

July 10, 1928.

1,676,442

R. G. JONES

MANUFACTURE OF COMMUTATORS

Filed Sept. 18, 1924

2 Sheets-Sheet 1

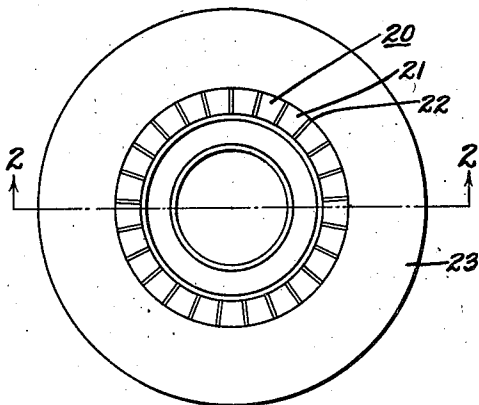


Fig. 1

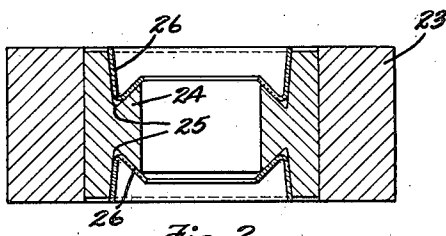


Fig. 2

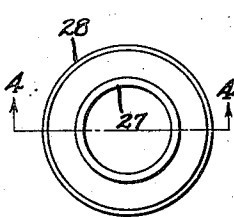


Fig. 3

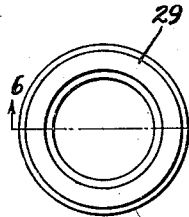


Fig. 5

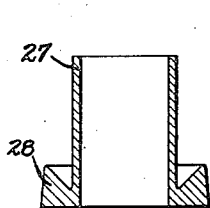


Fig. 4

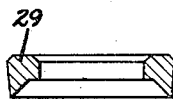


Fig. 6

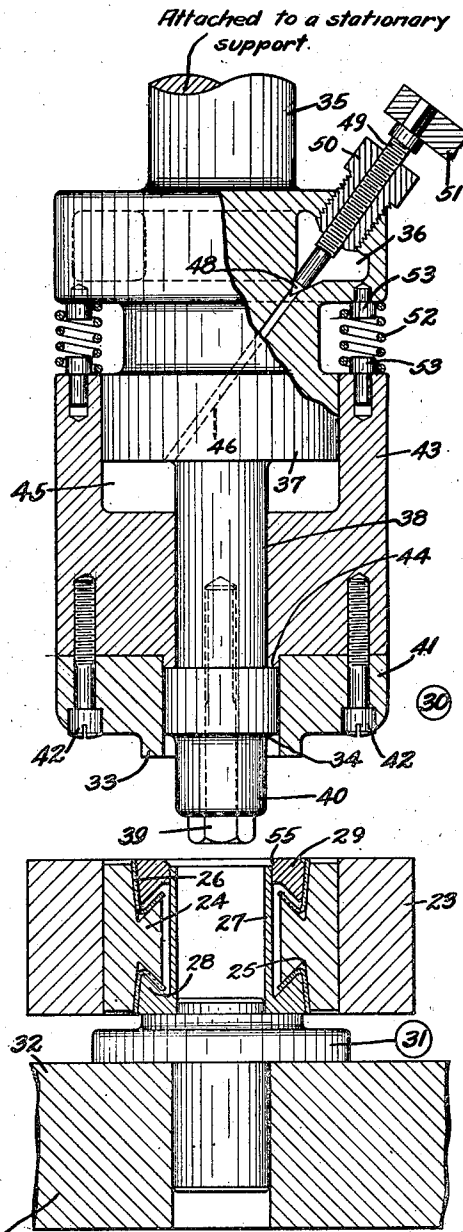


Fig. 7

Plunger of Hydraulic Press

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2 Sheets-Sheet 2

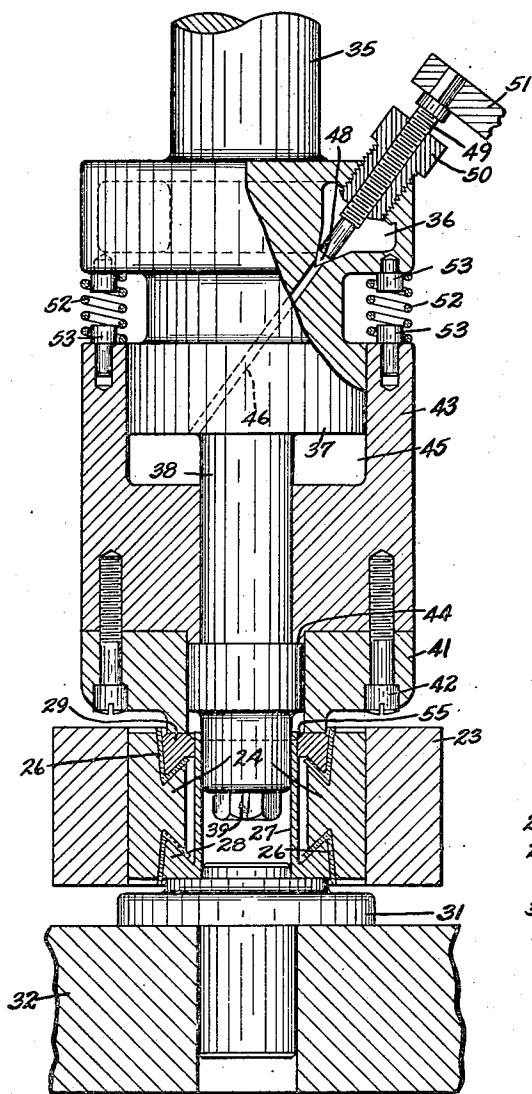


Fig. 8

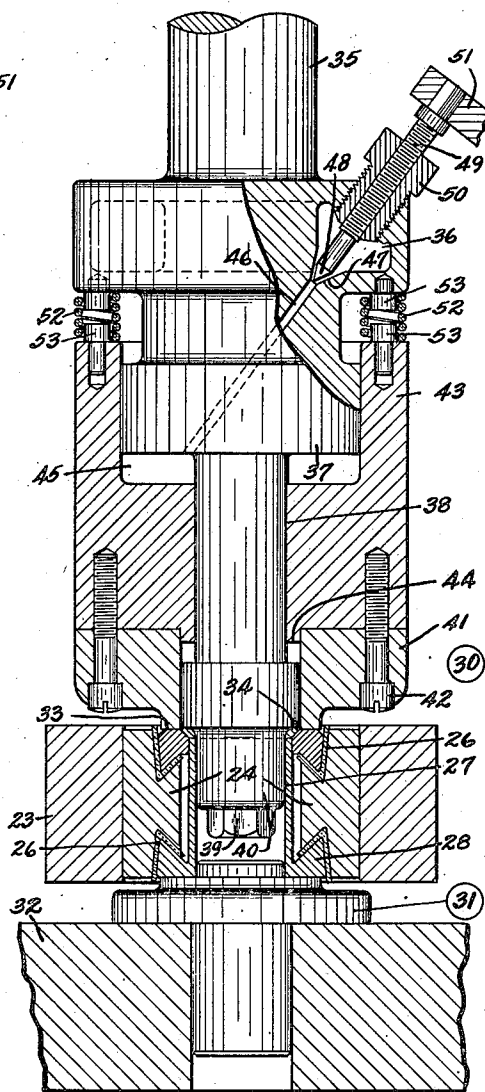


Fig. 9

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UNITED STATES PATENT OFFICE.

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DELCO-REMY CORPORATION, OF DAYTON, OHIO, A CORPORATION OF DELAWARE.

MANUFACTURE OF COMMUTATORS.

Application filed September 18, 1924. Serial No. 738,549.

This invention relates to commutators for dynamo electric machines and particularly to the type of commutator which includes an annulus of metal segments having tangs and spaced by insulating segments, insulating rings adjacent the ends of the annulus of segments, metal rings bearing against the insulating rings and clamping the tangs of the segments between them, and means such as a tubular sleeve extending through the annulus for permanently maintaining the clamping rings in position.

One object of the present invention is to simplify the manufacture of commutators of this type. One method employed heretofore is disclosed in the patent to O. F. Conklin, No. 1,503,484, patented August 5, 1924, which specifies placing insulating varnish upon the ends of the annulus of metal segments before the insulating rings are assembled, partially crimping the ends of the center sleeve or core against the clamping rings, heating the entire commutator to a temperature and for a time sufficient to cause the varnish to expand and fill the crevices between the parts of the annulus, completing the crimping operation while the commutator is still hot, and then baking the commutator to dry the varnish. More particularly, it is a further object of the present invention to provide certain improvements in the method of manufacturing commutators as described in the Conklin patent, said improvements tending to minimize the loosening of the commutator segments.

The objects of the present invention are accomplished by using insulating rings which will soften under heat, forcing metal clamping rings, which have been heated to a temperature sufficient to soften the insulating rings, against the insulating rings with pressure sufficient to cause the insulating rings to be pressed into the surface irregularities of the segments and to cause the tangs of the segments to be bent so that the pressure applied initially to the tangs will be substantially equalized, and in securing the clamping rings in clamping position while the clamping rings are still at a higher temperature than the segments and while maintaining the pressure initially applied between the clamping rings and segments.

A further object of the present invention is to provide apparatus by which this method may be practiced.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is an end view of an assembled annulus of metallic and insulating segments;

Fig. 2 is a sectional view on line 2—2 of Fig. 1;

Fig. 3 is an end view of a commutator sleeve integral with one of the segment clamping rings;

Fig. 4 is a sectional view on the line 4—4 of Fig. 3;

Fig. 5 is an end view of the other segment clamping ring;

Fig. 6 is a sectional view on the line 6—6 of Fig. 5; and

Figs. 7, 8 and 9 are fragmentary views partly in section showing apparatus in various stages of operation for carrying out the method described hereinafter.

Referring to the drawings, 20 designates an annulus of metallic segments 21 spaced by non-conducting segments 22. These segments are assembled within a metallic ring 23 which temporarily supports the annulus or segments. The ring 23 is shown, for sake of simplicity, as a solid ring but may be made in two or more parts secured together by clamping screws, such construction being well known to those skilled in the art.

The segments are each provided with a dove-tail portion 24 so that the annulus will provide two annular V-shaped grooves 25. These grooves are lined with non-conducting V-shaped lining rings 26. These rings are made of non-conducting material which preferably includes mica and a substance such as shellac or varnish, so that the rings will soften under the action of heat.

For clamping the annulus permanently together there are provided a central core 27 and two clamping rings 28 and 29. Ring 28 is shown integral with the sleeve 27, however it will be apparent that the invention could be applied to a structure within both clamping rings or separated from the central sleeve.

The clamping rings and sleeve are first heated to a temperature of about 900° F. in a suitable furnace, and are then removed and promptly assembled within the annulus as

shown in Fig. 7 and the entire assembly is pressed within the apparatus which permanently secures the central core 27 to the clamping ring 29. This apparatus comprises two clamping elements 30 and 31, which are movable, the one relative to the other. The clamping element 30 may be secured to a suitable stationary support and the element 31 may rest upon the plunger 32 or other movable member actuated by hydraulic press, or vice versa. The clamping member 30 includes a pressure ring portion 33 adapted to engage the clamping ring 29, and a staking or flaring portion 34 adapted to engage the end of the sleeve 27 and to flare the same outwardly against the ring 29 as shown in Fig. 9. The pressure ring 33 is normally located in advance of the flaring portion 34 so that the V-ring 29 is held firmly in clamping engagement with the annulus before the flaring operation begins. The clamping member 30 includes a support 35 carrying an annular chamber 36, a piston 37 and a pilot member 40 which provides the flaring or staking portion 34. The pressure ring 33 is provided by a block 41 attached by screws 42 to a cylinder 43 which receives the piston 37, and which is provided with an opening through which the shank 38 extends. Separation of the cylinder and piston is prevented by an annular boss 44 of the cylinder 43 which engages the upper surface of the pilot member 40 which extends around the shank 38. The space between the piston 37 and the interior cylinder 43 provides a liquid chamber 45. Chambers 36 and 45 are connected by a relatively restricted passage 46 provided at its upper end with a valve seat portion 47 adapted to be engaged by a needle valve 48 having a screw-threaded shank 49 engaging a bushing 50 which is screwed into the wall of the chamber 36. The upper end of the shank 49 is attached to an operating handle 51. The cylinder 43 is maintained normally with respect to the piston 37 as shown in Fig. 7 by a plurality of springs 52 located between the walls of chamber 36 and cylinder 43. The springs 52 are retained in position by studs 53.

The operation of the apparatus shown in Figs. 7 to 9 inclusive is as follows:

The cylinder chamber 45 and passage 46 contain oil or other suitable pressure transmitting fluid and the valve 48 is closed upon its seat 47. The hydraulic press is operated to cause the plunger to move upwardly to cause the clamping member 31 to approach the clamping member 30. As shown in Fig. 8, the pressure ring 33 engages the V-ring 29 before the flaring portion 34 engages the upper end of the sleeve 27. The pressure exerted upon the V-rings must be sufficient to squeeze the mica insulating rings firmly and to draw all of the copper segments toward the central sleeve. The heat of the clamping

rings warms the mica rings causing them to become plastic and to accommodate themselves to the adjacent surfaces of the V-rings and segments. If there is a variation in the form of the segments the longer one tends to bend until the V-rings press substantially equally on all the segments.

Pressure is applied directly to the V-rings long enough to allow the heat to soften the mica rings. A few seconds application is generally sufficient. Then while this ring pressure is still applied, the valve 51 is opened, as shown in Fig. 9, to permit a part of the liquid within the chamber 45 to flow upwardly through the passage 46 and into the chamber 36. This operation will permit movement of the clamping ring portion 33 relative to the flaring portion 34. The movement of the fluid through the passage 36 is relatively retarded so that there will be a gradual decrease of clamping pressure upon the ring 29 and, at the same time, a gradual increase of pressure between the flaring portion 34 and the upper end of the sleeve 27. When the flaring operation is completed, as shown in Fig. 9, substantially all of the pressure exerted by the hydraulic press is localized between the flaring surface 34 and the flared-out edge of the central sleeve 27, and substantially all of the pressure exerted by the press is relieved from the ring engaging surface 33. As shown in Fig. 9, the flared edge of the sleeve engages the chamfered surface 55 of the ring 29.

To restore the swedging press to the position shown in Fig. 7, the hydraulic press plunger is caused to move downwardly in order that the finished commutator may recede from the clamping member 30. The springs 52 will be permitted to expand to restore the normal relative positions of the clamping portions 33 and 34. Some of the oil in the chamber 36 will flow downwardly to fill the passage 46 and the chamber 45. The valve 48 is closed and the completed commutator and ring 23 are removed from the swedging press. The ring 23 is then removed from the completed commutator.

One of the principal advantages of the method included in the present invention is that clamping pressure is maintained upon the V-rings substantially throughout the entire flaring or swedging operation to form upon the end of the central sleeve. At no time is there substantial release of pressure between the clamping rings and the dove-tailed portions of the segments. Therefore from the time the rings are first clamped against the dove-tailed portions until the sleeve flaring operation is completed, there is no substantial easing up of pressure on the segments, therefore very little likelihood that any of the segments can become at all loose before the flaring of the sleeve is completed. In other words, the clamping sleeves

are initially located in the correct clamping position and are clamped together with such force as to cause the dove-tails of the segments to be distorted somewhat in order to clamp securely all of the dovetail portions regardless of slight variations in dimensions. The pressure between the flaring surface 34 and the end of the sleeve 27 is applied and this pressure gradually increases while the pressure against the clamping rings decreases so that there is little danger of the clamping rings backing away from the segments. There is a transfer of pressure from the ring engaging surface 33 to the sleeve flaring surface 34. Therefore the pressure maintained by the press need not exceed that which is required for the sleeve flaring operation.

A further advantage of the invention is to be found in the fact that after the assembly of the annulus and clamping rings has been made there is but one press operation to be performed. In methods of commutator manufacture heretofore employed, such as disclosed in the Conklin Patent No. 1,503,484, a commutator is baked after an initial press operation for securing the clamping rings, and then a final press operation is performed. It is apparent that the present invention simplifies the method of commutator manufacture by reason of the fact that the clamping rings and central tube are heated prior to their assembly with the annulus of segments. There is sufficient heat in the V-rings to cause the insulating rings 26 to soften and be pressed into the surface irregularities of the V-rings and segments.

The metallic segments are usually made of copper and the clamping rings and central sleeve of steel. Heating of the segments and rings in the baking operation referred to as a part of an old process is disadvantageous in that the copper, having greater coefficient of expansion than the steel rings would tend to loosen on cooling from the steel rings. In the present invention the steel sleeve and rings are pressed on while at a much higher temperature than the copper segments. The rings and sleeve contract on cooling and cause the segments to be more firmly clamped.

The staking pressure is preferably greater than the V-ring clamping pressure. If, for example, 8 tons per square inch is suitable for ring clamping pressure, about 12 tons per square inch is suitable for staking pressure.

The temperatures of the sleeve and rings at the time the press operation begins is preferably above 600° F. There may be considerable variation in temperature above this amount.

While a hydraulic press is indicated on the drawing, an air press may be used ad-

vantageously since air is more elastic and will not transfer extreme pressures suddenly in case of the sticking of a spring or valve in the pressure regulator.

The radius of curvature of the staking surface 34 will depend on the size of commutator. A radius of $\frac{1}{8}$ inch to $\frac{5}{8}$ inch has been found satisfactory for a two inch commutator sleeve.

This invention is not limited to the manufacture of commutators having one of the V-rings integral with the sleeve. Both V-rings may be separate from the sleeve and the sleeve may be staked at both ends in one operation by a press having two clamping elements 30 or "hydraulic pressure pads" operating upon both ends of the commutator. It has been found desirable to form one of the elements 34 to a radius of curvature different from the element 34 operating upon the opposite end of the commutator. For example, for a 2 inch sleeve the radius of curvature of element 34 of the upper hydraulic pad may be $\frac{1}{8}$ inch, and that of the lower $\frac{5}{8}$ inch. The surface 34 of small radius will force the sleeve upon the surface 34 of larger radius until the sleeve abuts a definite stop whereupon both staking surfaces 34 begin flaring the ends of the sleeve.

While the form of embodiment of the invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What I claim is as follows:—

1. The method of making a commutator which comprises assembling an annulus of metal segments having anchoring tangs and spaced by insulation, placing against the ends of the tangs rings of insulating material adapted to soften under heat, forcing metal clamping rings, which have been heated to a temperature sufficient to soften the insulating rings, against said insulating rings with pressure sufficient to cause the insulating rings to be pressed into the surface irregularities of the segments and to cause the tangs to be bent so that the pressure applied to the tangs will be substantially equalized, and in securing the clamping rings in clamping relation while the clamping rings are still at a higher temperature than the segments.

2. The method according to claim 1, in which the metal clamping rings are secured in clamping position while maintaining the pressure initially applied between the clamping rings and segments.

3. The method of making a commutator which comprises assembling an annulus of metal segments having anchoring tangs and spaced by insulation, placing against the ends of the tangs rings of insulating material adapted to soften under heat, providing metal clamping rings adapted to clamp the

tangs and a central, metal sleeve for securing the rings in clamping position, at least one of the rings being separate from the sleeve, heating the clamping rings and sleeve to a temperature sufficient to soften the insulating rings, assembling said clamping rings and sleeve with the segments and insulating rings, the clamping rings being placed against the insulating rings and the sleeve located centrally of the assembly, forcing the clamping rings while thus heated against the insulating rings with pressure sufficient to cause the insulating rings to be pressed into the surface irregularities of the segments and to cause the tangs to be bent so that the pressure applied to the tangs will be substantially equalized, and in swedging the sleeve against the separate ring while the rings and sleeve are still at a higher temperature than the segments.

4. The method according to claim 1, in which the sleeve is swedged while maintaining the pressure initially applied between the clamping rings and segments.

5. The method of making a commutator which comprises assembling an annulus of metal segments having anchoring tangs and spaced by insulation, placing against the ends of the tangs rings of insulating material, forcing metal clamping rings against the insulating rings with pressure sufficient to force the insulating rings into the surface irregularities of the segments and to cause the tangs to be bent so as to tend to

equalize the pressure applied to the tangs, and then securing the clamping rings in clamping position by joining them by a part extending through the commutator annulus while maintaining the clamping pressure initially applied between clamping rings and segments.

6. The method of making a commutator which comprises assembling an annulus of metal segments having anchoring tangs and spaced by insulation, placing against the ends of the tangs rings of insulating material, providing metal clamping rings adapted to clamp the tangs and a central, metal sleeve for securing the rings in clamping position, at least one of the rings being separate from the sleeve, assembling said clamping rings and sleeve with the segments and insulating rings, the clamping rings being placed against the insulating rings and the sleeve located centrally of the assembly, forcing the clamping rings against the insulating rings with pressure sufficient to cause the insulating rings to be pressed into the surface irregularities of the segments and to cause the tangs to be bent so as to tend to equalize the pressure applied to the tangs, and in swedging the sleeve against the separate ring while maintaining the pressure initially applied between the clamping rings and segments.

In testimony whereof I hereto affix my signature.

RUSSELL G. JONES.