

Aug. 25, 1936.

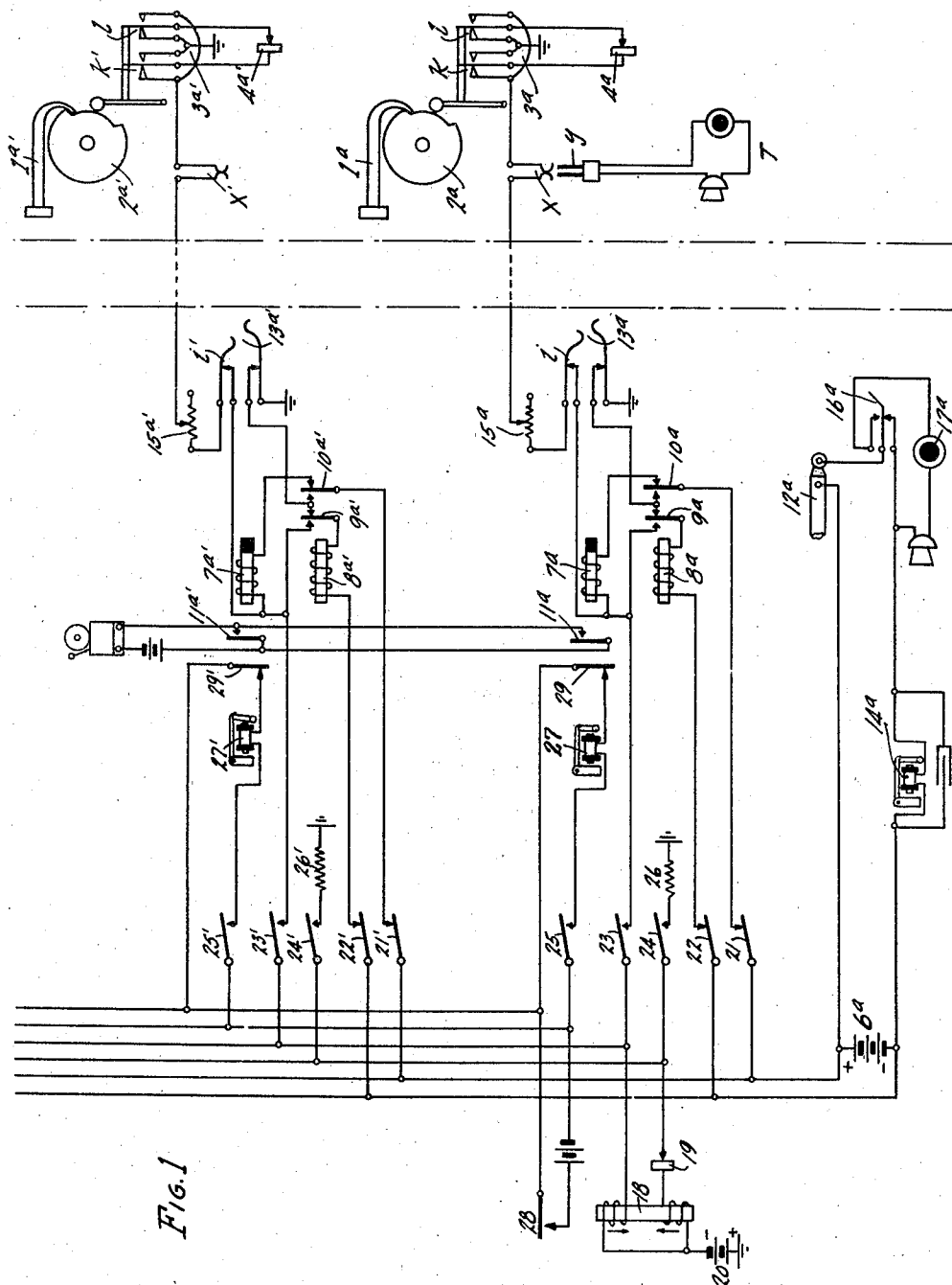
F. REID

2,052,057

FIRE ALARM SYSTEM

Filed Nov. 7, 1929

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

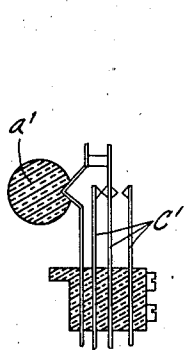


FIG. 2

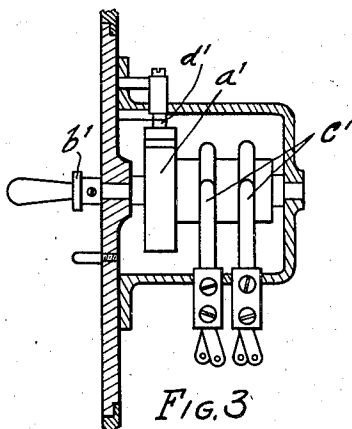


FIG. 3

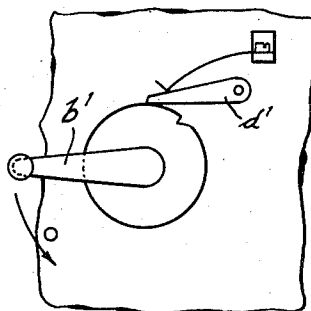


FIG. 4

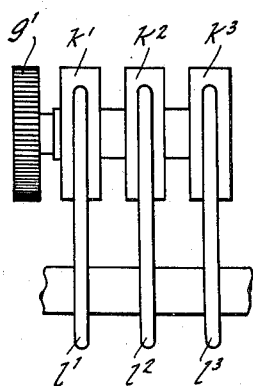


FIG. 5

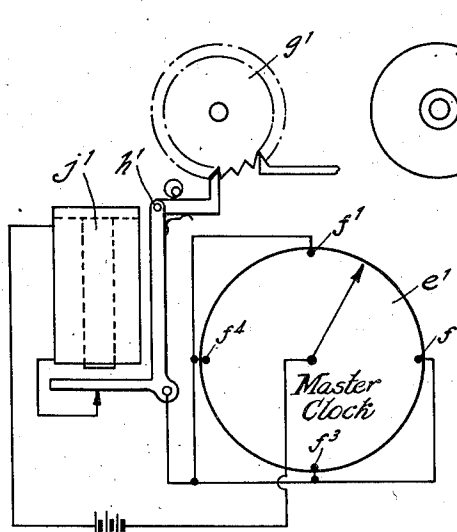


FIG. 6

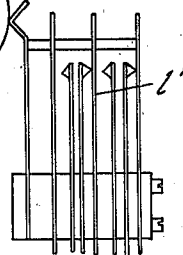


FIG. 7

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FIRE ALARM SYSTEM

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6 Claims. (Cl. 177—352)

This invention relates to fire alarm systems and is applicable to analogous systems such as ambulance call systems so that whenever the expression "fire alarm system" occurs herein it is to be understood as including such analogous systems and the expression "fire alarm" is to include analogous calls.

Such systems are divided broadly into two main classes, namely, "closed circuit" systems in which the current supply is interrupted for the purpose of giving a fire alarm, and "open circuit" systems in which the line circuit is completed for current to flow therein for the purpose of giving the fire call. The former systems in general are constructed on the closed circuit metallic loop system, while the latter may be of either the metallic loop or earth return type.

The object of the invention is to improve the arrangement of "open circuit" systems whereby they may be adequately and continuously or frequently tested and to provide means for readily distinguishing fire calls from electrical faults.

Another object of the invention consists in the provision of means for facilitating automatic routine testing in "open circuit" systems and other details and arrangements hereinafter described or indicated.

The accompanying drawings illustrate one form of apparatus in accordance with the invention.

Figure 1 shows a diagram of an open circuit fire alarm system in accordance with the invention embodying an arrangement for automatic and regular routine testing of each fire alarm circuit.

Figures 2, 3 and 4 show parts of apparatus on an alarm box whereby a signal is transmitted, and

Figures 5, 6 and 7 show routine testing arrangements for use in such circuits.

When applying my invention to "open circuit" systems I may provide my improvements in such systems independently of whether they are metallic loop or earth return systems.

It is usual in such arrangements for the various boxes each to operate in a separate circuit on the indicating device; or, at least, to have a separate lead therefrom, earth return being then common to all; and it is such a parallel arrangement now considered (as shown for example in Figure 1).

As generally arranged the line is normally disconnected at the fire alarm box, and a fire signal is sent by connecting the line to the earth return either temporarily or until released in some manner, or in accordance with a definite nu-

merical code. The defects of such arrangements as hitherto adopted are:—

(1) That earth or electrical faults may cause false calls;

(2) That it is difficult to arrange for either a continuous or frequent test of the continuity of the line under conditions identical with working conditions.

In order to remedy these defects of existing systems in accordance with this invention a suitable rectifier is inserted in the earth return or metallic return at each box, and is arranged in relation to the station battery so that normally no current will pass in the line, but when a box is pulled to give a fire alarm the connections to the rectifier are reversed by suitable means in order that the current may then pass to actuate the alarm apparatus and preferably the rectifier is held in its reversed condition by the locking of a cam or otherwise until released by a fireman or responsible official. Such an arrangement is shown in Figures 2, 3 and 4 and comprises a cam-shaft *a'* provided with a handle *b'* which projects from the call box and is rotated in a counter-clockwise sense to transmit an alarm signal. This reverses the circuit connections by relative movement of contacts *c'* and the shaft is held in its signalling position locked by a spring controlled pawl *d'* until released by a responsible official. Such an arrangement permits of the application of simple means for testing the line since it will be clear that by reversing the station battery the current may be passed through the line at any desired time, the testing circuit including a suitable indicator (such as a milliammeter) to enable the observer to test whether the current is of proper strength, in which case the line may be regarded as satisfactory.

The use of a rectifier at the fire call point also provides a ready means of distinguishing fire calls from earth faults. In one arrangement of the station apparatus, for example, a relay is connected in each circuit to reverse the polarity of the line and cut off the fire alarm indicator in the operated position.

The reversal of the rectifier at the call point on a fire call causes the relay to operate like a trembler bell as current can only flow when the relay is in the non-operated position. Pulses of current are therefore sent through the fire alarm indicator which is preferably a slow acting type, causing it to be actuated.

An earth fault causes the relay to operate and remain in its operated position, cutting off the

fire alarm indicator which in consequence is not actuated.

Figure 1 shows one convenient arrangement of "open circuit" system according to the invention, which, for the sake of simplicity, is arranged as an earth return system, although as above indicated the invention is equally applicable to metallic return circuits. In Figure 1 I have shown two lines connected to the main station, each line having a call box and each line having its indicator 7^a, its indicator control or reversing relay 8^a, its jack 13^a and resistance 15^a, and its set of cam springs 21-26, inclusive. The alarm signal controlled by indicator 7^a may be common to a group of lines as shown as may also be relay 18, batteries 6^a and 20, and signal 14^a and jack 12^a with its key 16^a. As indicated a cam operates springs 21 to 25 at one time to disconnect battery 6^a from the first line and connect the test relay 18 thereto while springs 21' to 25' are operated at another time by another cam to disconnect battery 6^a from another line and connect test relay 18 thereto. Normally in such an arrangement the battery 6^a has its positive pole connected via contact 10^a, indicator 7^a, contacts *i*, resistance 15^a, by line to the box, contacts *k*, rectifier 4^a, contacts *l* to earth; and its negative pole via relay 8^a, contacts 9^a and contacts 13^a also to earth.

The rectifier 4^a in the fire alarm box is normally connected so that no current can flow to earth from the battery 6^a.

A fire call is made by pulling handle 1^a which operates and locks cam 2^a and reverses contacts *k* and *l* on switch 3^a permitting current to flow from the positive pole of battery 6^a through the normal line circuit and new arrangement of contacts *k* and *l* to earth, returning through contacts 13^a, 9^a and relay 8^a to the negative pole of battery 6^a.

Relay 8^a will operate and change over contacts 9^a and 10^a. Contacts 9^a and 10^a reverse battery to line and as the rectifier is now in inoperative condition for this direction of current flow the current to line will be small and relay 8^a will restore when process is repeated. Relay 8^a therefore vibrates like a trembler bell sending pulses of unidirectional current through indicator 7^a which is slugged or otherwise made slow to operate. This will cause indicator 7^a to operate giving a visual and audible signal of a fire call, the audible signal being made by the closing of contact 11^a on account of the operation of indicator 7^a.

In the event of an earth fault on the line, relay 8^a will operate and remain operated as current will flow through the earth fault even when the battery is reversed. Contact 10^a cuts off the indicator 7^a so that the latter is not operated by the steady current. An earth fault will therefore not give a fire call. Plug 12^a can be plugged into jack 13^a to give a warning by the operation of indicator 14^a when the fire call point has been restored to normal. An adjustable resistance 15^a can be employed if desired to balance all lines to a common resistance (e. g. 500 ohms). A speaking key 16^a and telephone 17^a can be provided if desired and when used a telephone such as T can be inserted into the line by means of plug Y and jacks such as X and X' if the fireman desires to converse with the central office as is common practice.

When plug 12^a is inserted in jack 13^a on receipt of a fire call due to the reversal of rectifier 4^a at call point, the negative pole of battery 6^a is

connected via indicator 14^a, back contacts of key 16^a, tip of plug, short spring of jack 13^a to line, whilst the positive pole of battery is connected via "ring" of plug and long spring of jack 13^a to earth.

No current flows under these conditions as rectifier 4^a has been reversed so that current can now only flow from the line through the rectifier 4^a to earth when the line is connected to the positive pole of the battery. Indicator 14^a is therefore not operated until the rectifier 4^a has been reset to normal by the fireman at the call point.

The station attendant can, by throwing key 16^a, introduce a telephone transmitter and receiver 17^a into the circuit.

The testing may be performed by hand but I prefer to arrange for an automatic testing to be carried out and where, as is usual, the system will include a number of boxes, an automatic routine test is preferably provided, it being understood that by routine tester I mean an automatic tester which when set into operation will run round a set of circuits and test each one individually. Obviously such routine test may be applied in many different ways since basically the rectifiers provided in accordance with the invention enable the lines to be tested under actual working conditions.

In one particular construction, for example as shown in Figures 5, 6 and 7, I may provide a master clock *e'* which will close a contact, e. g. *f'*, *f*², *f*³, *f*⁴, say, once every 15 minutes for the purpose of starting the test and will then by means of ratchet wheel *g'* (stepped by the ratchet lever system *h'* of the electromagnet *j'* energized by the closed circuit), cause cams *k'*, *k*², *k*³, etc. which are on the same shaft as the wheel *g'* each to close a set of contacts *l'*, *l*², *l*³, etc. whereby the different circuits are reversed for testing. The cams are set at angles to one another on the shaft in order that only one circuit is tested at a time. The stepping of the wheel *g'* may be effected one tooth per second until it has made one complete revolution. As soon as the stepping switch of a particular line operates to reverse the circuit, the fire alarm indicator for that line will be cut off, and one coil of a testing (differential) relay will be connected to line with reversed battery so that the current which then flows through the line will be balanced against a current through the other coil of the testing (differential) relay, and if the current in the line is not equal to the standard working current within a prescribed margin the line will be faulty and a fault indicator will drop and, if necessary, a fault bell may be made to ring.

In another particular construction specially suitable for systems where the lines are to be tested at frequent intervals I employ a motor driving through a reduction gear to operate the test switches.

Figure 1 embodies one arrangement which may be used for the automatic and regular routine testing of each fire circuit.

When springs 21, 22, 23, 24, 25 by cams such as *k'*, *k*², *k*³, etc., Figure 7, are changed over the station battery 6^a and fire indicating apparatus are cut out of circuit and a testing battery 20 with the positive pole earthed (i. e. reversed with respect to station battery) is connected to the normal line circuit via one coil of a differential relay 18 and through the other coil of 18 to a rectifier 19 and a resistance 26 which exactly balances the line resistance. Rectifier 19 is introduced into the routine testing compensation cir-

cuit in order to give a proper balance. If the line is free from faults the differential relay 18 will not operate but any fault—whether earth, high resistance, or disconnection—will vary the current flowing through one of the coils of differential relay 18 from battery 20 respectively through rectifier 19, spring 24, resistance 26 to earth, and spring 23, resistance 15^a, rectifier 4^a to earth, thus giving rise to an unbalance, operating relay 18 and closing contact 28 which drops fault indicator 27 associated with the line being tested. A contact 29 associated with each line is broken when the fire indicator 7^a is actuated to prevent fire calls also actuating the fault indicator.

Each line is provided with a set of springs 21, 22, 23, 24, 25. These sets are operated in succession by cams of the kind shown in Figure 7 driven for example by a ratchet drive operated by a magnet controlled from a clock.

It is proposed to arrange a group of ten lines on one cam assembly and arrange to test each line in turn one every minute.

The period of test need not exceed one second so that the testing would not delay any call for more than one second and on the average only one call in sixty would be so delayed.

The mechanical arrangement for driving the routiner and the period of test are of course subject to wide variation in accordance with the requirements of any system.

As previously pointed out the mechanical devices illustrated in Figures 2 to 7, inclusive, are merely one form of well known mechanism which may be utilized. The clock controlled sequence switches such as indicated in Figures 5, 6 and 7 are well known in the telephone art and merely consist of a series of cams on a shaft which shaft is rotated by a magnet operating a pawl and ratchet and controlled from contacts on an electric clock such as a program clock. The detailed mechanisms are not a part of my invention.

It will be understood that the details of the testing arrangement thus given are purely by way of illustration as obviously the periods of test may be varied and the particular mechanisms employed for automatically bringing each line into test may also be modified within wide limits, the essential feature of the invention being that in an open circuit system the line or lines may be subjected to test automatically and as frequently as may be considered desirable.

In the foregoing description it is assumed that the line will normally be connected to earth through a rectifier connected, for example, so that current can only pass to earth when the line is negative to earth but some features of the invention could be applied to systems in which the line is normally disconnected from earth and a fire signal is given when the line is connected to earth through a rectifier.

The invention is not to be limited to any particular number of boxes arranged in any particular system to which the invention is to be applied, nor to any particular mechanisms employed in such boxes, nor to the manner of connecting the same with a central station, as these and other details may be variously modified in accordance with any practical requirements that may have to be fulfilled.

Further, any convenient form of rectifier may be employed in accordance with the invention, although I have found that very satisfactory results may be obtained by the use of copper oxide rectifiers.

I claim:—

1. An open circuit fire alarm system comprising a call point, a central station, an electric circuit connecting the two, a source of current in said circuit, a rectifier at said call point so arranged in said circuit that no current normally flows, means at said call point for reversing the connections to the rectifier in order to cause a signalling current to flow over said circuit, and receiving means at the station operated, under the influence of said signalling current, temporarily to reverse the connections of said source to the line to temporarily stop the flow of signalling current thereover, said receiving means intermittently operated responsive to said source connections reversal to give a fire alarm in case the current flow is stopped by said reversal and operated steadily to prevent a fire alarm responsive to said reversal in case the flow of current is due to causes other than the reversal of the rectifier connections and therefore current flow is not stopped by said reversal.

2. In a fire alarm system, a plurality of lines connecting call points to a central station, a battery and alarm equipment connected to each line at the station, a rectifier in each line at the call point normally connected to prevent current flowing from the battery over such line, means at each call point for reversing the connection of the rectifier of that line to permit current to flow to operate the alarm equipment of that line, test equipment for successively connecting a battery of reversed polarity to the lines, a relay in the test equipment operated only in case of a fault in the line, an indicator controlled by said relay, and means controlled by the alarm equipment of a line for preventing operation of the test equipment indicator if it is associated with that line when the rectifier thereof is reversed.

3. In a fire alarm system, a line connecting a call point to a central office, a battery and a signal connected to the line at the office, a rectifier in the line at the call point normally preventing any current from flowing from the battery over the line to operate the signal, means at the call point for reversing the connections of the rectifier to the line to thereby permit current to flow over the line to operate the signal, another signal at the office, means for disconnecting the first signal from the line and connecting the second signal thereto, said second signal so connected to the line as to be inoperative when the rectifier is reversed, said second signal operated responsive to the reversal of the rectifier to its normal connection to the line.

4. In a fire alarm system, a line connected between a call point and a central station, a rectifier in the line at the station, a battery connected in the line at the central station, said rectifier normally preventing current flow from the battery over the line, a control relay and an alarm relay connected to the line at the station, means at the call point for reversing the rectifier to transmit a fire alarm by causing a current to flow in the line, said control relay operated responsive to said current flow to reverse the connections of said battery in the line to test the line for accidental grounds, said control relay continuously operated responsive to an accidental ground on the line to prevent any further operation of said alarm relay and intermittently operated in case the line is normal to control the alarm relay.

5. In a fire alarm system, a line connecting a main station to a call point, a rectifier in the line at the call point and a battery connected thereto

at the main station, said rectifier normally connected in the line in such manner as to prevent any current flow from the battery over the line, a relay in the line at the main station, means for
5 reversing the connections of said rectifier to said line, said relay operated responsive to current flow from the battery when the rectifier connections are reversed, means controlled by the operation of said relay to reverse the connections of the
10 battery to the line, said relay operated steadily if a direct ground is present on the line when the battery is so reversed and said relay operated intermittently when the battery is reversed responsive to said current flow if no direct ground
15 is present on the line, and an alarm controlled by said relay when intermittently operated.

6. In a fire alarm system, a line leading from a central station to a call point, alarm equipment

and a source of current supply at the station for said line, a rectifier in said line at the call point normally preventing operation of the equipment, means at the call point for reversing the connections of the rectifier to its line, means in the station responsive to the reversal of the rectifier for
5 reversing the connections of said source to the line, means at the station operating in one manner responsive to said reversal of the source and to said reversal of the rectifier connections to
10 cause an operation of said alarm equipment, said means at the station operating in another manner responsive to said reversal of the source to prevent operation of the alarm equipment for
15 such line in case an accidental ground is present on the line.

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