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(54) AN IMPROVED ELECTRIC PLUG ASSEMBLY

(71) We, BICC LIMITED, a British Company, of 21 Bloomsbury Street, London WC1B 3QN, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an electric plug assembly of the kind in which line and neutral plug pins and usually but not necessarily an earth plug pin and their associated conductor terminals are mounted in a preformed body of electrically insulating material, the conductors of a length of flexible insulated multi-conductor cable are electrically connected to appropriate terminals of the plug, and a moulded plug body of electrically insulating material wholly or partially encapsulates the preformed body and the plug pins and associated conductor terminals with an appropriate length of each pin protruding from the plug assembly and is permanently bonded to the insulating covering of a part of the length of cable. Electric plug assemblies of this kind will hereinafter, for convenience, be referred to as "of the kind described".

Three pin electric plug assemblies of the kind described are especially suitable for use with domestic electrical appliances because such appliances can be sold to the public with the electric plug permanently bonded to the flexible cable of an appliance, thereby eliminating the risk that an unskilled user of an appliance may connect a conventional three pin plug to an end of the flexible cable of the appliance in an incorrect manner which, when the appliance is used, may result in injury to the user and/or permanent damage to the appliance.

It has been found that, in manufacturing electric plug assemblies of the kind described, there is a risk that, during moulding of the plug body, a wire or wires of the exposed end of a cable conductor connected to one of the terminals will become detached from the terminal and will protrude through the moulded plug body. A plug assembly which is connected to a domestic electrical appliance and which has a live wire or wires

protruding through the plug body is extremely dangerous, especially if handled with damp hands—as may be the case when the plug assembly is connected to a domestic washing machine.

It is the object of the present invention to provide an improved electric plug assembly of the kind described in which the aforesaid risk is eliminated or at least substantially reduced.

In the electric plug assembly of the kind described according to the present invention, a preformed cover of an electrically insulating material that is substantially harder than the moulded insulating material of the plug body is encapsulated in the moulded plug body and is connected to the preformed body in which the plug pins and associated conductor terminals are mounted in such a way as to overlie at least the line and neutral terminals, and preferably all of the terminals, thereby to form a guard between said terminals and the outer surface of the moulded plug body.

The provision of a preformed guard of a hard insulating material between the conductor terminals and the outer surface of the moulded plug body eliminates or substantially reduces the risk that a conductor wire or conductor wires may protrude through the moulded plug body.

Preferably, the preformed cover is initially detachably connected to the preformed body in which the plug pins and associated conductor terminals are mounted and in a preferred embodiment the preformed cover has protuberances which are snap fits in appropriately located holes or recesses in the preformed body.

In a preferred form the preformed cover comprises a top and a side wall or side walls, an aperture being provided in a side wall, or one of the side walls being omitted, to provide access for the flexible cable.

The preformed cover may have protruding inwardly of its top, ribs which are so positioned that, when the cover is connected to the preformed body, they bear against the inner ends of the plug pins and hold them firmly in position during moulding of the 100

plug body. Where, as is described and claimed in the Complete Specification of our co-pending Patent Application No. 25251/77 (Serial No. 1604424), the preformed body has separately formed cable-gripping means detachably mounted on the body, a rib or side wall of the preformed cover may hold the cable-gripping means firmly in position. Alternatively, a side wall of the preformed cover and a neighbouring part of the preformed body may be appropriately shaped so as to co-operate to form means for gripping the cable, or a side wall of the preformed cover may be appropriately shaped so as to form means for gripping the cable.

Preferably, the preformed cover is of nylon or polyester.

The electric plug assembly of the present invention may be made by the method of forming an electric plug assembly described and claimed in the Complete Specification of our co-pending Patent Application No. 25253/77 (Serial No. 1604426).

The invention is further illustrated, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is an exploded view of a preformed body (with the plug pins and conductor terminals omitted) and a preformed cover of a three-pin electric plug assembly in accordance with the invention;

Figure 2 is a front view of the plug assembly in Figure 1 with the moulded body and preformed cover omitted;

Figure 3 is a sectional side view taken on the line III—III in Figure 2 with the preformed cover in position;

Figure 4 is a view, partly in section and partly in elevation, of the fuse clips carrier in Figure 3 with two fuse clips mounted thereon.

Figure 5 is an exploded view of a preformed body (with the plug pins and conductor terminals omitted) and the preformed cover of an alternative three-pin electric plug assembly in accordance with the invention;

Figure 6 is a front view of the plug assembly in Figure 5 with the moulded body and preformed cover omitted; and

Figure 7 is a sectional side view taken on the line VII—VII in Figure 6 with the preformed cover in position and with the conductors and conductor terminals omitted.

Referring to Figures 1 to 4, the electric plug assembly comprises a preformed body 1 of moulded plastics insulating material such as urea, a preformed cover 2 of moulded plastics insulation material such as nylon which is detachably connected to the body 1 and, encapsulating the cover 2 and the body 1 in such a way that the rear face 4 of the body is exposed, a plug body (not shown) of moulded thermoplastics material which is bonded to the insulating covering 11 of a flexible cable 10.

The preformed body 1 has apertures 21, 22 and 23 through which protrude a line pin 24, a neutral pin 25 and an earth pin 26. Mechanically and electrically secured to the neutral pin 25 is a conductor terminal 28 to which the neutral conductor 14 of the flexible cable 10 is electrically connected by a crimped connection 31. A conductor terminal 29 is mechanically and electrically connected to the earth pin 26 and the earth conductor 15 of the flexible cable is electrically connected to the terminal 29 by a crimped connection 32.

In snap engagement in a rectangular hole 33 in the preformed body 1 is a carrier 34 of moulded plastics material which carries at its opposite ends spring clips 35 and 36 located in a cartridge-fuse recess 37 in the rear face 4 of the body. As will be seen on referring to Figure 3, the walls of the hole 33 converge towards one another in a direction towards the rear face 4 of the body 1 and the side faces of the carrier 34 are of complementary shape, the tightness of the fit of the carrier in the hole thereby increasing as the carrier is introduced into the hole from the front face 5 of the body. The spring clips 35 and 36 are each of such a shape and size, having regard to the size of the hole 33, what when the carrier 34 is fully home in the hole, the spring clips effect a snap fit so that the carrier cannot subsequently be withdrawn.

Mechanically and electrically connected to the line pin 24 is a conductor terminal 27 which is electrically connected to the spring clip 35 through a length 30 of conductor, one end of which is electrically connected to the conductor terminal 27 by a crimped connection 38 and the other end of which is electrically connected to the spring clip 35 by a crimped connection 39. The line conductor 12 of the flexible cable 10 is electrically connected to the spring clip 36 by a crimped connection 40. The spring clips 35 and 36 are electrically connected through a cartridge fuse 41.

The cartridge-fuse recess 37 in the rear face 4 of the body 1 is closed by a removable cover 42.

The preformed cover 2, which overlies and provides a guard for the electrical connections on the front face 5 of the preformed body 1, is detachably connected to the body 1 through stepped flexible protuberances 6, which are in snap engagement in holes 43 in the preformed body. The cover 2 has inwardly directed ribs 7 which bear against the ends of the conductor terminals connected to the pins and, when the cover is connected to the body 1, serve to retain the pins in their apertures. At one end of the cover 2 is an opening 9 for passage of the flexible cable 10, the cable being gripped to prevent strain from being imparted to the cable conductor connections by a separately formed cable-

gripping member 45 which engages in a slot in the body 1 and is held therein by the cover 2. The cover 2 provides a guard against an unconnected wire or unconnected wires of a cable conductor from being caused to protrude through the plug body (not shown) during the moulding operation.

In manufacturing the electric plug assembly shown in the drawings, the conductor terminals are connected to the pins and the cable conductor connections are made before any of these parts are mounted on or in the preformed body 1. When these connections have been made, the pins 24, 25 and 26 are introduced into the apertures 21, 22 and 23, and the carrier 34 with the spring clips 35, 36 mounted thereon is introduced into the hole 33 from the front face of the preformed body 1 until the pins are fully insulated and the carrier has snapped into the place in the hole. The cover 2 is next detachably connected to the preformed body 1, thereby retaining the pins, and the cable-gripping member 45 which has previously been applied to the flexible cable 10 and engaged in the slot in the body 1, in position. The assembly so formed is then placed in an appropriately shaped mould and molten thermoplastics material is injected into the mould to form a plug body which is bonded to the insulating covering 11 of the cable 10 and which fully encapsulates all the electrical connections of the plug assembly, leaving the rear face 4 of the body 1 exposed for insertion of an appropriate fuse 41 and closure by the removable cover 42 after the plug body has cooled.

In the alternative electric plug assembly shown in Figures 5 to 7, the preformed cover 102 has a raised portion 103 to allow a clearance around the cable 104. The preformed body 101 has two pairs of slots 105 and 106, each of which receives an approximately U-shaped metal spring clip 107 and 108. An arm of each spring clip 107 and 108 passes through a slot of each pair of slots 105 and 106 so that the free ends of the arms protrude into a cartridge-fuse recess 109 in the rear face 110 of the preformed body 101. A cartridge fuse 111 electrically connects the spring clips 107 and 108. The line pin 112 is mechanically and electrically connected to one of the spring clips 107 by a strip of shaped metal sheet 113. In all other respects the electric plug assembly shown in Figures 5 to 7 is substantially the same as that in Figures 1 to 4.

WHAT WE CLAIM IS:—

1. An electric plug assembly of the kind described, wherein a preformed cover of an electrically insulating material that is substantially harder than the moulded insulating material of the plug body is encapsulated within the moulded plug body and is con-

nected to the preformed body in which the plug pins and associated conductor terminals are mounted in such a way as to overlie at least the line and neutral terminals thereby to form a guard between said terminals and the outer surface of the moulded plug body.

2. An electric plug assembly of the kind described, wherein a preformed cover of an electrically insulating material that is substantially harder than the moulded insulating material of the plug body is encapsulated within the moulded plug body and is connected to the preformed body in which the plug pins and associated conductor terminals are mounted in such a way as to overlie all the terminals thereby to form a guard between said terminals and the outer surface of the moulded plug body.

3. An electric plug assembly as claimed in Claim 1 or Claim 2, wherein the preformed cover is initially detachably connected to the preformed body in which the plug pins and associated conductor terminals are mounted.

4. An electric plug assembly as claimed in Claim 3; wherein the preformed cover has protuberances which are snap fits in appropriately located holes or recesses in the preformed body.

5. An electric plug assembly as claimed in any one of the preceding Claims; wherein the preformed cover comprises a top and a side wall or side walls, an aperture being provided in a side wall, or one of the side walls being omitted, to provide access for the flexible cable.

6. An electric plug assembly as claimed in any one of the preceding Claims; wherein the preformed cover has protruding inwardly of its top, ribs which are so positioned that, when the cover is connected to the preformed body, they bear against the inner ends of the plug pins and hold them firmly in position during moulding of the plug body.

7. An electric plug assembly as claimed in Claim 5 or 6; wherein the preformed body has separately formed cable-gripping means detachably mounted on the body and a rib or a side wall of the preformed cover holds the cable-gripping means firmly in position.

8. An electric plug assembly as claimed in any one of Claims 1 to 6; wherein a side wall of the preformed cover and a neighbouring part of the preformed body are appropriately shaped so as to co-operate to form means for gripping the cable.

9. An electric plug assembly as claimed in any one of Claims 1 to 6; wherein a side wall of the preformed cover is appropriately shaped so as to form means for gripping the cable.

10. An electric plug assembly as hereinbefore described with reference to, and as shown in, Figures 1 to 4 of the accompanying drawings.



(12)

gripping member 45 which engages in a slot in the body 1 and is held therein by the cover 2. The cover 2 provides a guard against an unconnected wire or unconnected wires of a cable conductor from being caused to protrude through the plug body (not shown) during the moulding operation.

In manufacturing the electric plug assembly shown in the drawings, the conductor terminals are connected to the pins and the cable conductor connections are made before any of these parts are mounted on or in the preformed body 1. When these connections have been made, the pins 24, 25 and 26 are introduced into the apertures 21, 22 and 23, and the carrier 34 with the spring clips 35, 36 mounted thereon is introduced into the hole 33 from the front face of the preformed body 1 until the pins are fully insulated and the carrier has snapped into the place in the hole. The cover 2 is next detachably connected to the preformed body 1, thereby retaining the pins, and the cable-gripping member 45 which has previously been applied to the flexible cable 10 and engaged in the slot in the body 1, in position. The assembly so formed is then placed in an appropriately shaped mould and molten thermoplastics material is injected into the mould to form a plug body which is bonded to the insulating covering 11 of the cable 10 and which fully encapsulates all the electrical connections of the plug assembly, leaving the rear face 4 of the body 1 exposed for insertion of an appropriate fuse 41 and closure by the removable cover 42 after the plug body has cooled.

In the alternative electric plug assembly shown in Figures 5 to 7, the preformed cover 102 has a raised portion 103 to allow a clearance around the cable 104. The preformed body 101 has two pairs of slots 105 and 106, each of which receives an approximately U-shaped metal spring clip 107 and 108. An arm of each spring clip 107 and 108 passes through a slot of each pair of slots 105 and 106 so that the free ends of the arms protrude into a cartridge-fuse recess 109 in the rear face 110 of the preformed body 101. A cartridge fuse 111 electrically connects the spring clips 107 and 108. The line pin 112 is mechanically and electrically connected to one of the spring clips 107 by a strip of shaped metal sheet 113. In all other respects the electric plug assembly shown in Figures 5 to 7 is substantially the same as that in Figures 1 to 4.

WHAT WE CLAIM IS:—

1. An electric plug assembly of the kind described, wherein a preformed cover of an electrically insulating material that is substantially harder than the moulded insulating material of the plug body is encapsulated within the moulded plug body and is con-

nected to the preformed body in which the plug pins and associated conductor terminals are mounted in such a way as to overlie at least the line and neutral terminals thereby to form a guard between said terminals and the outer surface of the moulded plug body.

2. An electric plug assembly of the kind described, wherein a preformed cover of an electrically insulating material that is substantially harder than the moulded insulating material of the plug body is encapsulated within the moulded plug body and is connected to the preformed body in which the plug pins and associated conductor terminals are mounted in such a way as to overlie all the terminals thereby to form a guard between said terminals and the outer surface of the moulded plug body.

3. An electric plug assembly as claimed in Claim 1 or Claim 2; wherein the preformed cover is initially detachably connected to the preformed body in which the plug pins and associated conductor terminals are mounted.

4. An electric plug assembly as claimed in Claim 3; wherein the preformed cover has protuberances which are snap fits in appropriately located holes or recesses in the preformed body.

5. An electric plug assembly as claimed in any one of the preceding Claims; wherein the preformed cover comprises a top and a side wall or side walls, an aperture being provided in a side wall, or one of the side walls being omitted, to provide access for the flexible cable.

6. An electric plug assembly as claimed in any one of the preceding Claims; wherein the preformed cover has protruding inwardly of its top, ribs which are so positioned that, when the cover is connected to the preformed body, they bear against the inner ends of the plug pins and hold them firmly in position during moulding of the plug body.

7. An electric plug assembly as claimed in Claim 5 or 6; wherein the preformed body has separately formed cable-gripping means detachably mounted on the body and a rib or a side wall of the preformed cover holds the cable-gripping means firmly in position.

8. An electric plug assembly as claimed in any one of Claims 1 to 6; wherein a side wall of the preformed cover and a neighbouring part of the preformed body are appropriately shaped so as to co-operate to form means for gripping the cable.

9. An electric plug assembly as claimed in any one of Claims 1 to 6; wherein a side wall of the preformed cover is appropriately shaped so as to form means for gripping the cable.

10. An electric plug assembly as hereinbefore described with reference to, and as shown in, Figures 1 to 4 of the accompanying drawings.

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11. An electric plug assembly as hereinbefore described with reference to, and as shown in, Figures 5 and 7 of the accompanying drawings.

5 12. For use in an electric plug assembly as claimed in any one of the preceding Claims, a preformed cover comprising a top and at least one side wall, and at least two protuberances for snap fitting the cover to
10 the preformed body of the plug assembly.

13. For use in an electric plug assembly as claimed in any one of Claims 1 to 11, a preformed cover substantially as hereinbefore described with reference to and as
15 shown in Figures 1 and 3 of the accompanying drawings.

14. For use in an electric plug assembly as claimed in any one of Claims 1 to 11, a preformed cover substantially as hereinbefore described with reference to and as
20 shown in Figures 5 and 7 of the accompanying drawings.

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