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COMMUTATOR AND METHOD OF ATTACHING SAME

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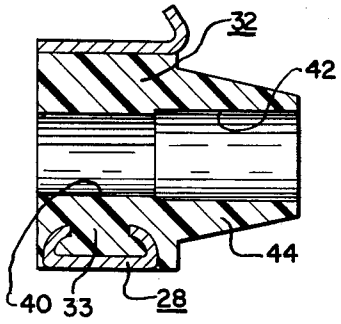


Fig. 2

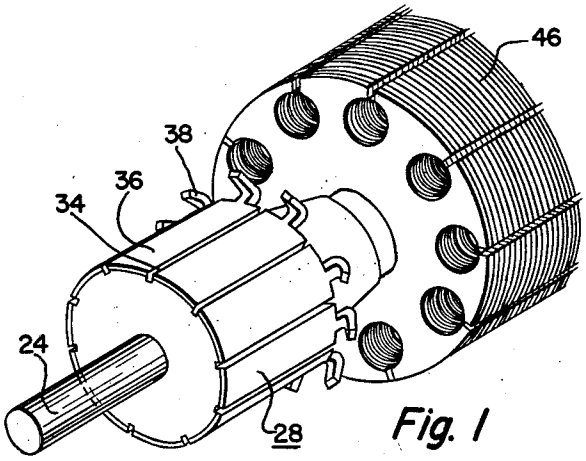


Fig. 1



Fig. 3

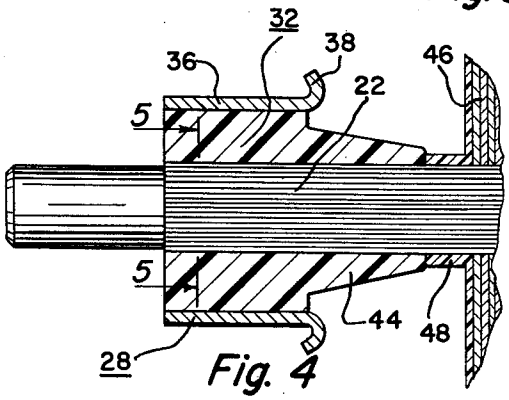


Fig. 4

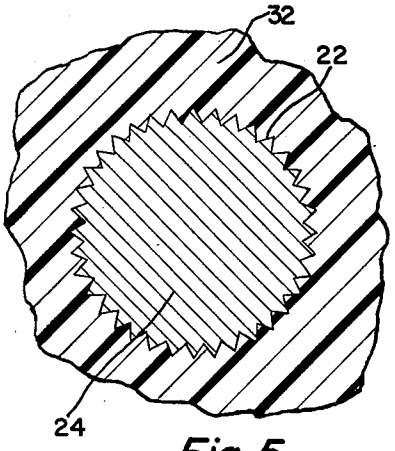


Fig. 5

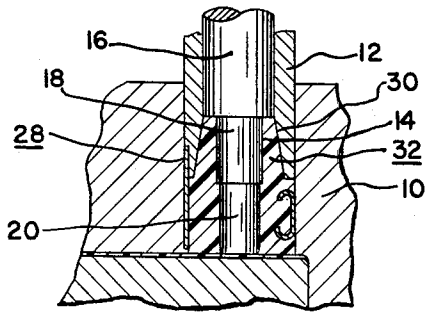


Fig. 6

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COMMUTATOR AND METHOD OF ATTACHING SAME

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This invention pertains to commutators, and particularly to an improved commutator construction and a method of attaching the same to an armature shaft.

It is well recognized that commutators which include core bodies of molded heat resistant phenolic can be easily fractured when forced onto a motor shaft with a press fit. Thus, numerous small motors have been made in the past wherein a bushing of soft conductive metal such as aluminum lines the hole in the core and is formed as an integral part of the commutator assembly during the molding operation. The aluminum bushings can be readily press fitted onto a knurled motor shaft without fracturing the phenolic insulating material. However, the use of bushings increases the cost of the commutators, and hence a commutator design wherein the bushing is eliminated will result in a substantial cost saving. The present invention relates to a commutator construction and method of attaching the same to a shaft, wherein a liner for the hole in the core is eliminated. Accordingly, among our objects are the provision of a frangible body having a stepped bore therethrough; the further provision of a commutator including a core of phenolic resin having a commutator shell and a frusto conical portion with a stepped diameter bore therethrough; the further provision of a method of attaching a commutator of the aforesaid type onto a knurled shaft; and the still further provision of a method of attaching a frangible body onto a knurled shaft by hot flowing the molded resin.

The aforementioned and other objects are accomplished in the present invention by curing the thermosetting phenolic resin and heating the shaft to which the frangible article is to be attached prior to press fitting the article thereon. Specifically, the commutator includes a skeleton cylindrical commutator shell of conductive metal which forms a part of the retaining wall of the mold cavity and is mechanically interlocked with the insulative core body of the commutator. The core body also includes a frusto conical spacer portion, and is formed with a stepped diameter throughbore, the larger diameter portion of the bore being encompassed by the frusto conical insulating portion. The core is cured under heat and pressure in the mold, and is thereafter removed from the mold and placed in an oven for eighteen hours at 250° F., after which it is allowed to cool at room temperature. Thereafter, the shell is cut into the desired number of segments by a broaching operation and the segments are formed to receive the ends of the armature windings.

The armature shaft with which the commutator is to be assembled is formed with a knurled section. The armature laminations are first assembled onto the shaft, after which a fibrous or plastic end lamina is placed over the shaft and then heated to between 600 and 700° F., after which the commutator is press fitted onto the shaft. The larger diameter bore beneath the frusto conical insulating portion is of a diameter at least equal to the diameter of the knurled section which retains the armature laminations. Moreover, the bore encompassed by the armature shell is of lesser diameter than the diameter of the knurled section such that when the commutator is press fitted onto the shaft, the phenolic resin will hot flow and upon cooling the commutator will be rigidly connected to the shaft. By heating the shaft prior to fitting the commutator thereon, fracture of the phenolic core is prevented.

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

In the drawing:

FIGURE 1 is a fragmentary perspective view of an armature including a commutator constructed and assembled therewith in accordance with the present invention.

FIGURE 2 is a longitudinal sectional view of a commutator constructed according to the present invention.

FIGURE 3 is a fragmentary view, in elevation, of an armature shaft adapted for use with the commutator of the present invention.

FIGURE 4 is a fragmentary, longitudinal sectional view showing the commutator attached to the shaft.

FIGURE 5 is an enlarged sectional view taken along line 5—5 of FIGURE 4.

FIGURE 6 depicts the manner in which the commutator cores are molded.

With particular reference to FIGURE 6, commutators constructed according to the present invention are made in a mold which includes a hollow die **10** having a vertically movable plunger **12** with a hole **14** which slidably receives a vertical mandrel **16** having portions **18** and **20** of different diameters. The larger diameter portion **18** is at least equal to or slightly larger than the diameter of the knurled portion **22** of an armature shaft **24** as seen in FIGURE 3.

The mandrel **16** has a flange **26** which fills the bottom end of the mold cavity in the die **10** during the molding process. The flange **26** is used to eject the finished commutator after completion of the molding process. A skeleton cylindrical commutator shell **28** of conductive metal forms a part of the retaining wall of the mold cavity, the shell being inserted into the mold cavity prior to adding a powered condensation product of thermosetting resin, such as phenolic. The plunger **12** is formed with a frusto conical recess **30** such that after the mold cavity has been filled with the powdered condensation product, the plunger **12** is forced downwardly to the position shown in FIGURE 6. With the mold in this position, the entire contents are heated under pressure and the condensation product melts and conforms to the faces of the mold cavity so as to form a commutator core **32**. The core is cured within the mold, and during this operation the shell **28** becomes interlocked with the core **32**. After the commutators are removed from the mold they are placed in an oven, not shown, which is heated to 250+ F. The commutators remain in the oven for a period of eighteen hours, after which they are removed and allowed to cool at room temperature. Thereafter, the desired number of slots **34**, as seen in FIGURE 1, are simultaneously cut in the shell **28** by a broaching operation to form commutator segments **36**. In the disclosed embodiment, the end portions of the segments **36** have hooks **38** formed thereon around which the one end turn of each armature winding is connected.

The commutator, as shown in FIGURE 2, includes a body portion **33** having a smaller diameter bore **40** disposed within the frusto conical insulating portion **44**. As aforementioned, the diameter of the bore **42** is at least equal to, but preferably greater than, the diameter of the knurled sections **22** on the shaft **24**. However, the diameter of the bore **40** is less than the diameter of the knurled sections **22** on the shaft **24**. The shaft **24** shown in FIGURE 3 has two axially spaced knurled sections, the larger section of which is adapted to have press fitted thereon armature laminae **46**. The diameter of the knurled sections **22** may be on the order of .387" whereas the diam-

eter of the bore **42** is at least .388". However, the diameter of the bore **42** is no greater than .398".

In assembling the armature, the laminae **46** and **48** are press fitted onto the longer of the knurled sections on the shaft **24**. Thereafter, the shaft is heated to within the range of 600 to 700° F. at the commutator end only. Thereafter, the commutator is press fitted onto the shaft. The knurled section **22** does not bite into the frusto conical portion **44** since it is of larger diameter than the knurls. However, the knurls do bite into the portion of the body beneath the shell **28** since the bore **40** is of lesser diameter than the knurls **22**. By heating the shaft to between 600 and 700° F., the cured phenolic hot flows thereby preventing fracturing thereof so that when the assembly cools, the commutator will be rigidly connected to the shaft **24**. As seen in FIGURE 5, the knurled section **22** bites into the core **32** so as to rigidly interconnect the commutator and the shaft **24**.

Obviously, application of the principles of this invention can be applied to the attachment of frangible articles other than commutators to knurled shafts.

While the embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted.

What is claimed is as follows:

1. The method of securing a molded commutator to a knurled shaft, which comprises molding the body of said commutator from a cured, thermosetting, synthetic resin with a hole having a diameter slightly less than the diameter of the knurled shaft, heating the knurled shaft, and thereafter forcing the commutator onto the knurled shaft to hot flow the synthetic resin without fracturing said body.

2. The method of securing a molded article to a knurled member, comprising molding the body of said article from a thermosetting, synthetic resin with a hole having a diameter slightly less than the diameter of the knurled member, curing said body of thermosetting resin under heat and pressure, heating the knurled member to between 600 and 700° F., and thereafter forcing the article onto the knurled member to hot flow the synthetic resin without fracturing said body.

3. The method of securing a molded commutator to a knurled shaft, which compirses molding the body of said commutator from a thermosetting, synthetic resin with a hole having a diameter slightly less than the diameter of the knurled shaft, curing said body under heat and pressure, heating the knurled shaft to between 600 and 700° F., and thereafter forcing the commutator onto the knurled shaft to hot flow the synthetic resin without fracturing said body.

4. The method of securing a molded commutator to a knurled shaft, which comprises molding the body of said commutator from a thermosetting, synthetic resin with a hole having a diameter slightly less than the diameter of the knurled shaft, curing said thermosetting synthetic resin under the heat and pressure, placing said commutator in an oven heated to at least 250° F. and allowing said commutator to remain in said oven for at least eighteen hours, removing said commutator from said oven and allowing it to cool at room temperature, heating the knurled shaft to between 600 and 700° F., and thereafter forcing the commutator onto he knurled shaft to hot flow the synthetic resin without fracturing said body.

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