Sept. 20, 1960 J. E. COX 2,953,665

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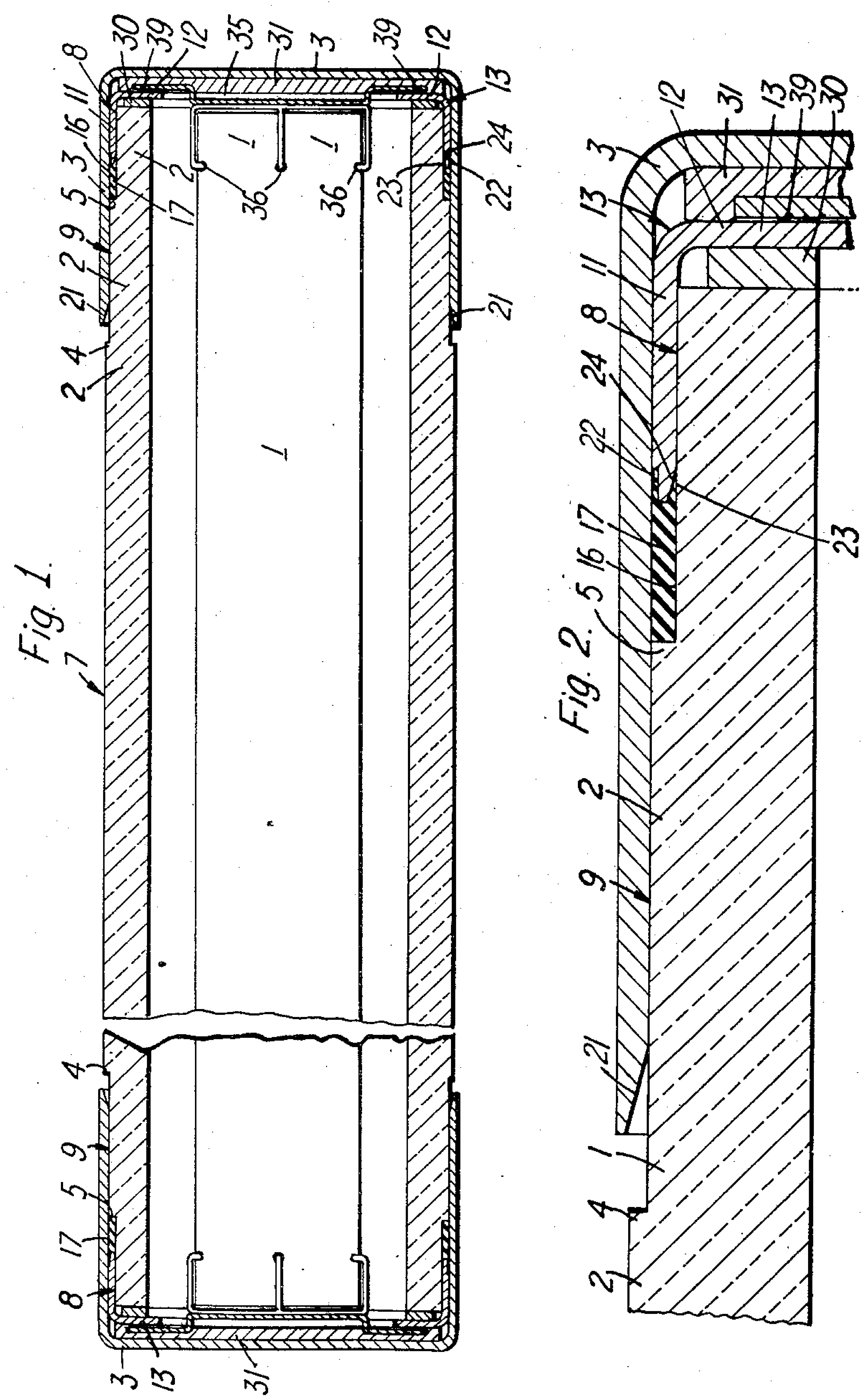
Filed Dec. 30, 1958

2 Sheets-Sheet 1



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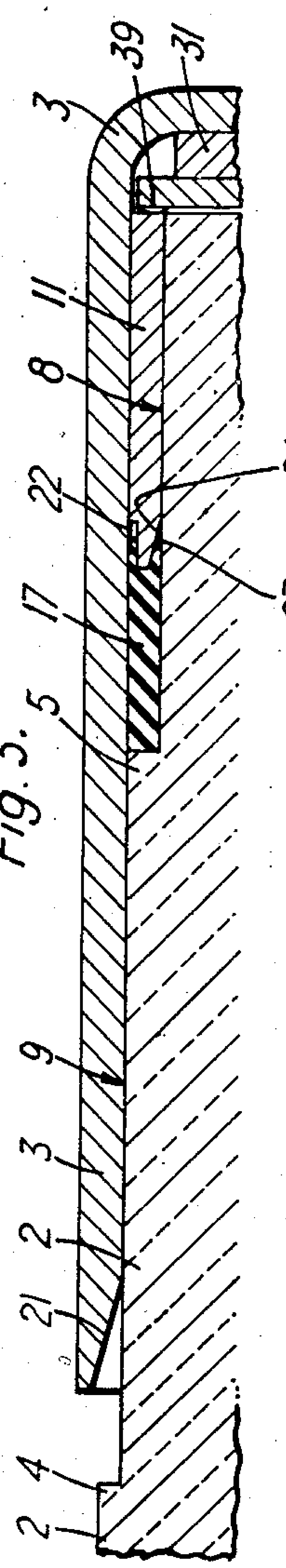

Fig. 3.

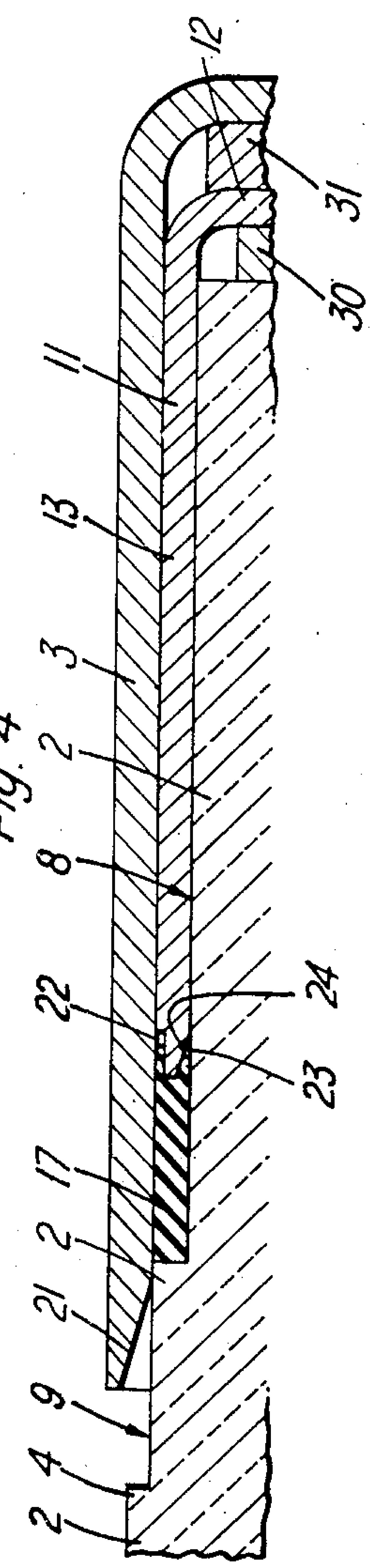

Fig. 4

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9 Claims. (Cl. 200—132)

In an electrical cartridge fuse it is important to provide at each end a closure which is gas-tight, water-tight and oil-tight and which is also able to stand up to the abrupt mechanical shock occasioned by the rupturing of the fuse which occurs with explosive violence. One form of closure for such a fuse is described in British specification No. 692,627 and as described in that specification a terminal cap each end of the cylindrical body of the fuse is secured in position by means of one or more yieldable sealing rings which are seated in corresponding annular grooves and which are engaged and deformed under compression by each terminal cap as it is forced onto the end of the body. In practice, and as illustrated in the specification, the grooves for the reception of the sealing rings are formed in the cylindrical body, which is commonly made of porcelain.

The presence of these grooves in the body is found to constitute a source of weakness in the fuse. The explosive shock caused by the rupture of the fuse and the pressure of the gases remaining in the fuse after such rupture act on the terminal caps and on the rare occasions when one or other of these is blown off the body of the fuse it is found that the failure is in the region of the grooves. These grooves not only cause a local reduction in the thickness of the cylindrical body and hence in its tensile strength but also produce concentrations of stress which are accentuated on rupture and which may lead to failure. If it is attempted to overcome this by thickening the wall, this leads to further difficulties. For a given capacity of fuse, the fuse holders are of standard size so that the outer diameter cannot be increased and any thickening of the wall, leading to a decrease of the internal diameter, reduces the internal volume of the fuse and thus its resistance to thermal shock, so that its circuit-breaking properties are impaired.

According to the present invention, in an electric fuse in which the fusible element or elements are housed in a cylindrical insulating body closed at its ends by caps, each end portion of the body is of reduced diameter and supports a sleeve lying between this portion and the respective cap and defining with this cap and the body an annular passage, which is filled substantially by a sealing ring held in radial compression by this cap, each of the caps having an interference fit with the body, either directly or through the respective sleeve. By substantially filling the annular passage with the ring, and radially compressing the latter, the necessary gas-tight, water-tight and oil-tight seal is provided, whilst the interference fit gives the necessary mechanical strength. By avoiding the use of grooves in the cylindrical body, the dangerous stress concentrations referred to previously are avoided, whilst in addition the body is manufactured more easily.

Four examples of electrical fuses constructed in accordance with the invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a longitudinal section, partly broken away, to show the first fuse;

Figure 2 is an enlarged longitudinal section of the top right hand part of the first fuse as seen in Figure 1; and

Figures 3 and 4 are corresponding enlarged sections of parts on the second and third fuses.

The first fuse has a single elongated insulating core **1** around which and along which are wound in spiral fashion one or more fusible elements (not shown). This core **1** and the element or elements are housed in a cylindrical porcelain body **2** which is closed at its ends by copper terminal caps **3**. Towards each end, the body is provided with two right angled steps or shoulders **4**, **5** so that the body **2** comprises a main central portion indicated at **7**, two end portions of reduced diameter indicated at **8** and two intermediate portions of intermediate diameter indicated at **9**.

Each end portion **8** supports a copper sleeve **11**, which is integral with a flange **12**, the sleeve **11** and flange **12** constituting an inner cap indicated generally at **13**. As can be seen most clearly in Figure 2, each sleeve **11** lies between the reduced diameter portion **8** and the respective cap **3** and defines with this cap and with the body at the shoulder **5** an annular passage **16** of substantially rectangular cross section. This passage **16** is filled substantially by a neoprene sealing ring **17**. In its unstressed state, each ring **17** has an axial length substantially equal to that of the passage **16**, its inner diameter is substantially equal to the diameter of the end portion **8**, whilst its outer diameter is somewhat greater than the diameter of the portion **9**. As a result of this, when the cap **13** has been pressed onto the end portion **8**, and the ring **17** is pushed into the groove defined by this cap **13** and the body **2** at the shoulder **5**, the ring **17** stands proud of this groove. When the cap **5** is subsequently forced on, the ring **17** is compressed radially by the cap, which is provided with a bevelled edge **21** to permit this compression to be effected gradually. During this gradual increase in radial compression, the neoprene extrudes into two spaces **22** and **23** (see Figure 2). The space **23** is created by providing the cap **13** with a bevelled edge **24** to permit it to be readily pushed over the end of the body **2**. The space **22** is provided solely to permit the extrusion of the neoprene and is extremely small (0.008") in a radial direction, this radial dimension being shown much exaggerated in Figure 2, the axial dimension being 0.062".

It has been found advisable to employ a lubricant when pressing on the cap **3**.

When assembled as shown in Figures 1 and 2, the ring **17** provides a gas-tight, water-tight and oil-tight seal between the body **2** and the end cap **3**.

The caps **3** are mechanically held on to the body **2** by virtue of interference fits between them. One interference fit is a direct one between the cap **3** and the portion **9**, whilst the other interference fit is an indirect one, via the sleeve **11**. Thus, in the particular fuse illustrated, the diameter of the portion **9** is 2.370 inches whilst the inner diameter of the cap **3** is 2.363 inches, so that there is an interference fit corresponding to .007 inch. The diameter of the portion **8** is 2.268 inches, whilst the inner diameter of the sleeve **11** is 2.266 inches, so that there is an interference fit between them corresponding to .002 inch. The outer diameter of the sleeve **11** when unstressed is 2.362 inches, so that the outer diameter when in position over the portion **8** is some 2.364 inches, so that there is an interference fit corresponding to 0.001 inch between the sleeve **11** and the cap **3**.

The flange **12** of each cap **13** is spaced from the body **2** by an asbestos washer **30** and from the top of the cap **3** by an asbestos disc **31** which acts as a resilient pad. The core **1** supporting the fusible element or elements is embedded in an arc-quenching powder such as quartz powder. The core **1** is held in position within this powder by means of two conducting supports **35**, arranged at opposite ends. Each support comprises a claw having four prongs which engage in four notches **36** formed in the core **1**. This claw is welded to a U-shaped conducting member whose ends are bent outwards and welded to the flange **12** as indicated at **39**. The fusible element or elements are connected electrically to the claw which, as will be appreciated, is connected electrically to the cap **3** via the cap **13**.

If the illustrated fuse ruptures, the caps **3** tend to be pushed off, but the seal between them and the body **2** is not impaired because the rings **17** are retained in position, engaging the caps **3**, by the caps **13**. The latter are retained in position by the frictional forces between the caps **13** and the portions **8**, forces which are significantly greater than the frictional forces between the caps **13** and the caps **3**.

The ring **17** need not be of rectangular section when unstressed but may, for example, be of circular section or of elliptical section. The angle of the bevelled edge **21** may have to be adjusted with such rings, whilst the cross sectional shape of the passage **16** might also require adjustment.

The second fuse is identical with the first, except that the asbestos washer **30** is omitted, the flanges **12** are omitted and the bent over ends of the U-shaped conducting member are elongated and welded to the ends of the sleeve **11**.

The third fuse, shown in Figure 3, is again identical with the first, except that here the portion **8** has a greater axial length, whilst the portion **9** has a much shorter axial length. Because of this, there is virtually no interference fit between the cap **3** and the portion **9**, and the cap **3** is therefore held in position by virtue of the interference fit between the two caps and between the cap **13** and the portion **8**.

It will be appreciated that in all the fuses illustrated the rings serve to some limited extent to hold the caps **3** in position, but their prime function is to serve as a gas-tight, water-tight and oil-tight seal. The major part of the force holding on the caps **3** arises from the interference fits.

The constructions shown in Figures 2, 3 and 4 may of course be applied to any of the fuses shown in my British Patent No. 692,627. In particular, they may of course be applied to fuses having an indicator.

I claim:

1. An electrical fuse comprising fusible means and an insulating body having a through bore housing said fusible means and having end portions each formed ex-

ternally with a cylindrical surface of reduced diameter, said fuse also comprising at each end of said body an end cap closing said end, a sleeve on said reduced diameter portion, said sleeve having smooth internal and external surfaces and lying between said portion and said cap, said sleeve and said cap defining with said body an annular passage, and a sealing ring of elastomeric material filling substantially said passage and held in radial compression by said cap, said cap having an interference fit with said body.

2. An electrical fuse comprising fusible means and a tubular insulating body housing said fusible means and having stepped end parts each having an even external surface of less diameter than the external diameter of the body, said fuse also having at each end of said body a sleeve having internal and external surfaces and closely embracing a part of the said external surface of one of said end parts of the body, an end cap embracing and extending beyond said sleeve to embrace the body and to define with said body and said sleeve an annular passage, and elastomeric material filling substantially this passage, said material and the wall of said end part of the insulating body being held in a state of compression by the circumferential wall of said end cap.

3. A fuse according to claim 1, said interference fit being partly an indirect interference fit through said sleeve.

4. A fuse according to claim 1, said passage being of substantially rectangular section.

5. A fuse according to claim 1, each cap having a bevelled edge to permit said cap to be readily pushed onto said body over said ring.

6. A fuse according to claim 1, each sleeve having a bevelled edge to permit said sleeve to be readily pushed over the end of said body.

7. A fuse according to claim 1, each sleeve being provided with an annular flange to make up an inner cap, said inner cap serving to support one end of said fusible means.

8. A fuse according to claim 1, said rings being of synthetic rubber.

9. A fuse according to claim 1, and also comprising arc-quenching powder housed in and serving to fill said body.

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