

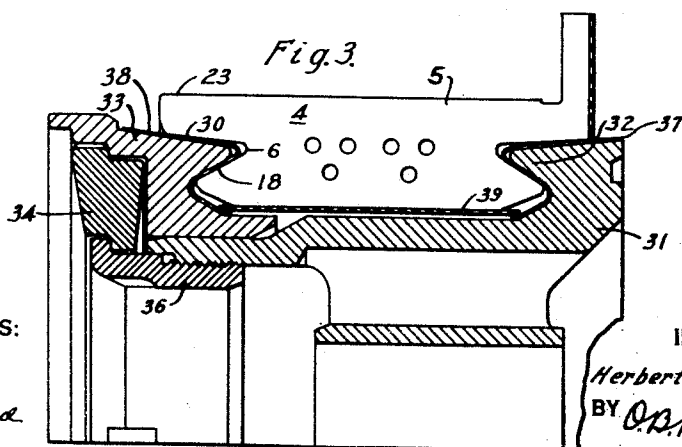
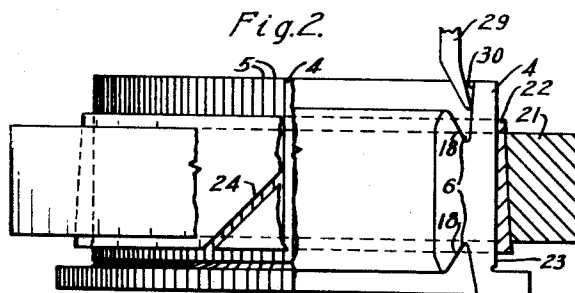
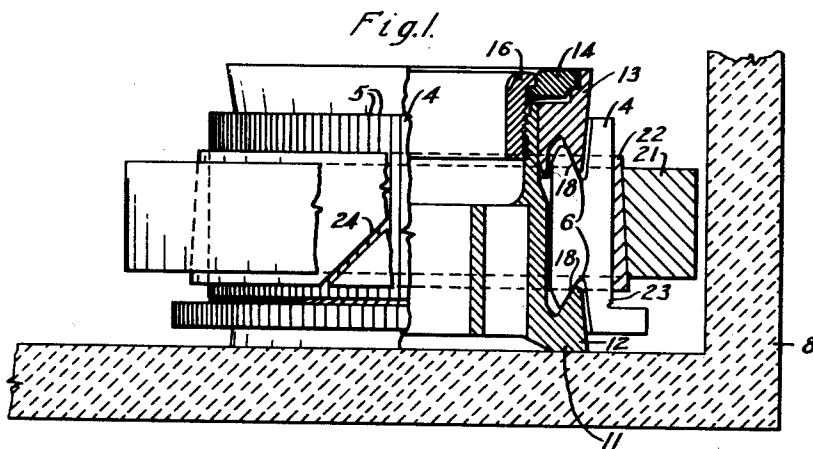
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H. W. GRAYBROOK

2,379,145

COMMUTATOR PROCESSING

Filed May 23, 1942



WITNESSES:

H. I. Sugar.
Du. C. Jones

INVENTOR

Herbert W. Graybrook.

BY *O. P. Buchanan*
ATTORNEY

UNITED STATES PATENT OFFICE

2,379,145

COMMUTATOR PROCESSING

Herbert W. Graybrook, Irwin, Pa., assignor to
Westinghouse Electric Corporation, East Pitts-
burgh, Pa., a corporation of Pennsylvania

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My invention relates to improvements in the process of manufacture of cylindrical commutator members such as are utilized in commutator-type dynamo-electric machines, either alternating-current or direct-current. My invention was particularly designed and adapted for the pre-seasoning processing of high-speed commutators for large alternating-current railroad-motors such as are used in locomotive-drives, but the invention is of general application in other types of commutators.

My present invention is a development of, and an improvement on, the disk-spring commutator which is described and claimed in a patent of G. A. Moore, No. 1,826,628, granted October 6, 1931, and assigned to the Westinghouse Electric & Manufacturing Company. In the Moore commutator, a movable steel V-ring was resiliently pressed into position by means of a disk-shaped spring, so that the cylindrical assembly of copper commutator-bars, separated by mica strips or bars, was held between two clamping steel V-rings, with smooth mica V-rings interposed between the steel clamping V-rings and the V-grooves in the ends of the commutator-bars and mica bars. The Moore structure and process, both as described in his patent, and as actually practiced by the Westinghouse Electric & Manufacturing Company, has had to do exclusively with the treatment, or processing, or pre-seasoning, of a finished commutator including the mica V-ring insulation; and a commutator cylinder was so defined in the Moore patent. As time has passed, however, and as requirements have become more and more exacting, it has become increasingly difficult to manufacture the best type of commutator in accordance with the methods set forth in the Moore patent.

It is an object of my present invention to pre-season an assembly of commutator-bars and mica bars previous to the building of a finished commutator-cylinder with the mica V-rings in place. It is my idea that the seasoning, or flowing, or squeezing out, of the binders which are utilized in building up the mica bars is at the root of the principal trouble which has been experienced in the way of eccentricities in the commutators which have been produced heretofore; and I have found, by actual experience, that if a continuous pressure is applied to the commutator-assembly while it is being baked, it is possible to season the mica bars which are interposed between the adjacent commutator-bars or segments, and it is possible to cause the commutator to shrink in diameter by substantially the full amount which

it will ever shrink, as a result of seasoning, provided only that an adequate arch-binding pressure is maintained on the commutator-assembly throughout the entire baking process. I have also discovered that the amount of shrinkage which is thus obtained is quite considerable, amounting to something like 0.070 inch in diameter, which corresponds to a considerable inward movement of the movable clamping steel V-ring, in case the spring-pressed V-ring support is utilized during the baking process. This inward movement of the V-rings means that there would have to be a considerable slippage between the inner conical surface of the V-ring and the inner conical surface of the V-grooves in the commutator-bars and mica bars, which would be ruinous to any mica V-ring which might be interposed between these two surfaces while this excessive slippage is being obtained in such a pre-seasoning process.

It is an object of my invention, therefore, to provide a process in which the commutator-assembly is baked under conditions of a maintained arch-binding pressure without the use of the mica V-rings, and subsequently the entire commutator is assembled, with the necessary mica V-rings which will be smooth and unwrinkled at the time when they are interposed between the steel V-rings and the V-grooves in the bars.

With the foregoing and other objects in view, my invention consists in the methods, apparatus, structures and products hereinafter described and claimed, and illustrated in the accompanying drawing, wherein:

Figure 1 is a vertical cross-sectional view illustrative of the pre-seasoning baking process in accordance with my invention;

Fig. 2 is a similar view illustrative of a V-groove machining-process which I prefer to perform after the baking process; and

Fig. 3 is a similar view of the top half of a finished commutator-cylinder or device.

As shown in Fig. 1, my commutator-assembly consists of a plurality of copper commutator-bars 4 separated by thin mica insulating-bars 5. Both the copper bars 4 and the mica bars 5 are provided with V-grooves 6, one in each end. In accordance with my invention, such an assembly of commutator-bars 4 and mica bars 5 is held under arch-binding pressure, by any suitable means which is capable of yieldably holding the bars with a follow-up movement for maintaining a strong arch-binding pressure thereon throughout the shrinkage which occurs during baking, and the whole assembly is then placed in a baking-oven 8, for a baking process which is con-

tinued for as many hours as may be needed to season the mica, or to cause it to flow as much, or nearly as much, as it is going to flow, ever. In order to yieldably hold the bars with a maintained arch-binding pressure, I prefer to utilize a V-ring clamping-assembly which may be either the same as the final V-ring assembly which will be utilized in the finished commutator, or a special V-ring assembly which is utilized only for the baking process, although I wish it to be understood that, at least in its broader aspects, this baking-operation phase of my invention may be carried out with any kind of means for maintaining a sustained arch-binding pressure, that is, a pressure which will be maintained even when the commutator shrinks in diameter.

In Fig. 1, I show a special V-ring clamping-assembly which is utilized only in the baking process, and which includes a steel spider 11 carrying one of the V-rings 12, and a movable steel V-ring 13 which is resiliently pressed into position by means of a strong disk-spring 14, which is deflected under hydraulic pressure, and tightened in place by means of a nut 16. The amount by which the disk-spring 14 is set up initially, in being given its initial spring-tension, is usually enough to still maintain an adequate arch-binding pressure on the inner conical surfaces 18 of the V-grooves 6 in the bars, even at the end of the baking procedure. Since the amount of pressure exerted by the disk-spring 14 depends upon the amount of its deflection, this deflection can be measured, so as to positively determine, at the end of the baking operation, whether adequate arch-binding pressure was maintained on the commutator-bar assembly during the baking process, and such individual commutators as may have developed excessive shrinkage during this process may have their disk-springs again set up, and the baking process repeated.

I also very much prefer, during the baking process which has just been described, to utilize also an additional means for holding the commutator-bars and mica bars in arch-bound assembly, this additional means being a suitable form of peripherally applied clamping means such as may be provided by a heavy solid steel tapered clamping-band 21 surrounding a split inner tapered band 22 which, in turn, surrounds the cylindrical commutator in surface 23 of the commutator-bar assembly. As shown in Fig. 1, the split in the inner tapered band 22 is inclined with respect to the axis of the commutator cylinder, as indicated at 24. The particular kind of peripherally applied clamping-means 21-22 which I have illustrated is not regarded as being adequate to supply a sufficient arch-binding clamping-pressure to properly season the commutator, because, when the commutator-assembly shrinks in diameter, during the baking process, the tapered bands 21 and 22 become loose, and can do no more than to possibly be tightened up, by reason of the weight of the outer tapered band 21, so as to take up any slack that may be produced during the baking.

At some time during the manufacture of my completed commutator, the V-grooves 6 in the bars should be accurately machined, particularly as to the inner conical surfaces 18 thereof, which are usually held to an angle of 30° with respect to the axis of the commutator. This machining might have been done before the baking process which has just been described with reference to Fig. 1. However, in view of the lack of uniformity in the amount of shrinkage which I have obtained

from different commutator-assemblies during the baking process, and in view of the desirability of obtaining standard dimensions and proper clearances in the finished product, I prefer to utilize, during the baking process, bars which have been merely individually stamped out, with the V-grooves 6 therein, seasoning the commutator-assembly in this condition, by means of the baking process just described, and then machining the V-grooves 6 to standard and true dimensions.

As illustrated in Fig. 2, therefore, I remove the pre-seasoned commutator-assembly from the baking oven 8 of Fig. 1, and I remove the V-ring clamping-assembly 11-13-14-16 therefrom, leaving the peripherally applied clamping means 21-22 thereon so as to avoid any relative slippage between any of the commutator-bars and the mica bars. I then machine the V-grooves 6 to an accurate standard dimension, utilizing, for this purpose, a cutting-tool 29 which preferably machines, not only the outer cylindrical surface 30, which is usually cut to an angle of 6°, or sometimes 3°, but also the inner 30° conical surface 18. It will be readily understood that the machining process is most necessary on the inner conical surface 18 of each of the V-grooves 6.

In the final assembling-operation, which is illustrated in Fig. 3, my cylindrical assembly of pre-seasoned commutator-bars and mica bars are clamped in the final V-ring clamping-assembly of the finished commutator. As previously stated, this V-ring clamping-assembly may be either the same as, or different from, the one which was utilized in the baking process illustrated in connection with Fig. 1. I prefer to utilize a different assembly, which is shown in Fig. 3 as comprising a steel commutator-spider 31 which carries one of the clamping V-rings 32. The other V-ring 33 is a movable steel ring which is pressed strongly toward the first or fixed V-ring 32 by means of a disk-spring 34 which is held in its deflected position by means of a nut 36. In assembling the V-ring clamping-assembly 31-33, two smooth insulating V-rings 37 and 38, usually made of mica, are first prepared and laid over the surfaces of the two steel V-rings 32 and 33, respectively, so as to be interposed between the clamping V-rings and the V-grooves of the commutator-bars and mica bars. By reason of the pre-seasoning of the mica bars, the amount of axial movement of the movable V-ring 32, in the final assembly and subsequent use of the commutator cylinder, is of such small amount that the mica V-rings 37 and 38 are not harmed thereby. I also preferably utilize, as shown, a mica bushing 39 which is disposed underneath or inside the inner periphery of the cylindrical commutator-bar assembly.

At all times during the handling of the pre-seasoned commutator-bar assembly, it is necessary to be careful that there shall be no slippage or displacement between the various copper and mica bars. It is essential, therefore, to maintain some kind of peripherally applied clamping member around the outer cylindrical surface 23 of the commutator-assembly to definitely hold this assembly with sufficient arch-binding pressure to avoid slippage, until the setting up of the disk-spring 34 in the final assembly, and to this end I prefer to retain the tapered bands 21 and 22 which are shown in Figs. 1 and 2, leaving them in place until the final assembly of the commutator is completed, after which these peripherally applied tapered clamping-bands 21 and 22 are

removed, leaving the finished commutator in the condition shown in Fig. 3.

Experience has shown that commutators built in accordance with my invention can be successfully trued, as to their outer cylindrical commutator-surface 23, and can be relied upon to retain reasonably true cylindrical commutator-surface 23 during repeated cycles of heating and cooling, not only during the necessary processes of heat-treatment of the dynamo-electric machine (not shown) during the fabrication and insulation thereof, but also during the actual cycles of use and non-use of the machine after the commutator is put into service. I have found that my invention makes it possible to produce an adequate number of the highest-class commutators, and to get them into service, whereas, prior to the introduction of my improvements, only a small percentage of the required number of commutators could be produced, and then only at an excessive cost.

While I have illustrated my invention in a preferred form of embodiment, both as to tools and equipment, and as to the precise order and nature of the steps which make up my seasoning and manufacturing process, I desire it to be understood that my invention, at least in its broader aspects, is not limited to these various details. I desire, therefore that my appended claims be accorded the broadest construction consistent with their language.

I claim as my invention:

1. The method of building a V-ring commutator-assembly, comprising the steps of assembling a plurality of V-ring commutator-bars and mica bars between a pair of metallic clamping V-rings without V-ring insulation between the commutator-bars and the metallic clamping V-rings, pressing said clamping V-rings toward each other with a follow-up movement in such manner as to yieldably apply a strong, uniformly distributed, arch-binding pressure on said commutator-bars and mica bars, with a direct metal-to-metal contact between the clamping V-rings and the inner conical surfaces of the V-grooves

of the commutator-bars, subjecting said assembly to a heating operation while strongly maintaining the uniformly distributed follow-up pressure on the clamping V-rings throughout the entire shrinkage which occurs during all of the heating operation, subsequently removing the clamping V-rings while applying a peripheral pressure for holding the commutator-bars and mica bars assembled, and subsequently applying V-ring insulation between the commutator-bars and the clamping V-rings and reassembling the clamping V-rings in yieldably pressed engagement with said V-ring insulation.

2. The method of building a V-ring commutator-assembly, comprising the steps of assembling a plurality of V-ring commutator-bars and mica bars between a pair of metallic clamping V-rings without V-ring insulation between the commutator-bars and the metallic clamping V-rings, temporarily applying a peripheral arch-binding pressure on said commutator-bars and mica bars, pressing said clamping V-rings toward each other with a follow-up movement in such manner as to yieldably apply a strong, additional, uniformly distributed, arch-binding pressure on said commutator-bars and mica bars, with a direct metal-to-metal contact between the clamping V-rings and the inner conical surfaces of the V-grooves of the commutator-bars, subjecting said assembly to a heating operation while strongly maintaining the uniformly distributed follow-up pressure on the clamping V-rings throughout the entire shrinkage which occurs during all of the heating operation, subsequently removing the clamping V-rings while maintaining a peripherally applied arch-binding pressure on said commutator-bars and mica bars, subsequently applying V-ring insulation between the commutator-bars and the clamping V-rings and reassembling the clamping V-rings in yieldably pressed engagement with said V-ring insulation, and subsequently removing the peripherally applied arch-binding pressure.

HERBERT W. GRAYBROOK.