Dec. 1, 1959 W. G. BRADLEY ET AL 2,915,731

ELECTRICAL CONTACT APPARATUS

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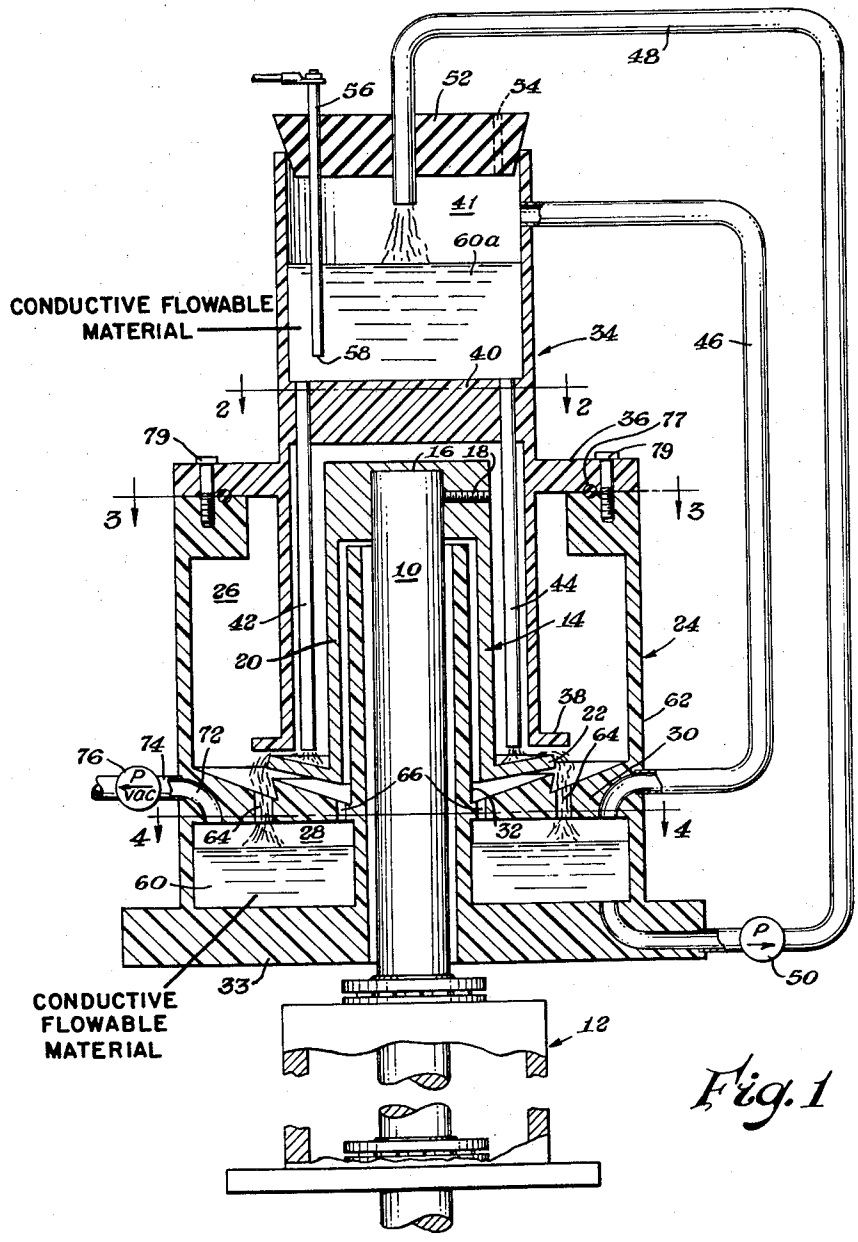


Fig. 1

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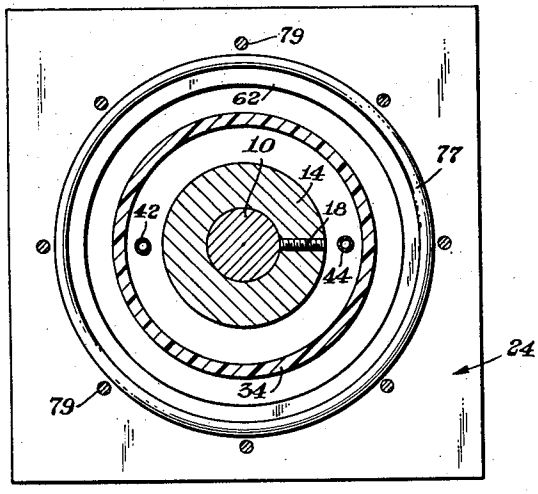
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Fig. 3



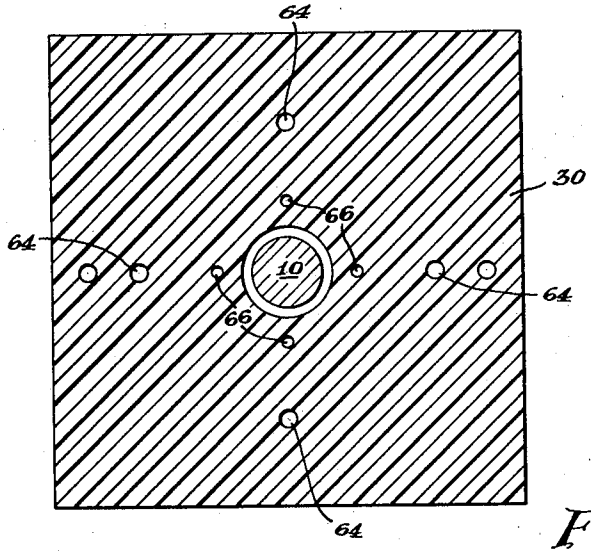


Fig. 4

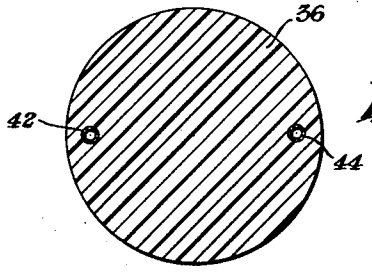


Fig. 2

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ELECTRICAL CONTACT APPARATUS

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4 Claims. (Cl. 339—5)

This invention relates to apparatus for stabilizing the electrical resistance between a fixed electrical contact and a rotatable contact which operates at high radial velocity.

When electrical contact is to be made between a rotating member, such as a shaft, and a fixed electrical contact, two types of wiper contacts are commonly used. A carbon or graphite brush pressed against the rotating member is one common type of wiper contact.

Another type of wiper contact comprises a contact arm carried by the rotating member, the arm moving through a stationary pool of mercury to complete the electrical contact between the rotating member and a fixed contact which is connected to the mercury.

Both of the above types of wiper contacts are less satisfactory than is desirable for specific electrical uses. For example, carbon brush type contacts often generate static currents when the shaft or rotating member rotates at high velocities, or the brush makes only intermittent contact with the rotating member. In the mercury type contact described above, as the radial velocity of the rotating contact arm increases the mercury tends to vortex and the electrical contact between the arm and mercury is interrupted.

In some current and potential measuring applications, especially laboratory type measurements, the use of electrical contacts of the above described types introduces considerable error.

Accordingly, a principal object of this invention is to provide improved electrical contact apparatus of the type in which a fixed electrode is coupled to a moving electrode and which exhibits low electrical noise, low resistance and no current interruption while the apparatus is operated.

In accordance with this invention, apparatus is provided for directing a stream of electrically conductive fluid (connected to a fixed electrode) against a moving electrode to maintain positive electrical contact therebetween.

The invention, as well as additional objects and advantages thereof, will best be understood when the following detailed description is read in connection with the accompanying drawings, in which:

Fig. 1 is a side elevational view, partly in section of electrical contact apparatus in accordance with this invention;

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 1, and

Fig. 4 is a sectional view taken along the line 4—4 of Fig. 1.

Referring to the drawing, there is shown a rotatable shaft 10 supported in a vertical position on a suitable journal and thrust bearing assembly, indicated generally by the numeral 12. A somewhat cup-shaped member, indicated generally by the numeral 14, is secured to the upper end 16 of the shaft 10 by any suitable means such as the set screw 18. The cup-shaped member 14 has a

side wall 20 which is cylindrically shaped and which has an inner diameter which is somewhat larger than the diameter of the shaft 10. The side wall 20 and shaft 10 are coaxially disposed with respect to one another. The "brim" or flanged part 22 at the lower part of the cup-shaped member 14, when viewed in transverse cross-section, defines an acute angle with respect to the side wall 20. The flanged part 22 may, however, be disposed between the ends of the side wall 20 if desired.

The upper part of the shaft 10 and the cup-shaped member 14 are surrounded by a box-like structure, indicated generally by the numeral 24, which has an upper compartment 26, and a lower compartment 28, the compartments being separated by a common partition 30. A hollow cylindrical member 32 extends upwardly from the base 33 of the box-like enclosure 24, passing through the partition 30 (and sealed with respect thereto) and extending between the shaft 10 and the side wall 20 of the cup-shaped member 14.

A hollow cylindrical member 34 which is larger in diameter than the diameter of the side wall 20 of the cup-shaped member 14 extends through the removable top 36 of the enclosure 24 and telescopes over the cup-shaped member 14 to near the brim or flanged part 22 of the cup-shaped member 14. An outwardly extending flange 38 is provided at the lower end of the cylindrical member 34. A partition 40 extends across the cylindrical member 34 above the cup-shaped member 14 to form an upper reservoir compartment 41 within the member 34. The cylindrical member 32 and the cylindrical member 34 are telescoped within one another over a part of their length and are coaxial with respect to the shaft 10 and cup-shaped member 14.

A pair of conduit members 42, 44, disposed on diametrically opposite sides of the cup-shaped member 14, extend from near the brim or flange part 22 of the cup-shaped member 14 through the partition 40 and communicate with the upper compartment 41 of the cylindrical member 34. The conduit members 42, 44 are disposed between and are substantially parallel with the side wall 20 of the cup-shaped member 14 and the cylindrical member 34. The output end of the members 42, 44 are close to and directed toward the flange 22.

An overflow conduit 46 is coupled between the upper compartment 41 and the lower compartment 28 of the enclosure 24. A fluid return line 48 is coupled, through a pump 50, from the bottom of the compartment 28 to the upper part of the upper compartment 41. As shown, the line 48 is coupled to the upper compartment 41 through the top or closure section 52 of the cylindrical member 34. A vent 54 and a fixed or non-rotatable electrode 56 also extends through the top or closure section 52, the lower end 58 of the electrode 56 being near to the partition 40 and in any event is below the fluid level of the compartment 41.

In operation mercury (or other electrically conductive metal or alloy which melts at low temperatures, such as Woods metal, bismuth-tin alloys, or lead, for example) is placed in the upper compartment 41 of the cylindrical member 34. The electrically conductive metal 60, referred to hereafter as mercury, flows through the tubes or conduits 42, 44 and impinges as a continuous stream on the flange 22 of the cup shaped member 14. The rotation of the shaft 10 causes the mercury to be thrown, by centrifugal force, from the flange 22 and onto the side 62 or bottom partition 30 of the compartment 26.

The upper part of the partition 30 slopes downwardly, in a stepped manner, from the outer part to the inner part thereof. Fluid drainage bores 64, 66, extend through the partition 30 to permit mercury to pass through the partition 30 and fall into the lower compartment 28 from

whence it is pumped through the tube or line 48 into the upper compartment 41 of cylindrical member 34.

A bore 72 extends through the partition 30 from the side wall 62 of the enclosure 24, communicating with the compartment 28. A tube 74, coupled to the bore 72, may be connected, if desired, with a vacuum pump 76, to force air between the shaft 10, cylindrical member 32, down between the cylindrical member 32 and the wall 20 of the cup shaped member 14 and out through the partition 30, thus preventing a buildup of mercury along the space between the inner part of the wall 20 of the cup shaped member 14 and the wall of the cylindrical member 32.

Thus, with the fixed or non-rotatable electrode 56 making constant contact with the pool of mercury 60*a*, the continuous stream of mercury which impinges on the flange 22 of the rotating cup shaped member 14 assures a continuous low resistance, low noise level electrical contact with the rotating shaft 10 to which the cup-shaped member is secured. The pump 50 continually replenishes the mercury from the pool 60 in compartment 28 to the pool 60*a* in the upper compartment 41.

In one mercury brush type apparatus constructed in accordance with this invention the electrode 56 is made of carbon or "wetted" steel rod. The flange 22 of the cup shaped member 14 must also be "wetted," that is, freed of oxide film and amalgamated with mercury. The shaft 10 and cup shaped member are made of stainless steel and the enclosure 24, cylindrical member 32 and cylindrical member 34, plus partitions 30 and 40 are made of a plastic material such as "Plexiglas." The mercury pressure head is between 6 and 8 inches with tubes 42, 44 having an inner diameter of about 1/16 inch. However, other materials of construction and enclosure configurations than those illustrated may be adapted to usage in making mercury (or other electrically conductive flowable materials) brush contacts without departing from the scope of this invention.

We claim:

1. Apparatus for making continuous, substantially constant resistance electrical contact between a non-rotatable electrode and a vertically disposed metal shaft-like rotatable electrode having an upper end, comprising an inverted cup shaped metal member having a rim and being of larger internal diameter than the diameter of said rotatable electrode, said cup shaped member having an outwardly extending flanged part disposed adjacent to said rim, the cup shaped member being coaxially disposed rim downwardly over the upper end of said shaft and secured thereto, an upper reservoir of electrically conductive flowable material, the non-rotatable electrode extending into said flowable material, said upper reservoir being disposed above the upper end of said rotatable electrode, at least one tubular member having an upper end and a lower end, said upper end communicating with said upper reservoir and said lower end being close to and directed towards the rim on said inverted cup-shaped member, a lower reservoir, enclosure means for directing said flowable material which leaves said flange into said lower reservoir, and means including a pump and conduit for pumping said conductive flowable material from said lower reservoir to said upper reservoir.

2. Apparatus in accordance with claim 1, wherein an overflow conduit is connected between said upper reservoir and said lower reservoir.

3. Apparatus in accordance with claim 1, wherein a tubular wall extends through said lower reservoir and between said rotatable electrode and said inverted cup-shaped member.

4. Apparatus in accordance with claim 1, wherein a tubular section extends downwardly from said upper reservoir and telescope over said inverted cup shaped member.

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