June 27, 1961 F. SCHÄFER ET AL 2,990,488

COMMUTATORS AND METHOD OF MAKING THE SAME

Filed Sept. 8, 1958

Fig. 1

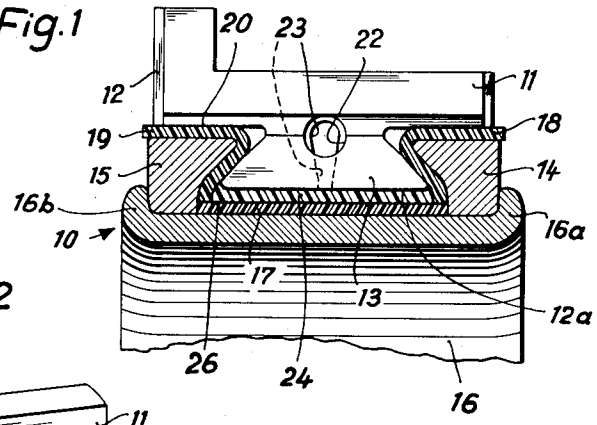


Fig. 2

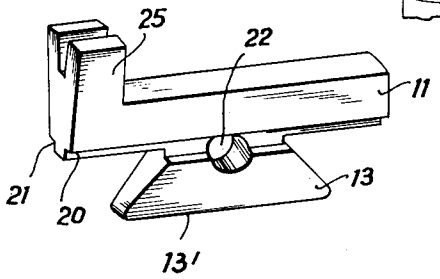


Fig. 3

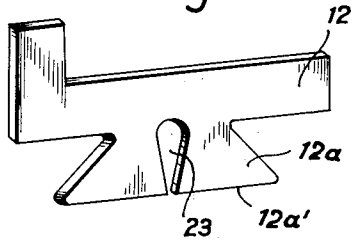


Fig. 4

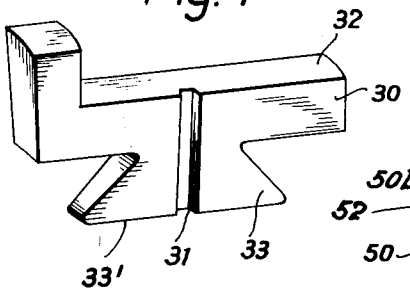
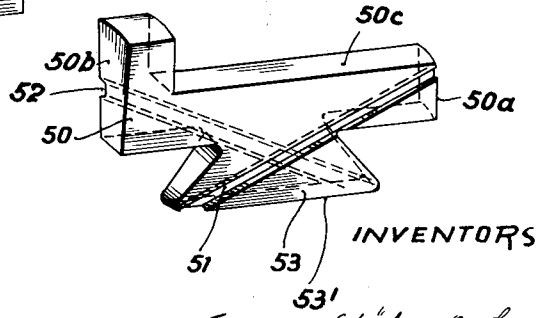


Fig. 5



INVENTORS

Fridolin Schäfer and
Karl Wick
by: Michael S. Striker
Attorney

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COMMUTATORS AND METHOD OF MAKING THE SAME

Fridolin Schäfer, Stuttgart, and Karl Wick, Stuttgart-Rohr, Germany, assignors to Firma Robert Bosch G.m.b.H., Stuttgart, Germany

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6 Claims. (Cl. 310—235)

The present invention relates to commutators for electric machines, and more particularly to improvements in commutators of the type in which an annulus consisting of insulated dovetailed segments is held together by a pair of clamping rings and by a tubular core whose longitudinal ends are deformed or swedged to bear against the end faces of clamping rings and to thereby hold the annulus of segments in required position with respect to the axis about which the commutator revolves.

According to the invention disclosed and claimed in a copending application by Karl Wick, Serial No. 759,695, displacements of dovetailed segments in commutators which comprise a rivet like core and an annularly disposed group of insulated segments is prevented by introducing a hardenable insulating substance into the space defined by the axially parallel end faces of the dovetailed portions forming part of the segments as well as of interposed nonconducting sheets, and by the peripheral zone of the rivet like core which latter is also called the nave of a commutator. According to said invention, the insulating substance is introduced in plastic state through at least one aperture which constitutes a communicating passage between said space and the axial bore in the core of a commutator. The apparatus for introducing the hardenable insulating substance (preferably a material with good heat conducting characteristics, such as Bakelite, an epoxy resin, or the like) comprises a pair of rams or plungers which are introduced from opposing ends of the core into its axial bore to compress and plasticize the insulating substance therebetween, to cause flow of plastic substance through the aperture into the annular space between the dovetailed portions and the peripheral zone of the core. After hardening, the insulating substance prevents tilting of segments about the clamping rings, such tilting being undesirable because it causes rapid destruction of the runway for customary carbon brushes or wipers when the commutator is in actual use. Since the insulating substance is introduced through the axial bore of the core, its introduction must precede the mounting of a so-constructed commutator onto the spindle of an armature because, as is well known in machines of this character, the spindle also passes through the axial bore in the core or rivet of such commutators.

An object of the present invention is to provide a novel method of filling the commutators with a hardenable insulating substance.

Another object of the invention is to provide a commutator whose annulus of segments and of non-conducting sheets therebetween may be filled with a hardenable plasticized insulating substance after mounting of the commutator onto the spindle of an armature.

A further object of the invention is to provide a commutator of the above described characteristics which is so constructed that the filling of its annulus with, and coating of armature coil by, an insulating substance may be carried out in a single operation.

An additional object of the invention is to provide a commutator having a rivet like core and a series of dovetailed annularly disposed segments which is so constructed that the insulating substance which prevents tilting of segments about their clamping rings may be introduced into the space surrounding the periphery of the core through a single segment or through a number of segments while the construction of all other component parts remains unchanged.

The above and other objects of the invention are attained by the provision of a commutator in which the annulus, and more particularly at least one segment defines at least one passage or channel through which the annular space between dovetailed portions and the core communicates with the surrounding atmosphere. Thus, instead of introducing the insulating material through an aperture in the core as disclosed in the aforementioned Wick application, the hardenable material may be introduced from the peripheral zone or from one or both end faces of one or more segments while the core is already mounted on the spindle of an armature and after the armature wires are already soldered to the lugs which latter form part of wedge-shaped dovetailed segments.

The formation of communicating passages or channels in the segments may be achieved in a number of different ways. According to one embodiment of our invention, a segment is formed with at least one longitudinal cutout or groove in one or both of its major surfaces, the groove or grooves communicating with a transverse bore extending between the major surfaces of the segment. At least one non-conducting sheet or plate adjacent to the so constructed segment or segments has its dovetailed portion formed with a cutout opening into the annular space defined by the dovetailed portions and the periphery of the commutator's core. Thus, the annular space may be filled with hardenable insulating material through the groove or grooves and the transverse bore in one or more segments, and through the cutout of one or more adjacent non-conducting sheets. According to our novel method, the introduction of insulating substance is carried out in vacuo by dipping the fully assembled commutator into the hardenable substance.

According to a slight modification of the invention, at least one segment is provided with one or more bores, grooves or cutouts which may be either perpendicular or inclined with respect to the axis about which the commutator rotates, one end of each cutout terminating in an exopsed surface of the segment, i.e. in its peripheral zone or in one of its end surfaces, and the other end opening into the space between the periphery of the core and the dovetailed portions of segments and of interposed non-conducting sheets.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of certain embodiments when read in connection with the accompanying drawing, in which:

FIG. 1 is an axial section through approximately one half of a commutator constructed in accordance with one embodiment of our invention;

FIG. 2 is a perspective view of the segment shown in FIG. 1, the segment having a pair of longitudinal grooves and a transverse bore between the grooves;

FIG. 3 is a perspective view of a non-conducting sheet;

FIG. 4 illustrates in perspective a modified segment having a radial groove; and

FIG. 5 is a perspective view of a different segment having a pair of inclined grooves in its major surfaces.

Referring first to FIG. 1, the commutator **10** comprises an annulus consisting of wedge-shaped segments **11**, one of which is shown in FIG. 2, and of non-conducting sheets or plates **12** interposed between the adjacent major surfaces of the segments, one sheet **12** being shown in FIG. 3. Segments **11** comprise dovetailed portions

13 alternating with similar dovetailed portions 12*a* of non-conducting members 12. Dovetailed portions 13, 12*a* are urged in direction perpendicular to and toward the axis of a tubular core 16 by a pair of clamping rings 14, 15 whose V-shaped extensions are received in complementary annular recesses defined by the portions 13, 12*a*. Rings 14, 15 extend into the axial bore of annulus constituted by members 11, 12 and are inserted into said bore from the respective ends of the annulus. Short-circuiting of segments 11 by rings 14, 15 or by core 16 is prevented by a pair of V-shaped annular insulators 18, 19 and by a cylindrical insulator 17 which latter surrounds the peripheral zone of core 16. Core 16 has a pair of deformed or swedged end portions 16*a*, 16*b* which are bent over the end faces of respective clamping rings 14, 15 and urge said rings in the direction of dovetailed portions 13, 12*a*. Core 16 constitutes the nave of commutator 10 in that it receives the spindle (not shown) of an armature, and is coaxial with the annulus of segments 11 and plates 12.

In accordance with our invention, one, more or all segments 11 are formed with a pair of longitudinal cutouts or grooves 20, 21 as is best shown in FIG. 2. These grooves are provided in the lateral or major surfaces of the segment and extend between its longitudinal end surfaces preferably so that they partially extend into the material of dovetailed portion 13. Grooves 20, 21 are connected by a transverse bore 22 extending between the major surfaces of the segment.

Referring to FIG. 3, there is shown a non-conducting sheet or plate 12 having a dovetailed portion 12*a* and a cutout 23 opening into the end face 12*a*′ of portion 12*a*. The upper part of cutout 23 is aligned with bore 22 of an adjacent segment 11, as is shown in FIG. 1. The exposed surface of insulating insert 17 and the end faces 13′, 12*a*′ on dovetailed portions 13, 12*a* of respective members 11, 12 define therebetween a space 24 which may be filled with a hardenable insulating substance 26 (shown broken away in FIG. 1) through grooves 20, 21, through transverse bore 22, and through the inwardly opening cutout or aperture 23. Hence, the introduction of insulating substance 26 may be carried out after the core 16 is already mounted on the spindle of an armature. Grooves 20, 21, bore 22 and cutout 23 thus form a channel or passage for introduction of insulating material 26 and, if the commutator comprises more than one segment of construction shown in FIG. 2 and more than one non-conducting sheet 12 of the construction shown in FIG. 3, the air from space 24 will escape through one or more channels while the material 26 is introduced through the remaining channel or channels.

It is preferred, however, to first evacuate air from space 24 and to thereupon dip the completely assembled commutator 10, after mounting same on the spindle of an armature and after the armature wires (not shown) are already soldered to lugs 25 of individual segments 11, into a hardenable plasticized insulating substance in such manner that the armature wires, too, are submerged into the plastic material. In this manner, the coil ends of an armature which face the commutator may be joined with the latter in a single operation to form an extremely strong unit.

The modified segment 30, shown in FIG. 4, is formed with a groove 31 extending from its exposed outer or peripheral surface 32 toward the end face 33′ of its dovetained portion 33. Thus, no cutouts or apertures need be provided in the non-conducting plates or sheets 12 because the hardenable insulating substance 26 may be introduced from the exposed peripheral zone of annulus constituted by segments 30 and by interposed plates directly into the annular space 24 of the commutator. As is known, the periphery of annulus constituted by the segments and interposed non-conducting sheets is the runway for carbon brushes or wipers (not shown) of an electric machine. It will be understood that groove 31 may be replaced by a radial or inclined bore between outer surface 32 and end face 33′ of segment 30.

Referring now to FIG. 5, the segment 50 therein shown is formed with a pair of inclined grooves 51, 52 extending in its major surfaces between the opposing end surfaces 50*a*, 50*b*, respectively, and the longitudinal ends of end face 53′ on dovetailed portion 53. If desired, the segment may be formed with a single groove 51 or 52, and such grooves may be provided in one, more or all segments of the commutator. The advantage of construction shown in FIG. 5 is in that the cutouts do not terminate in the exposed outer or peripheral surface 50*c* of the segment but rather in its end surfaces, so that the insulating substance filling the space 24 and the grooves or channels in the segment or segments cannot hinder the travel of wipers about the periphery of the commutator.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A commutator comprising, in combination: a core having an axis, a peripheral zone and a pair of deformed end portions; an annulus coaxially surrounding said core and having two ends and a bore, the annulus consisting of wedge-shaped segments and of interposed non-conducting plates, each segment and each plate having a dovetailed portion extending to said bore and each dovetailed portion having an axially extending inner face defining an annular space with the peripheral zone of said core, said annulus having at least one channel communicating with said space and with the surrounding atmosphere; a hardenable insulating substance filling said space; and a pair of clamping rings, one at each end of said annulus, and each engaging with one of said deformed end portions and with said dovetailed portions in such manner as to urge said segments and said plates toward the axis of said core.

2. A commutator comprising, in combination: a core having an axis, a peripheral zone and a pair of deformed end portions; an annulus coaxially surrounding said core, said annulus having two ends, a bore, and consisting of wedge-shaped segments and of interposed non-conducting plates, each segment and each plate having a pair of major surfaces so disposed that each major surface of each segment abuts against one major surface of an adjacent plate, each segment and each plate having a pair of end surfaces and a dovetailed portion extending to the bore of said annulus, each dovetailed portion having an axially extending inner face, the axially extending inner faces of said dovetailed portions defining an annular space with the peripheral zone of said core, at least one segment having at least one longitudinal groove in at least one of its major surfaces extending between the end surfaces of the respective segment and a transverse bore between the major surfaces communicating with said groove, and at least one plate adjacent to said one segment having a cutout in its dovetailed portion communicating with said transverse bore and terminating in the end face of said dovetailed portion, whereby said groove, said transverse bore and said cutout constitute a channel between said space and the surrounding atmosphere; a hardenable insulating substance filling said space; and a pair of clamping rings, one at each end of said annulus, and each engaging with one of said deformed end portions and with said dovetailed portions

in such manner as to urge the segments and the plates toward the axis of said core.

3. A commutator comprising, in combination: a core having an axis, a peripheral zone and a pair of deformed end portions; an annulus coaxially surrounding said core, said annulus having two ends, a bore, and consisting of wedge-shaped segments and of interposed non-conducting plates, each segment and each plate having a pair of major surfaces so disposed that each major surface of each segment abuts against one major surface of an adjacent plate, each segment and each plate having a dovetailed portion extending to said bore and each dovetailed portion having an axially extending inner face, the axially extending inner faces of said dovetailed portions defining an annular space with the peripheral zone of said core, each segment having a pair of end surfaces and at least one segment having in at least one of its major surfaces an inclined groove extending from one of its end surfaces to the axially extending inner face of its dovetailed portion and constituting a channel between said space and the surrounding atmosphere; a hardenable insulating substance filling said space; and a pair of clamping rings, one at each end of said annulus, and each engaging with one of said deformed end portions and with said dovetailed portions in such manner as to urge the segments and the plates toward the axis of said core.

4. A commutator comprising, in combination: a core having an axis, a peripheral zone and a pair of deformed end portions; an annulus coaxially surrounding said core, said annulus having two ends, a bore, and consisting of wedge-shaped segments and of interposed non-conducting plates, each segment and each plate having a pair of major surfaces so disposed that each major surface of each segment abuts against one major surface of an adjacent plate, each segment and each plate having a dovetailed portion extending to said bore and each dovetailed portion having an axially extending inner face, the axially extending inner faces of said dovetailed portions defining an annular space with the peripheral zone of said core, each segment having a pair of end surfaces and at least one segment having in each of its major surfaces an inclined groove extending from one of its end surfaces to the axially extending inner face of its dovetailed portion, said grooves being oppositely inclined with respect to the axis of said core and constituting two channels between said space and the surrounding atmosphere; a hardenable insulating substance filling said space; and a pair of clamping rings, one at each end of said annulus, and each engaging with one of said deformed end portions and with said dovetailed portions in such manner as to urge the segments and the plates toward the axis of said core.

5. A commutator comprising, in combination: a core having an axis, a peripheral zone and a pair of deformed end portions; an annulus coaxially surrounding said core, said annulus having two ends, a bore, and consisting of wedge-shaped segments and of interposed non-conducting plates, each segment and each plate having a pair of major surfaces so disposed that each major surface of each segment abuts against a major surface of an adjacent plate, each segment and each plate having a dovetailed portion extending to said bore and each dovetailed portion having an axially extending inner face, the axially extending inner faces of said dovetailed portions defining an annular space with the peripheral zone of said core, each segment having an outer surface and at least one of said segments having a radical groove in at least one of its major surfaces, the groove extending from the exposed surface of the respective segment toward the axially extending inner face of its dovetailed portion and constituting a channel between said space and the surrounding atmosphere; a hardenable insulating substance filling said space; and a pair of clamping rings, one at each end of said annulus, and each engaging with one of said deformed end portions and with said dovetailed portions in such manner as to urge the segments and the plates toward the axis of said core.

6. A commutator comprising, in combination, a core having an axis, a peripheral zone and a pair of deformed end portions; an annulus coaxially surrounding said core and having two ends and a bore, the annulus consisting of wedge-shaped conducting segments and of non-conducting plates interposed between and abutting against said wedge-shaped conductive segments, each segment and each plate having a dovetailed portion extending to said bore and each dovetailed portion having an axially extending inner face and a pair of side faces, said axially extending inner faces defining an annular space with the peripheral zone of said core and said pair of side faces defining respectively a pair of V-shaped grooves located respectively at said two ends of the annulus, said annulus being formed with channel means communicating with said space, the apices of said V-shaped grooves and the atmosphere; a pair of V-shaped insulating rings respectively located in said V-shaped grooves; a pair of clamping rings, one at each end of said annulus, and each engaging with one of said deformed end portions and with said V-shaped insulating rings in such a manner as to urge said segments and said plates towards the axis of said core; and a hardenable insulating substance filling said space and any free space in said V-shaped grooves not filled by said V-shaped insulating rings.

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