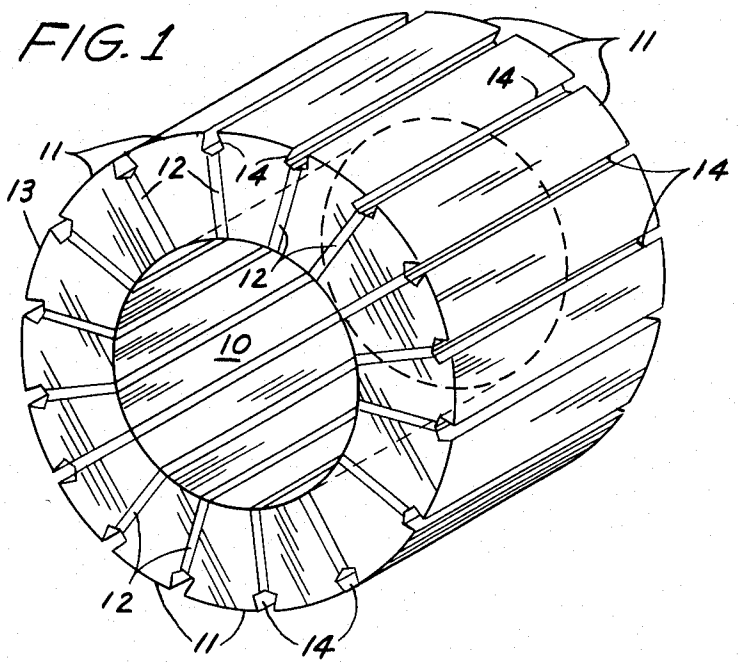
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UNDERCUT COMMUTATOR

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FIG. 1



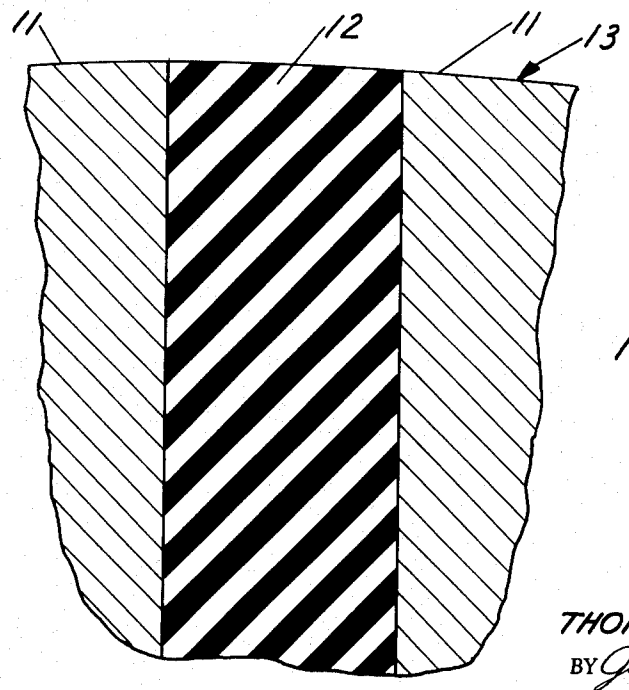


FIG. 2

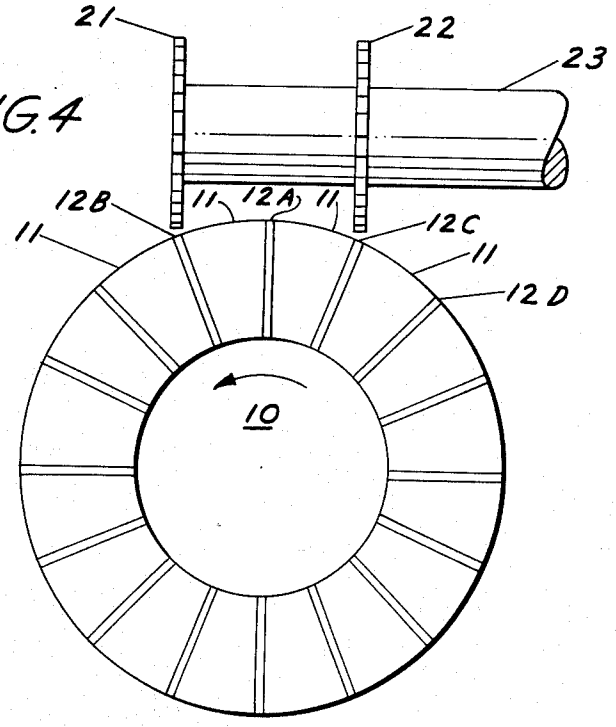
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FIG. 4



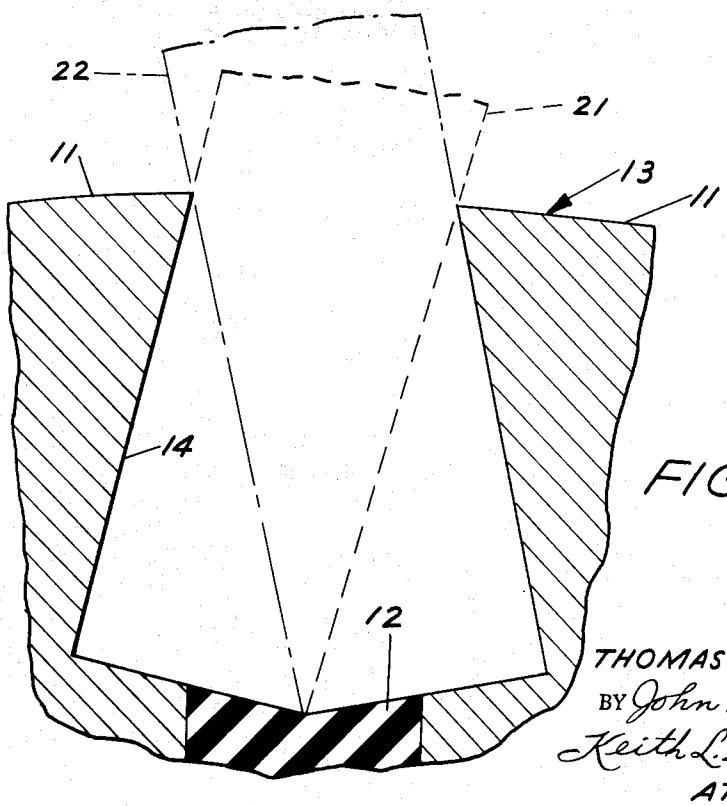


FIG. 3

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UNDERCUT COMMUTATOR

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3 Claims. (Cl. 310—233)

This invention relates to a method of undercutting the insulators of a commutator employed on dynamoelectric machines and to the commutator produced thereby.

In a dynamoelectric machine, it is desirable to use a narrow undercut at the commutator insulator segments to preserve the maximum amount of commutator bar surface in contact with the brushes of the machine. A narrow undercut is also effective in reducing the magnitude of brush noise. It is very difficult, however, to utilize a narrow undecut and still remove all of the insulator segment at the undercut. The reason for this difficulty is that commutator bars are usually not perfectly formed, and as a result the commutator segments may not be properly positioned angularly within the commutator. Also, the commutator bars and insulator segments are often poorly indexed relative to one another, even in premium commutators. This means that the circumferential dimension between the insulator segments may not be uniform. In mass production techniques, therefore, it is difficult to employ machines that utilize a narow undercut and will at the same time remove all of the insulator segments at the undercuts. This results in poor commutation, poor performance, poor durability and poor brush life, and it also results in brush noise.

The present invention is directed to a method of obviating the above-mentioned difficulties and to the commutator formed thereby. The method of the invention entails undercutting the insulator segment in such a manner as to produce a dovetail slot. The slot is narrow at the commutator surface and widens at the deepest portion of the cut toward the center of the commutator. This provides the benefit of a narrow slot at the surface of the commutator so that the commutator has low brush noise characteristics and has maximum commutator bar surface in contact with the brushes of the dynamoelectric machine. It also provides for the wide cut necessary to free the slot of all the insulating material.

The dovetail slot may be achieved by means of a circular milling cutter that is inclined at a slight angle with respect to the insulator segment. A first cut is then taken along the length of the insulator segment. A circular milling cutter is then inclined at a similar angle in the opposite direction with respect to the insulator segment and a second cut is taken. This produces a dovetail slot at each insulator segment.

In the preferred manner of performing the method of the invention, the dovetail slots may be formed by the use of two circular milling cutters that are mounted on a common shaft or arbor. One circular milling cutter will make all of the cuts at the insulator segments inclined in one direction and the other circular milling cutter will make all of the cuts inclined in the opposite direction. After the two circular milling cutters have made a pair of cuts into a set of insulator segments, the commutator is rotated about its axis to bring the next set of insulator segments into proper cutting relationship with these circular milling cutters. Mounting the two circular milling cutters on a common shaft will assist greatly in holding the exact location of the second cut at each of the insulator segments relative to the first cut at each of the insulator segments.

An object of the invention is the provision of a method for undercutting the insulator segments on commutators that will remove all of the insulator at the undercut area

and that will leave a maximum amount of commutator bar surface in contact with the brushes of the dynamoelectric machine.

Another object of the invention is to provide a method for undercutting the insulator segments of commutators that forms an undercut slot in a commutator at each insulator segment that is narrow at the surface of the commutator and that is wide at the portion of the slot positioned nearest the center of the commutator.

A further object of the invention is the provision of a commutator that provides a maximum amount of commutator bar surface in contact with the brushes of a dynamoelectric machine and that simultaneously has all of the insulating material of the insulator segments removed in the area of the undercut slots of the insulator segments.

Other objects and attendant advantages of the invention will become more apparent as the specification is considered in connection with the attached drawings in which:

FIGURE 1 is a perspective view of the commutator of the present invention;

FIGURE 2 is an enlarged sectional view of a portion of the commutator prior to undercutting showing adjacent conductive bars or segments separated by an insulator segment;

FIGURE 3 is a view similar to FIGURE 2 and showing how the commutator is undercut, and

FIGURE 4 is a partial schematic view of a means for carrying out the methods of the invention.

Referring now to FIGURE 1, there is shown the commutator **10** of the present invention that is formed of a plurality of commutator bars or conductive segments **11** that are separated by a plurality of insulator segments **12**. As conventional in commutator structures, the conductive segments **11** are formed of copper bars while the insulator segments **12** are formed of a mica base insulating material. The commutator is formed so that the alternating conductive bars or segments **11** and insulator segments **12** form a cylindrical array in which the insulator segments **12** extend radially inwardly from the surface **13** of the commutator toward the center of the cylindrical array. The commutator **10** is undercut at each of the insulator segments **12** to form a dovetail slot **14** that extends through the length of the commutator that is adapted to contact an electrical contact brush. This dovetail slot is narrow at the surface **13** of the commutator and is wider at the bottom thereof toward the center of the commutator **10**. This type of slot or undercut has the advantages pointed out in the introductory portion of the specification. It provides a maximum amount of commutator segments or bars in contact with the electrical brushes of the dynamoelectric machine and it insures that all of the insulating material is removed in the area of the undercut.

Referring now to FIGURES 2 and 3, the method of undercutting the insulator segments **12** of the commutator **10** and forming the dovetail slots **14** will now be described. The method comprises making a first cut into the commutator at the insulator segment **13** that is inclined in one direction with respect to the insulator segment. This first cut is directed into the conductive segment **11** positioned on one side of the insulator segment. A second cut is then made at the insulator segment **12** in a direction that is inclined to the insulator segment in a direction opposite to the first cut. This second cut is directed into the conductive segment **11** positioned on the other side of the insulator segment **12**. It can be appreciated that these two cuts form the dovetail slot **14** at the insulator segment and that the narrow portion of the dovetail slot at the surface **13** of the commutator spans or is wider than the mica segment at this position. Al-

though the method is not so limited, it is preferred that the two inclined cuts be made of the same width (wider than the insulator segment **12**) and be in the same position on the surface **13** of the commutator **10** as shown in FIGURES 2 and 3. It is to be understood that the first and second cuts described above extend through the length of the commutator that may come into contact with the electrical brushes of the dynamoelectric machine.

A practical means for making the dovetail slots **14** in the commutator **10** and for carrying out the method of the invention is shown in FIGURE 4. A first circular milling cutter **21** and a second circular milling cutter **22** are mounted on a common rotatable shaft **23**. This shaft is adapted for movement downwardly, as shown in FIGURE 4, to make the first and second cuts described above and for movement in a direction perpendicular to the plane of the drawings so that the cuts are made through a desired length of the commutator. The circular milling cutter **21** makes the first cut, as described above, and the circular milling cutter **22** makes the second cut, as described above, since the circular milling cutter **22** is inclined at an angle with respect to the conductive segments undergoing cutting opposite to the angle of the circular milling cutter **21**. In practice, the commutator assembly is rotated through one conductive segment **11** after the circular milling cutters **21** and **22** each make a cut. It can be seen that the dovetail slot **14** will be completed at each of the insulator segments **12** when the circular milling cutter **21** has made a first cut at each of the insulator segments **12** and the second circular milling cutter **22** has made a second cut at each of the insulator segments **12**.

It can be readily appreciated by an inspection of FIGURE 4 that the circular milling cutters **21** and **22** are rotatable about an axis that is substantially normal to the direction of the radially extending insulator segment **12A** that is positioned between the circular milling cutters **21** and **22** and the insulator segments **12B** and **12C** that are being cut by these cutters.

Considered in a broader aspect, it can be appreciated that the first cut at an insulator segment **12** is made by a circular milling cutter that is rotatable about an axis that is substantially normal to the adjacent insulator segment positioned on one side of the insulator segment undergoing cutting. The second cut is made by a milling cutter that is rotatable about an axis that is substantially normal to the adjacent insulator segment positioned on the other side of the insulator segment undergoing cutting. This can be appreciated by an inspection of FIGURE 4 and by considering that the commutator **10** is rotated or indexed in a counterclockwise direction.

As viewed in FIGURE 4, the insulator segment **12C** is being cut by the circular milling cutter **22**. The circular milling cutter **22** is rotatable about an axis that is substantially normal to the insulator segment **12A** positioned to the left of the insulator segment **12C**. After this cutting operation is performed, the second cut in the insulator segment **12C** will be made by the circular milling cutter **21** after the commutator assembly has been rotated or indexed counterclockwise to bring the insulator segment **12C** under the circular milling cutter **21**. In this position, the circular milling cutter **21** is rotatable about an axis that is substantially normal to the insulator segment **12D** that is now positioned between the circular milling cutters **21** and **22**. The insulator segment **12D** is the insulator segment adjacent the insulator segment **12C** and positioned on the other side thereof from the insulator segment **12A**. From this description of the method of cutting the dovetail slots **14** at the insulator segments **12** of the commutator **10** to undercut the commutator, it can be seen that the commutator assembly may remain stationary and that both circular milling cutters **21** and **22** may be revolved about the commutator assembly **10** to make the cuts in the directions described above. It can also be appreciated that a single milling cutter could be employed to cut the dovetail slots.

The advantage of using two circular milling cutters on a common shaft is that this assembly will assist greatly in holding the exact location of the second cut relative to the first cut.

The present invention thus provides a method for undercutting the insulator segments of a commutator in which the undercut is narrow at the surface to preserve the maximum amount of conductive bars or segments in contact with the brushes and is wider as the undercut deepens to insure that all the insulator in the area of the undercut is removed.

It will be understood that the invention is not to be limited to the exact construction shown and described, but that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A commutator for a dynamoelectric machine comprising a first conductive segment, a second conductive segment, an insulator separating said first and said second conductive segments, said commutator including a dovetail slot positioned in the surface of said commutator at said insulator with the narrow portion of said dovetail slot positioned at the surface of said commutator and being of sufficient width that none of the insulator segment is present at the surface of said commutator.

2. A commutator for a dynamoelectric machine comprising a first conductive segment, a second conductive segment, an insulator segment positioned between said first conductive segment and said second conductive segment, a dovetail slot positioned in said commutator at said insulator segment, the narrow portion of said dovetail slot being positioned at the surface of said commutator and being wider than and spanning said insulator segment, said dovetail slot extending over the length of the commutator adapted to be contacted by an electrical contact brush.

3. A commutator for a dynamoelectric machine comprising a cylindrical array of alternate copper commutator bars and insulator segments, each of said copper commutator bars being insulated from adjacent bars by an insulator segment, said insulator segments lying in radial planes that extend from the surface of said commutator toward the center of said cylindrical array, a plurality of dovetail slots positioned in said commutator, each of said dovetail slots extending radially inwardly from the surface of said commutator toward the center of said cylindrical array, a dovetail slot being positioned at each of said insulator segments, with the narrow portion of said dovetail slots spanning said insulator segment at the surface of said commutator.

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