April 2, 1968 J. W. McCOLL 3,376,443

COMMUTATOR AND METHOD OF MAKING

Filed Nov. 30, 1961

Fig. 1

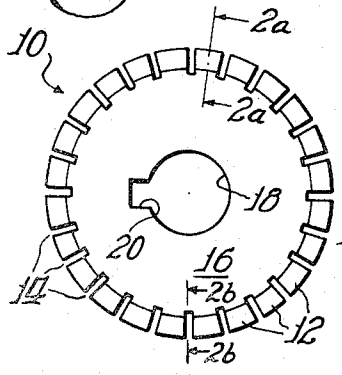


Fig. 2a

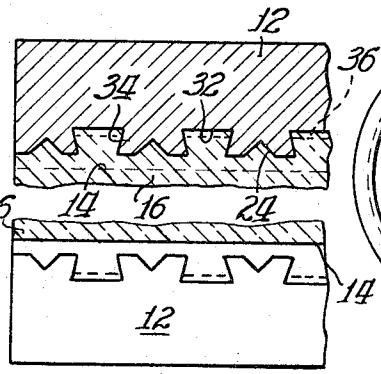


Fig. 7

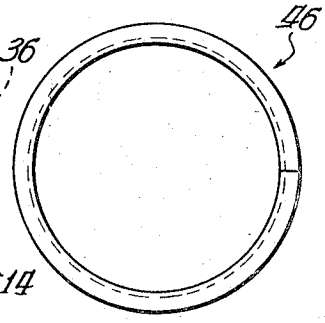


Fig. 3

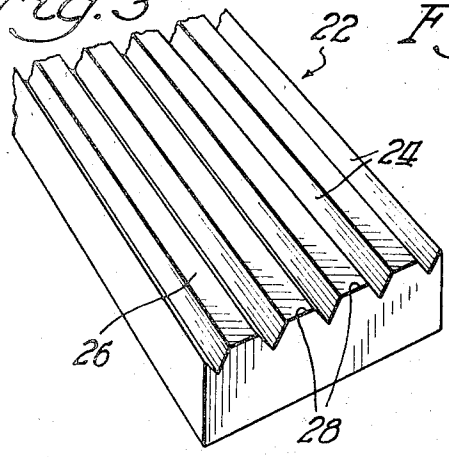


Fig. 2b

Fig. 4

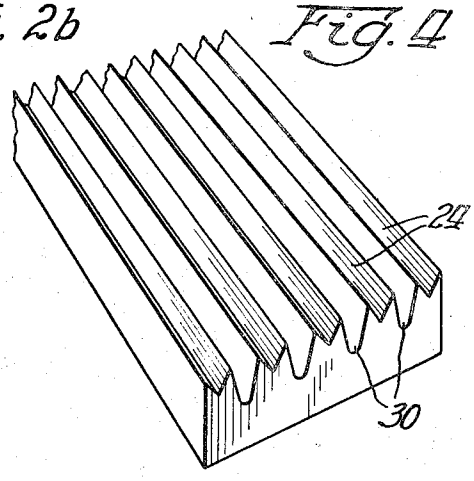


Fig. 5

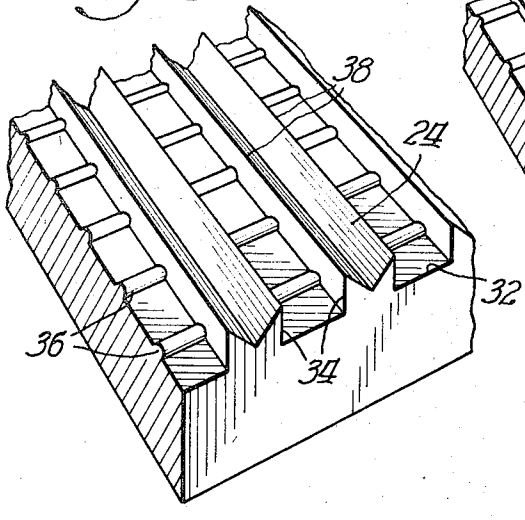
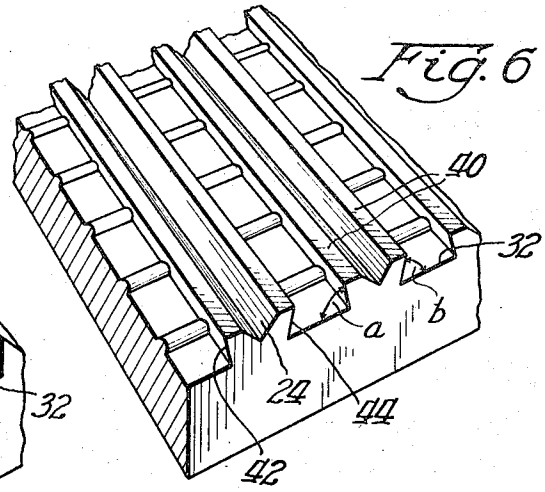


Fig. 6



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COMMUTATOR AND METHOD OF MAKING

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8 Claims. (Cl. 310—235)

This invention relates to current distribution devices and more particularly to molded commutator assemblies in which the commutator segments are embedded in a mass of molded insulating material.

Heretofore, one of the problems that has existed with respect to commutator devices is that of making a simple inexpensive quality structure which at the same time is easy to manufacture. Another problem is that of providing an adequate bond between each commutator bar and the molded insulation material while at the same time utilizing inexpensive manufacturing and assembly techniques. The bond is extremely important when the commutator bars are of a large axial length or the device operates at high speeds producing large centrifugal forces.

Thus, one of the objects of this invention is to provide a commutator assembly which is inexpensive and easy to manufacture.

Another object is to provide a commutator assembly wherein a dovetailed cross-section is formed on a blank of conductive material so that after the molded insulation material is applied to the blank and the conductive material is slotted to form the commutator segments, the commutator segments will have inwardly radially projecting ribs which furnish a bond with the insulating material throughout the full circumferential thickness of the commutator bar.

Other objects and advantages will be apparent as the description of an embodiment of the invention proceeds taken in connection with the accompanying drawings in which:

FIG. 1 is an elevational view of an embodiment of a unitary molded commutator assembly;

FIGS. 2*a* and 2*b* are enlarged partial sections taken at lines 2*a*—2*a* and 2*b*—2*b* of FIG. 1;

FIG. 3 is a partial view and perspective of a blank of conductive material on which the first forming operation has been completed;

FIG. 4 is a perspective view of the blank after the second forming operation has been performed thereon;

FIG. 5 is a perspective of the blank after the third forming operation has been performed thereon;

FIG. 6 is a perspective view of a portion of the blank after the final operation has been performed on the conductive material leaving a dovetailed cross-section; and

FIG. 7 is a view in elevation of the blank of conductive material after it has been bent into annular form and just prior to applying the insulating material thereto.

Referring now to FIG. 1 the numeral **10** indicates generally the molded commutator assembly. The assembly **10** comprises a series of commutator segments **12** separated by slots **14** which may be filled with insulating material. The assembly **10** further comprises a molded insulating material **16** which is bonded to dovetailed cross-section areas of the segments **12** as shown in FIG. 2. The assembly **10** has formed therein an aperture **18** for positioning on a shaft or other rotary member. A keyway **20**, for example, may be used to assist in positioning the assembly **10** on such shaft or member.

The method of making this molded commutator assembly will now be described. The commutator segments **12** are made from an electrically conductive material such as copper, for example. Initially V-shaped grooves **24** are formed in the surface **26** of conductive material

from which the blank **22** is eventually stamped. This leaves flat portions **28**. In the next operation substantially V-shaped grooves **30** of a greater depth than the grooves **24** are formed as by milling, for example, in the flat portions **28** leaving a cross-section as shown in FIG. 4. A roll-forming operation using a special rolling tool is then used to deform the material in the grooves **30** to leave substantially flat bottomed grooves **32** and ribs **34** as shown in FIG. 5. As a concurrent part of this last roll-forming operation a roll-forming tool is used which will form projections **36** in the groove **32**. In the alternative the roll-forming tool may have formed on its periphery projections so that the roll-forming operation will form slight depressions in the bottom of the groove **32** instead of leaving the projections **36**. In a final operation the top edges **38** of the V-shaped grooves **24** of the ribs **34** are flattened to squeeze these edges into adjacent grooves **32** and leave substantially flat areas **40**. This leaves an undercut or dovetailed cross-section as illustrated in FIG. 6 so that the sides **42** and **44** respectively form acute angles *a* and *b* with the bottoms of the grooves **32**.

The blank **22** is then stamped from the conductive material and then bent into annular form **46**. Molded insulation material **16** is then molded to the inside surface of the annular form. The aperture **18** and the keyway **20** may either be molded into the assembly originally or formed in the assembly after molding.

After the molding operation slots **14** are cut through the annular form **46** thus leaving separate commutator segments **12** each individually attached to the molded insulating material. It will be noted that the circumferential length of the portions of the ribs **34** on each of the commutator bars, that is after slotting, is the same length as the circumferential length of the main body of the commutator bar itself. This is extremely important in that it provides a maximum bond between the individual commutator bars and the molded insulating material.

As one example of the construction described, I have made a commutator assembly of approximately one inch in diameter. The total thickness of the conductive material blank and consequently the radial depth of the resulting bars was approximately .080 inch, the depth of rib portion being about .020 inch of the latter dimension. This commutator assembly was tested up to 60,000 r.p.m. Since there is very little radial space occupied by the commutator bars it is possible to provide a substantial number of them per inch of circumference. In addition the number of commutator bars is theoretically unlimited depending only on the narrowness of the cut taken when the bars are formed. The holding power of the rib and groove dovetailed pattern extends over the complete circumferential thickness of each bar so that no matter what its thickness each bar is firmly held by the molding.

It will be observed that this device can be relatively simply manufactured. In addition the problem of assembling individual commutator bars into an assembly does not exist. Also this construction advantageously provides a maximum bond extending over the complete circumferential thickness of the commutator bar.

While a preferred embodiment of the invention has been specifically disclosed it is understood that the invention is not limited thereto as other variations will be readily apparent to those skilled in the art, and the invention is to be given its broadest possible interpretation within the terms of the following claims.

I claim:

1. A commutator assembly comprising: a core of molded insulation material; a plurality of commutator bars disposed around and firmly anchored in said molded insulation material; circumferentially arcuately trans-

axially extending alternate ribs and grooves on the radial inward end of said bars forming a dovetailed axially positioned cross-section for anchoring said bars in said materials; and axially disposed deformations in said grooves for preventing relative circumferential movement between said bars and said insulation material.

2. The method of making a current distribution device comprising: cutting a first set of grooves on one side of a substantially flat electrically conductive material; cutting a second set of grooves on said material, each of the grooves of said second set being disposed between the grooves of the first set; thus leaving a plurality of ribs with the first set of grooves formed in the tops thereof; flattening the top of said ribs so that said ribs and grooves form a continuous substantially dovetail cross-section; stamping a blank from said material; bending said blank into an annular form so that the rib and groove pattern is on the inside surface thereof; molding an insulating material on the inside of said annular form so that the complete blank becomes firmly anchored to the insulating material upon hardening of the latter so that relative axial movement of the blank with respect to the molded insulation material is avoided.

3. The method of claim 1 which includes cutting a plurality of axial grooves in the outer periphery of said device through the annular form to provide a plurality of commutator segments.

4. The method of making a current distribution device comprising: forming a longitudinal rib and groove pattern on one side of a substantially flat electrically conductive material; forming the material in the grooves into substantially flat bottomed grooves; flattening the top of said ribs so that the ribs are undercut with respect to the adjacent grooves to form a substantially dovetail cross-section; stamping a substantially flat blank from said material; bending said blank into an annular form so that the rib and groove pattern is on the inside surface thereof; molding an insulating material on the inside of said annular form so that the complete blank becomes firmly anchored to the insulating material upon hardening of the latter so that both relative axial and relative circumferential movement of the blank with respect to the molded insulation material is avoided.

5. The method of making a current distribution device comprising: cutting a first set of grooves on one side of a substantially flat electrically conductive material; cutting a second set of grooves on said material each of the grooves of said second set being disposed between the grooves of said first set and being deeper than the grooves of said first set; thus leaving a plurality of ribs with the first set of grooves formed in the tops thereof; forming the material in said second set of grooves into a substantially flat bottomed groove and forming in said last named grooves a series of deformations positioned transversely of said grooves structure; flattening the ribs so that the sides of the ribs form acute angles bottoms

of the adjacent grooves of said second set of grooves; stamping a blank from said material; bending said blank into an annular form so that the rib and groove pattern is on the inside surface thereof; molding an insulating material on the inside of said annular form so that the complete blank becomes firmly anchored to the insulating material upon hardening of the latter so that relative axial movement of the blank with respect to the molded insulation material is available.

6. The invention according to claim 5 wherein said flat bottomed grooves and said series of deformations are formed simultaneously.

7. A commutator having an insulating core member comprising: a plurality of electrically separated commutator bar members of electrical conductive material each comprising a body portion of cylindrically curved configuration having side edges and end edges and which at its interior surface is provided with transversely extending integral ribs following said cylindrical curvature and extending between said side edges of said body portion substantially parallel with said end edges thereof, each rib being in the form of oppositely disposed split rib members forming acute angles with the interior surface of said body portion, a plurality of tooth-like impressions in the interior surface of said body portion between said ribs extending substantially transversely to said ribs, said ribs and said tooth-like impressions being effectively bonded to said insulating core member in peripheral spaced relationship.

8. As an article of manufacture for the construction of a commutator having a plurality of peripheral electrically separated portions of electrical conductive material provided with anchoring means embedded in an insulating interior core; a strip of sheet material following a cylindrical curvature and having on its inwardly facing surface a plurality of elongated parallel ribs integral with said sheet material and following annular paths and having side surfaces forming an acute angle with the interior surface of said cylindrical member, and tooth-like impressions in the interior surface of said cylindrical strip between said ribs substantially perpendicular to said ribs.

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