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SELF-EJECTING PLUG

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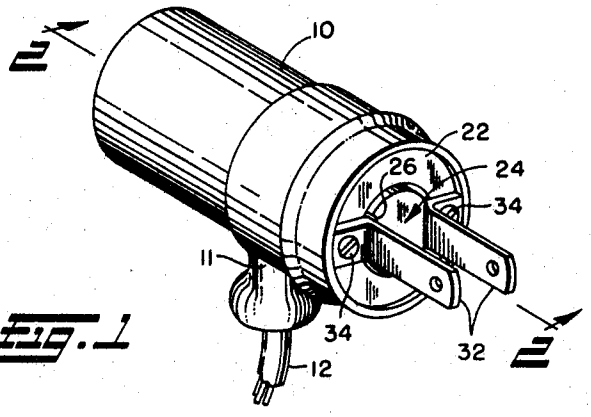


Fig. 1

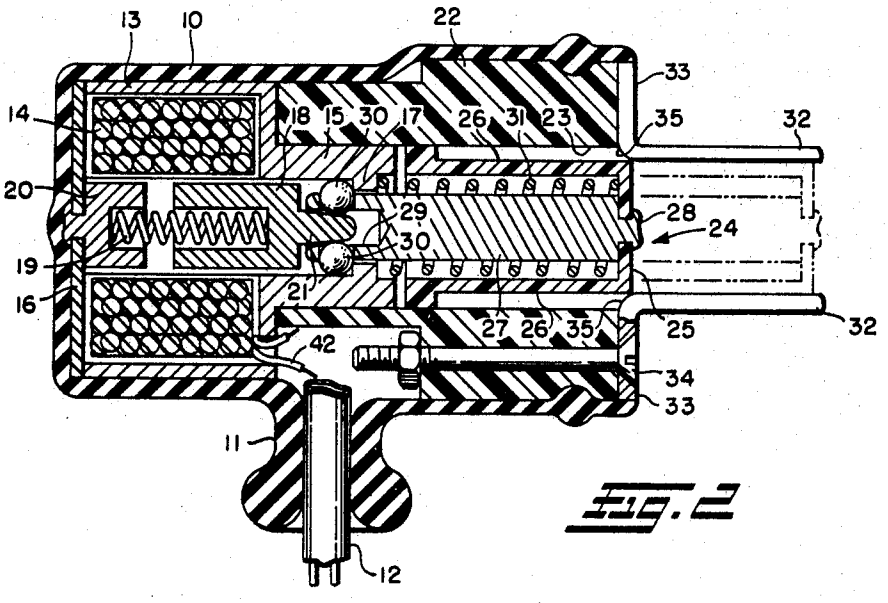


Fig. 2

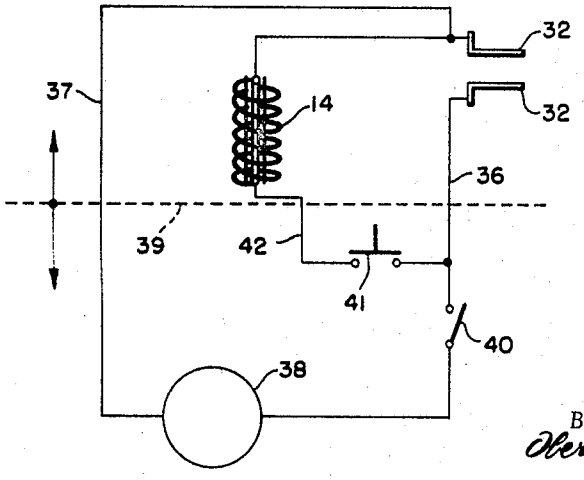


Fig. 3

INVENTOR

JOHN T. VENALECK

BY

Merlin, Maky, Donnelly & Renner

ATTORNEYS

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SELF-EJECTING PLUG

John T. Venaleck, Mentor, Ohio, assignor to Product Design & Manufacturing Corp., Willoughby, Ohio, a corporation of Michigan

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ABSTRACT OF THE DISCLOSURE

A wall plug for portable electric appliances and the like having a spring loaded ejector normally retracted from between the plug prongs and held by a ball detent assembly cooperating with a solenoid operated lock member. The appliance cord includes a separate circuit and a switch at the appliance for energizing the solenoid to release the ejector, the latter being driven against an outlet in which the plug is connected to disengage the same.

This invention relates to an electrical plug assembly including automatically controlled ejecting mechanism for disengaging the same from a wall outlet or the like.

Such self-ejecting action is considered to be of particular advantage in association with portable electric appliances the use of which either by necessity or for convenience involves a cord of substantial length extending from the appliance to a plug connection with a socket or outlet. This sector of the appliance industry has been steadily expanding with respect both to the number of the units produced and additional product types, with many of the latter requiring extremely long cords and corresponding increase in the remoteness of the use from the supply connection. For example, garden tools driven by electric motors, such as mowers and trimmers, have become widely accepted and these are regularly equipped originally with one hundred foot cords; the household vacuum cleaner is an obviously good example of an appliance with a very high rate of use and, while many models of these are now equipped with automatic reelers or winders for the cord, the user must still return first to the wall socket for manual removal of the plug, an action which has not to the knowledge of the present applicant been successfully made remotely automatic. The provision of an improved plug which can be caused by remote actuation to disengage itself from such a socket connection is, accordingly, the primarly object of this invention. The mechanical form and operating mode of the new plug must and do provide positive self-ejection, with particular significance in this connection to the commonly experienced variation in the amount of force needed to withdraw the prongs of a given plug from a given socket as a result of dimensional differences, distortion and the like.

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 drawing:

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

FIG. 2 is a longitudinal sectional view of the plug in which the prongs have been rotated 90° from their positioning shown in FIG. 1 to enhance the illustration, the section being 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 new plug is of cylindrical body form with an outer insulative cover **10**, preferably made of rubber, having an open end and an integral side nipple **11** for passage of the electrical cord **12**. The latter is of usual insulated type, but with a third wire in addition to the two normal supply wires for a purpose to be more fully described below.

Within the outer cover, at the closed end of the same, there is a cylindrical metal shell having a first section **13** which houses an annular solenoid coil **14**. The shell comprises a second relatively outer section **15** of reduced size and forming in effect a sleeve extension of the space within the coil. A metal disc **16** is applied against the innermost end of the shell, and an internal stop land **17** is provided at a slight inward spacing from the other end.

A solenoid armature or plunger **18** is slidable within the shell and coil and is biased outwardly as illustrated by a return spring **19** extending from within a recess at the rear of the plunger to a fixed socket **20** mounted on the end disc **16**. The forward or outer end of the plunger has a projecting locking finger **21** as a reduced axial extension of outwardly decreasing circular section. A plastic body **22** is within the remaining portion of the outer cover **10**, extending from an inner end abutment with the metal shell section **13** substantially to the open end of the cover. The body **22** is also annular and fits over the reduced shell section **15**, with the latter extending only partially into the plastic body, so that this body also defines a bore **23** extending to the plug end.

An ejector device designated generally by reference numeral **24** is disposed within the bore **23** and is movable between an inner retracted condition illustrated in full line and an extended condition indicated by the dashed outline. This device comprises a hollow cylindrical sheath **25** made of dielectric material closed at the outer end and open at the inner end. The sheath is in sliding engagement with the bore and has two exterior slots **26**. A metal rod **27** is supported axially in spaced relation within the sheath, with a connection **28** at one end to the outer closed end of the sheath and a socket **29** at the other end which, in the normal retracted condition of the device shown, projects through the stop land **17** in spaced relation and partially over the solenoid plunger extension or finger **21**. A number of metal balls **30** are loosely retained in openings in the wall of the socket **29** and normally bear against the plunger locking finger **21** and against the inner edge of the stop land **17**. An ejector spring **31** extends under compression from the exterior face of the land **17** to the outer end of the sheath **25**, and it will be obvious that the ball-carrying socket end of the rod and the locking finger constitute a detent assembly which normally holds the ejector device locked in the retracted condition.

The plug is completed by two metal prongs **32** having feet **33** attached to the end of the plastic body **22** for example by connector srcews **34**. It will be noted that the prongs are in register with slots **26** in the sheath **25** and their inner ends **35** where bent to form the feet have sufficient projection inwardly relative to the bore **23** to act as stops for the sheath by engagement with the ends of slots **26**.

The connector screws **34** of course serve as conductors for the prongs to which the two supply wires **36, 37** of the electrical cord **12** are respectively connected as shown by the diagram of FIG. 3. The circle **38** in this diagram is intended to represent an electric appliance and the dashed line **39** divides the circuit in the sense that that portion above this line represents the plug wiring while

the portion below is the cord and appliance wiring. The latter includes the usual on-off switch **40** and an added push-button switch **41** connected by the third cord wire **42** to one of the supply conductors **36** and through the solenoid coil **14** to the other supply conductor **37**, whereby the push-button **41** can be operated by the user of and at the appliance to energize the solenoid.

Reverting to FIG. 2, such solenoid energization causes the plunger **18** to retract or move inwardly against the force of the return spring **19**, and the locking finger **21** is thereby withdrawn from the ball assembly **30**, with the compression force in the ejector spring **31** sufficient to pull the balls over the stop land **17** and thus extend the ejection device **24**. This extension of course between the prongs **32** acts directly against a socket in which the plug may be inserted and forces the disengagement of the plug. For reuse, the ejector device **24** can simply be pushed in by hand, with the solenoid circuit open, forcing the balls **30** through the stop land **17** and onto the plunger finger **21** which is forwardly biased by return spring **19** and cams the balls outwardly for the locking action behind the land. The same loading can of course be accomplished in the act of inserting the plug in the wall outlet.

As noted previously, the ejector spring must be of appreciable strength to insure positive ejection of the plug, and this requires equally reliable and positive locking of the ejecting device in the retracted condition, an action which is accomplished by the disclosed ball detent assembly. This assembly has, moreover, with at least three balls used, the advantage of uniform gripping, i.e., about the periphery of the holding rod, as compared to a single point engagement, use of balls assuring long life in respect of wear, and the trigger action is sensitive in the sense that the solenoid is relatively small for the amount of force which can be stored in the ejector spring. The ramp or slope angle of the locking finger and also the angle of a line drawn from the center of a locked ball to its contact with the cooperable stop land are significant, and the first such angle can be varied to adjust the sensitivity of the device.

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 electric plug, comprising an insulative body having an opening which extends inwardly from one end thereof, a pair of contact-making prongs extending from said one end of the body respectively at opposite sides of said opening, ejector means movable in the opening between an ejection position in which it projects substantially from the body end between the prongs and a retracted position in which it is substantially fully withdrawn into the body, spring means normally urging said ejector means outwardly to said ejection position and being compressed by movement thereof to the retracted position, locking means for releasably holding the ejector means in its retracted position against the force exerted thereon by the compressed spring means, said locking means comprising fixed and movable members and cooperating ball detent means carried by the ejector means, the ball detent means being cammed into locking engagement therewith and with said fixed member when the ejector means is moved to its retracted position, said movable member of the locking means being separately actuatable from such locking engagement with the ball detent means and fixed member to free the ejector means for outward driving of the same by the spring means, whereby the plug if inserted in a socket is ejected therefrom, an electric solenoid means including coil and plunger means, the latter being operative upon energization of the coil to actuate said movable member from the locking engagement with the ball detent means and fixed member, and circuit means including a remote switch for controlled energization of the solenoid coil.

2. A plug as set forth in claim **1**, wherein the ejector means has an inner end socket, and the ball detent means comprises plural balls loosely disposed in the wall of such end socket for generally radial camming of the same.

3. A plug as set forth in claim **2**, wherein said movable member of the locking means extends into the end socket of the ejector means for outward camming of the balls, and said fixed member is an annular stop through which the balls move in the movement of the ejector means to its retracted position and into such camming engagement with said movable member.

4. A plug as set forth in claim **3**, wherein the plunger means includes said movable member as an extension thereof.

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MARVIN A. CHAMPION, Primary Examiner

PATRICK A. CLIFFORD, Assistant Examiner

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