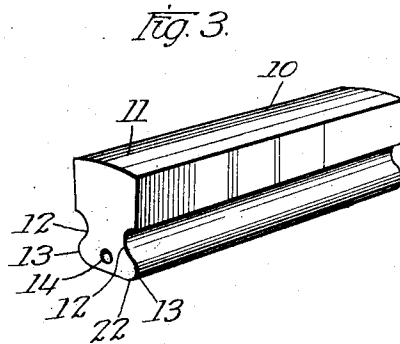
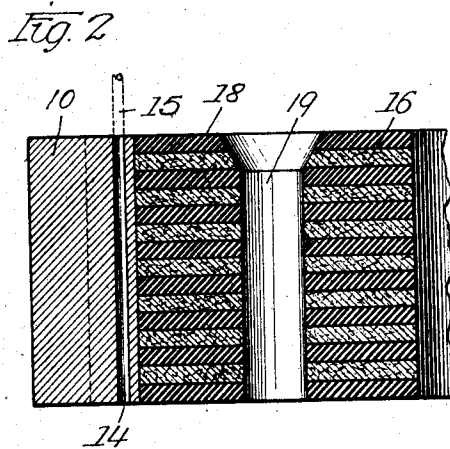
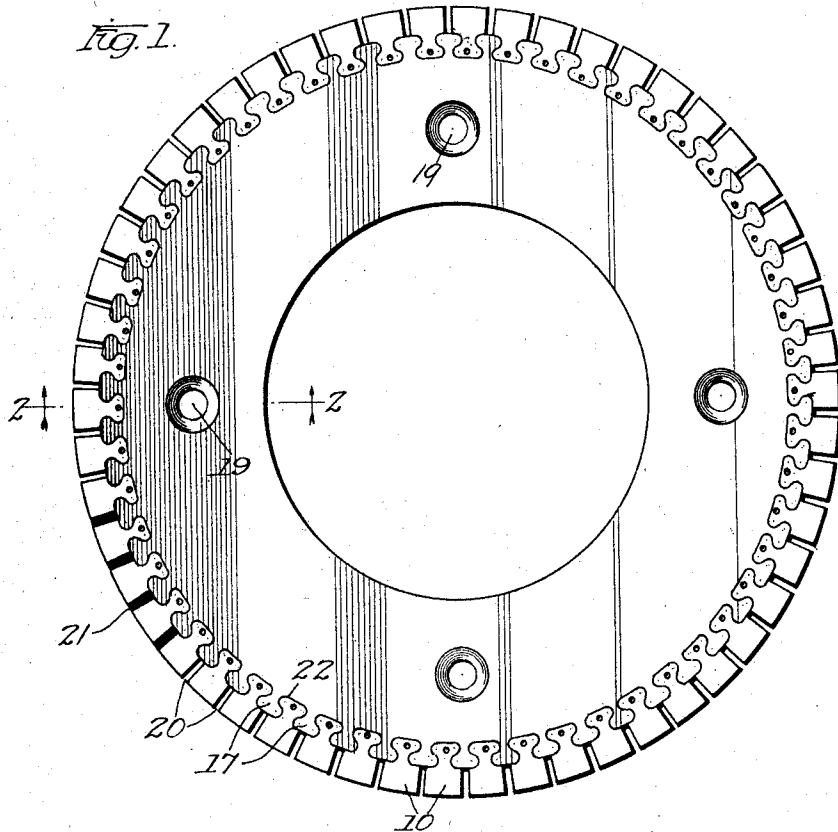


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METHOD OF BUILDING COMMUTATORS.  
APPLICATION FILED AUG. 6, 1919.

1,393,878.

Patented Oct. 18, 1921.  
2 SHEETS—SHEET 1.



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2 SHEETS—SHEET 2.

Fig. 4.

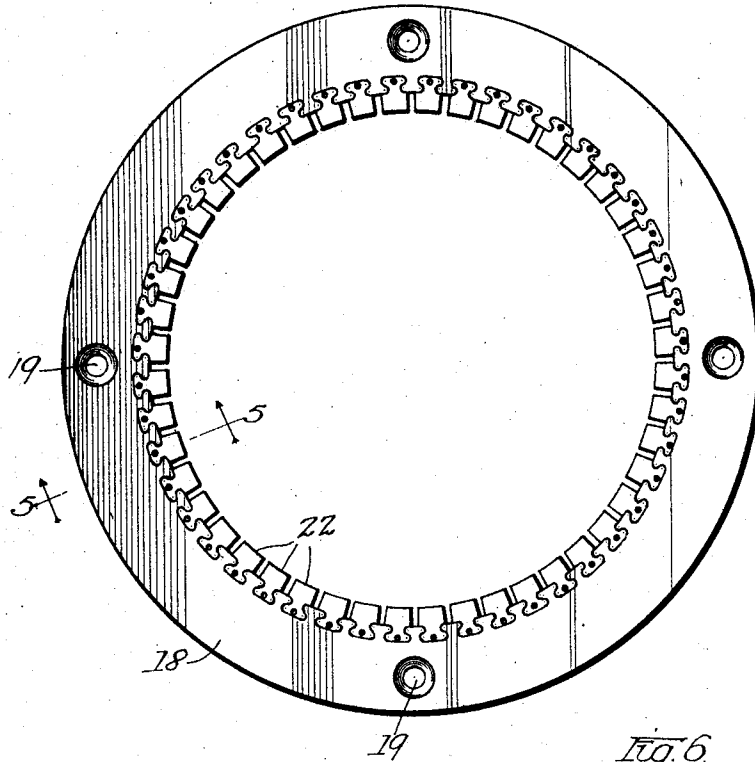


Fig. 5.

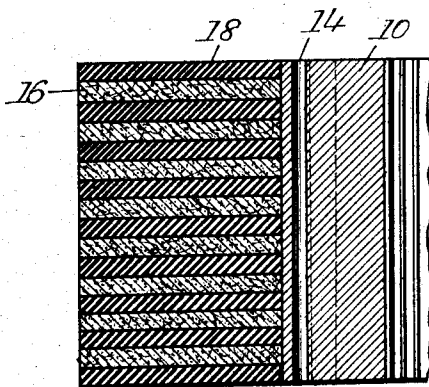
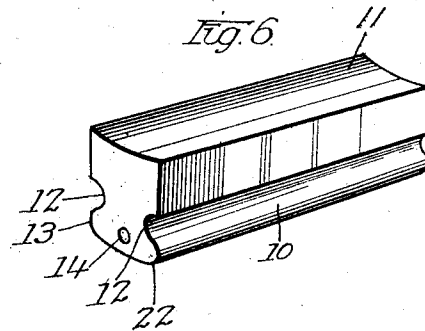


Fig. 6.



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Vincent G. Apple  
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# UNITED STATES PATENT OFFICE.

VINCENT G. APPLE, OF DAYTON, OHIO.

## METHOD OF BUILDING COMMUTATORS.

1,393,878.

Specification of Letters Patent.

Patented Oct. 18, 1921.

Application filed August 6, 1919. Serial No. 315,772.

*To all whom it may concern:*

Be it known that I, VINCENT G. APPLE, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Methods of Building Commutators, of which the following is a specification.

My invention relates to a method of building commutators for dynamo electric machines.

One of the objects of the invention is generally to improve the method of procedure in making structures of this character, to the end that the cost of production is greatly decreased; the commutator bars are more accurately positioned and more firmly retained in place; the mechanical strength, insulating and binding qualities materially enhanced, and the commutator rendered self-sustaining to withstand any stress to which it may be subjected by excessive centrifugal effect.

Other, further and more specific objects of the invention will become readily apparent, to persons skilled in the art, from a consideration of the following description when taken in conjunction with the drawings, wherein:—

Figure 1 shows an end view of the finished commutator, with the commutator bars arranged around the perimeter thereof.

Fig. 2 is an exaggerated cross section taken on line 2—2 of Fig. 1.

Fig. 3 is a perspective view of one of the commutator bars.

Fig. 4 is a modification of Fig. 1 showing the commutator bars arranged inside of the annular ring of insulation.

Fig. 5 is an exaggerated sectional view taken on line 5—5 of Fig. 4.

Fig. 6 is a perspective view of the commutator bar shown in Fig. 4.

In all the views the same reference characters are employed to indicate similar parts.

In making commutators, it is highly desirable that the commutator bars shall be uniformly spaced about the axis of the commutator, in order that proper and efficient commutation may be effected by the brushes that bear upon the face of the commutator. It is also highly desirable that the commutator bars shall be unyieldingly held in alignment in the finished product so that not any one or more of the bars may be depressed inwardly or projected outwardly with re-

spect to the neighboring or adjacent bars, thereby producing sparking by the imperfect contact of the displaced bar with the commutator brushes and producing destructive effects upon the bars last in contact with the brush. It is also highly desirable that the insulating material which holds the commutator sections in their respective positions, shall be tenacious and unyielding under great stress, due to centrifugal effect when the commutator is relatively large and the armature rotating at a high velocity.

I accomplish all of these results by building commutators by the mode of procedure hereinafter to be described.

In carrying out my invention, I prefer to produce the commutator sections, substantially as shown in Figs. 3 and 6, by cutting them from a continuous bar, of suitable material, such as copper, having substantially the cross section illustrated, except that the surfaces 11 may, primarily, be flat and given a convex or concave contour after they have been placed in the commutator and turned up on a suitable mandrel. The bar has grooves 12 near each of its edges, and on one side of each of the grooves is a rounded projection 13. The two grooves form a head 22 to retain the insulating material which is to be incorporated or inserted between adjacent grooves 12 of the confronting commutator bars. I prefer to drill a hole 14 in the end of the bars, after they have been cut in proper lengths from the original elongated bar, within which to insert a conducting wire 15, which may be of any suitable character. These wires, however, may instead, be welded to the respective commutator sections but when the holes or perforations 14 are provided, they serve as means for holding the commutator bars in spaced apart relation in the process of construction which is the position they will occupy in the completed commutator.

A series of bars 10 are placed around in a circle, as shown in Figs. 1 and 4, in accordance with the character and diameter of commutator which is to be built. If the bars are to occupy the positions shown in Fig. 1, the insulation will be located between the face of the bars and the axis of the commutator, whereas if they are to occupy the positions shown in Fig. 4, the insulation will be located radially beyond the respective commutator bars. The bars 10 are suitably fixed, as by means of pins inserted in the

perforations 14 and which may also be inserted into a plate having perforations properly spaced apart, or any suitable means may be used for temporarily holding the bars in the positions that they are to ultimately occupy in the finished product. I then take a series of fibrous sheets, preferably cotton duck, or other suitable fibrous material, and coat the fibrous material with a phenolic condensation product, condensite, bakelite, or the like, in liquid form, which consists of phenol or homologues and formaldehyde or polymers. This mixture, when sufficiently heated, is transformed, by reaction produced by the heat and pressure to which it may be subjected, to a hard body, that will be unaffected by moisture, insoluble by alcohol, or other similar agencies, infusible and resistant to acids and alkalis and possessing the highest insulating quality. After the fabric, being coated in a manner described with the material referred to, becomes dry or partially dry, rings or disks 16, of suitable conformation, are punched from the treated sheet. In the exemplification shown in the drawings, each of the sheets or rings, is punched with a head 17, which fits neatly in the grooves 12, there being a head furnished by the sheet for each head 22 of the commutator bars, and one of the fabric heads is contained between adjacent heads of the commutator. The sheets, or blanks, previously coated with phenolic condensation products, condensite, bakelite, or the like, are then stacked so that the heads 22 of the commutator bars will alternate with the heads 17 on the periphery or circumferential surface of the sheet, whether on the outside surface, as shown in Fig. 1, or the inside surface, as shown in Fig. 4. The stacked sheets or blanks are then placed between two plates, or other suitable pressure-applying means, and subjected to heat. The configuration of the plates best adapted for the purpose are those in which the outlines correspond closely with the outlines of the punch by which the fabric rings have previously been cut. Pressure is then applied between the opposing plates to compact the layers of fabric, preferably, previously saturated with the liquid of the described products which subsequently is transformed by the pressure and heat, into a hard infusible, insulating, insoluble mass. The commutator is left between the heated plates, with the pressure applied, until suitable reaction occurs, after which the plates are removed and the commutator bars are then held in place by the sheets of fabric and the interstitial permeation of the condensite, or bakelite.

About 750 pounds pressure is sufficient to force the saturated fabric into the desired contiguity with the metal bars thereby placing between the adjacent commutator bars a

head of strong, highly insulating material, held by a fabric, reinforced by the saturant.

In Figs. 2 and 5, I have shown layers of fiber 16 and the binder of condensite 18 therebetween. I realize that this is an exaggeration of the condition that exists, as the liquid condensite will impregnate and fill in the pores or the interstices that exist in the fabric sheet and it may, to some measure, be contained between the sheets of fabric. The fabric, however, in this instance, serves as a holding means and a restrainer of pressure, while the condensite serves as a binder and is excellently adapted for the purpose on account of its quality as an insulating material, its homogeneous association with the fabric, permeating every part of the fabric and firmly tying together every fiber that constitutes a part of the insulating portion of the commutator. The insulating portion of the commutator may be perforated, as at 19, for bolts or screws, by which the commutator may be bodily supported upon a rotatable shaft.

The spaces 20, between adjacent commutator bars may subsequently be filled with other insulating material, as shown at 21, best adapted for contact with the brush in which powdered mica may constitute a large portion of the insulation between adjacent commutator sections or, if desired, bakelite may be introduced between the bars, at the time when pressure is applied to the laminae constituting the insulation supporting mass or at a subsequent time.

It is manifest that the disks or rings of fabric, or other similar suitable material, may be punched and subsequently impregnated, but in practice I find it more convenient to impregnate the sheets and subsequently punch the rings or disks therefrom, as the fibers, constituting the weave of the sheets are more intimately held together by the binder with which it is impregnated, rendering the material more easily punched.

Having described my invention, what I claim is:—

1. Steps in the art of making commutators, which consist in uniformly spacing commutator bars, provided with projections, about a common axis; cutting rings or sheets of fabric with parts to be included between projections of adjacent bars; stacking the fabric holding sheets about said bars with parts therebetween; applying pressure to said stacked sheets and providing means to hold the fibrous material in a compressed state.

2. Steps in the art of making commutators which consist in uniformly spacing commutator bars provided with projections, about a common axis; cutting rings or sheets of fabric, with parts to be included between projections of adjacent bars; coating said

5 sheets with an adhesive material; stacking the fabric holding sheets about said bars, with parts therebetween; applying pressure and heat to the said stacked sheets; to com-

10 3. Steps in the art of making commutators, which consist in uniformly spacing and temporarily holding commutator bars provided with incut parts, about a common axis; coating sheets of fabric with a phenolic condensation product; punching blanks from said sheets, having parts to enter spaces between adjacent commutator bars provided by said incut parts; stacking  
15 said blanks with said parts within said spaces, then applying pressure and heat to the stacked blanks to harden the adhesive and to retain the blanks under compression.

20 4. An article of manufacture comprising a commutator, having a series of spaced apart bars and a compressed stacked pile of fabric blanks, each blank having an engaging part for each bar and means to hold said stacks under compression.

5. An article of manufacture comprising 25 a commutator, having a series of spaced apart bars and a compressed stacked pile of fabric blanks, each blank having an engaging part for each bar and adhesive means to hold the said stack under compression. 30

6. An article of manufacture comprising a commutator having a series of spaced apart bars and a stacked pile of fabric blanks, each blank having an engaging part for each bar and adhesive means, compris- 35 ing a phenolic condensation product, impregnating and surrounding said blanks to hold the stacks under compression.

7. A commutator having its conducting bars supported by a mass of material im- 40 pregnated with a phenolic condensation product and the spaces between the bars, near their faces, filled with a different insulation material.

In testimony whereof I hereunto sub- 45 scribe my name.

VINCENT G. APPLE.