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FIRE ALARM SYSTEM

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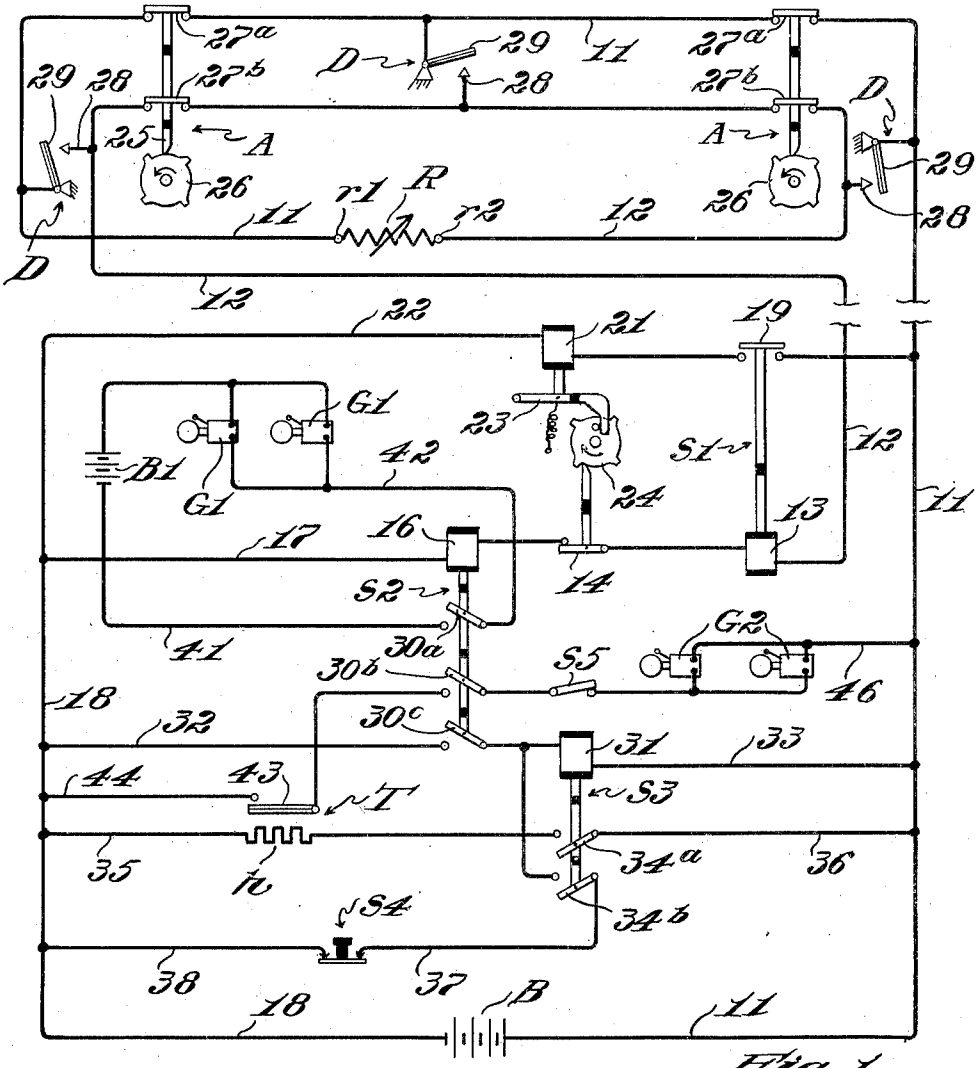


Fig. 1

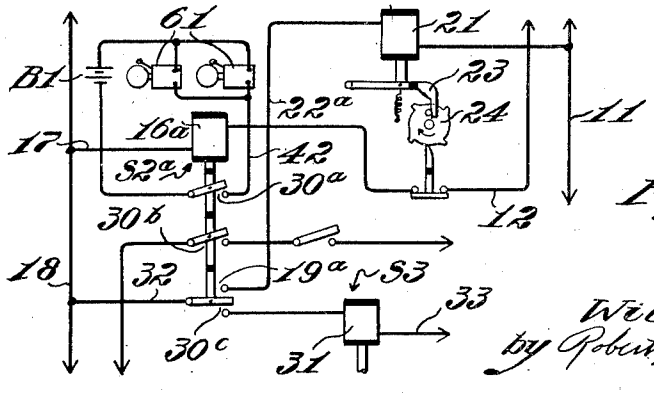


Fig. 2

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FIRE ALARM SYSTEM

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An analytical survey of any representative selection of serious conflagrations clearly shows that a delay in discovery makes the difference between a small easily controlled fire and a major disaster resulting from its neglect. This need for prompt discovery of an incipient fire has long been recognized and many systems and devices have been developed to control and indicate the presence of such a fire. Functionally, these devices are divided into two general groups.

One group includes systems with automatic detectors (responsive, for example, to the flow of water in a sprinkler system or to a thermostat) to operate electrical contacts thereby transmitting an alarm signal by means of an electrical circuit. The preferred type of such system comprises fundamentally a plurality of detectors with normally open electrical contacts for interconnecting two parallel conductors which are connected in series with a terminal resistor and a power source. The closing of any one of these contacts in response to a change in ambient temperature shunts the terminal resistor thereby decreasing the total resistance of the circuit. The resulting increase in the flow of current is used to operate a switching element of an associated alarm circuit, to open a sprinkler system or to initiate functioning of other fire preventive means.

The other group includes the systems with manually operated alarm stations for transmitting an alarm signal to a central station or to the fire department. Highly developed systems of this type transmit coded signals in response to rotation of a spring actuated code wheel which interrupts a series connected electrical initiating circuit continuously energized from a power source so as to be self-supervising.

Because of the danger of panic in public buildings such as hotels, theaters and schools, a general alarm should not be sounded unless it is absolutely necessary for the safety of the occupants. The common means for accomplishing this end is to have the signal transmitted upon ringing any one of the above-described alarm stations, give a preliminary alarm at a central station in the usual manner. If after an investigation a general alarm is found necessary, it is sounded from the nearest alarm station by means of a special key carried by the investigator.

The detecting and alarm systems are not generally combined in one system despite the obvious advantages in simplicity, economy and maintenance such an arrangement would have.

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If alarm detecting devices of the conventional type are used in the same electrical initiating circuit with series type manual alarm stations, the operation of any one of the detecting devices shunts the two parallel conductors so that the alarm stations positioned in the loop beyond the shunt with respect to the power source are rendered inoperative. The interruption of the system by the operation of one of the detecting devices also prevents the use of the alarm stations to sound a general alarm. If an automatic detector with a normally closed contact is connected in series with the initiating circuit, the interrupting action has the same electrical effect upon supervisory elements of the circuit as a ground or power failure so that the system does not distinguish a fire signal from a trouble signal.

Objects of this invention are to provide an electrical system which incorporates both manually operated alarm stations and automatically operated detecting devices in the same initiating circuit, which transmits coded signals, which first transmits a preliminary alarm either manually or automatically and which subsequently permits the manually sounding of a general alarm, and to provide such a system which is dependable and electrically self-supervising, which is simple and economical to install and maintain, and which advances the art of fire alarm and detection generally.

In a broad aspect the invention contemplates a signalling system comprising two conductors and a resistor connected in series with a power source to complete a continuously energized double loop initiating circuit. Each of a plurality of alarm stations is connected to transmit a signal by simultaneously opening both conductors thereby to interrupt the initiating circuit. A signal is also transmitted by changing the resistance of the initiating circuit by interconnecting the conductors thereof by means of any one of a plurality of detecting stations. A switching element, responding to a first signal from one of the stations, connects a preliminary alarm circuit and also a time delay device in a general alarm circuit with the power source. After the operation of the time delay device the switching element is responsiive to subsequent signals to energize both the preliminary and general alarm circuits.

In a different aspect the alarm circuit or circuits are energized from the same or different power sources by the use of two switching elements. One of these switching elements connects the alarm circuit either in response to a

signal resulting from the interruption of the initiating circuit by one of the alarm stations or in response to the operation of a second switching element by a signal from one of the detecting stations.

In a more specific aspect the switching element or elements are relays each having one or more contacts operated by a respective solenoid in response to signals from one of the stations. The interruption of the initiating circuit by one of a plurality of manually-operated alarm stations deenergizes the solenoid of a signal relay connected in series therewith to close three contacts in the preliminary alarm circuit, general alarm circuit and latching relay circuit respectively. The decrease in resistance of the initiating circuit resulting from the operation of one of a plurality of automatically operated code stations results in an increase in the current flowing therein so that the solenoid of a second relay is energized to release a detent restraining an automatically operated code wheel. A normally closed contact in series with the initiating circuit is opened in response to the rotation of the code wheel thereby deenergizing the signal relay and energizing the alarm circuit.

An additional feature is the closing of a normally open contact by the energization of a coil of a latching relay circuit by the signal relay, to connect a heater element of the time delay device to the power source. A latching relay is provided to maintain the contact in this position until manually released. After a predetermined time interval the rise in temperature resulting from the energization of the heater element closes a normally open heat responsive contact in the general alarm circuit.

Still another feature of the invention is the possibility of deenergizing, with the first signal in the above circuit, the signal relay solenoid so that two of the normally closed contacts complete the preliminary alarm and latching relay circuits respectively, the general alarm circuit being not energized as it is interrupted by the open heat responsive contacts of the time delay device. After a time delay determined by the characteristics of the time delay relay, the heat responsive contact closes. A subsequent signal from any one of the manually operated code stations deenergizes the signal relay a second time so that the closing of the contacts completes both the preliminary and general alarm circuits.

These and other objects, aspects and features will appear from the following description of two practical embodiments illustrating the novel characteristics of the invention. This description refers to a drawing wherein:

Fig. 1 is the circuit diagram of one embodiment; and

Fig. 2 a modification of part of the circuit according to Fig. 1, indicating a second embodiment of the invention.

As shown in Fig. 1, the initiating circuit of a fire alarm system comprises a double loop of two spatially parallel conductors 11 and 12. The adjacent ends *r1*, *r2* of these conductors are joined with respective terminals of a terminal resistor R the ohmic characteristics of which are adjustable. The opposite end of the conductor 11 is linked directly with one pole of a power source such as the battery B. The opposite end of the conductor 12 is connected to one terminal of the solenoid 13 of a first switching element such as the relay S1. The initiating circuit is completed to the opposite pole of the battery B through the solenoid 13, a normally closed contact 14, a solenoid 16 of a second switching element such as the signal relay S2, and the wires 17 and 18.

Energization of the solenoid 13 closes a normally open contact 19 thereby to connect a solenoid 21 to the battery B in a circuit including solenoid 21 of a transfer station, the contact 19, the conductor 11, the battery B and the wires 18 and 22. The energization of the transfer station solenoid 21 unlatches a spring biased detent 23 so that a spring actuated code wheel 24 rotates to open the contact 14 and interrupts the initiating circuit in a manner analogous to that in which a conventional manually operated alarm station transmits a coded signal.

The initiating circuit can also be interrupted by any one of a plurality of manually operated alarm stations A. Each of these stations A includes a spring actuated code wheel 26 with a cammed surface for opening the contacts 27*a* and 27*b* in a predetermined code sequence and is similar to a conventional alarm station with the exception that the two contacts are used to open both conductors 11 and 12 of the initiating circuit rather than a single series contact being used to interrupt the circuit as is the usual practice.

Any number of automatically operated detecting stations D can also be connected in the same initiating circuit. Several such automatic stations are shown schematically in the drawing each as having a normally open contact 28 which can be closed by a heat responsive element 29 thereby to complete a shunting connection between the conductors 11 and 12. Any or all of these detecting stations D can be replaced by devices with normally open contacts operated directly or indirectly when a fire occurs (for example by the flow of water in a sprinkler system), or by a continuous line type detecting cable wherein the conductors contact each other in response to a rise in temperature as is shown in my Patent 2,185,944, or by any of the other well-known types of fire detecting devices wherein a connection is completed in response to a change in ambient temperature.

The signal relay S2 has three contacts 30*a*, 30*b* and 30*c* opened conjointly by the energization of the solenoid 16. A preliminary alarm circuit and a general alarm circuit which will be described in detail hereinafter are energized by the closing of contacts 30*a* and 30*b* respectively.

The conjoint closing of the contact 30*c* energizes a locking relay S3 by means of a circuit including the relay coil 31, the normally closed contact 30*c*, the wires 32 and 18, the battery B and the wires 11 and 33. This energization of the coil 31 closes the contact 34*a* to connect a heater element *h* of a thermal timer T or time delay device of another type to the battery B by means of the wires 35, 18, 11 and 36. A second contact 34*b* closes conjointly with 34*a* to provide a holding circuit in parallel with the contact 30*c* by means of the wires 37 and 38 and the normally closed manually operated push button switch S4, so that the power supplied to the heater element *h* is not interrupted by the subsequent opening of the contact 30*c*. As will be recognized by persons skilled in the art it is possible to replace the holding contact and its associated circuit with a mechanical latching arrangement to hold the contact 34*a* in closed position until manually released.

The preliminary alarm circuit referred to above comprises one or more warning devices such as the bells G1 or other audible or visual signals which are energized from an auxiliary power source such as the battery B1 through

the wires 41 and 42 upon the closing of contact 30a. A plurality of additional warning devices such as the bells G2 are energized from the battery B by means of the general alarm circuit which also includes the manually operated switch S5, the contact 30b, a timing element such as the temperature responsive contact 43 of the thermal timer T and the wires 44, 18, 11 and 46.

Although this does not provide as flexible a circuit arrangement as that described above, it is possible to use one relay S2a of the marginal type combining the functions of relays S1 and S2. As is shown in Fig. 2, the relay S2a includes a solenoid 16a connected in series with the initiating circuit. The three contacts 30a, 30b and 30c are connected in a similar manner and perform analogous functions upon the deenergization of the solenoid 16a to the contacts 30a, 30b and 30c of the relay S2. A normally open contact 19a is closed upon the flow of a current equal to or greater than .010 amperes in the solenoid 16a.

The above described arrangements operate as follows:

In order to put the alarm system in operative condition the terminal resistor R is adjusted so that the battery B sends a continuous low current, in an actual embodiment of approximately .006 ampere, through the initiating circuit B—11—R—12—13—14—16—17—18. The solenoid 13 of commercially available apparatus suitable for relay S1 (or the solenoid 16a of the relay S2a) requires a minimum pickup current of .010 ampere so that the contact 19 (or 19a) is not closed upon the flow of the normal current through the initiating circuit. As the solenoid 16 (or 16a) of the signal relay S2 (or S2a) selected for proper operation in this circuit requires only .005 ampere to pick up its armature, the normal current flowing in the initiating circuit opens the normally closed contacts 30a, 30b and 30c thereby to interrupt the respective alarm and locking relay circuits.

When an alarm is sounded from any one of the alarm stations A, its spring actuated code wheel 26 is released. As the wheel 26 rotates, its cammed surfaces raise a follower and the attached contacts 27a and 27b to interrupt the current flowing in the initiating circuit in accordance with a preselected code signal. These interruptions deenergize the coil 16 (16a) thereby closing the contact 30a in correspondence with the sequence of interruptions of the code signal so that the preliminary alarm circuit B1—G1—42—30a—41 is energized and the code signal is sounded by the bells G1. The conjoint closing of the contact 30b does not sound the bell G2 as the general alarm circuit G2—46—11—B—18—44—43—30b—S5 is interrupted by the contacts 43 of the thermal timer T.

The first closing of the contact 30c completes the circuit 30c—31—33—11—B—18—32 to energize the coil 31 of the locking relay S3. The resulting closing of the contacts 34a and 34b completes the holding circuit 31—33—11—B—18—38—S4—37—34b to maintain the energization of the coil 31 after the contact 30c reopens, and also completes a heater element circuit h—34a—36—11—B—18—35 respectively. After an elapse of a predetermined time period, heat from the heater element h of timing device T raises the temperature of the heat responsive contacts 43 so that they close.

If the inspection made after the preliminary alarm indicates that a general alarm is necessary, the nearest alarm station A is rung. This signal is sounded on the preliminary alarm system as described above. With the contact 43 closed, the contact 30b is closed conjointly to complete the general alarm circuit so that the bells G2 are also sounded in response to the code signal. The push button S4 and the manually operated switch S5 are provided to open the holding coil circuit and the general alarm circuit respectively.

When a detecting station is subjected to an elevated ambient temperature, its normally open contacts are actuated shunting the terminal resistor R so that a current of greater than .010 ampere flows through the solenoid 13 (or 16a). The correlated contact 19 (or 19a) completes the circuit 19—21—22—11—B—18. The energization of the solenoid 21 unlatches the spring actuated code wheel 24 whereby the contact 14 interrupts the initiating circuit to sound a coded alarm in a manner analogous to the operation of a manually operated alarm station as described above.

When the above-described initiating circuit is used the operation of any detecting station does not interfere with the transmission of a coded signal from any alarm station. As can be readily seen from the drawing, the interrupting of both conductors at any position in the loop results in interruption of the initiating circuit irrespective of the location of a shunting connection so that the conjoint opening of the contacts 27a and 27b always interrupts the current flowing through the relay S2 thereby to transmit the coded signal. As the alarm system is operative at all times it can also be used to sound the general alarm of any manual alarm station regardless of whether the preliminary alarm was sounded by a manual or by an automatically operated station.

I claim:

1. A fire alarm system of the type having a plurality of alarm stations for interrupting a continuously energized initiating circuit to transmit a signal, comprising a power source, a signal relay having a solenoid connected in the initiating circuit and three contacts opened by the energization of said solenoid; a preliminary alarm circuit; a general alarm circuit having a normally open heat responsive contact connected in series therewith, each of said alarm circuits including a warning device energized from the power source by the closing of a respective one of said contacts; a locking relay including a normally open contact, a coil energized from said power source by the third signal relay contact to close the normally open contact, and latching means for maintaining the normally open contact in the closed position until manually released; and a time delay device including a heater element energized from said power source by closing of the latching relay contact to actuate said heat responsive contact after a predetermined time interval so that the first signal from any one of said alarm stations energizes the preliminary alarm circuit warning device and the timing element starts said time interval and signals subsequent to the elapse of the time interval energize the warning devices in both the preliminary and general alarm circuit.

2. A fire alarm system of the type continuously energized by a power source, comprising a preliminary alarm circuit, a general alarm circuit including a time delay device operating a predetermined period after being energized from said source and a warning device, an initiating circuit including two wires and a resistor con-

nected in series with said power source, one or more manually operated alarm stations, each having two contacts for transmitting a signal by simultaneously opening both of said wires thereby to interrupt said initiating circuit, one or more automatically operated detecting stations interposed with said alarm stations in said initiating circuit, each adapted to transmit a signal by interconnecting said wires thereby to change the resistance of said initiating circuit, said initiating circuit being arranged as a double loop with at least one contact of each alarm station disposed between said power source and the interconnection between said wires made by any one of said detecting stations, and a switching element energized from said initiating circuit and having a plurality of contacts operated by a signal from any one of said stations, two of said switching element contacts operating in response to a first signal to energize the time delay device and the preliminary alarm circuit respectively from said power source, and a third switching element contact operating in response to signals from manual stations subsequent to the elapse of the timing period of said timing device to complete a circuit including the timing device for energizing the warning device from said power source, said preliminary alarm circuit being energized by the simultaneous operating of its correlated contact.

3. A fire alarm system of the type continuously energized by a power source, comprising an alarm circuit having a warning device, an initiating circuit including two wires and a resistor connected in series with said power source, one or more alarm stations, each having two contacts for transmitting a signal by simultaneously opening both of said wires thereby to interrupt said initiating circuit, one or more detecting stations interposed with said alarm stations in said initiating circuit, each adapted to transmit a signal by interconnecting said wires thereby to change the resistance of said initiating circuit, said initiating circuit being arranged as a double loop with at least one contact of each alarm station disposed between said power source and the interconnection between said wires made by any one of said detecting stations, and a switching element connected in said initiating circuit and having contacts operated to connect said warning device to said power source in response either to the interruption of the initiating circuit by a signal from said alarm station or to the change in resistance of the initiating circuit by said detecting station.

4. A fire alarm system of the type continuously energized by a power source comprising an alarm circuit having a warning device, an initiating circuit including two wires and a resistor connected in series with said power source, one or more alarm stations, each having two contacts for transmitting a signal by simultaneously opening both of said wires thereby to interrupt said initiating circuit, one or more detecting stations interposed with said alarm stations in said initiating circuit, each adapted to transmit a signal by interconnecting said wires thereby to change the resistance of said initiating circuit, said initiating circuit being arranged as a double loop with at least one contact of each alarm station disposed between said power source and the interconnection between said wires made by any one of said detecting stations, a first switching element responsive to signals from any of said detecting stations to open said initiating circuit, and a second switching element connected in said initiating circuit and having contacts operated to connect said warning device to said power source in response to a signal from either the first switching element or any one of the alarm stations.

5. A fire alarm system of the type continuously energized by a power source comprising an alarm circuit having a warning device and contacts for connecting said warning device to said power source, an initiating circuit including two wires, a resistor, and a relay solenoid for actuating said contacts connected in series with said power source, one or more manually operated alarm stations, each having two contacts for transmitting a signal to said solenoid by simultaneously opening both of said wires thereby to interrupt said initiating circuit, and one or more automatically operated detecting stations interposed with said alarm stations in said initiating circuit, each adapted to transmit a signal to said solenoid by interconnecting said wires thereby to change the resistance of said initiating circuit, said initiating circuit being arranged as a double loop with at least one contact of each alarm station disposed between said power source and the interconnection between said wires made by any one of said detecting stations, said solenoid operated contacts being actuated in response to signals from any one of said stations thereby to energize the warning device from said power source.

6. A fire alarm system of the type continuously energized by a power source comprising an alarm circuit having a warning device and a first relay contact for connecting said device to said power source, an initiating circuit including two wires, a resistor and a marginal relay solenoid for closing said contact when deenergized connected in series with said power source, one or more manually operated alarm stations, each having two contacts for transmitting a coded signal to said solenoid by simultaneously opening both of said wires thereby to interrupt said initiating circuit, one or more automatically operated detecting stations interposed with said alarm stations in said initiating circuit, each adapted to transmit a continuous signal by interconnecting said wires thereby to change the resistance of said initiating circuit, said initiating circuit being arranged as a double loop with at least one contact of each alarm station disposed between said power source and the interconnection between said wires made by any one of said detecting stations, an automatically operated transfer station for interrupting said initiating circuit to transmit a coded signal to said solenoid, and a second relay contact closed by the energization of the solenoid by a continuous signal from any one of the detecting stations to operate the transfer station, said first relay contact being actuated to energize the alarm circuit from said power source upon deenergization of the solenoid by interruption of the initiating circuit by a coded signal from either the transfer station or from any one of the manually operated stations.

7. A fire alarm system of the type continuously energized by a power source comprising an alarm circuit having a warning device and a contact for connecting said device to said power source, an initiating circuit including two wires, a resistor, a relay solenoid for closing said contact when deenergized and a second relay solenoid connected in series with said power source; one or more manually operated alarm stations, each having

two contacts for transmitting a coded signal by simultaneously opening both of said wires thereby to interrupt said initiating circuit; one or more automatically operated detecting stations interposed with said alarm stations in said initiating circuit, each adapted to transmit a continuous signal by interconnecting said wires thereby to decrease the resistance of said initiating circuit; said initiating circuit being arranged as a double loop with at least one contact of each alarm station disposed between said power source and the interconnection between said wires made by any one of said detecting stations; an automatically operated trip station for interrupting said initiating circuit to transmit a coded signal to the first solenoid; and a second relay contact closed upon the energization of the second solenoid by a continuous signal from any one of the detecting stations to operate the trip station, said first relay contact being actuated to energize the alarm circuit from said power source upon de-energization of the first relay solenoid by the interruption of the initiating circuit by a coded signal from either the trip station or from any one of the manually operated alarm stations.

8. A fire alarm system of the type having a plurality of alarm stations for interrupting a continuously energized initiating circuit to transmit a signal, comprising a preliminary alarm circuit, a power source for energizing said circuit, a general alarm circuit including a warning device and a time delay device operating a predetermined period after being energized from said source, and a switching element energized from said initiating circuit and having a plurality of contacts operated by a signal from any one of said stations, two of said contacts operating in response to a first signal to energize both the time delay device and the preliminary alarm circuit from said power source, the third contact operating in response to signals from manual stations subsequent to the elapse of the timing period of

said timing device to complete a circuit including the timing device for energizing the warning device from said power source, said preliminary alarm circuit being energized by the simultaneous operating of its correlated contact.

9. A fire alarm system of the type having a plurality of alarm stations for interrupting a continuously energized initiating circuit to transmit a signal, comprising a power source; a signal relay having a solenoid connected in the initiating circuit and three contacts opened by the energization of said solenoid; a preliminary alarm circuit; a general alarm circuit, each of said alarm circuits including a warning device energized from the power source by the closing of a respective one of said signal relay contacts, a time delay device including contacts connected to the warning device in the general alarm circuit and a timing element for operating said device contacts a predetermined period after being energized from the power source by said third signal relay contact so that the first signal from any one of said stations energizes the preliminary alarm circuit warning device and the timing element to start said time interval and signals from any one of said alarm stations transmitted subsequent to the elapse of the period energizing the warning devices in both the preliminary and general alarm circuits.

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