J. SACHS.

THERMAL CUT-OUT.

APPLICATION FILED MAY 5, 1908

1,014,098.

Patented Jan. 9, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

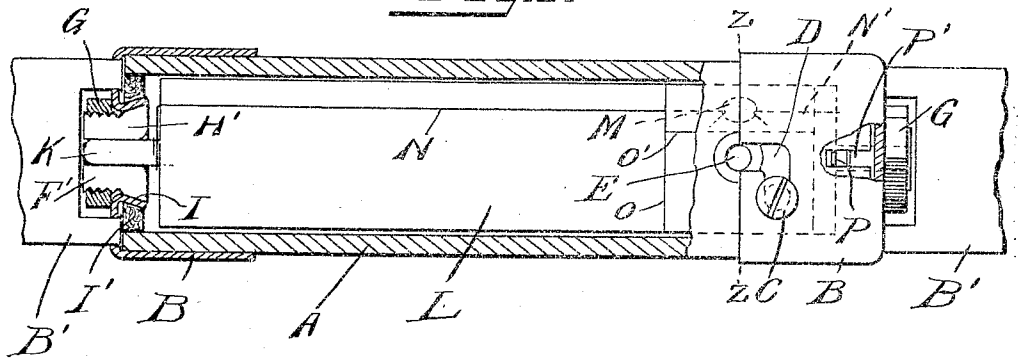


Fig. 2.

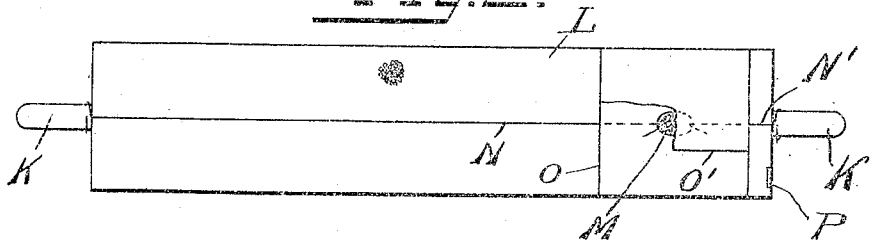


Fig. 3.

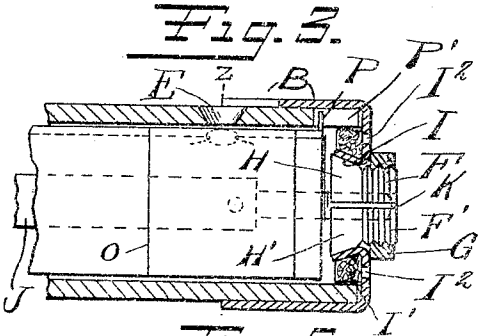


Fig. 4.

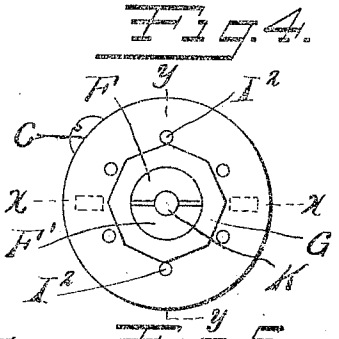


Fig. 5.

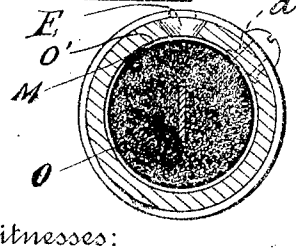


Fig. 7.

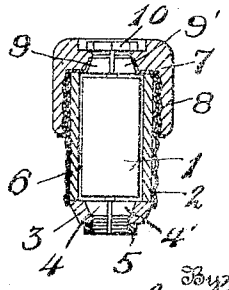
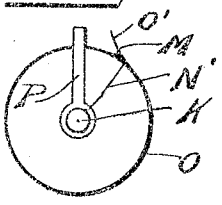


Fig. 6.



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2 SHEETS—SHEET 2.

Fig. 8.

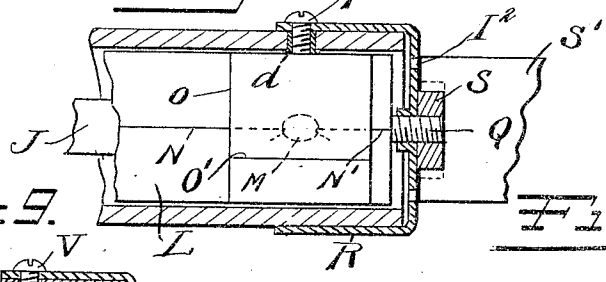


Fig. 9.

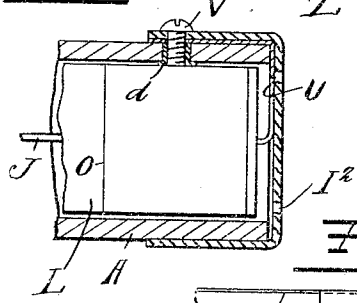


Fig. 10.

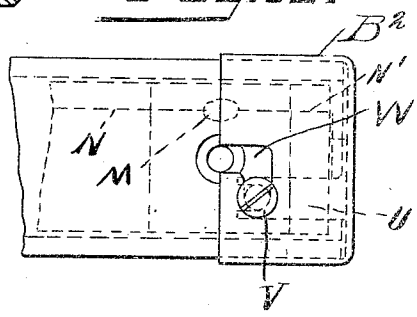


Fig. 11.

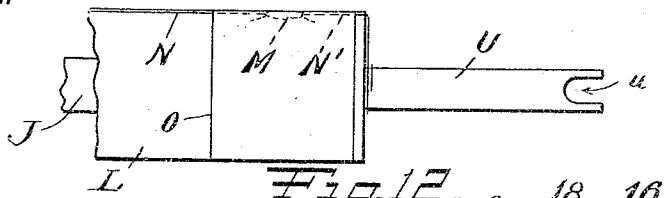


Fig. 12.

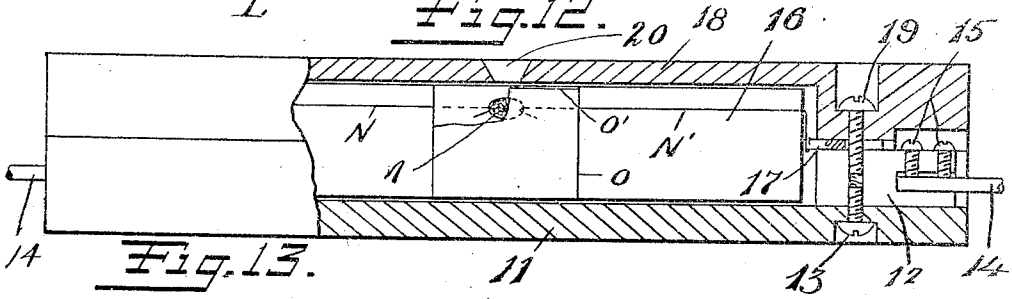


Fig. 13.

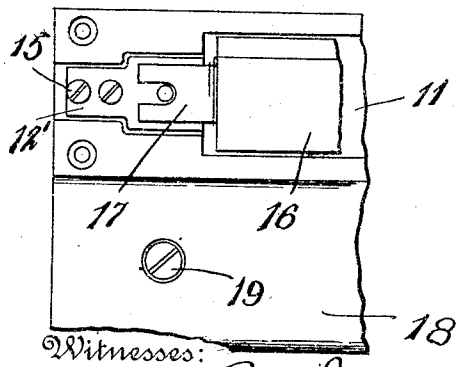
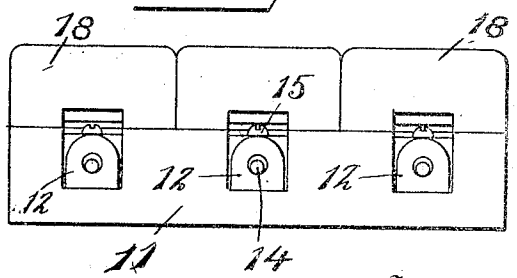


Fig. 14.



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UNITED STATES PATENT OFFICE.

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THERMAL CUT-OUT.

1,014,098. Specification of Letters Patent. Patented Jan. 9, 1912.

Application filed May 5, 1908. Serial No. 430,976.

To all whom it may concern:

Be it known that I, JOSEPH SACHS, a citizen of the United States, residing at Hartford, county of Hartford, State of Connecticut, have invented certain new and useful Improvements in Thermal Cut-Outs, of which the following is a full, clear, and exact description.

My invention relates to improvements in thermal cut-outs for electric circuits.

Fuses have been described in which a strip was surrounded by a thin layer of material applied directly to the surface of the strip in the form of a paste and hardened, and then secured in a tubular casing provided with proper terminals electrically connected to the fuse strip. In other instances, an immediately surrounding loose material has been held to the strip by a tubular sheath or interior casing surrounded in turn by an external casing having terminals to which the strip was electrically connected. The constructions referred to in this paragraph are described in a patent granted to me October 24th, 1899, No. 635,395.

In order to more advantageously use a loose filling in the inner tubes or casings referred to in the last paragraph, it has been suggested that that tube be provided with end closures so as to produce a cartridge, the casing and closures of which would keep the loose filling about the strip. This cartridge construction placed within a second casing is described and claimed in my Patent No. 737,282, granted August 25, 1903.

Fuses have also been patented in which the strip was jacketed with a woven asbestos tube so that the strip and tube were as a combined structure inserted in a box or casing, the whole constituting an inclosed fuse with a porous jacket as distinguished from a fuse surrounded by a loose porous material, inclosed in a non-porous sheath. This asbestos sleeve structure is described in patent to McCulloch, No. 550,638. In all these devices employing inner tubes, with or without closures for such inner tubes, the expense of the construction has been a great objection, furthermore a large portion of the space within the outer casing has not been utilized. Moreover, there has been no satisfactory means for ascertaining what the condition of the fuse strip may be by an inspection from without the outer casing. In the structures where an adhering substance was applied directly to the fuse strip it was a mere coating and not a filling or provided with chambers or interstices permitting the ready dispersion of the gases and metal of the fuse when molten, and did not fill the external casing. In the asbestos sleeve construction there was no filling, properly speaking, but simply a sleeve which occupied but a small portion of an inclosing casing, the gases discharging into the air space surrounding the sleeve. On account of the expense and little advantage of such devices the inclosed fuses of commerce are now and for a long time have been constructed without employing an inner cartridge, and without employing any inner sheath for holding the filling about the strip and without having the strip either jacketed or coated, but so that the outer casing holds a loose filling material about the strip and so as to be ready for use without doing more than to make connection with line terminals. That is, the inclosed fuses of commerce have been constructed with a fusible conductor surrounded by a loose insulating filling material held about said conductor by a tubular casing, the end openings of which were closed by conducting ferrules or end caps, which in themselves acted as the external contacts or from which the contact blades projected. This combination of parts formed a composite self-contained cartridge structure, and was manufactured, sold and used as a whole to be used without any additional casing and could only be replaced by an entirely new and similarly complete device whenever the fuse strip was blown or ruptured by an excess of current. These cartridges have been inclosed in fuse plugs, but except in fuse plugs they have not been introduced to any extent into commercial use in connection with other external casings. As the tubular casing, ferrules and external contacts form the major portion of the material cost of such inclosed fuses or cartridges, particularly in the larger sizes, the replacing of such blown or ruptured inclosed fuses of this type is necessarily expensive. As such complete structures are manufactured

for a definite carrying capacity and cannot be readily changed by the user or seller, it is necessary that he carry a large variety of the present form of complete inclosed fuses of different ampere capacities for a certain size block if he desired to be prepared to vary the current carrying capacity of his inclosed fuse cut-out appliance. This consequently necessitates a large expenditure for stock inclosed fuses, which could be eliminated if a cheap refill or reload were provided and the tubular casing, ferrules and external contacts were properly constructed, so that they could be used repeatedly if the disrupted strip and its arc-dissipating environment which is held around it within the tubular casing could be easily and properly renewed.

One of the objects of my invention is to satisfactorily accomplish this result, and to that end I provide an integrally combined "reload" or "refill" consisting of the fuse strip surrounded by a cohering arc-dissipating filling substance so that these two elements or parts are in themselves complete as a unit and will hold together without additional means, and also a suitable casing, box, tube, or other external protecting or inclosing structure, in which tube refills or reloads can be readily inserted and which they substantially fill, means being provided whereby the terminals of the fuse strip of the reload or refill can be easily, quickly and securely connected to the external contacts on the inclosing casing and the casing securely closed with slight effort and preferably by the same movement, thereby insuring the proper electrical connection of the fuse strip between the external contacts by the operation of sealing or closing the casing so that it will resist without dismemberment or derangement the internal pressures developed upon the blowing or disruption of the fuse strip. In such a structure the casing terminals are preferably casing closures and the unitary filling with the strip is removable and replaceable as a whole when these casing terminals are removed. It differs from fuses now in use in that, among other things, the granular filling is made to cohere and yet be of such dimensions as to substantially fill the casing and to permit easy insertion and removal as a whole.

Another object is to provide a jacketed fusible conductor with indicating means which is a composite self-contained connected part thereof and is held thereon or attached thereto, and which visibly or otherwise indicates the condition of the jacketed fusible strip, in order that the blowing of the jacketed fuse strip may be apparent without testing the strip for continuity. I also provide for detecting from the exterior of the external casing the condition of the reload or refill and in the preferred form entirely surround the indicating means by the casing.

Another object of my invention is to provide a suitable means for detachably connecting the terminals of the refill or reload to external contacts of the casing.

The following is a description of an embodiment of my invention, reference being had to the accompanying drawings, in which,

Figure 1 is a view partly in plan and partly in section on the line *x*—*x*, Fig. 4, showing the exterior of the casing and caps and a portion of the interior of a fuse embodying my invention. Fig. 2 shows in plan a reload or refill with the terminals of the fuse strip extending at its ends. This reload has located upon it an indicator forming a composite part thereof. Fig. 3 shows a partial view with the casing in longitudinal section on the line *y*—*y*, Fig. 4. Fig. 4, is an end view of the fuse of Fig. 1, the plate being removed. Fig. 5 is a section taken through Fig. 1 at the line *z*—*z*. Fig. 6 shows an end view of the refill shown in Fig. 2. Fig. 7 shows in section a fuse plug embodying my invention. Figs. 8 and 9, 10 and 11 show reloads with modified forms of terminals at their ends and corresponding casing terminals. Figs. 12, 13 and 14 show a fuse block embodying my invention, Fig. 12 being a side elevation partly in section, Fig. 13 a portion of the block with one of the covers removed, and Fig. 14 an end elevation.

Referring more particularly to the drawings, A is a casing, preferably tubular and constructed of fiber or other suitable insulating material. B—B are counterpart metallic end caps or casing terminals fitting over the ends of said casing and held thereto by suitable fastening devices, the fastening device shown consisting of a screw C engaging a bayonet slot D in each of the end caps. The screws C preferably engage with nuts or gromets *d* sunken in the tubular casing so as to furnish a strong screw-thread, and the ends of the screws may be headed over on the inside of the casing so that they cannot be entirely removed therefrom. The screws engaging with the bayonet slots constitute the preferred form for securing the caps in position. Any other suitable means, however, may be employed for accomplishing this purpose. When end closures are used one of them at least should be removable. In the large sized fuses the end caps are provided with contact blades B′. When these blades B′ are omitted as in Fig. 3 the caps B constitute both end closures and circuit connecting contacts. When the blades are provided they form the circuit connecting contacts. When an indicating device is employed, the casing is

preferably provided with a window or opening E, through which evidences of the condition of the refill can be detected.

Means are provided for securing the terminals of the fusible strip in electrical engagement with the end caps, the preferred form being that of Figs. 1-4 and consisting of a clamping device consisting of a split plug having two parts F—F′ and a nut G. The parts F—F′ each have a flaring end H—H′ which engages a conical bearing surface I on the inside of the cap. The split plug has a hole through it concentric with the end of the fuse strip terminal.

When the refill is secured in place the round terminals project into the holes in the clamps, and the nuts are screwed down so as to draw the split plug members F—F′ into close clamping engagement with the terminals, thus securing an excellent electrical continuity between the fuse terminals and the end caps and the contact blades B′ attached thereto if such contact blades are used. The caps when clamped to the fusible conductor terminals are by such clamping fixed in position relatively to one another and to the casing. The nuts G are screwed on by a right hand movement and the caps are turned by a movement in the same direction to seat the shanks of the screws C against the innermost ends of the bayonet slots. This seating of the screws C and the screwing of the nuts G can thus be done by the same movement or operation.

The refill or reload consists of a fusible conductor J which, as shown, is connected between terminals or connections K—K of copper or other metal harder and less fusible than the fusible conductor J. These terminals or connections are shown in Figs. 1, 2, 3, 4 and 6 as round wires, riveted, soldered or otherwise connected to the ends of the fusible conductor, and in Figs. 9, 10 and 11 as flexible strips of copper or the like. The fuse strip and the inner ends of the terminals are surrounded by a cohering jacket L, which consists of insulating material. I prefer to use for this purpose granular earthy substances of the calcium group, which are combined by means of suitable binders to produce an integral cellular multi-chambered spongy or porous mass, which mass is molded, compressed or otherwise formed and held around and in contact with the fuse strip so as to form therewith the jacketed strip or reload. A suitable way of making this cellular jacket is to combine coarsely ground set plaster-of-paris with a solution of silicate of soda, which forms therewith a pasty mass and at the right consistency can be cast or molded around the strip. It may also be formed by holding the ground material about the fusible conductor in a mold and pouring silicate of soda through it while thus held. The surplus silicate of soda is permitted to drain off leaving interstices between the granules or particles of the plaster-of-paris which are held together by the binding and chemical action of the silicate of soda, forming a cohering cellular jacket adhering to the fuse strip so as to be integral with the fuse strip. Although a suitable jacket may be made in this way, various features of my invention may be embodied without the use of a jacket which adheres to the strip. I therefore do not limit myself to such an adhering or integral jacket or the stated chemical elements, since they are not essential to form the cellular structure of my reload jacket.

It will be noted that the jacket L is molded so as to entirely inclose and surround the fuse strip J and also a small portion of the inner ends of the terminals or connections K—K between which the fuse strip J is connected. It is also preferably of such size as to nearly fill the casing, but not to bind therein when being inserted or removed.

Although I have shown terminals K—K of metal harder than the fuse strip and not integral therewith, this is not of essence, since other well known forms of strip and terminals can be used.

In order that the condition of the reload may be apparent on the exterior of the jacket, and if necessary on the exterior of the external casing surrounding the jacket or cohering filling, I provide indicating means which in Figs. 1, 2, 5 and 6 are shown as an indicating compound or connection M located and electrically connected between the ends of conductors N—N′ which at their outer ends are electrically jointed or connected to the terminals K—K. This indicating connection M is composed of a conducting material such as graphite with which has been incorporated an easily ignitible or heat affected material, such as gun powder, or picric acid. The combined substances are put into plastic or fluid condition, and in this state the compound is placed in position between the ends of the conductors N—N. These ends are previously hooked over from the under side of a perforated sticker or label O, so that the perforation between the two hooked ends forms a shallow locating recess for receiving the indicating connecting compound. The sticker or label O preferably encircles the refill and is provided with an unstuck flap O′, which, after the indicating connecting compound has been placed and dried, is folded down over the connection so as to just cover it.

In order to cause the proper registration of the refill and tube, so that the indicator will act properly, I apply to one fuse terminal K an arm or projection P, which is

secured against turning by being slightly embedded in the jacket, or by solder, or both, and extends beyond the periphery of the refill so as to engage a notch or recess P′ in one end of the tubular casing. This arm or projection has a fixed or definite position relatively to the indicator compound. The casing is provided with a window or aperture E, which is at a proper distance from the notch P′ so that the arm or projection P when within the notch P′ will cause the indicator compound to be in the proper position relatively to the window or aperture.

The jacket L after it is dried is preferably coated with one or more coats of asphaltum or similar heat-resisting varnish to give it a finish and increase its coherency. This should preferably be applied after the indicator conductors have been connected to the fuse terminals. The inner end surface of the caps is covered with a felted asbestos washer I′, held in place by the flaring upset portion that forms the conical recess I. This washer covers apertures or vents I^2 in the casing terminals.

In using my reloadable inclosed fuse, it is necessary simply to take the reload consisting of the combined strip and jacket, and insert it into the tubular casing through the opening at either end, one cap only being removed. After being positioned therein, the removed cap is replaced and turned so as to be secured by the bayonet joint and the nuts G screwed down so as to clamp the fuse terminals K to the caps B. It is desirable that the reload be so inserted that the indicating connection be removed from, though in proximity to, the aperture in the casing, and it will be noted that it is not possible to insert the reload otherwise on account of the registration pin P fitting in a recess P″ in the casing. The indicator compound is therefore entirely surrounded by the casing and there is, therefore, no exposed conducting element at the opening so that it is not possible to have any flash or arc at this opening, due to the rupture of any conducting element at that point, as would be the case if a current carrying conductor were located directly beneath the hole or aperture in the casing. An exposed flash at the opening would be a source of danger, since it is liable to ignite any explosive gases which may be present, or any easily ignitable material which may be at hand, and the presence of an exposed conductor at the opening is undesirable in that it enables an electric connection to be made at that point.

In operation, an excess of current passing through the fusible strip will melt it, causing it to rupture, and the products of the disrupted strip will be dissipated through the interstices of the cellular or chambered jacket around the strip, thus entirely breaking up the arc. As soon as the fuse strip has been thus ruptured, the current will then pass through the indicating connection, which is connected in shunt around the strip. This connection being of very high resistance, normally does not carry any appreciable current. When heated by the passage of current after the fuse strip is blown, the indicating connection will be ignited or otherwise affected, so that the products of such heating, ignition or other change, will be of a nature to discolor the surface of the label in proximity thereto. This discoloration will be visible from the exterior of the external casing through the aperture, and thereby the condition of the reload will be seen. The folded flap C′ serves to direct these products toward the aperture E so as to insure that the portion of the jacket beneath the aperture shall be subjected to them.

Fig. 8 shows the refill with another form of terminal and indicating device, and also other means of fastening the cap upon the casing and electrically connecting the fuse strip thereto. In this form the fuse strip is provided with screw-threaded terminals Q_1 over each of which is passed a cap R, having a screw-threaded opening engaging said terminal screw-threads. The cap is screwed on to a terminal Q and a set-nut S is then screwed upon the screw-threaded portion Q holding the parts together. A contact blade S′ free from the cap may be made integral with this nut, the thread being sufficiently fine so the blades at the two ends can be placed in the same plane. The cap is secured to the casing by a screw T passing directly through a hole in the cap. An indicating connection M electrically connected by conductors N—N as in Fig. 1, and acting in the same manner, is attached to and carried by the jacket of the refill and its strip.

Another means of securing the end cap to the casing and electrically connecting the fuse strip thereto is shown in Figs. 9, 10 and 11. In this construction U is the fuse strip terminal of thin flexible metal, preferably copper. It is bent back so as to come in direct contact with the exterior surface of the casing A. The terminal of the fuse strip is provided with a slot *u* which is slipped around the shank of the screw V. The cap B^2 with its bayonet joint W is then slipped on and turned in place and the screw set so as to hold the cap in place and clamp it against the terminal U.

Fig. 7 shows my invention as embodied in a fuse plug. In this construction, I is the refill, consisting of a jacketed strip such as shown in Fig. 2, but shorter and without an indicator, this latter feature not be-

ing demanded in plugs. 2 is a metal screw-threaded cylinder for engaging the ordinary plug socket. 3 is a porcelain disk having a conical perforation within which fits the expanded portions 4—4′ of a split plug engaged by the nut 5. Within the cylinder 3 is a fiber tube 6. A porcelain cap 7 lined with a metal screw-threaded cap 8, screws on to the cylinder 2. The cap is provided with a clamp consisting of a split plug and nut 9—9′ and 10 similar to the split plug clamps heretofore described. The cap 8 extends up into a conical hole in the porcelain cap so as to be engaged by the clamp. The terminals of the refill pass through the holes in the clamps and when the nuts are screwed on are tightly held therein. The composite structure thus constitutes a fuse plug having a removable fuse strip surrounded by a cohering cellular filling, the filling and strip being removable and replaceable as a single unitary structure, and substantially filling the casing so as to have the advantages of the loose fillings now in use.

Another embodiment of my invention is a form of fuse in which a fuse block is used and is shown in Figs. 12, 13 and 14. In these figures, 11 is a base block having a plurality of sets of terminals 12—12′ secured to the base block by screws 13. The circuit terminals 14 are fastened to these terminals by set-screws 15. Refills 16 similar to that shown in Fig. 11, but with shorter fuse terminals, are laid upon the base block 11 with the fuse terminals 17 in engagement with the block terminals 12—12′ and the covers 18 are then secured to the base by screws 19 which enter the block terminals. The covers are provided with apertures 20 through which the indications produced by the indicator connections M are visible. These fuse bases may be made large enough to provide for a number of refills and the several covers 18 being separate so that only that cover which conceals the refill to be replaced need be removed in order to replace any refill whose fuse may have been blown.

My invention is not limited to the precise form of casing or other elements disclosed, since various other forms may be employed in embodiments of it as will be evident to those skilled in the art.

What I claim is:

1. In an inclosed fuse, an external casing and circuit connecting contacts, a fusible conductor within said casing and electrically connected to said contacts, and a cohering cellular filling surrounding the conductor so as to be removable as a whole with the conductor from the casing.

2. In an inclosed fuse, an external casing and circuit connecting contacts, a fusible conductor within said casing, means for detachably electrically connecting the conductor to the contacts, and a cohering cellular filling surrounding the conductor so as to be removable as a whole with the conductor from the casing.

3. An inclosed fuse comprising an insulating tubular casing provided with end closures and circuit connecting contacts, a fusible conductor surrounded by an integral cellular jacket forming a reload and removable as a whole from said casing, and means for detachably holding the reload in the casing and electrically connecting the fusible conductor to the said contacts.

4. A tubular casing, a reload consisting of a fusible conductor and a cohering unitary cellular filling forming a mass held thereto, said fusible conductor having terminals electrically extended in line with the axial center of said mass, said casing being provided with detachable electrical connections at the ends thereof and concentric with and engaging said terminals.

5. In an inclosed fuse, an external casing provided with circuit connecting contacts, a fusible conductor therein electrically connected to said contacts, a cohering cellular filling surrounding the conductor and removable as a whole with the conductor from the casing, and indicating means attached to and removable with the removable filling and conductor, and means provided in the casing and coacting with the indicating means on the filling for externally indicating the condition of the fusible conductor.

6. In an inclosed fuse, the combination of a casing of insulating material provided with an aperture, a fusible conductor surrounded by a filling material within the case, and an indicator entirely within and entirely inclosed by the casing and adjacent to the interior surface thereof, being located out of alinement with said aperture so that it is not exposed at or visible therethrough, but provided with means for manifesting the rupture of the fusible conductor at said aperture.

7. A tubular inclosing casing provided with end closures and circuit connecting contacts, a fusible conductor surrounded by filling material within said casing and connected between said contacts, a shunt indicating circuit entirely within the casing and completely incased thereby, and means associated with said circuit for producing a discoloring medium, and an aperture in the casing through which the effects of said medium are visible, said aperture being out of alinement with the indicating circuit.

8. In an inclosed fuse, a casing provided with an indicating aperture, and circuit connecting contacts, a removable reload structure having a fusible conductor, filling and also a self-contained indicator exter-

nally manifesting the condition of the fusible conductor through the aperture, and means for positioning the reload in the casing so that the indicator is entirely inclosed and completely surrounded by the casing and out of alinement with said aperture.

9. In an inclosed fuse, the combination of a tubular casing of insulating material, an indicator hole in said casing, end closures and circuit connecting contacts at the end of the casing, a fusible conductor surrounded by a cohering integral cellular filling material forming together a removable reload, a shunt circuit indicator attached to and forming a part of said reload, said indicator being upon the outer surface of the filling material, means coacting with the end closures and the terminals of the fusible conductor projecting from the ends of the reload for detachably holding the reload within the casing, and electrically connecting the fusible conductor to the contacts, and registration means for locating the reload in the casing so that the shunt indicator of the reload is out of alinement with the indicator hole in the casing.

10. A reload for inclosed fuse casing composed of an integral insulating filling cylinder of cellular structure having a multitude of interstices for receiving the products of the fuse strip when disrupted, a fusible conductor within the filling with terminals extending beyond the ends of the cylinder, and an indicator mounted upon said cylinder.

11. A filling for inclosed fuses composed of granular non-conducting material, in combination with a non-conducting binding agent holding the same together in the form of a cohering cellular mass.

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Witnesses:
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