Aug. 1, 1933. A. B. CHAPMAN ET AL 1,920,742

PROTECTIVE SYSTEM

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Fig. 1.

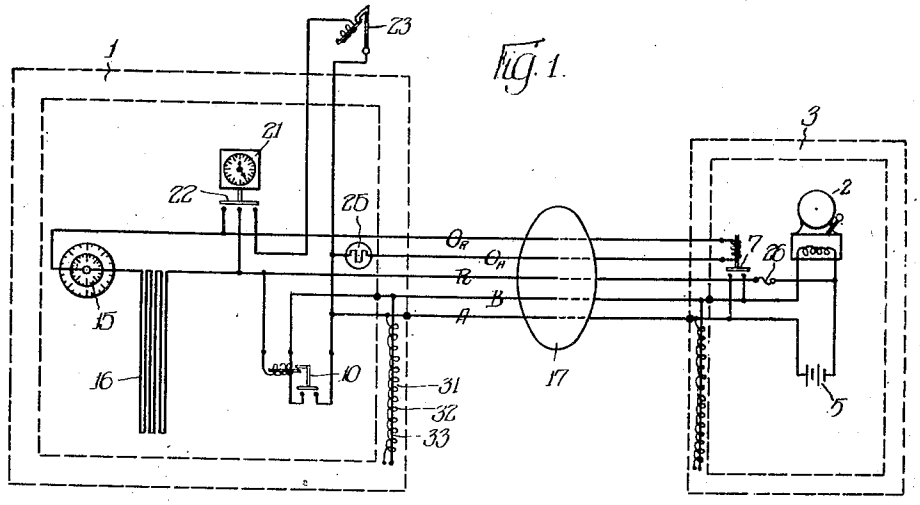


Fig. 2.

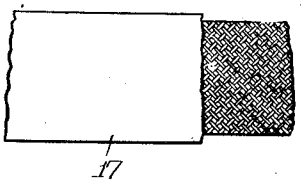


Fig. 3

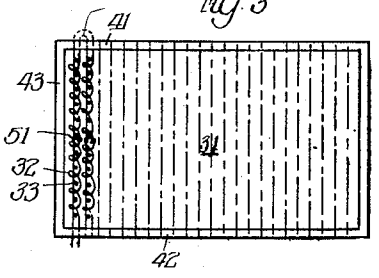


Fig. 4

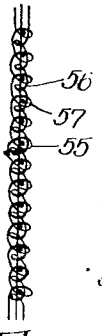


Fig. 5



Fig. 6.

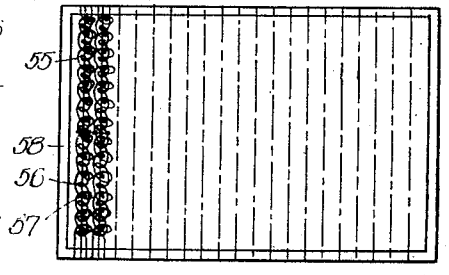
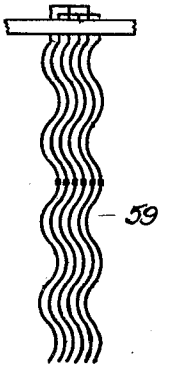


Fig. 7



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PROTECTIVE SYSTEM

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Fig 8.

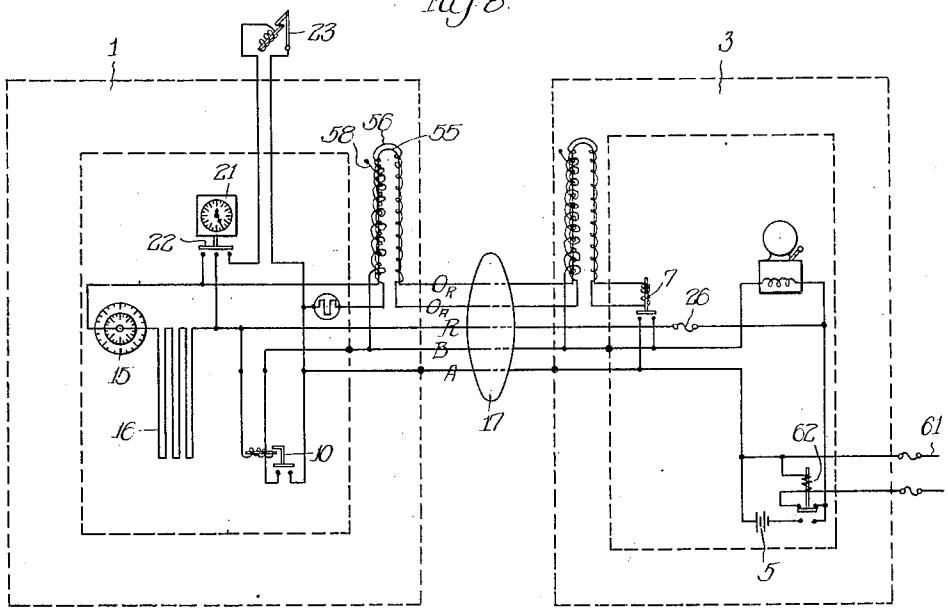
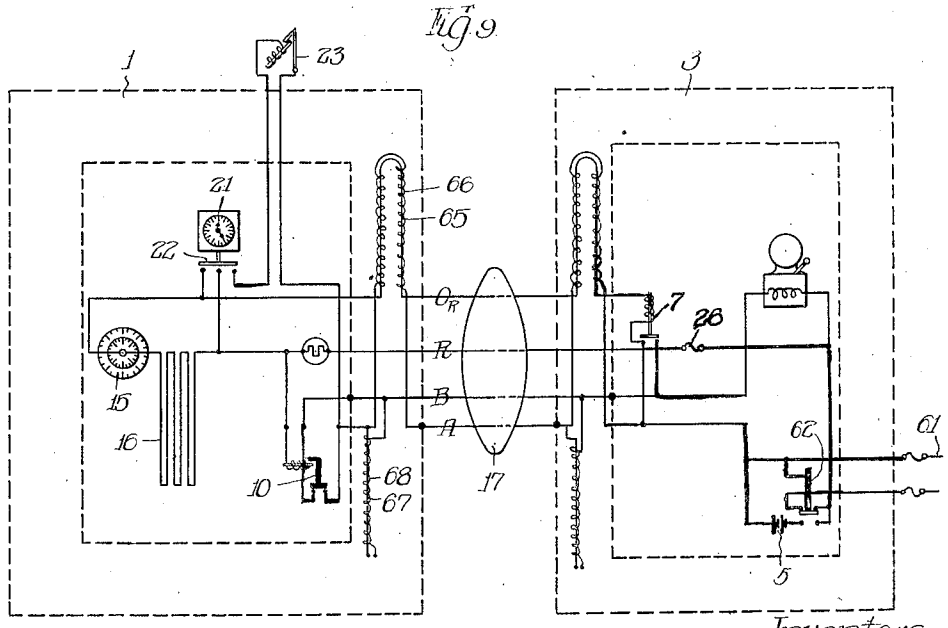


Fig 9.



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UNITED STATES PATENT OFFICE

1,920,742

PROTECTIVE SYSTEM

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Application February 28, 1927. Serial No. 171,577

2 Claims. (Cl. 177—316)

This invention relates to protective systems, and it has special reference to burglar alarm and similar systems wherein a signaling device is released or an alarm sounded upon unauthorized or improper entrance into or tampering with a housing or chamber that is to be guarded and protected.

Among the objects of the invention is a simplified system of the foregoing character, characterized by a number of novel features, such as the utilization of a common energy supply source associated with the signaling device both for operating the open circuit and the closed circuit alarms of the system; circuit connections whereby some of the conductors of the open circuit alarm constitute parts of the closed circuit alarm, and vice versa; the employment of braided, multiple conductor cables for establishing the alarm circuit connections where the signaling or alarm device is disposed at a distance from the guarded device, the open circuit alarm conductors being preferably formed of a plurality of parallel connected strands in such cable; special alarm elements comprising a plurality of adjacently disposed, resilient conducting elements, preferably constituting mechanical vibration elements of different natural frequencies and forming part of the protected enclosure; and other characteristics which will appear from the following specification and the drawings describing specific exemplifications of the invention.

In the drawings,

Fig. 1 is a diagrammatic view of the protective system embodying one form of the invention;

Fig. 2 is an elevational view of a portion of the cable carrying the circuit conductors extending between the guarded housing and the remotely disposed signaling device of Fig. 1, a part of the interior of the cable being exposed to indicate the structure thereof;

Fig. 3 is an elevational view of the improved spring alarm element of the invention;

Fig. 4 is an elevational view of the vibratory spring alarm element of another form of the invention;

Fig. 5 is a horizontal sectional view of the spring alarm element in Fig. 4;

Fig. 6 is an elevational view of a frame unit having mounted thereon a plurality of spring alarm elements to constitute a portion of the enclosing walls of the guarded structure;

Fig. 7 is an elevational view of a portion of the frame unit similar to Fig. 6 utilizing a different form of spring members; and

Figs. 8 and 9 are views similar to Fig. 1 illustrating protective systems embodying the invention in other forms.

The alarm system shown in Fig. 1 is of the type which is preferably employed for the protection of safes, bank vaults, or the like. In said systems the safe, or in general, the guarded structure, is disposed at some point in the interior of the building and an alarm device or signaling device that is disposed outside of the building is so connected by suitable alarm circuits with said guarded device as to sound an alarm and attract the attention of those in the neighborhood in case the guarded structure is tampered with. The signaling device is usually disposed at a point where an alarm released thereby will be noticed by observers, or the public passing at said point. Thus, in many cases, the signaling device for protecting a safe in the interior of a vault is placed at the front wall near the entrance of the building so as to attract the attention of the passers-by when sounding the alarm.

To make a protective system of the foregoing character effective, it is important that both the signaling device as well as the circuit connections between said signaling device and the guarded structure shall be "tamper-proof". That is, they must be so arranged as to positively prevent, or at least render very difficult and improbable, the cutting out, or otherwise rendering for a time inoperative, the alarm circuit. The fact that the signaling device is disposed outside of the guarded structure and that the circuit connections are also exposed, renders the foregoing requirements difficult to accomplish by simple means.

In our copending application Serial No. 121,454 of July 2, 1924 is described a protective system of the foregoing character in which the signaling device was enclosed in a suitable housing or casing and the circuit connections between said signaling casing in the guarded structure are effected through a cable so arranged as to cause the alarm to be released in case the cable was cut or the casing walls were intended to be broken.

To this end, there was provided, what might be designated, a closed alarm circuit and an open alarm circuit extending between the guarded structure and the signaling casing. The signaling device within the signaling casing was included in a local energizing circuit supplied from a local electric energy source, this circuit being held normally open by means of a switch held in open position by an electromagnet that was energized through a pair of conductors from a second energy source disposed inside the guarded struc-

ture. Cutting of any one of said wires, commonly designated as the closed circuit wires, would interrupt the energizing circuit of the electromagnet, causing said siwtch to close the local energizing circuit of said alarm device, releasing the alarm.

In order to prevent rendering said feature inoperative, additional conductors or, as they were termed, open circuit conductors, were provided between said guarded housing and said signaling casing so arranged as to cause the alarm to be sounded if said wires were bridged over or short-circuited. Since the open circuit wires were lead in one cable with the closed circuit wires, a person attempting to render the closed circuit protection ineffective by bridging said two wires with an auxiliary battery was likely to bridge over the open circuit wires of the cable, thus causing the alarm to be sounded. The degree of protection of such system depends on the difficulty with which the closed circuit wires can be separated and distinguished from the open circuit wires.

One of the distinguishing features of the present invention is a circuit arrangement whereby some of the closed circuit conductors serve as part of the open circuit alarm, while part of the open circuit conductors serve as part of the closed circuit alarm, thus mutually increasing the effective protection rendered by the two alarm circuits. Another feature resides in the utilization of a single electric energy source within the signaling casing for supplying energy to operate both the closed, as well as the open alarm circuits.

In the exemplification of the invention illustrated in Fig. 1, a guarded structure or housing 1 is arranged to be protected by means of a signaling device, such as a gong 2, disposed at a distance from the guarded housing and enclosed in a signaling casing 3. In the following specification and claims the term "housing" will, in general, be applied to designate the guarded structure 1, while the term "casing" will be applied to designate the housing or box enclosing the signaling device 2, in order to simplify the nomenclature. This difference of expression in designating the two structures is not intended to in any way limit or particularly distinguish the character of the two enclosures in respect to their construction, characteristics or otherwise. In some of the claims the term "housing" is intended to be applied both to the guarded structure and to the casing surrounding the signaling device.

Both the protected housing and the signaling casing are shown as having double walls, indicated by dotted lines. The walls are preferably of conducting material and are insulated from each other to constitute part of the alarm circuit as described hereinafter.

The signaling device 2 is supplied from an electric energy source, such as a battery 5, disposed within said signaling casing 3, through a local energizing circuit within the casing, said circuit including an electromagnetic switch 7. The switch 7 is normally held in open position by energizing the magnet thereof through a suitable switch control circuit including a pair of conductors O_a and O_r, commonly designated as the closed circuit conductors, leading from said casing into said guarded housing 1.

A second pair of conductors A and B, commonly designated as the open circuit conductors, are connected in parallel to the switch 7 and constitute a second external energizing circuit for said alarm or signaling device 2, said open circuit conductors leading from said casing into said housing like the closed circuit conductors. An electromagnetic tripping switch 10 within said guarded housing is arranged to bridge said open circuit conductors A and B when tripped, to permanently short-circuit said conductors, and thereby continuously sound the alarm until the switch is reset. The tripping magnet for the housing switch 10 is connected between the open circuit conductor B leading from the terminal of the signaling device 2 and an additional return conductor R extending between said casing and said housing, said conductor being connected to the terminal of the source 5, having a polarity opposite that to which the open circuit conductor A is connected.

In order to energize the control circuit of the casing switch 7, its closed circuit conductors O_a and O_r are connected within the housing 1, to open circuit conductor A and the return conductor R, leading to terminals of said energy source 5 within the casing, the circuit connections of said closed circuit wires O_a and O_r including suitable protective alarm elements within the guarded housing such as the combination lock 15 and the labyrinth lining 16. The alarm elements are well known in the art and no extensive description thereof will be given. The lock is usually so arranged that in locked position a circuit connection therethrough is completed and on tampering with said lock said connection is broken. The labyrinth lining usually consists of a metallic foil ribbon pasted over an insulating layer on the interior walls of the guarded housing, said ribbon constituting a part of the control circuit supplying current to the magnet of the casing switch 7. The labyrinth lining is so arranged as to break open upon tampering with the walls of the guarded structure, thereby interrupting the circuit through the closed circuit conductors O_a, O_r and starting the alarm.

The several wires A, B, R, O_a, O_r, leading between the signaling casing and guarded housing, are combined into a single multi-strand cable 17, such as shown in Fig. 2. According to the invention, the number of strands within the cable is greater than the number of signaling wires required to operate the alarms. Preferably, the open circuit conductors A and B are each formed of a plurality of similar strands which are electically connected together at the casing and housing ends of the cable, thus constituting multiple wire conductors.

The foregoing arrangement greatly reduces the probability of finding and segregating the closed circuit wires O_a, O_r from the open circuit wires within the cable and increases the chance that the open circuit wires will be bridged or close-circuited in case a burglar or other unauthorized person attempts to bridge out the closed circuit protective elements of the guarded structure by connecting an auxiliary battery across the closed circuit conductors O_a and O_r.

This protection is still further increased by reason of the fact that the open circuit conductor A constitutes a part of the closed alarm circuit including the conductors O_a and O_r, and on the other hand, the closed circuit conductor O_a serves in effect the same functions as a multiple conductor for the open circuit conductor A. Accordingly, the protection of the open circuit conductors is directly increased by the closed circuit conductors of the system, and vice versa.

In order to fully derive the benefits of this pro-

tective system and to render still further difficult the segregation of the closed circuit wires from the open circuit wires without releasing the alarm, the several strands of the cable are braided and interwoven to constitute a closely tied mass of wires, making it substantially impossible to separate one wire from another without short-circuiting the wires or cutting the same.

In operation of the foregoing system the protection of the interior of the guarded structure 1 depends, in the first instance, on the closed circuit alarm elements 15 and 16 and on the maintenance of said alarm circuit, including the closed circuit conductors O_a and O_r, in operative condition. This, in turn, is secured by the provision of the braided interconnected cable 18, including the open circuit alarm conductors A, B and the return conductor R. Thus, if the cable is directly cut, the de-energization of the control magnet of the switch 7 will close the local alarm circuit within the signal casing 3, continuously sounding the alarm.

An attempt to bridge out the conductors O_a, O_r without cutting the cable will, by reason of the above described multiple open circuit conductors A, B and the braided cable construction, invariably cause short-circuiting of the open circuit wires A, B. The latter are so arranged that bridging thereof for even a very short instant will energize the tripping magnet of the housing switch 10, thereby permanently establishing a short circuit across said wires and thus continuously energizing the alarm device and sounding the same until said housing switch 10 is reset. It will be noted that the casing switch 7 is connected directly in parallel to the open circuit wires A, B so that closure of said casing switch for even a short instant by reason of momentary interruption of the closed alarm circuits O_a, O_r, immediately trips the housing switch 10, thereby continuously sounding the alarm, even if the burglar was able to immediately restore the closed alarm circuit.

The complete protective system of the foregoing character, as applied to safes or vaults that are intended to be held open from 9 A. M. to 5 P. M., for instance, is provided in addition with an alarm cut-out clock 21 disposed within the safe, and arranged to actuate a suitable short-circuiting switch 22, to shunt the alarm elements 15 and 16 of the closed alarm circuit, including the conductors O_a and O_r. When the switch 22 is in lowered position, the alarm elements 15 and 16 are short-circuited making it possible to unlock the combination lock 15 and open the safe without sounding the alarm. When the switch 22 is in raised condition, the alarm elements 15 and 16 are effective and tampering therewith will release the alarm, as described above.

The closing and opening of the switch 22 is regulated by means of the clock 21 which is so arranged that when suitably set before closing the safe, it will open the short circuit established by the switch a short interval after the safe has been closed. The alarm elements 15 and 16 are thereby included in the circuit and the protective system rendered operative. The clock thereupon holds said switch 22 in raised condition for such time as was set on the clock, say till 9 A. M., at which time the switch 22 will be lowered and the short circuit again established. This will again cut out the alarm elements 15 and 16, making it possible to open the safe without sounding the alarm. A simple and effective clock performing the foregoing functions is described and claimed in the co-pending application of Arthur B. Chapman, Serial No. 105,786, filed April 30, 1926.

In order to give an external indication of the condition of the clock switch 22 so as to avoid premature opening of the clock of the safe and unnecessary sounding of the alarm, a suitable annunciator 23 is connected between the current supply wires A and R by means of an auxiliary contact at the switch 22, so that the annunciator is tripped upon closure of said clock switch 22.

In order to maintain the continuous current flow through the closed alarm circuit at a given small value, this circuit is made to include sufficient resistance to limit said current to a desired value. In the preferred construction, a resistor 25 is included in the circuit conductors leading to the energizing magnet of the casing switch 7, said resistor being disposed within the interior of the guarded housing 1, for reasons pointed out hereinafter.

As a safeguard against rendering the alarm system inoperative by short-circuiting the open circuit conductor A and the return conductor R, leading from the energy source 5, and thereby cutting off the energy supply to the signaling device 2, as for instance, by cutting the cable and immersing it in a conducting liquid like mercury, an overcurrent cut-out device, such as a fuse 26, is included in the circuit conductors leading from said source, to open said conductors and permanently release the alarm. This is an important feature of protection characterizing the alarm system of the present invention.

Another protective feature characterizing the invention resides in the utilization of the double walls of the guarded housing and the signal casing as elements of the open circuit alarm protection. To this end, the insulated double walls of the housing and casing are electrically connected to the open circuit conductor pair A and B, respectively. Accordingly, if a burglar, or other person breaking through the walls of either casing with a chisel, or the like, and establishes a conducting connection between the insulated double walls, the housing switch 10 is immediately tripped, permanetly closing the alarm circuit and continuously sounding the alarm until the housing switch 10 is reset.

The protective system of the present invention is further characterized by a special vibratory alarm element 31 so associated with the system as to release the alarm when the housing, or, as the case may be, the signaling casing is tampered with or violently forced.

The vibratory alarm element 31, as indicated diagrammatically in Fig. 1, comprises a plurality of resilient spring members 32, 33, insulated with respect to each other and suitably held under tension to constitute mechanical vibrators adapted to be set into vibration at their natural frequencies upon application of violence to the walls of the protected structures. As shown in Fig. 3, the vibratory spring members are suitably strung between supporting bars 41, 42, preferably arranged as frame units 43, constituting a portion of the enclosure of the protected housings. When such alarm elements are used in mercantile protective systems, such as stores, or the like, such vibratory elements may be formed by stringing the springs across skylights, back windows, and transoms, forming screen-like enclosures over said openings.

Adjacent, insulatingly mounted spring mem-

bers are connected to the open circuit conductors A, B, respectively, as shown in Fig. 1, so that when contact is established between any pair of adjacent spring members the housing switch 10 will be tripped and the alarm set into action. In order to make this protection effective against direct interference with the screen-like enclosures formed by such alarm elements, it is not essential that the same shall constitute mechanical vibrators having a tendency to start vibration and contact with each other upon receiving of an external impulse. It is sufficient for this function to make the screens by simply spanning across such windows, transoms, or the like, conducting wires disposed sufficiently close to each other to become short-circuited upon attempt to pass through such screen.

However, the use of spring members is advantageous even from the viewpoint of protection against direct interference with the screen-like enclosures inasmuch as the spring construction greatly facilitates the building of such enclosures. This is particularly the case if such screens are made in accordance with the present invention by utilizing double sets of coil springs, as shown in Fig. 3, an inner coil spring constituting one vibratory element 32 and an outer coil spring constituting the other vibratory element 33, surrounding said first vibratory element. The double coil spring structure makes it possible to quickly make up such screens, as it is merely necessary to pull the coil pair to the required length and to insulatingly secure it to the bars 41 and 42 on the opposite sides of the frame.

In the preferred construction the inner spring of one coil pair is connected to the outer of the next adjacent coil pair, etc.

When used in vaults, the screen-like frame units may be arranged to constitute a distinct part of the enclosing wall structure, as indicated in Fig. 1 where the vibratory alarm element is shown between the double walls of the housing and the casing, respectively.

In order to cause the vibratory spring elements to vibrate at frequencies at which the action will be most effective, they may be provided with special weight elements 51 suitably clamped or otherwise held on the individual spring members. By increasing or decreasing the mass of said weight elements the natural period of the individual vibrators may be adjusted to lie near the range of the frequencies of external shocks applied to the safe or vault when hammering against the walls thereof. In the preferred construction, where a large number of such mechanical vibrators is available, the natural frequencies of the individual vibrators are adjusted to lie over a wide range so as to obtain a greater assurance that at least one of the vibrator elements will readily respond to an external shock of some particular frequency within said range.

The vibratory alarm elements may also be made in the form of groups of three, spring units, as shown in Figs. 4 to 6, wherein three coil spring members 55, 56, 57 are wound around each other and suitably spanned on a framework 58, shown in Fig. 6. The modification shown in Fig. 7 utilizes adjacently disposed, corrugated wire springs 59 in place of the coil springs.

In the modification of the invention shown in Fig. 8, additional protection is obtained by including the vibratory spring elements as a part of the closed alarm circuit as well as the open alarm circuit. To this end, vibratory elements of the type shown in Figs. 4 to 6, preferably comprising three insulatingly supported spring members coiled around each other, have two coil spring members connected in series with the closed circuit conductors O_a and O_r of the closed alarm circuit, the third spring member being connected to the conductor B of the open alarm circuit.

With the foregoing connections, a contact or short established between the two spring members included in the closed circuit, will short-circuit the energizing coil of the operating magnet in the casing switch 7, thereby momentarily releasing said switch and tripping the housing switch 10, thus putting the alarm into action. If sufficient resistance is included in the energizing leads supplying said closed circuit conductors O_a and O_r, as by means of a resistor 25, included in series with one of said conductors, short-circuiting of the spring members serially connected with said closed circuit conductors will not constitute a complete short on the battery, and accordingly, will merely release the alarm, as explained above. However, if the short circuit current flowing into such short should be excessive, the cut-out device 26 will open, which would also release the alarm.

By connecting the third coil spring member 58 to the open circuit wire B, the vibratory alarm element of the system shown in Fig. 8 provides also for the actuation of the open alarm circuit in case of contact between adjacent spring members, since the immediately adjacent coil spring member 56 is a part of the closed circuit conductors O_a, which, in turn, has a direct connection with the other open circuit conductor A of the alarm system. All-around efficient protection is thus provided with a minimum of complications.

In the alarm system shown in Fig. 9, one of the closed circuit conductors O_a of a system such as shown in Figs. 1 and 8, is omitted and the open circuit conductor A is directly utilized to perform the functions of the omitted open circuit conductor. The energizing magnet of the casing switch 7 is, accordingly, directly connected to said open circuit conductor A within said casing. Two sets of vibratory alarm elements, one cooperating with the closed alarm circuit and the other cooperating with the open alarm circuit, are provided. To this end, one set of adjacent coil spring members 65, 66 of a vibrator structure, as described above, are directly connected in series with the closed circuit conductor O_r and the conductor A which serves both as a closed and open circuit conductor. Another set of adjacent spring members 67, 68 are connected in parallel to the open circuit conductors A and B, functioning like in the arrangement of Fig. 1.

In the modification shown in Figs. 8 and 9, the operating current is arranged to be normally supplied from the house current supply line 61, the battery 5 serving only as a standby source of energy. An electromagnetic actuating switch 62 holds the line normally connected to the supply circuit, but on failure of the supply line, the switch automatically connects the standby battery to operate the alarm circuit.

The invention is susceptible of many other modifications that will suggest themselves to those skilled in the art, such as the utilization of other switching and tripping means than those shown and described; substitution of other overcurrent cut-out devices in place of the fuses; the employment of multiple conductors for the other portions of the alarm circuit, etc. It is desired, however, that the appended claims be construed to cover all such modifications.

What we claim is:

1. In a protective system, a guarded housing, a signaling casing outside of said housing, a signaling device and an energy source within said casing, a local energizing circuit for said signaling device within said casing, a switch included in said circuit, a coil for controlling said switch, a circuit for said coil constituting a protective circuit and including said energy supply source and a pair of conductors extending from said source to said guarded housing and returning to said coil at said signaling casing, said coil closing said switch to energize said signaling circuit on rupture of said protective circuit; a normally open protective circuit including said source of current and the portion of one of said pairs of conductors which extends from said energy source to said guarded housing, an additional conductor extending between said housing and said casing and said signaling device; and a coil at said guarded housing connected between said additional conductor and the portion of the other of said pair of conductors extending from said energy source to said guarded structure, and a trip circuit closer controlled by said last named coil to permanently connect said additional conductor and said first mentioned portion upon the energization of said coil.

2. In a protective system, a guarded housing, a signaling casing outside of said housing, a signaling device and an energy source within said casing, a local energizing circuit for said signaling device within said casing, a switch included in said circuit, a coil for the switch, a protective circuit including said energy supply source, a pair of conductors extending from said source to said guarded housing and said coil at said signaling casing; said coil closing said switch to energize said signaling circuit on rupture of said protective circuit; and normally open protective circuit including said source of current, and one of said pair of conductors, an additional conductor extending between said housing and said casing and said signaling device; and a coil at said guarded housing connected between said additional conductor and the other of said pair of conductors, and a trip circuit closer controlled by said last named coil to permanently connect said additional conductor and said one of the conductors upon the energization of said coil.

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