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F. E. WELD

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PULSE TRANSMISSION CIRCUIT

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FIG. 1

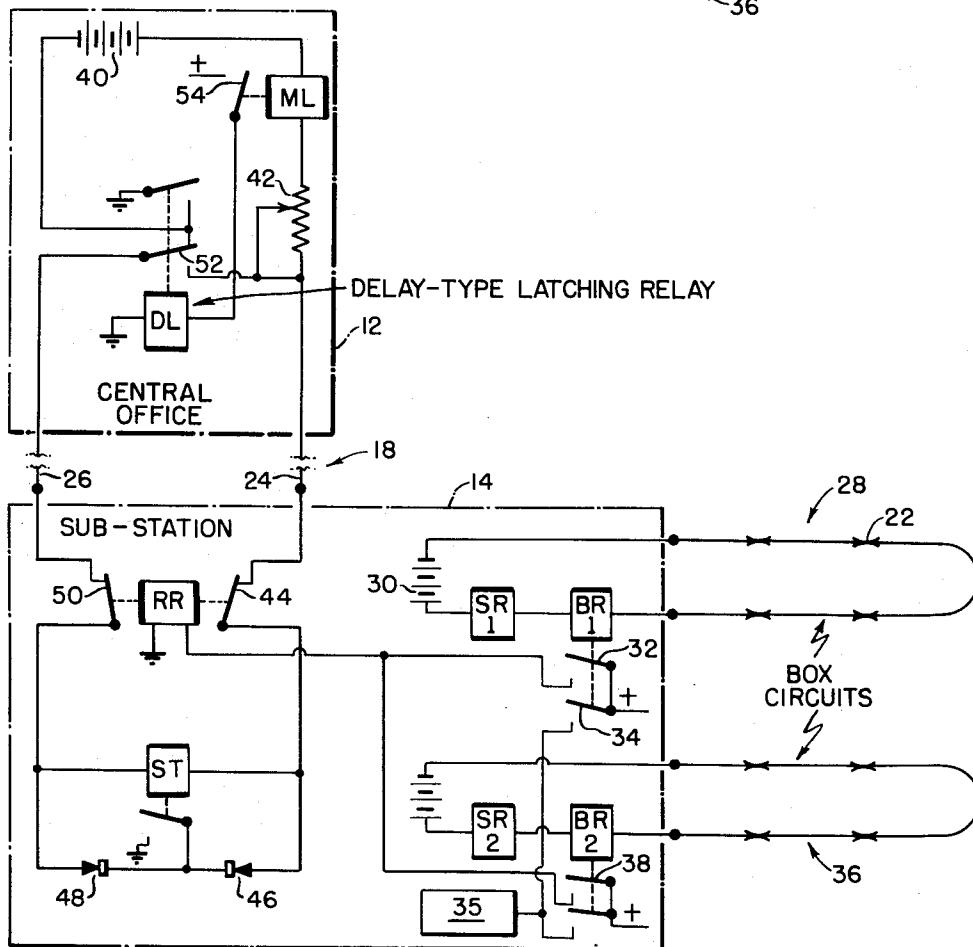
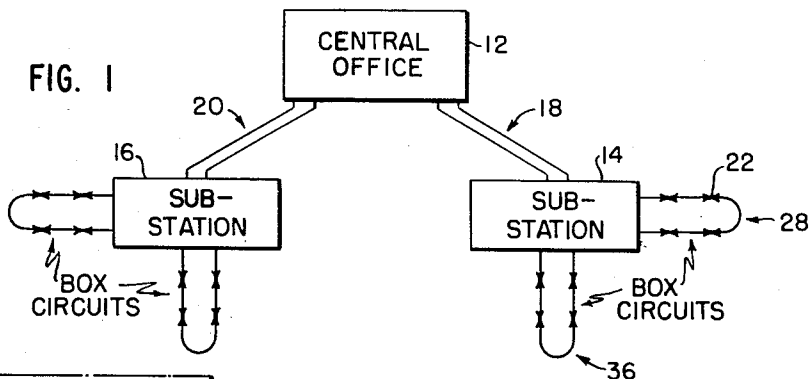


FIG. 2

INVENTOR.
FOSTER E. WELD
BY *Raymond Jenner*
Walter Hildreth
ATTORNEYS

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2,994,860

PULSE TRANSMISSION CIRCUIT

Foster E. Weld, Newton Highlands, Mass., assignor, by mesne assignments, to The Gamewell Company, Newton, Mass., a corporation of Delaware

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6 Claims. (Cl. 340-292)

The present invention relates generally to coded pulse transmission circuits, and more particularly to wire transmission circuits of the metallic type which, in case of breakage of one of the transmission wires, provides for continued transmission using the unbroken wire and ground.

For many years municipal fire alarm systems of the so-called "centralized" type have been installed. In such a system all of the alarm box circuits are directly connected to a central office. From this office tie-lines extend to each of the fire stations controlled by the central office. In so-called "Class A" systems, that is, those installed in cities having more than a designated population or more than a designated number of alarms per unit of time, an operator is on duty for twenty-four hours per day in the central office, and the operator sends signals over the tie-lines only to selected fire stations according to the nature of the alarm. In so-called "Class B" systems for municipalities of smaller population or fewer alarms, the central office may be unattended at certain times, and the equipment in this office is designed to retransmit all box alarms over the tie-lines to all fire stations.

More recently, the so-called "decentralized" arrangement has been favored for Class A systems. Under this arrangement, each fire station is designated a substation and each alarm box circuit is connected to the nearest substation rather than to the central office. In this case the tie-lines which extend from each substation to the central office are connected with circuits which cause coded pulse alarm signals from the box circuits to be repeated in the central office.

It is a principal object of this invention to provide pulse repeating circuits for Class A decentralized systems, such circuits being adapted to use the last-mentioned tie-lines for repeating alarm signals in the central office.

A second object of this invention is to provide metallic circuit tie-lines with provision, in case one of the transmission wires in the tie-line should be accidentally broken, to provide an alternative transmission circuit utilizing the unbroken line and ground.

A third object is to provide pulse repeating circuits of simple and straightforward design, thereby minimizing the costs of installation and repair and the possibilities of faulty operation.

With the foregoing and other objects in view, the principal feature of this invention resides in a pulse repeating circuit having a so-called "supervisory" feature, whereby the tie-line from each substation to the central office forms a normally-closed circuit through which a predetermined current normally flows. A supervisory relay has its operating coil normally connected in this circuit and energized. Under these normal conditions, the pulse repeating circuit is metallic and the supervisory relay is continuously energized. In case one of the wires in the tie-line should break the supervisory relay is deenergized due to interruption of the supervisory circuit. This relay then prepares the pulse transmission circuit, whereby the unbroken wire in the tie-line forms a pulse repeating transmission circuit with ground, and service is not interrupted.

Another feature of the invention resides in the provision of a pulse repeating relay in the transmission cir-

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cuit having two pairs of contacts each connected to open one of the two wires in the tie-line.

Other features reside in certain details of the circuit connections, modes of operation and arrangements of the parts which will become evident from the following description of a preferred embodiment of the invention, having reference to the appended drawing illustrating the same, in which

FIG. 1 is a block diagram illustrating the principal elements of a typical decentralized municipal fire alarm system; and

FIG. 2 is a circuit diagram illustrating the box signal repeating circuit according to this invention.

Referring first to FIG. 1, there is illustrated a central office at 12 which may be located approximately in the center of a large municipality. Substations designated 14 and 16 are fire stations having fire-fighting personnel and equipment and also serve to repeat alarm signals from their respective box circuits to the central office. Two-wire tie-lines 18 and 20 extend from each substation to the central office.

One or more box loop circuits of conventional type are connected to each substation. As is well-known in the art, each box circuit is a series circuit or loop having a pair of contacts in each alarm box to which it is connected which may be used for transmitting alarm signals from the box to the substation. The patent to Suren et al. No. 1,986,026 describes a suitable means for operating the contacts in each alarm box. These contacts are schematically shown at 22. It will be seen that since the system is decentralized the box circuits may be shorter than for a centralized system in which each box circuit would be brought directly to the central office. The advantages of this feature in terms of economy will be evident.

Referring to FIG. 2, the substation 14 is shown in further detail. It will be understood that the circuits in the substation 16 and the associated circuits in the central office 12 are the same as those illustrated. The tie-line 18 consists of a wire 24 and a wire 26 extending to the central office. In the central office 12 there is shown a main line representing relay ML. In general, the purpose of the illustrated circuit is to cause trains of coded pulses originating with the opening and closing of contacts such as 22 in the alarm boxes to cause energization and deenergization of the relay ML in sequences identical to the pulses, whereby suitable contacts associated with this relay may be used to operate recording devices and audible alarm devices in the central office. Also, similar devices in the substation are to be operated.

The box circuits connected with the substation 14 are well-known and are illustrated only to clarify the environment of the invention. A box circuit 28, for example, comprises a series circuit including a metallic loop through a number of boxes, a battery 30 and relays SR1 and BR1. The battery 30 may be replaced by a suitable rectifier circuit, according to conventional practice. The relay SR1 is a supervisory relay of the conventional type in such circuits and its contacts are not illustrated. The relay BR1 has a pair of break contacts 32 and 34 connected to a "plus" source, that is, a grounded source of direct current. In the drawings, all relay contacts are illustrated in the positions reached when a "normal" condition exists. The "normal" condition is defined as that condition in which (a) electrical power is supplied at all indicated connections in the diagram, (b) none of the contacts 22 in the alarm boxes is open, and (c) neither of the wires 24 or 26 is broken. The contacts 34, when closed, are connected to a device 35 which may be a recording device or a gong or other audible means for repeating an alarm signal in the substation, or a number

of such means. The contacts 32 are connected to a repeating relay RR.

Inspection of the drawing will show that a second box circuit 36 is identical to the circuit 28, and that break contacts 38 of a relay BR2 when closed, are also connected with the repeating relay RR. Additional box circuits of the same type may be provided. Thus a train of alarm pulses, commonly referred to as "strokes" occurring in coded sequence, are repeated by energization and deenergization of the relay RR. It will be understood that in accordance with usual practice, each pulse or stroke takes the form of a brief interruption in the steady-state current through the loop.

Under normal operating conditions a series circuit including the tie-line 18 is formed between the central office and the substation. A battery 40 supplies a supervisory current which flows continuously in this circuit except during an alarm, the current passing through the relay ML, a variable resistor 42 which is adjusted to fix the level of the current, for example to 100 milliamperes, the wire 24, contacts 44, the coil of a relay ST in parallel with opposed rectifiers 46 and 48, contacts 50, the wire 26, and contacts 52. The relay ST is energized. The supervisory current is also sufficient to energize the relay ML, thus holding a pair of break contacts 54 open. A relay DL is therefore not energized. This latter relay is a delay-type latching relay, that is, it becomes energized only if the energizing current is sufficiently sustained, and when energized holds its contacts in actuated position by reason of a mechanical latching device of a common type, not shown. Under the described circumstances, therefore, the contacts 52 remain closed.

Assuming these normal conditions, we may next examine the operation of the repeating circuit by an alarm signal from box contacts such as 22. Through the contacts 32 and the relay RR the alarm pulses or strokes are repeated by simultaneous opening of the contacts 44 and 50 associated with the relay RR, whereby the supervisory current described above is periodically interrupted and the relay ML in the central office repeats the alarm pulses. This completes the normal signal. It will be observed that the interruption of the circuit occurs only briefly for each pulse, the interval of interruption being less than the time required for energization of the relay DL. Hence an alarm signal does not operate the latter relay and the contacts 52 remain closed as shown in the drawing throughout the alarm signal.

According to an important feature of this invention, the circuit is adapted to permit transmission of alarm signals to the relay ML in the central office even though one of the wires 24 or 26 should break. In some installations these wires may be installed on poles, being therefore subject to breakage by falling limbs from trees, ice loads or other hazards. If either of these wires should break, the supervisory circuit becomes interrupted and the relay ST becomes deenergized. The relay ST closes its contacts to apply ground to the common connection of the rectifiers 46 and 48. If the interruption is more than momentary in character, the relay DL also becomes energized, thereby connecting together the wires 24 and 26 in the central office and grounding the negative terminal of the battery 40.

It will be seen that the central office then provides a circuit from ground through the battery 40, the relay ML and the resistor 42 to the common connection of the wires 24 and 26. In the substation, the wire 26 is connected through the contacts 50 and the rectifier 48 to ground, while the wire 24 is connected through the contacts 44 and the rectifier 46 to ground. Supervisory current is then sustained through this circuit including ground and the wire 24 or 26 which is not broken. When the repeating relay RR is then operated by an alarm signal, the pulse transmission is completed to the relay ML either through the wire 24 or the wire 26, which ever remains unbroken. Thus operation is continued on

a single-wire grounded transmission basis until the breakage can be repaired.

It will be recognized that while a relay DL has been shown for automatically connecting the wires 24 and 26 and grounding the battery 40, a manual switch may be provided, this switch being actuated by the operator upon his detecting the interruption of the supervisory circuit due to a line fault. Means for such detection are well known and are therefore not illustrated and described herein. It will be further recognized that means will ordinarily be provided to supervise the magnitude of the supervisory current, that is, to determine if the supervisory current should be reduced to a marginal level. These means are of a well known type and are not illustrated. A full disclosure of a central office system of a type well adapted for use with the circuits of the present invention is shown in my Patent No. 2,250,922.

Also, while the invention has been described with reference to a preferred embodiment thereof, other variations in the circuits will occur to those skilled in the art and may be incorporated without departing from the spirit or scope of the invention.

Having thus described the invention, I claim:

1. In a coded alarm pulse transmission circuit, the combination of a pair of terminals for connection to a transmission line, a pair of rectifiers series-connected in opposing relationship, a supervisory relay coil connected in parallel with said rectifiers, said coil having contacts connecting the common connection of said rectifiers to a ground, and a repeating relay having two pairs of contacts, each of said pairs connecting a side of said supervisory relay coil to one of said terminals.

2. In a coded alarm pulse transmission circuit, the combination of a pair of terminals for connection to a transmission line, a pair of rectifiers series-connected in opposing relationship, a supervisory relay coil connected in parallel with said rectifiers, said coil having contacts connecting the common connection of said rectifiers to a ground when said coil is deenergized and breaking said connection when said coil is energized, and a repeating relay having two pairs of contacts, each of said pairs connecting a side of said supervisory relay coil to one of said terminals.

3. In a coded alarm pulse transmission circuit, the combination of a pair of terminals for connection to a transmission line, a pair of rectifiers series-connected in opposing relationship, a supervisory relay coil connected in parallel with said rectifiers, said coil having contacts connecting the common connection of said rectifiers to a ground when said coil is deenergized and breaking said connection when said coil is energized, and a repeating relay having two pairs of contacts, each of said pairs connecting a side of said supervisory relay coil to one of said terminals when said repeating relay is deenergized and breaking said connection when said repeating relay is energized.

4. In a coded alarm pulse transmission circuit, the combination of a pair of terminals for connection to a transmission line, a pair of rectifiers series-connected in opposing relationship, a supervisory relay coil connected in parallel with said rectifiers, said coil having contacts connecting the common connection of said rectifiers to a ground when said coil is deenergized and breaking said connection when said coil is energized, a repeating relay having two pairs of contacts, each of said pairs connecting a side of said supervisory relay coil to one of said terminals when said repeating relay is deenergized and breaking said connection when said repeating relay is energized, and an energizing circuit for said repeating relay including a series-connected box alarm circuit, a relay in said circuit and contacts of the last-mentioned relay connected with the operating coil of said repeating relay.

5. In a coded alarm pulse transmission circuit, the combination of a two-wire transmission line extending between a transmitting station and a receiving station, a

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source of current and a repeating relay at the receiving station, a supervisory relay coil and a repeating relay at the transmitting station, the last-mentioned repeating relay having a pair of contacts in series with each wire of said line, the supervisory relay having contacts connected with a ground, a series circuit connected through said source, the operating coil of said repeating relay at the receiving station, both wires of said line, said pairs of contacts of the repeating relay at the transmitting station and said supervisory relay coil, a pair of opposed rectifiers connected in parallel with the supervisory relay coil, the common connection of said rectifiers being connected through said contacts of the supervisory relay coil to said ground, and switch means to connect said wires together at the receiving station and to provide a circuit to said ground from the connected ends of said wires through said source and the operating coil of the repeating relay at the receiving station.

6. In a coded alarm pulse transmission circuit, the combination of a two-wire transmission line extending be-

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tween a transmitting station and a receiving station, a source of current, a supervisory relay coil having contacts connected with a ground, a repeating relay at the transmitting station having a pair of contacts in series with each wire of said line, a repeating relay at the receiving station, a series circuit connected through said source, the operating coil of said repeating relay at the receiving station, both wires of said line, said pairs of contacts of the repeating relay at the transmitting station and said supervisory relay coil, a pair of opposed rectifiers connected in parallel with the supervisory relay coil, the common connection of said rectifiers being connected through said contacts of the supervisory relay coil to said ground, and switch means to connect said wires together at the end of said line opposite to the supervisory relay coil and to provide a circuit to ground the connected ends of said wires through the repeating relay at the receiving station.

No references cited.