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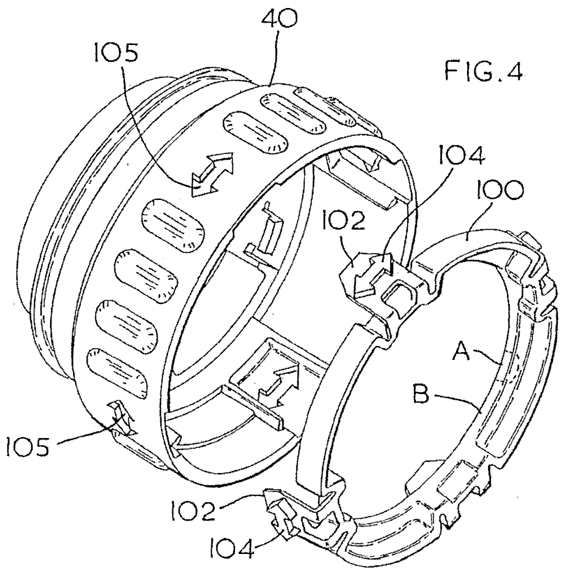
(54) **Drilling and / or hammering tool**

(57) A drilling and/or hammering tool which includes a hollow spindle (1) and a tool holder (10) that can be attached to an end (18) of the spindle and removed therefrom. The tool holder comprises a manually actuable sleeve (40) in which components of the tool holder are held within the sleeve by a snap ring (100) which snap ring is fitted within the sleeve. The snap ring has at least one resilient arm (102) and the sleeve has a corresponding number of holes (105) which extend to the outwardly facing surface of the sleeve. The arms are arranged such that each arm is engageable with a corresponding through hole in a snap fit and each arm and hole cooperate so that the portion (104) of each arm can be viewed from the surface of the sleeve appears in the shape of a symbol.



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Description

[0001] This invention relates to drilling and or hammering tools, and especially to hammers and rotary hammers, and to tool holders for use with such tools.

[0002] Such tools typically include a spindle that may be rotatably driven by means of a motor, and a hammer mechanism, for example an air-cushion hammer mechanism, for repeatedly striking a tool that is held by the hammer. The shank of a tool such as a drill bit or chisel bit is held in the tool by means of a tool holder so that the tool can slide axially in the tool holder by a few centimetres under the action of the hammer mechanism. In one well known design, sold under the designation SDS Plus, the tool shank has a pair of open-ended grooves for receiving splines in the tool holder for rotating the tool, and a pair of closed-ended recesses for receiving locking elements in the tool holder that limit the extent of axial movement of the tool in the tool holder. The tool holder can be manually manipulated by the operator, for example by means of axially slidable parts, in order to hold the tool therein and to release the tool therefrom.

[0003] In addition, the tool holder itself often will need to be capable of being released from the spindle in order to allow it to be changed, for example when a different type of tool is to be held in the hammer. In this case the tool holder body or the spindle is provided with one or more locking elements, for example locking balls, that are movable in a radial direction (with respect to the axis of the spindle) to retain the tool holder body on the spindle, or to allow release of the tool holder body therefrom.

[0004] While the tool holder body is normally located around the external surface of the spindle of the hammer, it has been proposed, for example in GB-A-2,313,566 (corresponding to DE-A-196 21 610) and in US-A-5,437,465, for the tool holder body to be inserted into the end of the spindle. Such designs have the advantage that the length of the tool can be significantly reduced since the bore of the tool holder that receives the tool shank, and the bore of the spindle may be allowed to overlap axially. In the previous designs in which the tool holder was located around the exterior of the spindle, the bore of the tool holder could only start at a position beyond the front end of the spindle.

[0005] These designs of tool holder suffer from a number of disadvantages, however. For example, with the tool holder described in GB-A-2,313,566, it can be difficult for the user to find the correct axial orientation of the tool holder on the spindle in order to lock the tool holder thereon, that is to say, it can be difficult to ensure that the locking elements located on the spindle are in circumferential alignment with corresponding elements on the tool holder for receiving them. In other cases, axial movement of parts of the tool holder in order to release it from the spindle can cause difficulties where axial movement of parts of the tool holder is required to release or retain the tool shank in the tool holder. For example, where a ring or skirt on the tool holder must be moved axially forwards to release it from the spindle, the user will often grasp the tool holder along its axis with their hand, and squeeze their hand to release the tool holder (thereby applying a Newtonian reaction force on the front end of the tool holder with the palm of his hand). This may cause the tool holder to unlock the tool shank held therein during removal of the tool holder, so that, when the tool holder is replaced on the spindle, the tool is ejected out of the tool holder as soon as the hammer is actuated. Alternatively, it is possible for the tool holder to be inserted incorrectly so that the tool holder is ejected when the hammer is actuated. In the case of the arrangement described in US-A-5,437,465 on the other hand, in which a ring must be moved axially rearwardly in order to remove the tool holder from the spindle, removal of the tool holder necessitates the operator using both his hands for the purpose.

[0006] According to a first aspect of the present invention there is provided a hammering and/or drilling tool which includes a hollow spindle and a tool holder that can be attached to an end of the spindle and removed therefrom, the tool holder comprising:

a tool holder body which can be fitted within the end of the spindle and releaseably locked therein by means of at least one locking element; and

a locking ring for releasably holding the or each locking element in a locked position in which the locking element(s) lock(s) the tool holder to the spindle,

<u>characterised in that</u> the tool holder comprises a manually actuable sleeve for rotating the locking ring in a first direction and for rotating the tool holder body in a second opposite direction, and resilient means for urging the tool holder body to follow the movement of the locking ring in the first direction and the locking ring to follow the movement of the tool holder body in the second direction, said resilient means urging the locking ring and the tool holder body into relative rotational positions in which the locking ring holds the or each locking element in the locked position.

[0007] This tool holder locking and release arrangement reliably fixes the tool holder to the spindle and enables quick and easy removal of the tool holder from the spindle and quick and easy replacement of the or an alternative tool holder to the spindle. Also, it is relatively easy to find the correct starting rotational positioning of the tool holder on the spindle in the same manual operation as rotating the manually actuable sleeve to fix the tool holder onto the spindle.

[0008] In one embodiment the locking ring may be rotated by the sleeve in a first, preferably clockwise, direction to release the tool holder from the spindle and the tool holder body may be rotated by the sleeve in the second opposite, preferably anti-clockwise, direction to lock the tool holder to the spindle. The locking elements may be mounted at the end of the spindle so as to be radially shiftable. The manually actuable sleeve may rotate the tool holder body via a member non-rotatably mounted on the tool holder body.

[0009] The manually actuable sleeve may be mounted for limited rotation with respect to the locking ring and the tool holder body. In particular the manually actuable sleeve may be mounted for limited rotation in the first direction with respect to the tool holder body and/or may be mounted for limited rotation in the second direction with respect to the locking ring.

[0010] The resilient means may be a coil spring with a first end fixed to the locking ring and a second end fixed to the member.

[0011] In one embodiment of the first aspect of the present invention the tool holder portion may have a recess for each locking element and the locking ring may have a recess for receiving each locking element, which locking ring recess has a deep portion and a shallow portion, arranged such that when the deep portion is in register with a locking element the locking element can move out of the tool holder recess and the tool holder can be removed from or fitted to the spindle and when a shallow portion is in register with a locking element the locking element is locked in the corresponding tool holder recess and the tool holder is fixed to the spindle. Each tool holder recesses may be formed in a radially outwardly facing surface of the tool holder and each locking ring recess may be formed in a radially inwardly facing surface of the locking ring.

[0012] The first aspect of the present invention also provides a tool holder that can be attached to an end of a spindle of a drilling and/or hammering tool and removed therefrom, the tool holder comprising:

a tool holder body which can be fitted to the end of the spindle and releaseably locked thereto by means of at least one locking element; and

a locking ring for releasably holding the or each locking element in a locked position in which the locking element(s) lock(s) the tool holder to the spindle,

characterised in that the tool holder comprises a manually actuable sleeve for rotating the locking ring in a first direction and rotating the tool holder body in a second opposite direction, and resilient means for urging the tool holder body to follow the movement of the locking ring in the first direction and the locking ring to follow the movement of the tool holder body in the second direction, said resilient means urging the locking ring and the tool holder body into relative rotational positions in which the locking ring holds the or each locking element in the locked position.

[0013] The tool holder according to the first aspect of the present invention may have the subsidiary features discussed above in relation to the hammering and/or drilling tool according to the first aspect of the present invention.

[0014] A second aspect of the drilling and/or hammering tool according to the present invention is characterised in that the locking ring has an internal radius that varies along its circumference so that rotation of the locking ring about the axis of the tool holder body will move it between a locking position in which it causes the or each locking element to retain the tool holder body in the spindle, and a release position in which it will allow the or each locking element to move radially to release the tool holder body.

[0015] Thus, since locking of the tool holder involves rotation of the locking ring, it is relatively easy to find the correct angular orientation of the tool holder about the spindle in the same manual operation. In addition, it is relatively easy to arrange for movement of the various parts of the tool holder for unlocking the tool from the tool holder and for releasing the tool holder from the spindle to occur in orthogonal directions so that the two operations will not interfere with each other.

[0016] The or each locking element will normally be located in an aperture in one of the spindle or the tool holder body, and will engage a depression in the other of the spindle or the tool holder body to retain the tool holder body in the spindle, so that the tool holder body can be retained in the spindle only when the tool holder body is in a defined orientation with respect to the axis of the spindle. In most cases, the or each locking element will be located in an aperture in the spindle, and will engage a depression in the tool holder body (inserted therein) when it is in its radially innermost position to retain the tool holder on the spindle.

[0017] The tool holder may include a manually operable sleeve that is associated with the locking ring in order to enable a user to rotate the locking ring between the locking position and the release position. The locking ring may have, in this case, a region of relatively large internal radius forming a pocket that can receive a locking element when the element is in its radially outermost position (to allow release of the tool holder body), and a region of relatively small internal radius that can receive the locking element only when the locking element is in a radially inner position in which it engages its depression. In this arrangement, the locking ring may be biased (usually spring biased) with respect to the tool holder body into its locking position. Thus, for instance, whether or not the tool holder is located on the spindle, the locking ring may be biased so that the region(s) of the locking ring of relatively small radius is in circumferential register with the depression(s) in the tool holder body that receive the locking element(s).

[0018] The second aspect of the present invention also provides a tool holder that can be attached to an end of a spindle of a drilling and/or hammering tool and removed therefrom, the tool holder having a tool holder body that can be inserted into the end of the spindle and retained therein by means of at least one locking element that is movable in a radial direction to retain, or to allow release of, the tool holder body, and a locking ring for holding the or each locking element in a position that retains the tool holder body in the spindle, characterised in that the locking ring has an internal radius that varies along its circumference so that rotation of the locking ring about the axis of the tool holder body will move it between a locking position in which it causes the or each locking element to retain the tool holder body in the spindle, and a release position in which it will allow the or each locking element to move radially to release the tool holder body.

[0019] The tool holder according to the second aspect of the present invention may have the subsidiary features discussed above in relation to the hammering and/or drilling tool according to the second aspect of the present invention.

[0020] As discussed above, in relation to both aspects of the present invention the manually operable sleeve may be rotatable with respect to the locking ring to a limited extent, and also with respect to the tool holder body to a limited extent. Thus, the locking ring can be held in its locking position in this case (or more accurately, the locking ring and the tool holder body are held with respect to one another so that the locking ring is in its locking position) against the spring bias by means of the manually operable sleeve, which can be provided with some form of detent to limit further rotation. Rotation of the manually operable sleeve in one sense (either clockwise or anticlockwise) may be arranged to cause corresponding rotation of the tool holder body but can allow the locking ring to remain stationary (with respect to the spindle), while rotation of the manually operable sleeve in the opposite sense may be arranged to require corresponding rotation of the locking ring but can allow the tool holder body to remain stationary. In this arrangement, the tool holder body can be inserted in the end of the spindle so that the or each locking element is in its radially outermost position and is received in a pocket of the locking ring, and manual rotation of the sleeve in one sense will cause the tool holder body to rotate with respect to the spindle but the locking ring will be prevented from rotating with respect to the spindle by means of the or each locking element until the or each depression is in circumferential register with a locking element, whereupon the or each locking element will move radially inwardly into its depression and allow the locking ring to rotate under the bias into its locking position. This rotation of the locking ring will normally be accompanied by a clear audible click that will signal to the operator that the tool holder is correctly engaged with the spindle in its locked state. In order to remove the tool holder from the spindle, the sleeve may be manually rotated about the spindle in the opposite sense which will cause the locking ring to rotate together with the sleeve against the spring bias until the or each locking element is in register with a pocket of the locking ring, whereupon the or each locking element will move radially outwardly into its pocket to allow removal of the tool holder.

[0021] Although the tool holder may, in principle, be arranged so that it can be released from the spindle by rotation of the locking ring and/or the sleeve in either the clockwise or anti-clockwise direction, it is preferred for the tool holder to be released from the spindle if the locking ring and/or the sleeve is rotated in the clockwise direction (viewed forwardly along the axis of the tool holder body) only. This is because rotary hammers are designed for the tool, and therefore the tool holder, to rotate in a clockwise direction. Therefore, if the sleeve accidentally brushes against a wall or other stationary object during operation, the wall or other object will exert a torque on the sleeve in the anti-clockwise direction (with respect to the rest of the tool holder) and so maintain the tool holder locked in the hammer spindle.

[0022] One form of hammer and tool holder in accordance with the present invention will now be described by way of example, with reference to the accompanying drawings, in which:

> Figure 1 is a sectional elevation along the common axis of the spindle and tool holder of a hammer and tool holder according to the invention;
> Figure 2 is an exploded perspective view of the tool holder and part of the spindle shown in Figure 1;
> Figure 3 is a sectional elevation along the common axis of the spindle and modified tool holder according to the invention; and
> Figure 4 is a perspective view of the manually operated sleeve of the modified tool holder of figure 4.

[0023] Referring to the accompanying drawings, a hammer that may be employed in a combination rotary hammer mode, includes a spindle 1 that is provided with an air-cushion hammer mechanism comprising a piston 2, that is caused to reciprocate within the spindle by a swash or wobble mechanism 4 driven by a motor (not shown). Reciprocating motion of the piston causes a ram 6 to reciprocate, which strikes a beatpiece 8. The beatpiece 8 strikes the shank of a drill or chisel bit (not shown) that is held in the bore of a tool holder 10 in known manner.

[0024] The hammer includes a removable tool holder 10 for holding the shank of a bit, for example a hammer drill bit or a chipping bit. The tool holder 10 as shown is designed to hold a bit that has a pair of closed-end elongate recesses for receiving a locking element for retaining the bit in the tool holder while allowing some degree of axial movement, and a pair of open-ended grooves for receiving rotary driving splines 12, such bits being of a design referred to as "SDS Plus", but tool holders for other designs such as SDS Max, hex shank etc. may also be employed. The tool holder includes a hollow, generally cylindrical tool holder body 14 that has a rearward end 16 that can be inserted into the forward end 18 of the hammer spindle 1. A locking ball 20 for retaining the bit in the tool holder 10 is located in an elongate aperture 22 in the tool holder body 14, and is held in a position in which it extends into the bore of the tool holder body 14 (and into the recess of any bit held therein) by means of locking ring 24. The locking ring 24 is located in an axially slidable release sleeve 26 which can be moved rearwardly against the bias of a spring 28 to allow the locking ball 20 to move radially outwardly into recess 30 in order to allow removal of the bit.

[0025] The tool holder body 14 is held in the spindle 1 by means of four locking balls 32 located in apertures 34 in the spindle wall. The apertures 34 are slightly tapered in order to prevent the balls falling into the bore of the spindle 1, and the balls are held in the apertures by means of a snap ring 36. The locking balls 32 can move to a limited extent in the radial direction between a radially outermost position which allows attachment and removal of the tool holder 10, and a radially innermost position in which the tool holder is retained on the spindle. The tool holder body 14 has four depressions 38 in its outer surface for receiving the locking balls 32 when the tool holder 10 is retained on the spindle.

[0026] The tool holder 10 is provided with a manually operable sleeve 40 that can be rotated about the tool holder body 14 to a limited extent, and which houses a locking ring 42 that is positioned about the locking balls 32, and is held in the sleeve 40 by a radially compressed snap ring 43. The sleeve 40 also houses an annular plate 44 (shown partially cut-away in figure 2 to show its flanged periphery 45). The locking ring 42 has four peripheral projections 46 that can abut internal shoulders 48 in the sleeve 40 formed by portions 50 of greater wall thickness in order to limit the extent to which the locking ring can rotate with respect to the sleeve. In a similar fashion, the annular plate 44 has a pair of projections 52 in its periphery that can abut further internal shoulders 54 in the sleeve 40 to limit the extent to which the annular plate can rotate with respect to the sleeve. The annular plate 44 has a central aperture 56 to enable it to be located about the tool holder body 14, the aperture 56 having a flat 58 that cooperates with a flattened region 60 of the tool holder body 14 in order to prevent rotation of the annular plate 44 about the tool holder body. The annular plate 44 and the locking ring 42 are connected to each other by means of a helical spring 62, one end of which is located in a hole 64 in the annular plate, and the other end of which rests against one of the projections 46 on the locking ring. The spring 62 biases the annular plate 44 and the locking ring 42 to the limit of their rotation within the sleeve 40, that is to say, so that the projections 46 and 52 thereon abut the internal shoulders 48 and 54 in the sleeve, and so that the locking ring 42 and the tool holder body 14 can only be rotated with respect to the sleeve against the bias of the spring 62.

[0027] The locking ring 42 has an irregular inner surface having four relatively thick (i.e. of relatively small internal radius) regions 66 separated by four recesses 68. The recesses 68 themselves each have one portion 70 that is relatively deep and an adjacent portion 72 that is relatively shallow. The portions 70 of the recesses that are relatively deep provide pockets that can receive the locking balls 32 even when they are in their radially outermost position for allowing attachment and removal of the tool holder 10, but the relatively shallow portions 72 of the recesses 68 can receive the locking balls 32 only when they are in their radially innermost position. The relatively thick regions 66 cannot receive the locking balls 32 whatever position they are in.

[0028] The sleeve 40, annular plate 44, locking ring 42 and tool holder body 14 are arranged so that the spring 62 biases the locking ring to a position in which the relatively shallow portions 72 of the recesses 68 are in circumferential register with the depressions 38 in the tool holder body, and so that the locking ring can be rotated by a maximum of about 45° until the pockets 70 are in register with the depressions 38.

[0029] In order to install the tool holder 10 on the spindle 1 of the hammer, it is simply pushed onto the end 18 of the spindle so that the end 16 of the tool holder body 14 is located within the bore of the spindle. The end of the tool holder body will force the locking balls 32 radially outwardly to their outermost position. Further pushing of the tool holder 10 onto the spindle will result in the locking ring 42 abutting the locking balls 32. The tool holder 10 can then be rotated until the locking balls 32 are in register with the pockets 70 in the locking ring, whereupon the tool holder may be pushed further into the spindle until the rearwardly disposed face of the annular plate 44 abuts the end of the spindle, and the locking balls 32 are received in the pockets 70. This is the intermediate position which is referred to below. The sleeve 40 is then rotated in an anticlockwise direction by about 45° which causes rotation of the tool holder body 14 via the annular plate 44. Because the locking balls 32 are in their radially outermost position, they cannot be received in the relatively shallow portions 72 of the recesses 68, and the locking ring remains stationary with respect to the spindle, and so rotates, with respect to the sleeve 40 in a clockwise direction against the bias of the spring 62. The rotation of the sleeve (40) causes rotation of the tool holder body (14) via the annular plate (44). As soon as the tool holder 10 has been rotated about the spindle by about 45°, the depressions 38 in the tool holder body 14 will become in register with the locking balls 32 and the locking balls will move radially inwardly into their locking position in which they are received in the depressions 38. This radial movement of the locking balls 32 enables them to be received by the relatively shallow portions 72 of the recesses 68 in the locking ring 42, whereupon the locking ring will rotate in the anticlockwise direction under the bias of the spring 62 into its locking position with a clearly audible snap. The tool holder 10 is then firmly fixed on the end of the spindle.

[0030] In this operation, it is not necessary for the operator to align the tool holder with any parts of the spindle. The tool holder is simply pushed into the spindle, rotated until the locking balls 32 are received within the pockets 70 (observed a further axial movement of the tool holder 10) and the ring 40 rotated further until the locking ring 42 snaps into its locking position.

[0031] In order to remove the tool holder 10 from the spindle 1, the sleeve 40 is simply rotated by about 45° in the clockwise direction. This movement forces the locking ring 42 to rotate with the sleeve 40, but tool holder body 14 and the annular plate 44 remain stationary, due to the locking balls 32 engaging the depressions 38. Thus, with respect to the sleeve 40 and locking ring 42, the tool holder body and annular plate rotate in an anti-clockwise direction against the bias of the spring 62. When the locking ring 42 has rotated so that the locking balls 32 are in register with the pockets 70, the locking balls 32 will immediately move radially outwardly into the pockets. The tool holder body 14 is now free to move and will rotate in the clockwise direction under the bias of the spring 62 until the protuberances 52 once again abut the internal shoulders 54 in the sleeve 40, and the depressions 38 are out of register with the locking bodies 32 and the recesses (38) in the tool holder body are out of register with the locking balls (32). This rotation also occurs with a clearly audible snap. The tool holder may then simply be pulled axially off the spindle 1.

[0032] A modified form of tool holder is shown in figures 3 and 4. This form of tool holder is essentially the same as that shown in figures 1 and 2, but instead of a snap ring 43, the locking ring 42 is held within the interior of the sleeve 40 by means of a retention ring 100 having a generally "L" shaped circumferential cross-section. The retention ring 100 is provided with four flap portions 102 which fit inside the interior of the sleeve 40, and are each provided with a small protuberance 104, as shown in the shape of a double-headed arrow, that will fit inside a corresponding hole 106 in the wall of the sleeve to provide a positive engagement of the retention ring 100 in the sleeve 40.

Claims

1. A tool holder for a drilling and/or hammering tool comprising a manually actuable sleeve (40) wherein components of the tool holder are held within the sleeve by a snap ring (100) which snap ring is fitted within the sleeve, **characterised in that** the snap ring has at least one resilient arm (102) and the sleeve has a corresponding number of through holes (105) which extend to a radially outwardly facing surface of the sleeve, arranged such that the or each arm is engageable with a corresponding through hole in a snap fit, and each arm and through hole cooperate so that the portion (104) of the or each arm which can be viewed from the radially outwardly facing surface of the sleeve appears in the shape of a symbol.

2. A tool holder according to claim 1 wherein at least the radially outermost part of the or each through hole (105) is formed in the shape of the symbol.

3. A tool holder according to claim 2 wherein the radially outermost portion of the or each arm (104) is formed in the shape if the symbol to fit the corresponding through hole.

4. A tool holder according to any one of the preceding claims wherein the radially outermost portion (104) of the or each arm extending through the corresponding through hole is in the shape of the symbol.

5. A tool holder according to any one of the preceding claims wherein the or each resilient arm (102) is formed with a latch element (104) in the shape of the symbol and the latch element is received in a snap fit within a correspondingly shaped through hole (105).

6. A tool holder according to any one of the preceding claims wherein the symbol is an arrow designating the direction in which the manually actuable sleeve can be moved.

7. A tool holder according to any one of the preceding claims wherein the manually actuable sleeve is actuable to fit and/or remove a tool or bit from the tool holder.

8. A tool holder according to any one of the preceding claims wherein the manually actuable sleeve is actuable to fit and/or remove the tool holder form the drilling and/or hammering tool.

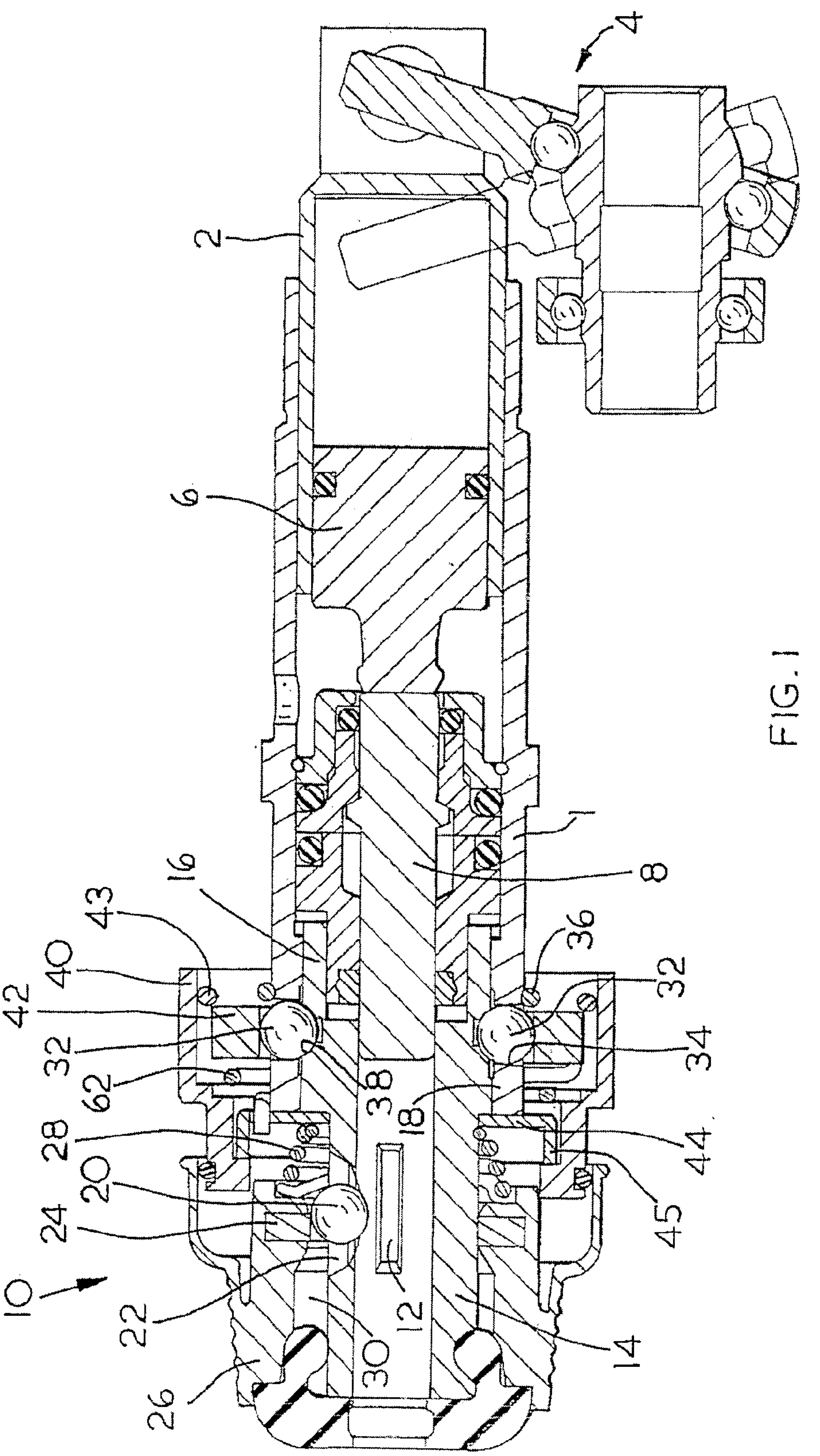

FIG. 1

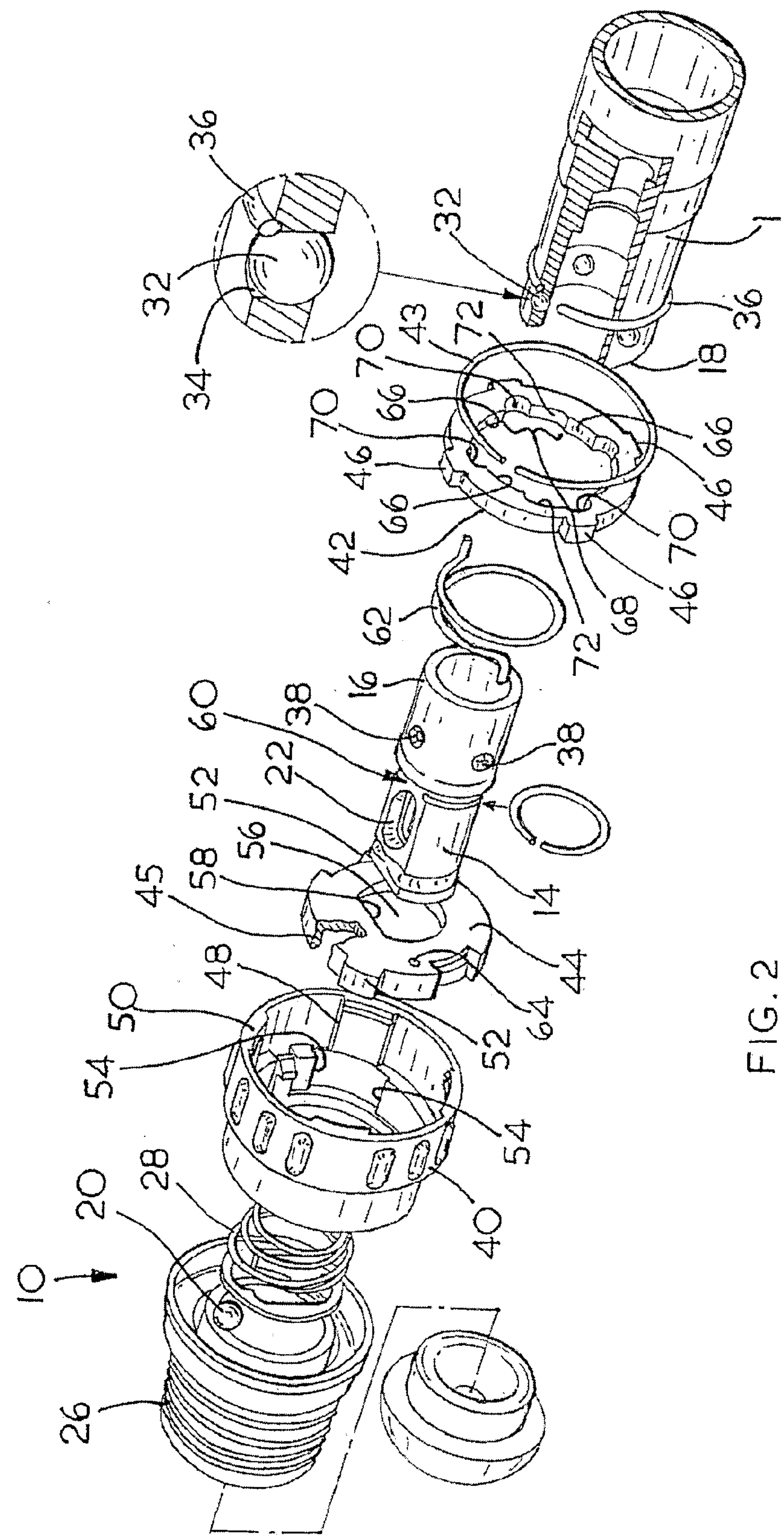
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FIG. 2

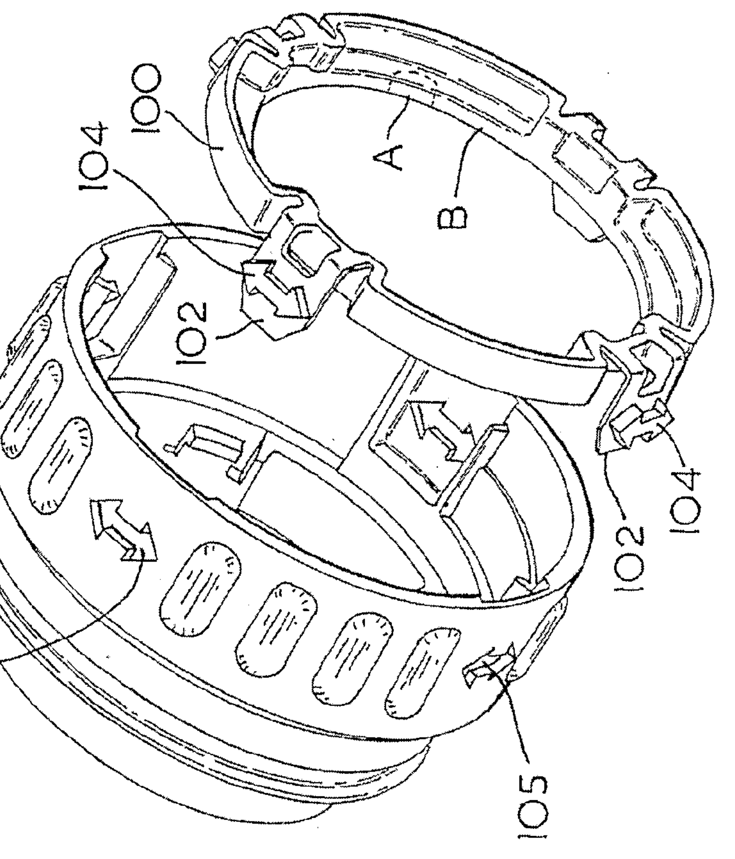

FIG.4

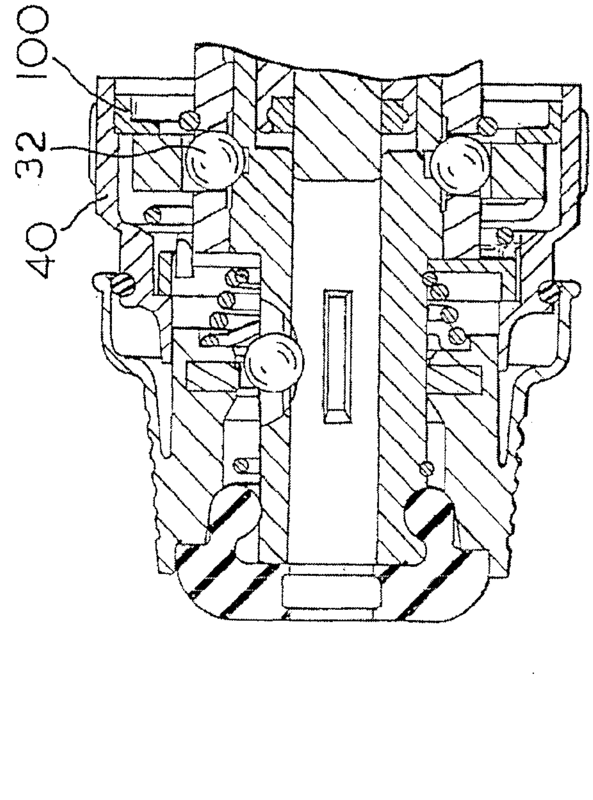

FIG.3

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- US 5437465 A **[0004] [0005]**