

[54] **METHOD OF MANUFACTURING
COMMUTATORS FOR SMALL-SIZE
ELECTRIC MACHINES**

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[30] **Foreign Application Priority Data**

Jan. 20, 1970 Japan45/5252

[52] U.S. Cl.**29/597**, 310/234, 310/235

[51] Int. Cl.**H01r 43/00**

[58] Field of Search29/597; 310/234, 235, 236

[56] **References Cited**

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Assistant Examiner—Carl E. Hall
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[57] **ABSTRACT**

A method of manufacturing commutators for small-size electric machines, which includes the steps of press forming a flanged hollow cylindrical workpiece, which has a flange at one end and is made of a conducting material, with outward protuberances defining corresponding inner recesses or cavities along a portion of the workpiece adjacent the flange, press forming the resultant workpiece into an axially grooved, flanged hollow body having eventual commutator segment portions and outward bridge portions bridging adjacent commutator segment portions, forming inner nails on the resultant body at positions corresponding to the respective commutator segment portions, mold filling an insulating material in the resultant nailed body, and die-stamping connection hooks from the flange while at the same time removing the outward protuberances.

1 Claim, 19 Drawing Figures

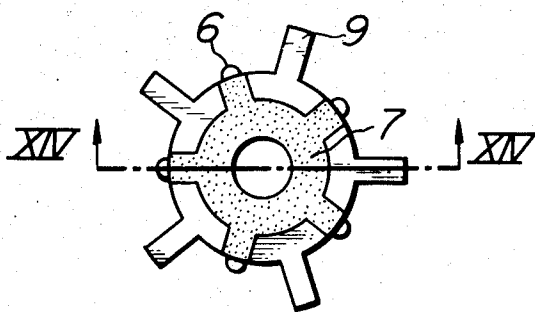


FIG. 1

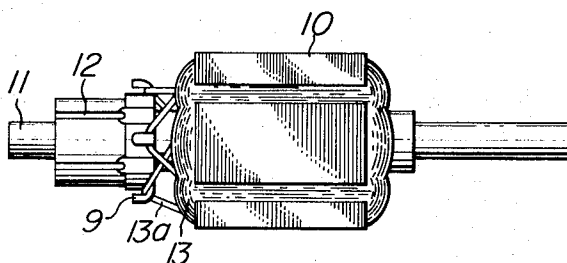


FIG. 2

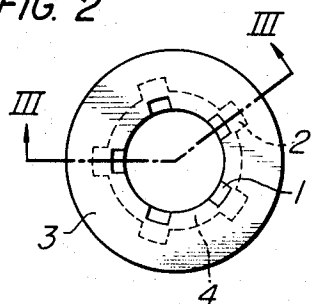


FIG. 3

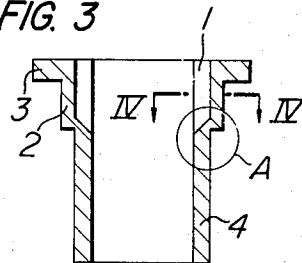


FIG. 4

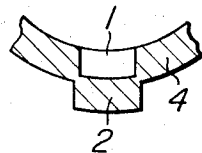


FIG. 5

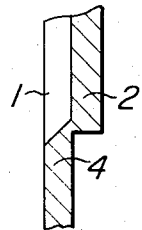


FIG. 6

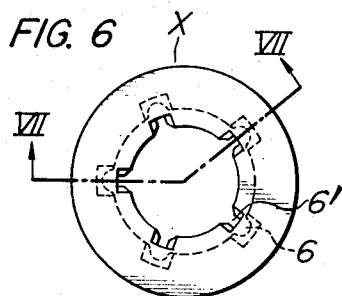
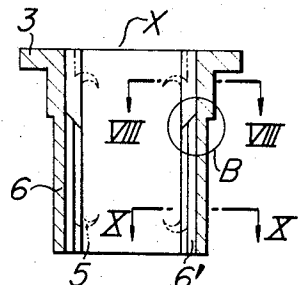


FIG. 7



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FIG. 8

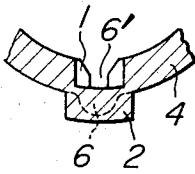


FIG. 9

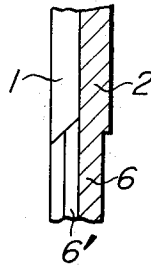


FIG. 10

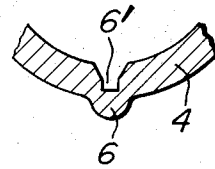


FIG. 11

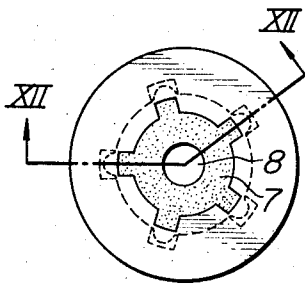


FIG. 12

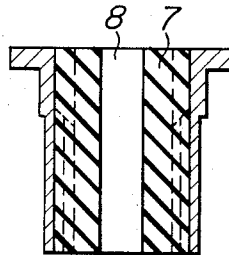


FIG. 13

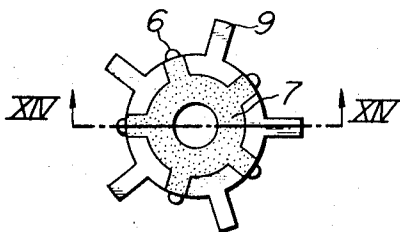
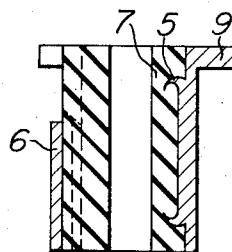


FIG. 14



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FIG. 15

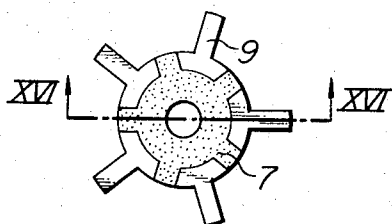


FIG. 16

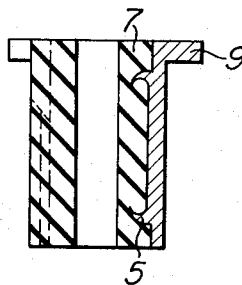


FIG. 17

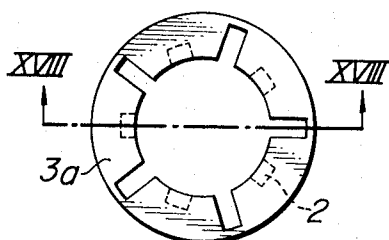


FIG. 18

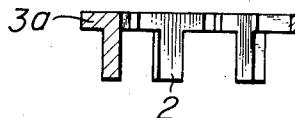
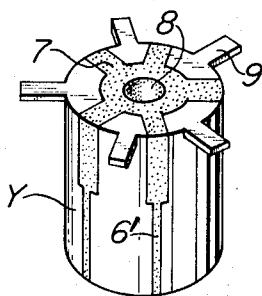


FIG. 19



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METHOD OF MANUFACTURING COMMUTATORS FOR SMALL-SIZE ELECTRIC MACHINES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the method of manufacturing commutators for installation on the armature shaft of electric machines.

2. Description of the Prior Art

In the manufacture of commutators for revolving-armature type electric machines, the commutator segments are produced usually from copper strips or from a copper ring or tube. The manufacture of a commutator from a copper ring involves the steps of pre-shaping the workpiece by such means as rolling, punching, stamping and embossing, mold filling such insulating material as a phenol resin containing asbestos in the pre-shaped ring body, fitting the resultant ring body on the armature shaft, then machining the periphery of the ring body to the end to prevent the vibration of the brushes, and finally splitting the machined ring body into a required number of mutually insulated commutator segments by cutting the corresponding number of axial grooves across the thickness of the ring body. This method requires special equipment and extra steps for cutting the axial grooves to split the ring body into the commutator segments, which is a significant disadvantage in respect of productivity.

To facilitate the process of cutting the axial grooves splitting the ring body into the commutator segments after machining the ring body, it is the usual practice to pre-form appropriate slots or notches in the workpiece in the afore-said pre-shaping step adjacent the end of the workpiece and hence eventual commutator nearer the armature core in alignment with the axial grooves to be subsequently cut. This measure is taken particularly when the armature is small in size. Where the distance between the armature core and the commutator is small, the above slots aids facilitating the cutting of the axial grooves to divide the ring body.

However, in mold filling an insulating material in the pre-shaped ring body having such slots, the insulating material migrates through these slots to adhere to the outer surfaces of the eventual commutator segments and connection hooks. The insulating material thus adhered is extremely difficult to remove, which is not only undesired in respect of productivity but is also a disadvantage in that a high-grade commutator cannot be obtained.

SUMMARY OF THE INVENTION

An object of the invention is to provide a method of manufacturing commutators for revolving-armature type electric machines, in which the steps for cutting axial grooves in the workpiece to define splitted commutator segments are dispensed with.

Another object of the invention is to provide a method of manufacturing commutators, in which the mold filling of an insulating material in the eventual commutator is free from the adherence of the insulating material to the outer surface of the eventual commutator segments and connection hooks.

According to the invention, the above ends are achieved by press forming a flanged hollow cylindrical workpiece, which has a flange at one end and is made of a conducting material, with outward protuberances

defining corresponding inner recesses along a portion of the workpiece adjacent the flange, press forming, for instance squeezing, the resultant workpiece into an axially grooved, flanged hollow body having commutator segment portions and outward bridge portions bridging adjacent commutator segment portions, forming the resultant body with inner nails at positions corresponding to the respective commutator segment portions, mold filling an insulating material in the resultant nailed body, and die-stamping connection hooks from the flange while removing the outward protuberances, whereby excellent commutators with high production efficiency are obtained.

One feature of the invention resides in that the axially grooved and nailed hollow body may be split into a required number of portions constituting the commutator segments in machining the body to remove the bridge portions, for instance after fitting the body with the insulation on the armature shaft, so that the undercut is required only to such an extent that a slight superficial part of the insulation between the adjacent commutator segments is removed. As the depth of cut is slight, a cutter with a thin cutter blade may be used without causing damage thereto. Also, the undercutting operation may be carried out at an extremely high speed.

Another feature of the invention resides in that the undesired adhering of the insulating material to the outer surfaces of the eventual commutator segments and connection hooks is prevented from resulting during the step of mold filling the insulating material in the axially grooved and nailed hollow body, since the flanged hollow cylindrical workpiece of a conducting material is not formed with slots, but is formed with outward protuberances defining corresponding inner recesses prior to converting the resultant workpiece into the axially grooved, flanged hollow body having eventual commutator segment portions and outward bridge portions by such means as squeezing or percussion punching and form the resultant grooved body with inner nails and the protuberances are removed at the time of die-stamping the connection hooks from the flange after mold filling the insulating material in the axially grooved and nailed hollow body. Thus, clear and excellent commutators may be obtained. Also, as the step of removing the insulating material adhered to the outer surfaces of the conducting parts of the eventual commutator as in the conventional method is not involved, much time and labor can be saved to improve productivity.

Furthermore, the formation of the protuberances to define the corresponding recesses and the formation of bridge portions to define the corresponding grooves are achieved in separate steps, because the press forming the protuberances and recesses in the portion of the workpiece adjacent the flange, in which comparatively heavy pressure is required to deform the material, requires a punch and die block having a comparatively great mechanical strength, while the bridge portions and grooves can be press formed in the remaining portion with a punch and die block having a comparatively small mechanical strength, without causing damage thereto. Also, the deformation of the flange during the squeezing step as in the conventional method can be prevented.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation of a rotary armature having a commutator manufactured according to the invention.

FIGS. 2 through 19 illustrate one embodiment of the method according to the invention, in which:

FIG. 2 is an end view showing a flanged hollow cylindrical workpiece formed with outward protuberances defining corresponding inner recesses;

FIG. 3 is a sectional view taken along line III—III in FIG. 2;

FIG. 4 is a fragmentary sectional view, to an enlarged scale, taken along line IV—IV in FIG. 3;

FIG. 5 is a fragmentary sectional view, to an enlarged scale, showing a portion indicated at A in FIG. 3;

FIG. 6 is an end view showing an axially grooved, flanged hollow body having eventual commutator segment portions and outward bridge portions, which is obtained by squeezing the flanged hollow cylindrical workpiece formed with the outward protuberances and inner recesses shown in FIG. 2;

FIG. 7 is a sectional view taken along line VII—VII in FIG. 6;

FIG. 8 is a fragmentary sectional view, on an enlarged scale, taken along line VIII—VIII in FIG. 7;

FIG. 9 is a fragmentary sectional view, on an enlarged scale, showing a portion indicated at B in FIG. 7;

FIG. 10 is a fragmentary sectional view, on an enlarged scale, taken along line X—X in FIG. 7;

FIG. 11 is an end view showing the axially grooved, flanged hollow body of FIG. 6 provided with a molding of an insulating material;

FIG. 12 is a sectional view taken along line XII—XII in FIG. 11;

FIG. 13 is an end view showing an axially grooved hollow body with connection hooks and without the protuberances;

FIG. 14 is a sectional view taken along line XIV—XIV in FIG. 13;

FIG. 15 is an end view showing a machined commutator with the insulation and without the outward bridge portions;

FIG. 16 is a sectional view taken along line XVI—XVI in FIG. 15;

FIG. 17 is an end view showing a removed portion produced at the time of die-stamping the connection hooks while removing the outward protuberances;

FIG. 18 is a sectional view taken along line XVIII—XVIII in FIG. 17; and

FIG. 19 is a perspective view of the completed commutator.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The invention will now be described in conjunction with a preferred embodiment thereof with reference to the accompanying drawing.

The starting workpiece is made of a conducting material such as copper and has a flanged, hollow cylindrical configuration.

As shown in FIGS. 2 and 3, the workpiece is press formed with outward protuberances 2 defining corresponding inner recesses 1 along a portion of the workpiece adjacent a flange 3. As clearly shown in FIGS. 4 and 5, the margin of the protuberance 2 in-

tegral with the main portion 4 and flange 3 of the workpiece defines a narrow part not too narrow to cause cracks at the time mold filling an insulating material to be described later.

Then, the resultant workpiece is squeezed (or percussion pressed) into an axially grooved, flanged hollow body with outward bridge portion 6 bridging adjacent eventual commutator segment portions and corresponding inner axial grooves 6' as generally indicated at X in FIGS. 6 and 7. FIGS. 8 to 10 show in detail the outward bridge portion 6 bridging adjacent eventual commutator segment portions and the corresponding inner axial groove 6'.

Subsequently, inner nails 5 as indicated by dotted lines in FIG. 7 are formed on the resultant body at upper and lower positions for the respective commutator segment portions.

Thereafter, the resultant body having inner nails 5 is filled with an insulating material by using a mold having a required configuration, as shown in FIG. 11 and 12. In the Figures, numeral 7 designates the insulator molding having a shaft insertion bore 8. At this time, the protuberances 2 prevents the insulating material 7 filled in the inner recesses 1 from migrating therethrough and adhering to the outer surfaces of the commutator segment portions and the flange 3. The inner nails 5 are entirely embedded in the insulating material 7.

Afterwards, connection hooks 9 are formed by die-stamping the flange 3 of the flanged body, as shown in FIGS. 13 and 14. By the die-stamping operation, the outward protuberances 2 are removed at the same time. As the protuberances 2 defining a narrow part with the integral main portion 4 of the body is integral with the flange 3 as mentioned earlier, they are removed integrally with the stamp-out portion 3a, as shown in FIGS. 17 and 18.

Finally, the resultant hollow body filled with the insulating material 7 and deprived of the outward protuberances 2 is machined to complete the commutator, as shown in FIGS. 15 and 19. At this time, the outward bridge portions 6 are cut away, so that the resultant commutator segments as indicated by Y in FIG. 19 are isolated by the insulating material filled in the previous inner axial grooves 6'.

Actually, the machining of the periphery of the hollow body filled with the insulating material is carried out after fitting the body on the armature shaft 11 such that the connection hooks 9 face the armature core, as shown in FIG. 1.

After the machining of the hollow body filled with the insulating material, grooves 12 (FIG. 1) are undercut in portions corresponding to the previous 6' in FIG. 9 to slightly indent the surface of the insulating material filled in the previous grooves 6' with respect to the periphery of the commutator Y. This is made because the copper segments wear sooner than the insulating material. In case of using a punch having a diameter smaller than the diameter of the machined commutator for the formation of the outward bridge portions 6 and inner grooves 6', the bridge portions 6 are not completely removed and the commutator segment portions still remain integral with one another through thinner bridges after the machining. In such case, the thinner bridges corresponding to the inner

I claim:

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