No. 854,781.

PATENTED MAY 28, 1907.

# L. E. UNDERWOOD.

## COMMUTATOR.

APPLICATION FILED AUG. 9, 1905.

Fig. 1.

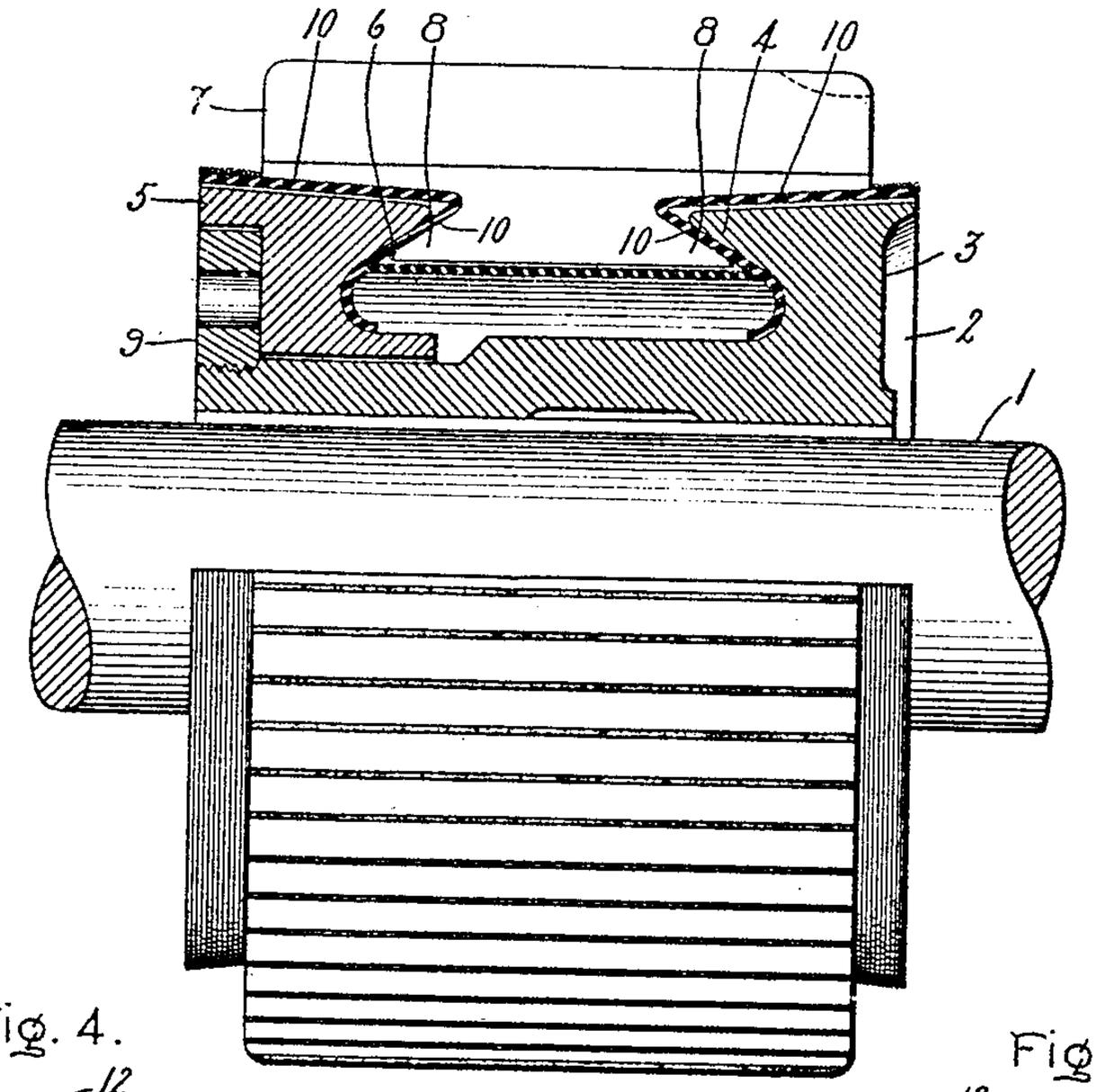



Fig. 4.

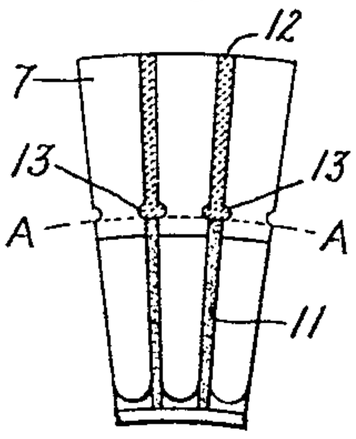



Fig. 2.

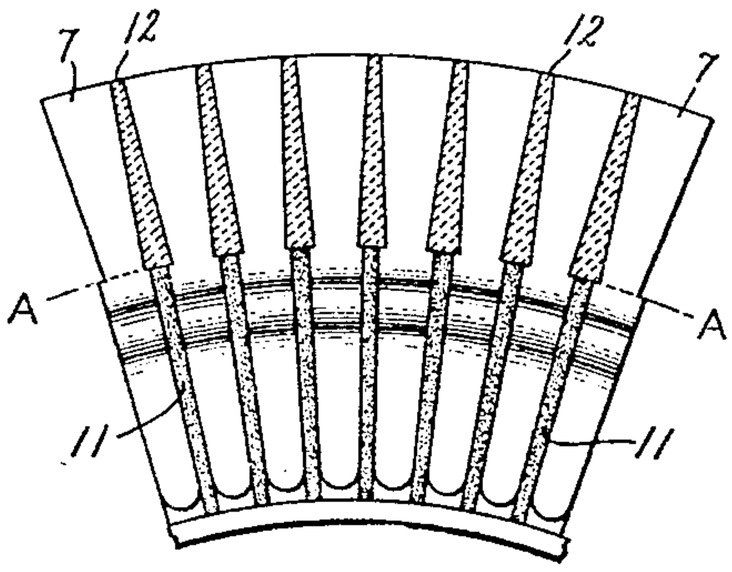



Fig. 3.

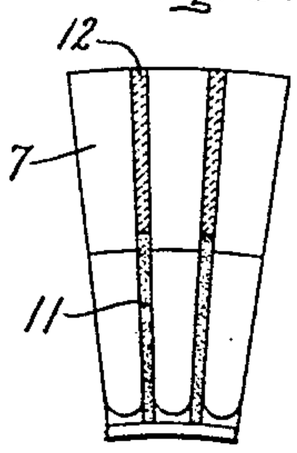
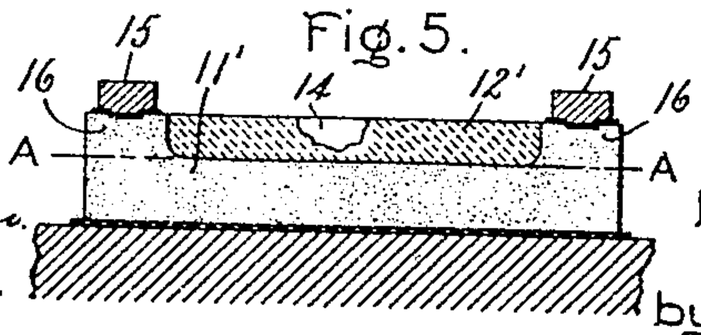



Fig. 5.

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# UNITED STATES PATENT OFFICE.

LOUIS E. UNDERWOOD, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## COMMUTATOR.

No. 854,781. Specification of Letters Patent. Patented May 28, 1907.

Application filed August 9, 1905. Serial No. 273,389.

*To all whom it may concern:*

Be it known that I, LOUIS E. UNDERWOOD, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Commutators, of which the following is a specification.

Heretofore a large proportion of all commutators for dynamo electric machines in general use have been made with sheet mica as the insulating material between adjacent conducting segments. Sheet mica is an excellent insulator, is not affected by moisture, and possesses features of mechanical strength and rigidity which fit it for such use. This material, however, possesses the disadvantage for the purpose in hand, of being comparatively expensive, and the further disadvantage that under many conditions of service, owing to its toughness, it is not worn away by the brushes as rapidly as are the commutator segments proper. This results in the fault known as "high mica" in which the outer edges of the insulation between the segments of a commutator which has been in service for some time project above the surface of the commutator, thereby causing sparking between the commutator and its brushes, and other troubles.

I have found that excellent results may be obtained by the use of insulating material such as sheet mica, or some other and preferably less expensive substance, such as leather board, possessing the proper insulating and physical properties, which may well be tougher than mica, as the means for mechanically separating the contact bars, when such insulation is so arranged and disposed that it does not come into engagement with the brushes in the normal operation of the commutator.

In carrying out my invention I arrange the insulation between an adjacent pair of commutator bars in two portions, one portion separating the outer portions of the conductor bars extending from the outer surface of the commutator to a depth substantially equal to the wearing depth of the commutator bars. This insulation may be formed of plaster of paris, pipe clay, or any other substance possessing suitable insulating properties and sufficient mechanical strength and rigidity to prevent it from becoming displaced under the conditions of service, and which is of such nature that it will be worn away by the brush friction at substantially the same rate as are the conducting commutator bars. The other portion of the insulating material between the conducting bars which may be of sheet mica, leather board, etc., serves as the means principally relied upon to space the bars apart and with the bars to form a rigid structure when the commutator is assembled.

Commutators constructed in this manner possess practically all of the advantages of a commutator built in the ordinary manner with sheet mica insulation, while the insulation which is engaged by the brushes is of such a nature that it will be worn away at substantially the same rate as are the commutator bars. The outer insulating portion prevents the accumulation of dirt, copper dust, etc., between the outer portions of adjacent bars, and insures a smooth brush engaging commutator surface, and consequently noiseless and smooth running operation. The outer insulating portion also prevents moisture, etc., from coming into contact with the inner insulating portions, an important consideration when the inner insulating portions are formed of leather board or other substances which may be affected by moisture.

The features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of my invention, however, reference may be had to the accompanying drawings and descriptive matter in which I have illustrated and described some of the forms in which my invention may be embodied.

Of the drawings, Figure 1 is a side elevation partly in section of a commutator constructed in accordance with my invention; Fig. 2 is a partial end elevation showing a portion of the bars and insulation between them of the commutator shown in Fig. 1; Figs. 3 and 4 are views similar to Fig. 2 illustrating modifications of the bars which may be used in the commutator shown in Fig. 1; and Fig. 5 is an elevation partly in section illustrating the application of my invention to a different type of commutator.

In the construction shown in Figs. 1 and 2, 1 represents the shaft of a dynamo electric

machine upon which is mounted the commutator shell 2. The commutator shell is provided at one end with a flange portion 3 formed with an annular clamping jaw 4. An end member 5 formed with a clamping jaw 6 opposing the jaw 4 is mounted on the opposite end of the shell. The commutator bars or segments 7 which may be formed of copper in the usual manner are provided on their inner edges with integral undercut tenon portions 8 which are gripped between the jaws 4 and 6. The bars 7 are locked in place between the clamping jaws by means of a nut 9 threaded on the commutator shell. Suitable insulation 10 separates the commutator bars from the flange 3 and end member 5.

Insulating material in the form of strips 11 of sheet mica, leather board, or other material possessing proper mechanical insulating properties, separate the portions of the commutator bars within the line A—A in Fig. 2 which represents the surface of the commutator when it is worn down to the stage at which it becomes necessary to provide new bars. In the construction shown in Figs. 1 and 2, opposite sides of the strips 11 are parallel. It will be understood that the strips 11 are substantially similar in outline to the portion of the commutator segments with which they are in contact, each being formed with a tenon similar to the tenons 8.

The spaces between adjacent commutator bars beyond the line A—A are filled with insulating material 12 which may be plaster of paris, a mixture of plaster of paris and alum, pipe clay, or other suitable material as before mentioned. In the construction shown in Figs. 1 and 2, the surface of adjacent commutator bars beyond the line A—A are shaped to form tapered spaces which the insulation 12 fills, the wide edge of each recess being the inner edge. The insulation 12 is ordinarily not put into place until after the tenon portions of the commutator bars 7 and strips 11 have been firmly clamped in position between the annular jaws carried by the end members 3 and 6. After the commutator bars are in place the insulation 12 may be inserted in any suitable manner as by forcing it into place in a suitable press, while the insulating material is in a plastic condition.

While the tapered recess construction for the reception of the insulating material 12 is advantageous as it greatly decreases the liability of the insulation 12 becoming displaced by the operation of the commutator, it is not always necessary to shape the bars in this manner. For instance, adjacent surfaces of adjacent commutator bars may be plane and parallel as shown in Fig. 3 or recesses or grooves 13 may be formed in the sides of the commutator bars at or about the line A—A as shown in Fig. 4. In any case, the liability of the commutator throwing the insulating material 12 out when in service is diminished by roughening the sides of the commutator bars as by a sand blast operation.

In Fig. 5 I have illustrated a construction in which the commutator bars or segments 14 in the form of prisms or bars with parallel edges are secured to their supporting shell by one or more rings 15 which are assembled while hot and shrunk into position. In this construction the strips of insulating material 11′ corresponding to the strips 11 of the construction first described are formed with ears 16 which project above the line A—A beneath the rings 15. In this construction also the spaces between adjacent commutator bars not occupied by the insulating material 11′ is filled by insulation 12′ which may be similar to the insulation 12.

It will be readily apparent to all those skilled in the art that changes may be made in the form of the embodiments of my invention disclosed without departing from the spirit of my invention, and I do not wish the claims hereinafter made to be limited to the particular constructions disclosed more than is made necessary by the state of the art.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The combination with the segments of a commutator, of insulation which is comparatively easily worn away by the commutator engaging brushes between those portions of adjacent segments which are worn away by the brushes during the life of the commutator, and tougher insulation between other portions of said segments.

2. In a commutator, a pair of adjacent commutator bars and insulation between them in two portions, one portion adjacent the brush engaging edges of the bars being formed of material which is readily worn away by the commutator engaging brushes, and the other portion of tougher material.

3. In a commutator, bars or segments each formed with a tenon, supporting jaws between which the tenons are clamped, and insulation between each adjacent pair of bars in two portions, an inner portion of tough material formed with a tenon similar to the tenons on the commutator bars, and an outer portion formed of material which is less tough.

4. In a commutator, a pair of adjacent bars, insulation between them in two portions, one portion adjacent the brush engaging surface of the bars of plaster of paris, and the other portion of tougher material.

5. In a commutator, bars or segments formed with tenons, supporting jaws between which the tenons are clamped, insulation between each pair of adjacent bars in two portions, an inner portion of tough material formed with a tenon similar to the ten-

ons on the commutator bars, and an outer portion formed of material less tough, the portions of adjacent surfaces of adjacent commutator bars between which the outer portion of insulating material is located being provided with means to facilitate the retention of said insulating material.

6. In a commutator, bars or segments formed with tenons, supporting jaws between which the tenons are clamped, insulation between each pair of adjacent bars in two portions, an inner portion of leather board formed with a tenon similar to the tenons on the commutator bars, and an outer portion formed of material less tough.

7. In a commutator, a pair of adjacent conductor bars and a layer of insulation between said bars, said layer being composed of a portion made of plaster-of-paris adjacent the brush engaging surface and an inner portion of leather board.

8. In a commutator, a pair of adjacent conductor bars and a layer of insulation between said bars, said layer consisting of an inner portion and a portion protecting said inner portion arranged adjacent the brush-engaging surface and which is usually worn away by the brushes during the life of the commutator.

In witness whereof, I have hereunto set my hand this seventh day of August, 1905.

LOUIS E. UNDERWOOD.

Witnesses:
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HENRY O. WESTENDARP.