

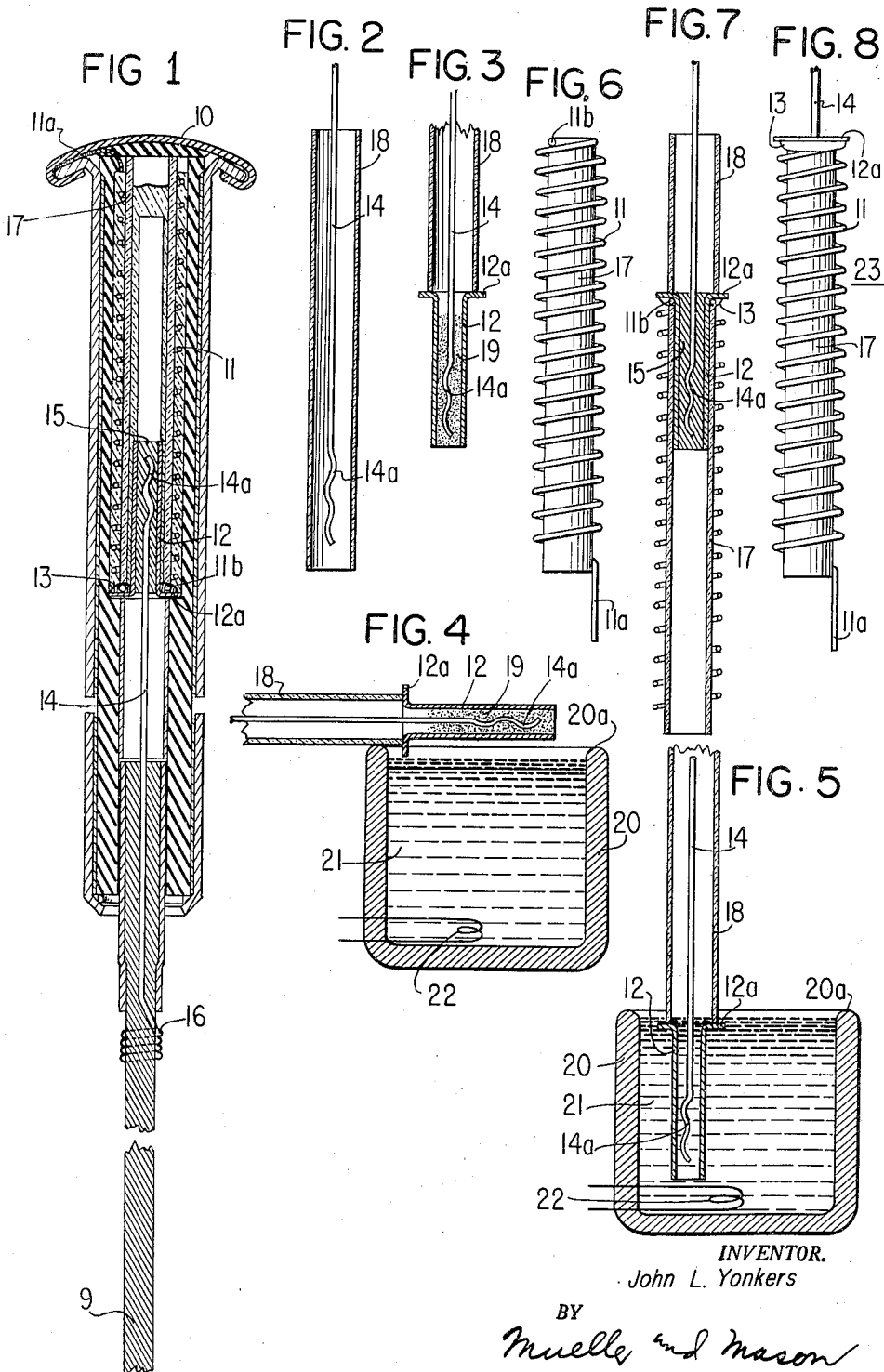
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J. L. YONKERS

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METHOD OF MANUFACTURING FUSE LINKS

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METHOD OF MANUFACTURING FUSE LINKS

John L. Yonkers, Northbrook, Ill., assignor to
Joslyn Manufacturing and Supply Company,
Chicago, Ill., a corporation of Illinois

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1

The present invention relates to a method of manufacturing fuse links, and more specifically to a method of manufacturing a sub-assembly comprising a plurality of serially arranged fusible elements such for example as are employed in a fuse link of the type disclosed and claimed in co-pending Yonkers' application Serial No. 637,528, filed December 28, 1945, now Patent No. 2,453,396 issued Nov. 9, 1948, and assigned to the same assignee as the present application.

Fuse links of the general type disclosed in the above-mentioned copending application are employed extensively in the protection of distribution circuits. When such fuse links have performed their protective function they must be replaced by a new link. An ordinary distribution system employs literally thousands of such fuse links and it is very important, therefore, that they be relatively inexpensive, since otherwise the cost of protecting the distribution circuits becomes unreasonable. In order that fuse links may be manufactured so as to be sold at a relatively low cost it is essential that they be produced on a mass production basis. Any manufacturing process which reduces the cost of assembly or manufacture becomes very important since if the process saves a few cents on each fuse link it will save a great many dollars to the utility which employs the resulting links in protecting its distribution circuits.

Quite recently fuse links of the type employing a plurality of fusible elements joined together by a meltable member such as solder, in which the fusible elements are ruptured in response to instantaneous or very high currents of short duration such as short circuit currents while the meltable member joining the two fusible elements is adapted to fuse or melt in response to long time overloads, have been extensively employed. The fuse link disclosed in the above-mentioned copending application is an improved link of this type. Fuse links of this improved form have very definite advantages from a functional standpoint over older types of links, but have been relatively expensive to manufacture, primarily due to the lack of a rapid and inexpensive method of uniting the two or more fusible elements of each link into the desired sub-assembly.

It is an object of the present invention, therefore, to provide a new, improved and inexpensive method of manufacturing a sub-assembly of fusible elements for use in a fuse link, which method lends itself readily to mass production of the links on a low cost basis.

It is another object of the present invention to

2

provide for use in the manufacture of fuse links a new and improved method of efficiently and rapidly uniting a tubular conducting member with a wire-like conducting element to form a fusible connection therebetween.

It is a still further object of the present invention to provide a new and improved method of constructing a fuse link which greatly reduces the manufacturing cost as well as the assembly time, and also permits the production of links having acceptably uniform operating characteristics on a mass production basis.

Further objects and advantages of the present invention will become apparent as the following description proceeds and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

For a better understanding of the present invention reference may be had to the accompanying drawings, in which:

Fig. 1 is a sectional view of a fuse link including or employing a sub-assembly constructed in accordance with the present invention;

Fig. 2 is a sectional view illustrating one step in the process of the present invention;

Fig. 3 is a sectional view illustrating still another step in the process of the present invention;

Figs. 4 and 5 are sectional views illustrating still other steps in the process of the present invention;

Fig. 6 is an elevational view illustrating still another step in the process of the present invention;

Fig. 7 is a sectional view illustrating still another step in the process of the present invention; and

Fig. 8 is an elevational view similar to Fig. 6 illustrating the resulting sub-assembly created in carrying out the process of the present invention.

Although the present invention has application in the manufacture of various types of fuse links, it is especially adaptable for the manufacture of fuse links of the improved form disclosed in the above-mentioned copending Yonkers' application and accordingly the present invention is described in connection with the manufacture of a fusible element sub-assembly for use in the fuse link of the above-mentioned application. Such a fuse link is adapted to provide short circuit protection and long time overload protection, and is also provided with surge protective means for preventing its operation in response to lightning or other high voltage surges of very short duration. Briefly and as best shown in Fig. 1 of

the drawings, the link comprises a line terminal 10 and a second terminal 9 in the form of a flexible cable or pigtail. Interconnecting the line terminal 10 and flexible cable 9 are a plurality of fusible elements 11, 15 and 14, the first of which is in the form of a helically coiled conductor having a longitudinally extending end 11a at one end thereof connected to the line terminal 10 and a single turn 11b of reduced diameter at the other end thereof. This end turn is adapted to engage the flange 12a of a tubular metal conductor 12 in the form of a hollow rivet which extends well within the convolutions of the helically wound fusible element 11, and is joined to this flange by means of a suitable solder connection indicated at 13. The second fusible element 14 is in the form of a wire-like conductor having a serpentine end 14a serially connected to the fusible element 11 through the tubular conductor 12, and the third fusible element 15, which latter element is in the form of a meltable solder filling the space within the tubular conductor 12 not occupied by the serpentine end 14a of the fusible element 14 and joining the fusible elements 11 and 14.

At its opposite end, the fusible element 14 is connected to the flexible cable 9 as indicated at 16. Thus the circuit between the line terminal 10 and the flexible cable 9 is completed through the three serially related fusible elements 11, 14 and 15. The fuse link of Fig. 1 also includes suitable housing elements as well as a shunt surge gap arrangement which form no part of the present invention and hence are not described herein. These elements are fully disclosed in the above-mentioned copending application.

Helically coiled fusible element 11 surrounds a suitable insulating tube 17, one end of which engages the end turn 11b of reduced diameter of the fusible element 11. Preferably the tube 17 is formed of a suitable ceramic or the like. The present invention is particularly concerned with the method of manufacturing the sub-assembly including fusible elements 11, 14 and 15, the tubular conducting member 12 and the ceramic tube 17. Specifically, the present simple and inexpensive method of constructing this sub-assembly has been found greatly to reduce the manufacturing cost as well as the time of manufacture of a fuse link of the type disclosed in Fig. 1.

In accordance with the present invention a fusible element 14 having a serpentine end 14a is inserted within a ceramic tube 18 which acts as a manipulating means and which is preferably a tube identical with the insulating tube 17. It should be understood that in manufacturing the fuse link of Fig. 1 it is necessary to employ insulating tubes 17 in quantity, and accordingly the manipulating means 18 may comprise any selected one of these tubes. In Fig. 2 of the drawings there is clearly illustrated the first step in the manufacturing process, namely the step of placing the manipulating means 18 around the fusible element 14 adjacent the end 14a of serpentine configuration. The next step in the manufacturing process consists in inserting the serpentine end 14a of the fusible element 14 into a tubular conducting element 12 until the flanged end 12a thereof engages manipulating means 18 in the manner clearly shown in Fig. 3 of the drawings. Preferably the conductive tubular members 12 are formed of brass, the reason for which will become apparent as the following description proceeds. The next step in the process consists in pushing the open, unflanged end of the tubular conducting member 12 into a paste solder flux

while in an unheated condition so that the hollow space within the conductor 12 is filled with this flux as is indicated at 19 in Fig. 3. The flux 19 serves to hold the tubular conductor 12 on the end of the fusible element 14. By finger manipulation of manipulating means 18 relative to the fusible element 14, the desired degree of telescopic overlap between the tubular conductor 12 and the serpentine end 14a of fusible element 14 can be readily obtained. When the desired degree of telescopic overlap is obtained, the fusible element 14 and manipulating means 18 are manually held against relative longitudinal movement.

The next step in the process consists in so positioning the assembly shown in Fig. 3 of the drawings that manipulating means 18 engages the rounded upper edge 20a of a solder pot 20 filled or substantially filled with molten solder 21 which is maintained in that condition by suitable heating means generally indicated at 22. The specific gravity of the molten solder 22 should be considerably higher than the specific gravity of the tubular member 12, the reason for which will become apparent from the following description.

After the above-described steps are completed, the manipulating means 18 is pivoted about the rounded edge 20a of the solder pot 20 in order completely to immerse the rivet or tubular conductor 12 in the solder 21 in the manner shown in Fig. 5 of the drawings. Incident to this step, the serpentine end 14a of the fusible element 14 is immersed in the solder, the interior of the conductor 12 is filled up with solder which displaces the solder paste, and a solder film is formed on all of the external surfaces of the conductor 12. Since the solder has a specific gravity considerably higher than the specific gravity of the conductor 12, the tubular conductor 12 floats in the solder bath and consequently cannot fall from the end of fusible elements 14 to the bottom of the solder bath. This is an important feature of the present invention since it eliminates the necessity for in any way supporting the conductor 12 during the described solder immersion step.

After immersion in this solder bath in the manner just described, the fusible element 14 and the tubular conductor 12 are rocked or pivoted by means of the manipulating means 18 about the rounded edge 20a of solder pot 20 back to the position shown in Fig. 4 of the drawings. Capillary attraction prevents the molten solder filling the tubular conductor 12 from running out the ends of this conductor and causes an excess of solder to remain on the external surfaces of the conductor at the junction between the flange 12a and the tube portion of the conductor.

As a separate operation, a ceramic tubular member 17 is inserted in a helically coiled fusible element 11 in the manner shown in Fig. 6 of the drawings, so that the end of the tube 17 engages the end turn 11a having a diameter somewhat smaller than the diameter of the tube 17. Before or after this assembly step, the end turn 11b of the coiled conductor 11 is dipped in a solder flux bath or paste. Immediately after the fusible element 14 and tubular conductor 12 have been removed from the solder bath, the component assembly comprising the ceramic tube 17 and the fusible element 11 is telescoped over the end of the tubular conductor 12 in the manner clearly shown by Fig. 7 of the drawings, to bring the flange 12a of the tubular conductor 12 into engagement with the small diameter end turn 11b and to telescope the tubular conductor 12 within the ceramic tube 17. As the end turn 11b is

moved against the flange 12a it becomes immersed in the solder excess accumulated at the juncture between this flange and the tubular portion of the conductor 12. Pressure is now applied through manipulating means 18 and ceramic tube 17 tightly to press the end turn 11b of the fusible element 11 against the flange 12a of the tubular conductor 12. The solder is permitted to cool to produce the desired internal solder union 15 between the fusible element 14 and tubular conductor 12, and the desired external solder union 13 between the small diameter end turn 11b of the fusible element 11 and the flange 12a of the tubular conductor 12. The manipulating means 18 is now removed and the sub-assembly indicated generally at 23 in Fig. 7 of the drawings is ready to be incorporated in a fuse link of the character shown in Fig. 1 of the drawings, in the manner described in the copending application referred to above.

By practicing the process described above, the cost of manufacturing the fusible element assembly is reduced to a fraction of its cost when manufactured by prior art methods. Not only is the ultimate cost of the fuse link greatly reduced by employing this improved process, but in addition, a substantial saving in manufacturing time is effected and the resultant product is more satisfactory due to greater uniformity in the character of the solder union 15 produced by this method.

It should be understood that the present invention is not limited to the particular process disclosed and described in detail above and that changes and modifications may occur to those skilled in the art without departing from the spirit and scope of the present invention. It is, therefore, aimed in the appended claims to cover all such changes and modifications.

I claim:

1. In the manufacture of fuse links, the method of forming a fusible solder connection between a tubular conducting member and a wire-like conducting element to provide a fuse link sub-assembly, which comprises inserting an end of said element within said member, placing a tube around said element to aid in manipulating said element to a desired position relative to said member, placing said tube against the upper edge of a solder pot containing molten fusible solder having a specific gravity greater than that of said member, and pivoting said tube about said edge to immerse said member and the inserted end of said element in said solder, thereby to form a solder connection between said member and said element.

2. In the manufacture of fuse links, the method of forming a fusible solder connection between a tubular conducting member and a wire-like conducting element to provide a fuse link sub-assembly, which comprises inserting an end of said element within said member, placing a tube around said element to aid in manipulating said element to a desired position relative to said member, placing said tube against the upper edge of a solder pot containing molten solder having a specific gravity greater than that of said member, and pivoting said tube about said edge to immerse said member and the inserted end of said element in said solder, thereby to form a solder connection between said member and said element, said member tending to float in said molten solder when immersed therein whereby it is maintained in engagement with said tube.

3. In the manufacture of fuse links, the method

of forming a fusible solder connection between a tubular conducting member and a wire-like conducting element to provide a fuse link sub-assembly, which comprises inserting an end of said element within said member, placing a tube around said element to aid in manipulating said element to a desired position relative to said member, moving said tube to provide the desired telescopic overlap between said member and said element, inserting the end of said member into a paste solder flux to fill the same therewith, placing said tube against the upper edge of a solder pot containing molten solder having a specific gravity greater than that of said member, and pivoting said tube about said edge to immerse said member in said solder, thereby to form a solder connection between said member and said element by filling said tubular member with solder except for the space occupied by said element.

4. In the manufacture of fuse links, the method of forming a fusible solder connection between a tubular conducting member and an end of a wire-like conducting element to provide a fuse link sub-assembly, which comprises telescoping the end of said element into said conducting member, and immersing said member and the telescoped end of said element in molten solder having a specific gravity greater than that of said member while holding only said element, whereby said member tends to float and thus maintains its telescopic relationship with said element.

5. In the manufacture of fuse links, the method of forming a fusible solder connection between a tubular conducting member and a second conducting member to provide a fuse link sub-assembly, which comprises arranging said members to have a predetermined telescopic overlap, and holding only one of said members while pivoting said members about the upper edge of a solder pot containing molten solder having a specific gravity greater than that of at least one of said members, whereby the telescoped portions of said members are held immersed in said solder by holding only said one of said members while the other member floats in said solder.

6. In the manufacture of fuse links, the method of forming a fusible solder connection between a tubular conducting member and a second conducting member to provide a fuse link sub-assembly, which comprises arranging said members with a predetermined telescopic overlap, placing a tube around said wire-like member to act as manipulating means to control said telescopic overlap, pivoting said tube about the upper edge of a solder pot containing molten solder having a specific gravity greater than that of said tubular member so that the telescoped portions of said members are immersed in said solder and said tubular member is filled with solder except for the space occupied by said wire-like member, said tubular member floating in said solder so as to remain in position relative to said wire-like member, and pivoting said tube about said edge to remove said members from said solder.

7. In the manufacture of fuse links, the method of forming a fusible solder connection between a hollow rivet and a wire-like conducting element to provide a fuse link sub-assembly, which comprises inserting an end of said element within said rivet, placing an insulating tube around said element to engage the head of said rivet and act as manipulating means to position said element relative to said rivet, pivoting said tube against the upper edge of a solder pot containing molten solder having a specific gravity greater

than that of said rivet so that said rivet is floated in said solder, whereby the relative positions of said rivet and element can be controlled solely by movement of said element, and removing said rivet and element from said solder after said rivet is filled with solder except for the space occupied by said element.

8. In the manufacture of fuse links, the method of forming a fusible solder connection between a hollow rivet and a wire-like conducting element having a serpentine end to provide a fuse link sub-assembly, which comprises inserting said serpentine end within said rivet, placing an insulating tube around said element to engage the head of said rivet and act as manipulating means to position said element relative to said rivet, inserting the end of said rivet into a paste solder flux to fill the same therewith, pivoting said tube against the upper edge of a solder pot containing molten solder having a specific gravity greater than that of said rivet so that said rivet is floated in said solder, whereby the relative positions of said rivet and element can be controlled solely by movement of said element, and removing said rivet and element from said solder after said rivet is filled with solder except for the space occupied by said serpentine end.

9. In the manufacture of fuse links, the method of forming a fusible solder connection between a fusible member and a hollow rivet member to provide a fuse link sub-assembly, which comprises arranging said members to have a predetermined telescopic overlap, placing an insulating tube around said fusible member in engagement with the head of said rivet member to act as manipulating means to control said telescopic overlap, and pivoting said tube about the upper edge of a solder pot containing molten solder having a specific gravity greater than that of said rivet member so that the telescoped portions of said members are held immersed in said solder by holding only said tube and said fusible member while the rivet member floats in said solder.

10. In the manufacture of fuse links, the method of making a fusible element assembly which comprises the steps of placing a fusible element having a serpentine end within a tubular insulating member which acts as a manipulating means, inserting the serpentine end of said fusible element within a tubular conductor having a flanged end so that the flanged end engages said manipulating means, inserting the unflanged end of said conductor into a paste solder flux to surround said serpentine end of said fusible element and position the same within said tubular conductor, placing said manipulating means on the rounded upper edge of a solder pot containing a molten solder having a specific gravity substantially greater than the specific gravity of said tubular conductor, pivoting said manipulating means about said rounded edge of said solder pot so that said unflanged end of said tubular conductor is immersed in said solder but floats therein so as to remain in engagement with said manipulating means which is moved to give the desired overlap between said tubular conductor and said serpentine end of said fusible element, pivoting said manipulating means about said solder pot edge to remove said tubular conductor from said solder, constructing a sub-assembly comprising a second tubular insulating member inserted within a helically wound heater coil having one end turn of reduced radius engaging the

end of said second insulating member, inserting the unflanged end of said tubular conductor before the solder associated therewith has hardened into the tubular insulating member of said sub-assembly so said one end turn is soldered to the flanged end of said tubular conductor while the solder in said tubular member connects it with said fusible element, and removing said manipulating means from said fusible element.

11. In the manufacture of fuse links, the method of making a fusible element assembly which comprises the steps of placing a fusible element within a tubular insulating member which acts as a manipulating means, inserting the end of said fusible element within the hollow of a hollow tubular rivet so that the head of said rivet engages said manipulating means, placing said manipulating means on the upper edge of a solder pot containing a molten solder having a specific gravity substantially greater than the specific gravity of said rivet, pivoting said manipulating means about said edge so that said rivet is immersed in said solder but floats therein so the head thereof remains in engagement with said manipulating means which is moved relative to said fusible element to give the desired telescopic overlap between said rivet and said fusible element, pivoting said manipulating means about said edge to remove said rivet from said solder, constructing a sub-assembly comprising a second tubular insulating member inserted within a helically wound heater coil having one end turn of reduced diameter engaging the end of said second insulating member, inserting the end of said rivet before the solder associated therewith has hardened into the tubular insulating member of said sub-assembly so said one end turn is soldered to said head of said rivet and said fusible element is embedded in the solder contained in said hollow rivet, and removing said manipulating means from said fusible element.

12. In the manufacture of fuse links, the method of making a fusible element assembly which comprises the steps of arranging a wire-like fusible element and a hollow tubular rivet so as to have a predetermined telescopic overlap, pivoting said element and rivet about the upper edge of a solder pot containing molten solder having a specific gravity greater than that of said rivet so that the telescoped portions of said element and rivet are immersed in said solder, by holding only said element while said rivet floats in said solder, constructing a subassembly comprising a tubular insulating member inserted within a helically wound heater coil having an end turn of reduced diameter engaging the end of said insulating member, and inserting the end of said rivet while the solder associated therewith is still soft into said tubular insulating member so said one end turn is soldered to the head of said rivet and the solder in said rivet unites it with said fusible element.

JOHN L. YONKERS.

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