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(71) Applicant: **NEWMAN TONKS LIMITED**
Hospital Street
Birmingham B19 2YG(GB)

(72) Inventor: **Smith, Roger Michael**
23 Lovell Road
Yoxall Staffordshire(GB)

(74) Representative: **James, Michael John Gwynne et al,**
Wynne-Jones, Lainé & James 22, Rodney Road
Cheltenham Gloucestershire GL50 1JJ(GB)

(54) Improvements relating to lock assemblies.

(57) Magnetically attractive pins (13) are pivotally mounted in a disc (8) secured to a drive head (10) carrying a drive spigot (9). When a key incorporating suitably disposed magnets is positioned above the drive head (10), the pins (13) will be aligned with holes (20) in a gate moulding (4) so that the gate moulding is able to slide up the drive spigot (9) and pins (13) and be rotated with the drive head (10) and drive spigot (9) to allow cam follower surfaces (25) to ride out of engagement with stop members formed on the inner wall of a casing for the assembly. The drive spigot (9) is therefore allowed to rotate, together with the freed gate moulding (4) to operate a lock associated with the assembly.

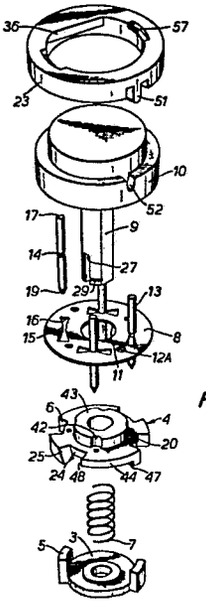

FIG. 2.

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"Improvements relating to lock assemblies"

A conventional form of cylinder lock is operated by a key so as to enable the cylinder to rotate and drive a drive tongue which controls opening and closing of a latch on the lock. In most forms of lock of this type the cylinder incorporates a number of tumblers which are moved by the key into positions enabling the cylinder to be rotated if the right key is used. The pins can either be moved by the particular profile of the key used or can be orientated into the necessary positions by means of magnets distributed within the key which attract the tumblers. Such locks are of relatively intricate construction requiring a large number of parts and a complicated assembly process.

It is an object of this invention to provide a lock assembly of reasonably simple construction which is easy to operate and yet tamper-resistant.

Accordingly this invention provides a lock-operating assembly comprising a drive head from which depends a drive spigot, a gate moulding keyed onto the drive spigot and incorporating holes for the receipt of ends of pins which are pivotally mounted on the drive head and are formed from magnetically attractive material, the drive head being formed to receive a key incorporating magnets which, if correctly disposed within the key, will

attract the pins so as to pivot them into alignment with the holes in the gate moulding, and allow rotation of the drive head, drive spigot and gate moulding to cause the gate moulding to ride up the drive spigot and drive pins and out of engagement with stops on a body housing the other parts of the assembly, the stops otherwise preventing rotation of the gate moulding.

With such an assembly the pins will be totally enclosed within the lock body and thus cannot be manipulated by a lock-picking tool. In order to be able to rotate the drive spigot it is essential that the pins should be aligned with the holes in the gate moulding and this can only be achieved by using a key which has magnets disposed therein in the correct array. For each position corresponding to each pin a large number of possible magnet locations within the key body can be provided so that the total number of combinations of magnet positions can be very large. Furthermore the avoidance of the conventional tumblers leads to a much simpler form of assembly which can be put together quite easily and does not require carefully matched parts for each particular lock combination. In the lock assembly itself the only features defining the particular lock combination are the positions of the holes in the gate moulding which receives the pins.

In the preferred construction the stops and gate moulding define cam and cam follower surfaces for directing

the gate moulding towards the drive pins as the drive spigot rotates. Ideally the gate moulding is biased towards the pins, such as by a compression spring acting on the gate moulding. In order that the assembly shall be relatively compact in the axial direction the movement of the gate moulding along the drive spigot may be limited by engagement with the drive head provided that, when this condition is reached, the gate moulding will be disengaged from the stops. Thus the stops may be designed to slide below outward extensions of the gate moulding when the stops are disengaged. The cam and cam follower surfaces may be designed in the form of ramps which slide against one another as the gate moulding rotates. Alternatively the cam could be just a pin projecting into an angled slot within the gate moulding which defines the cam follower surfaces.

The assembly may effectively include a drive plate keyed onto the drive spigot and engaged with the gate moulding by interposed lugs and recesses, the drive plate and gate moulding moving apart as the gate moulding rides up the drive spigot.

Whilst the assembly could of course be returned to the locked position by reverse rotation of the key it may be preferred that the assembly should include return biasing means for driving the rotational parts of the assembly back to a condition wherein the gate moulding is disengaged from the pins. The return biasing means

effectively comprises a torsion spring acting on the drive spigot. The stops or separate stop members may be so positioned that they act to define the maximum limit of rotation of the rotational parts of the assembly.

Keying of the gate moulding onto the drive spigot may be achieved in any convenient manner but a preferred arrangement is to form the drive spigot with D-shaped cross-section, the parts engaging with the drive spigot being provided with correspondingly shaped holes. A D-shaped cross-section (or some other cross-section which is symmetrical only in one plane) ensures that the various parts are assembled together in one particular orientation only.

It is preferred that the drive head should incorporate recesses which house the heads of the pins, each recess being of polygonal cross-section such that the corners of the recesses define possible operating positions of the pin as determined by a magnet position in the kay. The pins themselves are ideally formed with a waist approximately midway between their ends, which waists are held within slots in a plate mounted on the drive head.

In the preferred construction the outer face of the drive head has a shaped recess to receive a key head such that interengagement of the key and recess enables the drive head to be rotated by the key. The sides of the recess are ideally chamfered so that the key will ride out

of engagement before excessive rotational force can be applied to the drive head. As a preferred alternative, the recess in the drive head is covered by a bezel having an opening with notches for the receipt of a correctly aligned key formed with flanges corresponding to the position of the notches, to enable the key to locate with the recess and be rotated so that the flanges ride below the rim of the bezel opening. In this case, means will be provided in the drive between the drive head and the drive spigot which will break the drive connection if excessive force is applied to the drive head when using an incorrect key. This ensures that the assembly cannot readily be tampered with when using an incorrect key. Furthermore if the outer surface of the drive head is recessed in the body of the assembly, then it is impossible to obtain a grip on the drive head, such as by a pipe wrench, in an attempt to force the lock.

The invention further extends to the lock operating assembly as hereinbefore described in combination with a key to be engaged with the drive head so as to cause the pins to be aligned with holes in the gate moulding. The key will have a head which fits with the drive head of the assembly together with a grip portion extending therefrom which may take many forms. Preferably the key will be so formed that there are groups of cavities in the keyhead which correspond to each pin position, a magnet being enclosed within one cavity of each group. Thus such a key will be

of standard construction for each lock combination which is determined solely by the cavities chosen for a magnet in each group of cavities.

The invention may be performed in various ways and one preferred embodiment thereof will now be described with reference to the accompanying drawings, in which:-

Figures 1 and 2 illustrate, in exploded view, the main parts of a lock operating assembly of this invention;

Figure 3 is a vertical cross-section through the parts of the assembly of Figures 1 and 2 when interconnected;

Figure 4 is an underneath plan view of the assembled unit shown in Figure 3;

Figure 5 is a vertical cross-section through the body part of the assembly;

Figure 6 is an underneath plan view of the drive head of the assembly;

Figure 7 illustrates the operation of one of the pins in the assembly;

Figure 8 shows the positioning of a pin within a recess in the drive head;

Figure 9 is a side view of a key assembly for operating the lock shown in Figures 1 to 3;

Figure 10 is a cross-section through the key grip portion of the key of Figure 9;

Figure 11 is an underneath plan view of the key grip portion of Figure 10; and

Figure 12 is a plan view of a key insert fitted into the key grip portion to form the assembly of Figure 9.

Referring firstly to Figures 1 to 4 of the drawings it will be seen that the assembly is housed within a body portion 1 which will be set into a hole drilled through a door or the like. The body portion 1 is held in position by means of screws which pass through a back plate and are received within screwthreaded holes 2 at the back of the body 1 (Figure 3). The parts of the assembly shown in Figure 2 are then assembled within the body portion 1. These parts comprise firstly a drive plate 3 which is interconnected with a gate moulding 4 by means of lugs 5 received in recesses 6 in the outer edges of the gate moulding 4. A coil spring 7 operates to drive the parts 4 and 5 away from one another. Next a pin disc 8 is positioned about a drive spigot 9 carried by a drive head 10. An anti friction ring 10A is provided between the drive head 10 and the body portion 1. It will be noted that the pin disc 8 has a central hole 11 which fits over an enlargement 46 of the drive spigot 9. Furthermore, the pin disc has four holes 12A near its outer edge which locate over bosses 12B projecting down from the lower surface of the drive head 10 (as shown in Figures 3 and 6). The pin disc 8 also carries four pins 13, each formed with a waist 14 which is held in a hole 15. Each hole 15 is in the centre of a slit 16, the pin disc

8 being formed from a flexible metal (thin phosphor bronze sheet) enabling the pins to be pushed into position as a snap-fit. The top ends 17 of the pins 14 are received within recesses 18 in the drive head 10 (Figure 6). The other ends 19 of the pins 13 are tapered to a point to enable them to enter holes 20 drilled into the gate moulding 4 in a manner which will be described hereinafter. A drive ring 23 of a plastics material is mounted on and linked to the drive head 10.

On the inner wall of the body 1 there are formed two stop members 21 each having a ramp face 22 (Figure 5). Notches 24 in the edges of the gate moulding 4 define inclined cam follower surfaces 25, which cooperate with the ramps 22.

When the various parts shown in Figure 2 have been assembled into the body part 1 (as illustrated in Figures 3 and 4) a location moulding 26A is keyed onto the drive spigot 9. The top end of a drive tongue 26B is also received in the lower portion of a slit 27 and the complete assembly is held in position by a circlip 28 which is snap fitted into a groove 29 in the drive spigot 9. A bezel 30 is secured onto the body 1 by rivets passing through holes 31A in the body (Figure 3). A pin 30A projecting from the bezel 30 will fix into the door body and resist attempts to rotate the whole assembly within the door.

Figures 9 to 12 illustrate the essential features of a key which will be used to operate the complete drive assembly illustrated in Figure 3. This key has a grip

portion 32 carrying a head 33 of generally circular cross-section incorporating a key insert 34 having one part cut away at 35 so that this portion of the key head corresponds to the shape of a recess 36 formed in the drive ring 23. Within the key insert 34 are formed four groups of cavities 37. These cavities are of cylindrical form and there are six in each group. A magnet is positioned in one cavity of each group 37 and the key insert is then inserted into a recess 38 of the key grip portion 32 to hide the magnets inside the key head 33. The key grip portion 32 has upstanding ears 39 with flanges 40 which will fit into the notches 41 of the bezel 30 and will be held below the rim 42 of the bezel as the key is rotated. When the key is positioned through the bezel 30 and into the recess 36 of the drive ring 30 the magnets attract the pins 13 (formed from soft iron) and, if the correct key is used, these pins are then aligned with the holes 20 drilled in the gate moulding 4 (these holes 20 will have been pre-drilled at any one of six positions in each of the four areas spaced at 90° from each other around the gate moulding 4). The parts 42 of a central boss 43 of the gate moulding 4 are cut away to allow for the necessary movement of the pins 13.

If the key is now turned to rotate the drive head 10 (by means of the interengagement of the key head 33 with the recess 36 and the linking of the drive ring 30 with the drive head 10 through the ring 23A), initial rotation of the drive spigot 9 in the clockwise direction will cause the cam follower surfaces 25 on the gate moulding 4 to ride

up the ramps 22 on the stops 21 so that the correctly aligned pins 13 enter the holes 20 in the gate moulding. Further rotation results in the gate moulding 4 driven round by the drive plate 3, sliding up the drive spigot 9 and the pins 13 until such time as the top surfaces of the stops 21 move to a position below outwardly extending flanges 44 of the gate moulding 4. With further rotation the flanges 44 slide over the top of the stops 21, whilst the top surface 45 of the gate moulding abuts an enlargement 46 of the drive spigot 9 which limits the maximum upward movement of the gate moulding 4. The upward movement of the gate moulding 4 is of course created by the compression spring 7. Rotation of the assembly continues until a downward extension 47 on the gate moulding 4 abuts each of the stops 21. Thus a 90^{o} rotation of the assembly is possible which is sufficient for the drive tongue 26 to open the latch of the lock.

If an incorrent key is inserted in the recess 36 the pins 13 will be pivoted into such positions that they do not all align themselves with the holes 20 in the gate moulding 4. Thus after a small movement of the gate moulding 4 towards the drive head 10 the pins 13 will contact the surface of the gate moulding and prevent further movement along the drive spigot 9. The abutment of the stops 21 against the edge surfaces 48 of the flanges 44 of the gate moulding will also prevent further rotation of the gate moulding and thus of the drive spigot 9.

Attempts to force the further rotation of the drive head 10 will not meet with success because of the shape of the drive ring 23 which has a flexible finger 51 received in a notch 52 in the drive head 10. Undue force will result in the finger 51 flexing out of the notch 52. Furthermore since the drive head 10 is recessed within the body portion 1 and below the bezel 30 (as shown in Figure 3) the drive head 10 is immune from attack by such tools as a pipe wrench. The drive plate 3 and the gate moulding 4 are of substantial construction and so will not bend against the stops 21 due to the limited amount of force which can be applied to the drive head 10.

The key can only be removed from the recess 36 by rotating the flanges 39 back into alignment with the notches 41 in the bezel 30, with the result that the assembly will naturally revert to the normal, or locking, position. In the process the ramp 22 will come into engagement with the cam follower surfaces 25 on the gate moulding 4 causing the gate moulding to be driven, against the bias of the spring 7, into the condition shown in Figure 3 where the pins 13 are free of the holes 20 in the gate moulding. The bezel 30 may be modified to have four equiangularly spaced notches 41 enabling the key to be removed in the unlocking position. The location moulding 26A carries bosses 53 on arms 54 which click into recesses 55 in the base of the

body portion 1 (see Figures 1 and 4) to hold the assembly in the alternative locked and unlocked conditions.

As noted previously there are six possible positions for the insertion of a magnet in each of the groups of cavities 37 shown in Figure 12. This means that there are six possible alignments for each pin 13 and Figures 7 and 8 show how the recess 18 in the drive head 10 is formed to assist in accurate location of a drive pin in each of the six possible positions. Thus each recess 18 is of hexagonal cross-section which provides six corners into which the top end 17 of the pin 13 can be directed. As can be seen from Figure 7 the pin 13 may be moved from the rest position 13A to the correct angled position 13B where the tip 19 will lie directly above the hole 20 in the gate moulding 4. The provision of four pins with six positions for each pin provides a total of 1296 alternative pin configurations (or combinations).

Various styles of key are possible apart from that shown in Figure 9 which also serve as a fob for carrying other conventional keys etc. on the ring portion 56. Thus, for example, the key grip portion 32 could lie at right angles to the head 33 producing a key of T-shaped form in side view.

It would be possible to supply key kits so that the retailer and/or user could assemble keys to the pattern applicable to a particular lock (as defined by the config-

urations of the holes 20 on the gate moulding 4). The purchaser would of course be told the combination in an instruction leaflet accompanying the lock at the time of sale.

It is also envisaged that automatic machinery could be programmed to drill the four holes 20 in the gate moulding to a predetermined pattern in accordance with the 1296 combinations available. The machine could also assemble the magnets into two or three key mouldings to be supplied with the lock and issue a print-out of the combination.

The lock assembly could be modified in various ways. For example, the cam follower surfaces 25 and end surfaces 48 of the flange 44 of the gate moulding 4 could be formed to define an angled slot receiving a pin-like stop 21. Furthermore the number of possible combinations can be varied by changing the number of pins 13 and the possible orientations thereof. As another modification the bezel 30 may be formed without the notches 41 and with a reduced rim 42 so that the key can be applied directly to the recess 36 in the drive ring 23. The notches 57 and the ears 40 on the key will be omitted, but the edge wall of the recess 36 will be chamfered inwardly. Interlinking of the key head 34 and the recess 36 will then be solely by the shape of the recess 36 mating with the flat 35 on the key head. Thus if undue force is applied with an incorrect key, the key will tend to ride out of the recess 36. In this case it is desirable to provide means

for driving the mechanism back to the locking position if the key is removed, and this can be achieved by providing a torsion spring acting between the body portion 1 and the drive spigot 10.

If desired, the drive tongue 26B may be offset from the axis of the assembly defined by the drive spigot 9. This could be achieved by providing a drive member for the drive tongue which is offset to one side of the body portion 1 and interconnected with the drive spigot 9 by gearing.

CLAIMS

1. A lock-operating assembly comprising a drive head from which depends a drive spigot, a gate moulding keyed onto the drive spigot and incorporating holes for the receipt of ends of pins which are pivotally mounted on the drive head and are formed from magnetically attractive material, the drive head being formed to receive a key incorporating magnets which, if correctly disposed within the key, will attract the pins so as to pivot them into alignment with the holes in the gate moulding, and allow rotation of the drive head, drive spigot and gate moulding to cause the gate moulding to ride up the drive spigot and drive pins and out of engagement with stops on a body housing the other parts of the assembly, the stops otherwise preventing rotation of the gate moulding.

2. An assembly according to claim 1, wherein the stops and gate moulding define cam and cam follower surfaces for directing the gate moulding towards the drive pins as the drive spigot rotates.

3. An assembly according to claim 1 or claim 2, wherein the gate moulding is biased towards the pins, such as by a compression spring acting on the gate moulding.

4. An assembly according to any one of claims 1 to 3, wherein the movement of the gatemoulding along the drive spigot is limited by engagement with the drive head, in which condition the gate moulding will be disengaged from the stops.

5. An assembly according to claim 4, wherein the stops slide below outward extensions of the gate moulding when the stops are disengaged.

6. An assembly according to any one of claims 1 to 5 including a drive plate keyed onto the drive spigot and engaged with the gate moulding by interposed lugs and recesses, the drive plate and gate moulding moving apart as the gate moulding rides up the drive spigot.

7. An assembly according to any one of claims 1 to 6 including return biasing means for driving the rotational parts of the assembly back to a condition wherein the gate moulding is disengaged from the pins.

8. An assembly according to claim 7, wherein the return biasing means comprises a torsion spring acting on the drive spigot.

9. An assembly according to any one of claims 1 to 8, wherein the stops or separate stop members act to define the maximum limit of rotation of the rotational parts of the assembly.

10. An assembly according to any one of claims 1 to 9, wherein the drive spigot is of D-shaped cross-section and the parts engaging with the drive spigot are provided with correspondingly shaped holes.

11. An assembly according to any one of claims 1 to 10, wherein the drive spigot carries a drive tongue for operating the latch of a lock.

12. An assembly according to any one of claims 1 to 11, wherein the drive head incorporates recesses which house the heads of the pins, each recess being of polygonal cross-section such that the corners of the recesses define possible operating positions of the pin as determined by a magnet position in the key.

13. An assembly according to any one of claims 1 to 12, wherein the pins are formed with a waist approximately midway between their ends, which waists are held within slots in a plate mounted on the drive head.

14. An assembly according to any one of claims 1 to 13, wherein the outer face of the drive head has a shaped recess to receive a key head such that inter-engagement of the key and recess enables the drive head to be rotated by the key.

15. An assembly according to claim 14, wherein the sides of the recess are chamfered so that the key will ride out of engagement before excessive rotational force can be applied to the drive head.

16. An assembly according to any one of claims 1 to 15, wherein the outer surface of the drive head is recessed in the body of the assembly.

17. An assembly according to any one of claims 1 to 16 including a key to be engaged with the drive head so as to cause the pins to be aligned with holes in the gate moulding.

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18. An assembly according to claim 17, wherein groups of cavities in the key correspond to each pin position and a magnet is enclosed within one cavity of each group.

19. An assembly according to any one of claims 1 to 18, wherein the drive spigot is in two parts, interconnected by gearing, so that the second part is offset from the axis of the assembly.

20. A lock-operating assembly substantially as herein described with reference to the accompanying drawings.

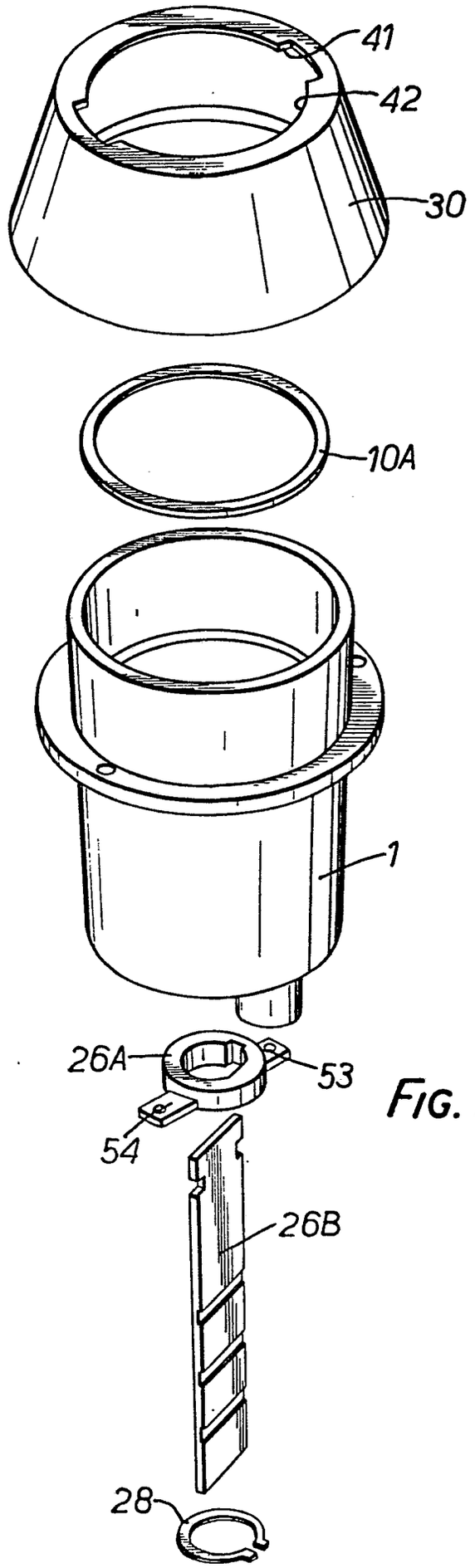

FIG. 1.

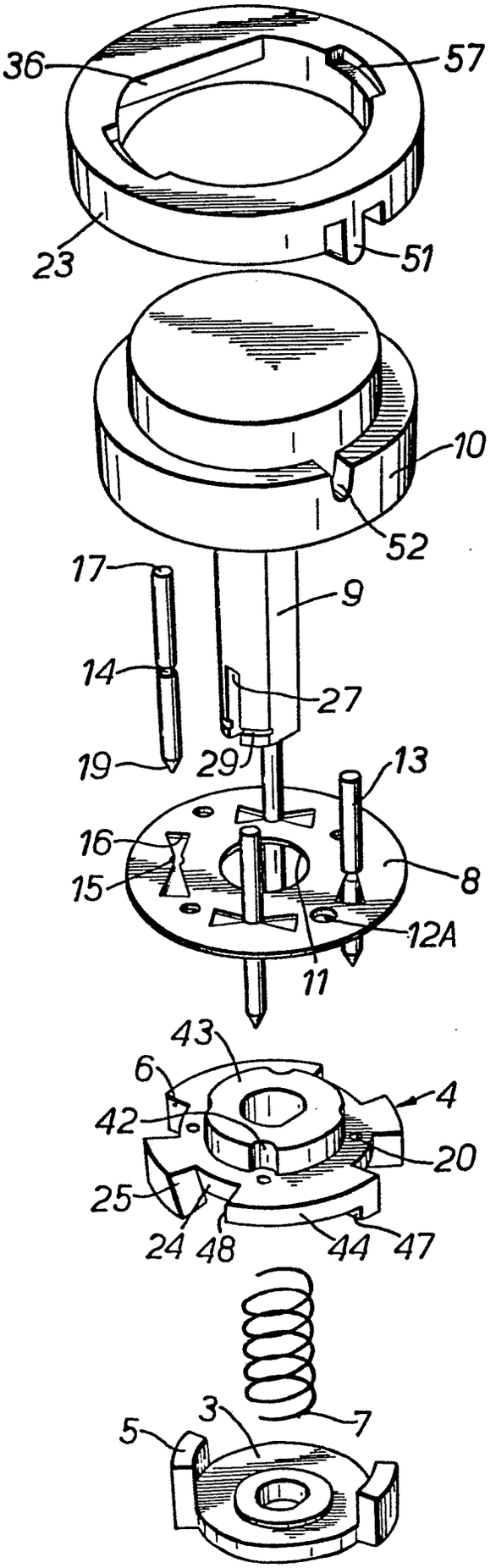
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FIG. 2.

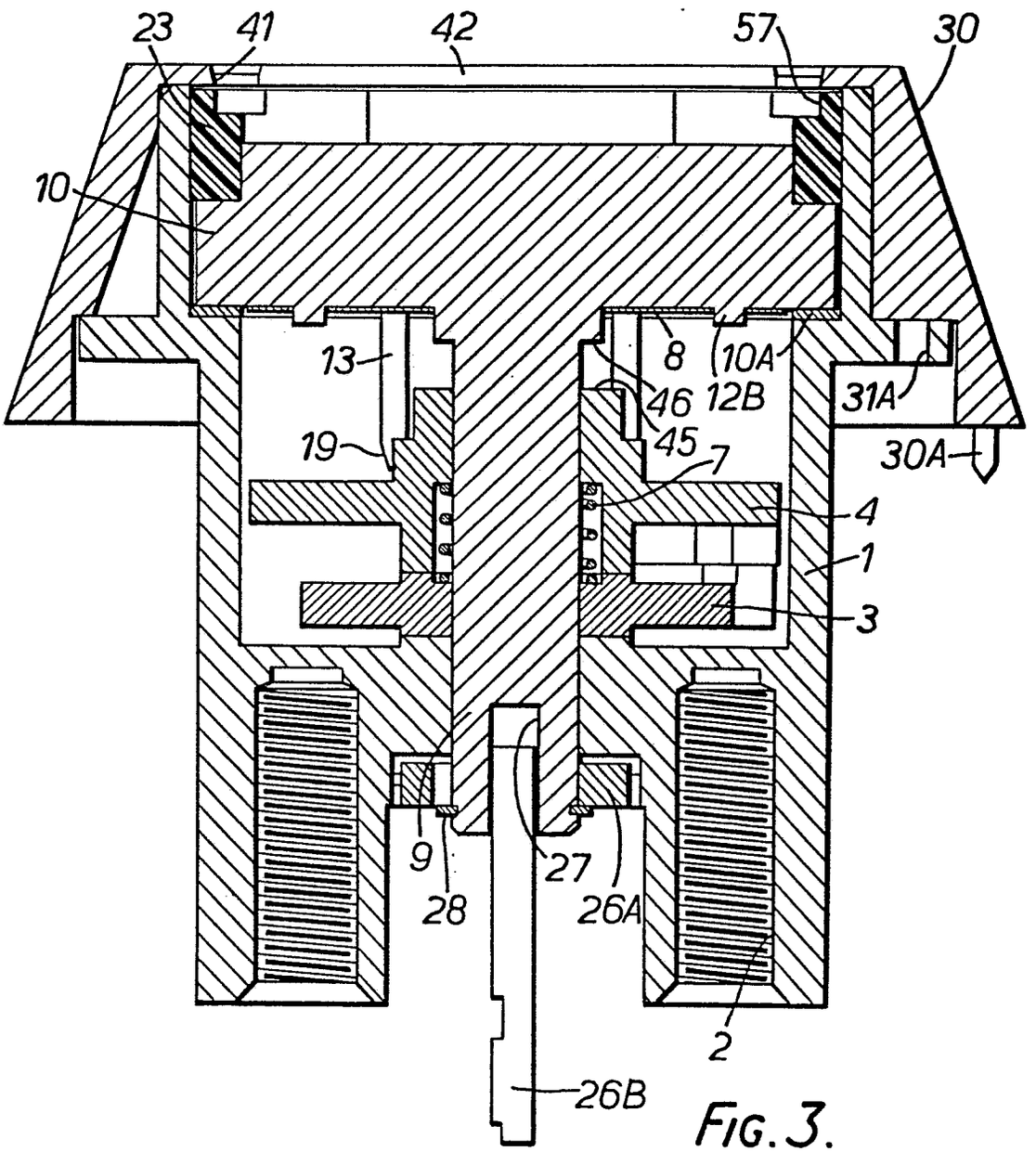

FIG. 3.

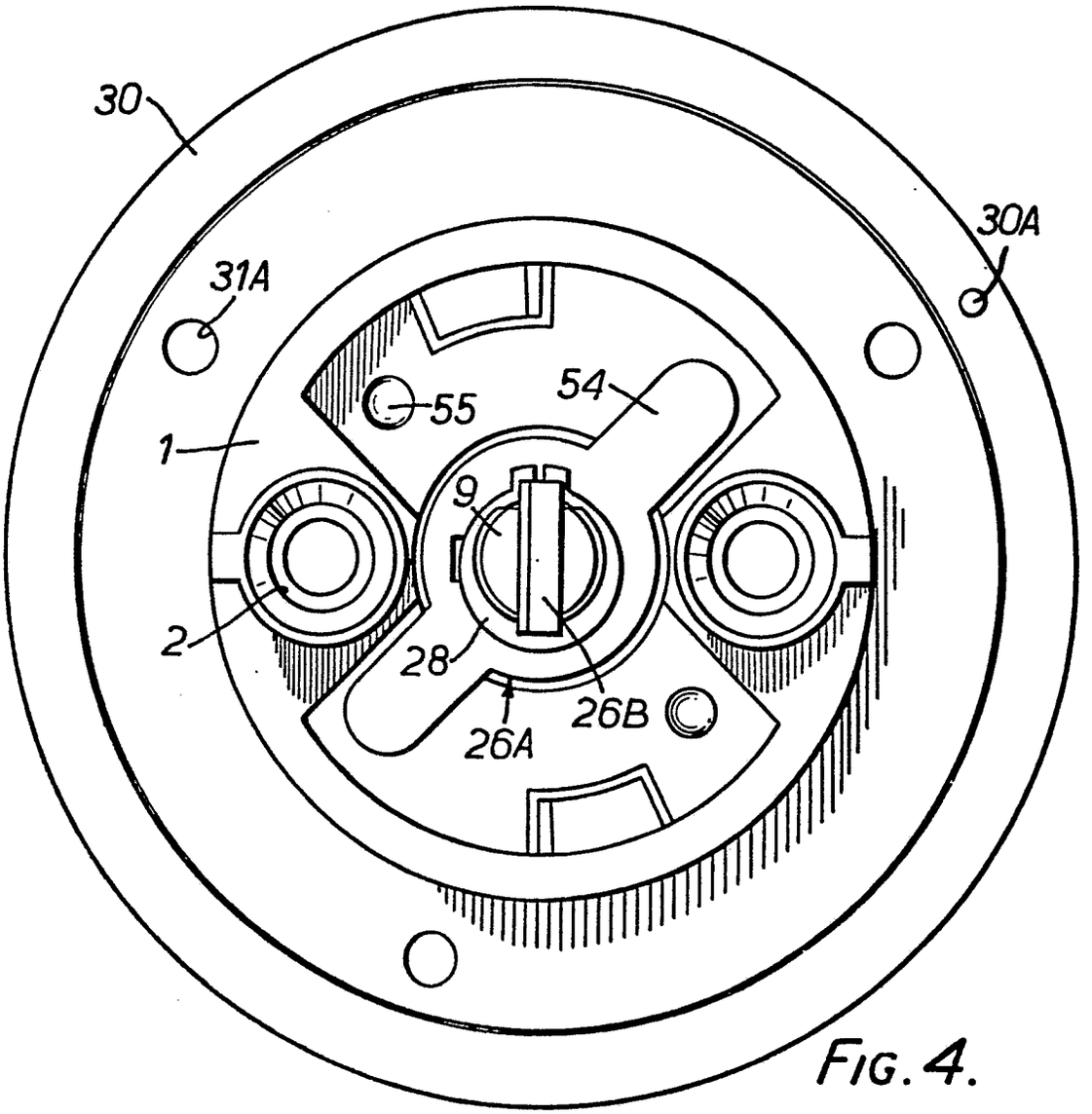

FIG. 4.

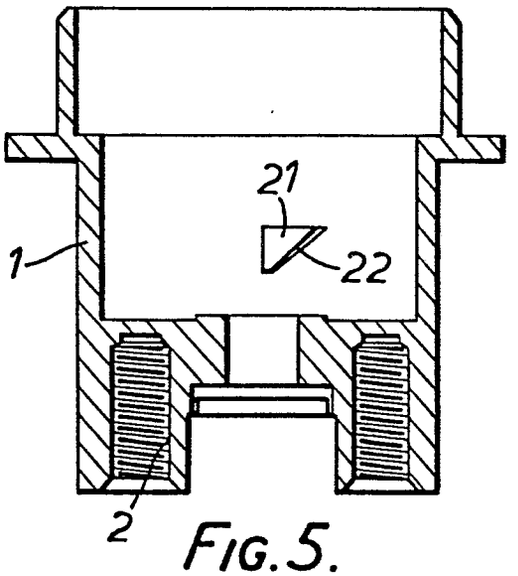

FIG. 5.

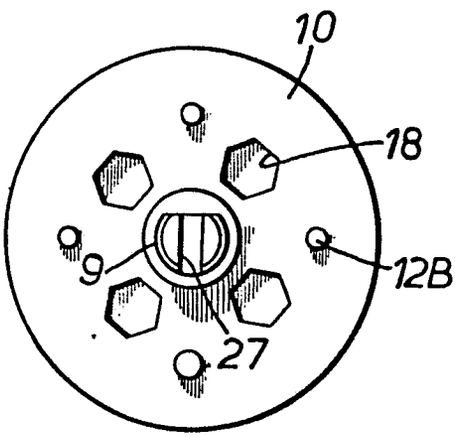

FIG. 6.

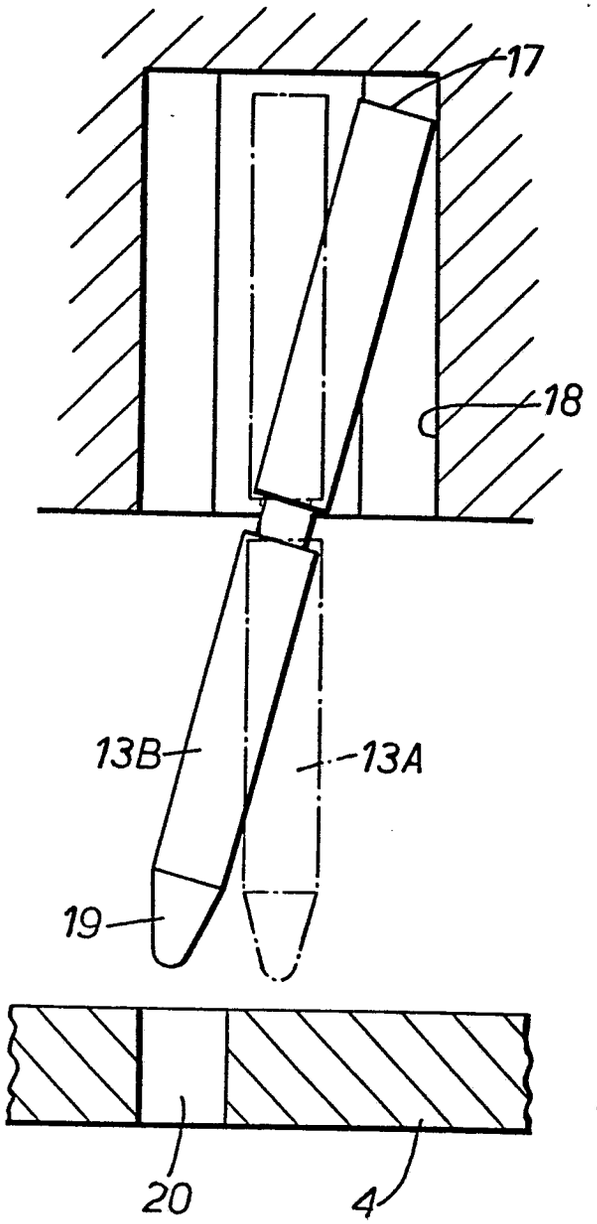

FIG. 7.

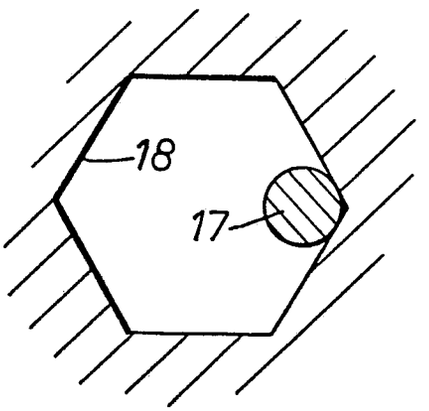

FIG. 8.

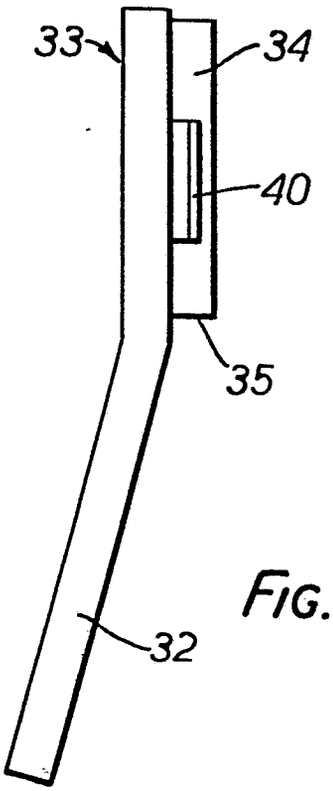

FIG. 9.

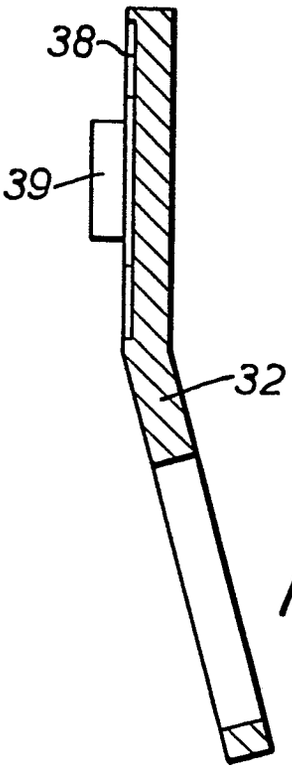

FIG. 10.

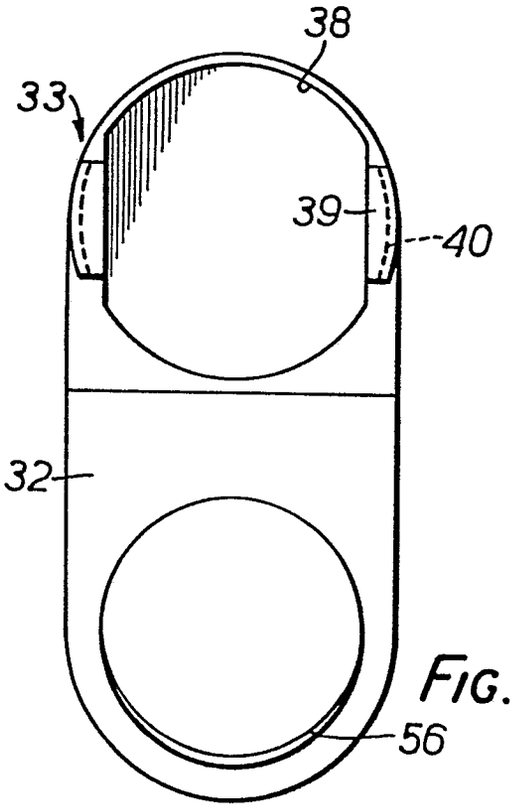

FIG. 11.

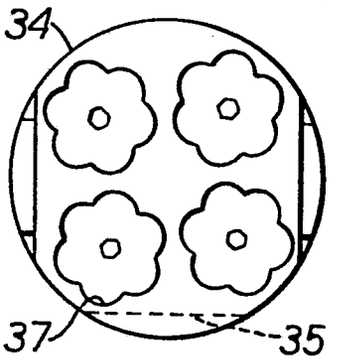

FIG. 12.

0042756

Application number

EP 81 30 2811.5

European Patent Office

EUROPEAN SEARCH REPORT

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.³)
	DE - B - 1 911 413 (F. C. SIEVERS) * column 3, line 61 to column 6, line 26; fig. * --	1,3,7, 13,17	E 05 B 47/00
	DE - A - 2 132 917 (HUWIL-WERKE H. WILLACH & SÖHNE) * complete document * --	1,13, 17	
A	US - A - 4 133 194 (B.S. SEDLEY et al.) * column 2, line 6 to column 4, line 13; fig. * --	1	TECHNICAL FIELDS SEARCHED (Int. Cl.³)
A	DE - B2 - 1 901 968 (MRT MAGNET-REGEL-TECHNIK GMBH) * column 2, line 49 to column 3, line 8 * & US - A - 3 570 287 ----	1	E 05 B 47/00

CATEGORY OF CITED DOCUMENTS

- X: particularly relevant
- A: technological background
- O: non-written disclosure
- P: intermediate document
- T: theory or principle underlying the invention
- E: conflicting application
- D: document cited in the application
- L: citation for other reasons
- &: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	07-09-1981	WUNDERLICH