature as above described. Upon the completion of the sending in of the signal, which is commonly repeated four times by four revolutions of the code wheel, the code lever is moved to the left by the stopping land 242 of the code wheel, and the line relay 12 is energized, thereby lifting its armature and breaking the circuit through the time element relay 18, which permits the pin 24 to engage the screw 26 of the spring motor 21, so that the lever 22 is moved to the right, as shown in Fig. 9, and the shoulder 23 is ultimately presented to the contact pin 20, which it arrests, at the same time closing the pole changer circuit and reversing the polarity of the box circuit, and thereby restoring it to normal. This restoration of the box circuit to normal causes the polarized magnet armature to re-assume the position illustrated in Fig. 8, thereby holding the non-interference magnet armature 207 depressed.

The non-interference of two boxes on one box circuit is secured by the cooperation of the non-interference magnet with the code wheel, because once a given box shall have gained control of the box circuit, the sending in of a signal from such box cannot be interrupted by the other boxes. This is due to the fact that the polarity of the box circuit is reversed, or abnormalized, and any other box the door of which is open, and the lever of which is pulled, will, due to the reversal of polarity of its polarized magnet, swing its arm 212 upward, thereby permitting, on the first break of the circuit at the operating box, the armature 207 of such second box to rise into position opposite the lower end of the code lever of that box, thereby preventing it from dropping into the depression at the end of the land 242, and at the same time the finger 244 of the non-interference magnet lever will be in front of the pin 206 of the escapement, and the code wheel of such second box will thereby be held stationary until the first box has completed the sending in of its signal, and causes

the restoration of the polarity of the box circuit to normal, whereupon, in such second box, the polarized magnet will again act to depress the armature 207 of such second box, and thereby remove the finger 244 from in front of the pin on the escapement and permit the code wheel of such box to rotate. The withdrawal of the finger 244 of such second box from in front of the escapement will permit the code lever to drop into the depression beyond the stopping land 242, and that will secure the opening of the contacts 209 of such second box, and thereby again reverse the polarity of the box circuit, and the second box will begin sending in its signal.

Any number of boxes in a box circuit may have their doors opened, and their levers may be pulled at identically the same time, but in one of such boxes the tooth on the code lever will drop into the depression at the end of the stopping land before the corresponding code lever in the other boxes drops into such depression, and thereupon such first operating box will gain control of the line, and the other boxes will be held inoperative in the manner described, until the completion of the sending in of the signal from the first box. Thereupon the polarity of the box circuit will be restored to its normal condition, and all of the boxes will start to rotate their code wheels, until one of them gains control of the line and stops the others until it has sent in its signal.

From a consideration of the foregoing description of the signal as a whole, and the box circuit as an integral part of it, it will be seen that the boxes in each box circuit are non-interfering and successive in operation, and each operates under the power of the spring motor, which is wound up by the pulling of the box lever. It will be further seen that the several box circuits are non-interfering and successive, in the same manner as the boxes of the signal box circuit. It is not, however, to be understood that one box in one box circuit having gained control of the system, such box circuit will retain control of the system until all of the boxes in such box circuit have sent in their signals, but that upon the restoration to normal of the current in any given box circuit all of the box circuits are restored to normal, and the first box in any box circuit which opens its box circuit line, will gain control not only of that box circuit, but of the system as well, so that as a practical matter, the superimposition of non-interference and successivity of the system as a whole upon the non-interference and successivity of a box circuit, renders the entire system non-interfering and successive as to all of its boxes, and all of its signals.

It will be seen that the non-interference

characteristics of the system as a whole depend in the last analysis on the non-interference characteristics of the boxes. Each box is so constructed that it will fail to transmit a signal if it looks into an open line when it is itself closed. A signal box is said to be closed when its switch 209 is closed. If the switch 209 is closed and the box circuit is open (the door of the box being assumed to be open) the code lever 208 is necessarily in such position as to permit the armature 207 to rise to a position out of the effective field of the magnet. The armature is permitted thus to rise because since the line is open, the polarized magnet is deenergized and the arm 212 has been raised by the spring 214. Such a box can not regain control of the system until the armature 207 is moved within the effective field of the magnet 206, this action being brought about by the normalization of the box circuit current which restores the retaining arm 212 to the position shown in Fig. 8. Since a box is inoperative to transmit a signal if it looks into an open line when it is itself closed, it is apparent that there can be no interference between boxes on the same circuit or boxes on different circuits. The non-interference between boxes on different circuits is effected by the operation of the non-interference relays which open and close with each opening and closing of a box circuit in accordance with the operation of the code lever of a box which is transmitting a signal. Thus, when an active box circuit is transmitting a signal through operation of one of its boxes, all other box circuits are opened and closed in synchronism with the movements of the code lever of the operating box. This opening and closing of all box circuits in synchronism with the operation of a single active box, affords a means for preventing transmission of a jumbled signal in the event that two boxes should happen to gain control of the line at exactly the same instant of time. If such two boxes are on the same box circuit, both will be permitted to operate so long as they act in exact unison but because of the necessarily different code wheels on the two boxes, a time will eventually come when one of the boxes will be closed and the other open. The box which is closed will then lose control of the line because it is looking into an open line and the other will continue transmission of the signal. This same action results if two boxes in different circuits gain control at the same instant. So long as they operate in unison, they open and close their box circuits together, but eventually one of the boxes will open its circuit while the other box and its circuit are closed. The action of the former box in opening its own box circuit operates through the non-interference relays to open all other box circuits, including the box cir-

cuit of the second box. This second box will therefore look into an open line and lose control of the system, permitting the first box to complete the transmission of a clear signal.

A feature of construction of the line relay 12 and the non-interference relay 82 should be referred to by virtue of which their capacity to support their armatures is not destroyed by the slight interval of time which is required for the operation of the pole changer. That is to say, these magnets are of the kind known as slow-acting, having their pole pieces surrounded by a copper body to cause it to be de-energized slowly, and to be re-energized slowly. After the completion of the sending in of a signal from a box circuit, the rising of the code lever on the stopping land of the code wheel closes the box circuit and these magnets are energized and their armatures raised. These positions of the armatures are not disturbed by the closing of the pole changer circuit, due to the striking of the contact 20 against the lever on the armature 19, which operates to reverse the polarity of the circuit, but the slow-acting character of these magnets is such that the short interval of time during which the box circuit is open when its polarity is being changed is insufficient to permit the line relay armature or non-interference relay armature to drop.

Reference has been made in the foregoing specification to the normal direction current of the box circuit when it is in non-operating condition. This has been called the normal direction current, or normal current, and when it is reversed and in condition for the operating box to send in a signal, the direction of the current has been referred to as the reverse current, or reverse direction current, or abnormalized current. It is to be understood that the present invention contemplates an apparatus in which the box circuit is of closed circuit type, conducting at such time a certain kind of current, which in the described embodiment is a continuous current flowing in one direction, and that when a box in such circuit is engaged in the operation of sending in a signal, the current in such circuit is different, and in the described embodiment is a direct current having a direction the reverse of the non-operating current. But such box circuit current might be of one character in its non-operating condition, and of a different character in its operating condition. It is within the purview of the invention that other differences between the non-operating current and the operating current might be resorted to with proper changes in the apparatus to secure the mode of operation and results secured by the present invention, and for this reason, therefore, the non-operating current is referred to by the broad term normal current, and the operating cur-

rent is referred to by the broad term of abnormalized current, as the invention contemplates such variations within its purview.

Single box-circuit system.—The fire alarm system as thus far illustrated and described contemplates a plant of considerable size. It being possible to put as many as thirty boxes on each box circuit, it will be apparent that a very large system is provided for. In many towns a single box circuit will afford ample provision for all of the alarm boxes required to give adequate facility of sending in alarms, and under such circumstances the provision of more than one box circuit is unnecessary, as the latter may be made, by simple elimination of parts, to give entirely satisfactory, non-interfering and successive service. Such a system is illustrated in Fig. 10, which is identical in operation with each box circuit of the more elaborate system hereinbefore described, except that the trouble circuits are omitted, and the non-interference relay, which prevents the interference of other box circuits with the operating box circuit, is omitted, as well as the non-interference lines.

Referring to Fig. 10, the box circuit B, the pole changer PC, the line relay LR, and their connections, are all arranged as hereinbefore described. The signal connections, however, are different. The armature 16 of the line relay is provided with a second contact 300, which is connected by the wire 301 to the binding post 302, in turn connected by the wire 303 with the box signal 43, which may conveniently comprise the audible signal 44 and recording signal 45, as shown in Fig. 1. The wire 304 leads to the binding post 305, which is connected by means of the wire 306 to the binding post 35, in turn connected by a wire to the far end of the box circuit battery 36. The operation is as follows: Upon the pulling of a box in the box circuit B, the line relay LR is de-energized, and its armature 16 falls, making a contact with the wire 17 leading to the time element relay 18, which attracts the armature 19 and opens the pole changing circuit by withdrawing the lever 22 from under the pin 20 on the shaft 27, driven by the spring motor 21. This de-energizes the pole changer circuit as the circuit leads from the shaft 27 to the frame of the spring motor 21, and thence through the wire 33 to the pole changer, and back through the wire 34 to the binding post 35, connected to the far end of the box circuit battery 36. The sending in of the signal from the box circuit B then begins, and upon each de-energization of the line relay LR, the contact 300 supplies current to the wire 301 leading to the box circuit signal device 43, which leads back through the connections described to the binding post 35, connected to the far end of the box circuit battery. The boxes are the same as the boxes above described. There is no necessity for a trouble indicator in connection with this box

circuit system because the box circuit signal 43 will sound continuously as long as the box circuit remains open. Furthermore, inasmuch as there is no other box circuit connected with this box circuit, there is no necessity for a non-interfering relay, as there is no other box circuit to interfere with the operation of this box circuit.

Having thus described the invention, what is claimed is:—

1. A box for fire alarm systems having, in combination, a spring motor, a pull lever for winding up the spring motor, a non-interference magnet, a polarized magnet, a box circuit including both said magnets in series, a code wheel operated by the spring motor, the polarized magnet having interconnecting members operating upon the breaking of the circuit to permit the non-interference magnet to stop the motor.

2. A fire alarm system having, in combination, a normally closed box circuit, a plurality of boxes in the box circuit, each box being provided with a code lever and wheel for actuating it, a magnet having an armature adapted to be interposed in front of the code lever, and a polarized device in the box circuit for allowing the armature to rise out of the field of the magnet and render the code lever inoperative upon reversal of the box circuit current, a relay in the box circuit, and a pole-changing device operated by the relay for reversing the polarity of the box circuit current on the starting of a box to send in a signal.

3. A fire alarm system having, in combination, a box circuit, a plurality of boxes in the box circuit, each box having provision rendering it inoperative to send signals on reversal of the box circuit current, a time relay and a trouble relay each having a screw feed, a pole-changer controlled by the time relay for reversing the polarity of current in the box circuit and for thereafter normalizing the current, a trouble indicator connected with the trouble relay, and means cooperating with the screw feed whereby each making and breaking of the box circuit acts to delay the normalization of the box circuit current and the operation of the trouble indicator through the time relay and the trouble relay respectively.

4. A fire alarm box having, in combination, a box circuit, a spring motor provided with an escapement mechanism, a lever for winding up the motor, means for sending in a signal comprising a code wheel and a code lever, a magnet, an armature for the magnet normally maintained out of the path of the code lever and provided with a stop for the escapement mechanism, a spring tending to move the armature out of the field of the magnet, and means for normally holding the armature within the field of the magnet and

for allowing it to move out of the field of the magnet upon reversal of the current.

5 5. A fire alarm box having, in combination, a box circuit, a spring motor, a lever for winding up the motor, means for sending in a signal comprising a code wheel operated by the motor and a cooperating code lever, a non-interfering magnet, an armature for the non-interfering magnet normally maintained
10 out of the path of the code lever and provided with a spring urging it into the path of the code lever and out of the field of the magnet, a polarized magnet having an armature adapted to normally hold the armature of the non-interfering magnet in operative position in the field of its magnet and to allow it to move out of the magnetic field upon reversal of current through the polarized magnet.

20 6. A fire alarm system having, in combination, a plurality of normally closed box circuits, a plurality of boxes in each box circuit, each box having provision for rendering it inoperative to send signals on reversal of the box circuit current, means for reversing the current after opening of the circuit, a non-interference relay in each box circuit adapted to be actuated on the pulling of a box in the circuit, a circuit opening relay for each
30 box circuit, non-interference lines connecting the circuit opening relays for opening all other box circuits and causing reversal of the box circuit current, and means for energizing the non-interference lines upon actuation of any non-interference relay.

35 7. A fire alarm system having, in combination, a plurality of normally closed box circuits, a plurality of boxes in each box circuit, each box having provision rendering it inoperative to send signals on reversal of the box circuit current and provided with code signalling means for making and breaking the current, a time relay in each box circuit at the central station adapted to be actuated
40 on each breaking of the circuit when a box sends in a signal, a pole changer controlled by the time relay for reversing the current after the first breaking of the circuit, and for restoring the current to normal after completion of the signal, each operation of the time relay by the opening and closing of the box circuit acting to delay the normalizing of the current, a non-interference relay in each box circuit actuated in accordance
50 with the code signalling means, non-interference lines, means operated by the non-interference relay of the circuit in which a box is operated for energizing the non-interference lines, and means operated on energization of the non-interference lines for reversing the current in all other box circuits.

8. A fire alarm system having, in combination, a plurality of box circuits, a plurality of boxes in each box circuit, signal preventing means in each box circuit for preventing in-

70 terference between boxes in the circuit, a non-interference device for each box circuit comprising a non-interference relay in the box circuit and a circuit opening relay adapted to be energized by the actuation of the non-interference relay, armatures for the relays constructed and arranged so that movement of one armature operates to hold the other armature in its normal position, non-interference lines connecting the circuit opening relays whereby upon operation of any one non-interference relay the circuit opening relays of all other circuits are actuated, and means for operating the signal preventing means in said other box circuits when the circuit opening relays are actuated.

9. A fire alarm system having, in combination, a plurality of normally closed box circuits, a plurality of boxes in each box circuit adapted to send a signal by the making and breaking of the circuit, a trouble relay associated with each box circuit, a screw feed and a feed member connected with the trouble relay for engaging the screw feed, means for allowing the feed member to move over the screw feed when the box circuit is open and for resetting such member at the beginning of the feed when the box circuit is closed, and means for short-circuiting the loop containing the boxes of box circuit if such member remains in engagement with the screw feed for an extended length of time so as to eliminate such box circuit from further participation in the government of the system.

10. A fire alarm system having, in combination, a plurality of normally closed box circuits, repeating means for the box circuits operating upon opening of a box circuit, means for short circuiting the loop containing the boxes of each box circuit, a trouble relay operable upon opening of a box circuit, and means operated by the trouble relay after a box circuit remains open longer than a predetermined time to operate the short circuiting means of said box circuit.

11. A fire alarm system having, in combination, a plurality of normally closed box circuits, repeating means for the box circuits operating upon opening of a box circuit, means for short circuiting the loop containing the boxes of each box circuit, a trouble relay having a part movable toward a position to operate said short circuiting means upon occurrence of an open box circuit, and constructed and arranged to be reset upon closure of the circuit, whereby the short circuiting means of an open box circuit is operated after said circuit remains open longer than a predetermined time.

12. A fire alarm system having, in combination, a plurality of normally closed box circuits, repeating means for the box circuits operated upon opening of a box circuit, short circuiting contacts for short circuiting the loop containing the boxes of each box circuit

cuit, a trouble relay operable upon opening
of a box circuit, and having a part movable
to close the short circuiting contacts of an
open box circuit after a predetermined time,
5 and means for resetting said part upon closure
of the box circuit.

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