March 25, 1941. A. C. BORCHERS 2,236,257

COMMUTATOR

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Fig. 1.

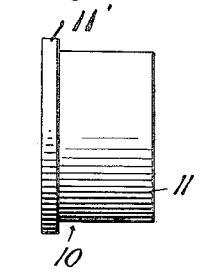


Fig. 2.

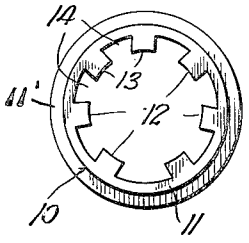


Fig. 3.

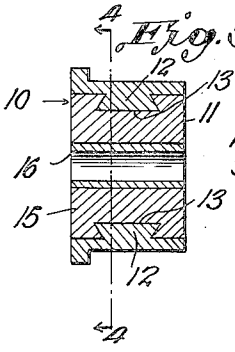


Fig. 4.

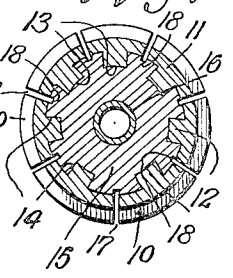


Fig. 5.

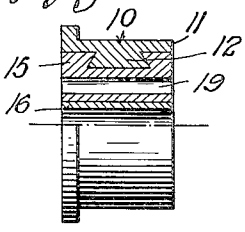


Fig. 6.

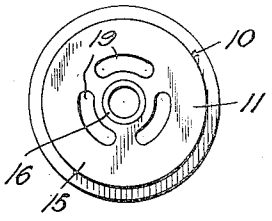


Fig. 11.

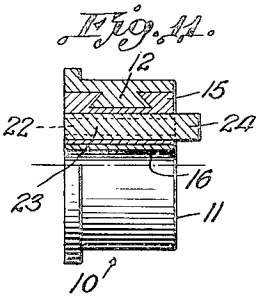


Fig. 7.

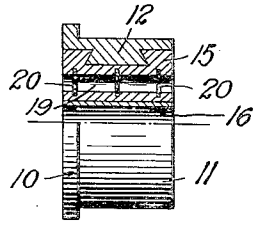


Fig. 8.

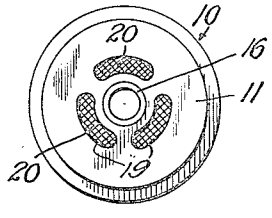


Fig. 12.

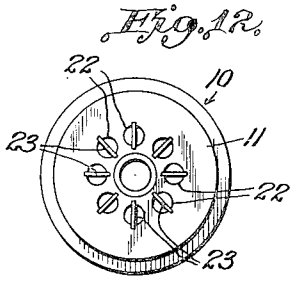


Fig. 9.

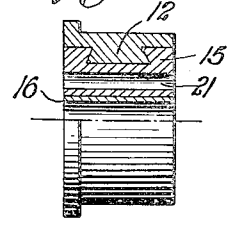
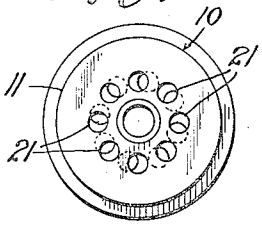


Fig. 10.



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BY
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Fig. 13

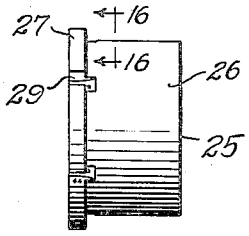


Fig. 15

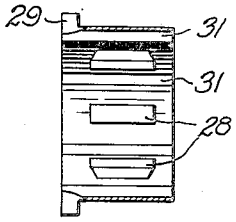


Fig. 14

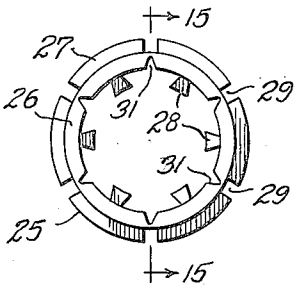


Fig. 16

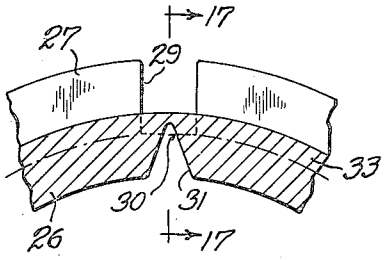


Fig. 17

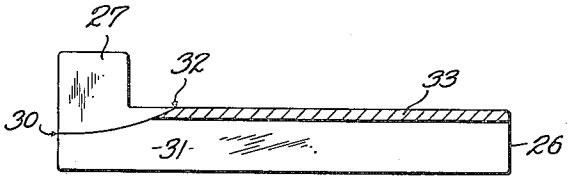
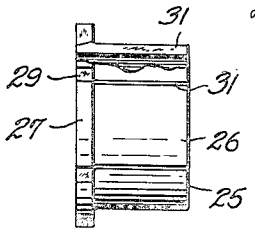


Fig. 18



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Patented Mar. 25, 1941

2,236,257

UNITED STATES PATENT OFFICE

2,236,257

COMMUTATOR

Alvin Carl Borchers, Elyria, Ohio, assignor to General Industries Company

Application March 23, 1938, Serial No. 197,653

10 Claims. (Cl. 171—321)

This invention relates to commutators for electro-motive apparatus, and more particularly to an improved method of forming and arranging the commutator segments in an insulating body.

Heretofore, it has been common practice in constructing motors with which I am familiar, to mold graphite into the brushes to reduce operating noise of the motor. However, the material forming the brushes is necessarily softer than that of the commutator and as the brushes become worn, the graphite dust falls into the insulating space between the commutator bars resulting in smudging of the bars and also sludging between bars.

I have provided a commutator shell formed of molded copper and graphite, the amount of graphite being dependent on the lubricating qualities desired and the requirements as to a proper soldering joint. The resulting product may be more easily machined than drawn copper, most generally used in built up commutators, although providing a very hard surface and permitting closer tolerances in machining than with drawn copper or the like.

I combine the molded shell with an insulating body formed of phenolic condensate material or the like so that when the shell is subsequently divided to form individual commutator bars, the bars are rigidly anchored. Additionally, I may provide improved ventilator means for the commutator to reduce the heating effect on the commutator and brushes and thereby increase the useful life of the brushes.

I may also form the shell of molded pure copper dust without the addition of graphite wherein various advantages of manufacture may be achieved as to a drawn copper shell such as relative ease in machining and working to closer tolerances together with the fact that the molded construction permits of an improved design with a minimum of machine operations and waste material.

Also, I have provided an improved design for commutator shells whereby the necessity of saw cuts or the like to separate the shell into bars may be eliminated and this may be effected by a shell shaving operation.

It is an object of my invention therefore, to provide an improved commutator for electromotive apparatus.

Another object of my invention is to provide an improved method of forming electrical conducting material.

Another object of my invention is to provide improved means for anchoring commutator bars in an insulating body.

Another object of my invention is to provide a commutator having improved ventilating means associated therewith.

Another object of my invention is to provide an improved commutator having a lubricant material molded thereinto and which may be machined with relatively close tolerances.

Another object of my invention is to provide an improved commutator which is relatively inexpensive to manufacture and has improved operating characteristics.

Another object of my invention is to eliminate the necessity of providing mica insulation between the commutator bars and resultant performance of the motor or generator on which the commutator is used due to growing high mica.

Another object of my invention is to eliminate the manufacturing difficulties of a built-up commutator as to correct width of mica between bars, symmetry of the commutator relative to its axis, and holding the mica strips parallel to the commutator axis.

Another object of my invention is to prevent the danger of bar edges breaking through insulation and leading to grounds through providing an air gap between bars.

Another object of my invention is to reduce the contact resistance between the commutator and brushes and thereby improve the operating characteristics of the motor or generator.

Another object of my invention is to reduce arcing under the brushes and thereby reducing radio interference.

Another object of my invention is to provide a commutator construction permitting the lead wires to be firmly staked to the bars.

Other objects of my invention and the invention itself will become more apparent from the following description of the drawings wherein:

Fig. 1 is a side elevational view of a commutator shell which I may employ;

Fig. 2 is an end elevational view of the shell of Fig. 1;

Fig. 3 is a sectional view of a commutator constructed according to my invention, taken along a plane including the commutator axis;

Fig. 4 is a transverse section taken along the lines 4—4 of Fig. 3;

Fig. 5 is a side elevational view partially in section of a commutator constructed in accordance with my invention and provided with ventilating means;

Fig. 6 is an end elevational view of the commutator of Fig. 5;

Figs. 7 and 8 are views similar to Figs. 5 and 6 respectively showing a modified construction;

Figs. 9 and 10 are views similar to Figs. 5 and 6 respectively showing a further modified construction;

Figs. 11 and 12 are views similar to Figs. 9 and 10 respectively wherein ventilating blades are provided;

Fig. 13 is a side elevational view of a further modification of my invention;

Fig. 14 is an elevational view of the modification of Fig. 13;

Fig. 15 is a section along line 15—15 of Fig. 13;

Fig. 16 is an enlarged fragmentary section along line 16—16 of Fig. 13, and

Fig. 17 is a section along line 17—17 of Fig. 16.

Fig. 18 is a side elevational view similar to Fig. 13 but showing certain sections broken away for the purpose of illustration.

Referring now to the drawings, and more particularly to Figs. 1 and 2, I have indicated at 10 a generally cylindrical commutator shell including an axially extending flange 11 at one end of the shell and a radially outwardly extending flange 11' at the opposite end and a plurality of radially inwardly extending anchoring lugs 12 intermediate said flanges. The shell is formed of molded copper and graphite and since the copper may be molded with any degree of porosity, the graphite may be molded therewith under proper pressure and temperature conditions. The material of the commutator shell may be either pure copper dust which after molding will preferably have a density of approximately 80% or may be made of a mixture of graphite in powdered form and copper dust.

The amount of graphite added to the copper is dependent on the lubricating qualities desired as limited by the amount of graphite which might be added and still provide a composition forming a good solder joint. I have found that at least up to 20% by volume of graphite may be added to the copper dust and the resulting molded composition still provides a proper solder joint.

Inasmuch as the material of the shell is molded rather than spun or drawn, the shape of the shell may conform closely to the finished shell with proper allowance for machining, resulting in a minimum of waste material. I find that although the molded copper, or the molded copper and graphite composition provides a very hard surface having considerable strength and which will resist abrasions from the brushes of the electrical apparatus in which the commutator is located that the molded metal is relatively free cutting so that the machining of the commutator to a desired size is not only easier than machining drawn material but the material may be machined to closer tolerances. The graphite when molded with the copper is permanently suspended and since the copper is harder than the material of the brushes, the commutator does not wear to any appreciable extent by contact with the brushes so that a very small amount of graphite is freed due to wear of the commutator bars thus eliminating the tendency of graphite to fall into the space between adjacent bars to cause smudging of the bars and slugging between the bars due to the graphite dust.

The anchoring lugs as best illustrated in Fig. 3, are of dove-tailed form in an axial direction so that the bases of the lugs as indicated at 13 are greater in axial extent than the lugs at the juncture with the inner walls of the shell. It will be noted by reference to Fig. 4 that the lugs 12 extend in a radial direction and that the thickness of the lugs is substantially constant so that the opening between adjacent lugs as indicated at 14 is also substantially of dove tail form in a radial plane.

The shell 10 has a body of insulating material indicated at 15, which may be a phenolic condensate or similar material molded therewith, and which, in a well known manner, when subjected to heat, may be poured into a mold and subsequently hardened. A tube 16, formed preferably of steel or brass, may be molded to the body 15 to provide a bearing for the commutator although I contemplate that under certain conditions this will not be necessary and the material of body 15 may directly contact the shaft projected therethrough.

It will be noted that due to the dove-tail construction of anchoring lugs 12, together with the dove-tail form of the openings 14, a three-way anchor is provided preventing relative movement between the shell 10 and the body 15 in an axial, radial and circumferential direction. Also, the axial ends of the anchors 12 are completely embedded in the insulating material so that there is no danger of a short circuit through the anchoring lugs. After molding the body 15 with the shell 10, the shell is separated into commutator bars by radial cuts as indicated at 17 which extend slightly into the insulating material as indicated at 18 to insure complete separation of the shell into individual insulated bars but the narrow depth of the cuts in body 15 does not weaken the body in any appreciable degree. Each of the commutator bars will be provided with an upstanding segment 8A to which conducting wires may be soldered in a well known manner.

Referring now to Figs. 5 and 6 I have shown a commutator constructed in a manner similar to that illustrated in Figs. 3 and 4, but wherein a plurality of ventilation holes 19 are formed in the body 15 permitting air to traverse the body and cool the commutator and resultantly the brushes which reduces the tendency of the brushes to deteriorate due to heat and prolongs the useful life of the brushes.

Figs. 7 and 8 illustrate a modified form of commutator generally similar to that illustrated in Figs. 5 and 6, but wherein a plurality of axially spaced metal screen elements 20 are provided through which air must pass in traversing the ventilating holes in body 15. The screen elements 20 serve the dual function of reinforcing the body 15 and conducting the heat generated in the commutator to the air holes or ventilating passages.

Referring now to Figs. 9 and 10, I have shown a further modified form of commutator similar to that illustrated in Figs. 3 and 4, but wherein a plurality of preferably cylindrical passages 21 are skewed or run obliquely through the insulating body 15 and act as a fan for effecting movement of air in cooling the commutators.

Referring now to Figs. 11 and 12, I have shown a further modified form of commutator wherein vent holes 22 are provided permitting the passage of air axially to the body 15 and plates 23 embedded in the insulating material have an end portion as indicated at 24 extending axially beyond the insulating body to direct air through the vent holes. Although I have shown the blades of straight form, I contemplate that they

may be slewed or extend obliquely through the body 15 in the manner of the vent holes of Figs. 9 and 10.

Referring now to Figs. 13 to 18 inclusive, I have shown generally at 25 a molded shell which may be formed either of copper or copper and graphite, the shell including a cylindrical portion 26 having a radially outwardly extending flange 27 and a plurality of anchoring lugs 28 on the inner side of the shell. Intermediate the lugs 28 the flange 27 is provided with slots 29 extending radially inwardly partially through the cylindrical portion to a point, such as 30, indicated in Fig. 16. In the same radial zone of each of the slots 29 the inner walls of the cylindrical portion 26 are provided with axially extending preferably V-shaped grooves 31 extending radially outwardly beyond point 30. It will be noted that the slot 29 extends axially along the cylindrical portion beyond flange 27, as indicated at 32, whereby shaving the cylindrical portion by a turning operation to a depth, such as 30, will sever the shell into a plurality of individual bars. This eliminates an expensive saw cutting or the like operation for severing the bars, although I contemplate that the shell may be divided into bars by saw cuts and in which case the slots 29 act as guides for the saw, molded with slots therein similar to slots 29 for guiding the saw or the like since it is difficult to align the cuts with the embedded lugs 12.

The shell of the modification of Figs. 13 to 18 will have a body of phenolic condensate material or the like molded therein in the manner previously described which may conform to the modifications of Figs. 1 to 12 but the condensate material is preferably permitted to flow into the slots 29 of flange 27 to provide further insulation between the bars.

The material to be shaved from the shell is indicated at 33, Figs. 16 and 17. Thus, a molded shell is provided wherein, after molding of the plastic material therein, the shell may be separated into individually insulated bars through removing a thin cylinder of material from the cylindrical portion 26 of the shell by turning in a lathe or the like.

Although I have shown and described preferred form of my invention, I contemplate that numerous and extensive departures may be made therefrom without departing from the spirit of my invention or the scope of the appended claims.

Having thus described my invention, what I claim is:

1. An article of manufacture, a commutator comprising a body of insulating material having an axial shaft receiving perforation therethrough, a plurality of commutator bars containing at least 80% copper encircling said body in circumferentially spaced relation, each of said bars having an anchoring lug extending radially inwardly into said body and progressively increasing in cross-sectional area radially inwardly, the body being provided with a plurality of generally axially extending air passages therethrough, and blades in said passages supported by the body having their axial end-portions extending beyond the body to direct air through said passages.

2. The method of making commutators which includes molding a generally cylindrical shell comprising copper as a chief constituent, the shell being formed with radially inwardly extending anchoring lugs on the inner wall of the shell and intermediate the shell axial ends, the shell having radially outwardly extending segments having recesses therebetween extending into the shell cylindrical portion, the shell inner wall having axially extending grooves in the radial zone of said recesses extending radially outwardly beyond the depth of said recesses, molding a body of insulating material within the shell to embed the anchoring lugs, and shaving the external surface of the shell cylindrical portion at least to the depth of said grooves to provide individual insulated bars anchored in said body.

3. As an article of manufacture, a commutator comprising relatively spaced commutator segments each comprising a molded mixture, at least 80% of said mixture being of finely pulverized copper powder, and the balance comprising a major portion of finely divided material having lubricating qualities of substantial electrical conducting characteristics.

4. As an article of manufacture, a commutator comprising relatively spaced commutator segments, at least some of said segments comprising a mixture of finely pulverized good electrical conducting copper material, and finely pulverized graphite, the metallic material comprising at least 80% of the volume of the mixture.

5. As an article of manufacture, a commutator comprising a plurality of relatively spaced commutator segments, at least one of said segments containing a mixture of finely pulverized copper and graphitic material having respectively good electrical conducting and low frictional characteristics, said material being molded to the solid form of the segment.

6. An article of manufacture, a commutator comprising a generally cylindrical shell of at least 80% molded copper by volume and 20% graphite by volume, a generally cylindrical body of phenolic condensate of the like insulating material being disposed within the shell, a plurality of generally axially extending air passages disposed through said body, the shell being severed axially thereby providing a plurality of individual commutator bars anchored to said body.

7. An article of manufacture, a commutator comprising a body of insulating material having an axial shaft receiving perforation therethrough, a plurality of commutator bars encircling said body in circumferentially spaced relation, each of said bars having an anchoring lug extending radially inwardly into said body, the body being provided with a plurality of generally axially extending air passages therethrough, a plurality of axially spaced screen elements disposed in association with said air passages providing reinforcement for the body and conducting heat generated in the commutator through said air passages.

8. An article of manufacture, a commutator comprising a body of insulating material having an axial shaft receiving perforation therethrough, a plurality of commutator bars encircling said body in circumferentially spaced relation, each of said bars having an anchoring lug extending radially inwardly into said body, the body being provided with a plurality of generally axially extending air passages therethrough, said air passages being skewed through the body for effecting movement of air therethrough.

9. An article of manufacture, a commutator comprising a generally cylindrical body of insulating material, a generally cylindrical outer shell encircling said body in circumferentially spaced relation, said shell composed of a mixture of molded copper and graphite powder, a plurality of radially inwardly extending lugs on the shell inner walls embedded within the body of insulating material, said shell having been di-

vided intermediate the spaced lugs to provide anchored individual insulating commutator bars.

10. An article of manufacture, a commutator comprising a body of insulating material having an axial shaft receiving perforation therethrough, a plurality of commutator bars, containing at least 80% copper and a balance of graphitic material, encircling said body in circumferentially spaced relation, each of said bars having an anchoring lug extending radially inwardly into said body and progressively increasing in cross-sectional area radially inwardly, the body being provided with a plurality of generally axially extending air passages therethrough, and blades in said passages supported by the body having their axial end portions extending beyond the body to direct air through said passages.

ALVIN CARL BORCHERS.