

PATENT SPECIFICATION

(11)

1 595 151

1 595 151

(21) Application No. 1138/78 (22) Filed 11 January 1978

(23) Complete Specification Filed 31 May 1978

(44) Complete Specification Published 12 August 1981

(51) INT. CL.³ F16B 19/10

(52) Index at Acceptance

F2H 11B13 11B1A 11B22A

(72) Inventor: JOHN THOMAS CLARK

(19)



(54) CLOSURE DEVICE

(71) We, ASSOCIATED ELECTRICAL INDUSTRIES LIMITED, of 1 Stanhope Gate, London W1A 1EH, a British Company, do hereby declare the invention, for which we pray

5 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:-

10 This invention relates to electrical apparatus of the kind having current carrying components enclosed in an outer casing, usually of insulating material, and to the closure of cable entries of such apparatus.

15 Cable entries through which cables can be passed between the interior of the apparatus and its exterior are often formed by holes extending through appropriate parts of the outer wall of the casing.

20 In order to prevent accidental, or unauthorised entry of conductors and other foreign bodies, the cable entries of such apparatus are usually required to be blanked off during manufacture. The practice hitherto, has been to provide a thin diaphragm across each cable entry hole, which can easily be broken away during

25 installation of the apparatus by applying pressure to the diaphragm by means of, e.g., a screwdriver blade, or a similar implement. Particularly where the casings are moulded from a plastics material, with the diaphragms, also known as 'knockouts', being formed

30 integrally with the casing, weak zones may be formed in an otherwise strong casing, thus reducing the overall impact withstanding strength of the casing.

35 It is an object of the present invention to provide an alternative to knockout diaphragms, which avoids some of the disadvantages associated with such diaphragms. According to the present invention a closure device for blanking off cable entry holes in a casing of electrical apparatus comprises a generally cylindrical first member having a bore extending in an axial direction through it, and

40 a second member capable of being accommodated within the bore of the first member, the first member having at one end a plurality of axially extending resilient fingers circumferentially surrounding the bore, with the bore having a part of reduced width extending over

45 at least part of the length of the fingers such that the introduction of the second member

into said part of the bore from the other end of the first member displaces the fingers or at least part thereof, radially outwards, said device being dimensioned in relation to an associated cable entry hole such that the fingered region of the first member will easily pass through the cable entry hole when the fingers are in their original, unexpanded state, but is unable to pass through the cable entry hole when expanded by insertion of the second member into the bore of the first member, wherein the said second member is capable of being driven completely through the bore of the first member, and wherein the latter is formed of a material having such resilience that the fingers then return to a position which does not obstruct withdrawal of the member from the cable entry hole.

70 The insertion of the second member into that part of the bore of the first member which is of reduced width and the consequential outward displacement of the fingers increases the effective diameter of the fingered region of the first member, preventing subsequent withdrawal of the closure device, which thus provides an effective blanking off of the respective cable entry hole. The invention is especially applicable to fuse cut-outs but may also be applied to other forms of electrical apparatus having a casing with one or more entry holes.

80 The first member may be prevented from passing completely through the cable entry hole by a suitable stop in the interior of the casing, e.g. the body of a cable terminal, but preferably the first member widens at a position spaced axially from the fingered region, for example at said other end, into a radially outwardly extending flange large enough to prevent its passage through the associated cable entry hole. Cable entry holes are frequently of tapered shape with the taper opening towards the exterior of the casing, so as to facilitate the insertion of cables and conductors, and in such cases the external diameter of the flange can conveniently be chosen to be between the maximum and minimum internal diameters of the tapered hole, so that when the first member is fully inserted the flange lies within the hole.

100 The use of a closure device in accordance with the invention allows the cable entry holes to be formed as unobstructed bores, having a

55

60

65

70

75

80

85

90

95

100

substantially smooth internal surface, and thus aids the prevention of weak zones during the manufacture of the casing, particularly if the casing is made by a moulding process.

5 The external diameter of the second member is preferably approximately equal to the internal diameter of the bore at said other end of the first member.

10 The first and second members of the closure device are preferably formed of electrically insulating material, and are conveniently moulded from resilient plastics material, such as a thermo-plastic material, with said fingers forming an integral part of the first member.

15 The use of a thermo-plastic material is particularly advantageous as it permits the outer end of the bore of the first member to be deformed, e.g. by heating, after the second member has been inserted, so as to retain the latter against withdrawal from the first member without an appropriate tool. The fingers of the first member are thereby held in their expanded condition and hold the first member firmly in position within the respective cable entry hole.

25 Some or all of the fingers may incorporate at least one radially outwardly extending projection, for example at their free ends, which assists in securing the first member within a respective cable entry hole when the fingers are in the expanded condition.

30 The bore of the first member and the co-operating second member may have any convenient shape of cross-section.

35 Preferably, however, the bore of the first member is substantially cylindrical at the end remote from the fingers and the second member is also substantially cylindrical in shape, the bore of the first member having a diameter which, over part at least of the length of the fingers is smaller than the diameter of the second member and which at the other end of the first member is such as to permit the second member to be introduced into the bore from said other end to a position at which the bore has said smaller diameter.

45 The first and second member may in some cases be formed as a one-piece moulding with the second member extending axially away from said other end of the first member, and being secured to the first member by an annular shear joint arranged to shear if the second member is driven into the axial bore of the first member.

The invention will now be described further by way of example only and with reference to the accompanying drawings of which:-

55 Figure 1 is a composite drawing showing a partly sectional view, cut along the line I-I, of a closure device in accordance with the present invention;

60 Figure 2 shows a closure device as shown in Figure 1 located in a cable entry hole and locked therein respectively, and

65 Figures 3a and 3b of Figure 3 illustrate two stages during the extraction from a cable entry hole of a closure device in accordance with the present invention

Referring first to Figure 1, a closure device 1 moulded integrally from thermo-plastic material, comprises a second cylinder-shaped member, or pin, 2 and a tubular first member, or plug 3, the pin being secured coaxially to an end of the plug along a shear joint 15. The plug 3 comprises a cylindrical section 5 divided at the end further from the pin 2 by radial slots 13 into a plurality of fingers 10, and widening at that end where it joins the pin 2 into an annular flange 4. An axial through bore 17 extends over the whole length of the plug 3, and has a cylindrical section 8 substantially within the annular flange 4 and a tapered section 7 extending up to, and narrowing towards that end of the plug 3 which incorporates the fingers 10. Each of the fingers 10 carries a radially outwardly extending projection 6. Alternatively, the projection 6 may be provided on only some, but not all, of the fingers 10.

The plug 2, which has an external diameter equal to the internal diameter of the cylindrical section 8 of the bore, has an axial blind hole 14 entering from the end face 16 of the pin 2. The hole 14 is a stepped bore having a wider outer section 11 and a narrower inner section 12, the function of the bore 14 being explained below.

The material chosen for the plug should be such that plastic deformation of the fingers will not occur even after long periods in the expanded state, in order to facilitate withdrawal of the plug, as described with reference to Figure 3, even after long storage periods of the associated electrical apparatus.

Figure 2 shows a part sectional view of part of a fuse unit 20, which has two cable entry holes 21 and 22. Each of these cable entry holes 21 and 22 is aligned with a respective one of cable tunnels 27 of a cable terminal 23. Each of the cable tunnels has associated cable clamping screws 24 and 25, which enter the respective cable tunnel at right angles to its direction and which are of the socket type. A slot 26 is located between the cable terminals to accommodate one set of fuse contacts (not shown) in use of the fuse unit. Both the illustrated cable entry holes 21 and 22 are formed by tapered bores widening outwardly.

The closure members 1 located within the cable entry holes 21 and 22 are illustrated respectively before and after locking into position has taken place. As can be seen from the drawing, the flange 4 of the closure device 1 abuts with its tapered circumferential surface against the inner surface of the respective tapered bore, with the fingers 10 projecting beyond the inner end of the bore. In the case of the closure device 1 inserted in the bore 21, the fingers 10 and their respective projections 6 are arranged to easily pass through the narrowest part of the tapered bore, their external diameter being such that withdrawal of the closure device at this stage can easily be carried out. The diameter of the pin 2, and of the bore

70

75

80

85

90

95

100

105

110

115

120

125

130

17 of the plug 3, is chosen to be less than the diameter of the adjacent cable tunnel 27. Also, before locking the closure device within the cable entry hole, the clamping screws 24 and 25 are inserted fully into the associated cable tunnel. The locking of the closure device 1 within the cable entry hole is achieved, as illustrated with respect to bore 22, by driving the pin 2 into the bore 17 of the plug 3 until the pin 2 abuts against the side of the cable clamping screw 24. The application of a driving force to the end face 16 of the pin 2 initially causes the shearing of the shear joint 15, whilst further entry of the pin 2 into the bore 17 causes the fingers 10 to move radially outwards, with the projections 6 abutting against the inside wall 29 of the fuse unit 20, thus preventing withdrawal of the closure member. In order to provide a tamper proof blanking off of the cable entry holes, the pin 2 is dimensioned such that its end face 16 lies after insertion within the bore 17. The outermost part of the bore 17 is reduced in diameter subsequent to the insertion of the pin 2, for example by applying a heated rod to the outside of the flange, thus preventing the withdrawal of the pins by forming a rim 32 (Figure 3).

Referring now also to Figure 3, removal of the closure member for installation of the fuse unit is achieved by the following method, and requires a tool having a shaft 35 and an axially projecting spigot 36 at an end of the shaft. This tool may be the same as the tool 33, shown in Figure 3a, used for rotating the clamping screws 24 and 25. The shaft of the tool needs to be of a diameter less than that of the pin 2, but large enough to form an interference fit with the rim 32, as shown in Figure 3b. The spigot has to be of a diameter such as to form an interference fit with the inner section 12 of the blind hold 14 in the pin 2.

After withdrawing the clamping screws 24 and 25 sufficiently to provide a clear passage through the cable tunnel, the tool is located with its spigot 36 in the outer section 12 of the blind hole 14 of the pin, and by applying to the pin 2 a driving force directed towards the cable tunnel 27, the pin is driven out of the bore 17 and into the cable tunnel 27. The shaft 35 of the tool enters the bore 17, but as its diameter is less than that of the pin 2, the fingers 10 can return to their position as moulded. By driving the pin 2 through the cable tunnel until it abuts against the wall 30 of the fuse unit, and applying further pressure to the tool, the spigot 36 will enter the inner section 12 of the blind hole 14, thus attaching the pin 2 to the spigot 36. As the shaft of the tool also forms an interference fit with the rim 32 of the plug 3, and as the fingers 10 in their position as moulded do not obstruct passage of the plug 3 through the cable entry hole 2 withdrawal of the tool will thus result in withdrawal of the plug 3 and the pin 2. As it will in general not be possible to reinsert the pin 2 into the plug 3

from that end of the plug 3 incorporating the flange 4, unauthorised removal of a closure device in accordance with the present invention can easily be detected. Also, as the removal of the closure device for installation does not entail any breaking action, the formation of weak zones in the casing is avoided, thus preserving the overall impact withstanding strength of the casing.

It will be understood that the invention includes within its scope electrical apparatus, more especially fuse cut-outs having one or more cable entries blanked off by closure devices as above described.

WHAT WE CLAIM IS:

1. A closure device for blanking off cable entry holes in a casing of electrical apparatus, comprising a generally cylindrical first member having a bore extending in an axial direction through it, and a second member capable of being accommodated within the bore of the first member, the first member having at one end a plurality of axially extending resilient fingers circumferentially surrounding the bore which bore has a part of reduced width extending over at least part of the length of the fingers such that the insertion of the second member into said part of the bore from the other end of the first member displaces the fingers, or at least part thereof, radially outwards, said device being dimensioned in relation to an associated cable entry hole such that the fingered region of the first member will easily pass through the cable entry hole when the fingers are in their original, unexpanded state, but is unable to pass through the cable entry hole when expanded by insertion of the second member into the bore of the first member, wherein the said second member is capable of being driven completely through the bore of the first member, and wherein the latter is formed of a material having such resilience that the fingers then return to a position which does not obstruct withdrawal of the member from the cable entry hole.

2. A closure device as claimed in claim 1, wherein the first member carries a radially outwardly projecting flange at a position spaced axially from the fingered region and large enough to prevent its passage through the cable entry hole.

3. A closure device as claimed in any preceding claim, wherein some or all of the fingers incorporate at least one radially outwardly extending projection at their free ends.

4. A closure device as claimed in any preceding claim, wherein the core of the first member is substantially cylindrical at the said other end, and the second member is substantially cylindrical in shape and of an external diameter approximately equal to the internal diameter of the bore at said other end.

5. A closure device as claimed in any preceding claim, whose first and second members are made of thermo-plastic material.



* C L M S *

12

17 of the plug 3, is chosen to be less than the diameter of the adjacent cable tunnel 27. Also, before locking the closure device within the cable entry hole, the clamping screws 24 and 25 are inserted fully into the associated cable tunnel. The locking of the closure device 1 within the cable entry hole is achieved, as illustrated with respect to bore 22, by driving the pin 2 into the bore 17 of the plug 3 until the pin 2 abuts against the side of the cable clamping screw 24. The application of a driving force to the end face 16 of the pin 2 initially causes the shearing of the shear joint 15, whilst further entry of the pin 2 into the bore 17 causes the fingers 10 to move radially outwards, with the projections 6 abutting against the inside wall 29 of the fuse unit 20, thus preventing withdrawal of the closure member. In order to provide a tamper proof blanking off of the cable entry holes, the pin 2 is dimensioned such that its end face 16 lies after insertion within the bore 17. The outermost part of the bore 17 is reduced in diameter subsequent to the insertion of the pin 2, for example by applying a heated rod to the outside of the flange, thus preventing the withdrawal of the pins by forming a rim 32 (Figure 3).

Referring now also to Figure 3, removal of the closure member for installation of the fuse unit is achieved by the following method, and requires a tool having a shaft 35 and an axially projecting spigot 36 at an end of the shaft. This tool may be the same as the tool 33, shown in Figure 3a, used for rotating the clamping screws 24 and 25. The shaft of the tool needs to be of a diameter less than that of the pin 2, but large enough to form an interference fit with the rim 32, as shown in Figure 3b. The spigot has to be of a diameter such as to form an interference fit with the inner section 12 of the blind hold 14 in the pin 2.

After withdrawing the clamping screws 24 and 25 sufficiently to provide a clear passage through the cable tunnel, the tool is located with its spigot 36 in the outer section 12 of the blind hole 14 of the pin, and by applying to the pin 2 a driving force directed towards the cable tunnel 27, the pin is driven out of the bore 17 and into the cable tunnel 27. The shaft 35 of the tool enters the bore 17, but as its diameter is less than that of the pin 2, the fingers 10 can return to their position as moulded. By driving the pin 2 through the cable tunnel until it abuts against the wall 30 of the fuse unit, and applying further pressure to the tool, the spigot 36 will enter the inner section 12 of the blind hole 14, thus attaching the pin 2 to the spigot 36. As the shaft of the tool also forms an interference fit with the rim 32 of the plug 3, and as the fingers 10 in their position as moulded do not obstruct passage of the plug 3 through the cable entry hole 2 withdrawal of the tool will thus result in withdrawal of the plug 3 and the pin 2. As it will in general not be possible to reinsert the pin 2 into the plug 3

from that end of the plug 3 incorporating the flange 4, unauthorised removal of a closure device in accordance with the present invention can easily be detected. Also, as the removal of the closure device for installation does not entail any breaking action, the formation of weak zones in the casing is avoided, thus preserving the overall impact withstanding strength of the casing.

It will be understood that the invention includes within its scope electrical apparatus, more especially fuse cut-outs having one or more cable entries blanked off by closure devices as above described.

WHAT WE CLAIM IS:

1. A closure device for blanking off cable entry holes in a casing of electrical apparatus, comprising a generally cylindrical first member having a bore extending in an axial direction through it, and a second member capable of being accommodated within the bore of the first member, the first member having at one end a plurality of axially extending resilient fingers circumferentially surrounding the bore which bore has a part of reduced width extending over at least part of the length of the fingers such that the insertion of the second member into said part of the bore from the other end of the first member displaces the fingers, or at least part thereof, radially outwards, said device being dimensioned in relation to an associated cable entry hole such that the fingered region of the first member will easily pass through the cable entry hole when the fingers are in their original, unexpanded state, but is unable to pass through the cable entry hole when expanded by insertion of the second member into the bore of the first member, wherein the said second member is capable of being driven completely through the bore of the first member, and wherein the latter is formed of a material having such resilience that the fingers then return to a position which does not obstruct withdrawal of the member from the cable entry hole.

2. A closure device as claimed in claim 1, wherein the first member carries a radially outwardly projecting flange at a position spaced axially from the fingered region and large enough to prevent its passage through the cable entry hole.

3. A closure device as claimed in any preceding claim, wherein some or all of the fingers incorporate at least one radially outwardly extending projection at their free ends.

4. A closure device as claimed in any preceding claim, wherein the core of the first member is substantially cylindrical at the said other end, and the second member is substantially cylindrical in shape and of an external diameter approximately equal to the internal diameter of the bore at said other end.

5. A closure device as claimed in any preceding claim, whose first and second members are made of thermo-plastic material.

13



* C L M S *

4

1 595 151

4

6. A closure device as claimed in any preceding claim in combination with a fuse unit having a casing incorporating cable entry holes adapted to receive respective said closure devices
5 by having cable entry holes which provide an unobstructed passage to, and are substantially in alignment with cable tunnels of cable terminals within the casing.
7. A closure device substantially as described
10 with reference to, and as shown in Figure 1 of the accompanying drawings.
8. A method of blanking off a cable entry hole in a casing of an electrical apparatus, utilising a closure device according to any preceding
15 claim wherein the said first member of the device is inserted, fingered end first, into the cable entry hole until at least the free ends of the fingers project therefrom, and introducing said second member into the reduced width part of
20 the bore so as to displace the fingers radially outwards by an amount which prevents withdrawal of the first member from the hole.
9. A method according to claim 8, wherein the first member is formed of a thermo-plastic
25 material, and the outer end of the bore of the member is deformed, e.g. by heating, after the second member has been introduced into it so as to retain the latter against withdrawal.
10. A method of removing a closure device from a cable entry hole which has been blanked
30 off by the device by the method as claimed in claim 8 or 9 including the steps of driving the said second member completely from the bore of the first member to permit the fingers of the
35 latter to return to a position which no longer obstructs the withdrawal of the member from the hole, introducing through the bore of the first member a tool capable of engaging the said first and second members in a manner which
40 permits withdrawal thereof, and withdrawing the first and second members from the hole.
11. A closure device adapted to be inserted and withdrawn respectively from an associated
45 cable entry hole in a manner substantially as described with reference to, and as shown in Figures 2 and 3 of the accompanying drawings.
12. A fuse unit incorporating a closure device substantially as described with reference
50 to, and as shown in the accompanying drawings.

H V A KIRBY
Chartered Patent Agents
Agent for the Applicant