Jan. 11, 1927. 1,613,802

T. A. MOLLARD

SIGNALING SYSTEM

Filed May 19, 1923 2 Sheets-Sheet 1

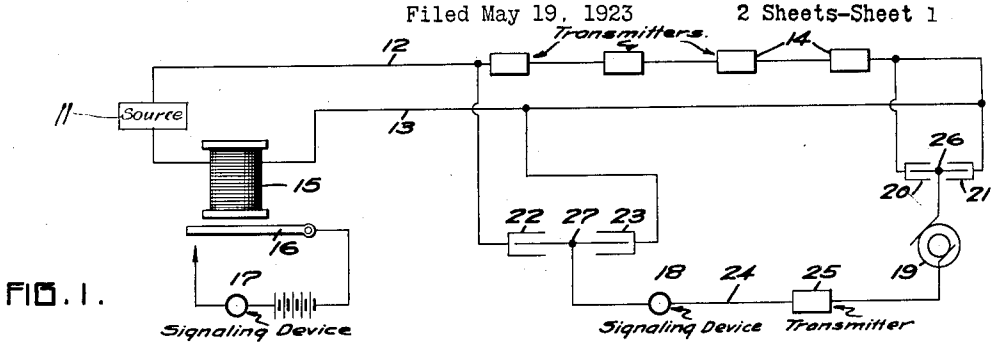
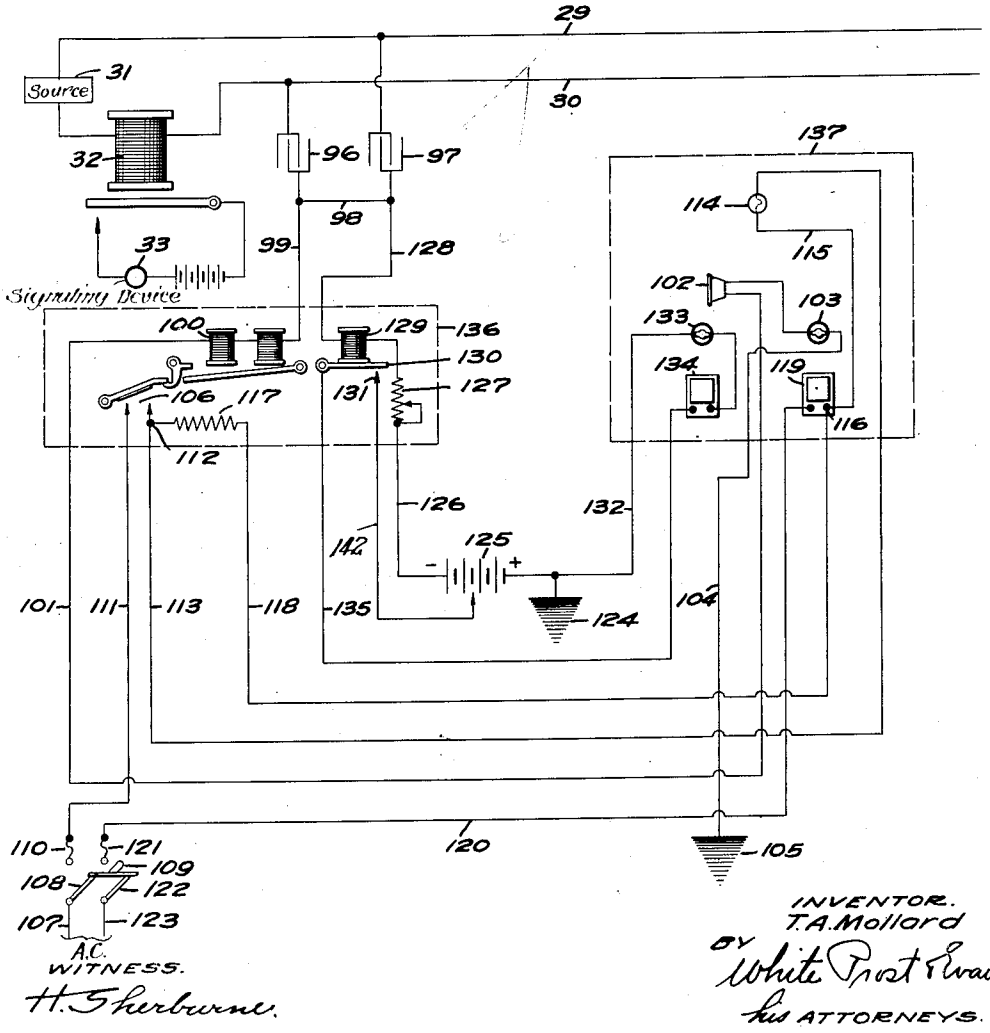


FIG. 1.

FIG. 3.



WITNESS.
H. Sherburne.

INVENTOR.
T.A. Mollard
BY White Frost & Evans
his ATTORNEYS.

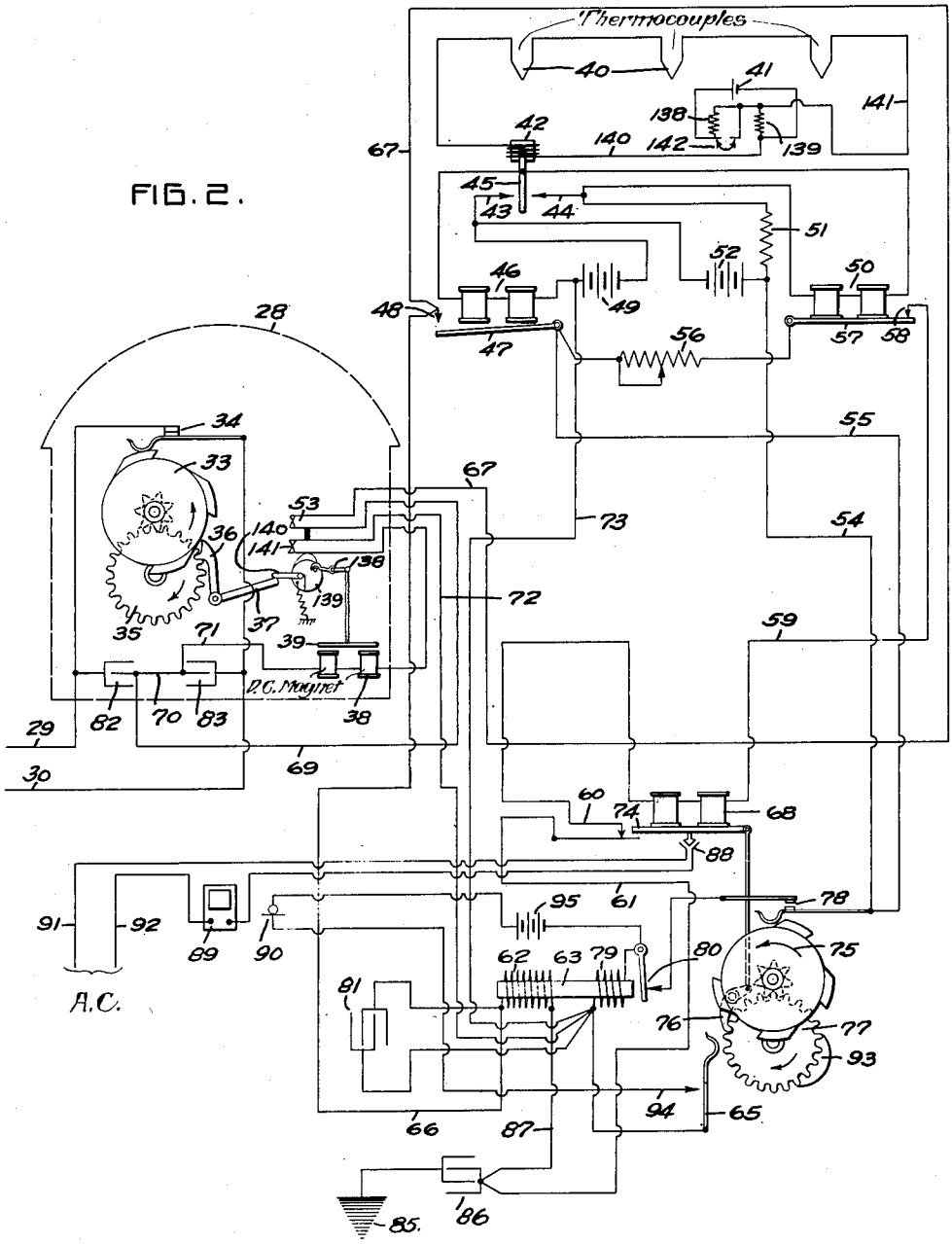
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T. A. MOLLARD

SIGNALING SYSTEM

Filed May 19, 1923 2 Sheets-Sheet 2

FIG. 2.



INVENTOR
T.A. Mollard.
BY
White Prat & Evans
his ATTORNEYS.

WITNESS.
H. Sherburne

Patented Jan. 11, 1927. 1,613,802

UNITED STATES PATENT OFFICE.

THOMAS A. MOLLARD, OF OAKLAND, CALIFORNIA, ASSIGNOR TO PACIFIC FIRE EXTINGUISHER CO., OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA.

SIGNALING SYSTEM.

Application filed May 19, 1923. Serial No. 640,070.

This invention relates to a signaling system, and more particularly to a system in which a plurality of signals may be independently transmitted and may be caused to affect independent receiving circuits. I have developed such a system for use with certain types of fire prevention circuits, but as will become apparent from the following description, the broad features of my invention may be applied to a wide variety of signaling circuits.

It is thus one of the objects of my invention to provide a signaling circuit for a plurality of signals that may be separately transmitted and received by proper selective devices.

In order to effect this result, I utilize signaling currents of radically different characteristics so that the same path may be used by them without substantial interference. Thus in those embodiments I shall describe, I utilize a normally closed circuit for signaling by direct current, the signaling being performed by opening the circuit one or more times in succession or in a definite sequence. I make use of the same closed circuit, or a part thereof, as a portion of another circuit for sending alternating or periodic current signals. In the broader aspects of my invention, it is possible to use periodic currents for both signals, provided they employ frequencies of such relative values that each of the selective devices receiving the signaling impulses may be arranged to exclude substantially all of the current transmitting the other signal, as by the aid of inductances and capacities. It is thus another object of my invention to provide a closed circuit over which two separate signals may be sent, one by interrupting the circuit in a predetermined order, and the other by transmitting over at least a portion of it, a current having substantially no effect upon the devices for receiving the other signal.

My invention is especially applicable for certain types of automatic fire alarm signals, in which some form of temperature responsive element, such as a thermostat or a thermocouple, is arranged to operate the alarm upon the production of abnormal temperature effects. Such thermal responsive elements may be appropriately located in buildings or other places where the protection is desired. It is usual in such systems to arrange a circuit that is rendered active by these elements to operate that street fire alarm box which is nearest the scene of installation of the thermal responsive elements, so that the fire department may be summoned, in a manner entirely similar to a manual operation of the alarm box. The circuit over which the alarm box sends signals is a closed one, and includes a source of direct current. The signals are sent by interrupting the circuit in a predetermined order, as by the use of a "code wheel" operating a contact in the fire alarm box. The closed circuit includes all of the fire alarm boxes in their various locations, so that the one closed circuit serves for the transmission of signals from any point. Furthermore such an arrangement has the additional advantage that the whole circuit is "under test"; that is, an accidental break in the circuit is immediately brought to the attention of the fire department, since the station receivers are made to respond to the opening of this circuit.

In order to ensure that the circuits associated with the thermal responsive elements are in proper working order and capable of giving protection, it has been proposed so to arrange these circuits that any accidental derangement, such as a break in a wire, would also serve to operate the fire alarm box with which the protection system is associated, even if there is no fire. It was intended that such derangement of the circuit would thus call the attention of the fire department to these conditions. However, such an arrangement is not only annoying, but also disadvantageous in other ways. Although a separate, distinguishable code is sent for the trouble signal, still it ties up the series circuit, and thus a true fire alarm in another vicinity, simultaneously turned in, would pass unnoticed at the central station, or else be materially delayed, because of the prior open-circuiting of the series alarm box circuit by the occurrence of trouble in the thermal responsive protective system. It is another object of my invention to correct such conditions, and to make it possible to receive at the central station, simultaneously and without interference, both a true fire alarm, and a "trouble" signal at the site of the installation of the thermal responsive devices.

The occurrence of "trouble" in the auto-

matic fire protection circuits, is so arranged in my invention that it leaves the series direct current fire alarm system intact, but instead use is made of this circuit to transmit alternating current signals of a predetermined character. These alternating current signals operate upon a proper form of signaling device at the fire station and serve to apprise the station that there is some trouble with the circuits. The trouble may then be corrected by those whose duty it is, upon their attention being called to these conditions by the fire department.

My invention possesses other advantageous features, some of which with the foregoing, will be set forth at length in the following description, where I shall outline in full those forms of the invention which I have selected for illustration in the drawings accompanying and forming a part of the present specification. Although I have shown in the drawings only a few forms of my invention, I do not desire to be limited to them, since the invention as expressed in the claims may be embodied in other forms also.

Referring to the drawings:

Figure 1 illustrates in a diagrammatic manner, the broad features of my invention;

Fig. 2 is a more detailed wiring diagram of my invention as applied to an automatic fire alarm system; and

Fig. 3 is a wiring diagram of the receiving apparatus that may be used in conjunction with the arrangement of Fig. 2.

In Fig. 1, I illustrate my invention as applied to any form of normally closed signaling circuit, including the source 11, and leads 12 and 13. There is a completely closed circuit including this source and the leads, as well as one or more signal transmitters 14 and a relay coil 15. The transmitters 14 may be caused to operate to open this closed circuit in a definite sequence, and the relay 15 will drop its armature 16 in the same sequence. Thus for example one of the transmitters 14 may be arranged to open the circuit once and to close it again, while another may be arranged to open the circuit twice. The number of such transmitters may be multiplied to any desired extent, and under such circumstances, they may be provided with code transmitting devices, to cause interruptions of the circuit to transmit two or more separated series of signals. Thus if one transmitter 14 is associated with the number 251, for example, it will be arranged to interrupt the circuit twice, then after an appreciable interval of rest, five times, and after another rest interval, once. These signals may be most conveniently transmitted by code wheels arranged to be rotated by any appropriate source of power, such as a spring motor for instance.

The relay coil 15, in dropping its armature 16, completes a local circuit for energizing an alarm signal 17, such as a lamp, bell, buzzer, or a tape recorder. From the sequence of operation of this local circuit, it is ascertained which one of the transmitters 14 has been actuated. This system as thus far described is substantially that which is in common use for turning in fire alarms, the transmitters 14 being in that case alarm boxes situated on the streets of the protection area.

My invention contemplates the use of the system for transmitting signals which do not affect the alarm 17, but which do affect another device 18. For this purpose a source of current 19 is utilized, which has a frequency characteristic materially different from that of source 11. For example, source 11 may be a direct current source, or in general, a low frequency source; while source 19 may be of materially higher periodicity. This source 19 is connected between the condensers 20 and 21 bridged across the leads 12 and 13 near the place where these A. C. signals are to be propagated. A pair of condensers 22 and 23 are similarly bridged across the leads 12 and 13 near the place where the A. C. signals are to be received. Between these condensers the signal responsive device 18 is connected. A connection 24, which may be the earth, serves to complete the A. C. circuit through transmitter 25 and the source 19. The A. C. signaling circuit may then be traced as follows: from the source 19 to the point 26, where the circuit branches, one branch including condenser 20, line 12, and condenser 22, and the other branch including condenser 21, line 13, and condenser 23; the branch circuits reunite at point 27, through the device 18, connection 24, transmitter 25 and source 19. Substantially none of the alternating current can flow through the direct current signaling relay 15, since both leads 12 and 13 are operated in parallel for the A. C. signal. Furthermore condensers 20, 21, 22 and 23 prevent the flow of direct or low frequency current through the signaling device 18. It is thus evident that the two kinds of signals do not interfere with each other, even if transmitted at the same time. Various modifications may also be resorted to, the arrangement being merely diagrammatic.

As mentioned hereinbefore, this principle may be utilized with fire alarm systems, where the periodic current signal may be turned in whenever there is something wrong with an automatic alarm circuit having thermal responsive elements. Fig. 2 illustrates in a more elaborate fashion one adaptation of the invention for such a purpose. In this figure I indicate but one fire alarm box 28, the outline of which is shown in dotted lines, but of course it is to be understood that the circuit, completed by connections 29 and 30, may include as many of these

boxes as desired. At the fire station, the leads 29 and 30 may be connected to appropriate signaling devices and also to a direct or low frequency current source 31, as illustrated in Fig. 3. In the present instance this circuit operates substantially as that illustrated in Fig. 1; that is, upon the occurrence of an open circuit through the alarm boxes 28, the relay 32 causes a current to flow through a signaling device 33.

I have also indicated, in a purely diagrammatic manner, one form of mechanism in the box 28 that serves to transmit the fire alarm signals. A code wheel 33 having projections on its periphery is so arranged with respect to the spring contacts 34, that its rotation first causes one of the projections on the wheel to move away from the contacts and permits them to open. Continued rotation of the wheel 33 will obviously cause the contacts to be made and broken in succession in a predetermined order dependent upon the particular arrangement of the projections. The wheel 33 may be rotated by any appropriate mechanism, as for example a spring motor 35, and may be normally restrained by the aid of a pawl 36. To release the pawl for turning in an alarm, a lever 37 is provided, which when operated permits the spring motor 35 to rotate. The operation of this lever may be manual, or as in the system illustrated, may be effected automatically in response to dangerous temperature conditions in a locality which is in electrical connection with the mechanism of the box 28. One form of such an automatic arrangement is illustrated, in which the electromagnet 38, when strongly enough energized, serves to trip the lever 37, by the aid of its armature 39. This armature, when attracted, releases a hook 138, releasing a spring actuated wheel 139, which carries the arm 140. This arm in turn performs the actual tripping operation.

The circuit for the electromagnet 38 is controlled by the aid of a closed thermocouple circuit disposed in the locality which is protected. This circuit usually includes a plurality of thermocouples 40, all in series with each other. A small battery 41, serves to furnish a minute current to this closed circuit. For this purpose a pair of resistances 138 and 139 are connected across the battery 41, and leading from the ends of one of these resistances are wires 140 and 141, which connect the thermocouples in series with a current responsive element or contact making galvanometer 42. This galvanometer is so arranged that under normal circumstances, it is in a neutral position as shown between two contacts 43 and 44. The small battery 41 (usually a single cell) furnishes just enough current to the circuit in shunt to resistance 139 to keep the contact making arm 45 in this central position, by appropriate adjustment of these resistances. When, however, there is a dangerous temperature rise, one or more of the thermocouples create a sufficient E. M. F. to cause the contact arm 45 to move to the left and make contact with the point 43. This movement serves to cause strong energization of the actuating electromagnet 38, by the aid of certain circuits now to be described. The same result may be manually accomplished, if desired to turn in an alarm, by short circuiting the resistance 138, as by aid of the switch 142.

The relay 46 is so arranged that while arm 45 is in the neutral position, a weak current only flows through it, which is insufficient to cause its armature 47 to be attracted to make contact with point 48. The circuit for this relay may then be traced as follows: from battery 49, relay 46, contact arm 45, relay 50 of relatively high resistance, (the purpose of which will be hereinafter explained), resistance 51, battery 52 and back to battery 49. When, however, the contact arm 45 touches contact 43, the circuit may be traced as follows: from battery 49, relay 46, contact arm 45, contact 43, back to battery 49. Thus the resistances represented by the coils of relay 50 and the resistor 51 are shunted out of the circuit, together with battery 52. The net result is, by proper design, that the current flow through relay 49 is increased materially. The relay arm 47 is attracted, and contact made between it and the point 48.

The completion of this circuit in turn causes a strong energization of the electromagnet 38 by acting directly upon the circuit which includes this electromagnet. Even when the contact is broken between armature 47 and contact 48, a weak current flows through the coils 38 so as to place this circuit "under test". This weak current is insufficient to operate the electromagnet, but it is sufficient to maintain certain other "trouble" contacts in a definite relation. Should this circuit become inoperative, so that the weak current is interrupted, these "trouble" contacts cause the transmission of a signal to the fire station. I shall later on describe this "trouble" signaling arrangement more in detail; I touch on it here in order to explain why electromagnet 38 has a weak current flowing through it when there is neither a fire nor any circuit disturbance. The batteries 49 and 52 serve to provide in this instance the necessary electrical energy for operating substantially all of the circuits. When there is neither a fire nor trouble, the circuit for the electromagnet 38 may be traced as follows: from the right hand terminal of the battery 52, connections 54 and 55, adjustable resistance 56, armature 57 of relay 50, contact 58, connection 59, relay coils 68, a pair of spring

contacts 60 normally in engagement, connections 61 and 87, a secondary coil 62 on a core 63, connections 66 and 67, a pair of contacts 53 that are maintained in closed condition by the wheel 139 until the transmission of a fire alarm, connections 69, 70 and 71, electromagnet 38, a pair of contacts 141 operated similarly to contacts 53, connections 72 and 73 to the left hand terminal of battery 49, through this battery and back to battery 52. This circuit as traced includes the sources 49 and 52, as well as the resistance element 56 and the relay 68, and the current therethrough, while sufficient to operate relay 68, is insufficient to operate the electromagnet 38. However, upon closing of contact between armature 47 and point 48 of relay 46, in response to a dangerous rise in temperature, or in response to the shorting of resistance 138 by switch 142, the resistance 56 is shunted out of this circuit, as well as relay coils 68, and the resultant strong energization of magnet 38 is sufficient to cause operation of the mechanism in the alarm box 28. The circuit may now be traced as follows: from the right hand terminal of battery 52, connections 54 and 55, armature 47, contact 48, connection 67, contacts 53, connections 69, 70, 71, electromagnet 38, contacts 141, connections 72 and 73 to the left hand terminal of battery 49, through this battery and back to battery 52.

Should the thermocouple circuit be inoperative for any reason, the arrangement is such that relay 68 becomes deenergized, and drops its armature 74. The dropping of this armature sets into operation signal transmitting devices which do not in any way alter the main fire alarm circuit including the leads 29, 30, and the transmitter boxes 28, nor the control circuits therefor which have just been traced. This is accomplished by causing the relay 50 to drop its armature 57. It is to be noted that the contacts controlled by this relay are in circuit with the electromagnet 38 and relay 68, while relay 46 is inactive, so that if the armature 57 drops, the relay 68 becomes open circuited, and the signaling devices controlled thereby are set into operation. Normally while the arm 45 of the contact making galvanometer 42 is in neutral position, the relay 50 is energized from both batteries 49 and 52, through resistance 51 and the coils of relay 46. This energizing circuit has been traced heretofore, and it is therefore not essential to repeat it. Upon the occurrence of trouble in the thermocouple circuit, which causes it to become inoperative, the galvanometer 42 becomes entirely deenergized, and the arm 45 is retracted to the right; contact is then established between it and the stationary contact 44. When this occurs, the relay coils 50 are shunted by the contacts, and the relay drops its armature. The status of relay 46 is unchanged, since resistance 51 is still in circuit with the batteries 49 and 52, and the resultant current flow is still too weak to cause a raising of armature 47. The circuit under these circumstances may be traced as follows: from battery 49, relay 46, arm 45, contact 44, resistance 51, and battery 52 back to the battery 49.

The relay 68 becomes inactive not only upon the occurrence of trouble in the thermocouple circuits, but also upon the occurrence of any improper open circuiting of the circuit for electromagnet 38. It is to be noted that this circuit, which is thus put under test purposely includes in series all of the connections that are useful in the automatic transmission of a fire alarm, and also, as will be evident later on, the important connections which serve to transmit the periodic current trouble signal. There is thus a strong assurance that any breaking of the wires, exhaustion of battery 52, or any other accidental happening that would destroy the utility of the system, will cause the transmission of an alternating current signal to the fire station.

The "trouble" signal may be transmitted by the aid of a code wheel 75, which may be entirely similar to the code wheel 33. A pawl or detent 76 is released upon the dropping of armature 74 which permits the continuous rotation of code wheel 75 until the spring motor 77 is completely run down. The spring contacts 78 operated by the code wheel are under normal circumstances open, and are closed and opened by the code wheel in succession as it revolves. These contacts control a source of periodic current. In the present instance this current is conveniently generated by the aid of an induction coil having a primary winding 79 and a secondary winding 62, which has been mentioned hereinbefore as being in the test circuit of electromagnet 38. A vibratory contact arrangement 80 is provided in the well understood manner for rapidly making and breaking the circuit through this primary coil 79 and a source of current, whereby the core 63 will be subjected to a rapidly varying magnetizing force. The batteries 49 and 52 are utilized to energize the coil 79, and the circuit for this purpose, when contacts 78 and 80 are completed, may be traced as follows: from the right hand terminal of the battery 52, connection 54, contacts 78, contacts 80, coil 79, connection 73 to the left hand terminal of battery 49, through this battery back to battery 52. Of course during the period when a code wheel projection connects the contacts 78, the circuit just traced is made and broken a very large number of times by the aid of the vibratory contacts 80 in a well understood manner;

thus during the intervals of closure of contacts 78, a train of current waves is generated in the secondary coil 62 in inductive relation with the primary 79. It is to be noted that signaling impulses would be transmitted even if the contacts 80 should stick for any reason. Under such circumstances the making and breaking of the circuit through coil 79 would be accomplished solely by contacts 78 and the projections of the code wheel 75. This make and break serves alternately to establish and to destroy the flux in core 63, and thus to generate an impulse E. M. F. in the secondary 62 at those times. The dropping of armature 74 of the test relay 68 also causes the contacts 60 to become separated. This serves to interrupt a circuit which would otherwise shunt some of the energy developed in the secondary coil 62 through the batteries 49 and 52; this circuit may be traced as follows: from the right hand terminal of coil 62, connections 87, 61, contacts 60, coils 68, connection 59, contact 58, armature 57, resistance 56, connections 55, 54, batteries 52, 49, connection 73, and condenser 81 to the left hand terminal of coil 62. The opening of this circuit also interrupts the test circuit, including coils 68 and magnet 38.

The secondary coil 62 is so connected, with respect to the fire alarm circuit wires 29 and 30, that the periodic current produced therein flows through these wires in parallel to affect certain current responsive signaling devices at the fire station. Direct current signals produced by the main fire alarm mechanism cannot flow in these devices due to the insertion of condensers in the periodic current circuit, and in this way it is also possible, as pointed out in connection with Fig. 1, to prevent interference with the operation of the series direct current fire alarm circuit. The periodic current circuit at the transmitting end may be traced as follows: from the left hand terminal of secondary 62, condenser 81, connection 72, contacts 141, electromagnet 38, connections 71 and 70 to the central point of the condensers 82 and 83 bridged across the wires 29 and 30. The current then is transmitted over the wires 29 and 32 in parallel to the fire station. The periodic current flowing through the electromagnet 38 is of such a nature that it does not affect its actuation, since it is a direct current magnet. At most it may cause the magnet to chatter a little. In order to ensure the transmission of the periodic current signal even if this path may fail, another path is offered from the secondary 62 to the condensers 82 and 83, which may be traced as follows: from the left hand terminal of coil 62, connections 66 and 67, contacts 53, and connection 69 to the condensers 82 and 83. The return for the coil 62 from the fire station may be effected in any desired manner; in the present instance grounded connections are used both at the transmitting and receiving end to accomplish this result. For this purpose the right hand terminal of coil 62 is grounded at 85 through the condenser 86 and connection 87. The contacts 53 and 141 are in circuit in each path for the periodic signaling current, and open when the wheel 139 is released upon turning in a fire alarm. Thus no trouble signal from this transmitter can be sent until after the fire alarm box is reset. Without this precaution, making of contacts 47 and 48 would result in shorting relay 68, with attendant deenergization thereof. This would cause the trouble signal to be given every time the fire alarm is operated, even if there is no trouble.

It may sometimes happen that the "trouble" signal at the fire station will remain unheeded during the whole period of operation of the trouble code wheel 75. In order to insure that some sort of a signal will still be active even after the spring motor 77 has run down, I provide a scheme for transmitting a periodic signaling current continuously over the closed fire alarm circuit. For this purpose the relay 68 is provided with a set of contacts 88 which are closed when this relay drops its armature. The closure of these contacts serves to connect the buzzer 89 to a commercial alternating current source by the aid of connections 91 and 92. This buzzer serves as an alarm near the scene of the trouble, but its main purpose is to affect a microphone or telephone transmitter 90. The circuit for this telephone transmitter includes the primary coil 79, the movable contact 65, the stationary contact 94, and a battery 95. While the code wheel 75 is rotating, the contacts 65 and 94 are open, so that the transmitter is incapable of affecting the flow of current through the primary coil 79. However, when the motor 77 has about run down, an arm 93 carried thereby is arranged to operate the movable contact 65 so as to connect it to the contact 94. The closing of contacts 65 and 94 serves to complete the circuit for the transmitter 90 through the primary 79. At the same time, by appropriate stops for the wheel 75, it is assured that the code wheel contacts 78 are open, so that the main batteries 49 and 52 are rendered inactive. The periodic signaling current paths are identical to those traced before; the sole difference is the substitution of the transmitter arrangement for the make and break devices. It is to be noted that the signal transmitted in this manner is a continuous one and is not coded, since it is used merely for ensuring proper attention to the prior signals sent by the code wheel 75. The buzzer 89 of course is placed in juxtaposition to the transmitter so as to affect it properly.

Upon the occurrence of a fire the trouble

circuit is opened at contacts 53 and 141, and therefore relay 68 will drop its armature. This sets the buzzer 89 in operation, which thus serves as a local alarm, as well as code wheel 75. However, no trouble signals can be transmitted in view of the opening of these contacts.

I have now completed the description of the operation at the transmitting end of the circuit, and there remains to be described the various signaling devices which are responsive to the periodic signaling currents at the fire station. At this end, illustrated in Fig. 3, the condensers 96 and 97 are connected to the lines 29 and 30, and a connection 98 is provided between them, so as to place the two in parallel in the connection 99. This connection leads to a relay 100, whence the signaling current, which is transmitted through lines 29 and 30 and condensers 96 and 97, passes through connection 101, and appropriate signaling device 102, such as a telephone receiver, the disconnecting snap switch 103, connection 104, to the ground 105. The device 102 is thus actuated in response to the transmitted periodic current signal. As soon as this signal is heeded, operation of device 102 may be stopped by actuating snap switch 103.

The actuation of A. C. relay 100 by the signaling current causes the closure of the relay contacts 106, which serve to produce other signaling indications by the aid of a commercial A. C. source, such as a lighting circuit. The relay contacts 106 are so arranged that they are closed upon the reception of the first signaling impulse, and remain closed thereafter until they are manually reset to open position. In other words, the relay 100 merely serves to trip these contacts to closed position, so as to energize other signaling devices continuously. The circuits for these other devices may be traced as follows: from the main 107 leading to the commercial source, blade 108 of a double pole switch 109, a fuse 110, connection 111, contacts 106, to a point 112, where the circuit divides—one branch including connection 113, a signaling device such as lamp 114, and lead 115 to the junction point 116; the other branch includes a resistance 117, and lead 118 to the point 116; at this point the circuit reunites through the A. C. buzzer 119, connection 120, fuse 121, and the other blade 122 of switch 109 to the main 123. From this circuit it is evident that both the lamp 114 and buzzer 119 are operated continuously on the occurrence of trouble and that even if lamp 114 be inoperative or broken for any reason, the buzzer would still be actuated due to the provision of the branch circuit including the resistance 117.

The various alternate paths and signaling devices both at the receiving end and the transmitting end are provided for the evident purpose of ensuring that the signal will be transmitted and received. In addition to all these checks and safety devices, I also preferably provide a test circuit for the main signal receiver 102, which will now be described. This test circuit may be traced as follows: from the positive right hand terminal of the test battery 125 to a test ground 124, ground 105, lead 104, switch 103, receiver 102, connection 101, relay 100, connections 99, 98, and 128, relay 129, adjustable resistance 127, and lead 126 to the negative terminal of battery 125. This circuit is adjusted to have a definite small amount of direct current flowing through it, sufficient to enable relay 129 to hold up its armature 130 and out of contact with the contact 131. Should this test circuit be interrupted, as for example by a break in any of the signaling connections, relay 129 would drop its armature and complete the contact between it and contact 131. An alarm circuit is then completed, over the following path: from the right hand terminal of battery 125, connection 132, a disconnecting device such as snap switch 133, a direct current buzzer 134, connection 135, armature 130, contact 131, and connection 142 back to a tap point of battery 125.

There is a path from condensers 96 and 97 through relay 129, resistance 127, battery 125 and ground 124 for the periodic signaling current, but this path has much greater impedance than that including relay 100 and the signaling device 102; therefore no substantial signaling current will flow to interfere with the operation of the D. C. test circuit.

In order to isolate the various apparatus, the control relays 100 and 131, together with resistances 117 and 127, may be housed in a common box or casing, as indicated by the dotted rectangle 136. Similarly the signaling devices and their switches may be housed in another casing, as indicated by the dotted rectangle 137.

A brief review of the operation of the system of Fig. 2 may now be set forth. If there is no fire or trouble, the thermocouple circuit is in the condition shown, the contact arm 45 being in neutral position, and therefore operating magnet 38 is inoperative to move its armature 39. Upon the occurrence of a fire, the contact arm 45 swings to the left, and thereby causes actuation of relay 46, which in turn causes actuation of the operating magnet 38. The transmitting mechanism in the box 28 is thus rendered active, and direct current signals are transmitted over lines 29 and 30 to the station, where they are received and properly recorded by one or more signal receiving devices, such as indicated at 33.

Now if any trouble should occur at the

transmitting end, the relay 68 would become inactive. Such trouble may for example exist in the thermocouple circuit, which would cause relay 50 to release its armature and thus deenergize relay 68, or else the trouble may be in the connections controlled by relay 46. The dropping of armature 74 of relay 68 causes the "trouble" code wheel 77 to rotate, and also to set into operation an induction coil for generating a periodic signaling current. The code wheel operates for a substantial period, during which signals are transmitted over the lines 29 and 30 in parallel, and through the condensers 82, 83, and 96 and 97. These signals operate the relay 100 as well as the receiver 102. The relay 100 permits a lighting current to operate, as additional signaling devices, the lamp 114 and the buzzer 119. In case these signaling impulses are perceived and steps taken to remedy the trouble, the signaling devices may be rendered inoperative by opening switch 103. Since this switch is also included in the local test circuit, with battery 125 and relay 129, the D. C. buzzer 134 will operate in response to the opening of the relay circuit, but by opening the switch 133, the test circuit may be temporarily rendered inoperative, at least until the trouble has been corrected at the transmitting point.

Should no heed be paid at the station to the trouble signal during the period of operation of code wheel 75, the completion of movement of this wheel will operate the contact 65 to connect the induction coil arrangement to a transmitter circuit for transmitting the sound from a buzzer 89 previously rendered active. A continuous periodic current is thereby transmitted, which is perceived at the station by the continuous operation of the signaling device 102, and by the operation of devices 114, and 119, caused by operation of contacts 106.

It is also to be noted that interruption of the fire alarm circuit by turning in an alarm at any other fire alarm box will not interfere with the transmission of the trouble signal, since under such circumstances only one of the two parallel paths for the trouble signal is interfered with. Conversely, operation of the trouble signaling system will in no way interfere with the transmission of a fire alarm signal from any one of the transmitter boxes 26.

In some of the following claims, the flow of current for operating the transmitters is referred to as a flow of low frequency. This expression is intended to cover the limiting condition of direct current flow as described specifically, since a direct current may be construed as one having zero frequency. The underlying thought of course is that two currents are used of widely differing frequency characteristics, and this is true even when one of these currents is a direct current.

I claim:

1. In a fire alarm system, a fire alarm transmitter, a closed signaling circuit controlled by the transmitter by varying the current flowing in the circuit, a circuit including means for increasing the current flow with the temperature, means operated in response to an increase in current flow in said last circuit for operating the transmitter, means responsive to the interruption of the temperature responsive circuit for transmitting a trouble signal over at least a portion of the signaling circuit, whereby only a portion of the path for the trouble signal is formed by the signaling circuit, and means for completing the path for the trouble signaling current, said means being independent of the closed circuit.

2. In a signaling system, a circuit, an induction coil having a primary and a secondary winding, a pair of means for supplying a periodic current to the primary winding, means for connecting the secondary winding to the circuit for transmitting a signal thereover, one of said pair of means being capable only of limited operation, and means responsive to the completion of operation of said means for connecting the other of said pair to the primary winding.

3. In a signaling system, a circuit, an induction coil having a primary and a secondary winding, means capable of a limited interval of operation for supplying a periodic current to the primary winding in a series of intermittent periods, means for connecting the secondary winding to the circuit for transmitting a signal thereover, another means for supplying a periodic current to the primary continuously, and means responsive to the completion of the operation of the first mentioned means, for connecting said other means to the primary winding.

4. In a signaling system, a circuit, an induction coil having a primary and a secondary winding, a vibratory contact for the primary winding, a source of direct current, a spring operated code wheel for completing the primary circuit through the contact and the source, means for connecting the secondary winding to the circuit for transmitting a signal thereover, a source of periodic current, and means responsive to the completion of operation of the code wheel for connecting the source to the primary winding.

5. In a signaling system, a closed direct current circuit, a transmitter for controlling the flow of current in the circuit, a signaling device responsive to the current variations in the circuit caused by the transmitter, and means for transmitting a signaling periodic current, comprising a transmitting device ca-

pable only of a limited period of operation, said transmittting device being adapted to send impulses in a definite sequence, means for capacitively coupling said transmitting device to the circuit whereby a portion of the circuit is used to transmit the periodic current signals, means for completing the path for these periodic current signals, said means being capacitively coupled to the circuit at a point remote from the transmitting device, and including a signal device responsive to the periodic current, a telephone transmitter arranged to be substituted for the transmitting device upon completion of its operation, and a sound producing device affecting the transmitter and adapted to be operated from a commercial source of electrical energy.

6. In a fire alarm system, a closed direct current circuit, a transmitter responsive to temperature conditions for controlling the flow of current in the circuit, a signaling device responsive to the current variations in the circuit caused by the transmitter, and means responsive to the occurrence of an inoperative condition of the transmitter for transmitting a signaling periodic current, comprising a transmitting device capable only of a limited period of operation, said transmitting device having means for sending impulses in a definite sequence, means for capacitively coupling said transmitting device to the circuit whereby a portion of the circuit is used to transmit the periodic current signals, means for completing the path for these periodic current signals, said means being capacitively coupled to the circuit at a point remote from the transmitting device, and including a signal device responsive to the periodic current, a telephone transmitter arranged to be substituted for the transmitting device upon completion of its operation, and a sound producing device affecting the transmitter and adapted to be operated from a commercial source of electrical energy.

7. In a signaling system, a circuit, an induction coil having a primary and a secondary winding, means for supplying a periodic current to the primary winding, said means being capable only of limited operation, means for connecting the secondary winding to the circuit for transmitting a signal thereover, a telephone transmitter, a source of current for the transmitter, means responsive to the completion of operation of said periodic current supplying means, for connecting the telephone transmitter and its source to the primary winding, and a sound producing device affecting the telephone transmitter and adapted to be operated from a commercial source of electrical energy.

8. In a signaling system, a circuit, an induction coil having a primary and a secondary winding, means capable of a limited interval of operation for supplying a periodic current to the primary winding in a series of intermittent periods, means for connecting the secondary winding to the circuit for transmitting a signal thereover, a telephone transmitter, a source of current for the transmitter, means responsive to the completion of the operation of the periodic current supplying means, for connecting said telephone transmitter and its source to the primary winding, and a sound producing device adapted to be operated from a commercial source of electrical energy and affecting the telephone transmitter.

9. In a signaling system, a circuit, an induction coil having a primary and a secondary winding, a vibratory contact for the primary winding, a source of direct current, a spring operated code wheel for completing the primary circuit through the contact and the source, means for connecting the secondary winding to the circuit for transmitting a signal thereover, a telephone transmitter, a source of current for the telephone transmitter, means responsive to the completion of the operation of the code wheel for connecting the telephone transmitter and its source of current to the primary winding, and a sound producing device adapted to be operated from a commercial source of electrical energy and affecting the telephone transmitter.

In testimony whereof, I have hereunto set my hand.

THOMAS A. MOLLARD.