

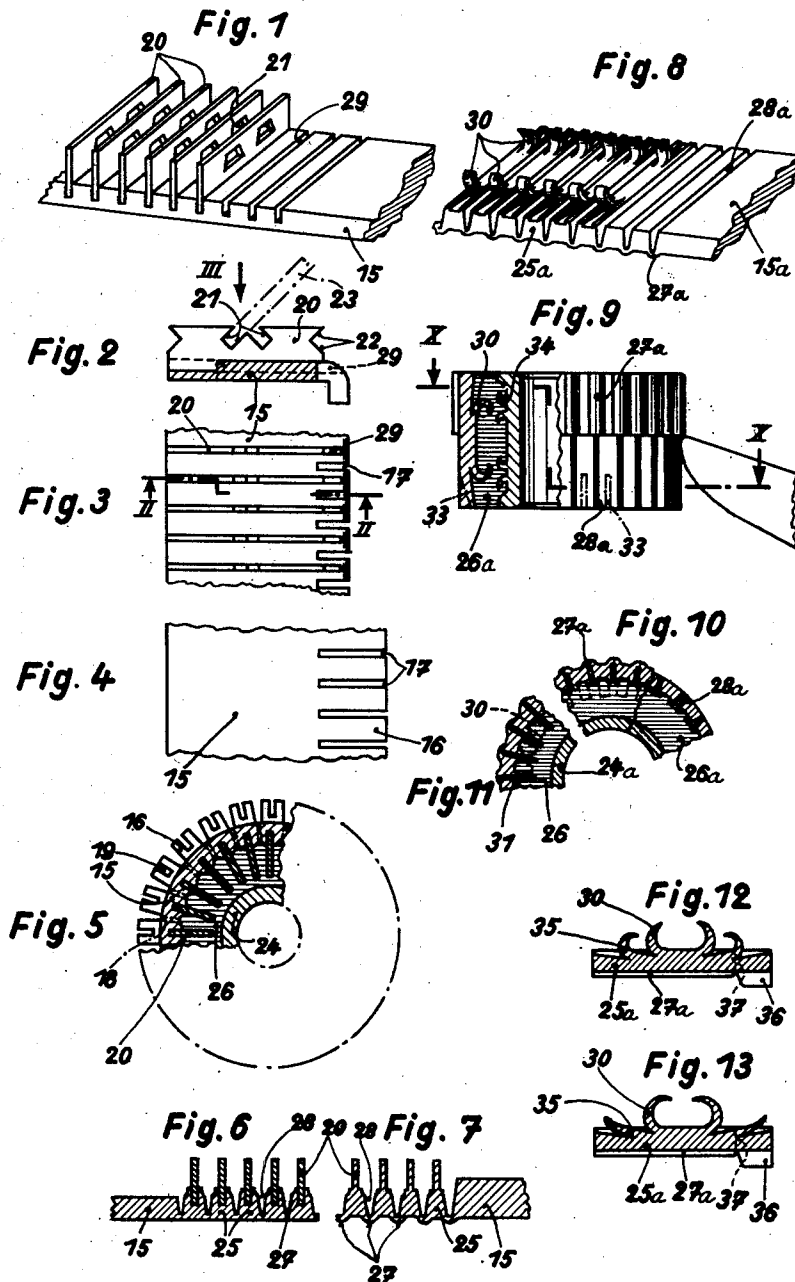
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METHOD OF MAKING COMMUTATORS

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METHOD OF MAKING COMMUTATORS

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This invention relates to a commutator with numerous bars and extensions connected to these bars for anchoring the bars in an insulating material which is introduced in a plastic or fluid condition and then solidified in the form of an annular hub; in view of the high centrifugal forces and thermal stresses occurring in operation said extensions act on the side of the bars directly opposite their running surface.

It is known that the production of commutators can be simplified by convolving a metal strip of a length corresponding to the circumference of the commutator into a hollow cylinder and inserting it in a mould together with a hollow cylindrical metal core to be used as a commutator hub, or together with the armature shaft. The annular space between the hollow cylinder and the core is then filled up with a plastic or fluid insulating material which after the hardening forms a hub. Finally the outer metallic cover is dissected by cutting it into single bars connected only by the insulating material, the longitudinal edges of said bars usually running parallel to the surface lines. In order to anchor the bars in the hub of insulating material, the metal strips intended for producing such a commutator were provided with incisions along the potential separating planes, and the border strips thus resulting were inwardly bent in the form of hooks before introducing the insulating material; thus after the hardening of the insulating hub the hooks formed anchorages engaging the front edges of the bars.

This anchoring at the front edges of the bars, however, more particularly in commutators with a relatively great length of the bars, does not ensure sufficient centrifugal strength. Moreover, so far all attempts to adopt the known method in the manufacture of commutators which have a relatively larger number e. g. 15 and more segments or bars and a relatively small diameter, were a failure. Hitherto, therefore, in making such commutators it was necessary to use individual wedge-shaped bars which are difficult to produce and which must be inserted into the press mould one by one individually and with great care. Owing to the individual manufacture and handling of the commutator bars this method is relatively time-wasting and expensive.

It is the object of the present invention to provide a manufacturing method by which these difficulties and disadvantages are avoided, and a design adapted for this manufacturing method.

With this object in view, according to the present invention the metal strip before its convolution is provided on its side facing away from the

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running surface with elevations or extensions which are suitable for anchoring the bars and whose height, as measured from the running surface, is at least equal to, but preferably about twice as much as, the pitch, i. e., the distance between the middle planes of two adjacent commutator bars. These elevations may be in the form of rib-shaped extensions between which the slots separating the single bars are to be arranged.

The extension may be attached to the metal strip in a preparatory operation, either in the form of separate parts, for instance in the manner known per se in the manufacture of the walls of heat exchanges with ribs, e. g. in the form of stamped sheets, or by a suitable cutting or plastic deformation of the metallic material, unless the metal strip is given the shape of a plate with ribs from the outset, e. g. by casting or extrusion. A particularly advantageous manner of manufacture consists in peeling the anchoring portions from the metallic material in the form of hook-shaped projections.

Our novel method renders it possible for the first time to produce multiple part commutators for high speed machines whose bars owing to the high stresses occurring in operation have to be anchored individually and directly at their side opposite the running surface, from a metal strip which is originally coherent while being dissected into single bars in a final operation.

Further objects and features of the invention will be seen from the following detailed description in connection with the accompanying drawing showing by way of example seven embodiments of the invention and in which:

Fig. 1 is a perspective view of the first embodiment,

Fig. 2 is a section on line II—II of Fig. 3, showing a second embodiment,

Fig. 3 is a view in the direction III of Fig. 2,

Fig. 4 is a plan view of a metal strip prepared for this embodiment, and

Fig. 5 is a cross section of a commutator made of this metal strip,

Figs. 6 and 7 are cross sectional views of a metal strip fit for a third and fourth embodiment,

Fig. 8 is a perspective view of a fifth embodiment and

Fig. 9 is a plan view, partly in a longitudinal section, showing the same embodiment,

Fig. 10 is a fragmentary cross section on the line X—X in Fig. 9, and

Fig. 11 is a fragmentary cross section of an additional embodiment, while

Figs. 12 and 13 are longitudinal sections

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through a bridge according to two further embodiments of the invention.

Similar reference numerals denote similar parts in the different views.

Referring now to the drawings in greater detail, and first to Fig. 1, it will be seen that a number of ribs 20 corresponding to the number of bars of a commutator are connected with a metal base 15 whose width corresponds to the length of the commutator. The ribs whose interspace is equal to the pitch of the commutator are inserted in cross grooves or transverse slots 29 of the metal base and if desired may be united with the same additionally by rolling-in, hard soldering or welding. The ribs consist of single metal strips which are provided with perforations 21. The metal strip 15 is rolled together or convolved in a manner which is known per se and will be discussed in greater detail with reference to the further embodiments, so as to form a hollow cylinder into whose interior space the anchoring ribs 20 project in a radial direction. This hollow cylinder is then inserted in a press mould together with a concentric metal core 24 and filled up therein with a plastic or fluid insulating material which penetrates also into the perforations 21 and after the solidification or hardening forms at these places coherent annular reinforcements substantially contributing to the safe anchoring of the ribs 20. The term "plastic" as used in this specification is meant to include all kinds of insulating material adapted to be moulded in a more or less plastic or fluid or liquefied condition. If desired, a satisfactory anchoring may also be obtained by interlacing the free edges of the ribs or by elevations on the rib surface unless the natural roughness of the rib surfaces already ensures a sufficient adhesion. The metal surface of the cylinder thus obtained is subdivided into single commutator bars fixedly anchored by the ribs 20, in the manner which will be hereinafter explained.

In the embodiment shown in Fig. 2 the recesses 21 defined by inclined edges are open at the free longitudinal edges of the ribs 20, so that the anchoring ribs which are additionally provided with recessed edges 22 take a dovetail shape. This shape may also be obtained by a cutting tool 23 after application of the ribs. According to Fig. 4 the metal strip 15 is provided with incisions 17 at its edges, and the edge portions 18 between these incisions are bent off in such a way that so-called connecting lugs are obtained which can be used in the usual manner with a slot 19 each (see Fig. 5) for introducing and fixing the coil ends, not shown. Having filled up the hollow space between the hub 24 and the rolled-up metal strip 15 with insulating material 26, in a press mould, which likewise is not shown, the surface of the cylinder is cut up, by incisions 18 shown in dash and dot lines, into commutator bars which are electrically insulated from each other and fixedly anchored in the solidified or hardened insulating material by the ribs 20. If necessary, the incisions 18 may be filled up by an insulating material, preferably of an inorganic composition, whose upper edge advantageously does not extend up to the surface of the cylinder.

As will be seen from the third and fourth examples illustrated in Figs. 6 and 7, a plastic deformation effecting the union of the ribs 20 with the metal strip or a plastic deformation causing the formation of rib-shaped anchorages from the material of the metal strip may be used to di-

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vide the metal strip before its convolution into single bars 25 defined by grooves 28, which bars cohere only by thin metal bridges 27. Advantageously the bridges are arranged in such a way that they project from the side of the metal strip which is used as the running surface in the finished commutator, as shown in Fig. 7. The advantages of this arrangement will be hereinafter discussed in greater detail in connection with the further embodiments.

In the embodiments shown in Figs. 8 to 13 the metal strip 15a is moved in steps in the longitudinal direction. After each step a tool impresses a wedge-shaped groove 28 transversely to the longitudinal direction of the strip, with such a depth that the bars 25a lying on both sides of each groove are interconnected only by short bridges 27a. By means of a pair of peeling tools which are moved across the metal strip simultaneously from the end edges of the bars towards their center, hook-shaped projections 30 are peeled out. The material being strongly compressed by this operation, these hooks have a high mechanical strength. For this reason, owing to the simplicity of shaping the material and the 100% utilization of the material thereby attained this peeling process can be applied in the manufacture of commutators which are produced of a hollow metallic cylinder which is subsequently to be provided with a carrier of insulating material and afterwards to be subdivided into bars which are electrically insulated from each other.

The grooves 28a facilitate the convolution of the metal strip to a hollow cylinder containing the desired number of bars. The wedge shape of the slots whose apical angle advantageously corresponds approximately to the angle at the center between the central planes of two adjacent bars, not only promotes the impressing operation but also ensures that the small distance of adjacent bar edges at the running surface which is desirable for a faultless operation of the commutator can be adhered to without reducing the distance at other parts of the cross section beyond the admissible minimum. When convolving the metal strip, the flanks of the grooves adjust themselves in pairs approximately parallelly, and as shown in Fig. 10 the insulating material 25 is caused to penetrate these grooves by the pressing operation, the hooks 30 also being fixedly embedded in the insulating material at the same time. In case the insulating substance being used does not have the high insulating capacity required for maintaining the desired minimum distance between the bars, insulating sheets 31 may be inserted previously into the grooves 28 as per Fig. 11, which sheets have the suitable dielectric properties and are clamped in position and anchored with the bars in the hub 26 of insulating material by means of the flanks of the bars which are approaching each other tongue-fashion in pairs on convolution. A further advantage obtained by the grooves 28 consists in that the final dissecting of the surface of the hollow cylinder into single bars which are electrically insulated from each other does not require an additional operation but takes place automatically when turning the outside diameter of the commutator, i. e. the running surface. Since only a small quantity of material has to be cut in this case, an efficient utilization of the material is obtained which means great savings especially in the slot designs as shown in Figs. 7 to 13.

In order to connect the wires of the coils, slots 33 may be provided in the ends of the bars 25 facing the armature, as indicated in Fig. 9 with dot and dash lines. Or, if required, suitable connecting lugs may be provided for this purpose, by plastic deformation of the metal strip 15. Such connecting lugs 16 separated from each other by edge incisions 17 of the metal strip 15 and then bent off in a vertical direction have been described already in connection with the second embodiment as per Figs. 2 to 5. As will be seen from Figs. 12 and 13, such connecting members can also be made by a reinforcement at the border produced by upsetting the metal strip which reinforcement is dissected into single reinforced end portions 36 by edge slots 37 before convolving the metal strip.

It will also be seen from Figs. 12 and 13, that further anchoring means 35 may be peeled out of the material forming the bars 25, in addition to the hook-shaped anchoring members 30.

In order that the insulating substance 26 serving as a carrier for the bars 25 may in its turn also be reliably secured to the hub, narrow ring-shaped border portions 34 are provided at the circumference of the hub and laterally bent off.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matter herein set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

Having thus described our invention, we claim as new and desire to secure by Letters Patent:

1. The process of forming a commutator from a flat metal strip having parallel faces comprising the steps of forming wedge-shaped transverse grooves in longitudinally spaced fashion through one face of the strip and spaced slightly from the second face to define spaced commutator bars connected by thin bridges protruding beyond the plane of the second face, peeling thin sections of metal from the unconnected faces of said bars along their longitudinal axes from each end thereof to form upstanding projections, convolving said strip into a hollow cylinder with the

projections extending inwardly from its inner side, filling up the hollow space within the hollow cylinder with a plastic insulating material forming a hub, and turning off the outer surface of the cylinder to remove the bridges and dissect said metal strip into a number of separate commutator bars corresponding to the number of projections.

2. The process of forming a commutator from a flat metal strip comprising the steps of pressing wedged-shaped transverse grooves in longitudinally spaced fashion through one face of the strip to a point slightly spaced from the other face to define spaced commutator bars connected by thin bridges, peeling said bars to remove a thin section of metal at their unconnected faces from each end thereof toward the center parallel with the grooves to form upstanding prongs, convolving said strip into a hollow cylinder with the prongs extending from the inner side of the cylinder, filling up the hollow space within the cylinder with a plastic insulating material to form a hub and turning off the outer surface of the cylinder to remove the bridges and dissect said convolved metal strip into a number of separate commutator bars and for forming a continuous, smooth outer surface to provide a smooth sliding face for the commutator brushes.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,808,750	Apple	June 9, 1931
1,974,251	Reutter	Sept. 18, 1934
1,974,252	Killorin	Sept. 18, 1934
2,038,419	Cotterman	Apr. 21, 1936
2,058,109	Redmond	Oct. 20, 1936
2,211,979	Kuchta	Aug. 20, 1940
2,236,257	Borchers	Mar. 25, 1941
2,247,199	Kritzer	June 24, 1941
2,251,074	Sibley	July 29, 1941
2,251,326	Cullin	Aug. 5, 1941
2,451,500	Le Greid	Oct. 19, 1948