July 23, 1940. A. B. BUSSMANN 2,209,048

ELECTRIC FUSE AND FUSE HOLDER

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Fig. 1.

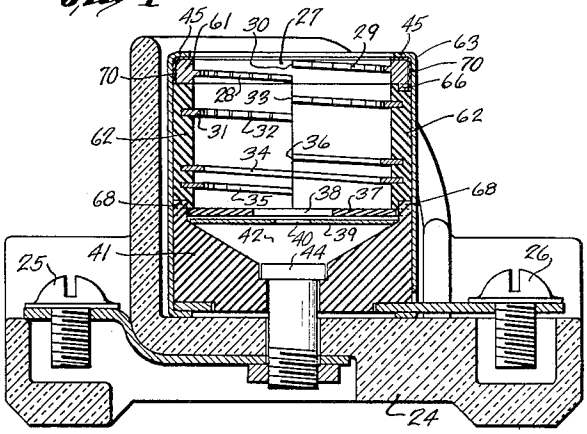


Fig. 2.

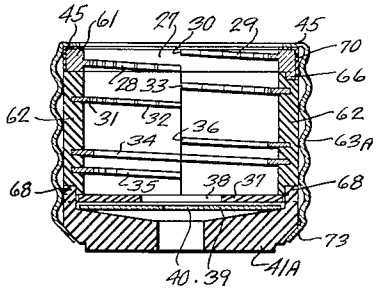


Fig. 3.

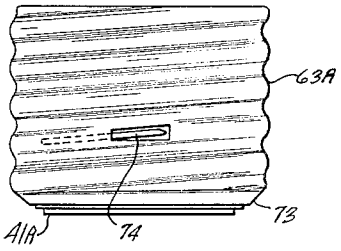


Fig. 4.

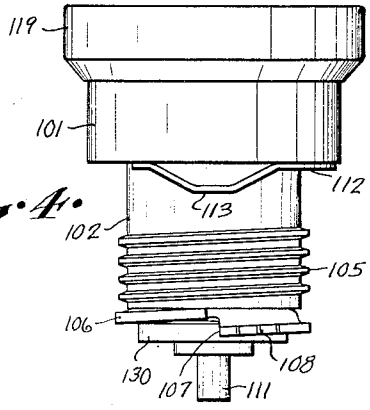


Fig. 5.

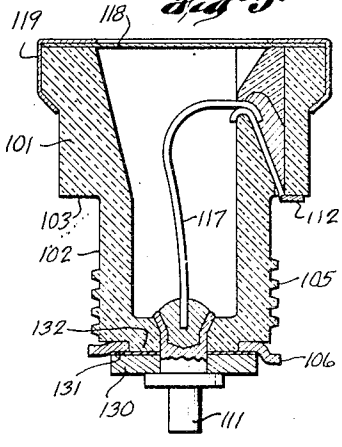
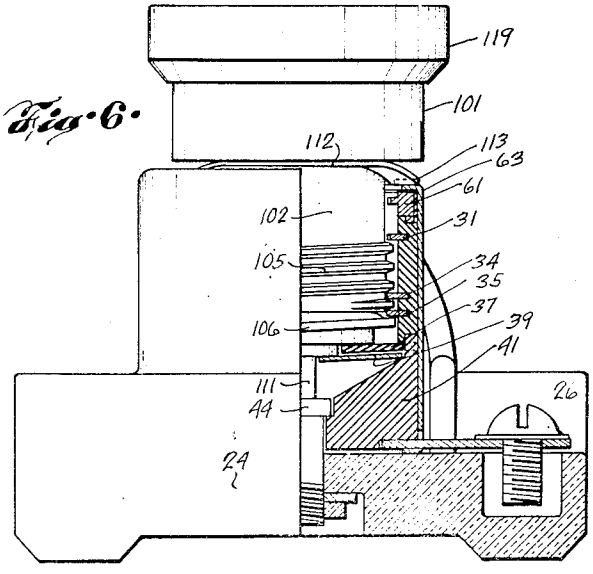


Fig. 6.



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ELECTRIC FUSE AND FUSE HOLDER

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Fig. 7.

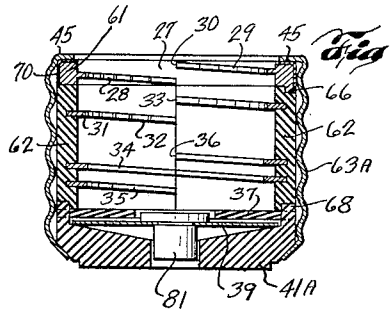


Fig. 8.

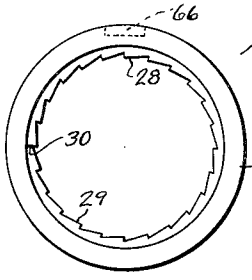


Fig. 9.

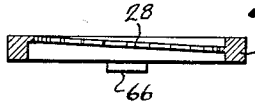


Fig. 10.

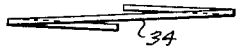


Fig. 11.

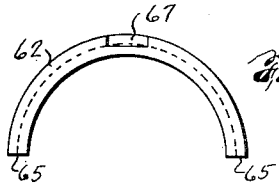


Fig. 12.

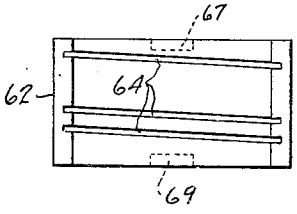


Fig. 13.

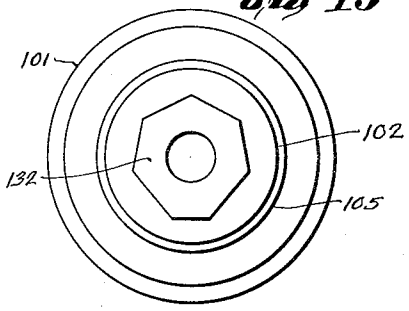


Fig. 14.

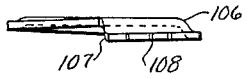


Fig. 15.

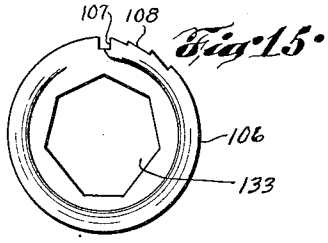
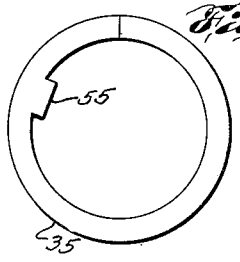


Fig. 16.



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UNITED STATES PATENT OFFICE

2,209,048

ELECTRIC FUSE AND FUSE HOLDER

Aloysius B. Bussmann, St. Louis, Mo.

Application July 20, 1936, Serial No. 91,492

44 Claims. (Cl. 200—119)

My invention relates to thermal protective devices designed to form part of an electric circuit for the purpose of protecting such circuit by interrupting the circuit when subjected to harmful overloads.

In referring to my invention, I use the terms fuse and fuse holder. It will be obvious to those versed in the art that a thermal cutout or circuit breaker or other form of protective device might be used in place of a fuse and my invention is intended to cover any form of electrical protective device capable of being associated with my fuse holder.

An object of my invention is to provide a fuse holder and a co-operating fuse which make difficult the bridging, shunting or shorting out of the fuse by a foreign electric conductor inserted in the holder in parallel with the fuse.

Another object of my invention is to provide a fuse holder and a co-operating fuse that make it difficult to use a fuse of greater carrying capacity than that for which the holder is designed.

Another object of my invention is to provide such fuse holder in the form of a receptacle. By receptacle I mean a fuse holder having permanently attached contact terminals for connection to the wiring of an electric circuit such as a fuse block, panel-board, fused switch and the like.

Another object of my invention is to provide such fuse holder in the form of an adapter for use in the Edison fuse holders already installed at the present time to permit of obtaining the above desired objects in old installations.

Another object of my invention is to provide a fuse assembly which permits of obtaining the above desired objects without impairment of the current-carrying, overload-blowing or short-circuit-protective operating characteristics required of standard fuses.

Another object of my invention is to provide such a fuse assembly which does not depend for its efficacy on dimensional exactitude of its correlating parts beyond what is ordinarily found in commercial manufacturing.

Another object of my invention is to provide a fuse which permits of obtaining the above desired objects which can be manufactured at a cost comparable to that of plug fuses such as are now in common use.

Other objects of my invention will more fully appear from the following description and accompanying drawings of devices embodying my invention in the forms now preferred by me, and will be pointed out in the claims.

Many of the users of electricity apparently do not appreciate the importance of the protection afforded by a fuse. Some of them feel that the blowing of a fuse is a waste of money. Others seem to feel that the inconvenience caused by a fuse blowing is not offset by the protection obtained. Still others will resort thoughtlessly to the use of a substitute when a fuse blows and they have no other to replace it. Even where owners fully realize the importance of the fuse, careless or thoughtless employees often resort to substitutes for fuses, sometimes to prevent their being inconvenienced by the blowing of the fuse, sometimes because of a desire to "economize" for their employer, or for other reasons.

Eliminating the blowing of fuses of course also eliminates the protection needed for electric circuits. Few of those who endeavor to prevent the blowing of fuses seem to realize the grave fire hazards created by their actions but records show that such actions result in losses amounting to millions of dollars of property annually and sometimes human lives.

The easiest way for the user to prevent or reduce the blowing of fuses is to use fuses of too large a size. A fuse having a carrying capacity greater than the carrying capacity of the circuit in which it is connected obviously cannot protect that circuit. Yet fuse receptacles in use up to the present time are so designed that the same receptacle will take many different sizes of fuses, so that a fuse of too great a current carrying capacity for many circuits can be inserted therein. In my new fuse and fuse holder, means are provided to make sure that when a fuse holder of the correct size is attached to the circuit, it is impossible to insert therein a fuse of too large a size.

Preventing the blowing of fuses by using substitutes is however still more hazardous. In such cases, the user may insert a metal disc, or a wire, or tin foil, or some of the metal parts of the fuse itself in such a manner that the fuse is partially or entirely eliminated from the circuit. What is particularly vicious is the fact that such substitution is made in the bottom of the fuse receptacle and in such a manner that, with the fuse installed, the tampering is not at all visible, so that, even if such particular electrical installation should be inspected, the inspector could not feel sure that proper fuse protection had been provided unless he removed each and every fuse from its receptacle and examined each of them.

Much has been done to design enclosed switches and fuse receptacle panels to make it practically impossible for the user to obtain access to any

connections that would permit him to install jumpers to by-pass, not alone the fuse, but the fuse receptacle as well. All of this, however, is useless if the fuse can be by-passed within the fuse receptacle itself.

The receptacles in use heretofore for holding the ordinary type of plug fuses are so made that it is a simple matter to insert a metal disc, such as a penny, in the receptacle and then by means of a fuse to hold such disc in place and thereby by-pass the fuse. This is prevented in my device.

Designing the fuse receptacle to prevent the use of such metal discs is however not sufficient. Fine wires such as the strands of a lamp cord, could be resorted to. Preventing the use of fine wires and metal discs is not sufficient because tin foil could then be employed as is already the practice with some of these short sighted users. Tin foil is always readily available. Its extreme thinness, flexibility and almost self-lubricating property makes it a reasonably easy matter to by-pass plug fuses known to the art up to the present time. My new fuse and fuse holder, however, makes it difficult or impossible to by-pass the fuse with either tin foil or wire and impossible to do so with a coin.

In the drawings,

Figure 1 is a view, in longitudinal section, through a receptacle embodying my invention,

Figure 2 is a view, in longitudinal section, through an adapter embodying my invention,

Figure 3 is a view in side elevation thereof,

Figure 4 is a view in side elevation of a fuse embodying my invention,

Figure 5 is a view in longitudinal section therethrough,

Figure 6 is a view, partially in side elevation of a fuse holder, with a fuse in position, both embodying my invention,

Figure 7 is a fragmentary view in longitudinal section of a fuse holder having a resiliently-supported center contact,

Figure 8 is a top plan view of a metal spacer and screw thread ring,

Figure 9 is a view in diametral section therethrough,

Figure 10 is a view in front elevation of a screw thread ring used in the tubular member shown in Figures 11 and 12,

Figure 11 is a top plan view of one-half of a tubular electric-insulating member constituting a part of the holder shown in Figures 1 and 2,

Figure 12 is a view, in front elevation, of the member shown in Figure 11,

Figure 13 is a bottom plan view of a fuse body,

Figure 14 is a view, in side elevation, of a screw disc adapted to be mounted on the fuse body of Figure 13,

Figure 15 is a bottom plan view thereof,

Figure 16 is a top plan view of a screw thread ring used in the tubular member shown in Figures 11 and 12.

Referring now to Fig. 1 of the drawings, I have there illustrated a receptacle having a block 24 of suitable electric insulating material having contacts 25, 26 for connection to the wiring of an electric circuit. The block and connections shown are of a form generally used for devices referred to as fuse blocks, but such block and connections may be of any suitable form such as might be necessary for a panelboard, fused switch and the like.

Near the top of the well 27 into which the fuse is to be inserted is a screw thread 28 which has a serrated inner edge 29 as will be seen more particularly by reference to Figs. 8 and 9 of the drawings. This screw thread extends through substantially one turn, but may be of slightly more or less than this peripheral extent. The leading end 30 of the screw thread is relatively abrupt or salient.

Slightly below this there is a screw thread 31 provided with saw teeth 32 in its inner edge and with a salient leading end 33.

Still further down in the well of the receptacle are two threads 34 and 35. These are shown as plain metal rings, but provided with a salient leading end 36.

At the bottom of the well is an insulating disc 37 having an aperture 38, and a resilient disc 39 provided with a central aperture 40. Beneath this disc is electric insulating material 41 with a recess 42 and provided with a central aperture within which is located contact member 44 to make electrical contact with the fuse. The other contact for the fuse is at 45.

The disc 39 as well as the threads 28, 31, 34, 35 are preferably all electrically insulated from each other and from the contacts 44 and 45.

Figs. 4 and 5 illustrate a fuse adapted to cooperate with the receptacle shown in Fig. 1. The fuse comprises a body 101 of electric-insulating material having a portion 102 adapted to fit within the receptacle and a shoulder 103 which does not enter the well 27 of the receptacle. At one end of the fuse is a contact member 111. At the shoulder 103 is a contact member 112 of U shape which extends partially annularly around the portion 102. Portions of this contact member 112 are located closely adjacent to the shoulder 103 while other portions thereof are bent away therefrom as shown at 113 to make this contact member resilient.

The contact members 111 and 112 extend into the body of the fuse and to their respective inner ends is attached a fuse link 117. While I have illustrated a simple fuse link, I do not desire to be limited thereto, as has hereinbefore been set forth. The fuse may include further a transparent disc 118 at the outer end held in place by a metal cover 119 as shown.

The body portion 102 is provided with screw threads 105, preferably integral with the body of the fuse.

At the lower portion 102 of the body there is provided a single screw thread 106 having a leading end 107 which is relatively abrupt and having the outer edge adjacent to this leading end provided with saw teeth or serrations 108 as shown in Figs. 14 and 15.

I preferably but not necessarily insulate the thread 106 from the contact 111.

It is to be noted that the external diameters of the screw threads on the fuse are but slightly less than the internal diameter of the well 27 and that the thickness of the threads on the fuse is but slightly less than the space in the threads 27, 31, 34, 35, whereby relatively small clearances are provided between the fuse and the receptacle. At the same time these clearances are not so small as to make it difficult to insert the fuse into the receptacle nor are they so small as to cause any extra cost in the manufacture of these devices.

The most commonly used method of bridging a fuse up until now has been by the use of a metal disc such as a penny. From what has been said, it is obvious that such a disc will not serve to bridge the fuse of my invention. If a disc were placed in the bottom of the receptacle

well 27, it would not make contact with the member 44. The presence of the disc would also prevent the fuse from entering the thread 35 which holds the fuse in position in the receptacle. Assuming that the fuse could be held in the receptacle in some manner, while a disc is in the well, there would be two gaps in the circuit, one from the member 44 to the bridging disc, another from the disc to the top contact 45. The difficulty of attempting to place conducting material in these gaps will be shown later. If the last mentioned gap were bridged, it would not be held in tight contact because the shoulder 103 or the contact 112 of the fuse would not be down far enough. Hence it would be necessary to place some material at this point to hold the bridging in contact. Such material would be in the open, where it would be quite plainly visible to inspectors, meter readers, service men and the like.

Another method of attempting to bridge the fuse might be by placing a strip of flat thin metal along the portion 102 of the fuse. Even though such strip were formed to fit the contour of the fuse body and the various threads as closely as possible, it would be found in turning the fuse body to engage the thread 28, that because of the relatively small clearance and because of the salient leading end 30 of this thread that the strip would probably be pulled out of position. However, assuming that the strip did get through this particular thread, it would then encounter the salient leading end 33 of the thread 31 where it would probably be pulled out of position. About that time also, the additional threads 105 on the fuse body would be engaging thread 28, adding to the strain on the metal strip and making it still more difficult to keep it in proper position.

If however, all of these difficulties were overcome, the strip must still stay in position when the thread 106 on the fuse body encounters the salient leading end 36 of threads 34 and 35 and must pass through the extremely small clearance in those threads. Assuming that this were possible, the strip would then have to be making tight engagement on the contact 111 because of its being insulated from the thread 106. During six, seven or eight revolutions of the fuse through all of these guards, the strip of metal would have to remain in position, if the attempt to bridge or shunt the fuse were to be successful. The strip would obviously be caused to take up a tortuous shape in the receptacle and between the receptacle and the fuse whereby the scraping, cutting or severing action at a number of points and the number of points at which this action takes place are both greatly increased.

It is also obvious that placing such a strip of thin metal in the receptacle and then attempting to insert the fuse would not in any wise decrease the difficulties of bridging the fuse in this manner, and that no different result could be looked for.

Another method of attempting to bridge the fuse might be to use fine wires, such as those found in flexible cords or lamp cords. Wrapping several of such fine wires around a portion of contact 112 of the fuse, then forming them to the contour of the fuse, over all the threads of the fuse and then around the contact 111, the next problem would be to screw the fuse into position so that such bridging would extend from the contact 44 to the contact 45 on the receptacle. Here again it would be found in turning the fuse body to engage the thread 28, that because of the relatively small clearance and more particularly because of the salient leading end of this thread, that the wires would probably be pulled out of position. If they did get past the salient leading end of the thread, the wires would still have to pass over the saw tooth serrations 29 on this thread, each tooth of which would be a considerable hazard for such wires.

If one succeeded in getting these fine wires past these hazards, the wires would be released as soon as the thread 106 of the fuse passed out of the thread 28. Being discontinuous, the threads in the receptacle do not hold such bridging material tightly in position to thereby be assisted in passing thru the next thread. At each revolution of the fuse such material is passed over the hazards of one of these threads, then released and then again subjected to a new hazard.

After passing out of the thread 28, the salient leading end 33 and the teeth 32 entirely around the inside of the thread 31 would then be encountered and if there should be any one of the wires remaining in position, it may be assumed that the salient leading end 36 of the threads 34 and 35 would sever it. Even if a wire got through here, it would still have to pass through the extremely small clearance between these threads in the receptacle and the thread 106 on the fuse. It is therefore easy to see how extremely difficult it would be for any wires to have remained intact during the six, seven or eight revolutions of the fuse necessary to put it in position. The exact number of revolutions depends of course on the pitch of the threads used, which preferably would be 12, 14 or 16 to the inch. The portion 102 being approximately one half inch long, the number of revolutions would have to be as stated.

If the fine wires previously referred to were wrapped around the body of the fuse, instead of being formed to the longitudinal contour of the fuse, no better result could be expected by the "bridger" because the threads 105 on the portion 102 would push the wires into engagement with the various salient leading ends of the threads in the receptacle and with the saw teeth serrations on these various threads so that during the entire period of each revolution, these wires would be subjected to a tearing, cutting or severing action.

In this connection, it must be borne in mind that the very natural unsteadiness of anyone attempting to screw in the fuse with bridging would serve to constantly cause the fuse and the bridging material to be pushed against these various hazards. The more the fuse and bridging material might be held, for a moment, away from one hazard the more it would be pushed against the hazard on the opposite side of the receptacle. There is nothing in this device to serve to steady the hand of the "bridger." From the moment he attempts to engage the first screw thread 28 until the fuse is finally in position it is moving from one side to the other and not being guided or held away from any of the hazards created for any of the bridging material or methods that might be used.

If the fine wires previously referred to were placed in position in the receptacle before any attempt were made to put the fuse in position, it is easy to see that the difficulties encountered in attempting to bridge the fuse would be just as great, if not greater, than those already mentioned.

One more method that might be tried to bridge

a fuse would be by means of metal foil. It might be wrapped carefully and tightly around the portion 102 of the fuse or applied to the fuse in many different ways or might be inserted in the receptacle well 27. It will be noted however, that no matter how it is applied, it will be subjected to the same severing, cutting, tearing and scraping action at almost every point in the entire inserting operation as above outlined. Tests show that such foil is cut up into many fine particles. Sometimes, after such an attempt, it is possible to get a small amount of current through the bridging for just a flash. The foil however, will have been so badly cut up that the carrying of any reasonable amount of current for more than a moment is impossible.

An additional safeguard is included that applies particularly when metal foil is used. I refer to the resilient disc 39 at the bottom of the receptacle well. This disc is flat when the fuse is not in position. It has an aperture 40 of almost the same diameter as the contact 111 which passes through it. The small aperture, plus the fact that there is a recess 42 between the insulating material 41 and the disc 39 when the fuse is out of the receptacle, makes the filling or partial filling of the space down to the contact 44 extremely difficult. A very small tool would have to be used to get into the aperture and infinite patience and care would have to be exercised to get enough foil, solidly packed, within this space to be of any help in bridging the fuse holder or the fuse. Naturally, even if the space referred to were filled solidly with foil, it would still be necessary to bridge all of the balance of the fuse holder well, or all of the portion 102 of the fuse.

This disc 39 is left loose and is made resilient. Drilling the aperture larger is practically impossible because of the resilient nature of the disc and because it is not tightly held in position. Furthermore, if this disc were tightly held in position, or were not resilient, it would often be impossible to insert the fuse in the receptacle, because the natural variations that occur in manufacture and assembly would result very often in the contact 111 not being exactly in line with the aperture 40. As it is, the contact 111 of the fuse often engages the top of the disc, but the disc being left loose and being resilient, the pressure applied by screwing in the fuse pushes down the disc and moves it laterally so that the fuse contact can enter in spite of the very small clearance, and make proper electrical contact on contact 44.

If an attempt were made to bridge the fuse, without inserting the fuse into the receptacle as far as it should go, it would not of course enter the threads 34, 35 which are the means for holding the fuse sufficiently tightly in position to make good electrical contact. No matter how much foreign material might be used in attempting to bridge a fuse, good contact would be necessary to prevent useless interruptions caused by the heating of such contact from the current normally flowing in the circuit. Hence, putting the fuse loosely in position with such bridging material would avail nothing. If it were possible to put it in tightly, with such bridging material, without turning the fuse the full six, seven or eight revolutions, the contact 112 or the shoulder 103 the fuse would not be down far enough to insure the bridging material being in contact with the contact 45 of the receptacle, so that some additional material would have to be used on the outside of the receptacle, where it would be plainly visible.

The devices embodying my invention thus provide a tamper-proof fuse and fuse holder which make it extremely difficult to short circuit the fuse link or to substitute for a blown fuse any foreign electric conductor, the receptacle being provided with means for severing the continuity of a foreign electric conductor located on a fuse screwed into the receptacle and the fuse being provided with means for severing the continuity of a foreign electric conductor inserted in the receptacle before the plug is operatively associated therewith.

It is obvious that the substitution for a fuse of proper capacity of a fuse having a smaller current carrying capacity will not constitute a fire hazard or endanger the energy translating devices which may be protected thereby; but it is desirable that the design and construction of the various plug fuses be such as to prevent the insertion in the fuse holder of a fuse having a fuse link therein of a greater continuous current carrying capacity than that of the circuit in which it is connected.

I therefore use different threads on different sizes of fuses which should not be interchangeable. For example, I may use 16 pitch threads on fuses up to 6 amperes, 14 pitch on fuses from 7 to 15 amperes and 12 pitch on fuses from 20 to 30 amperes. I may also use left hand threads or double pitch threads on some sizes and thus obtain further differentiation. Corresponding changes in the screw threads of the fuse holder must, of course, be made so that fuse and fuse holder may cooperate properly.

In addition to this, I may use stop lugs in the bottom of the receptacle well, to further limit the size fuse that might be used in receptacles designated for amperages of certain limits. I accomplish this by providing on the lowermost screw thread 35 a stop lug 55, as shown in Fig. 16. This lug is located in a predetermined position axially of the receptacle. The leading end 107 of the screw disc 106 is adapted to abut against the leading side of stop lug 55 when the fuse has been screwed into the receptacle. If the leading end of the screw disc 106 on a certain size fuse abuts against the stop lug before the member 111 is in contact with the member 44, it is obvious no current will flow and such fuse would be useless in such receptacle.

For example, if I use 14 pitch threads on 7 to 15 ampere fuses I may put a stop lug on receptacles intended for fuses not larger than 8 amperes. In that event I lengthen the contact 111 on 8 ampere fuses, so that when the screw disc 106 abuts on the stop lug, the longer contact 111 will be in contact with the member 44 and be in operative position. The 15 ampere fuse having the same threads could be inserted in the same receptacle, but having a shorter contact 111 would not be able to make contact with the member 44, because its screw disc 106 would be stopped by the stop lug and prevent the fuse being screwed down all the way. 10 ampere receptacles might be arranged with the stop lug in a slightly different position and with the contact 111 slightly shorter than that of the 8 ampere fuse but longer than that of the 15 ampere one.

Thus, another method of preventing the use of incorrect sizes of fuses is provided at practically no cost.

It is obvious that several different forms of construction might be used in building fuses and

fuse holders embodying my invention. I have shown the form of construction preferred by me at this time. In this construction, the fuse holder comprises a metal ring 61, two semi-annular members 62 of electric-insulating material and a disc 41 of electric-insulating material held together by a metal shell 63. The members 62 are shown particularly in Figs. 11 and 12 of the drawings. Each is provided with peripheral grooves or recesses 64 in the body thereof at the inside surface. The axial location of these peripheral recesses varies slightly in the two members, to the end that they may match properly, when the two members are placed in abutting position to hold the relatively thin metallic sheared rings 31, 34 and 35 in screw-thread formation. The axial spacing of these grooves is such that the latter constitute, when assembled in the grooves, an interrupted helical screw thread, of which screw thread 28 also forms a part. The ends 33, 36 of the respective screw threads 31, 34 and the leading end of the screw thread 28 are adapted to be located in peripheral alignment as shown in Fig. 2 with one of the diametral faces 65 of the semi-annular member 62, as is shown in Fig. 11 of the drawings. The initially flat rings 31, 34, 35, will then have the shape shown in Fig. 10 of the drawings, the axial distances between the two ends of the ring corresponding to a predetermined pitch. Instead of using continuous screw threads, I may use interrupted screw threads comprising properly spaced projecting lugs. The leading ends of the screw threads may be considered as projecting lugs.

The metal ring 61 having the screw thread 28 formed on its inner surface is made heavy and relatively long axially, the proportion of its axial length to the total length of the holder being substantially that shown in the drawings. The purpose of this is to prevent partial destruction of the fuse holder which might permit of bridging of the fuse or the use of an over-size fuse. The size of the ring is such that destruction thereof is difficult if not impossible. Removal thereof from the shell 63 will leave all the remaining parts loose in the shell, particularly the members 62 holding the threads 34, 35, thus preventing the holding of the fuse in the fuse holder in operative position. There would be nothing then to hold the fuse in tight contact with the contact 44 and the resilient disc 39 would even push the fuse away from such contact member. This ring is provided with an axially extending lug 66 at one side adapted to fit into a recess 67 provided in one of the semi-annular members 62 in order that the member 61 may have a definitely fixed position relative to the tubular body comprising the two portions 62. The ring 61 is preferably insulated from the shell 63 by insulation 70 in the form of an insulating washer or a coating of insulating paint, so as to insulate this ring from the contact 45.

The insulation material 41 is in the form of a disc and has an axially extending lug 68 to interfit with recess 69 on member 62. This construction enables members 61, 62 and 41 to be held together as a single unit in which rotation of any one of the members relative to the other is prevented.

Seated thereon is the resilient disc 39, preferably but not necessarily of metal, which when the fuse is in position is pressed down in the recess 42.

The shell 63 is turned over the ring 61 to form the upper contact 45 of the fuse holder. It is obvious that this contact need not be continuous and need not extend through substantially 360 degrees.

In building my preferred construction of the fuse, I provide a metal washer 130 between the contact 111 and the screw disc 106 which metal washer is covered by insulation 131 in the form of an insulating washer or a coating of insulating paint, so as to insulate the screw disc from the bottom contact. This washer is of course held by the bottom contact 111.

It is obvious that manipulation of the fuse body itself might be attempted to bridge the fuse. It is for this reason that I prefer the fuse body of a frangible material, such as porcelain, so that operation thereon will soon damage it beyond possibility of use in the receptacle in any way that would make the bridging operative.

The fuse body has a short projecting inner end 132 which may have an irregular polygonal periphery as is shown in Fig. 13 of the drawings. The screw disc 106 is provided with an opening 133 of the same contour as the end 132 so that the disc will fit in a definite position thereon. It will be obvious that the polygonal end 132 on the fuse body must be definitely located relatively to the threads 105 and that the polygonal opening 133 must be definitely located relative to the thread on the disc 106 in order that the single screw thread on the screw disc cooperates properly with the screw thread 105 to constitute a single helical screw thread.

Where fuses having different threads are used, the projecting ends 132 of the bodies are of different contours, the polygons having different numbers of sides, and the screw discs different openings 133 to fit the projecting ends of the bodies.

I may also arrange for a movable circuit breaking contact member at the bottom of the receptacle well 27, as shown in Fig. 7 by attaching to the resilient disc 39 substantially centrally thereof a contact member 81 of such size that when the fuse is out of position and the disc is flat, this contact will be out of engagement with contact member 44, but when the proper fuse is in place, this contact will be in close engagement with the contact member 44. This disc is preferably so made that it has sufficient strength to prevent the contact 81 from being held in contact with the contact 44 by the pressure of bridging material which might be packed in the fuse holder. This adds to the difficulty of bridging as it would make necessary not only bridging between contact 81 and 45, but holding the spring disc down as well.

To permit of my invention being used in old installations, I may make my fuse holder in the form of an adapter designed to permit the use of my fuse in plug fuse receptacles already installed. This adapter is shown in Figs. 2 and 3. It will be noted that instead of the plain shell 63, I use a screw shell 63A which holds in place parts similar to those that constitute the fuse holder in my receptacle shown in Fig. 1 except part 41. Instead of part 41 I use a part 41A of slightly different shape which serves the same purpose. The shell 63A is turned over the ring 61 and is also turned over against the lower angularly inclined surface 73 of disc 41A whereby the semi-annular members 62, the upper ring 61, the insulating disc 37, the resilient disc 39 and the insulation disc 41A are held in tightly assembled operative positions relative to each other to make a solid, compact unit for easy insertion in old

receptacles. The adapter has attached thereto some form of locking means whereby withdrawal of the adapter from the receptacle is prevented after it has once been inserted therein, as shown at 74.

Where I use the term "bridging a fuse" in the specifications and claims, I mean the bridging of the terminal contacts of the fuse or of the fuse holder whether or not the fuse link is blown. Where I use the words "fuse holder" it is to be understood that this term covers an adapter as well as a receptacle.

Various modifications may be made in the devices embodying my invention without departing from the spirit and the scope thereof, and I therefore desire that all such modifications shall be covered by the appended claims, which are to be limited only by the prior art.

I claim as my invention:

1. A plug fuse having a body adapted to be operatively engaged with a fuse holder by relative rotary movement, said fuse having means extending abruptly and substantially radially from the lateral surface of the body to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

2. A plug fuse adapted to be operatively engaged with a fuse holder and having an abrupt projection extending laterally outwardly from the fuse to engage with and impair the conductance of a foreign electric conductor positioned to bridge the fuse while being engaged operatively with the fuse holder.

3. A plug fuse adapted to be operatively engaged with a fuse holder and a toothed member extending laterally outwardly from the fuse to engage with and impair the conductance of a foreign electric conductor positioned to bridge the fuse while being engaged operatively with the fuse holder.

4. A plug fuse having a body adapted to be operatively engaged with a fuse holder, a fuse link substantially enclosed in said body, axially spaced contact members extending through the walls of the body and transversely projecting means on the body positioned axially between the contact members to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

5. A plug fuse adapted to be operatively engaged with a fuse holder by relative rotary movement, said fuse having means extending laterally outwardly therefrom comprising an abrupt leading surface to engage with and impair the conductance of a foreign electric conductor positioned to bridge the fuse while being engaged operatively with the fuse holder.

6. A plug fuse having a body adapted to be inserted in a fuse holder, a member on the body extending approximately laterally outwardly from the peripheral surface thereof and having an uneven outer surface to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

7. A plug fuse adapted to be operatively engaged with a fuse holder and a member carried by the fuse adapted to engage a thread on the fuse holder and having an abrupt projection thereon adapted to engage with and impair the conductance of a foreign electric conductor positioned to bridge the fuse while being engaged operatively with the fuse holder.

8. A plug fuse having a body adapted to be inserted in a fuse holder by relative rotary movement, said fuse having means projecting substantially radially outwardly from the peripheral surface of the body comprising an abrupt leading edge to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

9. A plug fuse having a body adapted to be inserted in a fuse holder by relative rotary movement, said fuse having a disc on the body with an abrupt radially-extending portion constituting a leading edge in the rotary movement to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

10. A plug fuse having a body adapted to be inserted in a fuse holder, said fuse having means projecting substantially radially outwardly from the peripheral surface of the body adapted to hold the fuse in a fuse holder, said holding means being designed and constructed to break, during insertion of the fuse in the fuse holder, the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

11. A plug fuse having a body adapted to be inserted in a fuse holder, said fuse having a disc-like member projecting radially outwardly beyond the peripheral surface of the body adapted to hold the fuse in a fuse holder and to break, during insertion of the fuse in a fuse holder, the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

12. A plug fuse having a body adapted to be inserted in a fuse holder, said fuse having a screw-disc projecting outwardly beyond the outer peripheral surface of the body adapted to hold the fuse in a fuse holder, said screw disc having an abrupt leading edge to break, during insertion of the fuse in a fuse holder, the continuity of a foreign electric conductor positioned to bridge the fuse within a fuse holder.

13. A plug fuse including a body, axially-spaced contact members thereon, one of which is of relatively short axial extent exteriorly of the body and means adapted to break the continuity of a foreign electric conductor positioned to bridge the fuse within a holder when the fuse is fitted therein, said breaking means extending radially to a distance from the axis of the fuse intermediate in value between the radial distances to which the respective contact surfaces extend and axially positioned between said contact surfaces.

14. A plug fuse as set forth in claim 9 in which the disc has inter-fitting engagement with a portion of the body.

15. A plug fuse having a body adapted to be inserted in a fuse holder, said fuse having a disc-like member projecting beyond the outer peripheral surface of the body adapted to hold the fuse in the fuse holder, said disc-like member having interfitting engagement with a portion of the body and having component parts of different radii and of different axial displacement to break, during insertion of a fuse in a fuse holder, the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

16. A fuse holder comprising a shell of electric-insulating material and a discontinuous screw thread held by the insulating shell and adapted to hold a plug fuse in the fuse holder.

17. A fuse holder comprising a shell of electric-insulating material and a discontinuous screw thread held by the insulating shell and having abrupt leading ends adapted to break the continuity of a foreign electric conductor positioned to bridge a fuse within the fuse holder.

18. A fuse holder comprising a shell of electric-insulating material and a series of discontinuous screw threads held by the insulating shell, one of said screw threads being adapted to hold a plug fuse in the fuse holder and one of said screw threads having an abrupt leading end adapted to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

19. A fuse holder comprising a shell of electric insulating material, a metal ring at one end thereof, an apertured disc of electric-insulating material at the other end of the shell, a metal shell enclosing said shell of insulating material and said metal ring and clamping them and said disc together and a discontinuous screw thread supported by the insulating shell and adapted to hold a fuse in the fuse holder, said metal ring having means thereon comprising a screw thread having an abrupt leading end thereon adapted to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

20. A fuse holder comprising a shell of electric insulating material, a relatively thick metal ring having a screw thread thereon and positioned at one end of said insulating shell, an apertured closure disc of electric-insulating material at the other end of said shell, relatively thin split metal rings supported by said shell and cooperating with the screw thread on the metal ring to form an interrupted screw thread, and a metal shell clamping together said metal ring, insulating shell and closure disc, said metal rings being insulated from said metal shell and from each other.

21. A fuse holder comprising a shell of electric-insulating material, a metallic member in the side wall of said shell adapted to detachably hold a plug fuse in the fuse holder, said metallic member being free of current flow therethrough.

22. A fuse assembly comprising in combination, a fuse holder and a plug fuse insertible in the fuse holder, said holder and fuse each having a discontinuous screw thread adapted to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

23. A fuse assembly comprising in combination, a fuse holder and a plug fuse insertible in the fuse holder, said holder having a discontinuous screw thread and said fuse having means cooperating with the screw thread adapted to detachably hold the fuse in the fuse holder and to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

24. A fuse assembly comprising in combination, a fuse holder member and a fuse member adapted for co-operative inter-fitting engagement with the fuse holder member, one of said members having a projection on an axial face adapted to catch in the surface and break the continuity of a foreign electric conductor positioned to bridge the fuse within the holder.

25. A fuse assembly comprising in combination, a fuse holder, and a fuse insertible in the fuse holder, said holder and fuse respectively including a discontinuous screw thread having means cooperating with each other to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

26. A fuse assembly comprising in combination, a fuse holder, a fuse, screw threads carried by the fuse holder and the plug cooperating to cause interfitting engagement thereof and stop means on the respective screw threads cooperating with each other to limit the degree of such interfitting engagement.

27. A fuse assembly comprising in combination, a fuse holder, a fuse, cooperating screw threads on the fuse holder and on the fuse to effect removable closely interfitting engagement thereof and means on the cooperating screw threads comprising saw teeth thereon, operable by relative turning movement of the holder and the fuse to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

28. A fuse assembly comprising in combination, a fuse holder having a succession of discontinuous screw threads therein, each of said screw threads being relatively thin in an axial direction and having relatively abrupt leading ends, and a fuse having a screw disc at its entering end, said screw disc having a relatively abrupt leading end to cooperate with the respective leading ends of the interrupted screw threads to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

29. A fuse assembly comprising in combination, a fuse holder comprising a shell of electric-insulating material, a plurality of axially-spaced discontinuous screw threads supported by the shell and projecting radially inwardly therefrom, a metal ring at the outer end of the shell having an inwardly extending screw thread integral therewith, certain of said sets of screw threads having an abrupt leading end, an apertured closure plate of electric-insulating material at the inner end of said shell and a metal shell clamping the closure plate and the metal ring against the shell of insulating material and a fuse having a screw threaded body portion adapted to be screwed into the holder and comprising a metal screw disc having an abrupt leading end cooperating with the leading ends of the discontinuous screw threads in the fuse holder to break the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

30. A fuse assembly comprising in combination, a fuse holder having non-current-carrying screw threads, one of which has a radially-inwardly extending projection thereon and a fuse adapted to be screwed into the fuse holder and comprising a center contact of predetermined axial length, and a metal screw disc having a leading end adapted to engage the projection on the screw thread in the fuse holder to limit the degree of interfitting movement of the fuse and fuse holder.

31. A fuse assembly comprising a fuse holder and a fuse adapted to be screwed into said holder, the fuse holder and the fuse respectively including a plurality of lugs located adjacent to the inner and to the outer peripheral surfaces thereof to plurally break during relative rotary movement of the fuse and fuse holder, the continuity of a foreign electric conductor positioned to bridge the fuse within the fuse holder.

32. A fuse assembly comprising a fuse holder including a plurality of lugs spaced both peripherally and axially thereof at its inner periphery and a fuse adapted to be screwed into the fuse holder and including a plurality of lugs spaced peripherally and axially thereof at its outer periphery, said lugs in the fuse holder and on the fuse interfitting closely with and moving

past each other when the fuse is screwed into the holder to break at a plurality of places a foreign electric conductor positioned to bridge the conductor within the fuse holder.

33. A fuse assembly including a fuse holder comprising a body of electric-insulating material and a plurality of axially spaced projections extending inwardly of the body and a fuse adapted to fit into the fuse holder and comprising a projection extending outwardly from the fuse at its leading end and cooperating with the projections in the body of the holder to break, at a plurality of spaced points, the continuity of a foreign electric conductor inserted in the fuse holder, when the fuse is fitted into the holder.

34. A fuse holder assembly comprising a plurality of insulation members, metallic screw threads fitted in the insulation members and means exterior of the insulation members and metallic screw threads adapted to hold the insulation members and metallic screw threads in position.

35. In an enclosed tamper-resistant fuse adapted to fit in a tamper-resistant fuse-holder, a body of insulation material, a contact projecting through the base, a contact projecting through an upper part of the body, remote from the base, said contacts being so arranged that a fuse link may be fitted in series therebetween within the body, said contacts being so spaced apart axially on the outside of the body as to leave a wide space of insulation around the body which can be left exposed to aid in preventing tampering, holding means on said space around the body arranged on the relative rotation of fuse and fuse-holder to co-act with means on a fuse-holder to hold their contacts in engagement, and abruptly extending means on the outside of the fuse to impair, during such rotation, the continuity of foreign electrical conducting material positioned between fuse and fuse-holder to bridge the fuse.

36. In an enclosed tamper-resistant fuse adapted to fit in a tamper-resistant fuse-holder, a body of insulation material, a fuse link within the body, a contact extending through the base to the bottom thereof, a contact extending through an upper part of the body remote from the base, said contacts on the outside of the body being so spaced apart axially as to leave a substantial band of insulation around the body which can be left uncovered to aid in preventing tampering, holding means on said band arranged, on the relative rotation of fuse and fuse-holder, to co-act with means on a fuse-holder to hold their contacts in engagement, and abruptly extending means on the outside of the fuse to impair, during such rotation, the continuity of foreign electrical conducting material positioned between fuse and fuse-holder to bridge the fuse.

37. In an enclosed tamper-resistant fuse adapted to fit in a tamper-resistant fuse-holder, a body of insulation material, a contact through the base and a contact through an upper part of the body, remote from the base; the contacts being so arranged that a fuse link may be fitted in series therebetween within the body; the contacts on the outside of the body being so spaced apart axially as to provide a relatively wide space of insulation around the body which can be left uncovered to aid in preventing tampering; threaded holding means, substantially free from current flow therethrough, on said space, adapted to co-act with threaded holding means on the fuse-holder, whereby the frictional engagement between the threads on fuse and fuse-holder may, by substantial relative rotation thereof, impair the continuity of foreign electrical conducting material positioned between fuse and fuse-holder to bridge the fuse, while bringing the contacts on the fuse into electrical connection with contacts on the fuse-holder.

38. An enclosed fuse arranged to resist the bridging thereof and adapted to be fitted into a tamper-resisting fuse-holder; said fuse comprising a body of insulation material, a fuse link within the body, a contact extending through the base thereof and a second contact extending through an upper part of the body and remote from the other contact; the contacts being so spaced axially on the body as to leave a substantial band of insulation between the contacts, a disruptive means on the outer periphery of the body so arranged that, on rotation of the fuse in the fuse-holder, the continuity of foreign electrical conducting material placed between fuse and fuse-holder to bridge the fuse may be impaired, and holding means between the contacts free from current flow therethrough, arranged to co-act with means on the fuse-holder to hold the fuse contacts in engagement with those on the fuse-holder.

39. An enclosed fuse adapted to be fitted into a tamper-resistant fuse-holder; said fuse having a body of insulation material, a fuse link within the body, a contact projecting through the base thereof, a contact projecting through an upper part of the body; the contacts being so spaced axially on the body that a substantially wide space around the body of insulation can be left exposed, and holding means on the outside of the fuse between the contacts and free from current flow therethrough, and having a sharp surface at an angle to the line of rotation of the fuse, so arranged that, on rotation thereof, such holding means may co-act with means on the fuse-holder to break the continuity of foreign electrical conducting material positioned between fuse and fuse-holder to bridge the fuse and to hold the contacts in engagement.

40. An enclosed fuse adapted to be fitted into a tamper-resistant fuse-holder; said fuse having a body of insulation material, a fuse link within the body, a contact projecting through the base, a contact projecting through an upper part of the body, remote from the other contact, the contacts being so spaced apart axially that a relatively wide band of the insulation around the body can be left exposed, and a projecting member on the outside of the fuse, independent of at least one contact, so arranged on rotation thereof in a fuse-holder as to co-act with means on a fuse-holder to impair the continuity of foreign electrical conducting material positioned between fuse and fuse-holder to bridge the fuse, and holding means between the contacts arranged to co-act with holding means on a fuse-holder to hold the contacts in engagement.

41. In an enclosed tamper-resistant fuse-holder adapted to detachably hold a tamper-resistant fuse in an electric circuit, a hollow body of insulation material, a contact projecting through the base, a contact on an upper part of the body remote from the base; said contacts being so spaced apart axially as to leave a substantial band of insulation on the inside wall of the body which can be left uncovered to aid in preventing tampering, holding means between

the contacts arranged, on the relative rotation of fuse and fuse-holder, to co-act with means on a fuse to hold their contacts in engagement, and abruptly extending means on the inner wall of the fuse-holder, to impair, during such rotation, the continuity of foreign electrical conducting material positioned between fuse and fuse-holder to bridge the fuse.

42. In an enclosed tamper-resistant fuse-holder adapted to detachably hold a tamper-resistant fuse in an electric circuit, a hollow body of insulation material, a metallic outer shell arranged to fit into a standard Edison screw socket, a contact projecting through the base, a contact on an upper part of the body remote from the base; said contacts being so spaced apart axially as to leave a substantial band of insulation on the inside wall of the body which can be left uncovered to aid in preventing tampering, holding means between the contacts arranged, on the relative rotation of fuse and fuse-holder, to co-act with means on a fuse to hold their contacts in engagement, and abruptly extending means on the inner wall of the fuse-holder, to impair, during such rotation, the continuity of foreign electrical conducting material positioned between fuse and fuse-holder to bridge the fuse.

43. A fuse assembly, arranged to resist tampering, comprising two members, each having a body of insulating material; one an enclosed fuse and the other a fuse-holder adapted to detachably hold the fuse in an electric circuit; in each member a contact projecting through the base and a contact on the upper part of the body remote from the base; said contacts being so spaced apart axially as to leave a substantially wide band of insulation around the body which can be left uncovered, means between the contacts on each member substantially free from current flow therethrough, arranged to co-act upon a relative rotation of the members to bring their contacts into engagement, and to impair the continuity of foreign electrical conducting material positioned between the members to bridge the fuse.

44. A fuse assembly, arranged to resist tampering, comprising two members, each having a body of insulating material; one an enclosed fuse and the other a fuse-holder adapted to detachably hold the fuse in an electric circuit; in each member a contact projecting through the base and a contact on the upper part of the body remote from the base; said contacts being so spaced apart axially as to leave a substantially wide band of insulation around the body which can be left uncovered, means between the contacts on each member substantially free from current flow therethrough, arranged to co-act upon a relative rotation of the members to bring their contacts into engagement, and means on the members co-acting to impair the continuity of foreign electrical conducting material positioned between the members to bridge the fuse.

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