

July 4, 1939.

F. R. BRIDGES ET AL

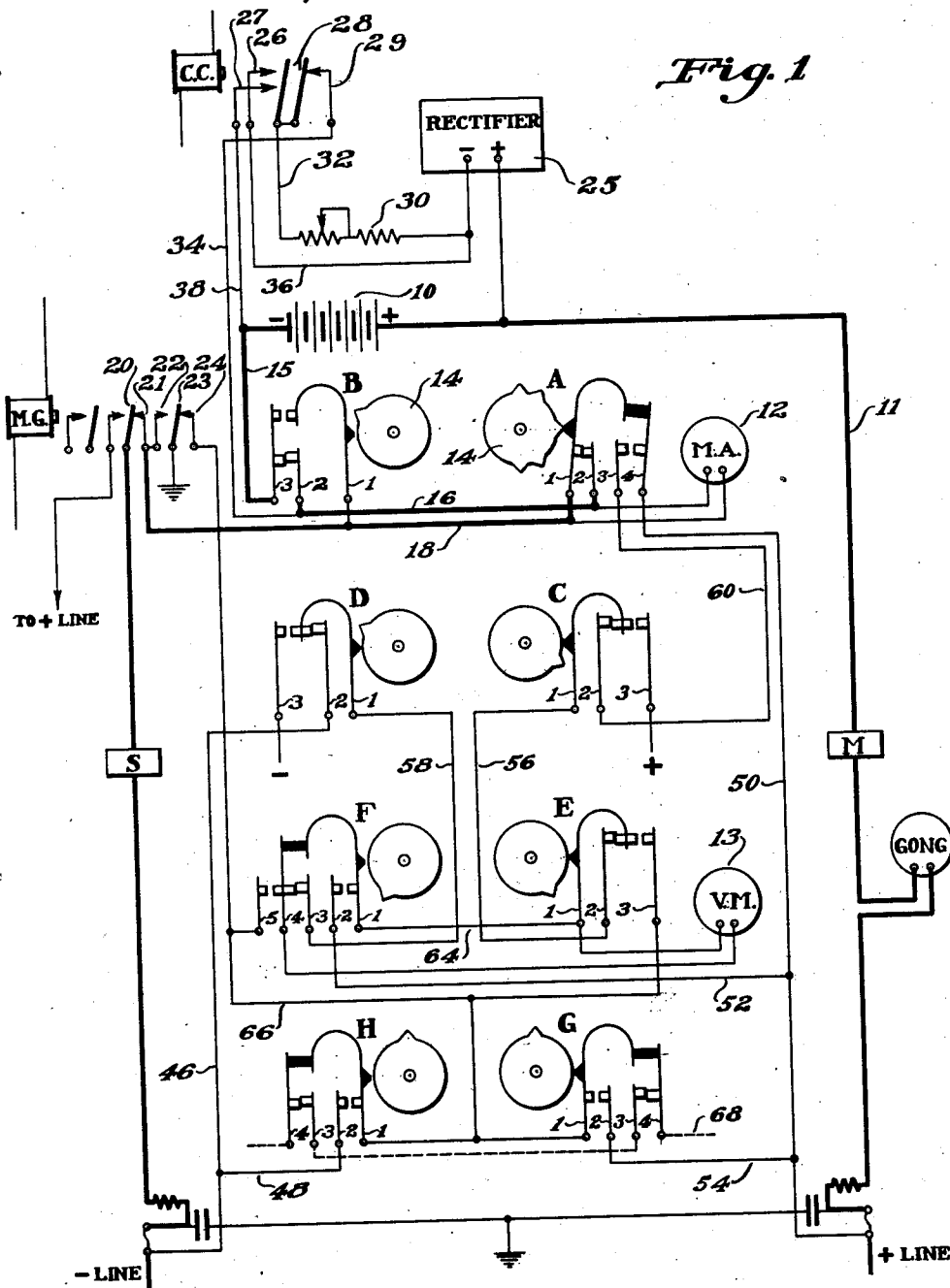
2,165,174

FIRE ALARM SYSTEM

Filed July 3, 1936

2 Sheets-Sheet 1

Fig. 1



Witness

Paul F. Bryant

Inventors

Frank R. Bridges

Foster E. Uell

by their attorneys

Fish, Wilderth, Cary & Henney

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2 Sheets-Sheet 2

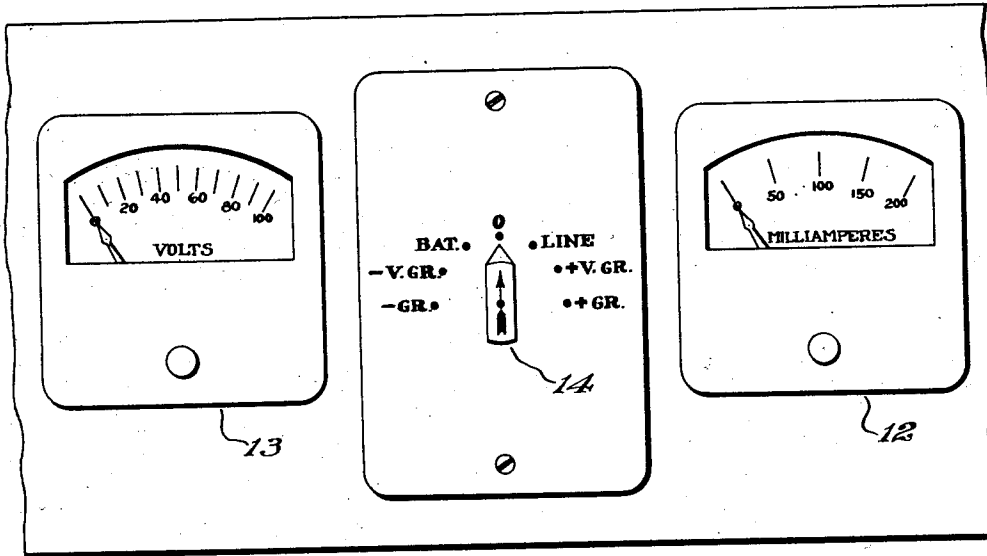


Fig. 2

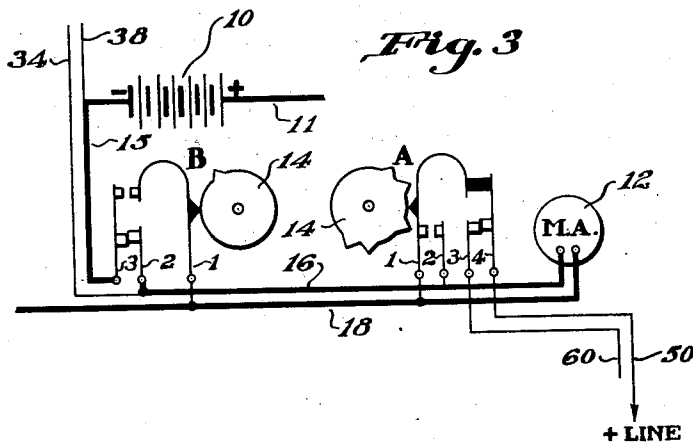


Fig. 3

Witness

Paul F. Bryant

Inventors
 Frank R. Bridges
 Foster E. Hall
 by their attorneys
 Fish, Wilder, Long & Jones

UNITED STATES PATENT OFFICE

2,165,174

FIRE ALARM SYSTEM

Frank R. Bridges, Needham, and Foster E. Weld,
Newton, Mass., assignors to The Gamewell Com-
pany, Newton Upper Falls, Mass., a corpora-
tion of Massachusetts

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6 Claims. (Cl. 171—314)

The present invention relates to fire alarm systems.

Our copending application filed of even date herewith describes a fire alarm system which is particularly adapted for small town use, principally because of the provision for substantially complete automatic supervision. The central office equipment is arranged to be completely housed in a small cabinet which is not necessarily kept under constant personal attention.

The present invention contemplates, as an addition to the system, the provision of built-in testing equipment whereby the conditions existing in the line and central office circuits may be readily determined. In the preferred form of the invention, all of the test operations are effected by a single manual switch by which an ammeter and a voltmeter may be variously connected into the circuits for indicating such factors as line current and voltage, charging current and voltage, and the condition of the line with respect to ground. An important feature is that no setting of the test equipment can in any way affect or interfere with a signal in process of transmission or one which may be subsequently transmitted.

In the accompanying drawings illustrating what is now considered the preferred form of the invention, Fig. 1 is a diagram of so much of the system as is necessary for an understanding of the invention, the switch groups being shown in normal position; Fig. 2 is a view of the switch and meter panel; and Fig. 3 is a view of a portion of the system showing certain of the switch groups in a different position from Fig. 1.

The illustrated embodiment of the invention comprises a single circuit system which is fully described in detail in our copending application above referred to. The system includes a battery 10, the positive terminal of which is connected by a wire 11 with the positive side of the line. The negative side of the battery is connected to the negative side of the line through connections to be hereinafter described. The line connections include suitable operating and signaling equipment illustrated as a main relay M, a gong and a supervisory relay S, the operation of which is described in the copending application.

The cabinet within which the central office equipment is contained has a panel provided with a milliammeter 12, a voltmeter 13 and a test switch 14. The test switch is a seven-position switch having a panel indicating the possible positions of the manual switch handle. The

switch includes eight contact groups indicated A to H inclusive in Fig. 1, each group having a set of contacts designated 1, 2, 3 etc. The contact designated at 1 for each group is a loop member which is acted upon by a cam operated from the switch handle. The cams are illustrated diagrammatically at 14 in Fig. 1, each disposed adjacent to the corresponding switch group. In a subsequent description the term "camming" refers to the action of a high point of a cam on the loop contact of the corresponding switch group; thus in Fig. 1 group A only is cammed and in Fig. 3 none of the groups are cammed.

The connections between the negative side of the battery and the negative side of the line include a wire 15 connected between the battery and contact 3 of group B. A wire 16 connects the contacts 2 of groups A and B. A wire 18 connects contacts 1 of both groups and the same wire continues to contacts of the grounding or conditioning relay MG, which as described in our copending application is normally inactive, but is arranged to condition the line for ground signaling whenever the line is accidentally broken. So far as the present invention is concerned, only the contacts designated 20 to 24 inclusive are important. The wire 18 connects with contacts 21 and 22, the contact 21 being normally closed on 20 which is connected with the negative side of the line. The contact 22 is associated with a contact 23 which is connected to ground. The operation of the relay is fully disclosed in our copending application, and it will suffice to note here that upon its energization, the negative side of the line is disconnected from the battery and is connected with the positive side of the line, while the negative side of the battery is grounded by the closure of contacts 22, 23. The contact 24 is normally closed on the grounded contact 23 and enters into a test circuit to be hereinafter described in detail.

The battery 10 is maintained under continuous charge by a rectifier 25 having its positive terminal connected to the positive terminal of the battery and its negative terminal normally connected for a low-rate or trickle charge, but adapted under some circumstances to be connected for a high-rate charge. The charging connections are under the control of a charge control relay CC, the operation of which is disclosed in the copending application. The relay CC has the contacts 26, 27, 28 and 29. The trickle charge is applied to the battery under normal conditions through a resistance 30 con-

connected to the negative terminal of the rectifier, a wire 32, contacts 28 and 29 of the relay CC, and a wire 34 which leads to contact 2 of the test switch group B, and thence to the negative battery terminal through the normally closed contacts 2, 3 of group B and the wire 15. The negative terminal of the rectifier is connected by a lead 36 with the contact 26, and the contact 27 is connected directly with the negative battery terminal by a lead 38. Upon energization of the charge control relay, the trickle charge circuit is opened and the high-rate charge is applied.

The milliammeter 12 is connected between contacts 1 and 2 of group A, and is normally shunted when the group A is cammed as shown in Fig. 1.

The negative side of the line is connected to contact 2 of group D and to contact 2 of group H by wires 46 and 48, respectively. The positive side of the line is connected to contact 4 of group A, contact 2 of group F, and contact 2 of group G by wires 50, 52 and 54, respectively.

The negative side of the battery is connected to contact 3 of group D and the positive side of the battery is connected to contact 3 of group C. To avoid confusion, the actual connections are not shown, but are merely indicated by appropriate plus and minus signs.

Contact 1 of group C is connected to contact 2 of group E by a wire 56. Contact 1 of group D is connected to contact 3 of group F by a wire 58. Contact 3 of group A is connected to contact 2 of group C by a wire 60. The voltmeter 13 is connected between contact 1 of group E and contact 4 of group F. Contact 1 of group E is connected to contact 1 of group F by a wire 64. Contact 3 of group E, contact 5 of group F, contact 1 of group G and contact 1 of group H are all connected to ground, but indirectly through a wire 66 leading to the contact 24 which is normally closed on contact 23 of the grounding relay MG, for purposes to be later explained. Contacts 3, 4 of both groups G and H are included in an alternating current lamp circuit 68 shown in dash lines.

The seven positions of the switch are as follows:

- I. Center position—normal.
- II. "Line" position—to indicate line current and voltage.
- III. "Bat." position—to indicate battery charging current and voltage.
- IV and V. "—VGR" and "+VGR"—to indicate voltage of either side of the line with respect to ground.
- VI and VII. "—GR" and "+GR"—to ground the positive or negative side of the line as a reference ground.

The connections for the several positions are described as follows:

- I. *Center or normal position.*—The switch groups are as shown in Fig. 1, group A only being cammed. The milliammeter is shunted at contacts 1, 2 of group A. All possible connections to the voltmeter are open. Accordingly no indication is given on either of the meters. This is the normal condition.
- II. *"Line" position.*—In this position of the switch none of the groups are cammed, switch groups A and B being then as shown in Fig. 3. Under these conditions the line current and the voltage across the line are indicated on the meters.
- The milliammeter shunt is broken at contacts 2 and

3 of group A. The line current, however, passes through the milliammeter by a circuit traced from the negative battery terminal through wire 15, contacts 3, 2 or B, wire 16, the milliammeter 12 and wire 18. The voltmeter circuit is traced as follows: From the positive line through wire 50, contacts 4, 3 of group A, wire 60, contacts 2, 1 of group C, wire 56, contacts 2, 1 of group E, the voltmeter 13, contacts 4, 3 of group F, wire 58, contacts 1, 2 of group D, and the lead 46 to the negative side of the line.

III. *"Bat." position.*—In this position of the switch groups B, C and D only are cammed. Group A is not cammed and is, therefore, as shown in Fig. 3, the milliammeter shunt being open. Since group B is cammed, contact 1 is closed on 3 and the latter is moved away from 2. The trickle charge current is passed through the milliammeter by the following circuit: From the negative terminal of the rectifier through the resistance 30, wire 32, contacts 28 and 29 of the charge control relay CC, wire 34, wire 16, the milliammeter 12 and wire 18 to contact 1 of group B, where the current divides, one portion going out on the line and the other passing through the now closed contacts 1, 3 of group B and the wire 15 to the negative battery terminal. The trickle charge current thus measured is the current supplied by the rectifier, which is the sum of the line current and the battery current. It is to be noted that if the charge control relay is set for the high-rate charge, the charging current is not permitted to pass through the milliammeter, the wire 38 from the contact 27 leading direct to the negative battery terminal. The high-rate charge would exceed the range of the milliammeter.

The battery voltage is indicated on the voltmeter regardless of the charging connections through the following circuit: From the positive terminal of the battery as indicated by the plus sign under contact 3 of group C, thence through contacts 3, 1 of the cammed group C, wire 56, contacts 2, 1 of group E, the voltmeter 13, contacts 4, 3 of group F, wire 58, and contacts 1, 3 of the cammed group D to the negative terminal of the battery.

IV. *Voltage of negative side of line above ground—"—VGR".*—In this position of the switch contact groups A and E are cammed. The voltmeter is connected between the negative side of the line and ground through the following circuit: From the negative side of the line through wire 46, contacts 2, 1 of group D, wire 58, contacts 3, 4 of group F, the voltmeter 13, contacts 1, 3 of the cammed group E, wire 66, and contacts 24, 23 of the relay MG to ground. Since group A is cammed the milliammeter is shunted. The purpose of this connection is to indicate whether or not a ground fault exists on the line. If the line is in proper condition the voltmeter should read zero.

It will be noted that if the grounding relay MG happens to be energized when the switch is set on this position, the voltmeter circuit is broken at the open contacts 24, 23 of the relay MG. Since the negative side of the battery is then grounded a reading of voltage above ground would be meaningless. It is for this reason that contact 3 of group E is connected indirectly to ground through the wire 66.

V. *Voltage of positive side of line above ground—" +VGR".*—This position of the switch is similar to that previously described except that the voltmeter is connected between the positive

side of the line and ground. Groups A and F only are cammed. As for the other connection the voltmeter should read zero if the line is in normal condition. The voltmeter circuit is traced from the positive side of the line through wire 52, contacts 2, 1 of the cammed group F, wire 64, the voltmeter 13, contacts 4, 5 of group F, wire 66, and contacts 24, 23 of relay MG to ground. If the relay MG is energized, this connection is ineffective.

VI and VII. *Grounding of one side of the line.*—To establish a reference ground as a preliminary for certain usual testing operations, either the positive or negative side of the line may be grounded by moving the switch to the points indicated +GR or -GR. To ground the positive side of the line the switch groups A and G only are cammed and a circuit is traced from the positive side of the line through a wire 54, contacts 2, 1 of the cammed group G, wire 66 and contacts 24, 23 of the grounding relay MG. For grounding the negative side of the line groups A and H only are cammed so that the circuit is traced from the negative side of the line through wire 48, contacts 2, 1 of the cammed group H to the wire 66 from which the circuit continues to ground through the grounding relay contacts. The fact that the circuit is completed through the grounding relay permits establishment of the reference ground only when the line is in its normal closed loop condition. If the grounding relay has been energized following a break in the line the negative side of the battery is grounded, and if a reference ground were then established the battery and central office equipment would be short-circuited. The circuit through the grounding relay contacts provided by the wire 66 prevents the short circuit in the event the grounding relay is energized. The lamp circuit 68 is broken at contacts 3, 4 of group G or contacts 3, 4 of group H whenever one side of the line is grounded.

The following general observation may be made concerning the functions of the several switch groups: Group A is primarily a milliammeter shunt, although it also includes the contacts 3, 4 whereby the connection of the positive line to the voltmeter is controlled. Group B is a selector to cut the milliammeter circuit into either the negative line or the trickle charge lead. Group C, D, E and F are voltmeter circuit controls whereby a variety of connections to the voltmeter may be established, some complication of circuits arising from the necessity of isolating both sides of the meter from all points except those between which the voltage is to be measured. Groups G and H are simply means for connecting one side of the line to ground.

The various switch connections above described provide for most of the necessary testing operations on the line and in no way affect any normal code signaling operation which may occur while the switch is set in any of its several positions. For example, although the normal position of the switch is in the center, the throwing of the switch to either the "line" or "bat." position merely throws the meters into circuit without opening the line. In the "line" position of the switch the milliammeter should read the normal line current and any deviation therefrom is indicative of some abnormal condition. The "bat." position indicates the normal trickle charge current unless the rectifier or its connections are faulty or unless the charge control relay has

been set for the high-rate charge. The other four positions of the switch do not involve any breaking into the line, but merely establish certain connections with respect to ground. In any event, whether the line is normal or conditioned by the grounding relay, no setting of the switch can interfere with a subsequent signaling operation. This feature is important since in a system of this type adapted for small town use and not under close personal supervision, it may happen that the switch may be tampered with by unauthorized persons or may be inadvertently left in one of its test positions after a test reading.

The invention having been thus described, what is claimed is:

1. In a fire alarm system having a battery and a line, an ammeter, charging means for the battery, a trickle charge circuit and a high-rate charge circuit, an ammeter switch for selectively cutting the ammeter into the trickle charge circuit or the line, and charge control means for connecting the battery with either charge circuit and having provision for preventing connection of the ammeter into the high-rate charge circuit.
2. In a fire alarm system having a battery and a line, an ammeter, charging means for the battery, a trickle charge circuit and a high-rate charge circuit, and an ammeter switch for selectively cutting the ammeter into the trickle charge circuit or the line, charge control means for connecting the battery with either charge circuit and having provision for preventing connection of the ammeter into the high-rate charge circuit, a voltmeter, and voltmeter switching means operable with the ammeter switch for selectively connecting the voltmeter to read the battery voltage or the line voltage.
3. In a fire alarm system having a line and a battery connected thereto, a conditioning relay for grounding one side of the battery under abnormal conditions, and test switching means for establishing a circuit between one side of the line and ground, said circuit including means controlled by the conditioning relay to prevent grounding of the line by said switching means when the battery is grounded by said conditioning relay.
4. In a fire alarm system having a line and a battery connected thereto, a normally inactive conditioning relay having contacts to connect one side of the battery to ground, a test switch to establish a circuit between one side of the line and ground, said circuit including contacts of the conditioning relay to prevent the ground connection when the relay is operative.
5. In a fire alarm system having a line and a battery connected thereto, a test switch to ground one side of the line, a conditioning relay adapted under abnormal conditions to ground the battery, and means controlled by the conditioning relay to prevent grounding of the line by the test switch.
6. In a fire alarm system having a line and a battery connected thereto, test switching means for selectively grounding either side of the line, a conditioning relay operative under abnormal conditions to ground one side of the battery and to connect both sides of the line together, and means controlled by the conditioning relay to render the test switching means ineffective to ground the line.

FRANK R. BRIDGES.
FOSTER E. WELD.