

SPECIFICATION

An improved electric plug assembly

5 This invention relates to an electric plug assembly of the kind in which the plug pins and 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 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.

35 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.

50 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.

According to the invention, the improved electric plug assembly of the kind described comprises a preformed body of electrically insulating material having holes therethrough in which are fitted plug pins which protrude from the rear face of the preformed body and each of which has at least one shoulder bearing against the front face of the preformed body to limit the extent of protrusion of the pin; a preformed spider of electrically insulating material which is supported by a plurality of limbs on, and is connected to, the

front face of the preformed body and which has protrusions bearing against parts of the plug pins protruding from the front face of the preformed body and/or against the conductor terminals or fuse contact associated with the pins to hold the pins in position in the holes with the shoulders bearing against the front face of the preformed body; an inner moulded body of electrically insulating material wholly encapsulating at least the conductor terminals associated with the line and neutral pins, and preferably the conductor terminals associated with all the plug pins; and an outer moulded body of electrically insulating material which wholly or partially encapsulates the inner moulded body and is bonded to the insulating covering of an adjacent part of the flexible cable.

Preferably the preformed spider is detachably connected to the preformed body and, in a preferred embodiment, the preformed spider has protuberances which are snap fits in appropriately located holes or recesses in the preformed body.

90 The preformed spider is preferably of an insulating material which is harder than the insulating materials of the inner and outer moulded bodies and which may be the same material as that of the preformed body. The preformed spider is preferably of a material which will withstand a test temperature of at least 750°C. Preferred materials of which the preformed spider may be made include a glass-filled polyester and nylon.

100 The provision of an inner moulded body of an insulating material which wholly encapsulates at least the line and neutral terminals and which thereby lies between them and the outer moulded body eliminates or substantially reduces the risk that a conductor wire or conductor wires may protrude through the moulded plug body.

Preferably, the material of the inner moulded body is bonded to the preformed spider. Preferably, also, the material of the outer moulded body is bonded to the material of the inner moulded body.

Where, for example, the outer moulded body is of urea or polyester, preferably the inner moulded body is of nylon, polyvinyl chloride or polyester. The inner moulded body may be of a colour different and readily distinguishable from that of the outer moulded body.

120 The invention also includes an improved method of manufacturing an improved electric plug assembly as hereinbefore described, which method comprises effecting the electrical and/or mechanical connections between the plug pins and their associated conductor terminals and the electrical connections between the conductors of the flexible cable and the conductor terminals; introducing the plug pins, with the cable conductors electrically connected to the conductor terminals associ-

ated with the pins; into holes extending through the preformed body from the front face thereof so that shoulders on the pins bear against the front face of the preformed body and appropriate lengths of the pins protrude from the rear face thereof; connecting to the front face of the preformed body a preformed spider of electrically insulating material which has a plurality of limbs supported on the front face and which has protrusions bearing against parts of the pins protruding from the front face of the preformed body and/or against the associated conductor terminals or fuse contact to hold the pins in position in the body with the shoulders bearing against the front face of the preformed body; moulding electrically insulating material around at least the terminals associated with the line and neutral pins, and preferably around all of the terminals, to encapsulate said terminals wholly in an inner moulded body; and moulding electrically insulating material around the sub-assembly so formed to form an outer moulded body which wholly or partially encapsulates the inner moulded body and is bonded to the insulating covering of an adjacent part of the flexible cable.

Preferably, the outer moulded body is moulded by an injection moulding technique but where, as preferred, the inner moulded body is to be made of nylon or other insulating material that is of low viscosity at the temperature at which it is to be moulded, preferably, to avoid risk of the material injected under pressure from flowing through the spaces between the pins and the walls of the holes in the preformed body through which they protrude, the inner body is moulded by a gravity or low pressure moulding technique. For this purpose, the preformed body may have, upstanding from its front face, a wall which surrounds the holes in the preformed body for reception of the plug pins and surrounds the conductor terminals associated with the plug pins and which has a gap or aperture therethrough for entry of the cable conductors, the wall being of such a height that it upstands beyond the conductor terminals. Gravity or low pressure moulding of the inner moulded body is effected by supporting the preformed body in such a way that the wall upstanding from the front face is substantially vertical and pouring molten insulating material into the space bounded by the wall to encapsulate wholly the conductor terminals. Preferably, a multiplicity of such preformed bodies, with plug pins and their associated conductor terminals mounted therein, are supported with said upstanding wall substantially vertical on an indexing table or conveyor and are caused to travel in turn past a station at which molten insulating material is poured into the space bounded by the wall.

A part of the upstanding wall bounding the gap or aperture in the wall for entry of the

cable conductors to the conductor terminals may constitute at least a part of a cable gripping member which serves to reduce the risk of strain being imparted through the cable to the electrical connections of the cable conductors when tension is applied to the cable in such a direction as to pull the cable away from the preformed body.

The conductors of the flexible cable may be electrically connected to the conductor terminals in any convenient manner, a crimped connection being preferred.

Where the plug assembly is to include means for electrically connecting a cartridge fuse between the line pin and its associated conductor terminal, preferably said means comprises two spaced electrical contacts, one of which is electrically and/or mechanically connected to one of the line pins and the other to its associated conductor terminal before they are introduced into the preformed body and which are introduced into slots in the front face of the body so that they protrude into a cartridge-fuse recess in the rear face of the body.

Alternatively, the two spaced electrical contacts are carried on a single preformed carrier or on two separate preformed carriers of insulating material, which contacts are electrically and/or mechanically connected to the line pin and its associated conductor terminal before they are introduced into the preformed body and which are introduced into a hole or holes in the front face of the body so that they protrude into a cartridge-fuse recess in the rear face of the body with their carrier or carriers fitting tightly in the hole or holes to prevent insulating material of the inner moulded body from entering the fuse recess when it is moulded around the conductor terminals. Preferably, the two electrical contacts are carried on a carrier of rectangular shape which is a tight fit in a hole of corresponding shape. To ensure that the carrier is a tight fit in the hole, preferably the walls of the hole converge towards one another in a direction toward the rear face of the preformed body and the side faces of the carrier are of complementary shape, the tightness of the fit thereby increasing as the carrier is introduced into the hole from the front face of the body.

One or each of the electrical contacts, preferably is a spring clip for gripping a terminal of a cartridge fuse and also is preferably of such a shape and size, having regard to the size of its associated hole, that when the carrier on which the spring clip or clips is or are carried is fully home in the hole, the spring clip or clips effect a snap fit so that the carrier cannot subsequently be withdrawn.

In all cases, preferably the wall upstanding from the front face of the preformed body and surrounding the conductor terminals also surrounds those parts of the electrical contacts for a cartridge fuse which protrude from the

front face of the preformed body and the electrical connections thereto, so that the insulating material of the inner body poured into the space bounded by the wall will also

5 wholly encapsulate said parts of the electrical contacts for a cartridge fuse and the electrical connections thereto.

The invention is further illustrated by a description, by way of example, of a preferred

10 13A three-pin plug assembly of the kind described with reference to the accompanying drawings, in which:-

Figure 1 is an exploded isometric view of the preformed body and preformed spider of the plug;

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Figure 2 is a sectional end view of the preformed body with the preformed spider and inner moulded body thereon;

Figure 3 is a sectional end view of the three-pin plug, and

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Figure 4 is an exploded isometric view of one alternative preformed body and preformed spider for use in a 13A three-pin plug.

Referring to Figs. 1 to 3, the preformed

25 body 1 of moulded plastics material has extending through the body three holes in which two line pins 4 and an earth pin 5, each of hollow form, are inserted from the front face 2 of the body so that they protrude from the rear face 3 of the body with shoulders 6, 7 on the pins bearing against the front face. The live conductor 11 of a flexible cable 10 is connected by a crimped connection 14 to one spring contact 15 of a pair of spring contacts which project into a cartridge fuse recess 16 in the rear face 3 of the preformed body 1; the neutral conductor 12 of the cable is connected by a crimped connection 17 to the neutral line pin 4; and the earth conductor 13

30 of the cable is connected by a crimped connection 18 to the earth pin 5. The live line pin 4 is connected direct to the other of the spring contacts 15. A preformed spider 20 of moulded plastics material is supported by a limb 21 and side limbs 22 on the front face 2 of the preformed body 1, the side limbs making snap-fits in holes 19 in the preformed body. The spider 20 has on its inner surface protrusions 23 which bear against parts of the earth pin and both line pins and their associated conductor terminals and spring contact to urge the shoulders 6, 7 against the front face 2 of the preformed body 1, so that appropriate lengths of the pins protrude from the rear face 3 of the body. An inner moulded body 24 of electrically insulating material wholly encapsulates all the crimped connections and is bonded to the preformed spider 20. An outer moulded body 25 of electrically

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insulating material wholly encapsulates and is bonded to the inner moulded body 24 and is bonded to the sheath of an adjacent part of the flexible cable 10.

Referring to Fig. 4, the preformed body 31 and preformed spider 50 are substantially

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identical to the preformed body 1 and preformed spider 20 shown in Fig. 1 except that the preformed body 31 has, upstanding from its front face 32, a wall 38 which surrounds

70 all the conductor terminals associated with the plug pins 34, 35 and which has a gap 39 in it for entry of the cable conductors of a flexible cable 40. The wall 38 is of such a height that it upstands beyond the conductor

75 terminals. Gravity or low pressure moulding of an inner moulded body on the preformed body 31 is effected by supporting the preformed body in such a way that the wall 38 is substantially vertical and pouring molten insulating material into the space bounded by the wall to encapsulate wholly the conductor terminals.

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CLAIMS

85 1. An electric plug assembly of the kind described comprising a preformed body of electrically insulating material having holes therethrough in which are fitted plug pins which protrude from the rear face of the

90 preformed body and each of which has at least one shoulder bearing against the front face of the preformed body to limit the extent of protrusion of the pin; a preformed spider of electrically insulating material which is supported by a plurality of limbs on, and is connected to, the front face of the preformed body and which has protrusions bearing against parts of the plug pins protruding from the front face of the preformed body and/or

95 100 against the conductor terminals or fuse contact associated the pins to hold the pins in position in the holes with the shoulders bearing against the front face of the preformed body; an inner moulded body of electrically insulating material wholly encapsulating at least the conductor terminals associated with the line and neutral pins; and an outer moulded body of electrically insulating material which wholly or partially encapsulates the

105 110 inner moulded body and is bonded to the insulating covering of an adjacent part of the flexible cable.

2. An electric plug assembly as claimed in Claim 1, wherein the preformed spider is detachably connected to the preformed body.

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3. An electric plug assembly as claimed in Claim 2, wherein the preformed spider has protuberances which are snap-fits in appropriately located holes or recesses in the preformed body.

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4. An electric plug assembly as claimed in any one of the preceding Claims, wherein the preformed spider is of an insulating material which is harder than the insulating materials

125 of the inner and outer moulded bodies.

5. An electric plug assembly as claimed in any one of the preceding Claims, wherein the material of the inner moulded body is bonded to the preformed spider.

130 6. An electric plug assembly as claimed in



front face of the preformed body and the electrical connections thereto, so that the insulating material of the inner body poured into the space bounded by the wall will also wholly encapsulate said parts of the electrical contacts for a cartridge fuse and the electrical connections thereto.

The invention is further illustrated by a description, by way of example, of a preferred 13A three-pin plug assembly of the kind described with reference to the accompanying drawings, in which:-

Figure 1 is an exploded isometric view of the preformed body and preformed spider of the plug;

Figure 2 is a sectional end view of the preformed body with the preformed spider and inner moulded body thereon;

Figure 3 is a sectional end view of the three-pin plug, and

Figure 4 is an exploded isometric view of one alternative preformed body and preformed spider for use in a 13A three-pin plug.

Referring to Figs. 1 to 3, the preformed body 1 of moulded plastics material has extending through the body three holes in which two line pins 4 and an earth pin 5, each of hollow form, are inserted from the front face 2 of the body so that they protrude from the rear face 3 of the body with shoulders 6, 7 on the pins bearing against the front face. The live conductor 11 of a flexible cable 10 is connected by a crimped connection 14 to one spring contact 15 of a pair of spring contacts which project into a cartridge fuse recess 16 in the rear face 3 of the preformed body 1; the neutral conductor 12 of the cable is connected by a crimped connection 17 to the neutral line pin 4; and the earth conductor 13 of the cable is connected by a crimped connection 18 to the earth pin 5. The live line pin 4 is connected direct to the other of the spring contacts 15. A preformed spider 20 of moulded plastics material is supported by a limb 21 and side limbs 22 on the front face 2 of the preformed body 1, the side limbs making snap-fits in holes 19 in the preformed body. The spider 20 has on its inner surface protrusions 23 which bear against parts of the earth pin and both line pins and their associated conductor terminals and spring contact to urge the shoulders 6, 7 against the front face 2 of the preformed body 1, so that appropriate lengths of the pins protrude from the rear face 3 of the body. An inner moulded body 24 of electrically insulating material wholly encapsulates all the crimped connections and is bonded to the preformed spider 20. An outer moulded body 25 of electrically insulating material wholly encapsulates and is bonded to the inner moulded body 24 and is bonded to the sheath of an adjacent part of the flexible cable 10.

Referring to Fig. 4, the preformed body 31 and preformed spider 50 are substantially

identical to the preformed body 1 and preformed spider 20 shown in Fig. 1 except that the preformed body 31 has, upstanding from its front face 32, a wall 38 which surrounds all the conductor terminals associated with the plug pins 34, 35 and which has a gap 39 in it for entry of the cable conductors of a flexible cable 40. The wall 38 is of such a height that it upstands beyond the conductor terminals. Gravity or low pressure moulding of an inner moulded body on the preformed body 31 is effected by supporting the preformed body in such a way that the wall 38 is substantially vertical and pouring molten insulating material into the space bounded by the wall to encapsulate wholly the conductor terminals.

CLAIMS

1. An electric plug assembly of the kind described comprising a preformed body of electrically insulating material having holes therethrough in which are fitted plug pins which protrude from the rear face of the preformed body and each of which has at least one shoulder bearing against the front face of the preformed body to limit the extent of protrusion of the pin; a preformed spider of electrically insulating material which is supported by a plurality of limbs on, and is connected to, the front face of the preformed body and which has protrusions bearing against parts of the plug pins protruding from the front face of the preformed body and/or against the conductor terminals or fuse contact associated the pins to hold the pins in position in the holes with the shoulders bearing against the front face of the preformed body; an inner moulded body of electrically insulating material wholly encapsulating at least the conductor terminals associated with the line and neutral pins; and an outer moulded body of electrically insulating material which wholly or partially encapsulates the inner moulded body and is bonded to the insulating covering of an adjacent part of the flexible cable.

2. An electric plug assembly as claimed in Claim 1, wherein the preformed spider is detachably connected to the preformed body.

3. An electric plug assembly as claimed in Claim 2, wherein the preformed spider has protuberances which are snap-fits in appropriately located holes or recesses in the preformed body.

4. An electric plug assembly as claimed in any one of the preceding Claims, wherein the preformed spider is of an insulating material which is harder than the insulating materials of the inner and outer moulded bodies.

5. An electric plug assembly as claimed in any one of the preceding Claims, wherein the material of the inner moulded body is bonded to the preformed spider.

6. An electric plug assembly as claimed in



any one of the preceding Claims, wherein the material of the outer moulded body is bonded to the material of the inner moulded body.

5 7. An electric plug assembly as claimed in any one of the preceding Claims, wherein the inner moulded body is of a colour different and readily distinguishable from that of the outer moulded body.

10 8. An electric plug assembly as claimed in any one of the preceding Claims, wherein the preformed body has, upstanding from its front face, a wall which surrounds the holes in the pre formed body in which the plug pins are fitted and surrounds the conductor terminals associated with the plug pins and which has a gap or aperture therethrough for entry of the cable conductors, the wall being of such a height that it upstands beyond the conductor terminals.

20 9. An electric plug assembly as claimed in Claim 8, wherein a part of the upstanding wall bounding the gap or aperture in the wall for entry of the cable conductors to the conductor terminals constitutes at least a part of a cable gripping member which serves to reduce the risk of strain being imparted through the cable to the electrical connections of the cable conductors when tension is applied to the cable in such a direction as to pull the cable away from the preformed body.

30 10. An electric plug assembly as claimed in any one of the preceding Claims, wherein the conductors of the flexible cable are electrically connected to the conductor terminals by crimped connections.

35 11. An electric plug assembly as claimed in any one of the preceding Claims, wherein each plug pin is of hollow form.

40 12. An electric plug assembly as claimed in any one of the preceding Claims, wherein the plug assembly includes means for electrically connecting a cartridge fuse between one of the line pins and its associated conductor terminal.

45 13. An electric plug assembly as claimed in Claim 12, wherein said cartridge fuse connecting means comprises two spaced electrical contacts carried on a single preformed carrier or on two separate preformed carriers of insulating material, which contacts are electrically and/or mechanically connected to the line pin and its associated conductor terminal, the carrier or carriers fitting tightly in a hole or holes in the preformed body so that the contacts protrude into a cartridge fuse recess in the rear face of the preformed body.

55 14. An electrical plug assembly as claimed in Claim 13, wherein two electrical contacts are carried on a carrier of rectangular shape which is a tight fit in a hole of corresponding shape in the preformed body.

60 15. An electric plug assembly as claimed in Claim 14, wherein the walls of the hole converge towards one another in a direction towards the rear face of the preformed body

and the side faces of the carrier are of complementary shape, the tightness of the fit thereby increasing as the carrier is introduced into the hole from the front face of the body.

70 16. An electric plug assembly as claimed in any one of Claims 13 to 15, wherein one or each of the electrical contacts is a spring clip for gripping a terminal of a cartridge fuse, each spring clip effecting a snap-fit in the hole so that the carrier cannot subsequently be withdrawn.

75 17. A method of manufacturing an electric plug assembly as claimed in any one of the preceding Claims, which method comprises
80 effecting the electrical and/or mechanical connections between the plug pins and their associated conductor terminals and the electrical connections between the conductors of the flexible cable and the conductor terminals;
85 introducing the plug pins, with the cable conductors electrically connected to the conductor terminals associated with the pins, into holes extending through the preformed body from the front face thereof so that shoulders
90 on the pins bear against the front face of the preformed body and appropriate lengths of the pins protrude from the rear face thereof; connecting to the front face or the preformed body a preformed spider of electrically insulating material which has a plurality of limbs supported on the front face and which has protrusions bearing against parts of the pins protruding from the front face of the preformed body and/or against the associated
95 conductor terminals or fuse contact to hold the pins in position in the body with the shoulders bearing against the front face of the preformed body; moulding electrically insulating material around at least the conductor
100 terminals associated with the line and neutral pins to encapsulate said terminals wholly in an inner moulded body; and moulding electrically insulating material around the sub-assembly so formed to form an outer moulded
105 body which wholly or or partially encapsulates the inner moulded body and is bonded to the insulating covering of an adjacent part of the flexible cable.

110 18. A method as claimed in Claim 17, wherein the inner moulded body is moulded by a gravity or low pressure moulding technique.

115 19. A method as claimed in Claim 18 in which the preformed body has, upstanding from its front face, a wall which surrounds the holes in the preformed body for reception of the plug pins and surrounds the conductor terminals associated with the plug pins and which has a gap or aperture therethrough for entry of the cable conductors, the wall being of such a height that it upstands beyond the conductor terminals, wherein the preformed body is supported with the upstanding wall substantially vertical and molten insulating
120 material is poured into the space bounded by
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the wall to encapsulate wholly the conductor terminals.

20. A method as claimed in Claim 19, wherein a multiplicity of preformed bodies, with plug pins and their associated conductor terminals mounted therein, are supported with their upstanding walls substantially vertical on an indexing table or conveyor and are caused to travel in turn past a station at which molten insulating material is poured into the space bounded by the wall.

21. A method as claimed in any one of Claims 17 to 20, wherein the outer moulded body is moulded by an injection moulding technique.

22. A method of manufacturing an electric plug assembly of the kind described substantially as hereinbefore described with reference to the accompanying drawings.

23. An electric plug assembly of the kind described substantially as hereinbefore described with reference to and as shown in Figs. 1 to 3 or 4 of the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1983.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.