

July 5, 1960

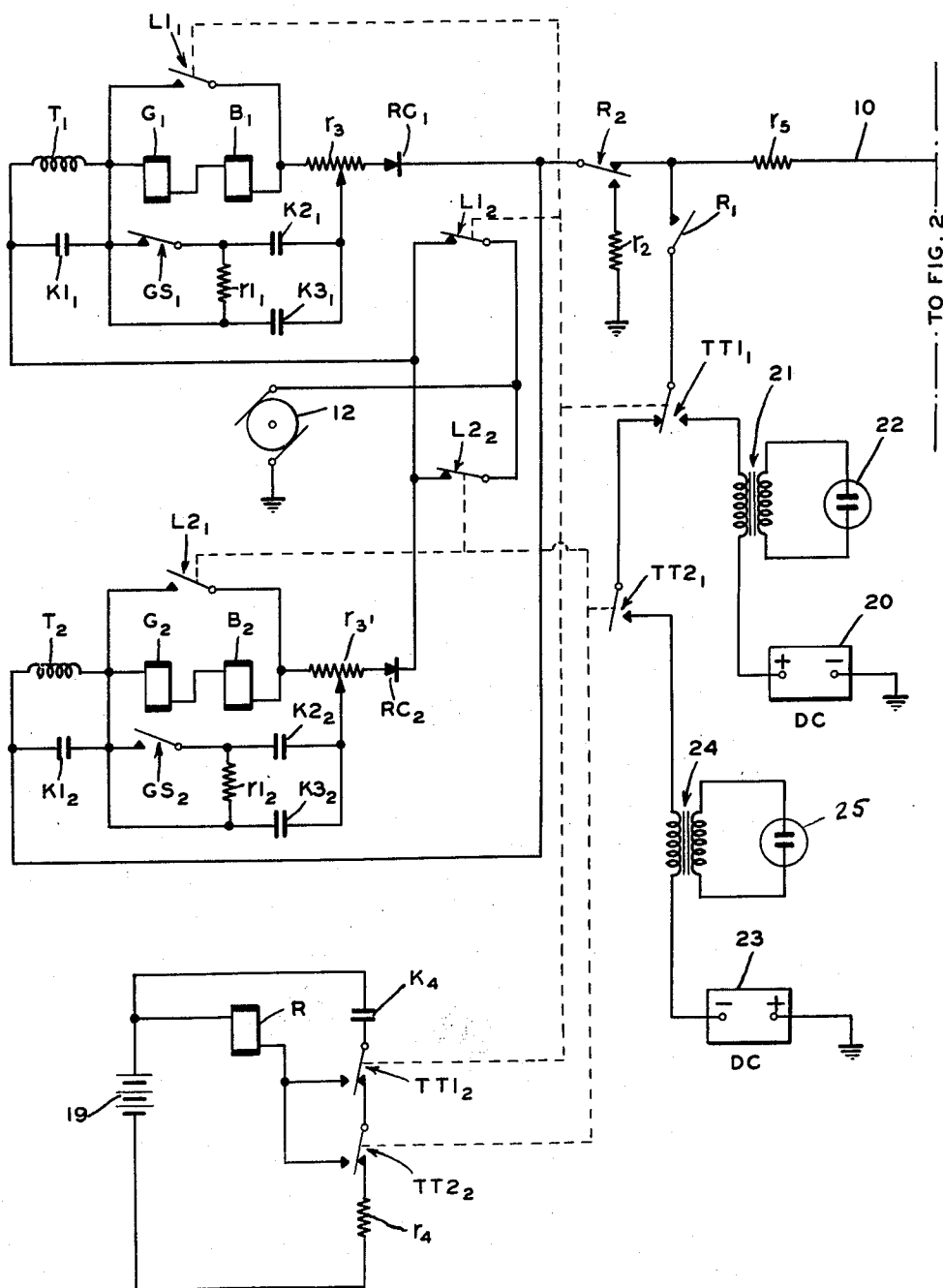
M. W. MUEHTER
INTRUDER ALARM SYSTEM

2,944,252

Filed Jan. 7, 1957

2 Sheets-Sheet 1

FIG. 1



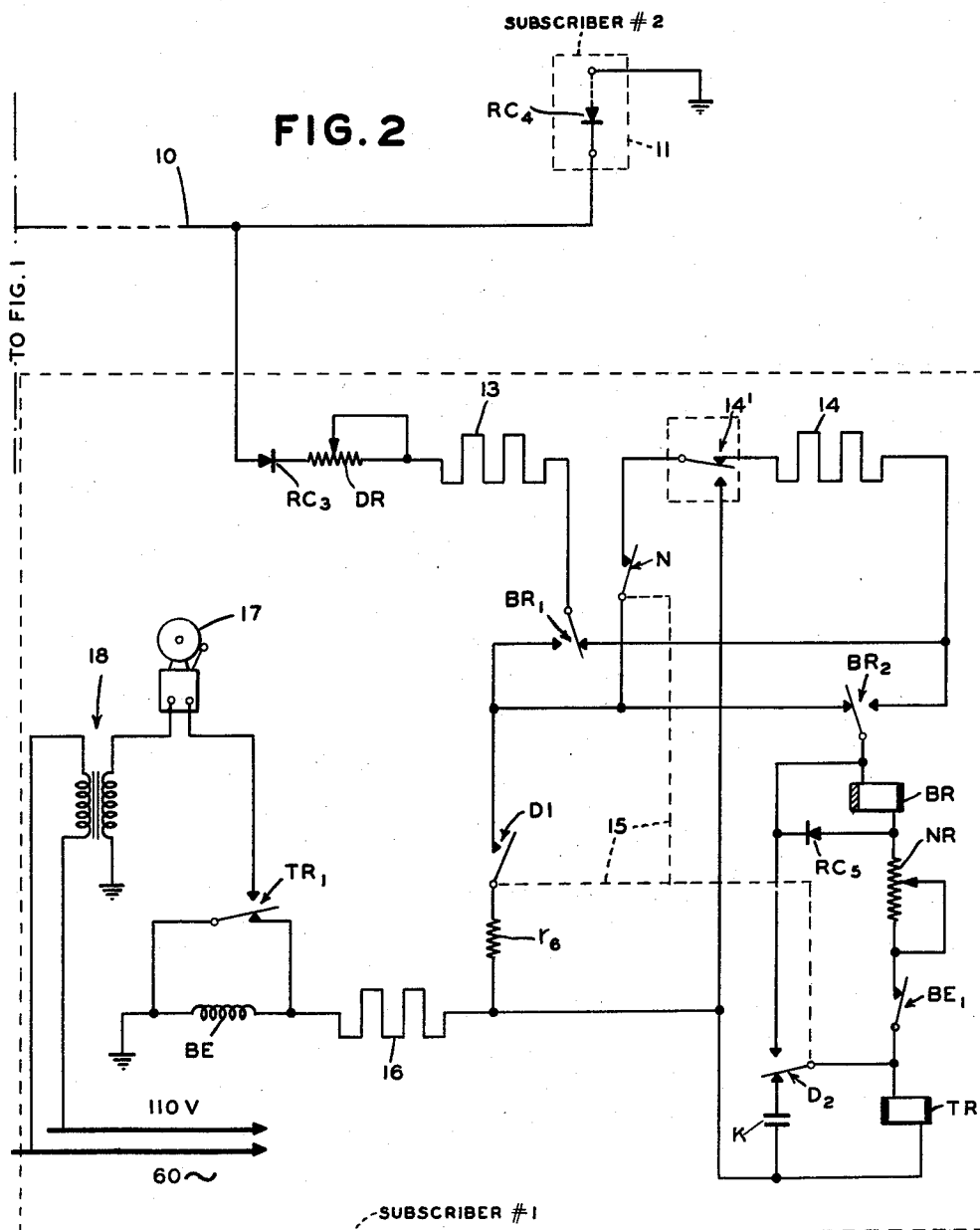
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INTRUDER ALARM SYSTEM

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12 Claims. (Cl. 340—276)

The present invention relates to intruder alarm systems and more particularly to intruder alarm systems in which the alarm is to be given at a remote central station.

In the operation of central station burglar alarm service, a major cost item is the requirement for wire facilities interconnecting the various protected premises and the central station. Another major cost factor in such a system is the requirement that enough operators be provided at the central station to handle promptly the closing operations of a large number of subscribers who close their premises during a relatively short time interval. Considerable time of central station personnel has been required to deal with subscribers whose premises are not properly closed, generally through carelessness or oversight.

An important object of the invention has been the provision of a novel and improved intruder alarm system in which efficient use of wire facilities connecting protected premises with a remotely located central station is achieved.

Another important object of the invention has been the provision of novel and improved testing equipment for facilitating the closing operation at the protected premises.

More particularly, it has been an object of the invention to provide testing equipment with which an individual subscriber can ascertain whether his premises are in a properly protected condition for closing without engaging the services of a central station operator.

A feature of the invention has been the provision of such testing facilities which can be used with multiple subscriber use of individual wire facilities without creating an extended interval in which protection is suspended for other premises sharing the wire facilities.

Other and further objects, features and advantages of the invention will appear from the following description.

The invention will now be described in greater detail with reference to the appended drawings in which:

Figs. 1 and 2, when joined as indicated, represent a schematic diagram of an intruder detection system constructed in accordance with the invention.

In the drawings, Fig. 1 contains central station equipment while Fig. 2 contains protection equipment located at subscribers' premises, the two being joined by a communication line such as the wire line 10 with a ground return. In Fig. 2, protection equipment for only one subscriber (subscriber #1) is shown, the equipment for subscriber #2 being indicated by a block 11. The equipment for these two subscribers may be identical except for one element which will be discussed subsequently. Additional subscribers can be accommodated, for example, four subscribers, by using a pair of wires with ground return. In such case the protection equipment for each additional pair of subscribers is connected to an individual wire, as shown for subscribers Nos. 1 and 2 in Fig. 2. For each additional pair of subscribers, the

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equipment of Fig. 1 would have to be duplicated, except for certain common equipment.

Central station intruder alarm systems usually have two circuit conditions, night and day. In the night condition, full protection is provided. In the day condition, less or even no protection is provided but the integrity of the wire line is supervised. The system of Figs. 1 and 2 provides both day, night and test conditions, the system being shown in the normal night condition.

In the central station there is provided a common power source 12 which might be a generator adapted to provide a suitable low frequency alternating current, e.g., 125 volts, 8 cycles. The generator 12 is connected between ground and the wire line 10 through a pair of parallel connected circuits. One of these circuits includes line switch contacts L₁, tapper coil T₁, ground drop coil G₁, break drop coil B₁, a potentiometer r₃, a diode or rectifier element RC₁, the armature and back contact R₂ of a relay R and a resistor r₅. The other circuit includes line switch contacts L₂, a diode or rectifier element RC₂, a potentiometer r₃, break drop coil B₂, ground drop coil G₂, tapper coil T₂, the armature and back contact R₂ and resistor r₅. The tapper coil T₁, the ground drop coil G₁ and the break drop coil B₁ form the coil elements of a galvanometer drop of the type generally used in central station intruder alarm service. The coils T₂, G₂ and B₂ form a similar drop. An open on the line of subscriber #1 will cause drop B₁ to deenergize from the decrease in current, causing an appropriate drop indicator to fall. Similarly, a short or ground on the line of subscriber #1 will cause drop G₁ to energize from the increase in current, causing a different drop indicator to fall. Repeated operation will cause the armature of tapper coil T₁ to oscillate. Similar conditions on the premises of subscriber #2 will cause corresponding operations of coils T₂, G₂ and B₂. Diode RC₁ is poled so that positive polarity current flows through the drop unit for subscriber #1 (coils T₁, G₁ and B₁). Diode RC₂ is poled so that negative polarity current flows through the drop unit for subscriber #2 (coils T₂, G₂ and B₂).

Positive polarity current on the line 10 flows through the equipment at the premises of subscriber #1 as follows: through rectifier RC₃, a resistor DR, a day protection circuit 13, make contacts BR₁ of a relay BR, night protection circuit 14, contacts N of a Day-Night switch 15, make contacts BR₂, the coil of relay BR, a resistor NR, bell contacts BE₁ of a bell coil BE, the coil of a relay TR, a day circuit 16 and back contacts TR₁ to ground. It should be observed that the normal night current flowing through the coil TR is insufficient to operate this relay. The day circuits 13 and 16 may be dummy circuits or may be made up in whole or in part of protection circuits which are intended to be in service at all times. Night circuit 14 includes the protection circuits which are intended to be operative when the premises are closed and may include a variety of protective devices which open the circuit upon actuation by an intruder. Some devices which may be used provide both an opening and a shorting (to ground) operation.

Negative polarity current flows through the premises of subscriber #2 in the same way as positive polarity current flows through the premises of subscriber #1, the rectifier RC₄ being poled oppositely to the rectifier RC₃ for this purpose.

Condensers K₁ and K₂ are connected across the tapper coils T₁ and T₂ respectively to smooth out the half wave current sufficiently for proper operation. The capacitors K₂, K₃, K₃ and K are provided for a similar purpose. Capacitors K₃ and K₃ are connected across coils G₁-B₁ and G₂-B₂, respectively. Capacitors K₂ and K₂ are similarly connected through switches

GS1 and GS2, respectively. A resistor r_1 is connected between one end of each of capacitors K2 and K3, and a similar resistor r_2 is connected between one end of each of capacitors K2₂ and K3₂. Capacitor K is connected across relay coil TR through the night position contacts D2 of Day-Night switch 15.

Relay BR, which may be of the so-called slow-to-release type, also has a crystal diode RC5 connected across its coil to keep the relay energized during the interval between successive half cycles. The relay BR, which may be termed the break sustaining relay, is provided for obtaining proper reception of break impulses in case of double drop alarms, i.e., those in which both a break (open) and a ground occur. The operation of this relay is described in detail in copending application Serial No. 556,633, filed December 30, 1955.

In case of a break alarm, as for example when a metal foil is broken by an intruder smashing a window on the premises of subscriber #1, only current flow of the positive polarity is interrupted on line 10. Such interruption causes break drop coil B1 to drop out giving a break alarm at the central station. In the case of a ground in the protection circuit of subscriber #1, an increase of current flow of positive polarity only occurs on line 10, causing ground drop coil G1 to respond giving a ground alarm at the central station. In the case of both a break and a ground, both alarms will be given at the central station by operation of both drops B1 and G1. In the case of a break or ground on the line 10, the corresponding drops B1 and B2 or G1 and G2, as the case may be, will be operated. Breaks and grounds of short duration are suppressed by capacitors K2₁, K3₁, K2₂ and K3₂ connected across the drop windings.

When a protective device with both normally closed and normally open contacts, such as the door contacts 14', is put into alarm condition, a break is first produced as the normally closed contact opens. In this case, break sustaining relay BR will be deenergized after a time delay caused by its characteristics and the diode RC5 shunting it. This insures a long enough break impulse to overcome the delay caused by the capacitors K2₁ and K3₁. After the release of relay BR, the circuit is grounded through the normally open contacts of door switch 14', the circuit extending from line 10 through rectifier RC3, resistor DR, day circuit 13, back contacts BR₁, contacts N, the normally open contacts of switch 14', day circuit 16 and back contacts TR₁ to ground, causing operation of the ground drop.

When a subscriber enters his premises at the end of a protected period, e.g., in the morning, a double drop signal will be received at the central station from the opening and closing, respectively, of the normally closed and normally open contacts of door switches 14'. The subscriber then operates Day-Night switch 15 to the "day" position in which contacts N are opened, contacts D1 are closed and contacts D2 are operated to the opposite position from the one illustrated. Relay BR, which will have dropped out upon opening of the door and picked up upon subsequent closing of the door, will again drop out upon opening of contacts N. This sets up the day condition circuit which extends from line 10 through rectifier RC3, resistor DR, day circuit 13, back contacts BR₁, contacts D1, a resistor r_6 , day circuit 16, and back contacts TR₁ to ground. The resistance of DR should be adjusted so that the current flow therethrough will be adequate to keep ground drop coil G1 energized, indicating the day condition at the central station. During the day, a break in the circuit will cause break drop coil B1 to be deenergized, giving a break indication at the central station.

When the subscriber wishes to restore protection, for example before closing up his premises for the night, he first puts all his protective devices in operation, as by closing doors and windows, setting traps, etc. He then places the Day-Night switch 15 in an intermediate or test

position in which contacts D1 and N are closed and contacts D2 are in a position opposite the one illustrated. If the night circuit is in its normal condition, a circuit is complete extending from line 10 through rectifier RC3, resistor DR, day circuit 13, back contacts BR₁, contacts N, back contacts 14', night circuit 14, back contacts BR₂, contacts D2, the coil of relay TR, day circuit 16 and back contacts TR₁ to ground. A parallel path through contacts D1 and resistor r_6 also exists. Since night resistor NR and the coil of relay BR are shunted by operated contacts D2, sufficient current will flow through the coil of relay TR to energize this relay. Back contacts TR₁ thereupon open, placing the bell coil BE in the circuit. The bell BE thus becomes energized, but does not operate as a vibrating bell since its bell contacts BE₁ are shunted by contacts D2 (in the test position thereof). Since the make contacts D2 are open in the test position, capacitor K is disconnected from relay coil TR, so that the latter may follow the low frequency positive pulses supplied over the line 10. The bell coil BE will in turn follow the low frequency pulses, producing a distinctive "fast-tapping" sound indicating to the subscriber that the night protection circuit is in order. The operating circuits for the relay TR and the bell coil BE will not be completed if the night protection circuit or the day circuit 13 is either open or grounded. A ground or open in day circuit 16 will prevent bell coil BE from operating, even though a ground in this circuit will permit operation of relay TR.

It will be evident that the subscriber can determine the integrity of his protection circuits without enlisting the aid of a central station operator or causing transmission of a signal to the central station since, when switch 15 is in the test position, the day current still continues to flow through contacts D1 and resistor r_6 even if there is an open in the night circuit.

If the subscriber fails to get the distinctive sound from the bell BE, he knows that his protection circuit is not in order and that it must be checked, for example for open doors or windows or loose trap connections. To facilitate such checking of a night protection circuit extending to points remote from the bell BE, one or more extension bells 17 may be provided at appropriate locations about the protected premises. As shown, the bell 17 may be provided with power from a commercial source through a transformer 18, the transformer secondary circuit being completed through front contacts TR₁. With switch 15 in the test position thereof, the bell 17 will ring when the faulty protection device is properly set up (if the rest of the circuit is operative). The bell BE will also produce its distinctive sound.

When the subscriber has obtained the bell signal indicating that his protection circuit is in order, he operates Day-Night switch 15 to the night position. In this position contacts D1 are open while contacts N are momentarily opened and then closed. Contacts D2 are operated to the make position illustrated. The momentary opening of contacts N causes a break signal to be received at the central station, advising the operator that the subscriber is ready to close. During the day condition switch GS1 (and also switch GS2) had been open so that capacitor K2₁ (and K2₂) had been disconnected, reducing the retardation of the break coil B1 (and B2) to make it more responsive to the momentary break signal transmitted as the Day-Night switch 15 is operated to its night position.

Upon receiving the break signal, the operator operates the test switch of the unit associated with the particular subscriber; in the case of subscriber #1 this is a switch TT1. The switch TT1 has contacts TT1₁ and TT1₂ and is ganged with switch L1 (having contacts L1₁ and L1₂). The switches TT1 and L1 may be a single three position telephone type switch. In one position (the normal position), contacts L1₁ are open, contacts L1₂ are closed, and contacts TT1₁ and TT1₂

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are in their back positions, as illustrated. In an intermediate position contacts $L1_1$ and $L1_2$ are closed and opened, respectively, while contacts $TT1_1$ and $TT1_2$ stay as shown. In the third position, contacts $L1_1$ and $L1_2$ stay closed and opened, respectively, while contacts $TT1_1$ and $TT1_2$ move to their front or make contacts. Contacts $TT2_1$, $TT2_2$, $L2_1$ and $L2_2$ associated with subscriber #2 behave in the same manner.

In the normal (unoperated) test switch position a capacitor $K4$ is maintained charged through a conduit extending from one terminal of a D.C. source 19, e.g. the central station local battery, through back contacts $TT1_2$ and $TT2_2$, and a resistor $r4$ to the other terminal of the D.C. source. Upon operation of switch $TT1$ (or $TT2$) the front contacts $TT1_2$ are closed, causing capacitor $K4$ to discharge through the coil of a relay R , causing the latter to become energized and to stay energized for a time interval dependent on the time constant of the discharging conduit of capacitor $K4$. Energization of relay R causes back contacts R_2 thereof to open, disconnecting the drops from the line 10. The front contacts R_2 close however, connecting the drops to ground through a resistor $r2$. This keeps drops $G2$ and $B2$ supplied with normal night current so that they are not affected by disconnection of the line 10. However, break drop $B1$ drops out because it is shunted by contacts $L1$, which are closed upon operation of the test switch.

At the same time a suitable potential, e.g. 125 volts D.C. is supplied from a negatively grounded supply 20 through the primary winding of a test transformer 21. This potential is delivered to the line 10 through front contacts $TT1_1$, and front contacts R_1 of the relay R . The resulting current flowing through relay TR will be of the order of twice the average D.C. current flowing therethrough when the circuit is supplied with the normal low frequency night current.

Energization of relay TR opens its back contacts TR_1 , removing the shunt around the bell coil BE and allowing it to operate in the series circuit. The bell will now sound in a normal manner (as distinguished from the aforementioned distinctive manner) since the Day-Night switch contacts $D2$ will be in their night position (as illustrated), in which they do not shunt bell contacts BE_1 . Current interruptions caused by the opening and closing of bell contacts BE_1 are reflected in the secondary winding of transformer 21, causing an indicating device such as the neon lamp 22 to be operated, showing the operator that the subscribers' protective equipment is in operating condition. The ringing of bell BE and the energization of lamp 22 are only of short duration since, even if the test switch is held in its third position, relay R will drop out upon discharge of capacitor $K4$ restoring the circuit to its night condition. This discharge time of capacitor $K4$ is preferably of a fraction of a second so that protection for subscriber #2 is interrupted for not more than a fraction of a second.

Even upon the happening of the remote coincidence that an alarm contact on the premises of subscriber #2 should be actuated while the test switch is being operated for subscriber #1, only the break signal of a double drop signal can be lost since the ground signal will still be received because the actuating contacts are operated for at least one second.

The integrity of the protection equipment provided for subscriber #2 is tested in the same way, except in this case the testing potential is supplied from a positively grounded source 23, the primary winding of a transformer 24, and through front contacts $TT2_1$, back contacts $TT1_1$, front contacts R_1 and resistor $r5$ to line 10. A similar neon lamp 25 may be connected to the secondary winding of transformer 24.

After the subscriber has heard the ringing of bell BE , he may leave the premises. Opening of the door causes a double drop signal to be received because of the opening of the back contacts and the closing of the front

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contacts of switch 14'. The operator, knowing that the subscriber has left the premises, restores the drops and the premises are protected.

While the invention has been described in connection with a specific embodiment thereof and in a specific use, various modifications thereof will occur to those skilled in the art without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. An intruder alarm system for servicing a plurality of protected premises from a single central station, each of said protected premises having individual protection equipment and said central station having individual equipment associated with particular premises and having common equipment, a communication path intercoupling said central station and at least two of said protected premises and comprising a common conductive line and a common return, the individual equipment at each protected premises and the corresponding individual equipment at said central station forming a set, a source of alternating current at said central station, means to supply said alternating current to said sets, rectifier means at said central station and at said protected premises, said rectifier means being arranged and poled so that one polarity of current flows through one set associated with a particular line while the other polarity flows through the other set associated with said particular line, whereby current flow through the individual equipment at each protected premises may be separately supervised, testing means at said central station for supplying a direct current over said line to the individual equipment at each subscriber's premises, said direct current being of the same polarity but of greater amplitude than the rectified alternating current supplied thereto from said source, means for automatically disconnecting the individual equipment at said central station and associated with the line carrying said direct current while said testing means is operated, and means for maintaining normal current flow through the individual equipment at the central station forming a part of the set associated with the line carrying said direct current but which is not being tested.

2. An intruder alarm system as set forth in claim 1 in which means are provided automatically to limit the time interval in which individual equipment at the central station which is associated with the line carrying said direct current but which forms a part of the set not being tested may be disconnected from said line.

3. An intruder alarm system as set forth in claim 2 in which said limited time is measured by the discharge of a capacitor.

4. An intruder alarm system for servicing a pair of protected premises from a remote central station connected thereto over a single wire line with a single return path, the central station having individual equipment for each premises and each premises having individual protective equipment, the associated individual equipment at the central station and at each premises forming a set, a source of low frequency alternating current at said central station, means to supply said alternating current to said line through the individual equipment at the central station, the individual equipment at said central station and at said protected premises each having a rectifying element arranged so that one polarity of current flows through one set while the other polarity of current flows through the other set, manually operable test means at said central station for supplying a direct current of selected polarity to said line, said direct current being greater than the rectified current from said source so as to effect a testing of the integrity of the individual equipment at one of said premises, circuit means having impedance characteristics substantially the same as those of said line and the individual equipment at a subscriber's premises, a relay having normally closed contacts arranged to connect the individual equipment at said central station to said line and having normally open contacts

arranged to connect the individual equipment at said central station and associated with the set not being tested to said circuit means, a normally charged capacitor, and a switching element associated with said manually operable means for causing said capacitor to discharge through the coil of said relay to energize the latter when said manually operable means is operated.

5. An intruder alarm system as set forth in claim 4 in which the discharge time constant of said capacitor is less than one second.

6. In an intruder alarm system for protecting premises connected to a remote station over a conductive path, the remote station having equipment separately responsive to circuit breaks and circuit grounds, the combination comprising a minimum protection circuit, a maximum protection circuit, a protection testing circuit, and switch means for selectively connecting said protection circuits to said path, said minimum and maximum protection circuits having some common elements including a local indicating device which normally is prevented from operating, said minimum protection circuit having a resistance in that portion thereof not common to said maximum protection circuit sufficient to maintain current flow in said path at a level at which said break and ground responsive equipment will not be actuated, said protective testing circuit including, in parallel connection, the non-common portions of said minimum and maximum protection circuits and said local indicating device, said switch means having contacts which, in a test position thereof, permit operation of said local indicating device provided the maximum protection circuit is operative.

7. In an intruder alarm system for protecting premises connected to a remote station over a conductive path, the remote station having equipment separately responsive to circuit breaks and circuit grounds, the combination comprising a minimum protection circuit, a maximum protection circuit, a protection testing circuit, and switch means for selectively connecting said protection circuits to said path, said minimum and maximum protection circuits having some common elements including a local indicating device which normally is prevented from operating, said minimum protection circuit having a resistance in that portion thereof not common to said maximum protection circuit sufficient to maintain current flow in said path at a level at which said break and ground responsive equipment will not be actuated, said protective testing circuit including, in parallel connection, the non-common portions of said minimum and maximum protection circuits and said local indicating device, said switch means having contacts which, in a test position thereof, permit operation of a relay included in said maximum protection circuit and having normally closed contacts shunting said local indicating device, said switch means, in said test position, also causing said local indicating device to operate in a distinctive manner, said relay being operable by a high current flow initiated as a test from said central station when said switch means is in the maximum protection position thereof, the local indicating device operating in a manner other than said distinctive manner in said last-mentioned connection.

8. In an intruder alarm system for protecting premises connected to a remote station over a conductive path carrying alternating current, the remote station having equipment separately responsive to circuit breaks and circuit grounds, the combination comprising a minimum protection circuit, a maximum protection circuit, a protection testing circuit, and switch means for selectively connecting said protection circuits to said path, said minimum and maximum protection circuits having some common elements including a local indicating device which normally is prevented from operating, and a rectifier which permits only one polarity of current to flow through said protection circuits, said minimum protection circuit having a resistance in that portion thereof not common to said maximum protection circuit sufficient to maintain

current flow in said path at a level at which said break and ground responsive equipment will not be actuated, said protective testing circuit including in parallel connection the non-common portions of said minimum and maximum protection circuits and said local indicating device, said switch means having contacts which, in a test position thereof, permit operation of said local indicating means provided the maximum protection circuit is operative.

9. An intruder alarm system as set forth in claim 8 in which another protected premises is connected to said conductive path, said other protected premises having similar protection circuits including an oppositely poled rectifier so that the opposite polarity current flows through the protection circuits thereof.

10. In an intruder alarm system for protecting premises connected to a remote station over a conductive path, the remote station having equipment separately responsive to circuit breaks and circuit grounds; the combination comprising a maximum protection circuit including, in series connection, first switch contacts of a manually operable switch, protective devices, a first relay coil, two sets of normally open contacts of said first relay, vibrating bell contacts, the coil of a second relay and the bell coil, said second relay being unoperated by the current through said maximum protection circuit and having normally closed contacts shunting said bell coil; a minimum protection circuit including, in series connection, a set of normally closed contacts of said first relay, a set of normally open switch contacts of said manually operable switch, a resistor adapted to provide sufficient current flow through said minimum protection circuit to prevent circuit break or circuit ground indications at said remote station, and said shunted bell coil; and a test circuit comprising the parallel combination of the non-common portions of said minimum and maximum protection circuits connected in series with the remainder of said maximum protection circuit, a further set of switch contacts of said manually operable switch being arranged to shunt the coil of said first relay and to decrease the resistance of said maximum protection circuit sufficiently to operate said second relay thereby removing the shunt from said bell coil, said further set of switch contacts also shunting said bell contacts so that said bell coil produces a distinctive sound, a break in the circuit of said protective devices preventing energization of said second relay and hence preventing removal of the shunt from said bell coil.

11. In an intruder alarm system for protecting premises connected to a remote station over a conductive path carrying a low frequency alternating current, the remote station having equipment separately responsive to circuit breaks and circuit grounds; the combination comprising a maximum protection circuit including, in series connection, a rectifier element, first switch contacts of a manually operable switch, protective devices, a first relay coil, two sets of normally open contacts of said first relay, vibrating bell contacts, the coil of a second relay and the bell coil, said second relay being unoperated by the current through said maximum protection circuit and having normally closed contacts shunting said bell coil; a minimum protection circuit including, in series connection, said rectifier, a set of normally closed contacts of said first relay, a set of normally open switch contacts of said manually operable switch, a resistor adapted to provide sufficient current flow through said minimum protection circuit to prevent circuit break or circuit ground indications at said remote station, and said shunted bell coil; and a test circuit comprising the parallel combination of the non-common portions of said minimum and maximum protection circuits connected in series with the remainder of said maximum protection circuit, a further set of switch contacts of said manually operable switch being arranged to shunt the coil of said first relay and to decrease the resistance of said maximum protection circuit sufficiently to operate said second relay thereby removing the shunt from

said bell coil, said further set of switch contacts also shunting said bell contacts so that said bell coil produces a distinctive sound, a break in the circuit of said protective devices preventing energization of said second relay and hence preventing removal of the shunt from said bell coil; said record relay also being energized upon presence of a direct current of sufficient magnitude in said path whereby said bell operates in a normal manner, consequent vibration of said bell contacts providing a test indication at said remote station.

12. In an intruder alarm system for protecting two premises connected to a remote station over a conductive path carrying a low frequency alternating current, the remote station having equipment separately responsive to circuit breaks and circuit grounds at each premises; each premises having protective equipment comprising a maximum protection circuit including, in series connection, a uniquely poled rectifier element, first switch contacts of a manually operable switch, protective devices, a first relay coil, two sets of normally open contacts of said first relay, vibrating bell contacts, the coil of a second relay and the bell coil, said second relay being unoperated by the current through said maximum protection circuit and having normally closed contacts shunting said bell coil; a minimum protection circuit including, in series connection, said uniquely poled rectifier, a set of normally closed contacts of said first relay, a set of normally open switch contacts of said manually operable switch, a resistor adapted to provide sufficient current flow through said minimum protection circuit to prevent circuit break or circuit ground indications at said remote station, and said shunted bell coil; and a test circuit comprising the parallel combina-

tion of the non-common portions of said minimum and maximum protection circuits connected in series with the remainder of said maximum protection circuit, a further set of switch contacts of said manually operable switch being arranged to shunt the coil of said first relay and to decrease the resistance of said maximum protection circuit sufficiently to operate said second relay thereby removing the shunt from said bell coil, said further set of switch contacts also shunting said bell contacts so that said bell coil produces a distinctive sound, a break in the circuit of said protective devices preventing energization of said second relay and hence preventing removal of the shunt from said bell coil.

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