

Dec. 4, 1962

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3,067,318

METAL-GRAPHITE BRUSH WITH BRAZED SHUNT

Filed Nov. 10, 1959

Fig. 3

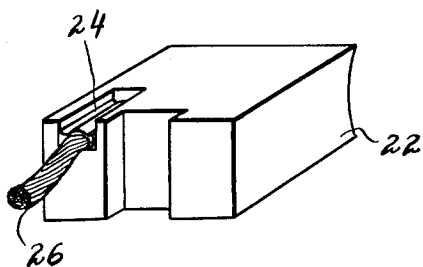


Fig. 1

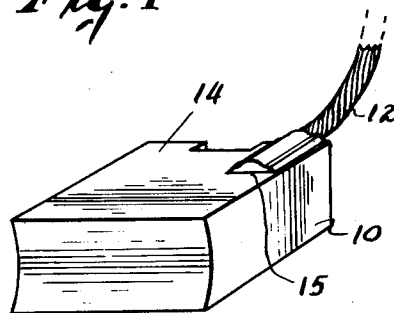


Fig. 4

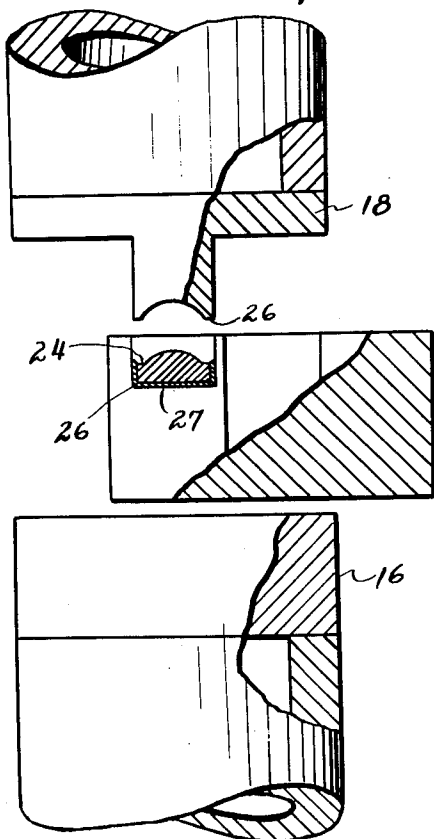
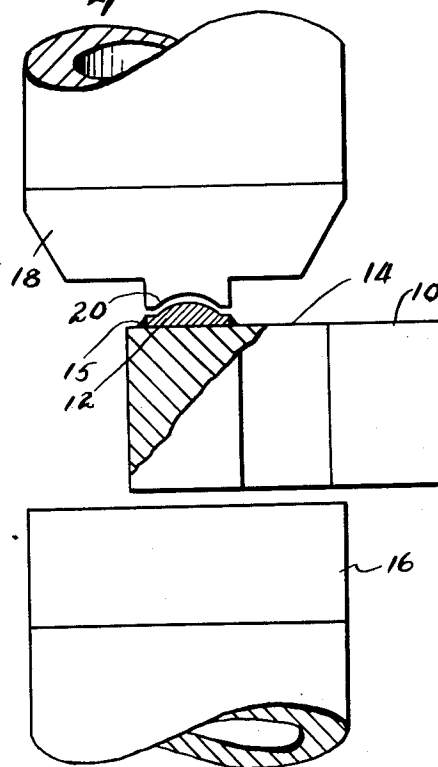


Fig. 2



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METAL-GRAPHITE BRUSH WITH BRAZED SHUNT
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Filed Nov. 10, 1959, Ser. No. 852,079
4 Claims. (Cl. 219-85)

This invention relates to an improved brush assembly comprising a metal-graphite brush with an attached shunt, and to an improved method of fabricating such brush assemblies.

Metal-graphite brushes are known to the art. The brush is formed from a mixture of powdered metal and powdered graphite molded into the desired final form, or cut into the desired final form from a larger block of material. The powdered metal may be entirely copper, although other metallic particles, such as tin, lead, zinc and silver, may be used in combination with copper.

Such brushes offer the requisite low conductivity, current handling capability and suitable contact resistance. The graphite particles in the brush lubricate the bearing surface of the brush as it rides on the contact surface, such as a commutator, and prevent welding of the brush to the surface by the intermittent arcs encountered in operation.

In order to bring electrical connections from the brush to the operating equipment, a shunt or wire conductor is affixed to the brush.

The shunt is generally a rope-stranded conductor formed of copper strands, tin-coated copper strands, or zinc-coated copper strands. The size and type of wire is determined by the application intended, and the wire is selected primarily on the basis of strength, current carrying capacity and flexibility. In a few applications it has been found desirable to use a solid instead of a stranded conductor.

In order to connect the shunt to the brush with the requisite mechanical strength and with the requisite low resistance bond, the art has resorted to drilling a hole in the brush, inserting one end of the shunt therein, and tamping the hole with a powder such as copper powder, or silver-coated copper powder. While such tamped shunt connection may give the requisite mechanical and electrical bond, such method of assembly results in brushes of higher than desired expense.

The art has also resorted to riveting or bolting the shunt to the brush, or to attaching the shunt to a conductive contact which is riveted or bolted to the brush.

While all of these methods give the requisite firm mechanical attachment of the shunt to the brush with a connection of low electrical resistance, it is apparent that the complications of assembly thereof increase the cost of the brush.

It is therefore the primary object of this invention to provide an improved brush assembly comprising a metal-graphite brush and a shunt affixed thereto by brazing.

It is a further object of this invention to provide an improved method for attaching a shunt to a metal-graphite brush.

The graphite particles in the brush composition serve to prevent welding of the commutator to the brush in the equipment for which the brush is designed. Therefore, it would seem that the graphite content of the brush would also preclude brazing of the shunt thereto. Surprisingly, however, it has been found that the shunt can be brazed to the brush with the desired mechanical and electrical bond. This startling and unusual result is unexpected and offers important advantages over the processes used by the art.

In a preferred embodiment of this invention there is provided a brush formed of metallic and graphite particles

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formed into the shape desired for the application intended. A shunt of rope-stranded copper wire is brazed thereto.

To practice the method of this invention, the metal-graphite brush and the shunt are orientated in the desired relative positions. A brazing compound is applied at the joint. The shunt and brush are then held in position and heated to braze the shunt to the brush. The shunt is thus brazed to the copper in the brush to provide a brush assembly of low fabrication cost.

A brush assembly and the method of fabrication thereof may best be understood by reference to the following description taken in conjunction with the accompanying drawings of which:

FIGURE 1 is a perspective view of a brush assembly fabricated in accordance with this invention.

FIGURE 2 is a partially sectioned perspective view of a brush assembly within heating electrodes illustrating the method of fabrication of the brush assembly shown in FIGURE 1.

FIGURE 3 is a perspective view of another embodiment of a brush assembly in accordance with this invention, and

FIGURE 4 is a partially sectioned perspective view of a brush assembly within heating electrodes illustrating the method of fabricating the brush assembly shown in FIGURE 3.

In FIGURES 1 and 2 there is shown a brush 10 to one side surface of which is to be attached the shunt 12.

The brush may be formed from a mixture of a powdered metal and powdered graphite molded into the shape desired for the application intended. The powdered metal used in fabricating the brush will comprise copper. However, other metals may be used in combination with the copper such as tin, lead, zinc and silver. Illustrative of the compositions used in typical brushes employed by the art are the compositions set forth in Table I.

Table I

- | | |
|-----|---|
| (1) | 77% copper, 18% lead, 5% graphite |
| (2) | 93% copper, 7% graphite |
| (3) | 75% copper, 10% tin, 8% lead, 7% graphite |
| (4) | 77% copper, 15% lead, 8% graphite |
| (5) | 85% copper, 5% tin, 10% graphite |
| (6) | 82% copper, 5% tin, 3% zinc, 10% graphite |
| (7) | 84% copper, 3% lead, 13% graphite |
| (8) | 75% copper, 25% lead |

As will be noted from Table I, the majority of brushes are formed with a relatively high percentage of metallic component. These brushes are widely used by industry.

The shunt to be attached to the brush may be a copper wire. In the usual case the shunt is a flexible rope stranded copper conductor selected primarily on the basis of strength, current carrying capacity and flexibility needed for the application intended. For example, a copper 7-43-.005 shunt may be employed for certain brushes. The numerals identify respectively the number of ropes, the number of strands or wires in each rope, and the diameter of each strand (e.g. 7 ropes, each having 43 strands of 0.005-in. diameter wire).

In the application shown in FIGURES 1 and 2, the shunt is to be affixed to one side of the brush. To do this one end of the shunt is merely brazed on face 14 of the brush. A brazing compound, such as a brazing alloy preform 15, is positioned at the joint between the shunt and the face of the brush. The brazing agents must be suitable for brazing the metals contained in the brush. Such brazing agents are readily available in strip, wire paste, and powdered form. The agent may be applied to the brush and to the shunt or placed between the two prior to heating. Illustrative of agents successfully applicable in this application are those listed in Table II.

Table II

Sil-Fos, Handy and Harman, melting point 1185-1300° F.
Easy-Flo, Handy and Harman, melting point 1125-1295° F.

To braze the shunt to the brush, the brazed joint is formed in the electric resistance unit having a base electrode 16 and a top electrode 18. The brush 10 rests on the base electrode; the other electrode 18 being positioned so that the shaped face 20 thereof is vertically above the shunt lead 12. The electrodes 16 and 17 may be formed of tungsten, molybdenum or other suitable material.

The heating unit electrode 18 is then moved down to contact the wire shunt 12. The shaped face 20 thereof ensures an evenly distributed pressure contact against the round shunt. When the electrodes are closed, heating current is passed therebetween to braze the shunt to the brush.

As an example of a specific operation, but not by way of limitation of this invention, a copper 7-43-.005 shunt was brazed to a brush composed of 93 percent copper and 7 percent graphite. The heating unit was a modified spot welder with the voltage and contact pressure between the electrodes reduced to just below the arcing point. The brazing alloy comprised Sil-Fos in ribbon form inserted between the brush material and the shunt. The force closing of the electrodes was 70 pounds. Brazing current was established at 7400 amperes and held for a brazing time of 15 cycles (¼ sec.) with a total hold time of 30 cycles (½ sec.). Brush assemblies so fabricated were found to have a maximum electrical resistance at the bond of 52 micro ohms. The mechanical bond required a force of at least 50 pounds to separate the shunt from the brush. It should be noted that in the separation, the brush material was fractured indicating that the welded bond was even stronger than the separation strength of the brush material. It will be further noted that these values equal or exceed those obtained with a tamped shunt connection of the same materials.

It will be noted that in addition to electric resistance heating that other conventional heating, such as by incandescent carbon electrodes, may be employed in the practice of this invention.

A surface preparation of the brush and shunt will depend greatly upon the materials employed and upon the brazing compound used. For example, when joining a copper shunt to a brush having a high copper content many brazing compounds are available which do not require fluxing. In other applications a suitable flux may be required for a proper bond.

Although it would be expected that the graphite would prevent an adequate brazed bond, the shunt is apparently brazed to the metallic particles in the brush to provide a mechanical and electrical bond between the brush and the shunt. This conclusion is supported by the fracturing of the brush material when the shunt is pulled from the brush. While this conclusion seems justified by observation of the results, the startling results obtained by this invention and the departure of the invention from the practices of the prior art caution against acceptance of this conclusion as the full explanation. However, whatever the reasons, the results are not disputable.

The strength of the brazed connection depends essentially on the contact area between the shunt and the metallic particles in the brush. The mechanical strength of the bond is decreased with a decrease in the percentage of the metallic particle component of the brush. While the method may be successfully employed with brushes having a low percentage of metallic particles, if the percentage of metal is lower than 50 percent, it is usually impossible to obtain the mechanical strength necessary to satisfy the dictates of operational environmental conditions. Fortunately, applications requiring high bond strength also usually require a brush of high metallic content.

In those applications where it is desirable to provide increased contact area and at the same time to provide

a brush having smooth sides, the embodiment shown in FIGURES 3 and 4 may advantageously be employed.

In FIGURES 3 and 4 there is shown a brush 22 molded from a mixture of powdered metallic particles and powdered graphite and having a slot 24 molded or cut in the face thereof. The shunt 26 is positioned within a slot with a brazing alloy, such as alloy preform 27, positioned between the shunt and the brush. The brush is then placed within the resistance heating unit and heating current passed between the electrodes 16 and 18 thereof to braze the shunt to the brush. In order to ensure contact of the upper electrode 18, the electrode is provided with an electrode tip 28 which will fit within the slot and contact the shunt over the peripheral surface thereof.

After passage of the heating current the brush will be brazed both to the bottom and the sides of the slot. The increase in the brazed contact area is advantageous in providing greater mechanical strength and increased electrical conductivity over the embodiment wherein the shunt is affixed to the side of the brush. The additional metal provided by the brazing agent is effective in increasing the area of contact between the shunt and the metal particles of the brush to give the requisite mechanical strength and electrical conductivity at the bond. Although the intended application determines the minimum strength and the maximum conductivity tolerable, considerable flexibility in meeting the requirements is provided during brazing since control over both the brazing agent and the contact area is afforded by this assembly method.

It will of course be noted that the position of the weld, the size of the shunt, and the shape of the slot will determine the shape of the welding tip used. Further, these factors will primarily be dictated by the application intended.

While the invention has been described with particular reference to brazing leads to metal-graphite brushes, it is applicable also to attaching leads to metal-graphite articles intended for other applications.

This invention may be variously modified and embodied within the scope of the subjoined claims.

What is claimed is:

1. The method of joining a shunt to a metal-graphite brush by heat supplied by current from electrode means which method consists of the steps of positioning the shunt adjacent to the brush with a brazing alloy in position to join confronting faces of the shunt and brush, holding the shunt, brush and brazing alloy with said confronting faces pressed together under substantial pressure, maintaining the pressure by force exerted by the electrode means and evenly distributed over the area of contact with the electrode means, then connecting the shunt to the metal particles of the brush by electric resistance brazing produced by current passed through the brush, shunt and brazing alloy from said electrode means with the current and brazing time limited to prevent damage to the metal-graphite material, the additional metal provided by the brazing alloy being effective in increasing the area of contact between the shunt and the metal particles of the brush.

2. A method in accordance with claim 1 in which said brush is composed of at least 50 percent copper.

3. A method in accordance with claim 1 in which said shunt is a copper shunt.

4. A combination in accordance with claim 1 in which said brazing alloy is a silver solder brazing alloy.

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