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J. JOYCE

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ELECTRIC PLUG AND SOCKET

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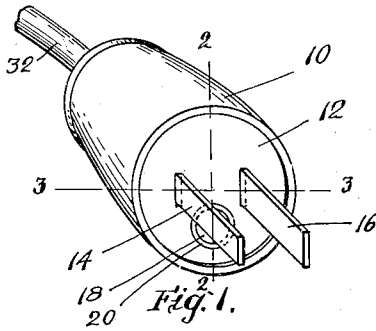


Fig. 1.

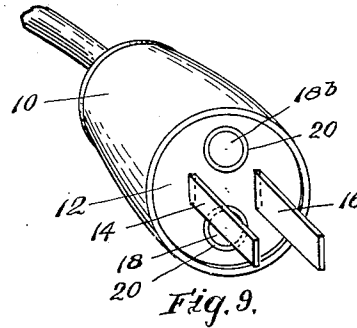


Fig. 9.

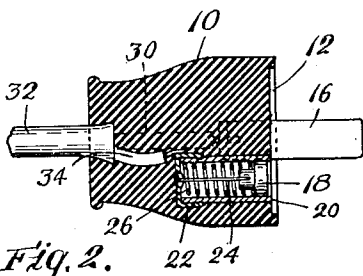


Fig. 2.

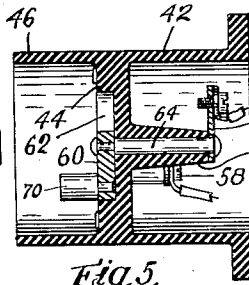


Fig. 5.

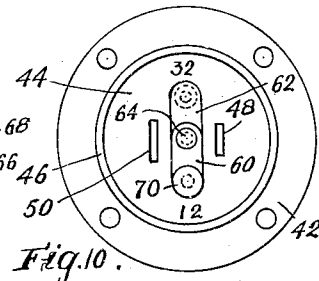


Fig. 10.

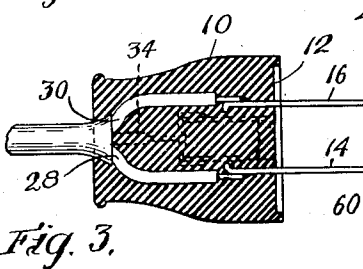


Fig. 3.

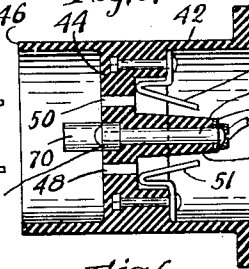


Fig. 6.

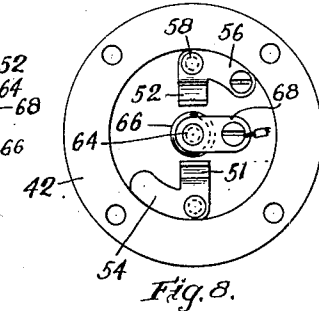


Fig. 8.

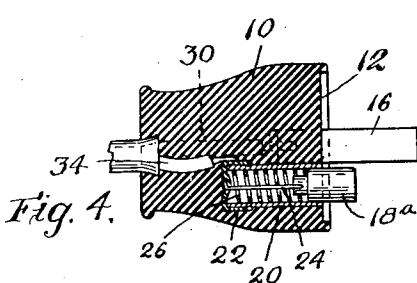


Fig. 4.

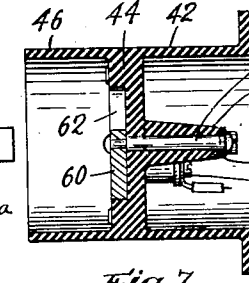


Fig. 7.

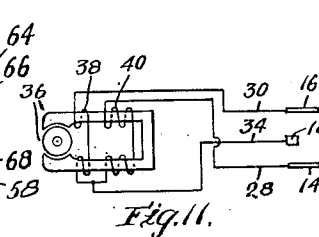


Fig. 11.

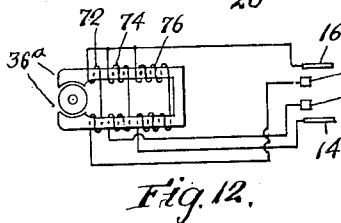


Fig. 12.

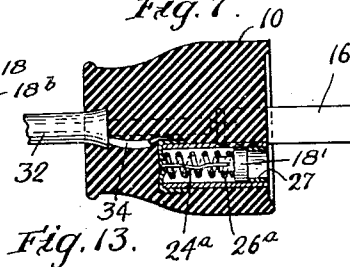


Fig. 13.

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## UNITED STATES PATENT OFFICE

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## ELECTRIC PLUG AND SOCKET

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5 Claims. (Cl. 171-97)

This invention relates to electric connectors or plugs adapted to connect an electric device with an electric circuit; and to sockets or receptacles adapted to receive the plug, and especially to a plug having multiple terminals connected to different voltage windings of an electrical device.

There are electrical devices having plural windings or circuits designed for different voltages, any one winding or circuit of which is designed to operate the device satisfactorily when energized at its designed voltage.

One of the objects of the present invention is the provision of a plug adapted to enter at will any one of a plurality of appropriate sockets energized at different voltages and automatically connect the socket terminals only with the winding or circuit of the associated device that is designed for operation on the voltage of the selected socket.

An electric razor, for instance, is normally designed for operation on 110 volts, which is the standard house voltage. The owner of the razor, however, would like to carry the razor on his travels and to use it on Pullman trains, airplanes and automobiles. The voltages of the electric circuits of these various conveyances, however, are different, 32 volts being common on railroad trains, also farm lighting plants, 12 volts being commonly used in airplanes, and 6 volts in automobiles. Electric razors have been proposed having windings and switches so arranged that by properly setting a control switch the razor would be conditioned for operation at any one of a plural number of different voltages. The objection to this arrangement, however, is that the user forgets to set the switch for the proper voltage and it is possible to plug the razor into a 110 volt circuit; for instance, with the razor set for operation on a lower voltage, thereby burning out an energizing winding.

It thus is an object of the present invention to provide an electrical appliance having multiple windings or circuits adapted for operation on different voltages with an attachment plug having terminals connected to the various circuits and so arranged that while the plug can be plugged into appropriate sockets energized at different voltages it can only establish a connection between the socket conductors and the appliance circuit that is intended for operation upon the voltage of the socket.

A further object of the invention is the provision of a plug having at least three terminals adapted for connection with circuits designed for different voltages, together with a socket adapted

to receive the plug and having two terminals arranged to be connected with a circuit of a selected voltage, the plug and the socket being so arranged that only the terminals of the plug connected to a circuit designed for the voltage applied to the terminals of the socket can be electrically connected with such socket terminals.

Another object of the invention is the provision of a plug having at least three terminals, the plug and the terminals being so constructed and arranged that the plug can be inserted in the present-day socket that is standard for 110 volts and the plug will have only its 110 volt terminals electrically connected with the socket terminals, the plug also being so arranged as to be received in a different socket having terminals energized at a different voltage with only the appropriate plug terminals in engagement with the terminals of such different socket.

A yet further object of the invention is the provision of a plug having two projecting terminals and a third terminal which can yield in the direction of insertion of the plug so as to permit the plug to enter the present-day 110 volt socket and also to engage a properly disposed terminal of a different voltage socket.

Another object of the invention is the provision of a socket having provision for receiving a contact or terminal member in any selected one of at least two different positions corresponding with two different voltages.

Another object of the invention is generally to improve the construction of plugs and sockets.

Fig. 1 is a perspective view of a multi-circuit plug embodying the present invention and provided with three terminals adapted for connection with two circuits of different voltages.

Fig. 2 is a sectional view taken along line 2-2 of Fig. 1.

Fig. 3 is a sectional view of the plug of Fig. 1 taken at right angles to the section of Fig. 2 or along line 3-3 of Fig. 1.

Fig. 4 is a section similar to Fig. 2 but illustrating a modified form of the third terminal.

Fig. 5 is a section taken through the axis of a socket or receptacle adapted for cooperation with the plug of Figs. 1 and 2.

Fig. 6 is a sectional view taken at right angles to the showing of Fig. 5 and corresponding with the view of the plug shown in Fig. 3.

Fig. 7 is a sectional view of a modified form of socket adapted for cooperation with the modified form of plug illustrated in Fig. 4.

Fig. 8 is an end or bottom view of the socket illustrated in Figs. 5, 6 and 7.

Fig. 9 is a perspective view of a modified form of plug having four terminals.

Fig. 10 is an end or top view of the socket of Fig. 5.

Fig. 11 is a circuit diagram illustrating the connections between the multiple windings of a power consuming device and the terminals of the plug of Fig. 1.

Fig. 12 is a circuit diagram similar to Fig. 11 but illustrating the connections between multiple circuits and the terminals of the plug of Fig. 9.

Fig. 13 is a sectional view similar to Fig. 2 but illustrating a further modified form of low voltage terminal.

The plug embodying the present invention, in the three-terminal form illustrated in Fig. 1, comprises an insulating body 10, that can be generally cylindrical in form and has a flat terminal end 12. A pair of terminals of the wiping contact type in the form of straight flat blades 14 and 16 project from said face in spaced relation with each other and with the flat faces parallel. The spacing between the blades, and the cross-sectional dimensions of the blades does not exceed the corresponding dimensions of the usual two-blade plug adapted for insertion in the present usual or standard 110 volt socket. Hence the present plug can be inserted in the usual 110 volt socket and establish connection with the socket terminals thereof. One of the blades, as the blade 14, is narrower, or has a smaller cross-sectional dimension, than the other blade 16 thereby to "polarize" the plug and prevent its being inserted in a special socket presently to be described, except in a predetermined manner, whereby to prevent improper connections between the plug and socket terminals.

The plug of Fig. 1 also is provided with a third terminal 18, preferably of the butt contact type, which is located below and between the terminal blades 14 and 16. Said third terminal is yieldingly supported so that it can move inwardly of the plug body when engaged with a third terminal of the special lower voltage socket to be described or when engaged with some projecting part of a standard 110 volt socket, to permit effective entrance of the blades 14 and 16 into either socket.

As illustrated in all figures but Fig. 4, the end or contact face of said third terminal 18 is generally flush with the end face 12 of the plug. Said terminal 18 comprises a cylindrical block which is slidably located in a, preferably, insulating tube 20, which may be made of fibre, with the longitudinal axis of the tube generally parallel with but offset from the longitudinal axis of the plug. The inner end of the tube is closed by a metal end cap 22 fixed thereon. A flexible conductor 24 connects the end cap with the terminal block 18 and the length of the conductor is such that, when taut, it holds the terminal block with its outer or contact face generally flush with the end face 12 of the plug. A helical compression spring 26 is located within the tube 20 about the conductor and bears at one end on the inner face of the end cap and at the other end against the inner face of the terminal block 18, thereby normally holding the conductor straight and taut. Thus the free or disengaged position of the third terminal is defined. Endwise pressure on the contact face of the terminal block causes the spring to yield and permit the block to move inwardly.

The method of anchoring the terminals in the plug body is not of importance herein. A quite

satisfactory method is to solder the terminals 14 and 16 to the ends of insulated conductors 28 and 30 respectively of a flexible conductor cord 32 and to solder the end cap 22 to a third similar conductor 34 of the cord and to mold the plug from a suitable rubber or other molding compound about the terminals and conductors, thereby anchoring the parts in the above described relation.

The cord conductors can be connected to the two different-voltage circuits of an electric device in the manner illustrated in Fig. 11. The electric device 36 can be the motor of an electric razor having, say, a 12 volt winding 38 and a 110 volt winding 40, which, with the connections illustrated, includes the lower voltage winding. Energization of the terminals 16 and 18 energizes the low voltage winding only, and energization of the terminals 16 and 14 energizes the high voltage winding. The different windings can be entirely separate as illustrated in Fig. 12, but some economy of wire and space is obtained by having the higher voltage current pass through the lower voltage winding or windings. So far as this invention is concerned, however, the more important object is to prevent a low voltage winding from being connected with a high voltage energizing circuit so that the winding receives excessive current.

A receptacle or socket adapted for cooperation with the above described plug is illustrated in Figs. 5, 6, 8 and 10. The socket includes a body 42 which can be of insulating material and tubular and has a transverse wall 44 of insulating material intermediate its ends and a forwardly projecting rim 46 forming a tubular recess adapted to be entered by the plug. The outer end face of the wall which confronts the end face of the plug is generally flat, preferably, and the wall is formed with slots or openings 48 and 50 therethrough adapted to be entered by the plug terminals 14 and 16, respectively. The slot 48 is transversely shorter than the corresponding dimension of the slot 50 and the cross-sectional dimensions of the slots conform closely to the corresponding dimensions of the plug terminals 14 and 16. Thus the plug terminal 16 cannot enter the slot 48 and hence the location of the third plug terminal 18 with respect to the socket is assured.

The rear face of the wall 44 is provided with suitable resilient contact fingers 51 and 52 which are in position to be engaged and wiped over by the plug terminals 14 and 16, respectively, the fingers having terminal parts 54 and 56 either of which can be connected with an energizing conductor. If the socket were to be used on a 110 volt circuit both parts would be provided with a conductor clamping screw 58 as shown screw-threaded in the terminal part 56. Since, however, the socket is intended primarily for use with lower voltages only one of the terminal parts and particularly the terminal part associated with the broader plug terminal 16 is provided with such a clamping screw.

The socket as so far described is in principle essentially a standard socket generally used on 110 volt circuits except that the slots corresponding to the slots 48 and 50 have the same cross-sectional dimensions as the slot 50.

When the present socket is used for the lowest low voltage, say 6 volts, or is to receive a plug having only three terminals for two circuits of different voltages, the slot 48 can be as large as the slot 50 as no harm will result if the plug is reversed when entered in the socket, the connection with the low voltage terminal merely not

being made as will be presently made clear. Since, however, it is desired to provide but one socket for use on all lower voltage circuits, as 6 volts, 12 volts, 32 volts, and in connection with plugs having more than three terminals and appliances having more than two circuits of different voltages, it is preferred to polarize the socket by making the slots 48 and 50 with different cross-sectional dimensions.

While only one of the contact fingers 51, 52 will be energized when the socket is used on the lower voltages, both fingers will be in mechanical engagement with the terminal blades of the plug and will act to hold the plug mechanically firmly in place.

The socket is provided with a third terminal in addition to the two terminals 51 and 52. To this end a contact plate 60 is located in an end part of a longitudinally elongated recess 62 located between the slots 48, 50 and extended substantially equally on opposite sides of the center of the socket. Said plate is held in place by a stud 64 riveted or otherwise secured to the inner end of the contact plate and located in the center line of the socket and passed through an insulating boss 66 projecting from the rear face of the wall 44, the stud having a wire connector 68 on the end thereof. In the form illustrated in Fig. 5, the outer end of the contact plate 60 has an outwardly projecting contact or terminal member 70 which is arranged to engage the third terminal 18 of the plug.

With the plug and socket as thus described the terminal member 70 engages the plug terminal 18 and causes it to be moved inwardly of the plug body as the plug is inserted in the socket. Connection is thus established with the particular low voltage circuit connected between the terminal blade 16 and the third terminal 18.

In the plug and socket as illustrated in Figs. 4 and 7, the third terminal 18a projects from the end face of the plug and is adapted to engage the outer face of the contact plate of the socket, the contact member 70 of Fig. 5 being omitted, and the third terminal yielding inwardly of the plug body, as before, upon inserting the plug in the socket. When such a plug is inserted in a standard 110 volt socket, having no contact plate, the terminal 18a bears against the outer face of the equivalent of the insulated wall 44 and yields inwardly to permit the plug terminals 14 and 16 to engage the socket terminals.

The purpose of the rim 46 is primarily to shield the contact member 70 from accidental engagement. The rim can be omitted when desired.

In the further modified form of low voltage plug terminal as illustrated in Fig. 13 the terminal 18' is inset below the end face of the plug, the compression spring 26a holding the contact face of the terminal yieldingly against the inner end of a bushing 27 fixed within the outer end of the tube 20. Thus the flexible conductor 24a is relieved from the spring pressure which, for some purposes, is advantageous. A socket cooperating with such a plug terminal will have a sufficiently long low voltage contact 70 to enter the bushing and engage and depress the terminal 18'.

With an electrical appliance such as 36a, Fig. 12, having three circuits or windings 72, 74, 76 of different voltages, the plug of Fig. 9 is used. Such a plug is similar to the plug of Fig. 1 except that it has a fourth terminal 18b similar to the terminal 18 but disposed on the opposite side of the line through the blade terminals 14 and 16, the terminal 16 being common to all windings

and the terminals 18, 18b and 14 being connected respectively to the lowest voltage winding 72, the intermediate voltage winding 74, and the highest voltage winding 76, respectively.

Such a plug can be inserted in a standard 110 volt socket in either of two positions displaced 180° and establish connection only with the high voltage winding 76 which usually will be designed for 110 volts. The plug can be inserted in the socket of Fig. 5 and will establish connection only with the lowest voltage winding 72. For a socket to establish connection with the intermediate voltage winding 74 the contact plate 60 will be in the opposite end part of the recess 62, as indicated by dotted lines, Fig. 10, so that the contact member 70 will engage only with the fourth plug terminal 18b. The socket may have appropriate markings 78, 78a at the opposite ends of the recess 62 to indicate the position of the contact plate for different voltages.

One socket type is common for all usual lower voltages and is conditioned for two different voltages by merely altering the position of the contact plate 60. This arrangement simplifies and cheapens the cost of the socket since the users of the various voltages are commercially distinct and there is little danger that a builder of a Pullman car, for instance, using 32 volts, would obtain and inadvertently install a 12 volt socket intended primarily for use on the 12 volt systems of airplanes.

It is thus apparent that the plug of the present invention can be inserted in a standard 110 volt socket and also in a special socket of a different voltage and will automatically establish connection only with the proper circuit of the associated device.

The plug can be used also on a single circuit appliance when the circuit terminals are connected to the proper plug terminals as above described. Thus the appliance, say for 32 volts, can be plugged accidentally into 110 volt socket without being damaged by being connected to the excess voltage and yet will have its connections properly established when plugged into the 32 volt socket.

I claim:

1. In combination with an electric power consuming device having a plurality of circuits of different voltages, of a plug having terminals connected with said circuits arranged to enter different sockets energized at corresponding different voltages and having differently positioned energized terminals, and means constraining the plug to enter all sockets in the same position and automatically connect the socket only with the circuit of the device adapted for the voltage of the socket.

2. In combination with an electric power consuming device having a plurality of circuits of different voltages, a plug having terminals connected with said circuits, and a socket having terminals energized at only one of said different voltages, said terminals in said socket being arranged to engage the terminals of said plug and automatically connect the energized terminals of the socket only with the circuit of the device corresponding to the voltage of the energized socket terminals.

3. A multi-circuit plug adapted for cooperation with a standard 110 volt socket having a pair of spaced contact members and also with a second socket having a contact member in the position of one of said pair of contact members and another contact member, said socket being ener-

gized at a different voltage from the first socket, said plug comprising a body having a pair of terminal blades enterable in both sockets and engageable with said pair of spaced contact members, said plug having means which constrains its insertion in the second socket in a predetermined position only and having a third contact member engageable in said predetermined position of the plug with the last named contact member of said second socket and constructed and arranged to admit the effective insertion of said pair of terminals in said first socket.

4. The combination with an electric power consuming device having a plurality of windings of different voltages, one of the voltages being adapted to be energized and operate satisfactorily when energized from the standard 110 volt house lighting circuit, a plug adapted for cooperation with a standard 110 volt socket having a pair of spaced contact members and also adapted for cooperation with a second socket having a contact member in the position of one of said pairs of

contact members and another contact member, said second socket being energized at a different voltage from the standard socket, said plug comprising a body having terminals connected with the windings of said power consuming device, one pair of said terminals comprising projecting terminal blades connected with the said 110 volt winding and enterable in both sockets and engageable with said pair of spaced contact members, said plug having a third terminal engageable with the last named contact member of said second socket and constructed and arranged to admit the effective insertion of said pair of terminals in said first socket.

5. The combination as in claim 4, wherein the plug has means which constrains its insertion in the second socket in a predetermined position only and said third terminal being engageable only in said predetermined position of the plug with the last named contact member of said second socket.

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