April 4, 1967 H. P. SHERLOCK 3,312,772

CONNECTORS WITH HEAT RECOVERABLE MEMBERS

Filed Aug. 23, 1963

FIG. 1.

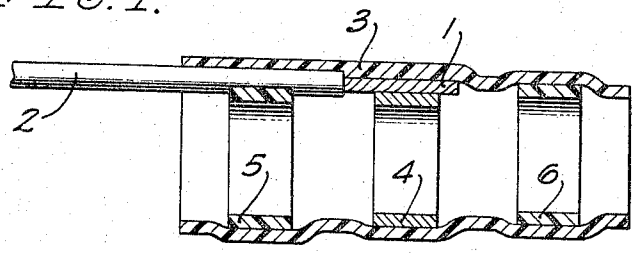


FIG. 2.

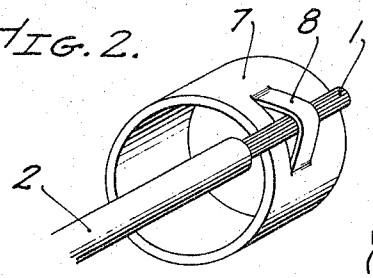
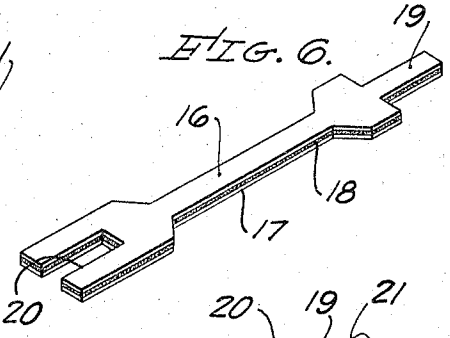


FIG. 6.



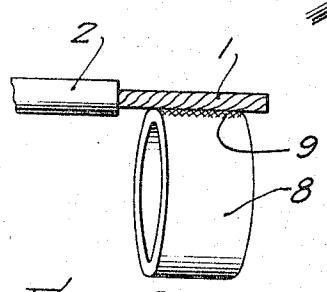


FIG. 3.

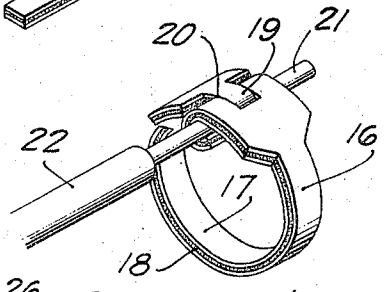


FIG. 7.

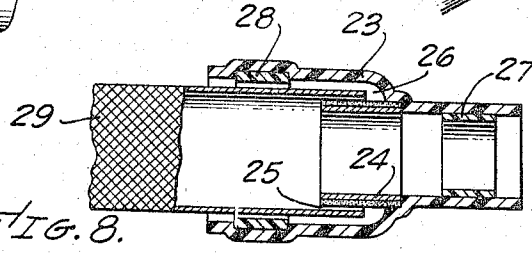


FIG. 8.

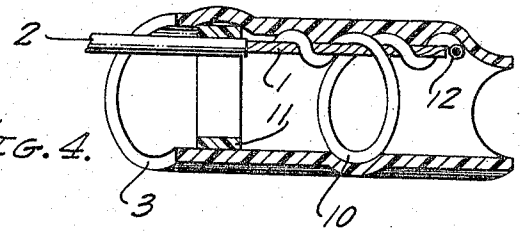
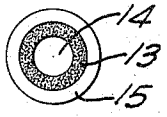


FIG. 4.

FIG. 5.



INVENTOR.
HUGH PAUL SHERLOCK
BY
Lyon & Lyon
ATTORNEYS.

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CONNECTORS WITH HEAT RECOVERABLE MEMBERS

Hugh P. Sherlock, Menlo Park, Calif., assignor to Raychem Corporation, Redwood City, Calif., a corporation of California

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12 Claims. (Cl. 174—75)

The present invention relates to recoverable members which may be used as wire junctions with insulation sleeves. More particularly, the present invention relates to recoverable members capable of creating intermetallic joints which have fusible members therein which are capable of functioning as dams and to insulation sleeves having preinstalled ground leads. The present invention also relates to shield termination devices comprising a recoverable member, a solder insert and an insert comprising metal foil.

Insulation sleeves of various types have been developed from time to time. One of the more satisfactory types of such sleeves is that disclosed in Wetmore application Ser. No. 211,747, filed July 23, 1962, which application is assigned to the assignee of the present application and is incorporated by reference herein. These prior art insulating sleeves comprise a heat recoverable member and a fusible or meltable member which are so arranged that the recoverable member is capable of urging the fusible member towards a third member, e.g., a cable, to which the sleeve is to be applied. In one embodiment of these sleeves, solder is used as the fusible member, but a variety of other materials may be used, e.g., thermoplastic polymers, thermosetting polymers, etc.

While these prior art sleeves have been entirely satisfactory for many uses, difficulty has been encountered in properly placing ground leads during termination. Furthermore, when different types of ground leads and/or insulating sleeves are required to be applied as part of a single operation, a substantial amount of difficulty has resulted from incorrect combinations of insulating sleeve and ground leads.

Furthermore, it has also been found that when fusible inserts which have low viscosities at the recovery temperature of the recoverable member are used, there is a pronounced tendency for the fusible member to be extruded out of the article during recovery. This is extremely undesirable since the fusible material which is extruded out of the article cannot perform a useful function.

Still further, it has been found that when recoverable articles comprising recoverable members provided with solder inserts are used as shield termination devices, serious difficulty resulting from the primary insulation coming into contact with the braid ends of braided shielding and/or ground leads has been encountered. Such contact is undesirable because it often results in the primary insulation being punctured by the braid ends or ground lead.

Thus, it is a primary object of the present invention to provide an insulating sleeve which assures that the ground lead will be correctly placed and of the correct type, which sleeve may be easily and rapidly installed.

It is a further object of the present invention to provide an insulating sleeve with a preinstalled ground lead.

It is another object of the invention to provide an article comprising a recoverable member and a fusible member in which members which function as dams to prevent extrusion of the fusible material out of the article during recovery are provided. These dams also function to create a higher effective shrinkage ratio since the inside diameter of the dam inserts is substantially less than that of the recoverable member. Furthermore, the dams

also flow around the leads or other element inserted into the recoverable member and create an encapsulation which protects the interior of the recoverable member from contamination by effectively isolating this interior.

It is still another object of the present invention to provide an article comprising a recoverable member, a fusible metallic member, and a metallic foil insert which foil functions to protect the primary insulation of the lead inserted into the recoverable member from being punctured or otherwise coming into contact with braid ends, ground leads and the like.

Other objects and advantages of the present invention, it is believed, will be apparent from the following description of specific embodiments thereof when read in connection with the drawings.

Briefly, one embodiment of the present invention comprises an insulating sleeve having a preinstalled ground lead. The sleeve is also provided with an insert comprising solder or other suitable material which insert is in contact with the conductive portion of the ground lead. In the preferred embodiment of the present invention, the device is provided with at least one fusible insert. The fusible insert may comprise a thermoplastic polymer, a thermosetting polymer or an equivalent material. This fusible insert may perform a variety of functions. For example, the fusible insert may facilitate bonding of the insulating sleeve to the member to which it is to be attached and/or may function as a dam to control the flow of the solder insert.

The heat recoverable member which comprises the insulating sleeve of the present invention is preferably fabricated from a polymeric material having the property of elastic memory (sometimes referred to as plastic memory). As is well known, such members are dimensionally heat unstable, that is, they will return to a predetermined configuration when they are heated to a temperature above the crystalline melting point of the material used. Many types of elastic memory materials are known to those skilled in the art, e.g., the materials disclosed in U.S. Patents Nos. 2,027,962 and 3,086,242. In general, it is preferred to use irradiated polymeric materials to which the property of elastic memory has been imparted, e.g., irradiated polyolefins such as irradiated polyethylene.

The fusible inserts are preferably prepared from thermoplastic polymers such as unirradiated or lightly irradiated polyethylene.

The conductive portion of the ground lead in the device of the present invention may simply be inserted between the solder and the recoverable member. Preferably, a more positive connection is made between the ground lead and the solder. For example, the solder may be crimped or formed around the ground lead or the ground lead may be lightly soldered, as by resistance heating of the lead, to the solder. Alternatively, a flux-cored solder wire may be wrapped around the lead.

The present invention also comprises a recoverable article comprising a recoverable member which is provided with a fusible insert comprising a material, e.g., solder, which has a low viscosity at the recovery temperature of the recoverable member. According to the present invention, this article is also provided with fusible inserts which retain a relatively high viscosity at the recovery temperature of the recoverable member. These high viscosity inserts are positioned between the low viscosity inserts and the open ends in the article and function as dams to effectively prevent extrusion of the low viscosity material out of the article during recovery.

In addition, the present invention comprises a recoverable article comprising a recoverable member which is provided with a metallic fusible insert, e.g., solder, and a metal foil positioned adjacent to the fusible metallic in-

sert. Preferably, the foil and solder are arranged such that they form an inner ferrule within the recoverable member into which ferrule braid ends or ground leads may extend such that the metal foil is positioned between the primary insulation of the article inserted into the recoverable member and the braid ends or ground lead. The solder is preferably plated on the outside diameter of a foil collar and the recoverable member preformed around one end of the collar. However, other configurations may be used.

Referring now to the drawings, FIGURE 1 illustrates an embodiment of the present invention in which the conductive portion of the ground lead is positioned between a solder insert and a recoverable member.

FIGURE 2 illustrates an embodiment of the present invention in which a mechanical connection is formed between the ground lead and the solder insert.

FIGURE 3 illustrates an embodiment of the present invention in which the ground lead and the solder insert are lightly soldered to form a connection.

FIGURE 4 illustrates an embodiment of the present invention in which a solder wire is wrapped around the ground lead.

FIGURE 5 illustrates a solder wire comprising an inner solder core, an intermediate layer of flux and an outer solder jacket which may be used in the present invention.

FIGURE 6 illustrates another solder member which may be used in the present invention.

FIGURE 7 illustrates the solder member of FIGURE 6 in installed position.

FIGURE 8 illustrates an embodiment of the present invention in which a recoverable member is provided with a metal foil insert to protect the primary insulation of such articles as may be inserted into the recoverable member.

The embodiment of the present invention illustrated in FIGURE 1 comprises a device in which the ground lead has been inserted between the recoverable member and the solder. As shown in this figure, the conductive portion **1** of a ground lead provided with insulation **2** is inserted between recoverable sleeve **3** and solder ring **4**. Preferably, the solder ring is crimped around conductive portion **1**. The device is also provided with fusible insert rings **5** and **6**. In order to attach this device to a shielded wire, the shielded wire is simply inserted into the interior of the device such that the exposed shielding extends through solder ring **4**. Recoverable member **3**, which preferably has the property of elastic memory, is then caused to recover by the application of heat which heat should also be sufficient to cause solder **4** to melt and rings **5** and **6** to become flowable. Preferably, rings **5** and **6** retain a substantial amount of viscosity at the temperature used such that rings **5** and **6** function as dams to prevent solder **4** from flowing out of the device. The result is a highly effective termination accomplished with a minimum amount of effort in a minimum amount of time.

FIGURE 2 illustrates an alternative mode of connecting the conductive portion **1** of a ground lead with solder ring **7**. In this embodiment, conductive portion **1** is inserted through the opening formed by raised wall **8** of ring **7**.

FIGURE 3 illustrates forming a connection between conductive portion **1** and ring **8** by means of a light solder indicated by numeral **9**. This light solder may be obtained by resistance heating the lead.

FIGURE 4 illustrates an embodiment of the present invention in which conductive portion **1** is provided with solder wire **10** which is wrapped around conductive portion **1** and also formed into a loop which is adjacent to the inside diameter of sleeve **3**. Only one meltable insert **11** is shown in this drawing, but it is to be understood that two or more such inserts could be provided. Solder wire **10** is also provided with flux core **12**. A solder wire

construction as shown in FIGURE 5 in which a flux layer **13** is positioned between a solid solder core **14** and outer solder jack **15** is preferred.

FIGURES 6 and 7 illustrate an alternative solder insert which may be used in the present invention. As shown in FIGURE 6, this solder insert comprises outer solder layers **16** and **17** and flux core **18**. One end of this solder insert is provided with tongue **19** while the other end is provided with groove **20**. As shown in FIGURE 7, this solder insert is positioned in the recoverable article of the present invention by positioning tongue **19** in groove **20**. The conductor **21** of ground lead **22** is then positioned adjacent to the solder insert. Preferably, the solder insert is crimped around the conductor **21**.

FIGURE 8 illustrates another embodiment of the present invention in which recoverable member **23** is provided with an insert comprising metal foil **24** and solder **25**. Recoverable member **23** is formed around the end of this insert such that the inner wall of recoverable member **23** and the outer wall of the insert cooperate to form ferrule **26**. The recoverable member may also be provided with fusible members **27** and **28** which function as dams as previously described. However, dam inserts **27** and **28** may be omitted. In use, braid shielding **29** is inserted into ferrule **26** such that the braid ends will be separated from the primary insulation which extends through metal foil **24**. The recoverable member is then heated to its recovery temperature such that it will contract around the shielding and primary insulation. When so heated, the solder **25** will melt and flow and the metal foil will collapse around the primary insulation. Preferably, the metail foil is slit and the ends overlap and held together by the solder to facilitate smooth contraction around the primary insulation. As previously described, the purpose of this structure is to provide a protection comprising foil **24** which will separate the braid ends from the primary insulation. In addition, this structure provides electrical continuity during solder melting in the event resistance heating is used. Resistance heating may be accomplished by inserting conventional resistance heating probes into ferrule **26**. This structure also serves to reduce wicking since the metal foil portion **24** acts as an additional surface which solder **25** can wet.

The structure illustrated in FIGURE 8 may also be provided with a preinstalled ground lead in the manner described herein, e.g., as illustrated in FIGURES 1–7.

It is also to be understood that the present invention includes within its scope the use of insulation sleeves for splicing, termination, etc., in which there are provided one or more meltable inserts which become quite fluid at the temperature to which the recoverable sleeve is heated to cause it to recover and one or more fusible inserts which retain a substantial amount of viscosity and function as dams to prevent the relatively fluid material from extruding out of the sleeve. For example, such a device would comprise that shown in FIGURE 1 without ground lead elements **1** and **2**. In such a device, rings **5** and **6** would function as dams to prevent extrusion of solder **4**. If the sleeve is fabricated as a cap, i.e., with only one open end, it will generally be necessary to use only one insert which functions as a dam. This dam insert would, of course, be positioned between the relatively fluid insert and the open end of the cap.

The dam inserts may be fabricated from lightly irradiated materials, e.g., lightly irradiated polyethylene or from materials having low melt indexes.

Any of the materials disclosed in copending application Ser. No. 211,747 may be used for the recoverable member and the fusible members of the present invention.

Having fully described the present invention, it is to be understood that it is not to be limited to the details set forth, but is of the full scope of the appended claims.

I claim:

1. An article comprising a tubular heat recoverable member, a first fusible insert, a second fusible insert and

a third fusible insert, all of said inserts being positioned within said member with said first fusible insert being positioned between said second and said third fusible inserts and said first fusible insert having a relatively lower viscosity than said second and third fusible inserts at the recovery temperature of said recoverable member.

2. An article comprising a heat recoverable member, a metallic foil insert, a solder insert positioned within said member, said solder insert being positioned between said metallic foil insert and a wall of said recoverable member, a portion of said solder insert being separated from said recoverable member.

3. An article comprising a tubular heat recoverable member, a tubular metallic foil insert positioned within said recoverable member, a tubular solder insert positioned between said foil insert and said recoverable member, a portion of said solder insert being separated from said recoverable member so as to form an annular space between said solder insert and said recoverable member.

4. An article comprising a dimensionally heat unstable sleeve, a ground lead having a conductive portion positioned within said sleeve, a solder insert positioned within said sleeve adjacent to said conductive portion, a first fusible insert positioned in said sleeve on one side of said solder insert, a second fusible insert positioned in said sleeve on the other side of said solder insert, said first and second fusible inserts having a relatively higher viscosity at the recovery temperature of said sleeve than said solder insert.

5. An article comprising a dimensionaly heat unstable sleeve, a solder insert positioned within said sleeve, a first annular fusible member positioned within said sleeve on one side of said solder insert, a second annular fusible member positioned within said sleeve on the other side of said solder insert and a ground lead having an insulated portion and a conductive portion, said ground lead being inserted into said sleeve so that said conductive portion of said ground lead engages said solder insert and said insulated portion of said ground lead passes between said first annular fusible insert and said sleeve, said first and second fusible inserts having a relatively higher viscosity at the recovery temperature of said sleeve than said solder insert.

6. The article of claim 5 wherein said conductive portion and said solder insert are connected to each other.

7. The article of claim 6 wherein said connection comprises a soldered joint.

8. The article of claim 6 wherein said connection comprises a mechanical joint.

9. The article of claim 5 wherein said solder insert

comprises a solder wire which is wrapped around said conductive portion.

10. An article comprising a dimensionally heat unstable tubular member, a tubular metalic foil insert positioned within said member, a tubular solder insert positioned within said member between said foil insert and the wall of said member, a portion of said solder insert being separated from said wall so as to form an annular space between said solder insert and said wall, a first fusible insert positioned in said member on one side of said solder insert, a second fusible insert positioned in said member on the other side of said solder insert said first and second fusible inserts having a relatively higher viscosity at the recovery temperature of said member than said solder insert.

11. The article of claim 10 wherein said first fusible insert is annular and has a greater diameter than said solder insert.

12. The article of claim 10 wherein a ground lead having a conductive portion is positioned in said tubular member with said ground lead engaging said solder insert.

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LEWIS H. MYERS, *Primary Examiner.*

DARRELL L. CLAY, *Examiner.*

W. B. FREDERICKS, J. F. RUGGIERO,
Assistant Examiners.