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(71) Demandeur/Applicant:
ULTRA-CORE LTD., GB

(72) Inventeur/Inventor:
MORGAN, STEVEN JOHN, GB

(74) Agent: MCFADDEN, FINCHAM

(54) Titre : NOYAUX
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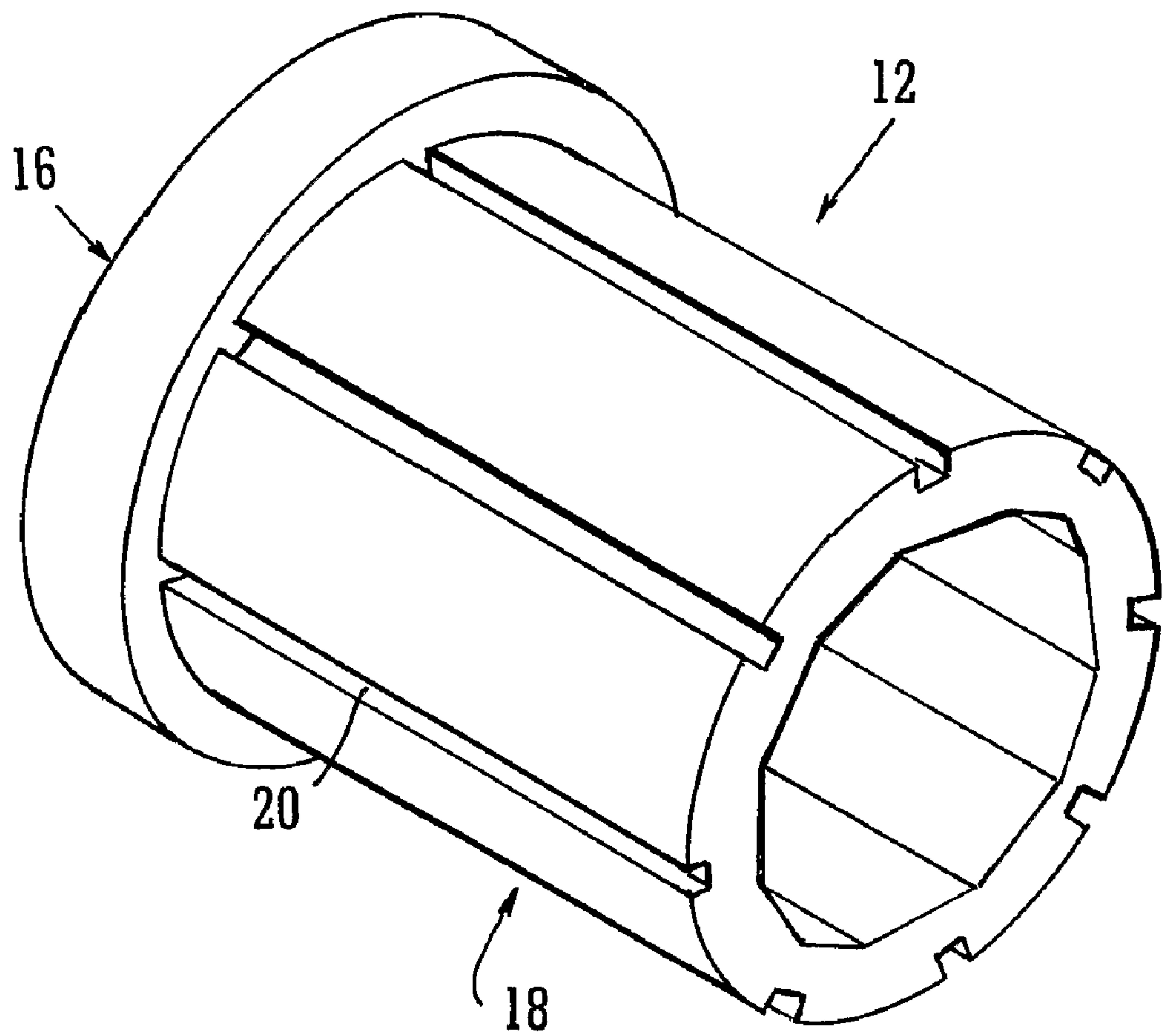

(57) Abrégé/Abstract:
An insert (12) that has particular use in construction of a web-winding core with a composite body (10). The insert (12) has an outer surface that can be inserted within a core body, and an inner surface that can be engaged to be driven by a chuck. The core

(57) Abrégé(suite)/Abstract(continued):
includes a restraining structure that can resist transmission of forces applied by the chuck to the insert to a core body. The insert is preferably formed from a resilient, self-healing polymer that can be repeatedly gripped by a drive chuck that is highly resistant to wear and damage.

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(71) Applicant *(for all designated States except US)*: DEVA COMPOSITES LTD [GB/GB]; 292 Parkstone Road, Parkstone, Poole, Dorset BH14 0RS (GB).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: MORGAN, Steven, John [GB/GB]; 40 King Street, Chester CH1 2AG (GB).

(74) Agent: HAMILTON, Alistair; Ty Eurgain, Cefn Eurgain Lane, Rhosesmor, Mold, Flintshire CH7 6PG (GB).

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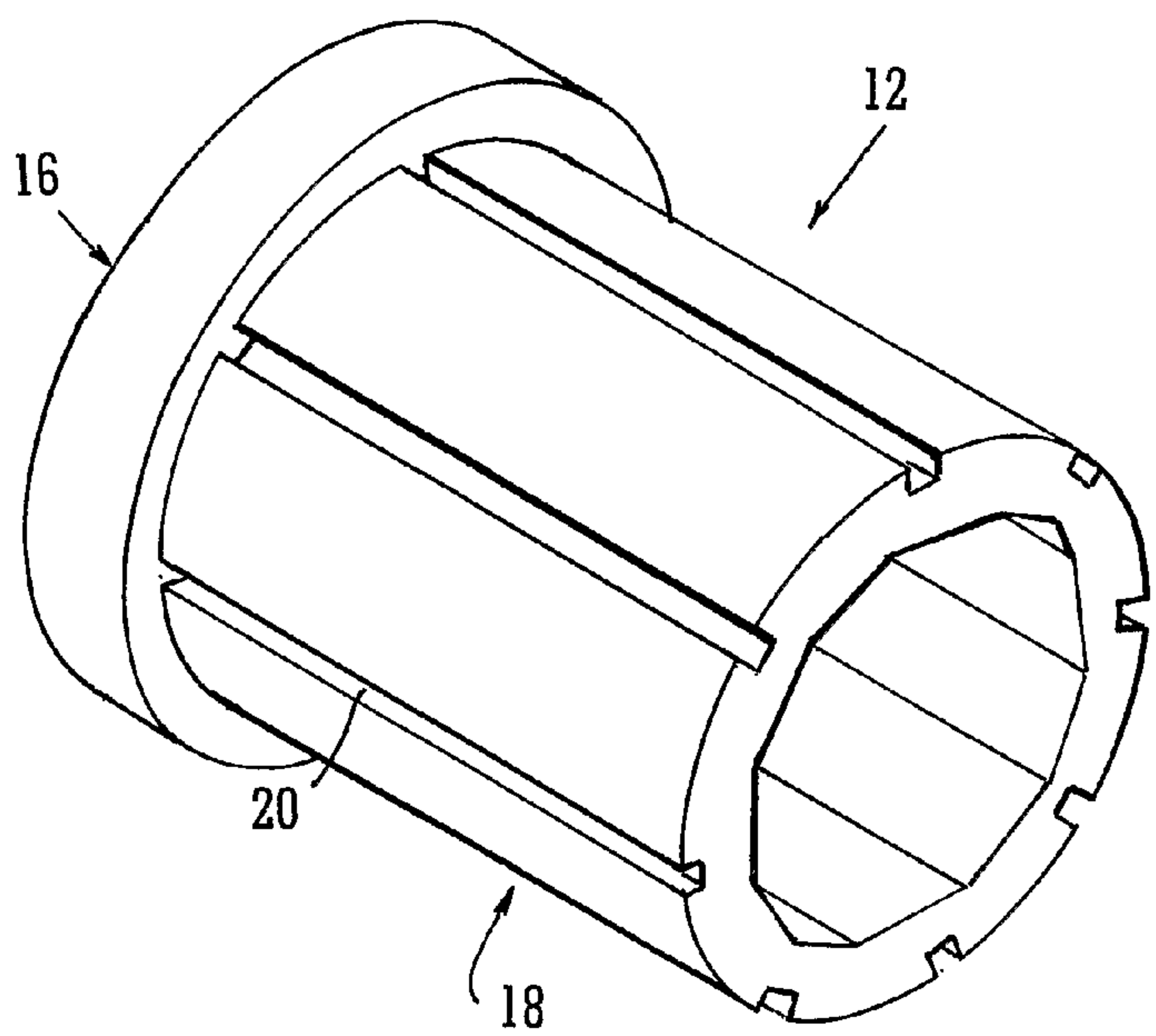

(57) Abstract: An insert (12) that has particular use in construction of a web-winding core with a composite body (10). The insert (12) has an outer surface that can be inserted within a core body, and an inner surface that can be engaged to be driven by a chuck. The core includes a restraining structure that can resist transmission of forces applied by the chuck to the insert to a core body. The insert is preferably formed from a resilient, self-healing polymer that can be repeatedly gripped by a drive chuck that is highly resistant to wear and damage.

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Cores

This invention relates to cores for use in forming wound rolls of elongate web material, and, more specifically, to inserts for transferring drive torque to a web-winding core formed from composite material.

Web material, including newsprint, fabric, metal foil amongst many others, is often formed, after manufacture, into wound rolls, which are suitable for mechanical handling. Such rolls are formed by winding the web material onto a core. Each roll may contain many hundreds of meters of wound web, and may be several meters in width. Traditionally, cores have been made of paper-based material.

In some cases, such as feeding paper to printing presses or during high-speed paper manufacture, the web is wound onto or drawn from the roll at high speed, in the order of tens of meters per second. If the feed of material is at a constant linear speed, the rotational speed of the roll increases is an inverse function of its outer diameter. Therefore, during withdrawal of web from the roll, assuming that the linear speed of removal remains constant, the rotational speed of the roll will increase over time. Moreover, as the amount of web within the roll decreases, the contribution made by the web material to the structural stiffness of the roll entire decreases, structural integrity of the roll becoming more dependent upon the strength of the core. One consequence of this is that operators of machinery that remove web from the roll tend to stop using a roll and change to a new one while there is a substantial quantity of web remaining on the core. This is done out of caution, to avoid the risk of whirling or excessive vibration of the roll as its rotational speed increases and stiffness decreases. Approximately 100 m of the material supplied on a roll of 1400 m to 1700m can thereby be wasted.

To mitigate this problem, the present applicant has proposed use of a core of composite material, aluminium, or paper-based material that has sufficient stiffness to remain stable until substantially all of the material has been removed from the roll. To be commercially acceptable, a composite core must be compatible with existing roll-handling apparatus. Most especially, the composite cores must be compatible with the chucks that are used to grip the traditional cardboard cores and transmit drive torque to them. Such chucks typically have several expanding jaws. Therefore, inserts are provided at each end of the roll that can be gripped by a chuck. These have proven to be successful in use.

When used with a typical conventional cardboard core, ends of the jaws penetrate the material of the core to provide a solid engagement with it that is capable of transmitting the required torque between the chuck and the core. If the insert were formed from polymeric compounds of low hardness, a sufficient frictional grip to the a chuck can be generally achieved. This is so because, as the jaws of the chuck are expanded to grip the material, the chuck jaws embed themselves into the polymer and deform it. By suitable selection of the polymer, this deformation can be almost entirely elastic so that the insert would quickly self heal and revert to its initial undeflected and unstressed profile and dimensions when the expanding forces are relaxed. In other words, the material has advantageously low deflection 'memory' and hysterisis advantageously allowing the core to be reused many times

After testing of composite cores, it has been found that, in extreme conditions, the expanding action of the chuck can cause damage to the material of the core, potentially causing it to burst. Since composite cores are intended to be capable of multiple re-use, such damage is most preferably to be avoided. Simply making the core from a material that is incapable of substantial deformation is not a solution, because a conventional chuck would fail to achieve sufficient grip on the core to transmit the required drive torque to it.

An aim of this invention is to provide an improvement that can be applied to a core to enable self healing and reduce or avoid such damage and increase grip.

From a first aspect, this invention provides an insert for a core, the insert having an outer surface that can be inserted within a core body, an inner surface (within a bore of the insert) that can be engaged to be driven by a chuck, the core including a restraining structure that can contain forces applied by the chuck to the insert to a core body.

The insert serves to isolate the composite material from the gripping forces of the chuck. This allows a user of the core to treat it in much the same way as a conventional core, without causing damage to the composite material of the core body.

Most typical embodiments of the insert are formed as mouldings of polymeric material. Such embodiments may be co-mouldings or multi-shot mouldings of two or more polymeric material. In the latter case, the moulding may be formed, in the region of the inner surface, of a relatively soft material of low elastic modulus, and the restraining structure is constituted by a region of relatively hard material of high elastic modulus.

Further embodiments may be formed from a moulding of at least one polymeric material within which reinforcing elements are provided. Such reinforcing elements may comprise fibres of high elastic modulus embedded within the moulding or surrounding the moulding. Alternatively or additionally they may include a sleeve or bands of solid material such as metal embedded within the moulding.

Alternative moulded embodiments may be formed of a single polymeric material of high elastic modulus. Such an embodiment is inherently capable of resisting the forces applied to it by the chuck. In order that the chuck can achieve a sufficiently strong grip upon the insert, formations are provided in the inner surface that can be engaged by components of the chuck. For example, the inner surface may have a cross-sectional shape that is a polygon, preferably a convex polygon, components of the chuck engaging with vertices of the polygon. (The vertices extending axially along the length of the insert. The polygon advantageously has vertices that are, in number, an integral multiple of the number of components of a chuck that will engage with it. This ensures that each component of the chuck can occupy a respective vertex and that the insert will be properly centred on the chuck.

Several or all of the above alternative configurations may be combined to provide further embodiments of the invention. As an example, an embodiment in which the restraining structure includes a metal hoop may be formed as a co-moulding in order to place high-modulus material in the region of the insert that will engage with the core body.

From a second aspect, this invention provides a core having a tubular core body, and a respective insert according to the first aspect of the invention disposed towards opposite ends of the core body.

In typical embodiments, the core body is formed as a composite material. For example, it may be formed from fibre-reinforced resin.

Embodiments of the invention will now be described in detail, by way of example, and with reference to the accompanying drawings, in which:

Figures 1, 2 and 3 are side, end and end views of a core insert being a first embodiment of the invention;

Figure 4 is a perspective view of a core insert being a second embodiment of the invention; and

Figure 5 is a perspective view of part of a core being suitable for use with an insert embodying the invention.

The embodiment comprises a cylindrical core body 10 of fibre reinforced composite material and two inserts 12, just one being shown. The inserts are disposed at opposite ends of the body 10. The core includes reinforcing fibres disposed substantially perpendicular to the longitudinal axis of the core and further reinforcing fibres disposed at at least one angle other than 90° to the longitudinal axis of the core. The fibres may comprise glass, carbon, aromatic polyamide such as Aramid and/or metallic fibres. The wall of the core body may comprise layers including respective different types of fibre. The construction of one example of a suitable core body has already been described in UK patent application No. 0516073.4 and will not be described further here. The invention also has application to cores that include bodies of other construction where there is a potential problem arising from the interaction between the core and a chuck.

The core body 10 comprises a generally cylindrical hollow body that has cylindrical inner and outer surfaces. Within the core body 10, longitudinal ribs 14 are formed, in this embodiment, projecting into the hollow within the core and extending longitudinally from each end of the core. An axial bore extends through the core body 10.

The insert 12 is formed as a rotationally symmetrical body of self-healing polymeric material. The insert has a head portion 16 and a tail portion 18 disposed coaxially. The head portion 16 has a cylindrical outer surface that is substantially the same diameter as the outer surface of the core 10 body, and extends longitudinally beyond the ends of the body 10. The head portion 16 thus protects the ends of the core body from damage that might arise, for example, by dropping the core, since the insert 12 is more resilient than the body 10. The tail portion 18 has an outer diameter that is substantially the same as the inner diameter of the core 10 body, and has a plurality of axial grooves 20. The diameter of the tail portion 18 and the size and position of the grooves 20 are such that the tail portion 18 is a close sliding fit within the core body 10, with each rib 14 entering a corresponding groove 20. Additional grooves are provided in some embodiments to accommodate other items, such as RFID antennas or other items. Thus, the core body 10 and insert 12 are constrained to rotate together. A fastener[s] (not shown) may be passed radially through the core body 10 to enter the material of the insert 12 to secure the insert axially in place. Alternatively or additionally, the insert 12 may be secured by adhesive.

The head portion 16, being of the same diameter as the core body 10, has an outer surface that forms a substantially continuous surface with the outer surface of the core body 10. This ensures compatibility of the core with existing apparatus that is intended for use with a conventional core of continuous diameter. Since the head portion 16 abuts an end surface of the core body 10, it serves to protect that end surface. The end surface of the core as a whole is formed by an end surface 22 of the head portion 16, which can be moulded or machined to a suitable shape and finish.

The insert can be formed by one or more of machining and moulding, including co-moulding or two-shot moulding, as required.

The characteristics of the various embodiments will now be described.

In the first embodiment, the core insert is principally formed from a self healing polymeric material to allow multiple reuse and high grip. The core insert is principally formed from a soft polymeric material and localised reinforcement is introduced to resist expansive deformation under the action of the jaws of the chuck.

One manner in which the required reinforcement in the insert can be achieved is through introduction of local reinforcement into an insert formed primarily from soft polymeric material that is suitable to be gripped by the chuck. For example, as shown in Figures 1 and 2, a sleeve 30 of high-modulus material is introduced into the insert during manufacture. The sleeve is coaxial with the bore of the insert 12. The bore can be formed to have substantially the same diameter as that of a conventional core, and the jaws of the chuck can penetrate into the material to provide the required grip. Material radially inwardly of the sleeve can be deflected by the chuck as required to achieve adequate frictional coupling between the sleeve 12 and the chuck. However, the sleeve 30 substantially prevents deflection of material radially outwardly of the sleeve 30, so that radial loads are substantially prevented from being transmitted to the core 10.

The sleeve 30 can be formed in a variety of ways. For example, it may be a simple metal tube moulded into the insert 12. This is a low-cost approach, but can, under conditions, cause weakness within the moulding of the insert 12. This disadvantage can be mitigated by use of a perforated sleeve 30, which allows the material of the insert 12 to flow through the perforations during moulding so promoting the integrity of the moulding as a whole. Likewise, this could be achieved by use of several coaxial, axially-spaced rings. Alternatively, the reinforcement may be formed from many high modulus materials, such as reinforcement using inorganic, organic or metallic fibres or high-modulus polymers. The reinforcement could be either integrally inserted within the insert profile during manufacture or subsequently fitted externally to the insert 12, for example, as a band surrounding it.

The embodiment of Figures 3 includes materials of different properties at different locations. A soft polymeric material forms that part of the body which surrounds the bore. The bore can be formed to have substantially the same diameter as that of a conventional core, and the jaws of the chuck can penetrate into the material to provide the required grip whilst advantageously self healing to allow multiple reuse.. This soft material is surrounded by material that is substantially harder and therefore more resistant to deflection. This serves to resist the forces exerted by the chuck and ensures that the outer diameter of the insert remains substantially unchanged, so preventing damage to the core. Such an insert can be formed as a co-moulding or a two-shot moulding. The layers may be either discrete or progressively blended in properties. By co-moulding compatible polymers a continuous bond between discrete layers or throughout the blended material wall is ensured. In addition, the tail portion 18 in the region of the grooves 20 may also be formed by a hard material so as to be more effective in transmission of torque between the insert 12 and the core body 10.

An alternative means for increasing the amount of grip that the chuck can achieve upon the core is to provide an insert that is shaped to accommodate the jaws of the chuck such that it can provide a sufficiently secure interaction with the chuck while undergoing deflection that is limited to such an extent that no damage to the core 10 will occur. This embodiment has the advantage that the insert can be formed as a simple moulding of a single polymeric material.

Most chucks are of 2, 3, 4, or 6 jaw configuration, with the jaws circumferentially disposed at equal intervals for radial expansion.

In this embodiment, the bore of the insert 10 has a polygonal cross section. The number of faces of the polygon is an integer multiple of the number of jaws of the chuck with which it is to be used. This embodiment has twelve faces, twelve being a multiple of all of the above numbers of jaws. Alternative embodiments may have, for example, twenty-four faces, and would also be suitable for use with chucks having the numbers of jaws listed above.

When the core is mounted and the jaws of the chuck are expanded, each jaw will typically make contact with one of the faces of the polygonal bore. As the jaws continue to expand, they tend to slide towards the vertices of the bore, causing the chuck and/or the core to rotate. Eventually, each jaw locates itself at one of the vertices of the bore, so enabling torque to be transmitted in both rotational directions between the insert and the core. This has an effect that is mechanically equivalent to the mechanical interaction that occurs as a result of indentation of a paper-based core by the chuck jaws.

Thus in the event of a 5-jaw chuck being used, a polygonal bore with 15, 20 or 25 sides may be appropriate.

In an alternative, ribs or grooves may be formed in the bore with which the jaws of the chuck can interact.

In the above embodiments, a suitable soft self healing polymeric material may be polyurethane with a Shore hardness of 40D. This material has been found to have the advantageous self-healing, low deflection memory and hysteresis properties to provide the level of grip that is sought after.

ARAMID is a registered trade mark of E. I. du Pont de Nemours and Company.

Claims

1. An insert for a core, the insert having an outer surface that can be inserted within a core body, an inner surface that can be engaged to be driven by a chuck, the core including a restraining structure that can resist transmission of forces applied by the chuck to the insert to a core body.

2. An insert for a core according to claim 1 which is formed as a moulding of polymeric material.

3. An insert for a core according to claim 2 in which the polymeric material is a self-healing polymer.

4. An insert for a core according to claim 2 or claim 3 which is a co-moulding or multi-shot moulding of two or more polymeric materials.

5. An insert for a core according to claim 4 in which the moulding is formed, in the region of the inner surface, of a relatively soft material of low elastic modulus and the restraining structure is constituted by a region of relatively hard material of high elastic modulus.

6. An insert for a core according to claim 2 or claim 3 formed from a moulding of at least one polymeric material within which reinforcing elements are provided.

7. An insert for a core according to claim 6 in which the reinforcing elements comprise fibres of high elastic modulus embedded within the moulding.

8. An insert for a core according to claim 6 or claim 7 in which the reinforcing elements comprise a sleeve or a band of material embedded within the moulding.

9. An insert for a core according to any preceding claim in which the restraining structure includes a sleeve or a band of material surrounding the outer surface.

10. An insert for a core according to any preceding claim in which formations are provided in the inner surface that can be engaged by components of the chuck.

11. An insert for a core according to claim 10 in which the inner surface has a cross-sectional shape that is a polygon, components of a chuck being engageable with vertices of the polygon.

12. An insert for a core according to claim 11 in which the polygon is a convex polygon.

13. An insert for a core according to claim 11 or 12 in which the polygon has vertices that are, in number, an integral multiple of the number of components of a chuck that will engage with it.

14. An insert for a core according to any one of claims 10 to 13 formed of a single polymeric material of high elastic modulus.

15. A web winding core having a tubular core body, and a respective insert according to any preceding claim disposed at opposite ends of the core body.

16. A core according to claim 15 in which the core body is formed of a composite material.

17. A core according to claim 16 in which the core body is formed from a fibre reinforced polymeric composite material.

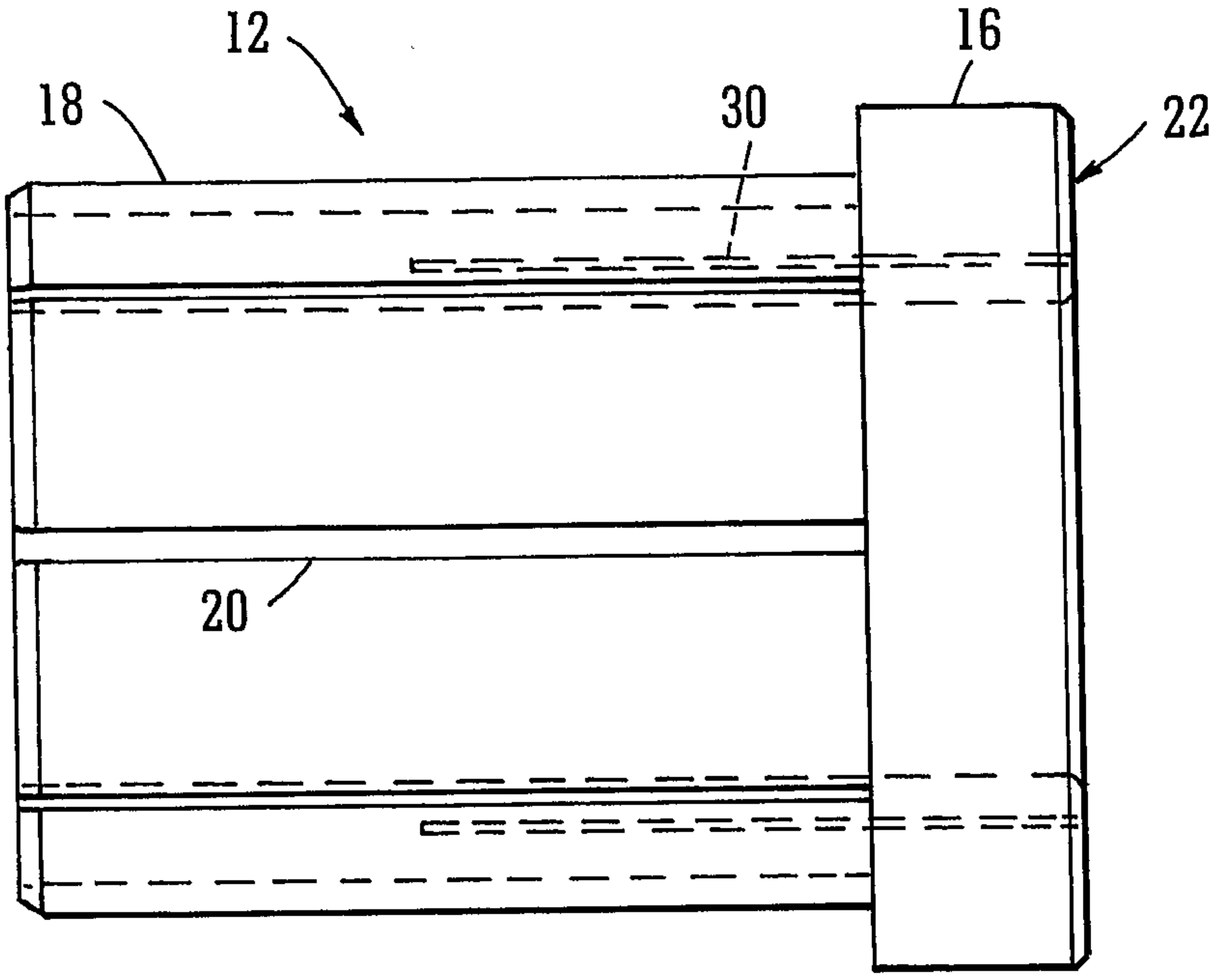


FIG. 1

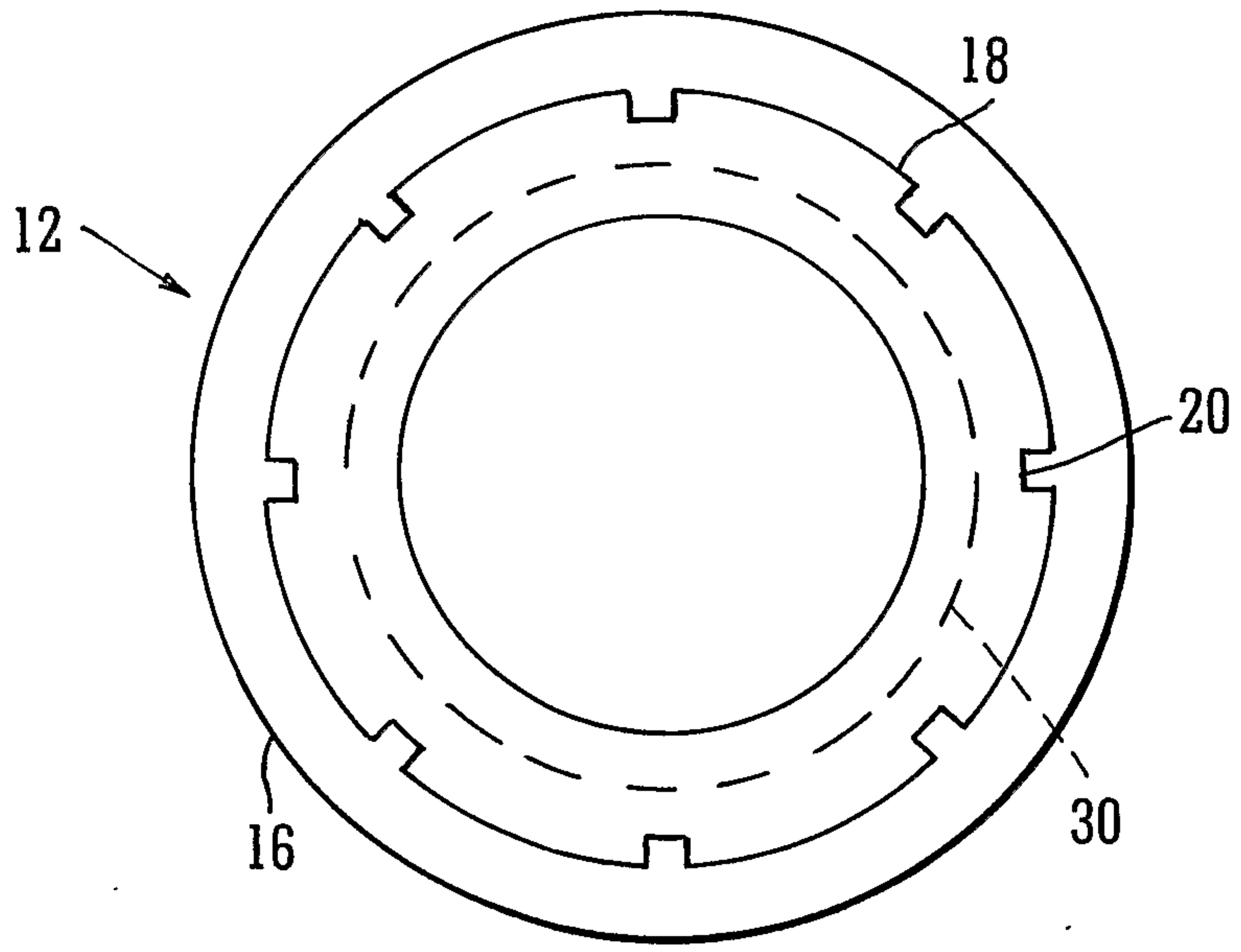


FIG. 2

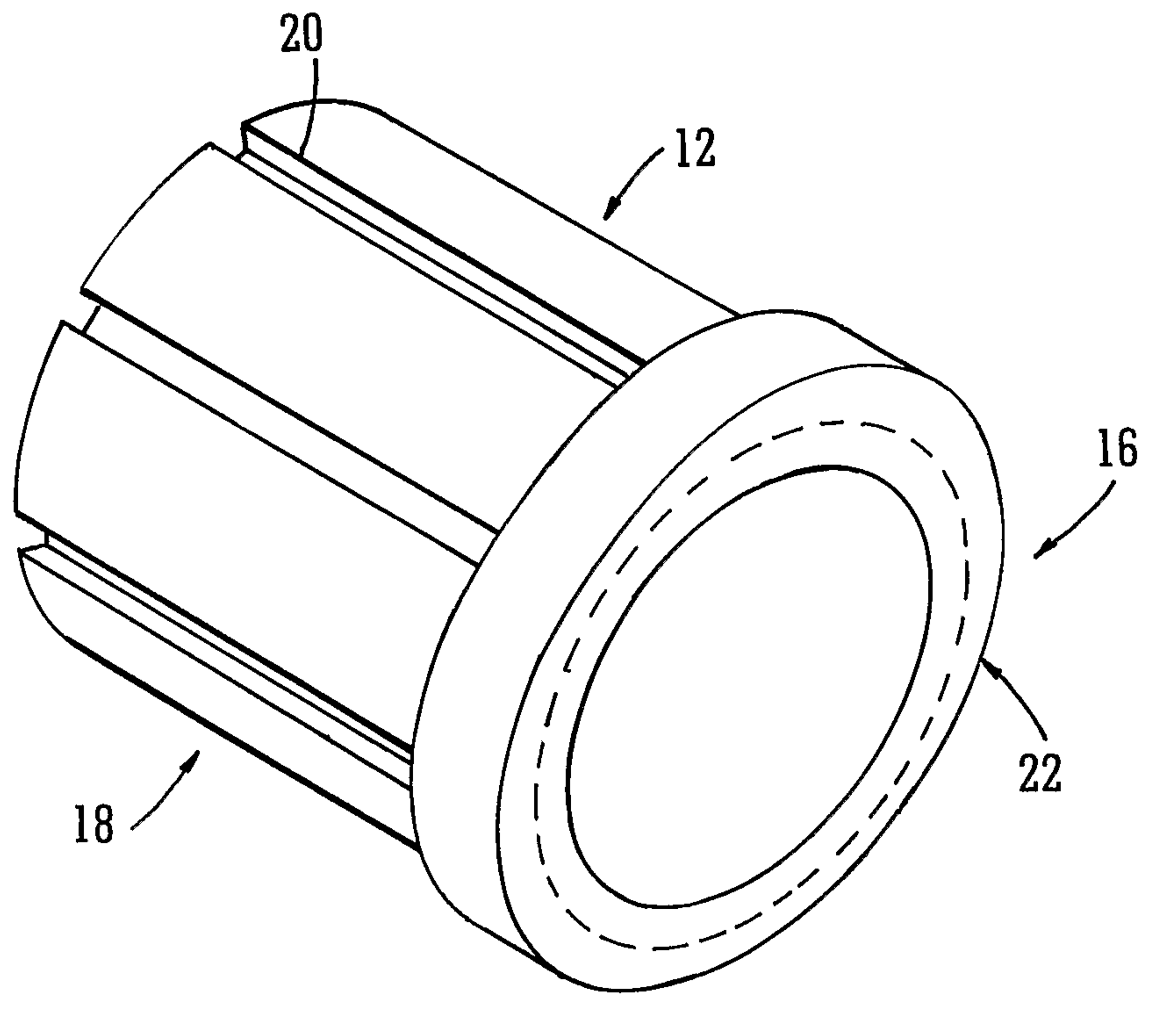


FIG. 3

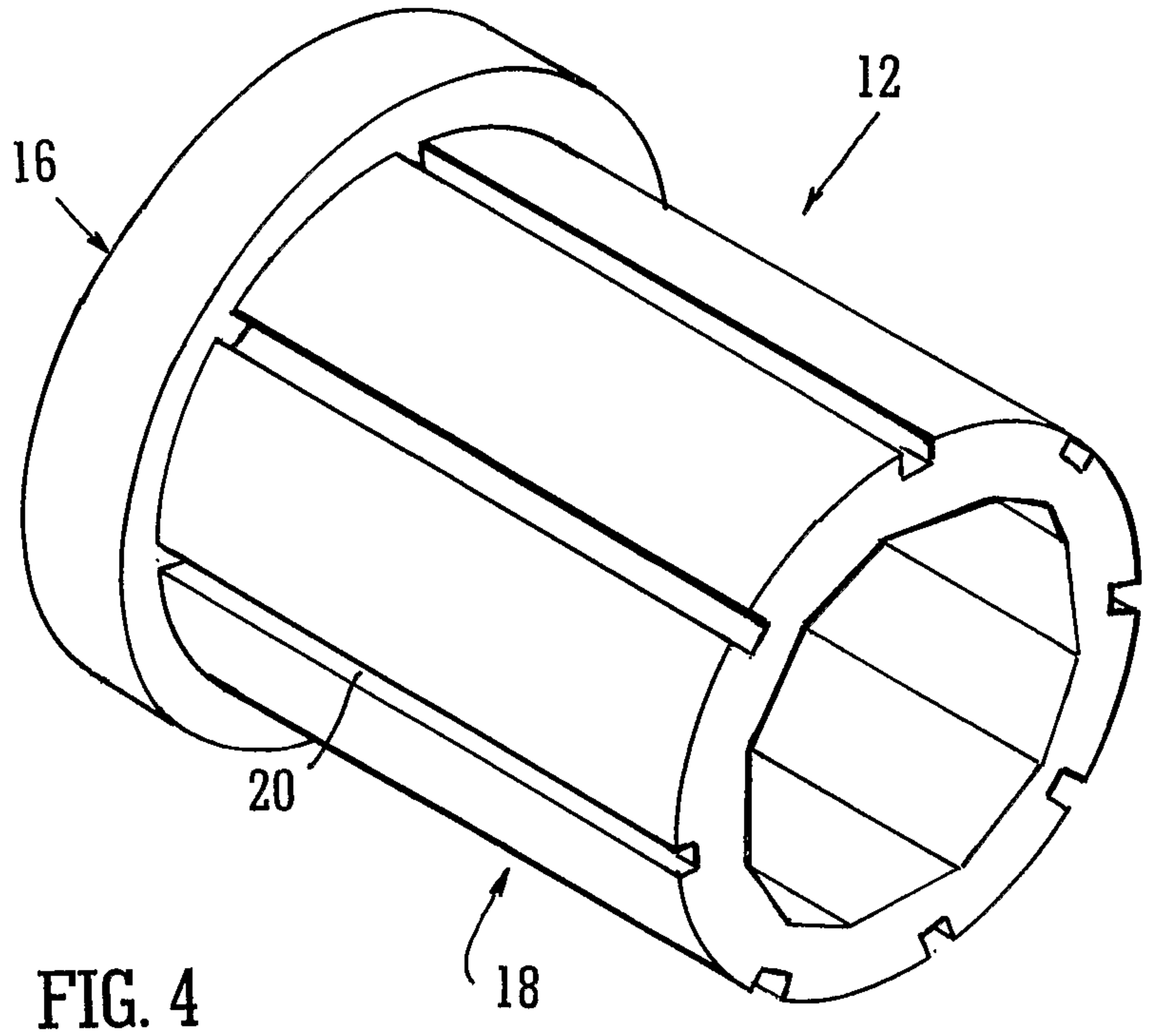


FIG. 4

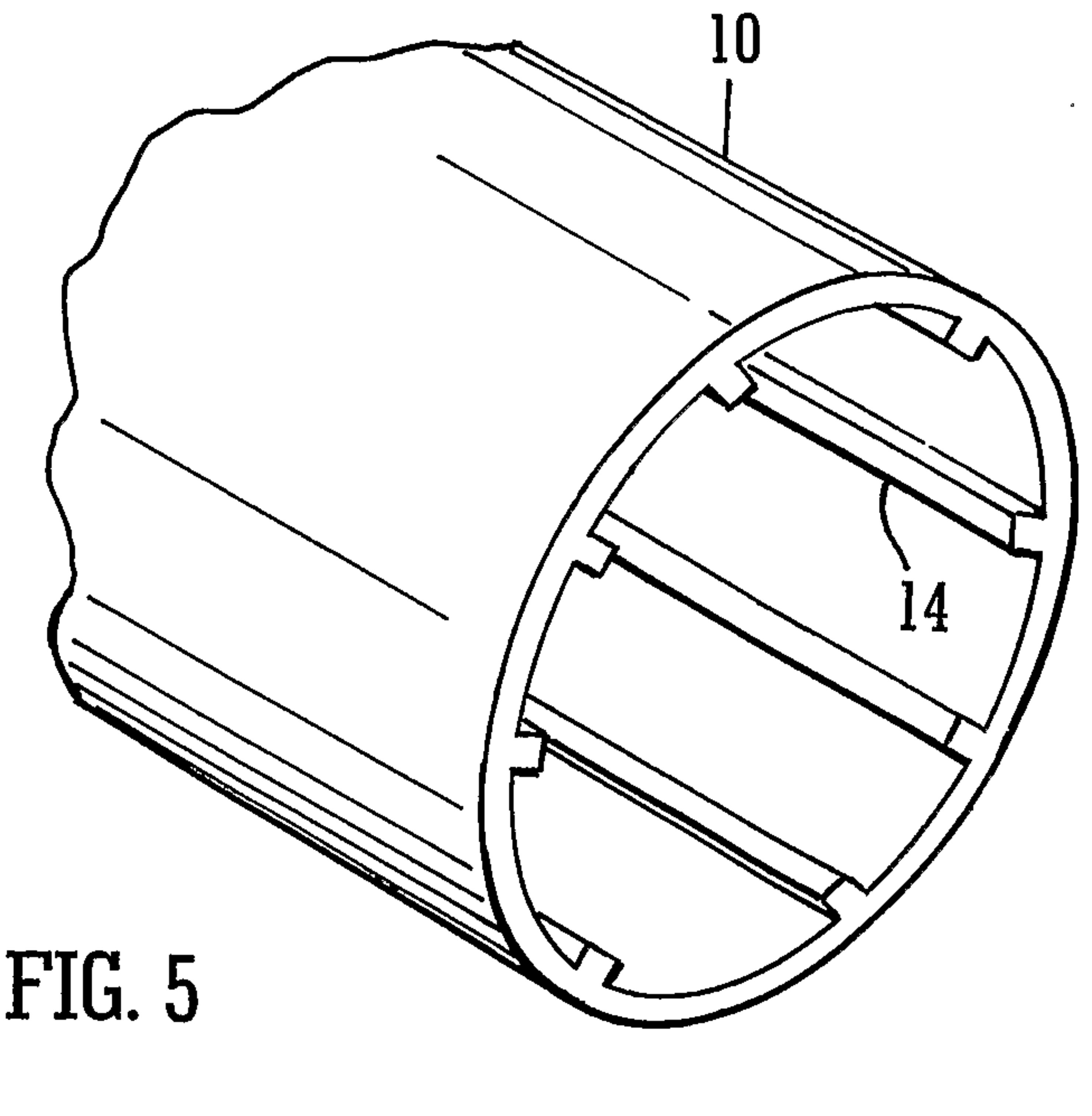
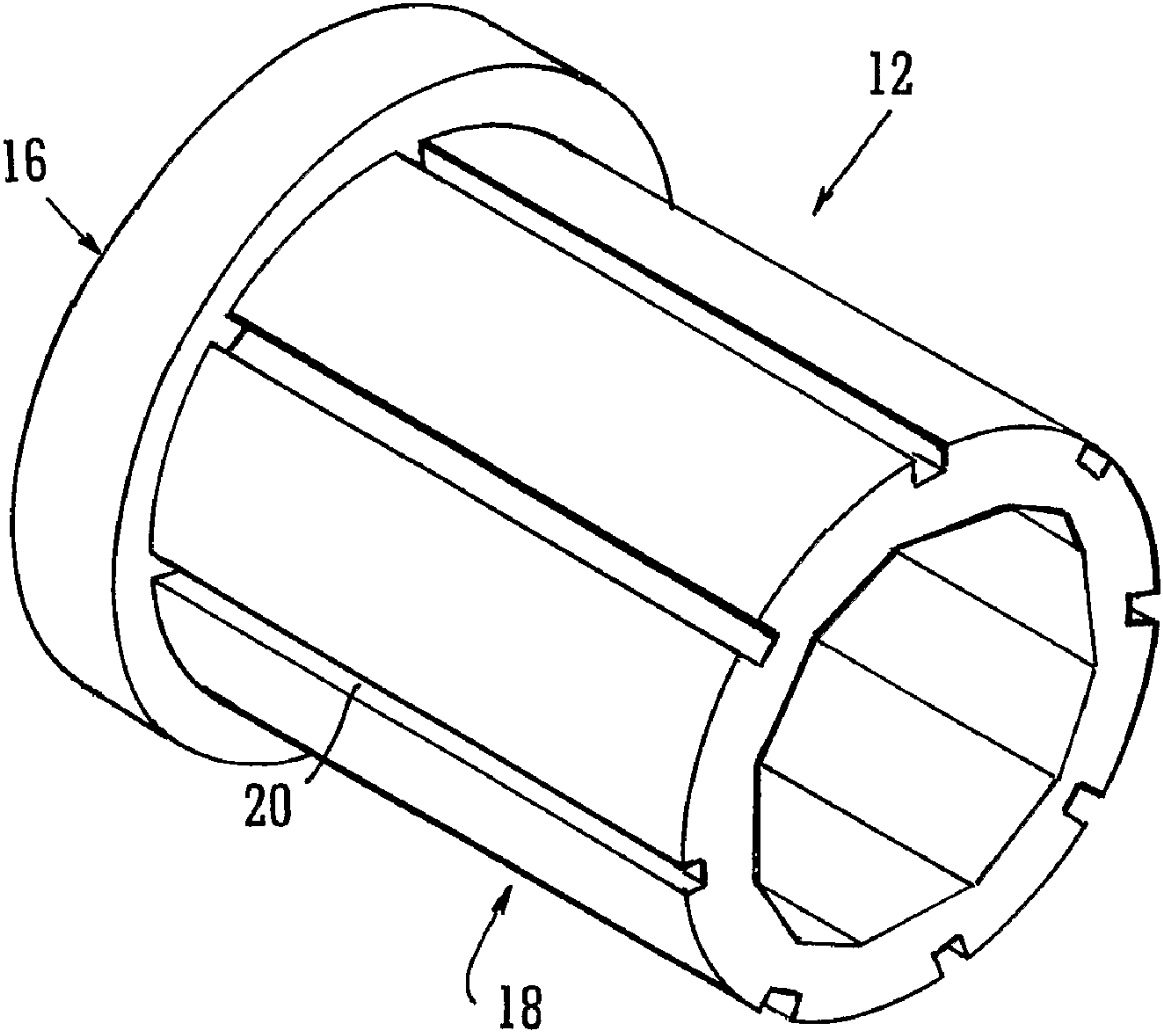


FIG. 5



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