Nov. 17, 1936. H. GROB 2,060,935

ARRANGEMENT FOR IMPROVING THE COMMUTATION IN DIRECT CURRENT MACHINES

Filed Oct. 22, 1935

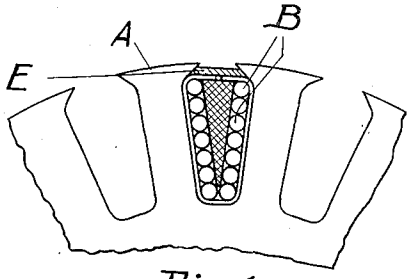

Fig. 1

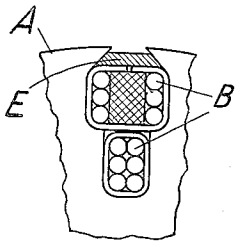

Fig. 2

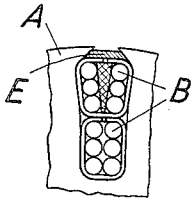

Fig. 3

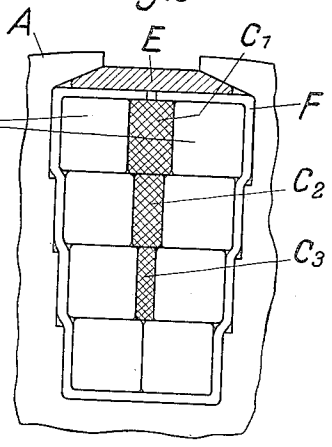

Fig. 4

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Patented Nov. 17, 1936 2,060,935

UNITED STATES PATENT OFFICE

2,060,935

ARRANGEMENT FOR IMPROVING THE COMMUTATION IN DIRECT CURRENT MACHINES

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Application October 22, 1935, Serial No. 46,147
In Germany September 12, 1934

9 Claims. (Cl. 171—228)

This invention relates to a device for improving the commutation of direct current machines.

In order to reduce self-induction which causes sparking at the commutators in machines of this type it is known to provide for greater spacing between the slot walls of the armature and the slot copper at a certain distance from the base of the slot at all points except at the root of the tooth.

In such machines, the distance between the winding wires and the slot wall increases with the distance from the base of the slot to the extent permitted by the saturation of iron in the outer parts of the teeth. Owing to the increase in the length of the air path of the cross field of the slot thus produced, the self-induction of the conductors embedded in the slots will decrease. Although a construction as described effects considerable reduction of sparking at the commutator, it is still open to certain objections.

One of these objections is that the discharge of the heat developed in the winding to the surrounding iron is seriously interfered with by the interposed reinforced insulating layers. Furthermore, the armature conductors with their high specific gravity act upon the center of the slot wedge and subject it to bending stresses, which makes it necessary to use relatively strong slot wedges and to increase the length of the slots accordingly.

The invention eliminates these drawbacks in a simple manner by arranging the insulating members disposed, in the known constructions, between the slot copper and the slot walls in the center of the slot whereby the slot winding itself is expanded, so that the copper is separated from the iron slot walls only by relatively thin insulating layers. At this position of the slot copper the heat developed in the winding is far less prevented from passing over into the closely adjacent iron than in known constructions and can thus be easily discharged through the surface of the armature in the normal manner.

A further improvement can be effected by providing the conductors with a rectangular instead of a round cross section so as to enlarge the heat eliminating contact surface between the conductors and the wall insulation considerably.

When the slot copper has the position indicated above, the slot wedge is, moreover, not so much subjected to bending stresses as in the known arrangements.

By way of example, the invention is illustrated in the accompanying drawing, in which Figure 1 shows a portion of the armature of a direct current machine provided with slots and conductors arranged therein; and Figs. 2, 3 and 4 show constructional embodiments similar to the one disclosed in Fig. 1.

In the slot shape shown in Fig. 1 the space of the slot widens continually in upward direction, and the insulating intermediate filling part has therefore the form of a wedge. According to Fig. 2, the slot is widened in steps. The slot shown in Fig. 3 is not widened in its lower portions, but broadens out towards the top. In the constructional embodiments shown in Figs. 2 and 3 the intermediate members are therefore provided only in the upper slot space.

A particularly suitable form of the invention is shown in Fig. 4. The slot has a gradually expanding cross section, similar to that shown in Fig. 2, and the steps are adapted to the electric conductors which may be of rectangular or square cross section. The slot is lined in the usual manner with an insulating material F which embraces all conductors. The spaces between the conductors B are filled with insulating members C_1, C_2, C_3 which are introduced between the conductors B after each insertion of a pair of wires, the whole being held together by the wedge E in the slot.

The arrangement in which the insulating members fill in the center of the slot in a radial direction instead of being disposed adjacent the walls thereof, particularly if rectangular instead of round conductors are employed, affords the added advantage that the wire to be inserted last can in many instances be put in very easily. If, as in known constructions, the fillers are disposed adjacent the slot walls, the first conductor of the top layer which is inserted will be positioned so as to render it difficult to insert the last conductor without considerable shifting of the elements. In the improved construction very little shifting of the elements is required if at all.

This invention is adapted for use with direct current machines having no reversing poles, in other words, machines having no special auxiliary poles which would otherwise be necessary to obtain satisfactory commutation. If reversing poles are used they are generally sufficient in themselves to suppress spark formations. While the invention improves commutation in such machines its advantages are particularly apparent where no reversing poles are used since it provides a cheap means to improve commutation substantially.

If each slot for instance accommodates three

instead of two conductors side by side, the fillers are disposed between every two conductors.

I claim:—

1. An armature having a plurality of slots the side walls of which are spaced apart a greater distance adjacent the open end than at the closed end, a layer of insulating material adjacent said walls and a plurality of conductors adjacent said insulating material only, said walls being spaced apart at least at the outer portion a distance greater than the combined cross section of said conductors and the insulating material, whereby at least a portion of said conductors are centrally spaced apart, and a separate insulating member within said space.

2. An armature as claimed in claim 1, said layer of insulating material being of uniform thickness throughout.

3. An armature as claimed in claim 1, the opposite portions of the side walls being parallel and the conductors being arranged in layers, the number of said opposite portions being equal to the number of said conductor layers.

4. An armature as claimed in claim 1, the opposite portions of the walls being parallel, and the conductors being rectangular in cross section and arranged in layers equal in number to the number of wall portions.

5. An armature having a plurality of slots the side walls of which are spaced apart a distance greater adjacent the open end than at the closed end, a flange extending circumferentially from each side wall at the periphery of the armature, an insulating layer adjacent each side wall, a plurality of conductors adjacent each insulating layer and lying within substantially the same radial planes as said flanges and an insulating member radially disposed between at least the outer conductors whereby the centrifugal force of all of said conductors is opposed by said flanges and the heat from all of said conductors is conducted to said walls.

6. An armature having a plurality of slots the side walls of which are spaced apart a distance greater adjacent the open end than at the closed end, a flange extending in circumferential direction from each side wall at the periphery of the armature, a layer of insulating material adjacent each of said walls and a plurality of conductors adjacent said insulating material and substantially within the same radial planes as said flanges respectively, said walls being spaced apart at least at the outer portion a distance greater than the combined cross section of said conductors and the layers of insulating material whereby at least the outer conductors are centrally spaced apart, and a separate insulating member within said space.

7. An armature as claimed in claim 6, the opposite portions of the side walls being parallel and the conductors being arranged in layers, the number of said opposite portions being equal to the number of said conductor layers.

8. An armature as claimed in claim 6, the opposite portions of the walls being parallel, and the conductors being rectangular in cross section and arranged in layers equal in number to the number of wall portions.

9. An arrangement for improving the commutation in direct current machines having no reversing poles which comprises, an armature having plurality of slots the side walls of which are spaced apart a greater distance adjacent the open end than at the closed end, a layer of insulating material adjacent said walls and a plurality of conductors adjacent said insulating material only, said walls being spaced apart at least at the outer portion a distance greater than the combined cross section of the conductors and the insulating material, whereby at least a portion of said conductors are centrally spaced apart, and a separate insulating member within said space.

HUGO GROB.