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(54) **Cylinder lock mechanism**

(57) There is provided a key operated cylinder lock mechanism, which comprises a housing (3), a barrel (5) rotatably mounted within the housing, and a set of discs (7) rotatably mounted within the barrel about an initial key insertion position, the set of discs (7) comprising a plurality of locking discs which are rotatable by means of combination surfaces on the shank (9) of the key. The cylinder lock mechanism also comprises a first locking bar (12) disposed in the barrel and operable to engage the housing to prevent rotation of the barrel from the initial key insertion position, and a peripheral notch (18) on each disc adapted to receive said locking bar whereby correct alignment of the peripheral notches in the discs forms an opening into which the locking bar can pass to release the barrel and thereby permit the barrel to rotate. The cylinder lock mechanism further comprises a second locking bar (31) disposed in the barrel and each of the discs (70) has a second peripheral notch (40) which when aligned form an opening for receiving the second locking bar.

The cylinder lock mechanism may also have spring means (72) acting radially on one or more of the locking discs separately urging each locking disc towards a rest position.

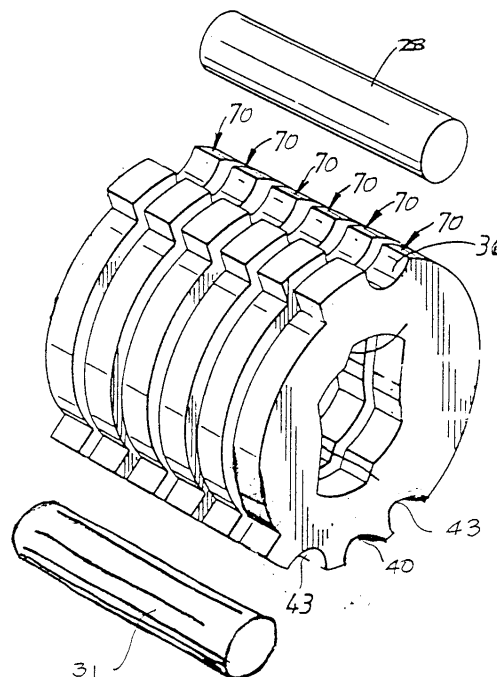


Fig. 2

Description

[0001] The present invention relates to a cylinder lock mechanism of the kind which incorporates rotary locking discs.

[0002] Such a cylinder lock mechanism is disclosed in EP-A-0215237. In that lock mechanism, the locking discs are rotatable within a barrel by means of a key and co-operate with a locking bar which can be moved radially into and out of locking engagement with a housing. The discs have a notch in their circumference and when the discs are rotated by means of combination surfaces on the shank of the key, the notches form a slot into which the locking bar can move, thus allowing the system to rotate and operate the lock.

[0003] It has become apparent that locks of this kind are being illegally by-passed. A turning moment is applied to the lock barrel and this turning moment induces a centripetal force in the locking bar. Using an appropriate tool, a skilled thief can locate the notches in the discs by feel and hence operate the lock.

[0004] The present invention provides a modified form of cylinder lock mechanism which reduces or eliminates the possibility of by-passing the lock in this way.

[0005] According to the present invention, there is provided a key operated cylinder lock mechanism, of the kind comprising a housing, a barrel rotatably mounted within the housing, a set of discs rotatably mounted within the barrel about an initial key insertion position, the set of discs comprising a plurality of locking discs which are rotatable by means of combination surfaces on the shank of the key; a first locking bar disposed in said barrel and operable to engage the housing to prevent rotation of the barrel from the initial key insertion position; and a peripheral notch on each disc adapted to receive the locking bar, whereby correct alignment of the peripheral notches in the discs forms an opening into which the locking bar can pass to release the barrel and thereby permit rotation thereof; the mechanism being characterised in that a second locking bar is disposed in the barrel and each of said discs has a second peripheral notch which when aligned form an opening for receiving said second locking bar, and at least one of the discs is provided with at least one additional peripheral notch, whereby alignment of respective notches on each disc with the at least one said additional notch by means other than the correct key permits the second locking bar to move into the aligned notches to allow partial rotation of the barrel from the initial key insertion position in relation to the housing, the first locking bar preventing further rotation of the barrel from the position of partial rotation whilst the correct peripheral notches remain misaligned.

[0006] By providing additional peripheral notches on one or more of the discs, manipulation of the system enables the locking discs to be rotated to one of several positions to form a slot into which the second locking bar can enter; however only when the correct alignment

of all discs is made using the key will the first locking bar be allowed to engage and permit rotation of the lock mechanism. This foils the location of the discs by "feel" since it provides a large number of different, incorrect, positions which give the impression that the discs are correctly aligned.

[0007] In one embodiment of the invention, all the discs may be provided with additional peripheral notches, and suitably more than one additional peripheral notch may be formed on each disc. In another embodiment, all the discs except one are provided with additional peripheral notches. The purpose of this is to prevent an incorrect selection of discs being made when using the correct key. By providing only correct notches at appropriate radial positions on one of the discs, the user of a key will be able to select only an alignment of notches which corresponds to the correct position for the first and second locking bars.

[0008] The additional notches are aligned in the discs such that any torque applied to the barrel of the lock is initially transmitted to the second locking bar, which, as before, may enable notches in the discs to be detected but the likelihood will be that these are the incorrect ones. Once all notches have been located, the barrel will begin to rotate but will then stop against the first locking bar unless the correct notches have been aligned. This is intended to confuse anyone trying to manipulate the system, who would then have to back-turn the lock barrel and start again. To implement this, in one embodiment of the invention, for each disc, in the direction of rotation of the lock, the radial distance between the first peripheral notch and the first locking bar is greater than the radial distance between the second locking bar and its additional peripheral notches.

[0009] According to another aspect of the invention, a key operated cylinder lock mechanism comprises a housing; a barrel rotatably mounted within the housing; a set of discs rotatably mounted within the barrel about an initial key insertion position, the set of discs comprising a plurality of locking discs which are rotatable by means of combination surfaces on the shank of the key; a locking bar disposed in the barrel and operable to engage the housing to prevent rotation of the barrel from the initial key insertion position; and a peripheral notch on each said disc adapted to receive said locking bar whereby correct alignment of the peripheral notches in said discs forms an opening into which said locking bar can pass to release the barrel and thereby permit rotation thereof; characterised in that spring means are provided acting radially on one or more of the locking discs and separately urging each disc towards a rest position.

[0010] The locking discs within conventional cylinder lock mechanisms are un-sprung which benefits anyone trying to manipulate the lock by aligning the discs one at a time. The object of individually spring-loading the discs is to make it difficult to move the discs separately. To achieve this, in one aspect of the invention, spacers are disposed between the discs and the spring means

comprise individual torsion springs mounted within the spacers, each acting on a corresponding adjacent disc. In an alternative aspect of the invention, the barrel has a spring abutment, the discs each have a respective shoulder and the spring means comprise individual compression springs disposed between the spring abutment and the disc shoulder, to act upon the discs.

[0011] In order that the invention may be more fully understood, embodiments in accordance therewith will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 shows a conventional key operated cylinder lock mechanism of the kind which incorporates rotary locking discs, according to the prior art;

Fig. 2 shows an exploded perspective view of the internal components of a cylinder lock mechanism in accordance with an embodiment of the present invention;

Fig. 3 shows a radial section through the cylinder lock mechanism of Fig. 2, shown with a key inserted; and

Fig. 4 is an exploded perspective view partly cut away of a disc and spacer of a cylinder lock mechanism according to another aspect of the invention.

Fig. 5 is a partial cut away view of a disc and a portion of the barrel showing a compression spring acting on the disc.

[0012] Referring to the drawings, Fig. 1 shows a conventional key operated cylinder lock mechanism comprising a hollow stationary cylinder housing 3, a lock barrel 5 mounted rotatably within the housing 3, and a set of discs 7 rotatably mounted within the barrel about an initial key insertion position. The discs comprise a stack of locking discs (as, for example, shown in Fig. 2) which are rotatable by means of combination surfaces on the shank 9 of a key. The cylinder lock mechanism is additionally provided with a locking bar 12 disposed in an axially directed slot 14 formed in the wall of barrel 5 which locking bar 12 is partially received within axially directed groove 16 formed in housing 3. The flanks 17, 17a of groove 16 act on locking bar 12 to prevent rotation of the barrel 5. As will be apparent from Fig. 1, in the locked position shown, limited relative rotation of barrel 5 in housing 3 is permitted by groove 16 between the abutments formed by flanks 17, 17a of groove 16.

[0013] Discs 7 are provided with peripheral notches 18 to receive the locking bar 12, whereby correct alignment of the peripheral notches 18 in each of the discs 7 enables the locking bar to pass into the opening formed by the aligned notches and, urged by the camming surfaces of the flanks 17, 17a of groove 16, allow the locking bar to pass beyond the groove 16 thereby

permitting rotation of barrel 5. The barrel is driven in rotation by stops 20, 23 formed on discs 5 which cooperate with grooves 22, 24 on barrel 5.

[0014] Such locks are conventional in the art and will not be described in further detail here. Referring now to Figs. 2 and 3 of the drawings, the lock according to the invention is similarly provided with a housing 30, a barrel 50, and discs 70, for operation by the shank of a key 90, but in this case two locking bars are provided 28, 31 housed in corresponding slots 33, 34 in barrel 50. First locking bar 28 is equivalent to locking bar 12 in the conventional lock shown in Fig. 1, and co-operates with similar notches 36 formed in discs 70. Alignment of the notches 36 in discs 70 is necessary before locking bar 28 can pass into the unlocked position shown in Fig. 3, thereby permitting rotation of barrel 50.

[0015] Likewise, second locking bar 31 is operable to pass into a second peripheral notch 40 disposed on each disc 70 opposite notch 36 thus permitting movement of second locking bar 31 radially inwardly when the discs are rotated into the correct unlocking position.

[0016] The use of two locking bars 28, 31 provides a more secure locking arrangement than the single locking bar of the prior art.

[0017] In addition to second peripheral notches 40, the discs 70 are provided with additional peripheral notches 42, 43 located adjacent notch 40. The purpose of these notches is to make operation of the lock without the proper key extremely difficult.

[0018] With the conventional lock system shown in Fig. 1, if a turning moment is applied to the lock barrel 5, a force is imparted to locking bar 12 and this enables the notches in discs 7 to be located by feel. The discs can be aligned using an appropriate tool, and the lock then operated once the discs are all in the correct position. In the lock of the present invention, the additional notches in the discs 70 mean that each disc can be rotated to one of several positions all of which will give the impression of accommodating locking bar 31. Eventually the discs 70 may be aligned to accommodate locking bar 31, but the likelihood will be that this alignment will not be the correct alignment to free the first locking bar 28, which will continue to prevent rotation of the lock barrel 50 within the housing.

[0019] Each of the locking bars 28, 31 cooperates with a corresponding axial groove 45, 46 in housing 30. The flanks of groove 45 extend slightly radially beyond the flanks of groove 46 in relation to locking bar 33 so that some rotation of the barrel 50 is permitted once second locking bar 31 has passed into the aligned notches in discs 70 even though locking bar 28 may still be in the locked condition. The effect of this is that when all the incorrect notches have been located, the barrel 50 will begin to rotate but will stop once the leading flank of groove 45 engages the first locking bar 28. This is designed to confuse anyone trying to manipulate the system, who will then have to turn the barrel 50 back to the starting position and begin again.

[0020] By providing additional notches 42,43 on the periphery of each disc 70, a very large number of possible combinations can be provided thus making it much more difficult to find the correct alignment of the discs by feel. During such an attempt, because of the orientation of correct notches 36 and the length of groove 45, even though locking bar 28 may be aligned with correct notches 36, this will not be apparent to the person manipulating the lock since there will be no camming action taking place between the flanks of groove 45 and locking bar 28.

[0021] Fig. 4 shows a further anti-theft feature applied to a lock of this kind. In this embodiment, the discs 70 (one shown cut away) are separated by spacers 60 each of which is provided with a circular groove 62 housing a torsion spring 64. One end 66 of the torsion spring is anchored in spacer 60 while the other end 67 is bent up to engage a hole 68 in discs 70. The torsion spring urges discs 70 radially towards stop 69 which engages a corresponding surface on barrel 90. By spring-loading all the discs 70 to a stop position, unauthorised movement of the individual discs 70 into their unlocking positions is made extremely difficult since each time a disc is aligned with the locking bar, it will try to return to its rest position unless it is held there. This frustrates any system which relies on relocating the discs one by one into their unlocking position.

[0022] Fig. 5 shows an alternative embodiment of the anti-theft feature shown in Fig. 4. In this embodiment, the discs 70 are each provided with a shoulder 71 and the barrel 50 is provided with a spring abutment here shown as a radially protruding finger 51. A compression spring 72 is disposed between the spring abutment and the disc shoulder to spring load the disc 70 towards a stop position. Spacers may be provided on either side of each disc so as to constrain the spring 72.

[0023] It will be understood by those skilled in the art that other resilient means imposing a couple between the barrel and the disc can be used to provide the desired anti-theft feature.

Claims

1. A key operated cylinder lock mechanism, comprising:
 - a housing;
 - a barrel rotatably mounted within the housing;
 - a set of discs rotatably mounted within the barrel about an initial key insertion position, the set of discs comprising a plurality of locking discs which are rotatable by means of combination surfaces on the shank of the key;
 - a first locking bar disposed in said barrel and operable to engage the housing to prevent rotation of the barrel from the initial key insertion position; and a peripheral notch on each said

disc adapted to receive said locking bar whereby correct alignment of the peripheral notches in said discs forms an opening into which said locking bar can pass to release the barrel and thereby permit rotation thereof; characterised in that

a second locking bar is disposed in said barrel and each of said discs has a second peripheral notch which when aligned form an opening for receiving said second locking bar; and at least one of said discs is provided with at least one additional peripheral notch, whereby alignment of respective second or additional peripheral notches on each disc by means other than the correct key permits the second locking bar to move into the aligned notches to allow partial rotation of the barrel from the initial key insertion position in relation to the housing, the first locking bar preventing further rotation of the barrel from the position of partial rotation whilst the correct peripheral notches remain mis-aligned.

2. A key operated cylinder lock mechanism as claimed in Claim 1, wherein said at least one disc is provided with at least two additional peripheral notches.
3. A key operated cylinder lock mechanism as claimed in Claim 1 or Claim 2, wherein all said discs are provided with additional peripheral notches.
4. A key operated cylinder lock mechanism as claimed in Claim 1 or Claim 2, wherein all said discs apart from one are provided with additional peripheral notches.
5. A key operated cylinder lock mechanism as claimed in any one of the preceding claims, in the direction of rotation of the lock, for each disc, wherein, in the direction of rotation of the lock, for each disc, the radial distance between the peripheral notch and the first locking bar is greater than the radial distance between the or each additional peripheral notches and the second locking bar.
6. A key operated cylinder lock mechanism as claimed in any one of the preceding claims, further comprising spring means acting radially on each locking disc and separately urging each said locking disc towards a rest position.
7. A key operated cylinder lock mechanism as claimed in Claim 6, wherein spacers are disposed between said discs, and said spring means comprise individual torsion springs mounted within said spacers, each acting on a corresponding adjacent disc.
8. A key operated cylinder lock mechanism as claimed

in claim 6 wherein the barrel has a spring abutment, each disc has a shoulder and said spring means comprise individual compression springs disposed between said abutment and said shoulder to act on a corresponding disc.

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9. A key operated cylinder lock mechanism, comprising:

a housing;

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a barrel rotatably mounted within the housing;

a set of discs rotatably mounted within the barrel about an initial key insertion position, the set

of discs comprising a plurality of locking discs

which are rotatable by means of combination

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surfaces on the shank of the key;

a locking bar disposed in said barrel and operable to engage the housing to prevent rotation

of the barrel from the initial key insertion position;

and a peripheral notch on each said disc

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adapted to receive said locking bar whereby

correct alignment of the peripheral notches in

said discs forms an opening into which said

locking bar can pass to release the barrel and

thereby permit rotation thereof; characterised

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in that spring means are provided acting radi-

ally on one or more of said locking discs and

separately urging each said locking disc to-

wards a rest position.

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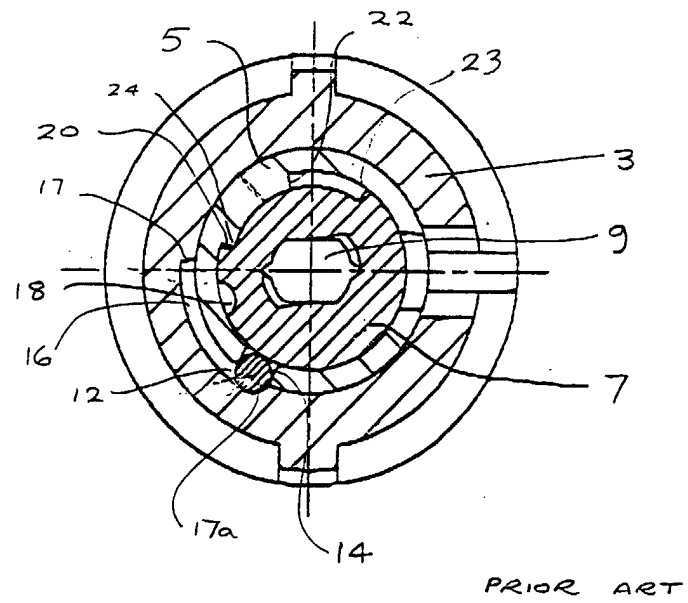


FIG. 1

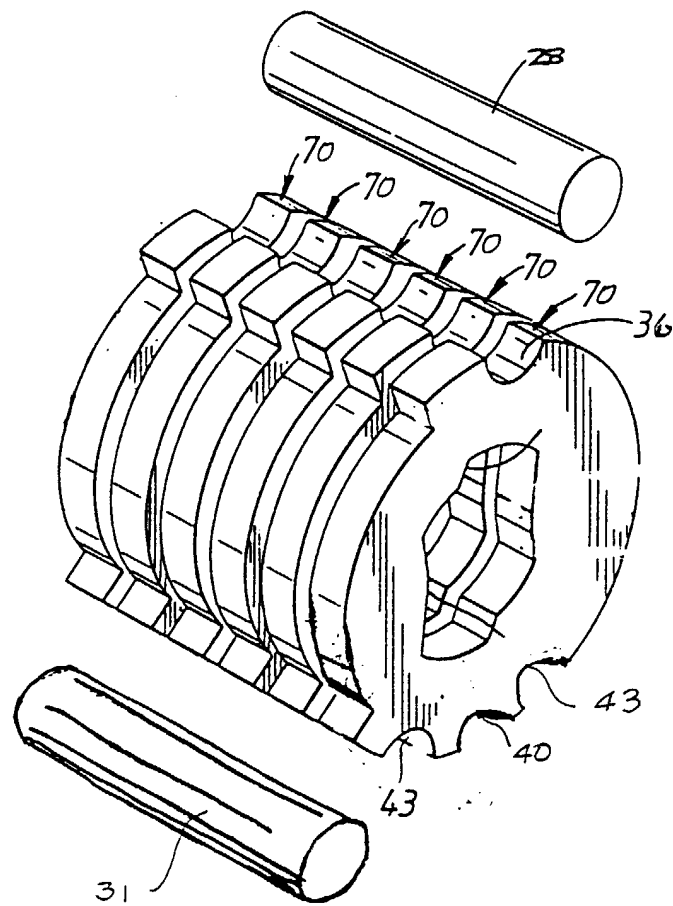


Fig. 2

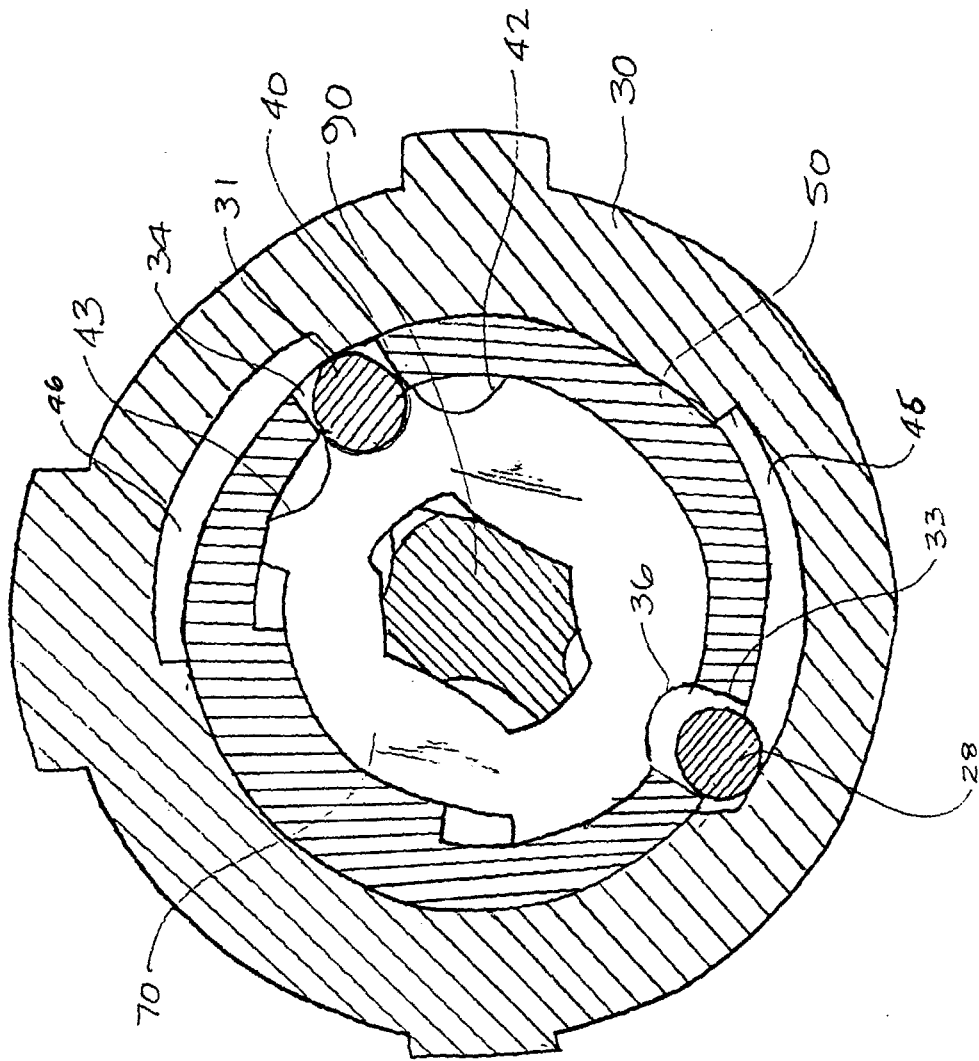


Fig. 3

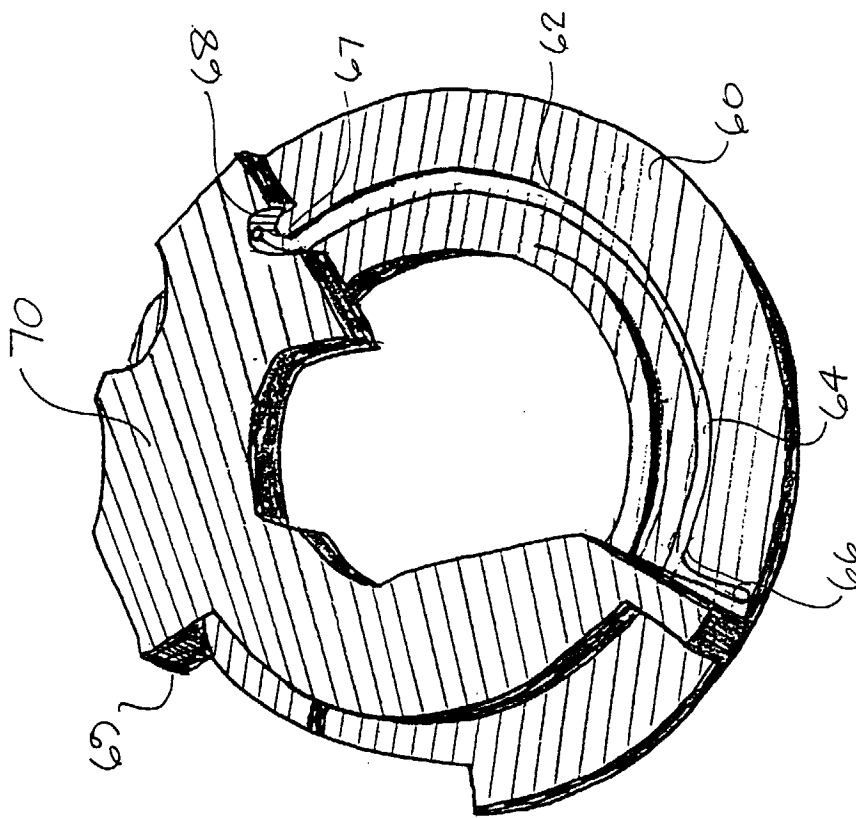


FIG. 4

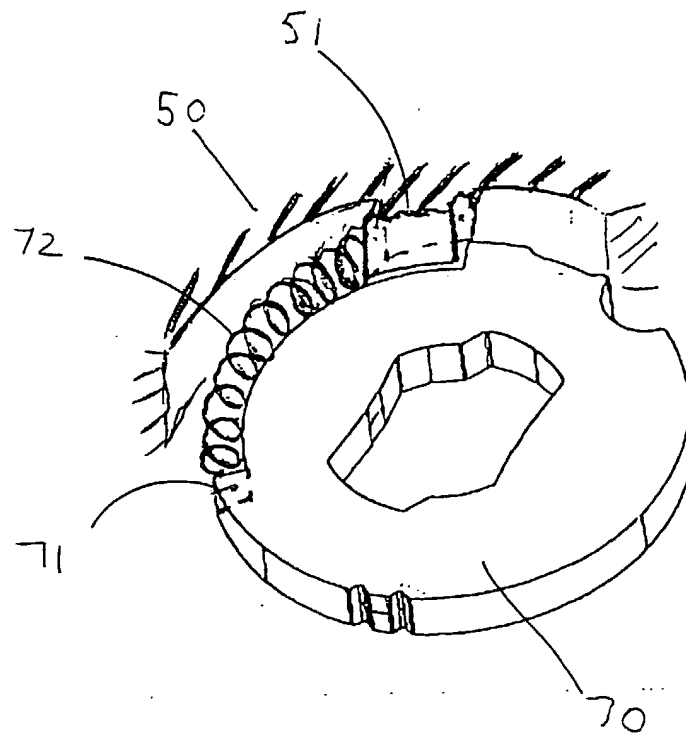


FIG 5



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 99 30 4688

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 712 979 A (ABUS AUG BREMICKER SOEHNE KG) 22 May 1996 (1996-05-22) * column 3, line 12 - column 6, line 58; figures 4-13 *	1-9	E05B21/06
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A	DE 21 35 106 A (HUELSBECK & FUERST) 25 January 1973 (1973-01-25) * page 4, paragraph 4 - page 7, paragraph 1 *	1-9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			E05B
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 7 December 1999	Examiner Friedrich, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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07-12-1999

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