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(54) AN IMPROVED METHOD OF MANUFACTURING AN 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 the manufacture of 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 a face of the plug assembly (hereinafter referred to as the rear face) and is permanently bonded to the insulating covering of a part of the length of the cable. Electric plug assemblies of this kind will hereinafter, for convenience, be referred to as "of the kind described".

The invention is especially, but not exclusively, concerned with three pin electric plug assemblies of the kind described suitable for use with domestic electrical appliances and with other three pin electric plug assemblies of the kind described which incorporate means for electrically connecting a cartridge fuse between the line pin and its associated conductor terminal.

It is an object of the present invention to provide an improved method of manufacturing an electric plug assembly of the kind described.

In the method according to the invention, the electrical connections between the plug pins and their associated conductor terminals and the electrical connections between the cable conductors and the conductor termi-

nals are effected; the plug pins, with their associated conductor terminals and cable conductors electrically connected thereto, are all introduced from the front face of, and into holes in, the preformed body so that appropriate lengths of the pins protrude from the rear face thereof; and electrically insulating material is then moulded therearound to form a moulded plug body which wholly or partially encapsulates the preformed body and the plug pins and associated conductor terminals with appropriate length of the pins protruding from the rear face of the plug assembly and which is bonded to the insulating covering of a part of the length of the flexible cable.

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 connected to the line pin and the other to its associated conductor terminal, before they are introduced from the front face of, and into holes in, the preformed body so that they protrude into a cartridge-fuse recess in the rear face of the body.

Alternatively the two spaced cartridge fuse contacts are carried on a single preformed carrier or on two separate preformed carriers of insulating material, which contacts are electrically connected to the line pin and its associated conductor terminal, before they are introduced from the front face of, and into a hole or holes in, the preformed 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 associated hole or holes in the preformed body to prevent insulating material of the plug body from entering the fuse recess when it is moulded around the preformed body and the pins and conductor terminals mounted thereon. Preferably the two cartridge fuse contacts are carried on a carrier of rectangu-

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lar 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 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. One or each of the cartridge fuse 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.

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

Preferably, as is described and claimed in the Complete Specification of our co-pending Patent Application No. 25252/77 (Serial No. 1604425), at least the line and neutral conductor terminals of the plug assembly are guarded by a preformed cover of an electrically insulating material that is harder than the insulating material of the moulded plug body, which cover is connected to the preformed body to overlie the conductor terminals. The preformed cover preferably has ribs or other protuberances projecting inwardly of the cover 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.

Preferably, also, the risk of strain being imparted through the flexible cable to the electrical connections of the cable conductors within the plug assembly is substantially reduced by the use of a cable gripping member as described and claimed in the Complete Specification of our co-pending Patent Application No. 25251/77 (Serial No. 1604424).

The invention also includes an electric plug assembly of the kind described manufactured by the method as hereinbefore described.

Two preferred forms of 13A three pin electric plug assembly of the kind described manufactured by the method of the invention will now be described, 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 one plug assembly;

Figure 2 is a front view of the plug assembly shown in Figure 1 with the

moulded plug 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 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 the second three-pin electric plug assembly;

Figure 6 is a front view of the plug assembly shown 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 insulating 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 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 10 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, that 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.

5 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.

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

20 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.

40 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 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 second 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. A method of manufacturing an electric
plug assembly of the kind in which the
plug pin 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 partly encapsulates the preformed
body and the plug pins and associated
conductor terminals with an appropriate
length of each pin protruding from the rear
face of the plug assembly and is permanently
bonded to the insulating covering of a part of
the length of cable; which method comprises
effecting the electrical connections between
the plug pins and their associated conductor
terminals and the electrical connections between
the cable conductors and the conductor
terminals, introducing the plug pins, with
their associated conductor terminals and
cable conductors electrically connected thereto,
from the front face of, and into holes in
the preformed body so that appropriate
lengths of the pins protrude from the rear
face thereof; and moulding electrically insulating
material therearound to form a
moulded plug body which wholly or partially
encapsulates the preformed body and the
plug pins and associated conductor terminals
with appropriate lengths of the pins protruding
from the rear face of the plug assembly and
which is bonded to the insulating covering
of a part of the length of the flexible
cable.

2. A method of manufacturing an electric
plug assembly of the kind in which the



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 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 second 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. A method of manufacturing an electric plug assembly of the kind in which the plug pin 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 partly encapsulates the preformed body and the plug pins and associated conductor terminals with an appropriate length of each pin protruding from the rear face of the plug assembly and is permanently bonded to the insulating covering of a part of the length of cable; which method comprises effecting the electrical connections between the plug pins and their associated conductor terminals and the electrical connections between the cable conductors and the conductor terminals, introducing the plug pins, with their associated conductor terminals and cable conductors electrically connected thereto, from the front face of, and into holes in the preformed body so that appropriate lengths of the pins protrude from the rear face thereof; and moulding electrically insulating material therearound to form a moulded plug body which wholly or partially encapsulates the preformed body and the plug pins and associated conductor terminals with appropriate lengths of the pins protruding from the rear face of the plug assembly and which is bonded to the insulating covering of a part of the length of the flexible cable.

2. A method of manufacturing an electric plug assembly of the kind in which the

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5 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, two spaced electrical contacts are provided for electrically connecting a cartridge fuse between the line pin and the associated conductor terminal, and a moulded plug body of electrically insulating material wholly or partly encapsulates the preformed body, the plug pins and associated conductor terminals, with an appropriate length of each pin protruding from the rear face of the plug assembly and is permanently bonded to the insulating covering of a part of the length of cable; which method comprises effecting the electrical connections between the plug pins and their associated conductor terminals and between the cartridge fuse contacts and the line pin and its associated conductor terminal, and the electrical connections between the cable conductors and the conductor terminals; introducing the plug pins, with their associated conductor terminals and cable conductors electrically connected thereto, and the cartridge-fuse contacts, from the front face of, and into holes in, the preformed body so that appropriate lengths of the pins protrude from the rear face thereof and the cartridge fuse contacts protrude into a fuse recess in the rear face; and moulding electrically insulating material therearound to form a moulded plug body which wholly or partially encapsulates the preformed body and the plug pins and associated conductor terminals with appropriate lengths of the pins protruding from the rear face of the plug assembly and which is bonded to the insulating covering of a part of the length of the flexible cable.

3. A method of manufacturing an electric plug assembly as claimed in Claim 2; wherein one or each of the cartridge fuse contacts is a spring clip for gripping a terminal of a cartridge fuse.

4. A method of manufacturing 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, means are provided for electrically connecting a cartridge fuse between the line pin and the associated conductor terminal, which connecting means comprises two spaced electrical contacts carried on a single preformed carrier or on two separate preformed carriers of insulating material, and a moulded plug body of electrically insulating material wholly or partly encapsulates the preformed body, the plug pins and associated conductor terminals, and the cartridge fuse connecting means, with an appropriate length of each pin protruding from the rear face of the plug assembly and is permanently bonded to the insulating covering of a part of the length of cable; which method comprises effecting the electrical connections between the plug pins and their associated conductor terminals and between the cartridge fuse contacts and the line pin and its associated conductor terminal, and the electrical connections between the cable conductors and the conductor terminals; introducing the plug pins, with their associated conductor terminals and cable conductors electrically connected thereto, and the cartridge-fuse contacts, from the front face of, and into holes in, the preformed body so that appropriate lengths of the pins protrude from the rear face thereof and the cartridge fuse contacts protrude into a fuse recess in the rear face; and moulding electrically insulating material therearound to form a moulded plug body which wholly or partially encapsulates the preformed body and the plug pins and associated conductor terminals with appropriate lengths of the pins protruding from the rear face of the plug assembly and which is bonded to the insulating covering of a part of the length of the flexible cable.

nals, and the cartridge fuse connecting means, with an appropriate length of each pin protruding from the rear face of the plug assembly and is permanently bonded to the insulating covering of a part of the length of cable; which method comprises effecting the electrical connections between the plug pins and their associated conductor terminals and between the cartridge fuse contacts and the line pin and its associated conductor terminal, and the electrical connections between the cable conductors and the conductor terminals; introducing the plug pins, with their associated conductor terminals and cable conductors electrically connected thereto, and the carrier or carriers of the cartridge fuse contacts from the front face of, and into holes in the preformed body so that appropriate lengths of the pins protrude from the rear face thereof and the cartridge fuse contacts protrude into a fuse recess in the rear face with their carrier or carriers fitting tightly into the associated hole or holes in the preformed body; and moulding electrically insulating material therearound to form a moulded plug body which wholly or partially encapsulates the preformed body and the plug pins and associated conductor terminals with appropriate lengths of the pins protruding from the rear face of the plug assembly and which is bonded to the insulating covering of a part of the length of the flexible cable.

5. A method of manufacturing an electric plug assembly as claimed in Claim 4 in which two cartridge fuse contacts are carried on a single preformed carrier, wherein the carrier is of rectangular shape and the hole in the preformed body in which the carrier is a tight fit is of corresponding shape.

6. A method of manufacturing an electric plug assembly as claimed in Claim 5; 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.

7. A method of manufacturing an electric plug assembly as claimed in Claim 5 or 6; wherein one or each of the cartridge fuse contacts is a spring clip for gripping a terminal of a cartridge fuse.

8. A method of manufacturing an electric plug assembly as claimed in Claim 7; wherein the or each spring clip is of such a shape and size, having regard to the size of the rectangular hole, that when the carrier is fully home in the hole, the spring clip or clips effect a snap fit.

9. A method of manufacturing an electric plug assembly as claimed in any one of the preceding Claims; wherein the conductors of the flexible cable are crimped to the



conductor terminals.

10. A method of manufacturing an electric plug assembly as claimed in any one of the preceding Claims; wherein before electrically insulating material is moulded around the plug pins and their associated conductor terminals a preformed cover of an electrically insulating material that is harder than the insulating material of the moulded plug body is applied over at least the line and neutral conductor terminals of the plug assembly and is connected to the preformed body.

11. A method of manufacturing an electric plug assembly as claimed in Claim 10; wherein the preformed cover has ribs or other protuberances projecting inwardly of the cover 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.

12. A method of manufacturing an electric plug assembly as claimed in any one of the preceding Claims; wherein a cable gripping member is used to reduce substantially the risk of strain being imparted through the flexible cable to the electrical connections of the cable conductors within the plug assembly.

13. A method of manufacturing an electric plug assembly substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

14. A method of manufacturing an electric plug assembly substantially as hereinbefore described with reference to Figures 5 to 7 of the accompanying drawings.

15. An electric plug assembly of the kind described manufactured by the method claimed in any one of the preceding Claims.

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