Aug. 9, 1966 D. M. PETERSON 3,265,781

ASSEMBLY METHOD

Filed June 17, 1963

FIG. 1

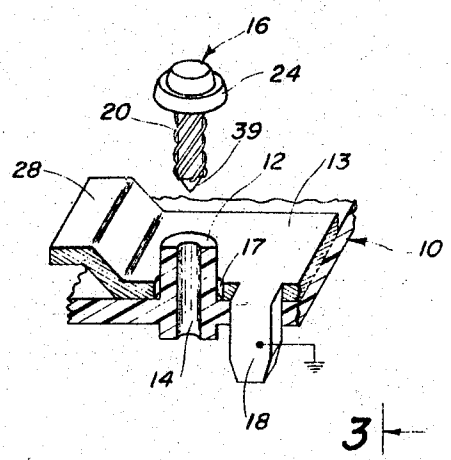


FIG. 2

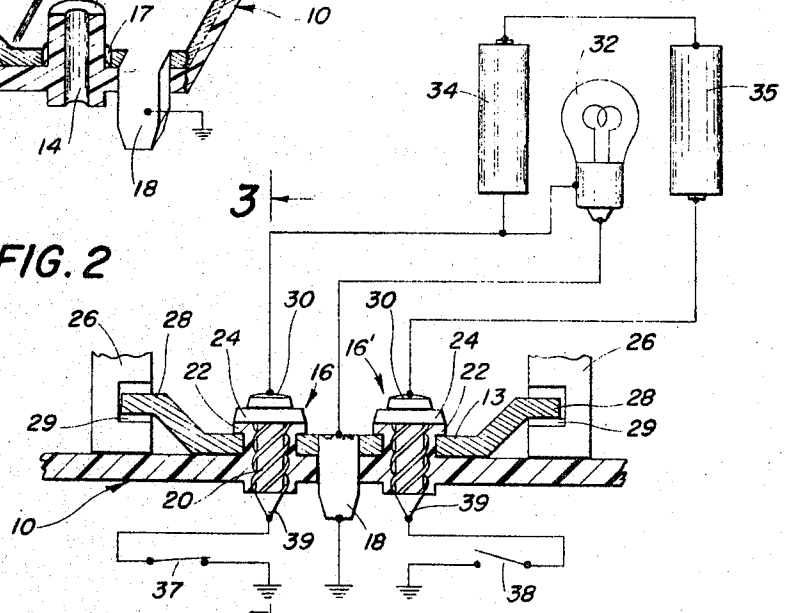
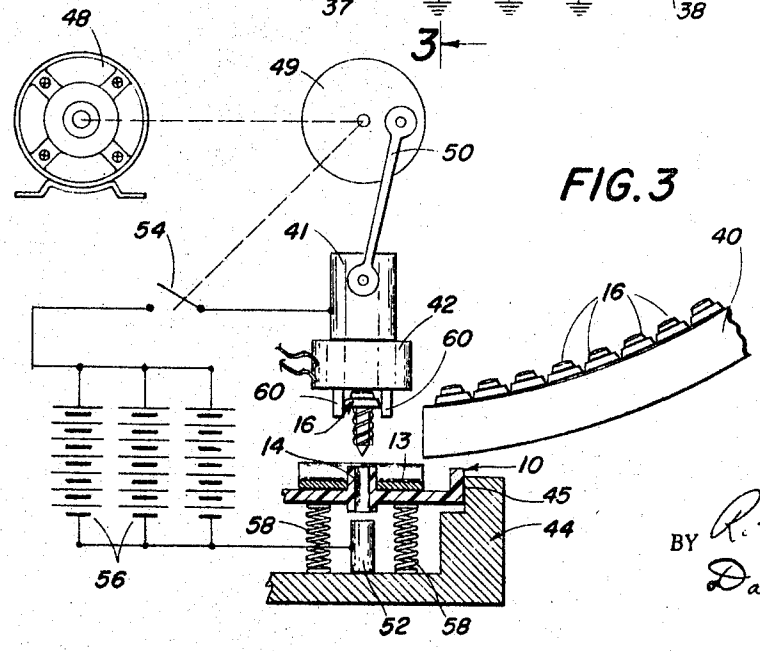


FIG. 3



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ASSEMBLY METHOD

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This invention relates to an electric conductor assembly and, more particularly, to a method for assembling a plurality of insulated electric conductor elements having a predetermined critical spacing.

In the art of electric conductors involving support of adjacent co-operating conductors and mechanical components with the conductors being respectively insulated, there are many complex and time-consuming arrangements for completing an assembly. A most troublesome problem is to assembly several closely spaced insulated conductors having critical spacing relationship, particularly if the parts or some of them are small or difficult to align in a particular assembly.

Therefore, an object of my invention is to provide a simple and reliable electric conductor assembly method.

A more specific object is to provide a method for assembling a plurality of closely spaced insulated conductors.

In accordance with one embodiment of my invention, a thermoplastic nonconductive base member is provided with a raised collar suitable for locating a sheet metal conductor therearound. A conductive headed contact member is then inserted through the center of the collar and heated to soften the collar and allow compression thereof over the plate member. The assembly is then cooled, whereby the thermoplastic, having compressional loading, insulates the plate member from the contact while holding both in place.

The subject matter which is regarded as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, as to its organization and operation together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing in which:

FIG. 1 is a perspective view partially in section of components of my invention prior to completion of the assembly;

FIG. 2 is a sectional side elevation view of a portion of a completed conductor assembly in a particular circuit arrangement; and

FIG. 3 is a simplified schematic drawing of an assembly machine for this invention.

Referring now to the drawing wherein like numbers refer to similar parts, I have shown in FIG. 1 a thermoplastic base member **10**, made of polystyrene or the like insulating material, provided with an upwardly extending collar **12** around which is located a sheet metal conductive plate **13**. In the center of the collar **12** is provided an aperture **14** suitable for defining the location of a knurled contact screw **16**, as shown in FIG. 2. In one particular arrangement, the inner diameter of the aperture **14** is .086" and the nominal diameter of the shank portion of the contact screw **16** is .082", with the threading of the knurled portion **20** being .1" overall. I prefer that the contact screw be of hardened steel and have a nickel plate finish if it is to be exposed to weathering.

By way of example, the thickness of the metal plate **13** is selected as .025", with the aperture **17** thereof being slightly greater than .156" and the diameter of the collar **12** being .156". As is a usual case, the largest conductor in assembly is grounded, as indicated on a tab **18** of the plate **13** which extends through the base **10**.

Referring now to FIG. 2, a portion of a completed

assembly is illustrated wherein the base **10** has received the contact screws **16** and **16'**, with the knurling **20** providing a nonslip fit. The particular knurling illustrated as helical, as indicated at **20**. The collars **12**, illustrated as substantially cylindrical in FIG. 1, have now been flattened substantially to provide integral plastic washers **22**. In the particular construction being explained herein, the thickness of these washers **22** is of the order of .012", with a portion of the mass of the material of the collar **12** being compressed downwardly to tightly engage the inner surface of the aperture **17** of the plate **13** during the assembly.

In order that the washers **22** are loaded only in compression wherein plastic materials are able to withstand substantial stresses, the tolerances of the assembly arrangement are controlled. Thus, the compressing action is limited so that the washers **22** do not extend substantially beyond the extremities of a flange **24** of the screw **16**. As indicated in FIG. 2, the plate **13**, being securely held by the screw **16**, may be utilized to physically support an additional member **26** which is inserted under a raised flange portion **28** and is provided with a ramp **29** to facilitate insertion thereunder. Another feature of the present invention which I prefer to use is an extraordinarily wide and flat head portion on the screw **16** so that the flange **24** extends substantially beyond the initial location of the collar **12** to facilitate use of a reasonably large washer **22**. The particular flange **24** is arranged with a flat lower surface of .187" in the example described herein. The screws **16** are also provided with a contact button **30** thereon suitable for engaging, in a usual manner, sliding or compressional contactors which may be an integral portion of the additional member **26**.

One circuit arrangement in which the present invention is useful is also illustrated in FIG. 2 wherein a lamp **32** must provide luminance at a specific instant. The lamp **32** is arranged to be energized by a pair of serially connected batteries **34** and **35**. Both the lamp **32** and the batteries **34** and **35** may be supported in the additional member **26**. Prior to initiation of illumination of the lamp **32**, a normally closed switch **37** grounds one side of the lamp **32** and the battery **34** through the contact screw **16**, with the other side of the lamp being grounded through the tab **18**. Immediately prior to initiation of illumination of the lamp **32**, the series battery circuit (**34–35**) is grounded by a normally open switch **38** to develop a substantial current flow through the contact screw **16'**, the batteries **34** and **35**, and the grounded contact screw **16**. An instant thereafter, the switch **37** is opened to force the circulating current through the lamp **32** and provide luminance at the desired instant.

In order to assure good contact between the contact screws **16** and **16'** and the circuit components of the switches **37** and **38**, I have provided the tips thereof with a sharpened lower extremity **39**. These tips are about 60° in cross section and also enhance contact during direct electric heating assembly, as discussed below. Such sharp contact points tend to cut through high resistance oxide layers that often develop on repetitive make-and-break connections to reduce the connection impedance and any localized heating which might be caused thereby.

As mentioned above, during assembly of the present invention, the collar **12** is forced to flow to attain the configuration of the circuit components illustrated in FIG. 2. Since the material of the collar **12** is an integral part of the base **10** and is, therefore, a thermoplastic, one means of obtaining plastic flow without excessive concentrations is to heat the collar **12** during assembly. This heating should be of the order of 180° F. with 130° F. and 280° F. being acceptable under certain operating conditions.

Generally speaking, the hotter the plastic becomes, the less "pressure-time" is needed to accomplish necessary plastic flow. By utilization of .6 second heating to temperatures of the order of 180° F. and applying pressure for approximately five seconds, plastic flow of the order of that discussed above results for components of the sizes indicated. Of course, larger assemblies require an increase in the temperature-pressure-time function to attain equivalent plastic flow.

While it is obvious that assembly of this invention could be accomplished by hand tools such as heated soldering irons being applied forcefully to the top of the contacts **30**, I prefer to use electric current heating, which is somewhat easier to regulate. With the particular size collar **12** and contact screw **16**, heating .6 second with 5 amperes per screw will soften the thermoplastic sufficiently. Also, I prefer to use controlled pressure and stroke limits during the period of plastic flow.

Referring now to FIG. 3, I have shown a simplified schematic diagram of a machine arranged to accomplish assembly of the contact screws **16** in the base **10**. As a first step in the assembly operation, contact screws **16** are presented one at a time from a feeder **40** to a drive shaft **41** and may be held on the drive shaft **41** by any convenient means such as clips or an electromagnet **42**. Next, the base **10** is located on a fixture **44** having various guide surfaces as illustrated at **45** for precisely locating the aperture **14** under the drive shaft **41**. Usually, such fixtures **44** are precisely engineered to attain close tolerance positioning. However, many such fixtures are presently known, and the details thereof need not be set forth here.

As a motor **48** drives an eccentric gear arrangement **49** and **50**, the drive shaft **41** inserts the contact screw **16** in the aperture **14** and positively drives it in accordance with the effective radius of the eccentric gear **49** until it engages a contact **52**. As soon as the drive shaft **41** has moved its full downward stroke, a switch **54** is energized to develop the .6 second high current flow through a loop circuit including the piston **41**, the contact **52** and the contact screw **16**. A high current source is indicated at **56** as having several batteries contacted in parallel. However, A.C may be used just as effectively.

I prefer that the electric impedance of the contact **52** and the drive shaft **41** be very low so that a primary heating within the loop circuit is in the contact screw **16** itself. The sharp point **39** of the contact screw **16** assures a low impedance coupling of the shank portion to the contact **52**. The low impedance connection is most easily accomplished by actually driving the sharp tip **39** into the surface of the contact **52**. By such a good contact, a large portion of the heat in the region of the tip **39** flows into the contact **52** to prevent excessive heating of the tip **39**. The plastic flow of the collar **12** is accomplished during the 5-second period after heating has been initiated, with presure being maintained by spring bias applied to the base member **10**, as by springs indicated at **58**. The exact thickness of the washer **22** is a function of the total mass of the collar **12**, and a pair of stop controls **60** which limit the drive stroke of the springs **58** as well as being a function of the heat-pressure-time function.

Obviously, two or more contact screws **16** may be set simultaneously by aligning two or more of the equipments illustrated in FIG. 3. Usually, at least two such screws will be required for securing a plate **13** subject to variable stress considerations, such as, from time to time, supporting the additional member **26**.

While I have shown and described particular embodiments of the present invention, other modifications may occur to those skilled in this art. For instance, the flange **24** may be inversely tapered slightly instead of being flat as suggested above. Such a taper would result in a slightly increased thickness in the region of the aperture **17**. However, in most embodiments of the present invention, such additional expense is not warranted by the increased physical and dielectric strength attainable thereby. I intend, therefore, to have the appended claims cover all modifications which fall within the true spirit and scope of my invention.

I claim:

1. An assembly method using a headed screw formed of heat conductive material, a plastic base member formed with an upstanding collar, and a plate to be connected to said member and having an aperture slightly larger than said collar for receiving the collar therethrough, comprising the steps of:

positioning a plate having an aperture therein over the upstanding collar;

driving the screw through the collar;

heating the screw sufficiently to soften at least a portion of the collar; and

pressing the screw toward the plate to expand the softened collar therebetween to form an integral washer over a portion of the plate lying under the lower surface of the screw head.

2. An assembly method using a thermoplastic base member and at least one conductive contact screw having a head with a flat lower surface large enough to extend over a portion of and retain a conductive plate, with the assembly being subject to critical spacing considerations, comprising the steps of:

positioning the conductive plate to at least partially encompass an upwardly extending collar of the thermoplastic base member, with the overall diameter of the collar being less than that of the flat lower surface of the head of the contact screw;

driving the conductive contact screw through the center of the collar;

heating the screw sufficiently to soften at least a portion of the thermoplastic collar;

pressing the screw toward the plate to expand the softened collar therebetween to form an integral washer over a portion of the plate lying under the flat surface of the screw head; and

allowing the assembly to cool to prevent relative motion of the parts thereof.

3. An assembly method using a thermoplastic base member and at least one heat conductive contact screw having a head with a flat lower surface for retaining a conductive plate, with the assembly being subject to critical spacing considerations, comprising the steps of:

positioning the conductive plate to at least partially encompass an upwardly extending collar of the thermoplastic base member;

driving the conductive contact screw through the collar so that the flat lower surface lies over a portion of the conductive plate;

heating the screw sufficiently to soften at least a portion of the thermoplastic collar; and

pressing the screw toward the plate to expand the softened collar therebetween to form an integral washer over the portion of the plate lying under the flat surface of the screw head.

4. An assembly method according to claim **3** wherein the heating step includes a step of passing a high electric current through the screw for a duration sufficient to raise the temperature of the collar to about 180° F.

5. An assembly method using a thermoplastic base member having an upwardly extending collar thereon and at least one conductive contact screw having a head with a flat lower surface large enough to extend over a portion of and retain a conductive plate, with the assembly being subject to critical spacing considerations, comprising the steps of:

positioning the conductive plate to at least partially encompass the upwardly extending collar of the thermoplastic base member;

resiliently supporting the region of the base member including collar;

driving the conductive contact screw through the collar so that the flat lower surface lies over a portion of the conductive plate, said driving step being sufficient to compress the resilient support of said supporting step;

heating the collar sufficiently to soften at least a portion thereof; and

raising the base member a limited amount while holding the screw down to compress a portion of the collar between the screw and the plate to thereby expand the softened collar therebetween to form an integral washer over the portion of the plate lying under the flat surface of the screw head.

6. An assembly method according to claim 5 wherein the heating step includes the step of passing a high electric current through a screw for a duration sufficient to

raise the temperature of the collar to between about 130° F. and 280° F.

References Cited by the Examiner

UNITED STATES PATENTS

271,035	1/1883	Carpenter.	
1,872,148	8/1932	Kurz	264—27
1,914,551	6/1933	Ainsworth	264—27
2,685,018	7/1934	Mynar	219—79
2,754,490	7/1956	Schnoll	339—218
2,905,803	9/1959	Brady	219—79
2,973,503	2/1961	Hansen	339—198
2,998,589	8/1961	Kukla	339—198

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