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(54) **Lock assembly**

(57) Lock mechanisms comprising a barrel, a housing within which the barrel may rotate, a plurality of tumblers adapted to be driven within passages formed in the barrel, and a channel within the housing adapted to engage with tumbler extending beyond a periphery of the barrel are known. Such mechanisms may be used to operate latch mechanisms of a motor vehicle. In the present invention, means 144, 146 are provided to limit a stroke of at least one tumbler 113 to prevent abutment of said tumbler with the housing.

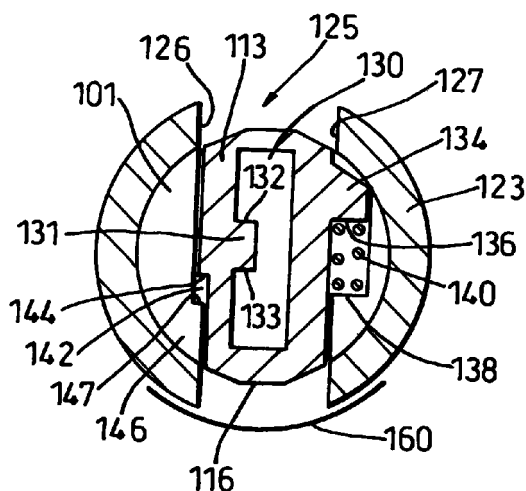


Fig. 3

Description

[0001] The present invention relates to a lock assembly and, in particular to a lock assembly for use with motor vehicle closures such as doors and bonnets.

[0002] Lock assemblies are known which include a housing and a barrel rotatable therein with respect to the housing which may be either in a locked mode or an unlocked mode as required by insertion or withdrawal of a correct key. This in turn allows a latch mechanism connected to the lock assembly to be locked or unlocked as required.

[0003] A lock assembly is known comprising a housing, a barrel, a channel having side walls and a plurality of tumblers located within the barrel. Each tumbler is provided with an opening therein. On insertion of a correct key through the tumblers, the tumblers are drawn within the barrel in order that the barrel may be allowed to rotate. If an incorrect key is inserted, the tumblers may be moved out of an initial position, but at least one tumbler will extend beyond a periphery of the barrel between the side walls of the channel to prevent movement of the barrel with respect to the channel.

[0004] It is a problem that each tumbler may be urged to a position of maximum displacement beyond the barrel, i.e. abutment with a surface disposed beyond the periphery of the barrel, by driving the tumbler to such a position, such that it is possible to identify a relative position of a driven surface of the tumbler and an edge of the tumbler abutting the surface. Since the clearance between the barrel and the surface is fixed, it is possible to interpolate an amount by which the tumbler at that position may be driven and remain within the barrel. Conducting the process for each tumbler will allow a key to be generated that will position each tumbler such that it is located within the barrel, so that the barrel is free to move. In this way, the security of the lock mechanism may be compromised.

[0005] It is an advantage of the present invention that it eliminates, or at least reduces, the risk of the security of the lock mechanism being compromised in this way.

[0006] According to the present invention, a lock mechanism comprises a barrel, a housing within which the barrel may rotate, a plurality of tumblers adapted to be driven within passages formed in the barrel, a channel having side walls adapted for abutment with side surfaces of the tumblers extending beyond a periphery of the barrel, and a surface disposed beyond a periphery of the barrel is characterised in that means are provided to limit a stroke of at least one of the plurality of tumblers to prevent abutment of the at least one of the plurality of tumblers with the surface.

[0007] Preferably, the at least one tumbler comprises a driven surface, an external shoulder extending from one side thereof, the external shoulder having a lower surface, and a shoulder is located in an adjacent region of the passage in which the at least one tumbler

is to be driven, spring means act between the passage shoulder and the tumbler shoulder, and a shoulder height of the at least one tumbler is less than the distance between a position of the lower shoulder surface within the barrel and the surface when the at least one tumbler is in a fully deflected position.

[0008] More preferably, the at least one tumbler further comprises a recess having a first surface, and in that the adjacent region of the passage in which the at least one tumbler is to be driven further comprises a ledge for abutment with the first surface of the recess, the at least one tumbler plate being in the fully deflected position when the first surface of the recess abuts the ledge. Alternatively, the at least one tumbler plate is in the fully deflected position when the spring means is in a fully compressed condition.

[0009] The present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows a cross sectional view along a lock mechanism of the present invention;

Figure 2 shows a cross sectional view across a tumbler and a neighbouring region of a barrel of a known lock mechanism;

Figure 3 shows a cross sectional view across a tumbler and a neighbouring region of a barrel according to a first embodiment of the present invention;

Figure 4 shows a cross sectional view across a tumbler and a neighbouring region of a barrel according to a second embodiment of the present invention;

Figure 5A shows a cross sectional view across a tumbler and a neighbouring region of a barrel according to a third embodiment of the present invention with the tumbler in a neutral position;

Figure 5B shows a cross sectional view across the tumbler and neighbouring region of the barrel of Figure 5B with the tumbler in an extended position;

Figure 6A shows a cross sectional view across a tumbler and a neighbouring region of a barrel according to a fourth embodiment of the present invention with the tumbler in a neutral position;

Figure 6B shows a cross sectional view across the tumbler and neighbouring region of the barrel of Figure 6B with the tumbler in an extended position; Figure 6C shows a cross sectional view along a lock mechanism according to the fourth embodiment of the invention; and

Figure 7A shows a cross sectional view across a tumbler and a neighbouring region of a barrel according to a fifth embodiment of the present invention with the tumbler in a neutral position;

Figure 7B shows a cross sectional view across the tumbler and neighbouring region of the barrel of Figure 7B with the tumbler in an extended position.

[0010] Referring first to Figure 1, there may be seen a section along a known lock mechanism comprising a cylindrical barrel 1 having a keyway 2. In the illustrated embodiment, the barrel 1 is rotatably mounted within a cylindrical sleeve 23 itself rotatably mounted in a housing 17. The sleeve 23 has a pair of oppositely disposed channels 25 extending therealong to receive a plurality of tumblers 13. The channels each comprise first and second side walls 26,27. The barrel may be either in a locked mode or an unlocked mode as required by insertion or withdrawal of a correct key (not shown) from the keyway 2. In the unlocked mode, the barrel rotates with respect to the sleeve and the housing such that a latch mechanism may be operated. In the locked mode, the barrel is keyed to the sleeve such that they rotate together with respect to the housing and operation of the latch is not possible.

[0011] In an alternative embodiment (not shown) the channel may be provided directly in the housing. In such an embodiment, in the unlocked mode, the barrel rotates with respect to the housing such that a latch mechanism may be operated, and in the locked mode, the barrel is keyed to the housing such that rotation of the barrel in the housing and operation of the latch is not possible.

[0012] The plurality of tumblers 13 are located individually in a corresponding plurality of slots or receiving passages formed in the barrel. Each tumbler 13 comprises a plate having an opening 30, as may be seen from Figure 2. The opening 30 forms a part of the keyway 2 through which a key must pass. The opening 30 includes an inwardly extending protrusion or shoulder 31. The shoulder is so located that on insertion of a key, an upper or lower surface 32,33 of the shoulder is driven to move the tumbler within its associated receiving passage.

[0013] An externally extending shoulder 34 is provided on one side of the tumbler. The shoulder 34 has a first surface 36. A shoulder 38 formed in the barrel is provided in the passage within which the tumbler is received. Spring means 40 are disposed between the first surface 36 of the tumbler shoulder 34 and the shoulder 38 within the passage. The spring means are used to maintain the tumbler in a neutral position such that as a leading edge of the key enters the opening in the tumbler, the upper and lower driving surfaces of the shoulder within the opening of the tumbler are in position to be presented to driving surfaces formed on the key. A helical spring is suitable for this purpose.

[0014] The shape of the slot or passage may be modified to accommodate the spring means. For example, in the case of a helical spring the shape of the slot or passage in the region of the helical spring may be generally cylindrical. In this way, the helical spring is located in an operative position within the slot or passage and will not prevent the correct insertion of an associated tumbler.

[0015] In a locked mode at least one of the plurality

of tumblers 13 extends radially outward from a periphery 15 of the barrel into one of the channels 25. Attempts to rotate the key will result in a side surface of the tumbler abutting a side wall of the channel to prevent relative rotation of the barrel with respect to the channel. The sleeve will then rotate with the barrel.

[0016] In operation, with the correct key inserted correctly into the keyway 2, the tumblers 13 will all be driven to a position such that none of the tumblers 13 extend beyond the barrel periphery 15, allowing rotation of the barrel with respect to the channel, and thus the sleeve which will thereby allow a latch mechanism to unlock or lock according to the direction in which the barrel is rotated. If an incorrect key or other unauthorised instrument is inserted into the keyway, one or more of the tumblers should extend beyond the barrel periphery and into one of the channels 25 thereby preventing rotation of the barrel with respect to the sleeve which in turn will prevent operation of the latch mechanism.

[0017] Turning to the present invention, means are provided to limit a displacement of at least one of a plurality of tumblers. In a first embodiment shown in Figure 3, there is shown one such tumbler 113 together with an associated portion of a barrel 101. The tumbler 113 is formed as a plate of generally rectangular shape and includes an opening 130 also of generally rectangular shape. In use, the opening forms part of a keyway. An internally protruding shoulder 131 is provided extending into the opening. Upper and lower surfaces 132,133 of this shoulder form driven surfaces which move the tumbler within an associated passage in the barrel on insertion of a key into the keyway. Conveniently, an upper edge and a lower edge 116 of the tumbler may be rounded to match the curvature of the periphery 115 of the barrel.

[0018] An external shoulder 134 extends from a first side of the tumbler. The shoulder 134 has a first lower surface 136. A recess 142 is provided on a second side of the tumbler. The recess is provided with a first lower surface 144.

[0019] A sleeve 123 is disposed about the barrel. The sleeve 123 includes a channel 125 having side walls 126,127. In the illustrated embodiment, a surface 160 of a housing is disposed beyond the periphery of the barrel.

[0020] An associated portion of the barrel is provided with a shoulder 138 to the first side of the tumbler. The associated portion of the barrel is provided with a ledge 146 having an abutment surface 142 to the second side of the tumbler. Spring means 140 are disposed between the barrel shoulder 138 and the tumbler shoulder 134. The spring means again act to maintain the tumbler in a neutral position such that as a leading edge of the key enters the opening 130 in the tumbler, the upper and lower driving faces of the shoulder within the opening of the tumbler are in position to be presented to driving surfaces formed on the key.

[0021] The abutment surface 147 forms a seating

for the first surface 144 of the recess formed in the tumbler. When the first surface 144 of the tumbler recess 142 abuts the ledge, the seating will resist attempts to move the tumbler beyond this position. The ledge position is so designed that all movement of the tumbler 113 required by the correct key is possible.

[0022] A shoulder height, that is the height of the lower shoulder surface 136 above the lower edge 116 of the tumbler, is less than the distance between the height of the lower shoulder surface 136 within the barrel and the surface 160 when the at least one tumbler plate is in a fully deflected position, that is when the first surface 144 of the tumbler recess 142 abuts the ledge. It will be understood that the precise locations of the ledge and recess are a matter of design.

[0023] A second embodiment of a suitable tumbler is shown in Figure 4. The tumbler 213 is provided in the form of a plate having an opening 230. An internally protruding shoulder 231 is provided extending into the opening. Upper and lower surfaces 232,233 of this shoulder form driven surfaces which move the tumbler within an associated passage in the barrel on insertion of a key into the keyway. An external shoulder 234 extends from a first side of the tumbler. The shoulder 234 has a first lower surface 236. A recess 242 is also provided on the first side of the tumbler. The recess is provided with a first lower surface 244.

[0024] An associated portion of a barrel 201 is provided with an abutment surface in the form of a ledge 246 having an abutment surface 147 to the first side of the tumbler. The associated portion of the barrel is also provided with a shoulder 238 to the first side of the tumbler. Spring means 240 are disposed between the barrel shoulder 238 and the tumbler shoulder 234. The shape of the slot or passage may be modified as noted above to accommodate the spring means.

[0025] On insertion of a key, the key drives one of the drive surfaces in the opening 230 provided in the tumbler to move the tumbler up or down as seen in Figure 4. It will be understood that the downward travel of the tumbler is limited by the abutment of the lower surface of the recess 242 formed on the tumbler with the abutment surface 247 of the ledge 246 formed on the barrel.

[0026] A shoulder height, that is the height of the lower shoulder surface 236 above the lower edge 216 of the tumbler, is less than the distance between the height of the lower shoulder surface 236 within the barrel and the surface when the at least one tumbler plate is in a fully deflected position, that is when the lower surface of the recess 242 abuts the ledge 246.

[0027] A third embodiment of a suitable tumbler is shown in Figures 5A and 5B. A tumbler 313 is provided in the form of a plate having an opening 330. An internally protruding shoulder 331 is provided extending into the opening. An upper surface 332 and a lower surface 333 of this shoulder form driven surfaces which move the tumbler within an associated passage in the barrel

on insertion of a key into the keyway. The plate has an upper edge and a lower edge 316. An external shoulder 334 extends from on a first side edge of the tumbler. The shoulder 334 has a first lower surface 336.

[0028] An associated portion of a barrel 301 is provided with a shoulder 338 to the first side of the tumbler. Spring means 340 are disposed between the barrel shoulder 338 and the tumbler shoulder 334. The shape of the slot or passage may be modified as noted above to accommodate the spring means.

[0029] A sleeve 323 is disposed about the barrel. The sleeve 323 includes a channel 325 having side walls 326,327. In the illustrated embodiment, a surface 360 is disposed beyond the periphery of the barrel.

[0030] A distance D is defined as the distance between the position of shoulder surface 336 within the barrel and the surface 360 when the spring means is in a fully compressed condition. A shoulder height d is defined as the height of the shoulder surface 336 above the bottom edge 316 of the tumbler. If the distance D is greater than the shoulder height d, then the bottom edge of the tumbler cannot touch the surface 316 even when the spring means is fully compressed.

[0031] On insertion of a key, the key drives one of the drive surfaces in the opening 330 provided in the tumbler to move the tumbler up or down as seen in Figures 5A and 5B. It will be understood that the distance D is a function of the compressibility of the spring means and the location of the barrel shoulder surface. Accordingly, a prior art device such as that illustrated in Figures 1 and 2 may be converted to a device in accordance with the present invention by substitution of the spring means 140 for spring means that prevent the lower edge 116 from abutting the surface disposed beyond the periphery of the barrel. Alternatively, the location of the barrel shoulder 338 may be varied as between tumbler locations and lock mechanisms. However, such barrels are typically die cast and such an arrangement would need the use of many different barrels produced by the use of many dies.

[0032] A forth embodiment of a suitable tumbler is shown in Figures 6A,6B and 6C. A tumbler 413 is provided in the form of a plate having an opening 430. An internally protruding shoulder 431 is provided extending into the opening. An upper surface 432 and a lower surface 433 of this shoulder form driven surfaces which move the tumbler within an associated passage in the barrel on insertion of a key into the keyway. The plate has an upper edge and a lower edge 416. An external shoulder 434 extends from a first side of the tumbler. The shoulder 434 has a first lower surface 436.

[0033] The associated portion of a barrel 401 is provided with a shoulder 438 to the first side of the tumbler. Spring means 440 are disposed between the barrel shoulder 438 and the tumbler shoulder 434. The shape of the slot or passage may be modified as noted above to accommodate the spring means.

[0034] A sleeve 423 is disposed about the barrel.

The sleeve 423 includes a channel 425 having side walls 426,427. In the illustrated embodiment, a surface 460 of a housing is disposed beyond the periphery of the barrel.

[0035] A distance D is defined as the distance between the position of shoulder surface 436 within the barrel and the surface 460 when the spring means is in a fully compressed condition. A shoulder height d is defined as the height of the shoulder surface 436 above the bottom edge 416 of the tumbler. If the distance D is greater than the shoulder height d, then the bottom edge of the tumbler cannot touch the surface 460 even when the spring means is fully compressed.

[0036] It will be further appreciated that the distance D is a function of the location of the surface disposed beyond the periphery of the barrel. Thus, the barrel of Figures 1 and 2 could be used with the housing of Figures 6A, 6B and 6C, in which the surface disposed beyond the periphery of the barrel is located beyond a maximum displacement of the tumblers, so they cannot abut the surface.

[0037] Other variations are also possible. For example, changing the location of the tumbler shoulder lower surface 736 with respect to the lower edge 716 of the tumbler will change the shoulder height d in each case. Accordingly, the thickness of the shoulder may be increased to lower the tumbler shoulder lower surface 736 to reduce the shoulder height d to be less than the distance D. The barrel of Figures 1 and 2 may be used with such a tumbler to produce a lock mechanism in accordance with the present invention (Figures 7A and 7B).

[0038] In all of the embodiments, it is preferred that the top edges of the plurality of tumblers are in different locations when all of the plurality of tumblers are in a fully deflected position, that is when each of the plurality of tumbler plates is in a fully deflected position, the top edges of the tumblers are not aligned.

Claims

1. A lock mechanism comprising a barrel (1;101;201;301;401), a housing (17) within which the barrel (1;101;201;301;401) may rotate, a plurality of tumblers (13;113;213; 313;413) adapted to be driven within passages formed in the barrel (1;101;201;301;401), a channel (25;125;225;325;425) having side walls (26,27;126,127; 226,227;326,327;426,427) adapted for abutment with side surfaces of the tumblers (13;113;213;313;413) extending beyond a periphery of the barrel (1;101;201;301;401), and a surface (160;260;360;460) disposed beyond a periphery (15;115) of the barrel (1;101;201;301;401), in which at least one of the tumblers (13;113;213;313;413) comprises a driven surface (32,33;132,133;232,233;332,333;432,433) and an external shoulder (34;134;234;334;434) extending from one side thereof, the external shoulder

(34;134;234;334;434) having a lower surface (36;136;236;336;436), in which a shoulder (38;138;238;338;438) is located in an adjacent region of the passage in which the at least one of the tumblers (13;113;213;313;413) is to be driven, and in which spring means (40;140;240;340;440) act between the passage shoulder (38;138;238;338;438) and the tumbler shoulder (34;134;234;334;434) is characterised in that a shoulder height (d) of the at least one of the tumblers (13;113;213;313;413) is less than a distance (D) between a position of the lower shoulder surface (36;136;236;336;436) within the barrel (1;101;201;301;401) and the surface (160;260;360;460) when the at least one of the tumblers (13;113;213;313;413) is in a fully deflected position.

2. A lock mechanism according to claim 1, characterised in that the at least one of the tumblers (113) further comprises a recess (142) having a first surface (114), and in that the adjacent region of the passage in which the at least one of the tumblers (113) is to be driven further comprises a ledge (146) for abutment with the first surface (114) of the recess (142), the at least one of the tumblers (113) being in the fully deflected position when the first surface (114) of the recess (142) abuts the ledge (146).

3. A lock mechanism according to claim 2, characterised in that the recess (142) and the externally extending shoulder (134) are disposed on one side of the at least one of the tumblers (113).

4. A lock mechanism according to claim 2, characterised in that the recess (142) and the externally extending shoulder (134) are disposed on opposite sides of the at least one of the tumblers (113).

5. A lock mechanism according to claim 1, characterised in that the at least one of the tumblers (13;113;213;313;413) is in the fully deflected position when the spring means (140;240;340;440) is in a fully compressed condition.

6. A lock mechanism according to any previous claim, characterised in that the at least one of the tumblers (13;113;213;313;413) comprises three or more tumblers (13;113;213;313;413).

7. A lock mechanism according to any previous claim, characterised in that the surface (160;260;360;460) is located between the side walls (26,27;126,127;226,227; 326,327;426,427) of the channel (25;125;225;325;425).

8. A lock mechanism according to any of claims 1 to 7,

characterised in that the surface (160;260;360;460)
is formed in the housing (17).

9. A lock mechanism according to any previous claim,
characterised in that the channel is formed in a sleeve disposed for rotation between the barrel
(1;101;201;301;401) and the housing (17). 5
10. A lock mechanism according to any previous claim,
characterised in that top edges of the plurality of
tumblers (13;113;213;313;413) are in different loca- 10
tions when all of the plurality of tumblers
(13;113;213;313;413) are in a fully deflected posi-
tion.

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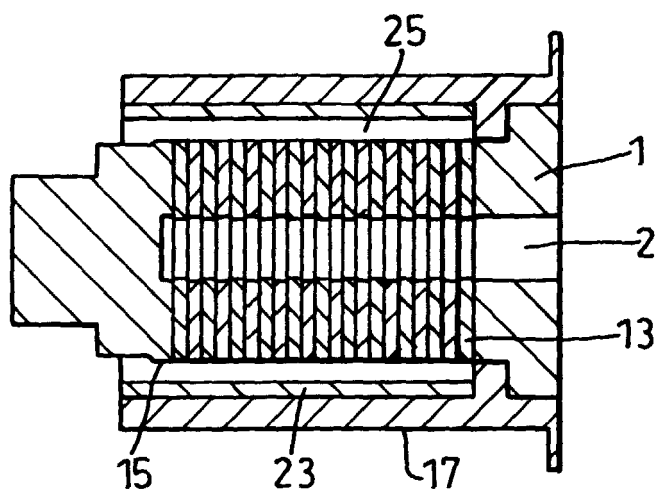


Fig. 1

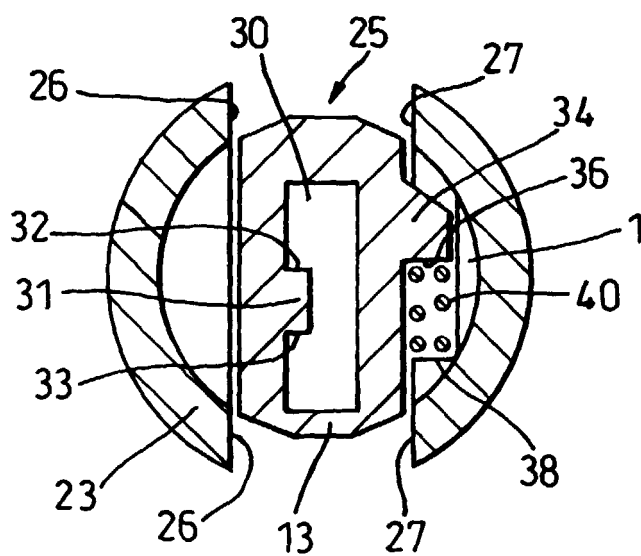


Fig. 2

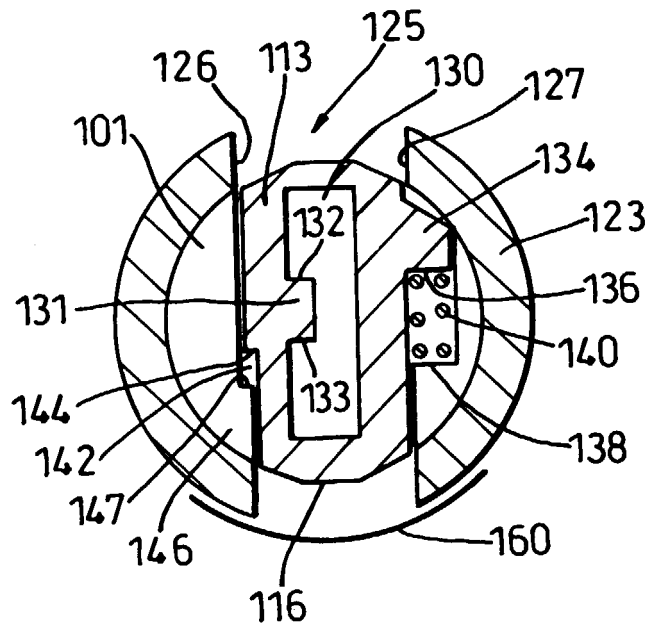


Fig. 3

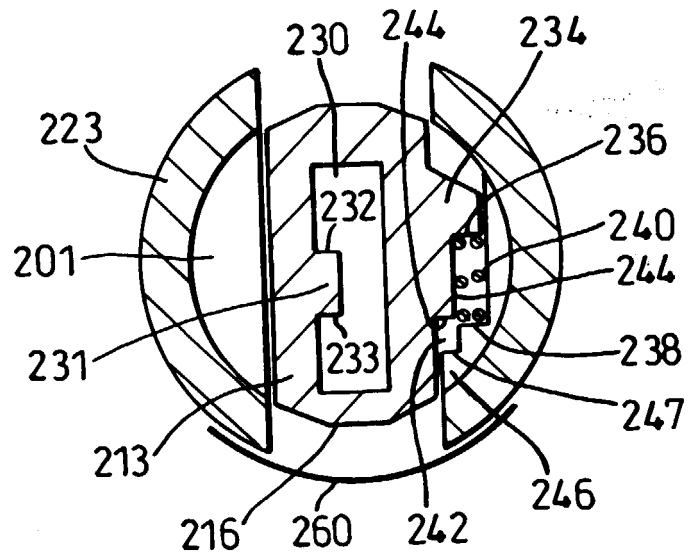


Fig. 4

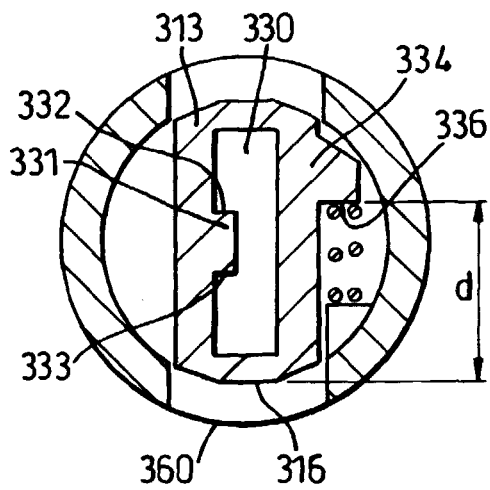


Fig. 5A

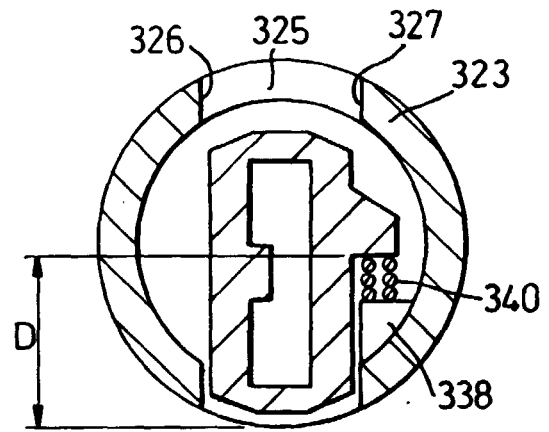


Fig. 5B

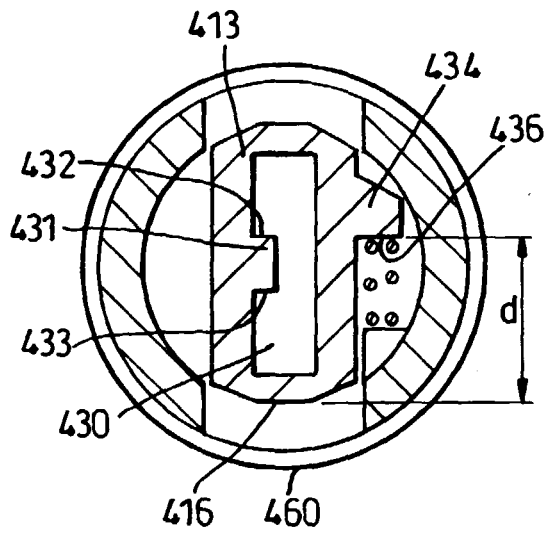


Fig. 6A

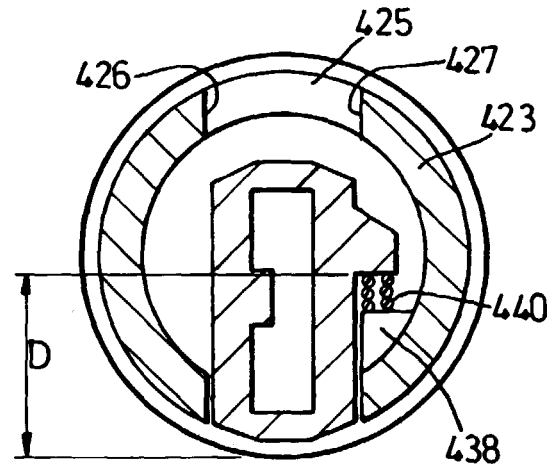


Fig. 6B

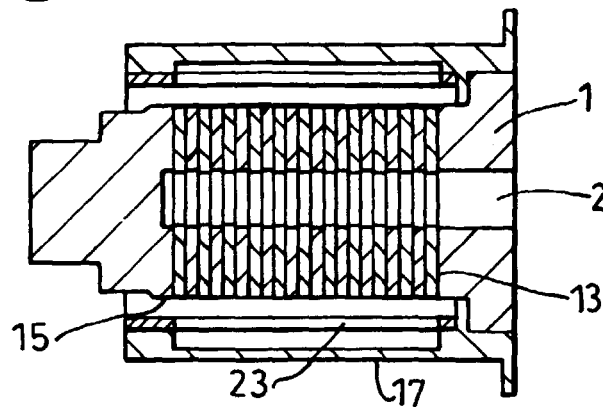


Fig. 6C

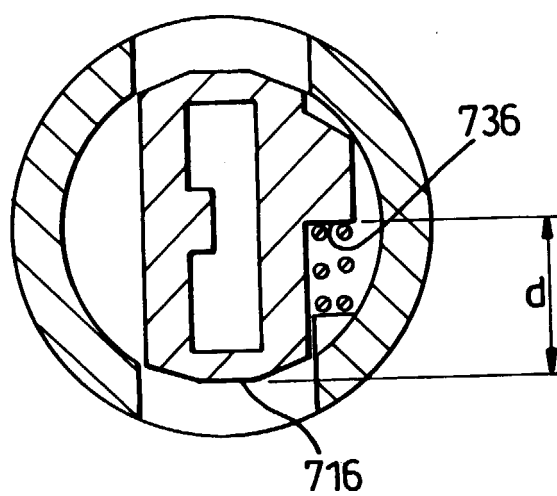


Fig. 7A

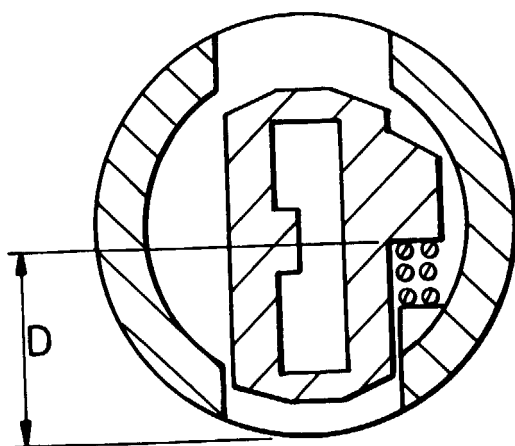


Fig. 7B