July 25, 1933. A. A. CLOKEY 1,920,153

CALL BOX REGISTER CIRCUIT

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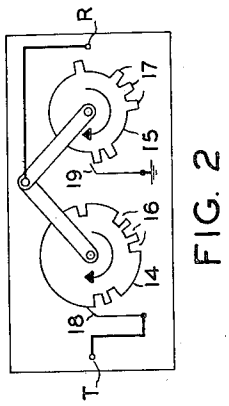


FIG. 2

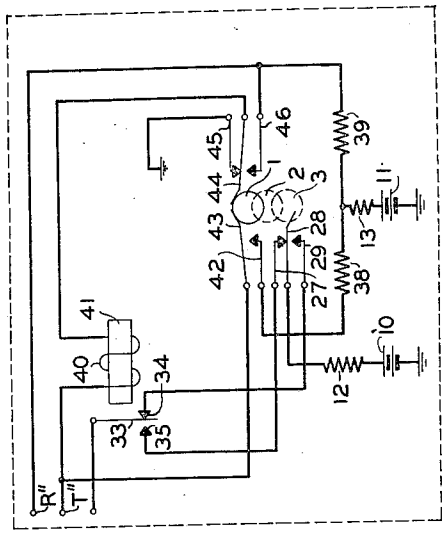
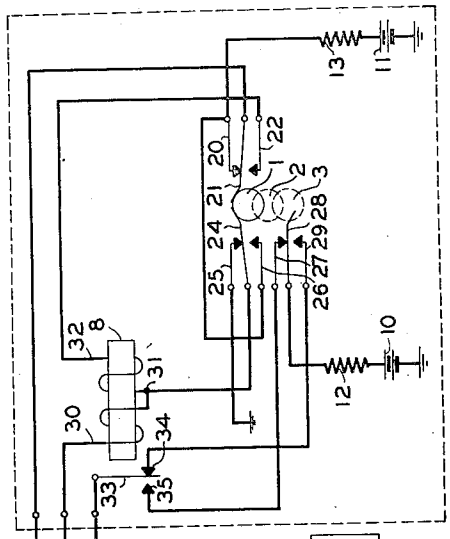
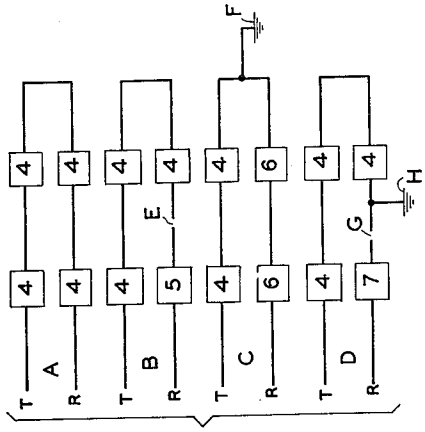


FIG. 3





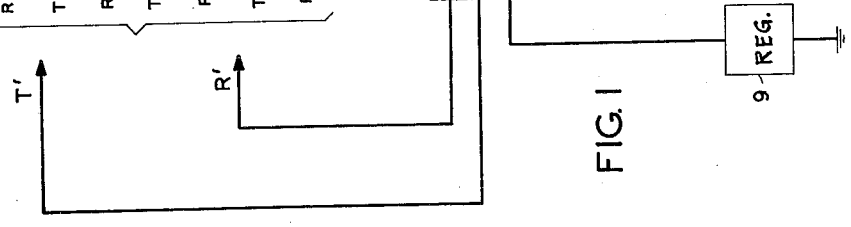


FIG. 1

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CALL BOX REGISTER CIRCUIT

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This invention relates to call box register circuits, such as messenger call systems, fire alarm systems and watchmen's signalling systems. It has particular reference to the line relay and other means whereby the code register may be caused to function, even under abnormal conditions of the circuit.

Systems which include a number of code signalling stations in series on one circuit are frequently subject to line trouble such as an open circuit, a ground, or a combination of the two. Means are known in the art whereby such line troubles can be overcome. The object of this invention, however, is to provide simpler arrangements to render the register operative under abnormal as well as normal conditions, and particularly to employ only one relay in the line circuit rather than two as heretofore.

In carrying out this invention it is preferable to use call boxes equipped with code impulsing wheels and to provide a contact device in association with the impulsing wheels such that in making a call not only is the line momentarily grounded but also opened for each pulse of the signal. This signalling means in combination with the novel arrangement of the receiving relay and its associated switching mechanism renders the circuit operative from a call box located on either side of an accidentally grounded point or break in the line, or a combination of the two.

In the drawing accompanying the following description:

Fig. 1 shows diagrammatically the call box circuit and the arrangements at the register station.

Fig. 2 shows a typical detail of the code wheels within a call box.

Fig. 3 shows an arrangement of the line relay and its connections alternative to the portion of Fig. 1 comprehended in the broken line enclosure.

In Fig. 1 four loop circuits, A, B, C and D illustrate respectively each of four line conditions which may possibly occur on any one circuit. The call boxes, 4, 5, 6 and 7 are placed at any desired points along the line. The two ends of the loop T and R should be regarded as terminating at the register station where they are connected respectively with the receiving relay circuit as at T′ and R′.

Loop A shows a normally closed circuit over which signals may be transmitted from any call box by opening the circuit for each code impulse. Loop B shows a break or open circuit condition as at E. Loop C shows an abnormal ground as at F. Loop D shows at G an open circuit and at H a ground.

The receiving apparatus comprises a line relay 8, a key switch having three positions designated 1, 2 and 3 respectively, a code signal register 9 and sources of potential 10 and 11, the voltages of which may be suitably cut down for practical purposes by the use of the resistances 12 and 13.

In the call box, Fig. 2, the code wheel 14 is recessed as at 16 to provide a series of open pulses when the wheel rotates in a clock-wise direction as indicated. This particular code wheel has notches arranged to send the signal "2—3—1". Associated with it is the code wheel 15 on which are teeth 17 arranged in the same code combination as the notches 16 on wheel 14. The contact spring 18 bearing against code wheel 14 normally completes the circuit through the box in the direction R—T of the loop. The contact spring 19 bearing against the teeth 17 of code wheel 15 momentarily puts ground on the loop immediately prior to opening it for the signalling pulses.

The operation of the system is as follows:

The normally closed circuit condition will first be assumed as represented by loop A. The proper position of the key switch for this condition is with its contact-spring operating lever in position 1 as shown. Prior to sending a signal, current flows from battery 11 through resistance 13, contacts 20 and 21, loop A in the direction R′—R—T—T′, the winding 30—31 of relay 8 and contacts 24 and 25 to ground.

This current energizes relay 8 and its armature 33 is held against the front contact 34, which does not at this time, how-

ever, close any circuit through the register 9.

If a call is sent in from any call box on the line the notches 16 in the code wheel 14 will send out a series of open pulses corresponding to the code number characteristic of that particular box. These open pulses cause relay 8 to release, thus closing the register circuit for each open pulse and recording the code number on the register tape which will be understood to be issued by the register 9.

The register circuit may be traced from battery 10 through resistance 12, contact springs 28 and 27 of the key switch, back contact 35 and armature 33 of relay 8 and thence to the register 9 which is grounded.

If the line is accidentally opened, as shown at E on loop B, a continuous mark will then be recorded by the register 9 owing to the release of relay 8. To overcome this condition, the operator at the register station places the switch key in position 3.

The operation of the circuit B will then be as follows: No current flows from battery 11 except when sending a signal and when the teeth 17 of the code wheel 15 are traversed by the grounded contact 19. The circuit then established for each signalling pulse may be traced from battery 11 through springs 26 and 24 of the key switch to the connecting point 31 between the two windings of relay 8, through one of said windings or the other according to the location of the break E with respect to the box from which the call is being made; thence the current flows either through loop terminal R to call box 5 or through terminal T to one of the boxes 4, the calling box in any case being the point where the circuit is grounded.

Relay 8, therefore, pulls up its armature 33 for each signalling pulse. The register 9 now responds to the closure of the armature 33 and front contact 34 of relay 8, since the key-switch contacts 28 and 29 are closed together.

For the condition of ground as indicated at F on loop C, the coils of relay 8 have to be differentially connected as shown and these windings have equal resistance and an equal number of turns.

To meet this condition the key-switch is placed in position 3 and current flows from battery 11 through resistance 13, contacts 26 and 24, through both windings of relay 8 in opposition (causing the relay to be de-energized) and thence through both legs of the loop circuit C to ground F. In passing to leg R, current flows from relay coil 31—32, through key-switch contacts 22 and 21.

Assuming now that one of the stations 4 on loop C makes a call, then the code signal will be transmitted in the form of open impulses on the leg T of the loop C. This will de-energize coil 30—31 of relay 8, while not disturbing the current flow in coil 31—32. The armature 33 will, therefore, be pulled up on each impulse, closing with contact 34 and relaying the signal to register 9. In case one of the stations 6 on the other side of the "ground" should call, then the signals would be received over the leg R of loop C and relay 8 would operate from the continuance of current flow in coil 30—31, while coil 31—32 de-energized at each signalling pulse.

The fourth condition which is provided for is a break G and a ground H, as shown in loop D. This fault is corrected by placing the key switch in position 2, whereat the operation of the circuit is as follows:

Before a call is made, current will flow from battery 11 through contacts 26 and 24 to the relay coil connection 31, thence through coil 31—30, leg T of loop D and through stations 4 of this loop to ground. The open circuit at G de-energizes the opposing winding 31—32 and hence the armature 33 is normally pulled up. Since contacts 28 and 29 are open for position 2 of the key-switch, no current can pass to the register 9 while the relay 8 remains energized.

Assume now that a call is made from one of the stations 4 on loop D. The open impulses will de-energize coil 31—30, of relay 8, causing its armature 33 to make with its back contact 35, thereby operating the register 9. If a call is initiated from box 7 which is on the R-side of the break G, then the ground impulses resulting from the rotation of code wheel 15 will cause current to energize coil 31—32 in opposition to the previously energized coil 31—30. Each impulse will, therefore, cause the relay to release, operating the register 9 when its armature makes with the back contact.

Referring now to Fig. 3, an alternative arrangement of the line relay and key-switch will be explained. In this embodiment of the invention it is not necessary for the relay winding to be tapped at the middle, but instead, two equal resistors 38 and 39 are provided and their connections through the key-switch are such that they may be bridged across between the terminals of the relay winding, while the midpoint between the two resistors is connected to the battery 11 through the resistance 13.

Relay 41 operates in the following manner under the four conditions indicated by the loop circuits A, B, C and D respectively:

The normally closed circuit represented by loop A is provided when the key switch is set in position 1. Current flows from battery 11 through resistances 13 and 39, loop terminals R''—R, thence through the call

boxes 4 to loop terminals T—T″ which are connected to the winding 40 of relay 41. The other side of the relay winding leads to the key-switch spring 44 which when closed against the grounded contact 45 causes the relay to be energized. A signal can then be originated from any one of the call boxes 4 in loop A, simply by rotating the code wheel 14 and sending open pulses to which relay 41 will respond by releasing its armature 33. Fig. 3 shows the same arrangement of key-switch contact springs 27, 28 and 29 as in Fig. 1, and it will be recalled that these springs supply current from battery 10 either to the front contact 34 or to the back contact 35, according as it is required that the register shall record signals when the line relay energizes or de-energizes. In signalling as on loop A, with switch-key in position 1, the register operates when relay 41 releases.

To meet the conditions that may exist either on loop B, or loop C, the key switch is placed in position 3. If the circuit is accidentally opened as at E then the potential at the two terminals of the relay winding 40 is normally equalized by the equal resistances 38 and 39, and no current will flow until a signal is initiated at one of the call boxes, say box 5. Thereat the grounding of the loop on the side of the terminal R, when the code wheel teeth 17 are traversed by contact 19 causes current to flow from battery 11 through resistances 13 and 38, contacts 42 and 43, relay winding 40, contacts 44 and 46, terminal R″ and the R-leg of loop B to call box 5 where the code signal is originated. Current will also be bypassed through resistance 39, but nevertheless the drop of potential through coil 40 will be sufficient to operate relay 41 in response to the signals. The relay 41 will respond equally well to a call originated at one of the stations 4 on loop B, but current will flow through coil 40 in the opposite direction to that caused by call from box 5.

If the circuit is accidentally grounded as at F on loop C, current will normally flow about equally through the two legs R and T of the loop C. Hence the drop of potential through relay winding 40 will be negligible until a call is made. When a call originates at one of the boxes 4, the opening of the circuit by means of the code wheel 14 at that box will remove ground from leg T of loop C and hence the potential drop in resistance 38 will be diminished and a current flow through coil 40 will be set up, extending through leg R to the grounded point F. Thus the relay will be energized in response to signals and will be restored to a balanced potential across its winding 40 when each signal ceases.

It is obvious that a signal originating at one of the call boxes 6 on loop C would likewise actuate relay 41 except that the drop of potential through its winding 40 would be in the opposite direction to that just described.

The fourth condition of an open, G, and ground, H, as represented by loop D is taken care of by placing the key-switch in position 2. Current normally flows from battery 11 through resistances 13 and 39, contacts 46 and 44, relay winding 40, and terminals T″—T to the grounded point H, thus energizing the relay. Current is also by-passed through resistance 38 but this has no effect until a call is originated, say at one of the boxes 4. The opening of the circuit on the T side of loop D causes the potential to be equalized across the winding 40 so that the relay 41 is deenergized in response to the breaking of the circuit for each signal from the calling box 4.

The potential across the winding 40 is also equalized but with current flowing when signals are transmitted from call box 7. In this case the code wheel 15 at call box 7 puts ground on the R side of loop D, so that current flows equally through resistance 39 to the grounded contact 19 and through resistance 38 to the accidental ground H. The relay 41 at this time de-energizes in response to each signal.

The operation of the register 9 in each of the four cases described in reference to Fig. 3 will be understood from the description applying to Fig. 1.

It will likewise be understood from an examination of the drawing and the accompanying description that whenever the switch key is positioned to take care of one condition of the loop circuit, as a break condition, and another condition of the loop then occurs, as a combination break and ground condition, the register 9 is arranged to mark continuously in response to the changed condition until the key has been properly positioned.

What is claimed is:

1. In a signalling system, the combination of a loop interconnecting a plurality of calling devices each provided with means for grounding and then opening a point on said loop, a relay and a register controlled thereby, and switching means normally connecting said relay and said loop in a closed series circuit, whereby said relay is de-energizable upon each opening of said loop by the operation of any calling device therein, and conditioning said register to respond to the release of said relay, said switching means being operable when an accidental break occurs in said loop to connect each leg of said loop through equal resistances to a grounded source of potential, to condition said register to respond to the operation of said relay, and to connect said relay in shunt across said loop whereby said relay is operated upon each grounding of the leg on one

side of said break by the operation of any calling device included in said leg.

2. In a signalling system, the combination of a loop interconnecting a plurality of calling devices each provided with means for grounding and then opening a point on said loop, a relay and a register controlled thereby, and switching means normally connecting said relay and said loop in a closed series circuit, whereby said relay is de-energizable upon each opening of said loop by the operation of any calling device therein, and conditioning said register to respond to the release of said relay, said switching means being operable when an accidental grounding of both legs of said loop occurs to connect each leg through equal resistances to a grounded source of potential, to condition said register to respond to the operation of said relay, and to connect said relay in shunt across said loop whereby said relay is operated upon each opening of the leg on one side of said ground by the operation of any calling device included in said leg.

3. In a signalling system, the combination of a loop interconnecting a plurality of calling devices each provided with means for grounding and then opening a point on said loop, a relay and a register controlled thereby, and switching means normally connecting said relay and said loop in a closed series circuit, whereby said relay is de-energizable upon each opening of said loop by the operation of any calling device therein, and conditioning said register to respond to the release of said relay, said switching means being operable when a break in said loop occurs and the leg on one side of the break is grounded to connect each leg of said loop through equal resistances to a grounded source of potential, to condition said register to respond to the de-energization of said relay, and to connect said relay in shunt across said loop whereby said relay is de-energized upon each grounding of the ungrounded leg by the operation of any calling device therein and is also de-energized upon each opening of the grounded leg by the operation of any calling device in said leg.

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