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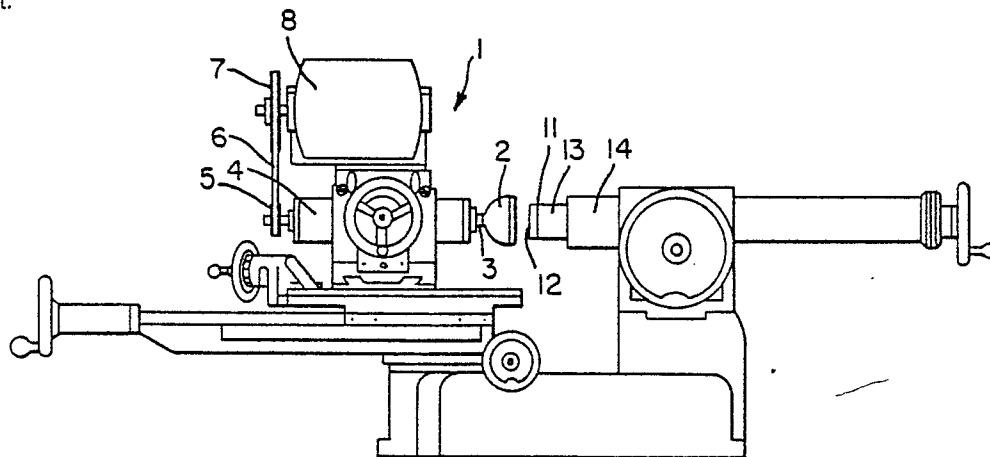
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54 Quick-change lens tool.

57 A lens grinding tool having a cylindrical shank and a radial shoulder is secured to the shaft of a motor for rapidly rotating the tool, by means of a drawbar extending the length of the shaft and threaded into an axial threaded bore in the cylindrical shank. The location of the tool is precisely fixed by means of ring-shaped shims adapted for placement about the cylindrical shank of the tool between the shoulder and either a mating surface on the shaft or intermediate means for securing the tool to the shaft.

FIG. 1



QUICK-CHANGE LENS TOOL

The present invention relates generally to the generating of ophthalmic lenses from lens blanks made of polymeric material or of glass. In particular, the present invention is an improvement in the conventional technique in which a lens blank is mounted in an appropriate means on a machine, and a rapidly rotating lens grinding tool is applied to the surface of the lens blank in a precisely determined manner in order to generate on the lens blank the desired surface.

In conventional lens grinding machines, the lens grinding tool comprises a metallic cup-shaped object whose rim is encrusted with hard abrasive material such as diamond grit, carbide, or the like. The grinding tool is rotated very rapidly by an electric motor, and is attached to the motor by means of a conical region of the tool which extends from the convex surface of the tool along the axis of the tool, in a manner such that the region is widest where it is attached to the convex surface of the tool and progressively tapers to a narrower width with increasing distance from that convex surface.

It will be appreciated that the generation of the desired surface on a lens blank requires extremely close tolerances and close control of the position of the grinding tool with respect to the lens blank. As the grinding tool is used it becomes progressively worn despite the extreme hardness of the grinding medium itself. Thus, it becomes necessary periodically to replace grinding tools to ensure that a fresh, sharp surface is used in generating the desired lens surface. Since the dimensions of different tools can differ slightly, and the relative position of the grinding surface and the lens blank must be very carefully maintained, industry practice to date has required extensive recalibration of the tool, or of the shaft and associated machinery to which the tool is attached, each time a new grinding tool is attached to the machine. This extensive recalibration introduces uncertainty into the operation, and consumes time and effort which should preferably be employed in generating additional lenses.

In one aspect, the present invention comprises apparatus for generating a surface on a lens blank, comprising

(a) shaft means having a first end, a second end, and an axis of rotation extending between said ends, said shaft means being rotatable about said axis of rotation, wherein said shaft means has a contact surface at said first end and has a bore extending through said shaft along said axis of rotation;

(b) tool means for grinding a lens, said tool means having an axis of rotation, and having a cylindrical shank extending from a surface thereof coaxially with said axis of rotation, said shank having a shoulder defining a contact surface perpendicular to said axis of rotation, and further comprising a threaded bore extending into said shank along said axis of rotation; and

(c) means for releasably securing said lens grinding tool means to said shaft means, with the axis of rotation of said lens grinding tool coaxial with that of said shaft means, said securing means including bolt means adapted to fit in said axial bore in said shaft means and having a threaded first end adapted to mate with said threaded bore in the shank of said lens grinding tool means.

Another aspect of the present invention comprises a machine for generating a lens surface included the afore mentioned apparatus in combination with means for holding a lens blank, means for moving said lens blank and said lens grinding tool means with respect to each other for lens generating engagement, and motor means for rotating said shaft means.

The present invention further comprises the aforementioned apparatus in combination with additional means, mountable on the shank of the lens grinding tool means, for respective engagement with the contact surfaces on said shank and said shaft.

The preferred aspect of the present invention comprises any of the aforementioned apparatus in combination with shim means for precisely varying the location of the lens grinding tool means with respect to the shaft means.

A detailed description of the invention will now be described with reference to the accompanying drawings, of which

Figure 1 is a perspective view of a lens grinding machine with which the present invention may be practiced, and

Figure 2 is a perspective view of a lens grinding tool useful in the present invention.

Figure 3 is a cross-sectional view of an embodiment of the present invention and

Figure 4 is a cross-sectional view of another embodiment of the present invention.

The present invention is adaptable with lens grinding machines having the conventional stations for mounting a lens blank and for mounting a lens grinding tool which is secured to a shaft that can be rotated at high speed by a suitable motor. One suitable example is shown in Figure 1, although other embodiments will readily come to mind.

Referring to Figure 1, numeral 1 denotes gen-

erally the grinding tool station. It includes cup-shaped grinding tool 2 secured to shaft 3 at the first end of shaft 3, in a manner which will be described in greater detail below. Shaft 3 extends through housing 4 and is supported for rotation within housing 4 by appropriate bearings. Pulley 5 secured near the second end of shaft 3 is connected via belt 6 to pulley 7 which is secured to the rotor of motor 8. Shaft 3 can alternatively itself be the rotor of motor 8. Housing 4 and motor 8 do not themselves rotate about the axis of rotation of shaft 3, but can be moved in other planes. In particular, the position of the unit comprising housing 4, motor 8 and shaft 3, can be pivoted about a vertical axis perpendicular to the axis of rotation of shaft 3, and can be moved toward and away from lens mounting station 11 in a direction parallel to the axis of rotation of shaft 3. Such movement can be carried out manually, by electro-mechanical control, or by computer control. Such controls are well-known in the art.

Still referring to Figure 1, reference numeral 11 denotes generally the lens mounting station. A lens blank 12 of glass or polymeric material (such as polymerized diethylene glycol bis (allyl carbonate)) is mounted on lens block 13 by any known means, such as with a waxy adhesive, so as to be immobile during the grinding operation but removable subsequently. Lens block 13 is in turn attached, removably but in a fixed position, to mandrel 14, for instance by mechanical coupling. In operation, lens grinding tool 2 is rotated about its axis by means of shaft 3 and motor 8, and the grinding surfaces of tool 2 trace a carefully controlled path across the surface of lens blank 12 to produce a surface having the desired geometric configuration. The ground lens blank can then be finely polished, to provide a finished ophthalmic surface, and the same operations can be carried out on the other side of the blank to provide a finished lens. Apparatus for moving the tool 2 across lens blank 12 so as to generate a desired ophthalmic surface on lens blank 12 is well-known to those acquainted in this art; one example is shown in U.S. Patent No. 2,806,327.

Figure 2 depicts a lens grinding tool 2 useful in the present invention. It has a cup-shaped configuration including a cylindrical rim portion 16 having an arcuate end surface 17. Tool 2 also comprises spaced notches 18. Cylindrical shank 32 extends axially from the convex side of tool 2. Shank 32 includes shoulder 34 which defines a planar contact surface perpendicular to the axis of rotation of tool 2. Grit plating is conveniently provided on the inside and outside of surface 16, and on surface 17. Such a tool can readily be manufactured by any of several suppliers to firms that make and use lens generating machines.

The present invention is shown in more detail in cross-sectional Figures 3 and 4. Turning first to Figure 3, lens grinding station 2 includes shaft 3 which is mounted for rotation in housing 4 by appropriate bearing means 20 including races 21 and ball bearings 22. End caps 23 provided with suitable bushings 24 seal the ends of housing 24 through which the ends of shaft 3 extend. Shaft 3 terminates with a contact surface 26 at its first end. Shaft 3 includes an axial bore 28 therethrough.

Cutting tool 2 is provided with integral cylindrical shank 32 which extends coaxially with respect to the axes of rotation of tool 2 and of shaft 3. Shank 32 also has shoulder 34 which lies in a plane perpendicular to the axis of rotation of tool 2. Shank 32 preferably is dimensioned so that an end portion thereof extends into the axial bore 28.

Bolt 36 in bore 28 is threaded at its first end 38 to mate with a corresponding axial threaded hole 40 in shank 32. Bolt 36 also has stop means for engaging the second end when the tool 2 and bolt 36 are threaded together tightly so as to secure tool 2 with respect to shaft 3 (by "secure" is meant that tool 2 and shaft 3 necessarily rotate together and tool 2 and bolt 36 cannot move axially with respect to the housing 4). Stop means can comprise a head 39 on bolt 36 wider than the axial bore 28.

The depth of hole 40, the length of bolt 36 and the extent of threading on first end 38 of bolt 36 are determined so that tool 2 can be secured onto bolt 36 by threading the two together as tightly as possible. While the parts of the invention have been illustrated in Figure 3 with contact surface 35 of shoulder 34 spaced apart from parallel contact surface 26 on shaft 3, in operation surfaces 34 and 26 would be tightly drawn toward each other so that rotation of shaft 3 causes tool 2 to rotate.

In this arrangement, the position of tool 2 (or, more practically, of grinding surface 17) with respect to the shaft 3 can be fixed precisely with the aid of a set of shims, which are preferably flat and circular having an outside diameter approximately equal to that of shoulder 34 and having a central hole whose diameter is slightly greater than that of shank 32. An appropriate set of shims would have a variety of thicknesses, as follows: 0.002 inch; 0.004 inch; 0.008 inch; 0.010 inch; 0.020 inch; 0.040 inch; 0.080 inch; two of 0.100 inch each; and 0.200 inch. Other combinations of thicknesses are of course possible. Those shims are capable of adjusting the axial position of grinding surface 17 with respect to housing 4 and shaft 3 by up to 0.500 inch, plus or minus 0.001 inch.

To replace a worn grinding tool with a fresh one, while taking advantage of the ability to adjust precisely the position of the fresh tool, it is necessary first to know the desired distance, preferably

to the nearest thousandth of an inch, from the end of the shaft (or other fixed reference point on the machine) to the grinding surface 17. Conveniently, the fixed reference point would be corner A on shaft 3. This distance is a function of the desired distance between the shaft and a lens blank mounted as shown generally in Figure 1. It may not be necessary to measure this distance more than once on a given machine. Next, the axial distance, also preferably to the nearest thousandth of an inch, is measured from the grinding surface 17 on the fresh grinding tool to a reference point on the tool, which should be point B on shoulder 34. This distance can be expected to vary by some thousandths of an inch from one tool to the next. The difference between the two distances thus measured is made up by a shim or an appropriate combination of shims which are placed on the shank 32. The fresh tool 2, with shims as necessary to make up the desired distance difference, is then secured to shaft 3 by inserting shank 32 into the first end of shaft 3, and tightening bolt 36 into hold 40 until tool 2 is secured to shaft 3.

An alternative, preferred embodiment of the invention is shown in cross-section in Figure 4. Shaft 3 is mounted in housing 4 as described above, and supported by bearings 22. The second end of shaft 3, not shown in Figure 4, is the same as Figure 3. The first end of shaft 3, which can include a vertical face as described above also comprises an angled portion 42. Tapered shim collar 44 adapted to fit around shank 32 has first face 45 which is parallel to the face of shoulder 34, and second face 46 which forms an angle with respect to the axis of rotation of tool 2. A double-tapered ring 48 is adapted to fit relatively tightly onto shank 32. Ring 48 has one tapered portion 49 whose angle with respect to the axis of rotation matches that of angled portion 42 in shaft 3. Ring 48 has second tapered portion 50 whose angle to the axis matches that of angles portion 46 on shim collar 44. Ring 48 preferably has a longitudinal slit extending the entire length thereof, so that when tool 2 is tightened onto shaft 3 as described herein the action of collar 44 forcing ring 48 against angled surface 42 forces ring 48 to grip shank 32 ever more tightly. Thus, the combination of collar 44 and ring 48 comprise a means for enhancing the immobilization of tool 2 onto shaft 3.

A fresh grinding tool 2 is secured to the shaft 3 in essentially the same manner as described above. The distances from grinding surface 17 to points A and B, respectively, are determined, and the difference is calculated. The shims necessary to make up that difference, taking into account the axial dimensions of shim collar 44 and ring 48, are placed over shank 32, followed by collar 44 and ring 48, and the shank is tightened onto bolt 36 as

described above.

It will be recognized that another aspect of this invention comprises a kit useful in adapting lens grinding machines already having a shaft with an axial bore and a vertical or inwardly tapered contact surface. The kit comprises the lens grinding tool described hereinabove, provided with a cylindrical shank (which is preferably capable of fitting within the first end of the shaft), and having a perpendicular radial shoulder as described herein, in combination with the shims described herein, and preferably also with the shim collar and a double-tapered ring whose tapered surfaces match with the tapered surface of the shim collar, and the tapered contact surface of the shaft, respectively.

The present invention provides the advantage of easy and rapid replacement of grinding tool 2. Replacement requires only loosening and subsequent retightening of bolt 36, without the need to deal with a bolt head or nut located inside the concave portion of tool 2. Also, as described above, the position of a given grinding tool can be adjusted very quickly. The axial distance from grinding surface 17 to point B can be measured at any time prior to actual attachment of the tool to shaft 3, so that when the time comes to replace a worn tool it is not necessary to consume extra down-time measuring and calibrating the new tool. One simply slips the necessary shims onto the shank of the tool and attaches the tool to the shaft.

Claims

1. Apparatus for generating a surface on a lens blank, comprising

(a) shaft means having a first end, a second end, and an axis of rotation extending between said ends, said shaft means being rotatable about said axis of rotation, wherein said shaft means has a contact surface at said first end and has a bore extending through said shaft along said axis of rotation;

(b) tool means for grinding a lens, said tool means having an axis of rotation, and having a cylindrical shank extending from a surface thereof coaxially with said axis of rotation, said shank having a shoulder defining a contact surface perpendicular to said axis of rotation, and further comprising a threaded bore extending into said shank along said axis of rotation; and

(c) means for releasably securing said lens grinding tool means to said shaft means, with the axis of rotation of said lens grinding tool coaxial with that of said shaft means, said securing means including bolt means adapted to fit in said axial

bore in said shaft means and having a threaded first end adapted to mate with said threaded bore in the shank of said lens grinding tool means;

wherein the position of said tool means with respect to said shaft means when the tool means is secured to said shaft means can be precisely adjusted by shim means interposed between the respective contact surfaces.

2. Apparatus according to claim 1 wherein said means for releasably securing said lens grinding tool means to said shaft means further comprises a second end adapted to engage said shaft when the first end of said bolt means is threaded into said threaded bore sufficiently so that said tool means is secured to said shaft means and wherein the second end of said bolt means comprises a head having a diameter greater than that of said axial bore in said shaft and adapted to engage said shaft outside the second end thereof.

3. A machine for generating a lens surface, comprising the apparatus of claim 1 in combination with means for holding a lens blank in lens generating engagement with said lens grinding tool means, means for moving said lens blank and said lens grinding tool means with respect to each other so as to generate an ophthalmic surface on a surface of said lens blank, and motor means operatively coupled to said shaft means for rotating said shaft means.

4. The apparatus of claims 1 or 2 in combination with shim means between said contact surfaces for precisely locating the position of the lens grinding tool means with respect to the shaft means.

5. The apparatus of claims 1 or 2 in combination with means mounted on the shank of the lens grinding tool between the contact surfaces on said shank and said shaft for enhancing the immobilization of said tool on said shaft.

6. The apparatus of claim 5 in combination with shim means between the contact surface on said cylindrical shank and the enhancing means.

7. The apparatus of claims 5 or 6 wherein said enhancing means comprises a tapered shim collar means having a surface perpendicular to said axis of rotation and a tapered surface, and a double-tapered ring means having a first tapered surface adapted to contact the tapered surface of said collar means, and a second tapered surface adapted to contact the tapered surface of said first end of said shaft.

8. The apparatus according to any one of the preceding claims wherein said lens grinding tool means is of cup-shaped configuration including a cylindrical rim portion having an arcuate end surface, wherein said shank extends from the convex

side of said cup-shaped configuration, and wherein said threaded bore in said shank is cylindrical and coaxial with said shank.

9. The apparatus according to any one of the preceding claims wherein said contact surface on said shaft lies in a plane parallel to the axis of rotation of said shaft, or wherein said contact surface on said shaft forms an acute angle with the axis of rotation of said shaft.

10. A lens grinding tool comprising a cylindrical rim portion having an arcuate end surface, at least said arcuate surface having abrasive grinding medium thereon, said tool also comprising a cylindrical shank extending from said tool, said shank and said cylindrical rim portion having a common axis of rotation, said shank including a shoulder defining a planar surface perpendicular to said axis and a hole in the end of said shank, which hole is coaxial with the shank.

11. A lens grinding tool comprising a cylindrical rim portion having an arcuate end surface, at least said arcuate surface having abrasive grinding medium thereon, said tool also comprising a cylindrical shank extending from said tool, said shank and said cylindrical rim portion having a common axis of rotation, said shank including a shoulder defining a planar surface perpendicular to said axis.

12. A tool in accordance with claim 11 and further comprising a hole in the end of said shank, which hole is coaxial with the shank.

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FIG. 1

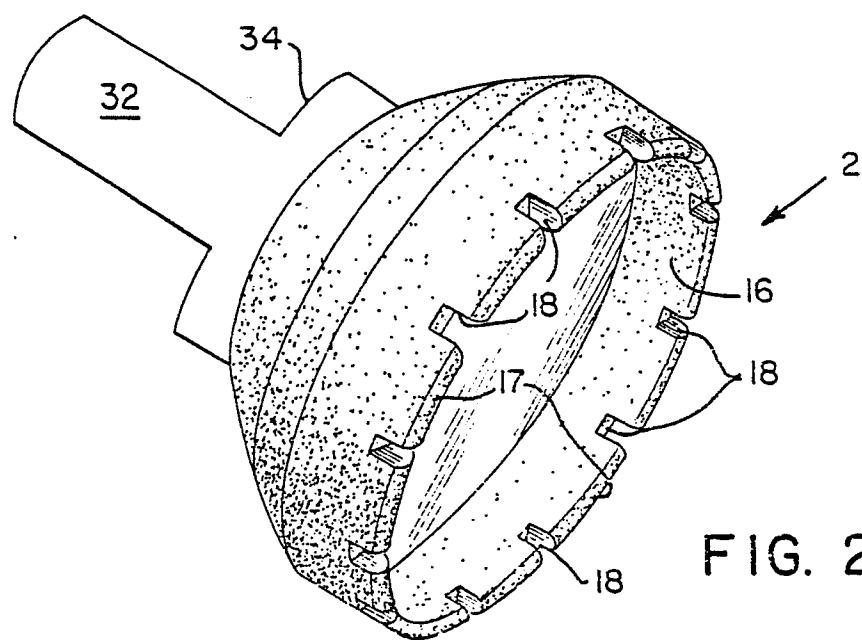
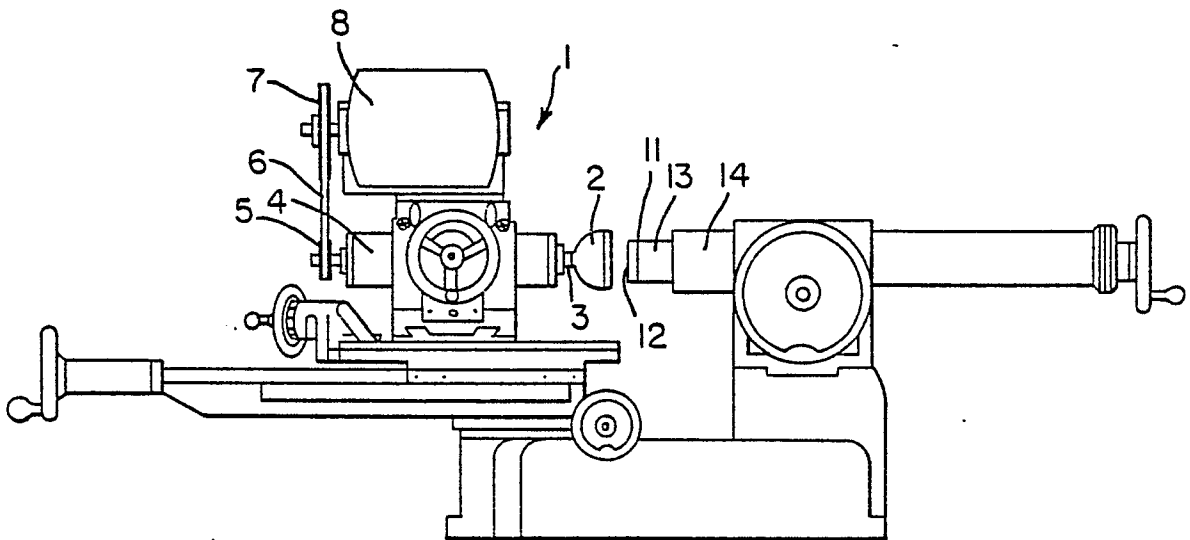
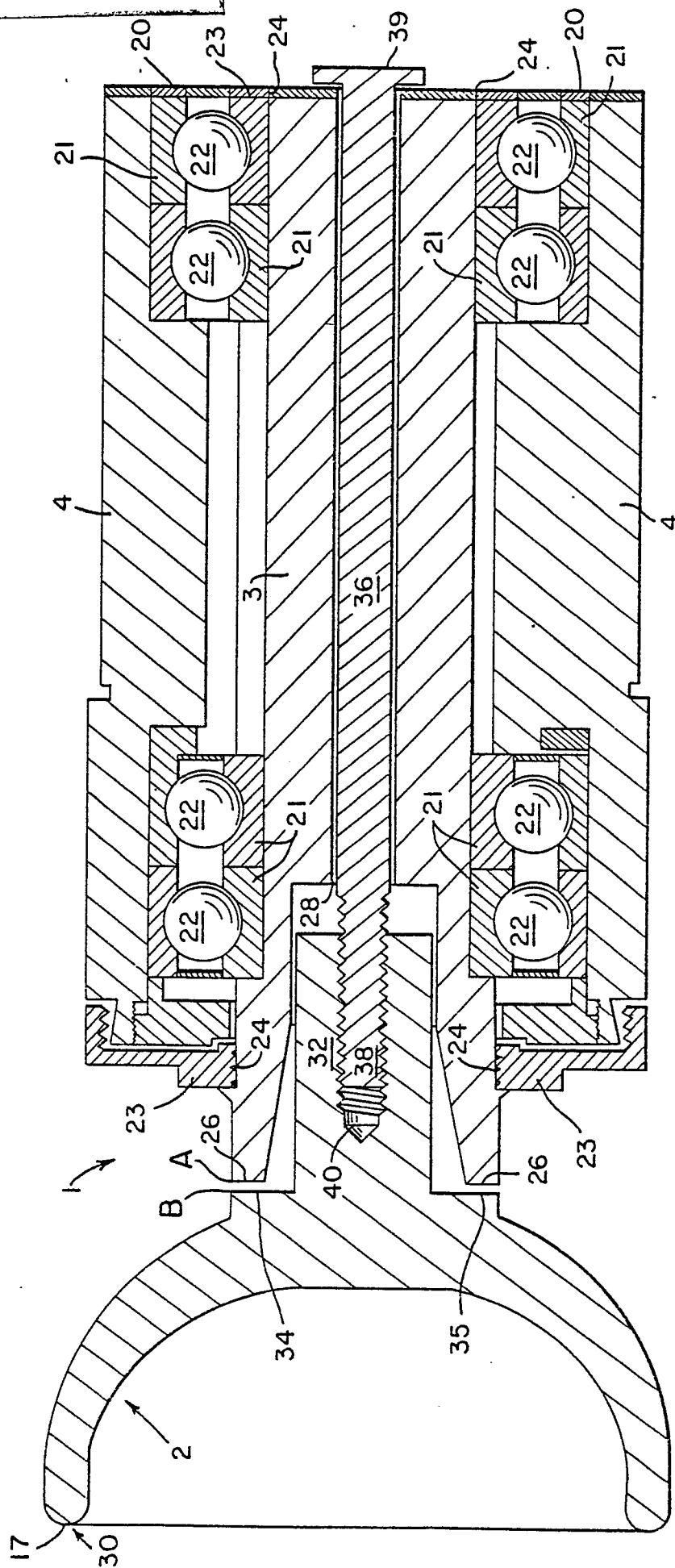


FIG. 2



Nou déposée / Newly Filed
Nouvelle brevet déposé

