United States Patent [19]

Harris

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[54] **SELF-EJECTING ELECTRIC PLUG**

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Related U.S. Application Data

[62] Division of Ser. No. 754,188, Aug. 21, 1968, Pat. No. 3,609,635.

[52] **U.S. Cl.** ..... **339/45 R**

[51] **Int. Cl.** **H01r 13/62**

[58] **Field of Search** ..... 339/45, 12, 112; 60/25, 23; 92/98 D; 251/61.4

[56] **References Cited**

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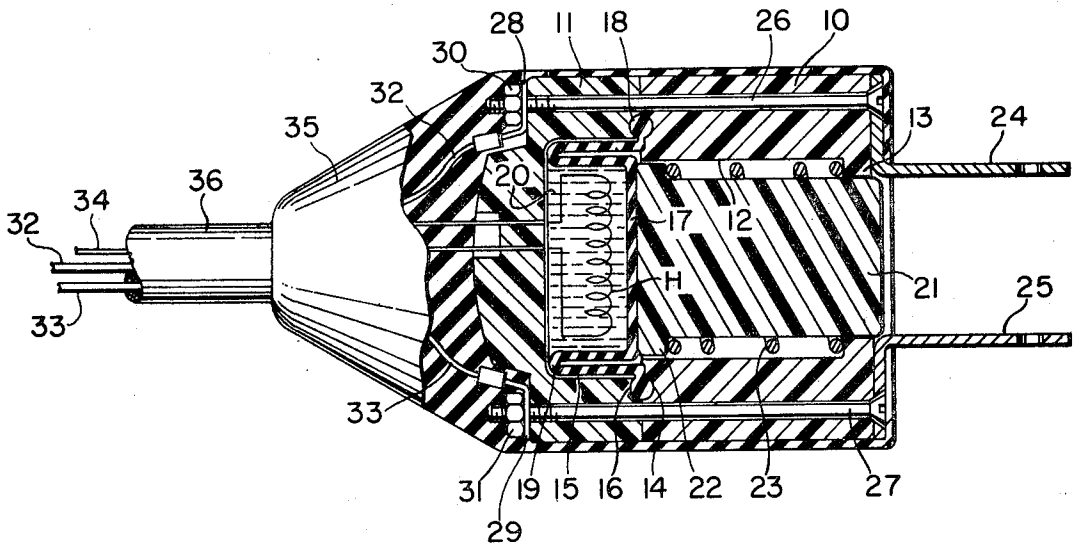
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[57] **ABSTRACT**

The plug includes a plunger normally spring retracted between the prongs and a chamber containing thermally expansible material and an electric heater which is the plug cord circuit, a remote switch closure energizing the heater to expand the material against the plunger to drive it outwardly and eject the plug from the receptacle.

9 Claims, 3 Drawing Figures



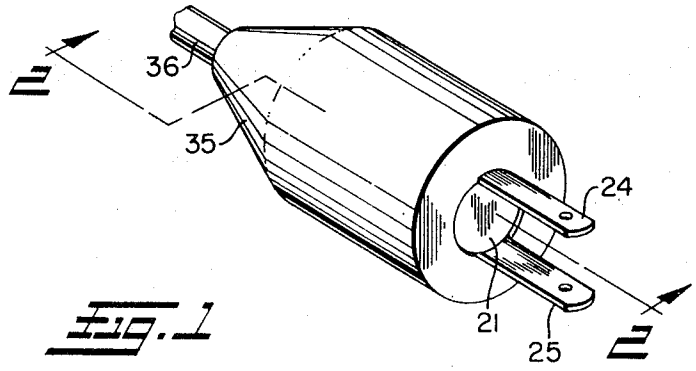


Fig. 1

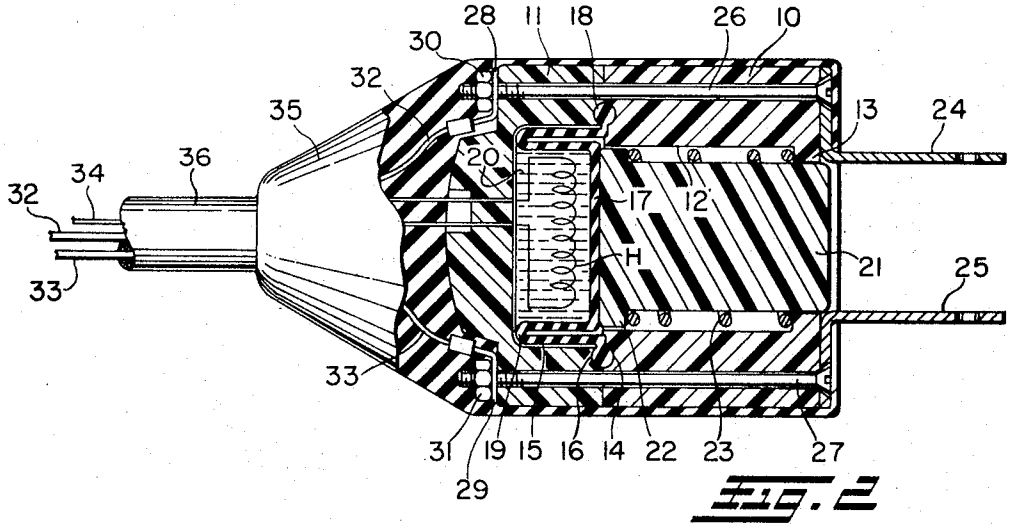


Fig. 2

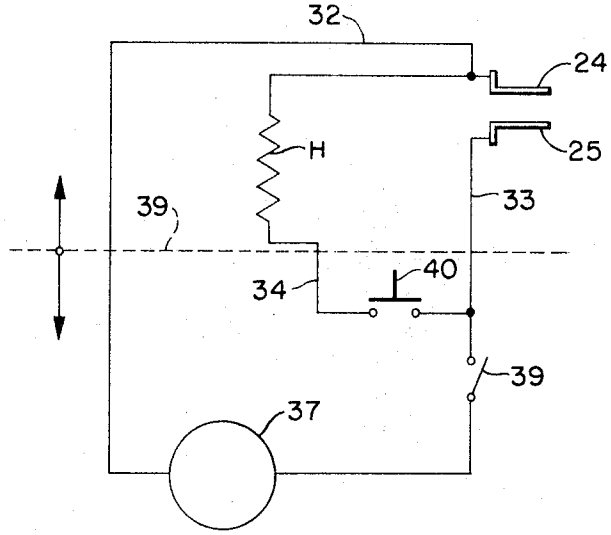


Fig. 3

SELF-EJECTING ELECTRIC PLUG

This is a division of application Ser. No. 754,188, filed Aug. 21, 1968 now U.S. Pat. No. 3,609,635, issued on Sept. 28, 1971.

This invention relates to an electric plug which can eject itself from a receptacle for self-disconnect action.

The co-pending application of John T. Venaleck, Ser. No. 689,663, filed Dec. 11, 1967, discloses a plug assembly on this order in which the ejection is under the control of a solenoid included in the circuit which is energized by connection of the plug in the receptacle. More particularly, this assembly comprises a plunger between the contact prongs which is normally biased outwardly by a spring and mechanically latched within the plug when pushed in by the insertion of the plug in the receptacle. The solenoid, when its circuit is completed by closure of a switch, withdraws the latch, thereby freeing the plunger for outward drive by its spring and hence the ejection of the plug from the receptacle.

One primary area of interest for this plug has been in electric cords for portable appliances used in the home, with the vacuum cleaner being a prime example, and it has been found that the variation in receptacles, especially throughout older homes, is even greater than was expected, with the result that the plug for this application required a fairly heavy spring force for reliable ejection. Increasing the spring force of course requires proportionately more pressure by the housewife in the insertion of the plug in the receptacle, with the latch necessarily stronger, the solenoid larger, and the overall size increased.

It is a principal object of the present invention to provide such a plug with an improved ejector mechanism having appreciably greater capacity without the noted shortcomings of the solenoid plug form.

Another object is to provide an improved self-ejecting plug which is inexpensive to produce and relatively trouble-free by virtue of simplicity of its design and operating mode.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail a certain illustrative embodiment of the invention, this being indicative, however, of but one of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

FIG. 1 is a perspective view of a new self-ejecting electric plug in accordance with the present improvements;

FIG. 2 is a longitudinal sectional view of the plug as indicated by the line 2—2 in FIG. 1; and

FIG. 3 is an electrical schematic of a plug and appliance combination.

Referring now to the drawing in detail, the plug comprises first and second body parts 10 and 11, which are preferably made of rigid plastic. The part 10 is generally annular, thereby defining a bore 12, with a radial stop flange 13 at the outer end of the bore and an annular relief 14 in the inner end face for purposes to be described.

The part 11 is in the nature of an end cap having a cylindrical recess 15 on the same axis as the bore 12, with a slightly larger inside diameter as shown. The outer or open end of the part 11 abuts the inner end of the part 10, with the two having the same outside diameter, and the end face of the former has a groove 16 opposed to the annular relief 14 in the end face of the latter.

An elastic diaphragm 17, made for example of rubber, is arranged as a wall separating the recess 15 from the adjoining bore 12 and sealing the joint between the parts 10 and 11 by having a peripheral bead 18 sealingly gripped in the groove 16 and relief 14. The diaphragm preferably has a fold 19 which it normally assumes and which permits ready distension of the diaphragm outwardly into the bore 12.

The recess contains a quantity of thermally expansible and contractible material 20 and a schematically shown electric heating coil H operative when energized to expand such material and thereby exert an outward force at the diaphragm 17.

Such force is applied through the diaphragm to a plunger 21 in the bore 12, also made of a rigid plastic, having a flange 22 at its inner end. A return spring 23 extends from this plunger flange to the stop flange 13 at the outer end of the bore 12 and serves normally to hold the plunger in the relatively retracted condition shown. Two metal prongs 24, 25 are attached to the outer face of the body part 10 by bolts 26, 27 which extend completely through this part and also through the part 11 at the rear of which they receive electric wire terminals 28, 29 and nuts 30, 31. Accordingly, the bolts serve also to unite the body parts 10 and 11 and electrically connect the prongs 24, 25 respectively to the terminals 28, 29. The plunger is between the prongs, and two wires 32, 33 extend from the terminals 28, 29. As shown in the schematic of FIG. 3, one end of the heating coil H is connected to wire 32, while the other continues as a third wire 34. The plug assembly is encased within an insulative cover 35, for example, of rubber molded thereabout, and the wires 32, 33 and 34 extend through an insulative cord body 36 to the appliance or other device served by the cord.

In the FIG. 3 schematic, the circle 37 represents an electric appliance and dashed line 38 the division between the plug circuit, above the line, and the cord and appliance circuit. The latter includes an on-off switch 39 and additionally a pushbutton switch 40 connected between wires 33 and 34, so that the heating coil in the plug can selectively be energized by closure of the push-button conveniently at the appliance.

When a housewife operating the appliance wishes to disconnect the plug from the circuit, she need only close the heater switch 40, with the resulting heating of the thermally expansive material 20 in the plug almost immediately effective to force the plunger 21 outwardly against the return spring force for automatic ejection of the plug from the receptacle. Such material is selected to provide quick response within substantially normal plug size and it has been found that Freon, a halogenated hydrocarbon containing a fluorine atom, is very satisfactory in this respect and also in recycling. This inert, dielectric liquid will vaporize at about 200° F, and that part of the liquid contacted by and proximate to the heater in the plug can be almost immediately heated to this temperature sufficiently to develop ejection force with a relatively small resistance element

at normal energization. For example, a plunger force well over the 15 lbs. which appears reliable for ejection from household sockets, has been developed in less than one second with a heater of about 470 watts at 115 volts.

When the plug is ejected, the circuit for the heater in the same is also automatically disabled along with the appliance or other cord connected device, the expansion material as quickly contracts and the return spring retracts the plunger to its normal non-obstructive position. The power output is substantial and more than adequate readily to effect disconnection of even a tightly held plug.

It will also be apparent that the number and character of the components permit economic manufacture with high efficiency and reliability. While the heating coil has been shown schematically for convenience of illustration, it can in fact be a simple wire coil of sufficient heating capacity relative to the fluid or material used to perform with the desired quick response.

While the plug part of the plug-receptacle combination is preferably the actuated part in the described application, it will be appreciated generally that such an automatic disconnect can also be realized comparably by incorporating the ejecting assembly in the receptacle, with the plunger in this case normally retracted between the socket contacts and driven outwardly against the plug to eject the latter.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. A self-ejecting electrical connector, comprising a body member having a recess therein, an annular member having a central bore in substantial alignment with said recess, an elastic diaphragm at the mount of said recess forming a fluid chamber therewith, said diaphragm having an annular fold therein disposed substantially in said recess in the collapsed condition of same and adapted for distension into said bore upon build up of pressure in said fluid chamber, a thermally expansible fluid filling said fluid chamber when said diaphragm is in the collapsed condition, electrical heater means disposed in said fluid chamber, said heater means being completely submerged in said fluid, a pair of electrical contacts extending outwardly of said annular member, said contacts being adapted for insertion into conventional outlet box connectors, means connecting said electrical contacts and said heater means for applying electrical energy to the latter to cause distension of said diaphragm and a change in the volume of said fluid chamber, and a plunger supported in said bore and abutting said diaphragm, said plunger adapted upon distension of said diaphragm to move between said electrical contacts for obstruction of the latter.

2. A connector as set forth in claim 1 wherein said connecting means comprises means for securing said body member, said annular member and said electrical contacts as a unitary structure.

3. A connector as set forth in claim 2 wherein said diaphragm is supported at the periphery thereof between said body member and said annular member and is retained in fluid tight engagement by said securing means.

4. A connector as set forth in claim 3 wherein said connecting means comprises a pair of electrically conductive bolts extending through said body means and said annular means for conducting electrical power from said contacts to said heater means.

5. A connector as set forth in claim 1 wherein said heater means is an electrical resistance heater supported in said body member and disposed in said fluid chamber, and said fluid is an inert dielectric fluorinated hydrocarbon liquid readily vaporizable by the energy supplied by said heater means.

6. A connector as set forth in claim 1 wherein said annular member includes a stop flange at the outer end of said bore and said plunger includes a flange at its inner end and further including a spring disposed between said plunger flange and said stop flange for biasing said plunger to a retracted position within said bore.

7. An electrical connector, comprising a body member, a pair of spaced contacts extending from said body member, a plunger slidable from a position within said body member to a position between said contacts for preventing association of the latter with conventional connector devices, spring means for biasing said plunger to a normally retracted position within said body member, and electrically actuated means for urging said plunger between said contacts and against the bias of said spring means comprising a fluid chamber in said body member, a flexible folded diaphragm forming one wall of said fluid chamber, said diaphragm being in abutment with said plunger and adapted to move the latter upon distension due to buildup of pressure in said fluid chamber, a readily vaporizable fluid in said fluid chamber, and resistance heater means in said fluid chamber energizable from a source of power for vaporizing said fluid to cause a buildup of pressure in said fluid chamber.

8. A connector as set forth in claim 7 wherein said fluid is a fluorinated hydrocarbon liquid.

9. A connector as set forth in claim 8. further including switch means in circuit with said contacts and said heater means for energization of the latter.

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