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L. A. PAINE

2,701,411

SOLDERING METHOD

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Fig. 1.

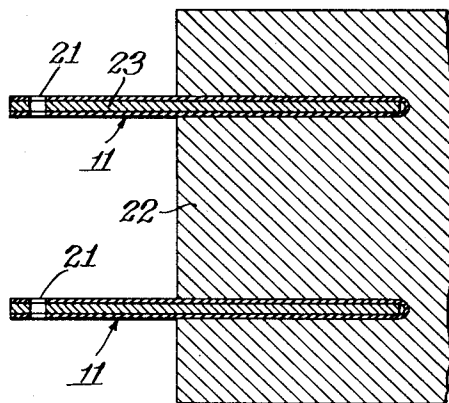


Fig. 2.

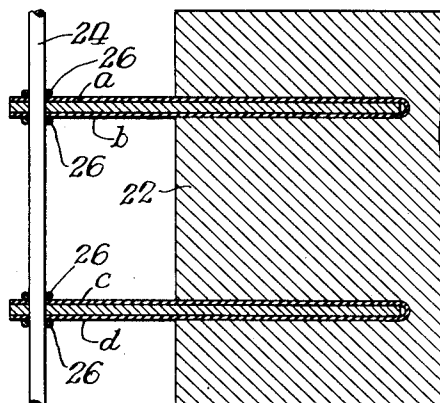


Fig. 3.

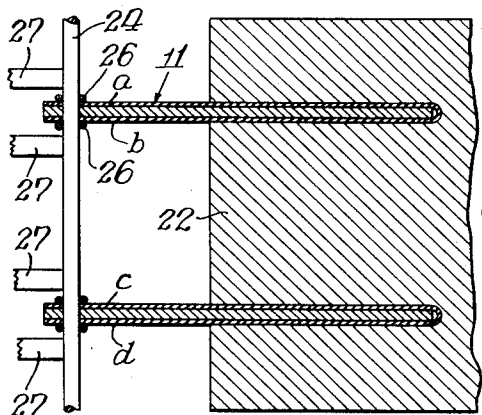
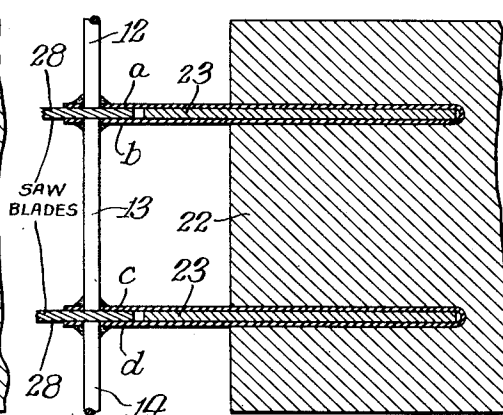
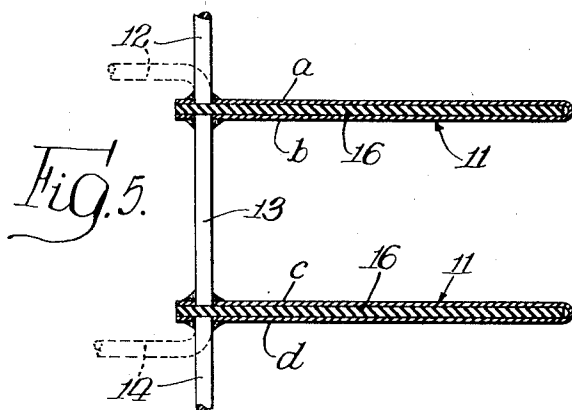


Fig. 4.



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SOLDERING METHOD

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3 Claims. (Cl. 29—155.5)

In the manufacture of thermal demand meters, it is desirable to make highly dependable, low-resistance electrical connections between the heaters and the wires supplying current to the heaters. The heaters are a part of the measuring element of such meters and hence the need for dependability is apparent. Not only is it essential that each connection be thoroughly dependable in having a constant value for its low resistance, but it is also important that all contacts have a dependably low resistance value so that the meter can be designed on this basis. Frequently the clearances around the parts are small so that access is difficult.

According to the present invention, a very economical method of producing highly dependable low-resistance connections in a limited space is devised. Additional objects and advantages will be apparent from the following description and the drawings.

Designation of figures

Figures 1 to 5 are longitudinal, cross-sectional views through the paired heaters, showing successive steps in the performance of the form of the process chosen for illustration of this invention.

Although the law requires a full and exact description of one or more forms of an invention, such as that which follows, it is of course the purpose of a patent to cover each new inventive concept therein no matter how it may later be disguised by variations in form or additions of further improvements; and the claims are intended to accomplish this purpose by particularly pointing out the parts, improvements or combinations in which the inventive concepts are found.

Although this invention may be used in many types of apparatus, it is especially suited for combined watt-hour and thermal watt demand meters. In such meters, the conservation of space is quite important. Consequently, the heaters 11 are located quite close together. In the form here illustrated, each of the heaters is a U-shaped strip of metal, with the two legs of the U positioned quite close together.

In its final form, each pair of heaters 11 will be in one series circuit, as indicated in Fig. 5. Thus a wire 12 at the top of the figure will be connected to one leg *a* of heater 11, a connecting wire 13 will be connected to leg *b* of the same heater 11 and to the leg *c* of the other heater 11. A wire 14 will be connected to leg *d*, comprising the other leg of the second heater. The legs are insulated from each other by insulating inserts 16. The spacing of the heaters is exactly that required for insertion in slots provided for them in the wall of the contemplated thermal unit, in which the heaters lie on opposite sides of bimetallic coils.

The wires 12 and 14 may extend directly to suitable leads from a transformer but preferably extend instead to terminals on a terminal block, to which various leads are removably connected. This facilitates removal of the thermal unit while leaving the watt-hour unit intact, except for the necessity of connecting certain ones of the leads.

Soldering method

To connect the heaters, as shown in Fig. 5, two such heaters are first punched to provide aligned apertures 21 and are inserted in a jig or holder 22, which spaces them apart according to the desired ultimate spacing. The jig 22 may extend closer to the aperture 21 than has been illustrated and the legs of the heater may be held

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in properly-spaced relationship from each other by spacer strips 23.

As the next step in the method, a wire 24 (which later forms the separate wire pieces 12, 13 and 14) is threaded through the apertures 21. At the same time, it is threaded through rings 26 of solder, preferably silver solder. These rings have an internal diameter small enough so that they preferably have a slight grip on wire 24 and stay in place thereon. Each of the four rings 26 is slid into contact with one of the legs, *a*, *b*, *c*, or *d*.

According to the next step of the operation, a pair of carbon electrodes 27 is so applied as to melt each pair of solder rings 26. It is believed most convenient to provide two pairs of electrodes 27, spaced as seen in Fig. 3, so that each pair will engage wire 24 on opposite sides of one of the heaters 11 and close to the heater. Thus the portion of the wire 24 between the two electrodes of one pair will be intensely heated and will melt the surrounding solder rings 26, so that they flow into contact with both the wire 24 and the heater legs *a*, *b*, *c* or *d* to provide a good electrical connection between the two. Soldering machines for such purposes are already known and it is only necessary to provide such machines with circuit portions having the electrode pairs 27 spaced as shown.

According to the next step of the process, which may be performed after cooling, the jig 22 then brings the heaters held thereby into cooperating position with saw blades 28, as seen in Fig. 4. These saw blades are positioned to saw between the legs *a* and *b* and between the legs *c* and *d*. Thus they sever the wire 24 into the three parts 12, 13 and 14. Finally, as seen in Fig. 5, the temporary spacers 23 are removed, insulators 16 are inserted in their places, and, if desired, the wires 12 and 14 are bent to the positions shown in dotted lines, corresponding more closely to the positions of use. Insulators 16 may be thin strips of mica or of sheets formed of a plastic. If desired, a thin strip of plastic may be laminated to the heater metal to be cut into strips and bent to U shape inside of it. In that event, spacers such as 23 and insulators 16 will also be used.

At the present time, it is preferred that new spacers 23 be used for each performance of the process, these spacers being inserted before the punching of the apertures 21, so that the spacers will also be punched. It is possible, however, to use slightly shorter spacers 23, which will not quite be reached by the saws in Fig. 4. Alternatively or in addition, temporary spacers could be inserted adjacent to the wire 24 until after soldering and removed prior to the sawing step shown in Fig. 4, or after the blades 28 are inserted between the legs but before they reach the spacer.

It will be apparent that the saw blades may be replaced by other tools which will perform the same function, such as milling wheels and broaches, and for the purpose of this application, all such tools may be classed as broaching tools.

From the foregoing, it is seen that an easily performed and dependable method of soldering has been devised, which is appropriate for such high requirements as those represented by the illustrated thermal demand meter. Of course it may be used in other situations and the respective ends of legs *a*, *b*, *c* and *d* may in fact be considered representative of any terminals to be similarly connected. Likewise, there may be only two such terminals instead of four, although the invention meets its greatest utility when there are four or more terminals to be connected in series.

I claim:

1. The method of soldering pairs of connections which comprises placing two apertured terminals with their apertures in closely spaced axial alignment, placing an intermediate portion of a conductor through the apertures by threading one end of the conductor through both apertures and beyond, soldering the conductor to each terminal on the side thereof remote from the other terminal, and removing a full cross-sectional portion of the conductor between the terminals, leaving the conductor portions extending beyond the terminals therefrom as connectors.

2. The method of soldering two U-shaped circuit members in series which comprises perforating the legs of the members, inserting a thin spacer between the legs of each member, placing the members with all four perforations in alignment, threading a conductor through all of the perforations and through interspersed solder rings and beyond to provide free ends of the conductor, adjusting the solder rings adjacent the outside of each leg, melting each solder ring to wet the conductor and the adjacent leg, and removing a full cross-sectional portion of the conductor from between the legs of each member.

3. The method of soldering pairs of connections which comprises placing two apertured terminals with their apertures in closely spaced axial alignment, placing an intermediate portion of a conductor through the apertures by threading one end of the conductor through both apertures and beyond, placing solder adjacent the conductor substantially in contact with each of the terminals, melting the solder adjacent both terminals by passing electric current through the portion of the conductor passing through and between the terminals, and removing the entire portion of the conductor between the terminals, leaving the conductor portions extending beyond the terminals therefrom as connectors, and inserting an insulator between the portions of the conductor thus left.

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