An electrical connector having mating frusto-conical plug and socket members with electrical conducting rings and contact members providing full swivel contact and a magnetically operated circuit closing means functioning exclusively on movement of the members to mated position.
MAGNETICALLY OPERATED ELECTRICAL CONNECTOR

The invention relates to detachable electrical connectors such as the conventional appliance cord plug and convenience wall outlet.

Conventional wall outlets have a pair of socket contacts charged normally with a 120 volt differential. The immediate accessibility of such charged contacts presents a potential hazard to manual engagement by metallic objects particularly in the hands of children. Also, engagement of the conventional plug in the wall outlet socket requires a precise orientation of the plug prongs with respect to the socket openings followed by the application of significant insertion force. In many instances, it is necessary to insert a line cord plug into a wall receptacle which is behind and covered by a relatively heavy piece of furniture such as a desk or the like. Visibility of the wall outlet and access thereto may be difficult and awkward.

In accordance with the present invention and as a principal object thereof, the plug and socket members incorporate a magnetically operated electric switch means which effects completion of the electric circuit to the contact members only after the plug and socket members are assembled. Accordingly, there is no voltage charge on the socket contacts when the wall outlet is in an open unused condition, thus avoiding the potential danger of manual engagement above eluded to.

As another feature of the present invention, the plug is designed to be essentially self-homing into the wall receptacle, thus greatly facilitating the connection of the parts where visibility is impaired or space restricted. It is accordingly a further object of the present invention that the plug and wall outlet parts only need be brought into close proximity when the magnetic couple provided in the structure will cause the units to move automatically together into proper fit and orientation for assured electrical connection.

Still another object of the present invention is to provide a magnetically operated electrical connector of the character described which will provide a full swivel action between the plug and wall socket while maintaining electrical continuity.

The invention possesses other objects and features of advantage, some of which of the foregoing will be set forth in the following description of the preferred form of the invention which is illustrated in the drawing accompanying and forming part of this specification. It is to be understood, however, that variations in the showing made by the said drawing and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawing:

FIG. 1 is a front elevation of a magnetically operated electrical connector constructed in accordance with the present invention;

FIG. 2 is a cross sectional view of the connector taken substantially on the plane of line 2—2 of FIG. 1;

FIG. 3 is a fragmentary back view of the wall receptacle;

FIG. 4 is a cross sectional view on a somewhat enlarged scale of the connector taken substantially on the plane of line 4—4 of FIG. 2;

FIG. 5 is a cross sectional view of a modified form of the invention.

The electrical connector of the present invention comprises briefly plug and socket members 6 and 7 having concentric frusto-conical mating walls 8 and 9; a pair of electric conducting rings 11 and 12 mounted in concentric axially spaced positions on and exposed at the exterior surface of wall 8 and in axially spaced planes substantially perpendicular to the common axis of the frusto-conical parts; external electric conducting means, here line cord 13, connected to rings 11 and 12; a pair of electric contact members 16 and 17 carried by the socket number 7 and exposed at the exterior surface 9 and being axially spaced to engage rings 11 and 12 when the plug and socket members are in mated position; external electric conducting means 18 and 19 connected to contact members 16 and 17, see FIG. 4; a magnet 21 carried by member 6, an armature 22 carried by member 7 for movement between unattracted and attracted positions and being displaced by magnet 21 to attracted position upon positioning of the plug and socket members in mated position, armature 22, here being connected to contact members 16 and 17 so as to move them into engaged position with rings 11 and 12 as the armature is displaced to attracted position. Contact members 16 and 17 thus form the moving part of an electric switch, and in the absence of plug 6, these contact members will be withdrawn into the wall receptacle. A leaf spring 26 secured to the armature and housing 27 of the wall receptacle serves as a biasing means for normally holding contacts 16 and 17 in a relatively retracted position.

Rings 11 and 12 may be conveniently cast or molded into the body of plug 6 made of thermoplastic or other electric insulation material; and the conductor ends of line cord 13 may be braised or otherwise secured to the plug with the cord molded in place. Alternatively, conventional screw terminals may be provided on plug 6 connected to rings 11 and 12 for connection of the conductor ends of line cord 13.

The wall receptacle unit 7 is here in the form of an adapter which may be added to the conventional wall outlet. Accordingly, socket member 7 is here provided with two laterally spaced pairs of prongs 18 and 19 which are spaced for insertion into the conventional double socketed wall outlet. Alternatively, the contact prongs 18 and 19 may be deleted and screw terminals provided for direct wall installation in the manner of the conventional duplex outlet. Also, while two socket units are provided in conformity with conventional practice, it will be understood that the two are of identical construction and a description of one will suffice for both. With reference to FIG. 2, no plug is shown mounted in the left-hand socket and accordingly the movable contacts 16-17 are retracted and the armature 22 in a lower position than the corresponding position of these parts in the right-hand socket structure where a plug 6 is shown mounted in place. In such case, magnet 21 has drawn armature 22 upwardly against the bias of leaf spring 26 and has advanced contact members 16 and 17 into engagement with rings 11 and 12 as illustrated in FIG. 4.

Preferably, and here best shown in FIGS. 3 and 5, prongs 18 and 19 are connected to contacts 16 and 17 by stationary switch contact members 28 and 29. Prongs 18 and 19 may be formed from electric conducting plates 32 and 33 secured as by screws 34 and
35 in the socket housing 27. Contact members 28 and 29 are here connected at one end to plates 32 and 33 and extend laterally and axially therefrom, as shown in
FIG. 4, around the base ends 37 and 38 with the distal ends 41 and 42 of members 28 and 29 positioned in engagement with contact ends 37 and 38 in the attracted
(raised) position of armature 22, and in spaced electric circuit open position from contact portions 37 and 38 in the unattracted (lowered) position of armature 22.
Contact members 16 and 17 are here secured to an insulation plate 43 which is positioned between contact members 16 and 17 and plates 32 and 33 in the unattracted armature position, thus, opening the electric circuit between prongs 18 and 19 and contact members 16 and 17. On insertion of plug 6 and attendant movement of armature 22 to attracted position, as shown in
FIG. 4, the electrical switch defined by parts 37-41 and 38-42 is closed thereby completing the electric circuit to contact rings 11 and 12. As will be observed, contact members 28 and 29 in their entirety are enclosed within, and protected from accidental external physical contact by, socket housing 27. It will further be noted that the free upstanding ends 41 and 42 of contact members 28 and 29 are by reason of the looped shape of the contact members supported for resilient axial displacement by contacts 37 and 38 as the latter move with the armature to attracted position. Consequently, a firm electrical contact will be established between switch contact portions 37-41 and 38-42 in advance of the movement of contact members 16 and 17 into engagement with contact rings 11 and 12 on the plug.

As will be observed from FIGS. 2 and 4, the magnet and armature are axially opposed for providing an axially aligned magnetic force drawing the plug and socket members into mated position as well as the rings and contact members into engaged position, and furthermore, the contact pressure between the electric parts is a function of the magnetic force. Thus, when the plug 6 is brought into close proximity to socket 7, the magnetic attraction will provide a self-holding force causing the plug to snap into a proper seated position in the socket and at the same time effect a closure of the electric circuit as above described. Accordingly, to effect the connection of the plug in the socket, it is only necessary to depend plug 6 on cord 7 into registration with the socket following which the self-holding attachment will take place. Only a very limited space through which to lower the plug is required for this purpose. Also, since perfect electric contact is made regardless of the angular orientation of the plug with respect to the socket, no other alignment of the parts is needed to be observed. In this connection, it will be noted that plug 6 may be rotated about its common axis with socket 7 through 360° while maintaining electrical continuity between contact members 16 and 17 and rings 11 and 12, thus affording full swivel action of the plug while maintaining full current flow. While the magnet and armature may be optionally incorporated in either the plug or socket member, I prefer to mount magnet 21 in plug member 6 with a magnet pole face 31 disposed centrally at the reduced end of the plug so as to provide for minimum spacing between the magnet pole face 31 and armature 22 when the plug is in attached position as shown in FIG. 4. Correspondingly, I prefer to mount armature 22 in the socket centrally of the reduced end thereof for axial movement to pole face 31.

A modified form of the invention is illustrated in FIG. 5 of the drawing wherein electromagnetic means is provided for augmenting the magnetic force of magnet 21a. This means may comprise a magnetic field winding 36 connected to the electric circuit for automatic energizing of the electromagnetic means upon closing of the electric circuit by the magnetically operated switch. Magnet 21a is designed to have sufficient residual, permanent, magnetism to effect the initial displacement of armature 22 as above described so as to close the electric circuit following which the electromagnetic means will be energized to increase the contact pressure. As here shown, winding 36 directly surrounds a magnetic core 21a and has its opposite ends connected to contact rings 11a and 12a.

I claim:
1. An electrical connector comprising:
   plug and socket members having concentric frustra-conical mating walls;
   a pair of electrical conducting rings mounted in concentric axially spaced positions on and exposed at the exterior surface of one of said walls and in axially spaced planes substantially perpendicular to the axis of said last named wall;
   external electric conducting means connected to said rings;
   a pair of electric contact members exposed at the exterior surface of the other of said walls and spaced axially from each other to engage said rings when said plug and socket members are in mated position;
   external electric conducting means connected to said contact members;
   electric switch means connected for completion of an electric circuit through said rings and contact members and having a switch part movable between circuit closing and circuit opening positions;
   means biasing said part to circuit open position;
   a magnet carried by one of said members;
   an armature carried by the other of said members for movement between unattracted and attracted positions and being displaced by said magnet to attracted position upon positioning of said plug and socket members in mated position; and
   means connecting said armature and switch part for movement of the latter to circuit closed position upon movement of said armature to attracted position.
2. A connector as defined in claim 1:
said magnet and armature being axially opposed and exerting an axially aligned magnetic force drawing said members into mated position and said rings and contact members into engaged position with the contact pressure therebetween being a function of said magnetic force.
3. A connector as defined in claim 2:
one of said contact members being mounted for axial reciprocation into and out of engagement with one of said rings and being connected to said armature for displacement into ring engaged position by said magnetic force.
4. A connector as defined in claim 3:
said magnet being mounted on said plug member and having a pole disposed centrally at a reduced plug end inserted into said socket member; and
said armature being mounted in said socket centrally of a reduced base thereof and for axial movement to said pole in the mated position of said plug and socket members.

5. A connector as defined in claim 1: electro magnetic means having a winding connected to said circuit and energized upon closing said circuit and disposed for augmenting the magnetic force of said magnet.

6. A connector as defined in claim 4: a magnetic field winding surrounding said magnet and connected to said circuit and energized upon closing of said circuit and augmenting the field strength of said magnet when said winding is energized.

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