

Sept. 19, 1944.

H. M. STIEGLITZ

2,358,745

METHOD OF FORMING SOLDERLESS CONNECTORS

Filed Feb. 19, 1941

2 Sheets-Sheet 1



FIG. 1

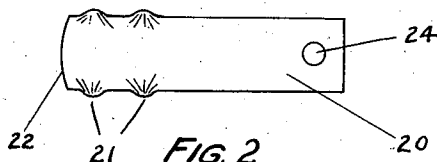


FIG. 2

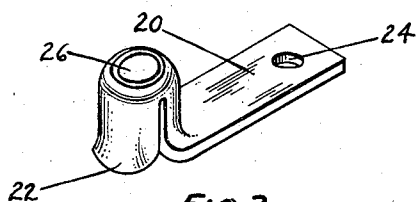


FIG. 3

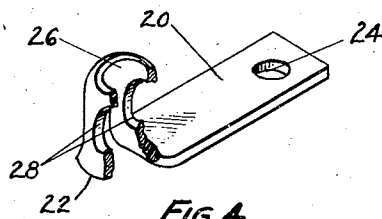


FIG. 4

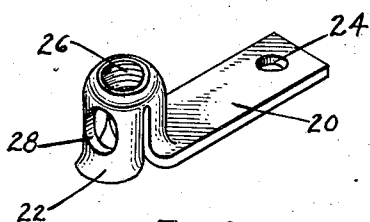


FIG. 5

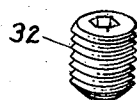


FIG. 6



FIG. 7

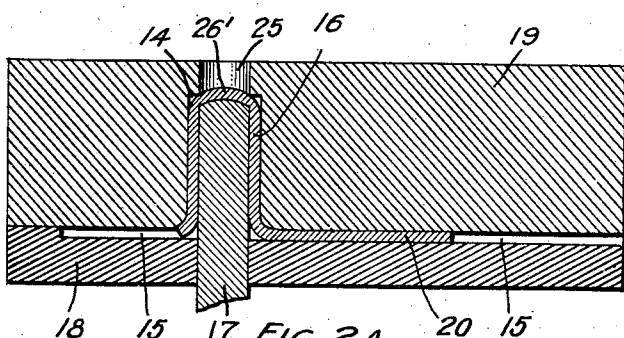


FIG. 2A.

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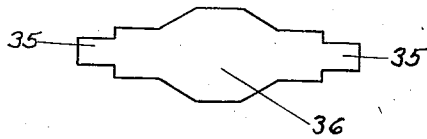


FIG. 8

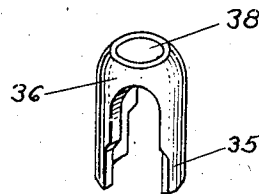


FIG. 9

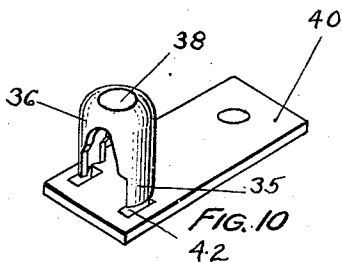


FIG. 10

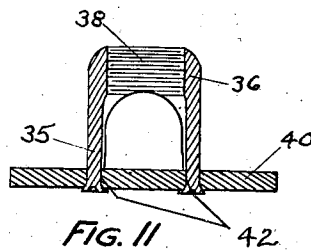


FIG. 11

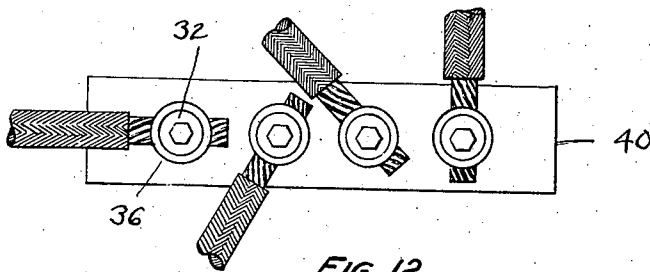


FIG. 12

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METHOD OF FORMING SOLDERLESS CONNECTORS

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Application February 19, 1941, Serial No. 379,607

2 Claims. (Cl. 29—155.55)

This invention relates to improvements in solderless connectors. More particularly, the invention relates to improvements in methods of forming solderless connectors.

It is an object of the present invention to provide an improved method of forming solderless connectors which makes a better connector cheaper.

Various forms of solderless connectors have been known and used for some time. Some of these connectors consist of a casting which has a cable-receiving portion that has been machined to receive a cable or wire conductor. These connectors are usually provided with a screw plug or similar cable-securing means that is threaded into the cable-receiving portion, and serves to hold the cable in engagement with the connector. Although these connectors are serviceable, they are not as satisfactory as they might be because of the relatively high cost of manufacturing them. The casting and machining operations used in making these connectors are quite expensive, and materially increase the cost of manufacture. The invention avoids these expensive operations by providing an improved method of forming solderless connectors that consists in drawing the connectors out of a flat bar of ductile metal.

It is, therefore, an object of the invention to provide a method of forming solderless connectors that consists in drawing the connectors out of a flat bar of ductile metal.

Some connectors have been formed by drawing them out of ductile metal, but the methods used are different from the improved method of the invention. Former methods consisted in striking a cylindrical piece of stock to form a cable-receiving portion or drawing a thin metal sheet to form a cable-receiving portion. The method of forming a connector by striking a cylindrical piece of stock is fairly satisfactory when the connector is small, but is not satisfactory when the connector is large. In such a case, the mass of the cylindrical piece of stock is so large, that it cannot be formed readily. The method of forming a solderless connector by drawing it from a thin metal sheet is also fairly satisfactory when the connector is small. When the connector is large the metal sheet must be made thicker, and this thick sheet metal cannot be drawn readily. This is especially true where the metal must be drawn into a relatively long tube to form the connector. In such a case, the metal must be struck several times with a drawing punch before the tube is drawn completely. This increases

the cost of manufacture is, therefore, objectionable.

The invention obviates these objections by providing a new method of forming connectors that can be used to make connectors of many different sizes. The method consists in drawing a true cylindrical formation with a round top for the cable and screw plug receiving portion from one end of a flat bar of ductile metal. By forming the connector at one end of a bar of ductile metal, a connector provided with a tang may be formed by a single stroke of the punch press. This is advantageous since it reduces the number of operations necessary in making a solderless connector. It is, therefore, an object of the present invention to provide an improved method of making connectors with a cable and screw plug receiving portion by a single operation of the punch press.

Various forms of solderless connectors are used today, and some of these are quite serviceable. Many of the connectors now in use are not as serviceable as they might be, because of the number of separate elements in them. Where a connector consists of a number of elements, the electrical conductivity of the connector is not as good as it would be if the connector was an integrated unit. Wherever two separate elements engage each other, a contact surface is formed which increases the resistance of the connector. This additional resistance makes this type of connector objectionable because the increased resistance produces more heat. The invention obviates this objection by providing a method of forming an integrated solderless connector. It is, therefore, an object of the present invention to provide a method of forming an integrated connector.

Other objects and advantages of the invention will appear from the drawings and accompanying description.

In the drawings and accompanying description, the various steps in the formation of a fixed and a removable type of solderless connector are shown and described, but it is to be understood that the drawings and the accompanying description do not limit the invention and the invention will be defined by the appended claims.

In the drawings, Fig. 1 is a plan view of a flat rectangular bar of ductile metal from which solderless connectors are formed by the method provided by the invention.

Fig. 2 shows the rectangular bar after the first operation if a narrow bar is used.

Fig. 2A is a longitudinal central section of the

die, punch, and blank at one stage of the operation.

Fig. 3 shows the solderless connector after the drawing operation.

Fig. 4 is a partial cross-sectional view of the connector after the conductor receiving holes have been punched.

Fig. 5 shows the completed solderless connector.

Fig. 6 is a side view of a screw plug that may be used with the connector.

Fig. 7 is an end view of the screw plug shown in Fig. 6.

Fig. 8 is a plan view of the blank from which the formation shown in Fig. 9 is drawn.

Fig. 9 is a perspective view of the cable and screw plug receiving formation of the connector after the drawing operation.

Fig. 10 is a perspective view of the cable and screw plug receiving formation shown in Fig. 9 as it is about to be assembled on a bus bar.

Fig. 11 is a cross-sectional view of the connector when completed, and

Fig. 12 is a plan view of a bus bar to which a number of the solderless connectors have been secured.

Referring to the drawings in detail, a rectangular bar of ductile metal is denoted by the numeral 20. This rectangular bar must be of a ductile metal that is a good conductor of electricity. Such a metal is copper, but any suitable metal may be used. The rectangular bar is operated on to make the two forms of solderless connectors shown in the drawings. For the purposes of illustration, the drawings show a number of individual operations in sequence, although in practice, a number of operations may be performed on the piece of stock at the same time. This may be done in a progressive die that is used in a punch press. In addition, it should be understood that the operations themselves, and not the order or sequence of the operations, are the important part of this invention. In making the removable type of connector that may be removably secured to a bus bar, the rectangular bar shown in Fig. 1 is formed in some cases in the shape shown in Fig. 2. This type of solderless connector may be removably secured to a bus bar, switch terminal, meter ring, or any other device to which wires or cables are to be secured. In the interest of convenience, these various devices will be represented by the phrase "bus bar," and the various devices mentioned above will be meant whenever the phrase "bus bar" appears in the description and claims. One end of the bar 20 is made in the form of a curve as indicated by the numeral 22, and an opening 24 is punched in the other end of bar 20. This first operation may be done by any suitable means, but can be done very readily and economically by a punch press. The hole 24 is used to secure the removable connector to a bus bar, and may receive a bolt or similar fastening means. The bar 20 is then placed in a drawing die 18 shown in Fig. 2A and drawn into the shape shown in Fig. 3. Fig. 2A shows the relation of the parts just before the opening 26 is punched. The blank 20 has been drawn from the depression 15 in the top of base 18, into the cylindrical cavity 14 of the die 18, by upward movement of cylindrical punch 17, forming the cylindrical portion 16. Continued movement of the punch will cut out the disk 26' as the end of the punch passes into opening 25 of the die, to form opening 26 in the upper end of cylinder 16. Where desired, ears 21 may be punched from the edges of the rectangular bar. The forming of

the ears 21 is a spreading of the metal which, in effect, increases the width of the bar at two points so that a narrow bar may be used. The increased width of the bar at these points is useful because it provides sufficient metal for the forming of the sides of the cable and screw plug receiving portion of the connector. The provision of an increased width of metal, makes it possible to make a somewhat larger connector from the same width bar. Where this is done, a substantial saving of metal may be effected. The drawing of the bar 20 into a true cylindrical formation is done by a drawing punch which draws the bar into a die to form the cylinder and continues further to punch out the hole 26 in the same operation. This operation is essentially a drawing operation, since the punch moves into the die and draws the metal along with it, thereby forming the cylindrical shaped cable and screw plug receiving portion. In the drawing operation, the bar 20 is drawn into the die, until it is folded back onto itself. The vertical lines in the side of the cable and screw plug receiving portion of the connector, are the abutting edges of the rectangular bar 20.

When the metal has been drawn into the shape indicated in Fig. 3, it is in contact with the die and cannot be drawn further. The punch, however, continues to move and is forced through the metal. The die into which the bar 20 is forced, has an opening 25 to receive the punch 17 and permits it to pass through the metal and form opening 26. It should be noted that the inside of the cylindrical formation is formed by the same punch that cuts the hole 26. This makes the diameter of the opening substantially the same as the inside diameter of the cylindrical formation. Punches are then used on the cable and screw plug receiving portion of the connector to form openings 28 therein. The hole 26 in the cable and screw plug receiving portion is then threaded to receive the screw plug 32. The screw plug will hold the smallest size conductor which the connector is designed for in a fixed and lasting connection. It can be seen that as the diameter of the opening is substantially the same as the internal diameter of the cylindrical formation, the threaded portion extends, as is shown in Figs. 5 and 11, a substantial distance down the internal walls of the cylindrical formation. This screw plug 32 has a rounded end with concentric grooves 34 on its face, that engage the cable or wire inserted in the connector and secures the cable.

The form of solderless connector shown in Fig. 10 of the drawings is also formed from a rectangular bar of ductile metal. This form of connector may be permanently fastened to a bus bar. Such an arrangement guarantees the attainment of high electrical conductivity for the connector. With such an arrangement, the cable or wire is pressed into direct and intimate engagement with the bus bar. This form of direct engagement is very efficient. This connector is formed from the blanks of the shape shown in Fig. 8. The blank of Fig. 8 is then drawn into the shape indicated in Fig. 9. This operation is essentially a drawing operation and is quite similar to the forming of the connector shown in Fig. 5. The drawing punch that draws the metal into this cylindrical shape, breaks through the metal and forms the opening 38. The cable and screw plug receiving portion 36 is then assembled with a bus bar 40 by inserting ends 35 into holes 42 in bus bar 40. The bus bar and the cable and

screw plug receiving portion 36 are then riveted together by striking the ends 35. The striking of the ends 35 is preferably so severe, that the particles of the ductile metal of the cable and screw plug receiving portion and the bus bar are intermingled. Such an intermingling of particles not only makes the mechanical connection between the cable and screw plug receiving portion and bus bar more permanent, but it also increases the electrical conductivity of the joint between the two. Where desired the ends 35 of the cable and screw plug receiving portion may be soldered or brazed to the bus bar. Such an arrangement would guarantee a very high electrical conductivity for the joint between the bus bar and the cable and screw plug receiving portion. To secure a maximum of electrical and mechanical efficiency for the joint between the bus bar and the cable and screw plug receiving portion, the cable and screw plug receiving portion might be both riveted and soldered to the bus bar. The holes 42 in the bus bar 40 that receive projections 35, may be punched out so the opening in the connector is parallel to, or at an angle to the axis of the bus bar 40. This is quite important since it is often difficult to bend large cables or wires that are to be inserted into the connector. By using this arrangement, it is possible to connect the cables to the bus bar with a minimum bending of the cables. Such an arrangement is indicated in Fig. 12. This figure shows a neutral bus bar that can be used in a switch box or other electrical device. The riveting or soldering of this type of connector to the bus bar is also quite advantageous, since it minimizes the space needed to connect the cables to the bus bar. Where a connector must be secured to the bus bar by its tang, a larger gutter must be provided. This necessitates the use of an oversize box, which increases the cost of the equipment. By using this type of connector it is possible to use a small box and yet have adequate gutter space. The opening 38 in the cable and screw plug receiving portion of the connector is threaded to receive screw plug 32 or a similar wire or cable-holding means. Among the many advantages and desirable features possessed by this type of connector, the direct intimate engagement possible between the wire or cable and the bus bar is quite noteworthy. This permits the electricity to pass directly from the bus bar into the wire or cable. Such an arrangement assures a high electrical conductivity for the electrical connection between the cable and the bus bar. The inside of the cable and screw plug receiving portion of this connector is formed with the die that cuts the hole 38. This makes the internal diameter of the cable and screw plug receiving portion substantially the

same diameter as the hole 28. This makes it possible for the threads to extend a substantial distance down into the cylindrical formation as shown in Fig. 11. This is especially advantageous since it makes possible the tight clamping of the conductor by the screw plug for a lasting electrical connection for small as well as large conductors.

Whereas a preferred method has been shown and described in the drawings and accompanying description, it is obvious to those skilled in the art that various changes in the invention may be made without altering the scope of the invention.

What I claim is:

1. The method of producing a one-piece solderless connector from a flat rectangular bar, said connector having a drawn cylindrical portion with an external circumference substantially double the width of the bar, which comprises drawing a portion of the bar into a die, having a cylindrical cavity therein and a central opening at the end of the cavity, by means of a cylindrical punch, said punch in one continued movement, drawing the bar portion into a cup-shaped cylinder, the side edges of the bar being folded into engagement as the bar is drawn into the die, until the bar metal reaches the end of the die cavity and thereafter the punch cuts through the metal and passes into the central opening, thereby forming a continuous cylindrical opening through the connector, then punching cable receiving openings through the side walls of the cylinder in line with the length of the bar and threading the interior wall of the cylinder from its punched out end to receive a clamping screw plug.

2. The method of producing a one-piece solderless connector from a flat rectangular bar, said connector having a drawn cylindrical portion with an external circumference substantially double the width of the bar, which comprises drawing a portion of the bar into a cylindrical die by means of a cylindrical punch and thereby folding the side edges of the bar about the punch into engagement to form a cup-shaped cylinder with an external circumference of substantially double the width of the bar, continuing the movement of the punch after forming the cup to punch an opening through the closed end of the cup of the same diameter as the inner diameter of the cup providing a continuous cylindrical opening through the connector, punching cable receiving openings in the side walls of the cylindrical portion, then screw-threading the interior wall of the cylindrical portion for a depth greater than the thickness of the bar for the reception of a cable securing screw plug.

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