Jan. 4, 1938. B. STEVENS, JR 2,104,141

METHOD OF MANUFACTURING COMMUTATORS

Filed Sept. 9, 1936

Fig. 1.

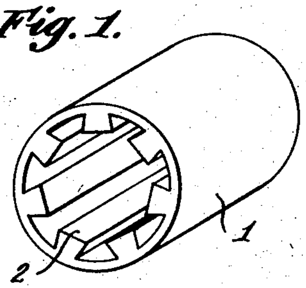



Fig. 2.

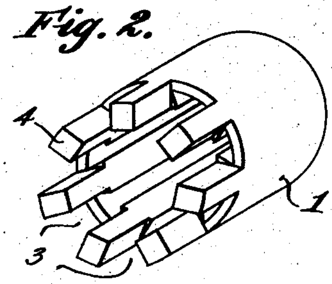



Fig. 3.

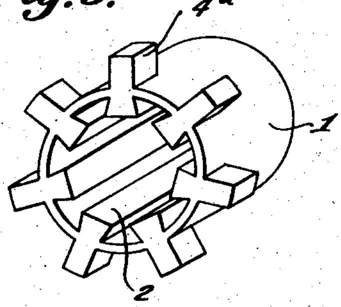



Fig. 6.

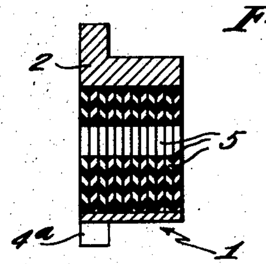



Fig. 4.

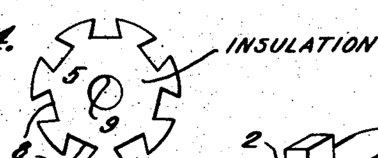



Fig. 7.

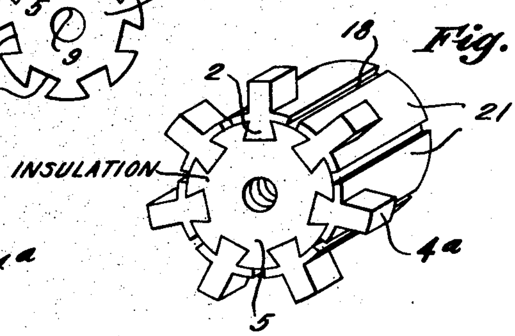
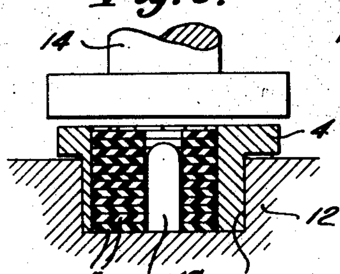



Fig. 5.




Inventor,
Brooks Stevens, Jr.,
by Roberts, Cushman & Woodberry,
Attys.

Patented Jan. 4, 1938 2,104,141

# UNITED STATES PATENT OFFICE

2,104,141

## METHOD OF MANUFACTURING COMMUTATORS

Brooks Stevens, Jr., Concord, Mass.

Application September 9, 1936, Serial No. 99,905

5 Claims. (Cl. 29—155.54)

This invention relates to commutators and the manufacture of the same, particularly pertaining to commutators of the type employed, for example in small electric motors. In accordance with this invention, such a commutator may be assembled without necessity for using a hot moulding process or employing any adhesive, while the resulting commutator may be of sturdy construction with the commutator bars firmly interlocked with an insulating core. A commutator of the type which may be manufactured in accordance with the present method is disclosed and claimed in my copending application Serial No. 163,027, filed September 9, 1937.

To permit these desirable results I preferably employ a short tube having internal ribs of dovetailed cross section and a plurality of insulating disks having peripheral recesses to interfit with the ribs of the tube. Before the tube is assembled with the insulating disks, its end portion may be cut away to provide small projections which may be bent over or swaged to afford a series of radial protuberances for connection to the wiring of the armature with which the completed commutator is ultimately assembled.

The insulating disks preferably may be assembled with the tube by the application of endwise pressure and at room temperature, i. e., without necessity for hot moulding. For this purpose the disks may be arranged in superposed relation in a stack which preferably is not quite as high as the tube. The tube may then be disposed in a suitable encircling member which prevents its expansion, and endwise pressure may be imposed by a die, preferably to force the metal of the tube into firm interlocking engagement with the edge surfaces of the disks. If desired, the disks may be formed of material which permits the area of each disk slightly to increase when its flat surfaces are subjected to high pressures, thus causing it firmly to grip the inner surface of the tube.

After the disks have been firmly engaged with the tube, the latter is cut into separate segmental sections to afford the individual commutator bars.

In the accompanying drawing:

Fig. 1 is an isometric view of a tube which may be employed to make a commutator in accordance with this invention;

Fig. 2 is a similar view of the tube after end portions have been cut away to provide a plurality of protuberances;

Fig. 3 is a similar view showing the protuberances swaged outwardly to afford radial projections;

Fig. 4 is an elevational view of one of the insulating disks which may be assembled with the tube;

Fig. 5 is a sectional view showing the disks and tube assembled in the die;

Fig. 6 is a sectional view of the commutator before the tube is cut to afford separate commutator bars; and

Fig. 7 is an isometric view of the completed commutator.

In making commutators of the class described, I have found it advantageous to employ short extruded copper tubes characterized by a plurality of internal ribs of dovetail cross section. In other words, the radially inward portions of these ribs are of greater cross section than their radially outward portions. Such a tube 1 of suitable length is shown in Fig. 1, being provided with a plurality of the internal ribs 2. The end portions of the wall of such a tube may be cut away, as designated by numeral 3, between the ends of the ribs (Fig. 2). Thus portions of the wall of the tube and of the ribs project from one end of the tube, as designated by numeral 4. The projections 4 may then be forced outwardly over the outer surface of the tube to provide a plurality of radial protuberances 4ª integral with the tube and substantially aligned with the corresponding ribs, as shown in Fig. 3.

An alternative method of providing the protuberances 4ª is permitted if the tube 1 is originally formed from a cup-like blank. Such a blank is commonly provided with an outer flange, and, for the purposes of the present invention, parts of such a flange may be cut away to leave radially protuberant portions similar to the projections 4ª of Fig. 5.

The preferred insulating core may comprise disks 5 cut from a sheet of suitable material, such as a phenol-aldehyde resin. These disks are provided with a plurality of circumferential recesses 8 of dovetail shape to fit the ribs 2 of the tube 1 and are also provided with central circular openings 9.

A plurality of disks 5 are assembled in superposed relation and are then firmly secured to the tube 1 without necessity for employing hot moulding. For this purpose the disks preferably are disposed within the tube in a suitable die assembly, including a lower member 12 (Fig. 5) providing a cylindrical socket 13 in which the cylindrical portion of the tube fits closely so that circumferential expansion thereof is substantially precluded. This member may also be provided with a centering pin 14ª to aid the proper positioning of the disks 5. The die assembly also includes an upper presser member 14 which is effective in forcing the metal wall of the tube downwardly, it being noted that before the pressure is applied to the tube the height of the stack of disks may be slightly less than the height of the tube. The metal of the tube, being pressed downwardly, is unable to expand circumferentially and accordingly the cold flow of the metal results in the inner surface of the tube and the surfaces of the ribs being firmly engaged with the edge surfaces of the disks. Thus the cross-sectional areas of the ribs 2 and of the wall of the tube itself are slightly increased and the ribs are expanded into firm interlocking engagement with the recesses of the core material. This pressing operation is also effective in accurately defining the positions of the end faces of the protuberances 4a so that these faces are aligned with the end face of the tube.

It is also possible to employ disks of insulating material which is capable of some expansion under the pressure of the die so that the flow of material takes place in the disks. Such material may be obtained which, under the pressure of the die, but without the use of a separate source of heat, increases in temperature sufficiently to permit limited flow of the particles thereof so that the area of each disk is slightly increased under the application of the endwise pressure by the die. Such material will then set firmly in place.

It is thus evident that the core material may be secured to the tube at room temperature by the application of endwise pressure, while the tube is held against circumferential expansion, the core being secured to the tube due to the flow of the metal of the latter or due to the flow of the insulating material or due to the flow of both the metal and the insulating material. Thus the core material and the metal may be held together by a firm frictional fit without necessity for employing hot moulding or any adhesive.

After the disks have been firmly joined to the tube, the wall of the tube is cut longitudinally, as designated by numeral 18, between each of the ribs 2, thus providing a plurality of commutator bars 21 which are separated from each other by air gaps, but which are firmly joined by continuous integral ribs to the core formed of insulating disks. The commutator may then be secured to the armature shaft, for example, by a press fit.

With the form of the invention illustrated in Fig. 7, the wiring of the armature may be soldered to the protuberances 4a, while if these protuberances are not provided, the wires may be soldered directly to the end surfaces of the commutator bars.

The principles of this invention may also be employed when the core is formed of a single piece of insulating material; for example a premoulded button-like element may be joined to the metal tube in the manner described above, as by applying endwise pressure to the tube to cause the metal ribs thereof to expand within the dovetail recesses of the core element.

Although no hot moulding operation was required in its assembly, a commutator made in accordance with this invention is characterized by separate bars each having a continuous integral rib firmly interlocked with the disks of the core. Each of these bars may have an integral protuberance for connection to the corresponding armature wire.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. Method of making a commutator comprising forming a metal tube with a cylindrical outer surface and with an inner surface provided with a plurality of elongate ribs parallel to the axis of the tube and disposed uniformly thereabout with their radially inward parts of greater cross section than their radially outward parts, forming a plurality of disks of insulating material with similar central openings and with peripheral recesses to interfit with said ribs, assembling the disks in superposed relation with their recesses in alignment, causing the superposed disks to fit firmly within the tube with the ribs interfitting with the recesses by subjecting the tube to endwise pressure at room temperature to cause cold flow of the metal inwardly, while confining the tube against circumferential expansion, and then cutting the wall of the tube between the ribs to provide a plurality of separate commutator bars each having a rib interfitting with each of the disks.

2. Method of making a commutator comprising forming a metal tube with a cylindrical outer surface and with an inner surface provided with a plurality of elongate ribs parallel to said axis and disposed uniformly thereabout with their radial inward parts of greater cross section than their radial outward parts, cutting away portions of one end of the wall of the tube between the corresponding ends of the ribs, thus leaving protuberant portions of the tube, bending said protuberant portions outwardly to afford substantially radial protuberances, forming a plurality of disks of insulating material with similar central openings and with peripheral recesses to interfit with said ribs, assembling the disks in superposed relation with their recesses in registration, causing the superposed disks firmly to fit within the tube with their recesses interfitting with the ribs thereof by subjecting the tube to endwise pressure at room temperature to cause cold flow of the metal inwardly, and then cutting the wall of the tube between the ribs to provide a plurality of separate commutator bars each having a rib interfitting with each of the disks and having a radial protuberance for attachment to armature wiring.

3. Method of making a commutator from a tube having internal dovetail ribs and a plurality of insulating disks having peripheral recesses of corresponding cross section, comprising disposing the disks in superposed relation with their recesses in registration and interfitting with the ribs of the tube, causing the superposed disks firmly to fit within the tube by pressing the tube endwise while confining it against expansion circumferentially, thus causing the metal of the tube to flow inwardly firmly to engage the edge surfaces of the disk, and cutting the wall of the tube between the ribs to afford separate commutator bars interconnected by the insulating disks.

4. Method of making a commutator comprising forming a metal tube with a cylindrical outer surface and with an inner surface provided with a plurality of elongate ribs parallel to the axis of the tube and disposed uniformly thereabout with their radially inward portions of greater cross section than their radially outward portions, forming a core of insulating material with peripheral recesses to interfit with said ribs, assembling the core with the tube by subjecting the tube to end-

wise pressure at room temperature to cause cold flow of the metal inwardly and increase in the cross-sectional area of the ribs while confining the tube against circumferential expansion, and then cutting the wall of the tube between the ribs to provide a plurality of separate commutator bars each having a rib interfitting with the core.

5. Method of making a commutator comprising forming a metal tube with a plurality of elongate ribs parallel to the axis of the tube and disposed uniformly thereabout and having their radially inward parts of greater cross section than their radially outward parts and also forming a plurality of radial projections on one end of the tube adjoining the respective ends of said ribs, forming a plurality of disks of insulating material with similar central openings and with peripheral recesses to interfit with said ribs, assembling the disks in superposed relation with their recesses in alignment, causing the superposed disks to fit firmly within the tube with the ribs interfitting the recesses, by subjecting the tube to endwise pressure at room temperature to cause cold flow of the metal inwardly, while confining the tube against circumferential expansion, and then cutting the wall of the tube between the ribs to provide a plurality of separate commutator bars each having a rib interfitting with each of the disks and each having an integral radial projection at one end.

BROOKS STEVENS, Jr.