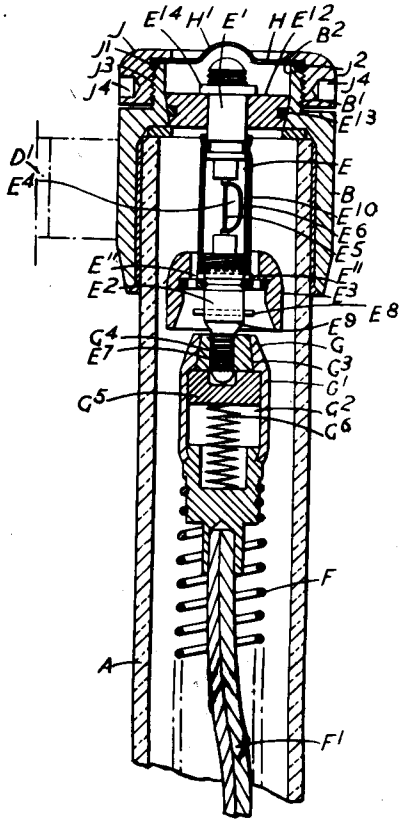
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ELECTRIC FUSES AND RELEASABLE CONNECTORS

Filed April 27, 1948

FIG. 1.



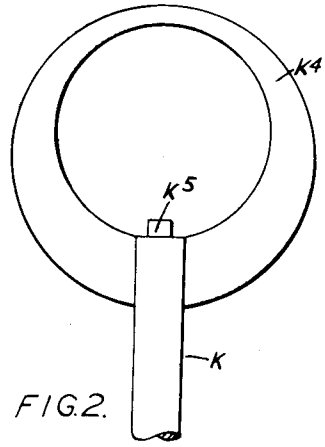
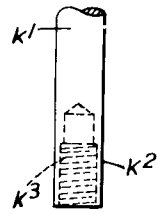
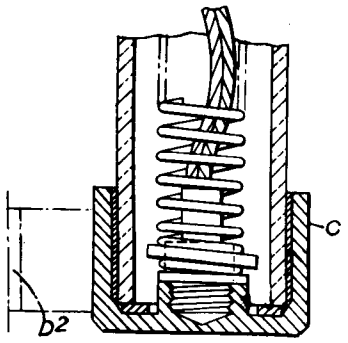


FIG. 2.





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ELECTRIC FUSES AND RELEASABLE CONNECTORS

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This invention relates to electric fuses and releasable connectors, and in particular, though not exclusively, to releasable connectors for high voltage electric fuses or cut-outs of the spring-separated type.

One feature of this invention concerns the removal and replacement of a fuse link. In this type of fuse, after a fault has been cleared, it is necessary to remove the blown fuse link and replace it with a new one. This has most commonly been performed in the past by returning the complete fuse carrier to the makers and substituting a spare fuse carrier. Naturally, this involves the user in keeping a stock of spare fuse carriers, which is generally undesirable, especially if a number of different types or sizes are employed. Proposals have therefore been made to provide an arrangement in which the new fuse link can be inserted in the fuse carrier by the user. One object of the present invention is to provide a particularly simple and convenient solution to this problem.

According to one feature of the present invention, a fuse of the spring-separated type includes releasable connecting means comprising two parts to be mechanically connected together, movable towards and away from each other in the directions of insertion and withdrawal respectively, including means for connecting them engaged by a spring acting in the direction of withdrawal and released by relative movement of the parts beyond their normal position in the direction of insertion, and delay means such as a dash-pot serving to delay the action of the spring and permit withdrawal if performed with sufficient rapidity.

The connecting means may comprise male and female members whereof the female member is in the form of a chuck comprising two or more jaws having tapered surfaces engaging a co-operating tapered surface relatively to which they are urged axially by a spring.

Thus according to one embodiment of the invention a fuse of the spring-separated type includes a releasable connector comprising male and female parts to be mechanically connected, whereof the female part includes a chuck comprising a cylinder having a bore with a cylindrical portion and a tapered end portion, jaws having outer conical surfaces corresponding to and engaging the tapered portion of the cylinder bore, a piston in the cylindrical part of the bore and abutting the ends of the jaws, the fit of the piston in the cylinder being such as to slow down the closing of the jaws and permit the male part of

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the connector to be withdrawn promptly after being moved beyond its normal position in the direction of insertion to open the jaws.

The male portion may have circumferential grooves or a screwthread cut in its surface to enable the jaws to hold it firmly against unintentional withdrawal.

Although primarily designed for a fuse of the spring-separated type, the improved connecting means may be employed for any purpose requiring a releasable connector, for which it is suitable.

In one form of the arrangement, each of the terminals at opposite ends of the fuse link is formed at its end remote from the separating spring for engagement, by screw threads or otherwise, by an inserting and withdrawing tool, so that either a complete fuse link or one end of a parted fuse link can be inserted into or withdrawn from the carrier.

The terminal of the fuse link remote from the separating spring is preferably formed for engagement by a split collar which seats in the end contact of the fuse carrier, and when applied to the fuse link terminal after the separating spring has been extended, holds that contact in its proper position in the fuse carrier.

The invention may be carried into practice in various ways, but one specific embodiment will be described by way of example, with reference to the accompanying drawings, in which

Figure 1 is a sectional elevation of a liquid-filled fuse embodying the invention; and

Figure 2 shows a withdrawing and inserting tool for use with the fuse of Figure 1.

In the particular embodiment shown in Figure 1, the invention is applied to a high-voltage liquid-filled fuse of known type, contained in an outer heat-resisting glass tube A having metal contact ferrules B and C secured at each end. Each contact ferrule is of circular cross-section, with a pair of parallel and opposite flat surfaces formed on its sides, by means of which the fuse is held in the usual fixed contacts D^1 and D^2, shown in broken lines in Figure 1. The tube A is normally arranged substantially vertically with a fuse link in the upper end.

An upper terminal E^1 of a fuse link E is mechanically supported by and electrically connected to the upper ferrule B, while a lower terminal E^2 of the link is subjected to the pull of a strong Phosphor bronze helical separating spring F, the lower end of which is secured to the lower contact ferrule C. The spring F is shunted by a tinned copper flexible conductor F^1 which carries the current. The tube A is filled with

an arc extinguishing liquid such as carbon tetrachloride, and the lower terminal E^2 of the fuse link is surrounded by a liquid guide or loose-fitting piston nozzle E^3 which directs a jet of liquid into the path of the arc.

The element E^4 of the fuse link E comprises a relatively high-resistance wire E^5 of high tensile strength, which takes the tension of the spring F, and, shunting the wire E^5, a loop of wire E^6 of silver which normally takes practically all the current.

The upper end of the separating spring F is secured to a chuck G which forms the female member of a releasable connector. The lower end of the fuse link terminal E^2 is formed with a pin E^7 having circumferential rings or a screw thread on its surface and a tapered shoulder E^9 at its upper end where it joins the body of the terminal. The pin E^7 forms the male member of the connector, and is received by the chuck G. Each terminal E^1 and E^2 is formed near its upper end with a male screw thread, so that it can be engaged by an inserting and withdrawing tool shown in Figure 2 and described later.

The chuck G comprises a cylinder G^1 having a bore with a lower cylindrical portion G^2 and an upper conical portion G^3. Within the latter are two or more jaws G^4 having outer conical surfaces corresponding with the conical portion G^3 of the bore, while beneath the jaws, within the cylindrical portion G^2 of the bore, is a piston G^5 which bears against the under side of the jaws, and beneath the piston is a compression spring G^6 which urges the piston and jaws upwards towards the tapered end of the bore and thus tends to close the jaws. A pin E^8 passes diametrically through the lower part of the body of the lower terminal E^2, with its ends projecting on each side of the terminal. These projecting ends can engage corresponding slots cut in the upper edge of the conical part G^3 of the chuck G when the terminal is pressed fully down into the chuck; rotation of the terminal will thus be prevented and the inserting and withdrawing tool referred to above can easily be screwed onto the lower terminal E^2. The piston has a recess in its upper surface to accommodate the head of the pin E^7 when the latter is gripped by the jaws. The fit of the piston G^5 in the cylinder bore G^2 is such as to provide a dash-pot effect, and to delay the upward movement of the piston under the action of the connector spring G^6 to close the jaws G^4.

The upper and lower terminals E^1 and E^2 of the fuse link are spaced apart by a tube E^{10} of non-combustible material, which is crimped onto the lower part of the upper terminal E^1 and is a loose fit over the upper part of the lower terminal E^2. A brass pin E^{11} passes transversely through the body of the lower terminal and its ends project slightly from the surface of the latter, forming a pair of lugs which co-operate with slots cut in the edge of the tube E^{10} to prevent the terminals E^1 and E^2 rotating relatively to each other or closing up towards each other, and thus prevent the element E^4 from being damaged.

The upper terminal E^1 of the fuse link is supported by a split collar E^{12} surrounded by a spring E^{13}, which allows the split collar to be opened and slipped around the terminal E^1 while the latter is screwed to the inserting and withdrawing tool. This terminal is fitted with a shoulder E^{14} which bears on the upper surface of the split collar, whose outer surface is tapered to seat in a corresponding taper inside the upper ferrule B of the carrier, and thus takes the tension of the separating spring F.

In order that the fuse link may be replaced by the user and the fuse carrier closed, for example in the field, it is necessary to provide a convenient form of seal which can be replaced by the user. The present construction employs a diaphragm H of soft metal such as annealed silver, having its marginal portion bent over and gripped between a pair of opposed conical surfaces, which are forced together axially by co-operating screw threads. Thus the upper end of the upper ferrule B is of reduced diameter and is formed with a male screw thread B^1. Above this the extreme end is tapered to form a conical seating B^2. The diaphragm H fits over the seating, and is bent down to lie in contact with the conical surface B^2 by means of a co-operating conical surface J^2 on a ring J^1 floating in a cap J. The cap is provided with a female screw thread J^3 so as to screw onto the upper ferrule B, and a flat inner face of the cap J presses axially on a corresponding opposed surface of the floating ring J^1 so as to force it to grip the edge of the diaphragm H.

The diaphragm H is provided with a dome H^1 which clears the top of the upper terminal E^1. The user, when he has fitted the diaphragm, presses down the dome with his finger until it makes contact with the top of the upper terminal E^1, thus providing an alternative parallel electric path. Thus if the split ring E^{13} rises from its seating on account of internal pressure, the alternative electric path will tend to prevent pitting of the split ring or its seating.

By employing the floating ring J^1 rather than forming the conical surface on the annular cap J, the advantage is obtained that the conical surfaces B^2 and J^2 can adapt themselves to exact alignment even if the axes of the screw threads and conical surfaces are slightly out of perfect alignment. Conveniently the screw thread in the cap J is undercut, and the ring J^1 is placed in a press and slightly expanded by a tool with a conical end which at the same time finishes the conical seating J^2 to the exact dimensions required. Thus the expanded ring cannot fall out of the cap and get lost.

Holes J^4 are drilled in the side of the cap for engagement by the inserting and withdrawing tool now to be described.

Figure 2 shows a tool K designed for inserting and withdrawing a fuse link and to act as a spanner for tightening or slacking the cap J of the upper ferrule.

The tool comprises a rod K^1 having a hole K^3 drilled in an axial direction in one end K^2, and a female screw thread tapped on the inside of this hole. The female screw thread is designed to engage the male screw thread at the upper end of either fuse link terminal E^1 or E^2. A ring K^4 is fixed to the other end of the rod K^1 as shown in Figure 2, its internal diameter being such that it will fit loosely over the outside of the cap J on the upper ferrule B. A stud K^5 projecting into the interior of the ring engages one of the series of holes J^4 drilled in the side of the cap J, thus transmitting to the cap the torque applied to the tool K, to tighten or untighten the cap.

The fuse link E is arranged to be inserted by pushing it down into the chuck G and allowing the jaws G^4 to grip it. Accordingly if a fuse link E, consisting of an element E^4 connected to upper and lower terminals E^1 and E^2 which are located with respect to each other by a tube E^{10}, is screwed into the threaded hole K^3 of the inserting

and withdrawing tool K and is pushed down into the chuck G, its rounded head will press the jaws G^4 and piston G^5 downwards against the action of the connector spring G^6, and will tend to part the jaws. When the head has passed through the jaws, they will tend to close on the shank of the pin E^7. The engagement of the grooved surface of the pin with the inside surface of the jaws provides a firm grip to prevent unintentional withdrawal.

Withdrawal of the complete fuse link E, or of the lower terminal E^2 of a blown fuse link, is effected by pushing it down into the chuck beyond its normal position and then promptly withdrawing it. When the lower terminal E^2 is pushed down beyond its normal position, the tapered shoulder E^9 bears against the upper surfaces of the jaws G^4 and parts them, as they and the piston G^5 are forced downwards against the connector spring G^6. The dash-pot effect provided by the piston G^5 in its cylinder G^2 delays the upward movement of the piston and jaws under the action of the spring G^6. Consequently if the fuse link is pushed down to its extreme position it opens the jaws, and an appreciable time, perhaps a second or two, elapses before they are closed again by the movement of the spring G^6 controlled by the dash-pot. This affords ample time for the fuse link to be withdrawn.

The precise clearance between the piston G^5 and the cylinder bore G^2 will depend upon circumstances, including the diameter of the piston, the strength of the connector spring G^6 and the nature of the fluid within the cylinder. In a particular case, it has been found that with air as the fluid, a clearance of substantially less than a thousandth of an inch is desirable, but if the device is only operated when filled with carbon tetrachloride, the clearance may be considerably more than a thousandth of an inch. With more viscous fluids it might be desirable to provide grooves or holes for the passage of the liquid.

The action of the seal at the upper end of the fuse carrier will be clear from the description of its parts. The thickness of the diaphragm H is so chosen that it will withstand a substantial pressure within the carrier but will fail at a pressure considerably below that required to damage the carrier. Consequently if the fuse blows on a relatively small overload, the diaphragm will remain unbroken and a pressure will build up inside the carrier which will materially assist in arc extinction. On the other hand, on a heavy overload or fault current the diaphragm will burst, so as to avoid, as far as possible, damage to the carrier and to allow the carrier to be used again.

If an overload or fault current flows through the fuse, the silver wire E^6 melts first, thus transferring the current to the high resistance strain wire E^5 which then also melts and allows the spring F to draw the terminals E^1 and E^2 rapidly apart; the lower terminal E^2 of the fuse link is drawn clear of the non-combustible tube E^{10} and the piston nozzle E^3 directs a jet of liquid into the path of the arc.

The operation of replacement of a blown fuse link is particularly simple, and is carried out with only the one simple tool K described above. First the fuse carrier is removed from the fixed contacts D^1 and D^2 and its cap J is unscrewed, using the ring K^4 and stud K^5 of the tool K as a spanner if necessary. The upper terminal E^1 of the fuse link is then withdrawn with the aid of the withdrawing tool K, the split collar E^{12} is slipped off and the terminal E^1 discarded. The withdrawing tool is then screwed onto the lower terminal E^2 of the fuse link without emptying the liquid out of the carrier. The tool is then pressed downwards and promptly withdrawn, thereby withdrawing the lower terminal E^2 from the jaws of the chuck G. This terminal is also discarded, although in some cases the piston nozzle E^3 may be fitted to a new fuse link. The liquid may then be poured away if it is not fit for further use. A fresh fuse link is then screwed into the tool and inserted into the chuck to be held by it. It is then drawn upwards, with the chuck attached to it, thereby extending the separating spring F. The split collar E^{12} is slipped over the upper terminal E^1 of the new fuse link and is allowed to be drawn down into position in the upper ferrule B of the fuse carrier. Finally the carrier is filled with fresh liquid if necessary, and a new diaphragm H is placed over the upper ferrule B and secued by the cap J. The spanner ring K^4 of the tool may be used to tighten the cap if necessary. Finally, the dome of the diaphragm is pressed down to make contact with the upper terminal E^1.

No claim is made herein for the particular construction forming a liquid seal, this constituting the subject matter of a separate application for patent filed November 2, 1948, Serial No. 57,886, now abandoned, for improvements in Liquid Seals.

What we claim as our invention and desire to secure by Letters Patent is:

1. A releasable connector comprising two parts movable towards and away from one another in directions of insertion and withdrawal respectively, means for connecting said parts adapted to be released by movement of said parts beyond their normal position in the direction of insertion, a connector spring carried by one of said parts opposing such movement, and delay means comprising a liquid filled dashpot serving to delay the action of the connector spring and permit withdrawal if performed with sufficient rapidity.

2. A releasable connector comprising male and female parts, whereof the female part is in the form of a chuck having a body affording tapered surfaces and two or more jaws having co-operating tapered surfaces and adapted to grip the male part when moved with it in the direction of withdrawal relatively to the body, and to release it when moved in the direction of insertion, a connector spring carried by said chuck body opposing the latter movement, and delay means comprising a liquid-filled dashpot serving to delay the action of the connector spring and permit the male part to be withdrawn promptly after being moved beyond its normal position in the direction of insertion to open the jaws.

3. A releasable connector comprising male and female parts to be connected, whereof the female part is in the form of a chuck body comprising a liquid-filled cylinder having a bore with a cylindrical portion and a tapered conical end portion, jaws having conical outer surfaces corresponding with and engaging the tapered portion of the cylinder bore and adapted to grip the male member when moved with it in the direction of withdrawal relatively to the cylinder, and to release it when moved in the direction of insertion, a piston in the cylindrical part of the bore abutting the ends of the jaws, and a connector spring in said body urging the piston towards the tapered end of the cylinder to close the jaws, the fit of the piston in the cylinder being such as to produce a dashpot effect and to slow the closing of the jaws and permit the male part of the con-

nector to be withdrawn promptly after being moved beyond its normal position in the direction of insertion to open the jaws.

4. A releasable connector as claimed in claim 3 in which the male part of the connector has substantially circumferential grooves formed on its surface to enable the jaws to hold it firmly against unintentional withdrawal.

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DOUGLAS ARTHUR JAMES OXLEY.

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