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㉓ **Locking device.**

㉔ A locking device, particularly suitable for use in the lid or door of a safe, comprises a first locking mechanism which extends and retracts bolts, and a second locking mechanism which acts to lock the first locking mechanism. The second locking mechanism is actuatable in stages by sequence of key operations in an externally accessible lock. For extra protection an obstruction may be included which requires a further operation to be carried out simultaneously with one of the key operations. In one embodiment the first locking mechanism comprises a set of bolts which each carry a toothed gear wheel, and a central gear wheel which meshes therewith. The second locking mechanism comprises a blind gear mounted co-axially with the central gear wheel and means for moving the gears along the axis to select the central or blind gear to open or lock the first locking mechanism.

EP 0 103 429 A2

-1-

LOCKING DEVICE

The present invention relates to locking devices which are particularly but not exclusively suitable for use in the lid or door of an underfloor safe.

5 At the present time houses, cars and safes are particularly vulnerable to forceable entry, and devices that can hamper or prevent such entry are in great demand. In particular safes of heavy construction, such as underfloor safes, are usually set in heavy concrete, or otherwise
10 firmly secured so that the only place that is vulnerable to an unauthorised attempt at entry is the lid or door. The present invention seeks to provide a tamper resistant locking mechanism that would be suitable for such use.

 According to the present invention there is
15 provided a locking device comprising at least two bolts, each rotatable between an open and a closed position by a first locking mechanism, and a second locking mechanism adapted to lock the first locking mechanism against
 movement to retract the bolts, the second locking
20 mechanism being releasable by a sequence of at least

two operations.

Advantageously the second locking mechanism is actuatable to disengage by an unlocking action of an externally accessible lock, followed by a relocking action
5 of the same lock.

Preferably the first locking mechanism comprises a first gear wheel on each of the bolts, which gear wheels mesh with a single second gear wheel. The second locking mechanism may include a blind gear wheel which is moveable
10 into engagement with the said first gear wheels to prevent the said first gear wheels turning to retract the bolts. The blind gear has sufficient cogs to mesh with the first gear wheels, but insufficient cogs to enable the wheels to be rotated to retract the bolts. Advantageously the
15 second locking mechanism includes means for locking the blind gear in engagement with the said first gear wheels including at least one externally accessible lock, in such a way that if an external lock is broken the blind gear remains in engagement with the first gears and the
20 bolts cannot be retracted.

Each accessible lock is advantageously connected to rotate an inclined cam face which is adapted to be located above or below a disk mounted co-axially with the second gear. The inclined cam may have a gap so that it can be
25 rotated out of the path of the said disk to enable the disk to move freely along its axis. In such an arrangement the disk is spring biased towards the upward position by a limited amount. Alternatively the inclined cam face can be part of a large screw so that it can move the disk
30 by itself up and down the axis.

In an alternative arrangement the ramped cam is replaced with an escapement mechanism and the central spring has a longer travel. In this design the central spring provides sufficient thrust to lift the spindle
35 to engage the first and second gear wheels. The escapement arms control the upward movement travel of the central spindle in two stages using a sequence of key operations.

The invention will now be described, by way of example, with reference to the accompanying drawings in which:-

Figure 1 is a plan view of a safe lid incorporating a locking device according to the present invention.

Figure 2 is a section through the lid of Figure 1 showing the locking device in its half locked position,

Figure 3 is an identical section to that of Figure 2 showing a further step in the locking action,

Figure 4 shows the same section again with the device in the fully locked position, and

Figure 5 is a detail illustrating the blind gear in engagement with the three bolt locking gears.

Figure 6 is a section through the lid of a second embodiment showing the locking device in its locked position,

Figure 7 is a section through the lid of Figure 6 showing the locking device in its half-locked position,

Figure 8 is a section through the lid of Figure 6 showing the locking device with the second mechanism unlocked, and

Figure 9 is a plan view of the escapement member of the second embodiment.

The locking device illustrated in the drawings comprises three bolts 11 shaped as shown in the drawings and each being rotatable on its own spindle 12 through approximately 90° . Each of these bolts 11 has attached thereto on its upper surface concentric with the gear wheel a multi-toothed gear wheel 13. The three bolts 11 when extended engage under a flange on the safe body and prevent the removal of the door or lid 10. The three gear wheels 13 are engageable with a central gear 14 which

is mounted on a central spindle 15. The outer end of the spindle 15 is provided with a head 16 which is indented at 17 so that the spindle can be turned from the outside of the safe by a screw driver or by a special key or device.

5 When the spindle is rotated through a sufficient angle, the central gear wheel 14 turns, which simultaneously rotates the gear wheels 13, thus moving the three bolts 11 into or out of engagement to lock or unlock the safe. To prevent tampering with the gear wheels 13, the top of each

10 spindle 12 on which a gear wheel 13 is mounted has a layer of tungsten carbide 18. The system of co-operating gear wheels 13, 14 forms the first locking mechanism for the bolts.

15 In order to prevent the central spindle from being rotated to disengage the bolts by an unauthorised person, a second locking mechanism is provided, which locks the first locking mechanism. This second locking mechanism involves a limited axial movement of the

20 spindle 15 inwardly against an outward bias from a coiled spring 19. The spring 19 sits in a bore 20 at the inner end of the spindle 15 and engages in a seating 21 in the bottom of the bore 22 of the safe lid 10 which contains the central spindle and its appendages.

25 The inward axial movement of the spring enables the gearwheel 14 to be moved out of engagement with the gears 13 and brings into engagement with gears 13 a partial or blind gear 23 (see Figure 5) which is mounted on the spindle 15 concentrically with the gear wheel 14 and slightly above that gear wheel. The blind gear 23 is

30 adapted to engage the three gear wheels 13 when the central spindle is pushed inwardly into the bore 22. The central gear 14 is pushed out of engagement with the three gears 13 as can be seen in Figure 3. Engagement of the three gears 13 with the blind gear 23 both prevents

35 the bolts from being rotated on their own spindles and also prevents the central spindle being turned.

Also mounted on the central spindle 15 is a disk 24 which is flat on top and chamfered on the underside which is inward of the lid. All three items, the driving gear 14 , the blind gear 23 and the disk 24 are concentric on the central spindle 15 and of equal diameter. In the lid adjacent to the disk 24 there is at least one ramped cam 25, in essence rather like part of a helter-skelter, but mounted on a spindle to be rotateable. A portion of the upper surface is flat and the under surface is flat. The ramp portion of the cam 25 extends from the top to the bottom over an angle of approximately 180°. Part of the cam is cut-away to allow clearance for vertical movement of the chamfered disk 24. The ramped cam engages the upper side of the disk 24 when the second locking mechanism is fully locked, to keep the blind gear in engagement with the three gears 13.

When the safe is locked the central disk 24, the spindle 15 and the concentric gears 14 and 23 are in the lower or inward position as shown in Figure 4, and the ramped cam has been rotated into the locked position. In this position the underside of the cam is on top of the disk 24, the main drive has been disengaged and the blind gear 23 is engaged. In this position the bolts cannot be moved.

To open the safe, the ramped cam is rotated by a key which engages in a multi-lever lock, the key hole 26 for which is on the outside of the lid. In the unlocked position the ramped cam is clear of the disk 24 and allows the spring bias of the coiled spring 19 to push the spindle 15 outwardly by a limited amount, say about 1/8 inch, (see Figure 3). The edge of the chamfered disk 24 is now higher than the bottom of the ramp on the cam but the blind gear is still engaged so that the lid is still firmly secured to the safe. If the ramped cam is now returned to the locked position by rotating it in the opposite position by means of the key in the lock 26, the ramp will engage the underside of the chamfered disk and rotation of the cam will raise the central spindle far

enough to disengage the blind gear 23 and engage the driving gear 14.

Using the special key or screw driver in the indentation 17, the central spindle is then rotated
5 until the bolts 11 are retracted and the safe is unlocked. The lid may now be removed.

To relock the safe, the central spindle 15 is rotated until the bolts 11 engage under the flange of the safe body. The ramped cam is rotated to the unlocked
10 position in which the spindle can be depressed against the spring 19 to a position below the cam and the cam 25 is then returned to the locked position, by a key in the lock 26, in which the underside of the cam engages over the top of the disk 24. This re-engages
15 the blind gear 23.

Any attempt to open the mechanism by tampering with the lock 26 will be self defeating since the lock must be closeable to operate the ramped cam mechanism which engages the drive gear 14.
20 Up to three ramped cams could be provided, each actuated by a separate lock 26, thus making the time required to pick the locks very much greater; and of course to manipulate them all into the closed position, should this be known to be required, would take very much
25 longer still.

The same sequence of operations to release the second locking mechanism, unlocking and re-locking the same set of locks, can be used in other embodiments. For example the cams could be replaced by an escapement
30 mechanism.

An embodiment including such a mechanism is illustrated in Figures 6 to 9. The disk 24 is replaced by a disk 24a to the top of which is fixed a small peg 31 which protrudes 1.5mm from the top surface of the
35 disk 24a. The ramped cam 25 is replaced by an escapement member 32 which pivots about a spindle 33. This member

32 is shown in detail in Figure 9 , from which it will be seen that the member 32 has a generally triangular shape, the pivotal axis 33 for which is near the vertex. At the other side from the axis the member is cut away centrally to reduce weight and also to leave two peninsulars 34 which are further away from the axis 33 than any other part of the member 32. The peninsulars are further cut away. The right hand peninsular 34a is cut away on top and the left hand one 34b from below so as to provide escapement arms at different operative heights. The bottom of the left hand peninsular 34b is about 5mm higher than the top of the right hand peninsular 34a. At an appropriate distance from the axis 33 and on its inner side the left hand peninsular 34b is cut away to provide a notch 36 which engages the peg 31 when the peninsular 34b is over the disk 24a. Although reference is made above to various parts being "cut away", in fact the escapement member 32 will be formed in one piece as a casting.

The member 32 is pivoted about the spindle 33 by movement of a locking arm 37 as a result of operation to unlock and re-lock the lock 26. The arm 37 is moved by the engagement of a hook (not shown) in a slot 38 in the arm 37. The said hook is fitted into the end of a mortice bolt of the lock 26, the travel of which is about 10mm. The stages of unlocking the safe are illustrated in Figures 6 to 9.

In Figure 6, which is the locked position, the right hand peninsular 34a is over the disk 24a and holds the disk down against the force of the spring 19. When the lock 26 is rotated to the unlocked position the arm 37 moves the member 32 anticlockwise. As the right hand peninsular 34a pivots off the top of the disk 24a the disk is raised by the spring 19. However the rise is limited because the left hand peninsular 34b moves at the same time to a position above

the disk 24a and the peg 31 becomes seated in the notch 36. The member 32 cannot be pivoted out of the rising path of the disk 24a while the peg 31 is engaged in the notch 36. The head 16 must first be depressed against the resilience of the spring 19 by about 2mm to release the peg 31 so that the member 32 can be pivoted clockwise by a relocking action of the lock 26. The upper peninsular 34b then moves out of the way of the disk 24a to enable the disk to rise to the maximum height
10 permitted by the spring 19 so that the gears 13 and 14 are engaged to enable rotation to the spindle 15 to unlock the bolts 11. The lower peninsular 34a does not obstruct the disk 24a in its upward movement on the re-locking action as it moves into a position
15 which is underneath the disk.

This system forms an added protection against the burglar as it would be necessary to apply pressure to the head 16 to hold the peg 31 out of engagement with the notch 36 for the whole time that the lock is being
20 picked to reclose it.

For still further protection the top disk is hollowed out and refilled with copper 40 into which is incorporated artificial diamonds in the form of zirconia which is caste into the copper. This provides an extra
25 resistance against drilling.

WHAT WE CLAIM IS:

1. A locking device comprising at least two bolts, each moveable between an open and a closed position by a first locking mechanism, and a second locking mechanism adapted to lock the first locking mechanism against movement to retract the bolts, the second locking mechanism including an externally accessible lock and being releaseable by a sequence of at least two operations.
2. A locking device according to claim 1 characterised in that the second locking mechanism is actuatable to disengage by an unlocking action of the lock followed by a relocking action of the same lock.
3. A locking device according to claim 1 or 2 characterised in that the second locking mechanism includes a further hindrance to unauthorised opening creating an added operation in the opening of the lock, which is to be carried out at the same time as at least one of the operations of said sequence of operations.
4. A locking device according to any of the preceding claims characterised in that the first locking mechanism comprises a first gear wheel on each of the bolts, and a single second gear wheel meshing with the first gear wheels, the first locking mechanism being actuatable by rotation of the second gear wheel.
5. A locking device according to claim 4 characterised in that the second locking mechanism includes a blind gear wheel which is moveable into engagement with the first gear wheels to prevent the first gear wheels turning to retract the bolts.

6. A locking device according to claim 5 characterised in that the blind gear wheel and the second gear wheel are located on the same spindle, the axial position of which spindle is adjustable to engage selectively the second gear wheel or blind gear wheel with the first gear wheels.
7. A locking device according to claim 6 characterised in that the second locking mechanism includes a member on the spindle and means for restraining the member to lock the axial position of the spindle in which the first gear wheels are engaged with the blind gear wheel.
8. A locking device according to claim 7 characterised in that the spindle is held in the locked position against a spring bias.
9. A locking device according to claim 8 characterised in that the second locking mechanism includes an element which engages above the member in the locked position and the second locking mechanism is unlocked by first moving the element out of the path of the member to allow the spindle to move axially under the influence of the spring bias, and then further moving the member and spindle along the axis by engagement underneath the member, the first and second gears only being in mutual engagement after the second operation.
10. A locking device according to claim 8 characterised in that the second locking mechanism includes two escapement arms at different positions with respect to the said axis, and pivotable into and out of the path of the said member; the said two operations

-11-

causing firstly a first said escapement arm to move out of the path of the member and at the same time a second said escapement arm to move into the path of the member at a point axially spaced from the first arm, and secondly the second said arm to move out of the path of the member so that the spindle can be moved to a position in which the first and second gears are engaged.

11. A device according to claim 10 characterised in that the member and the second escapement arm comprise cooperating portions whereby said second operation cannot be completed unless the said cooperating portions are disengaged while the second operation is being performed.
12. A device according to any of the preceding claims characterised in that one or more component incorporates a matrix of copper and artificial diamonds.
13. A locking device substantially as herein described with reference to the accompanying drawings.
14. A safe incorporating a lid having a locking device according to any of the preceding claims.

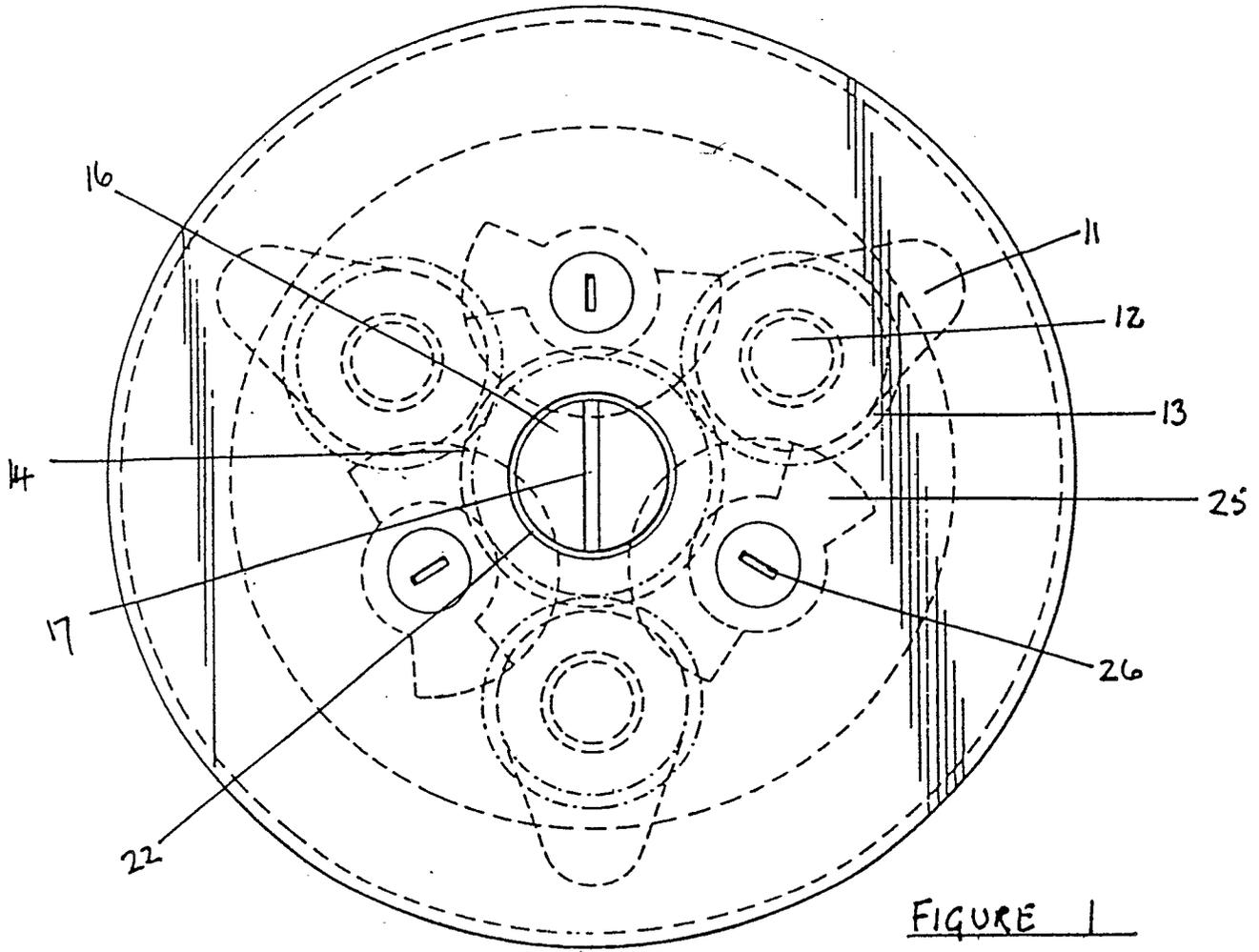


FIGURE 1

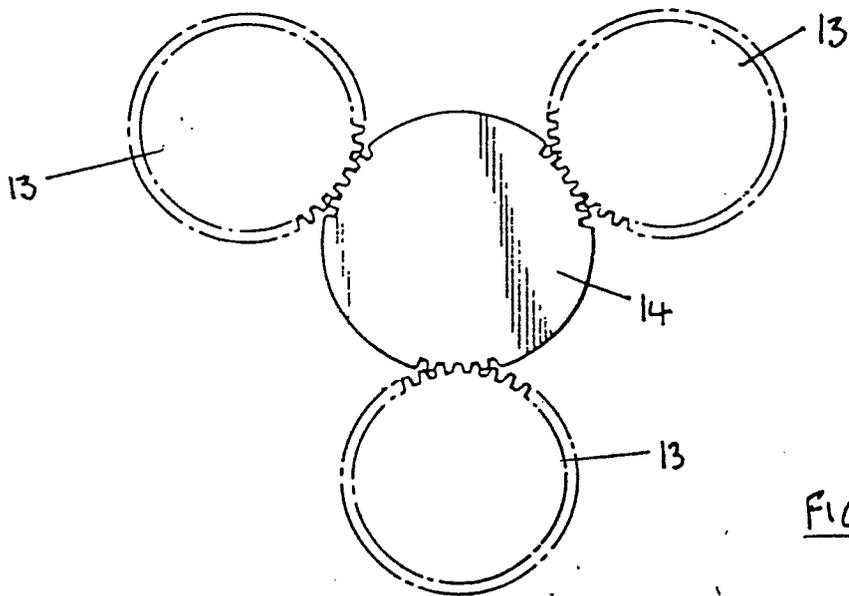
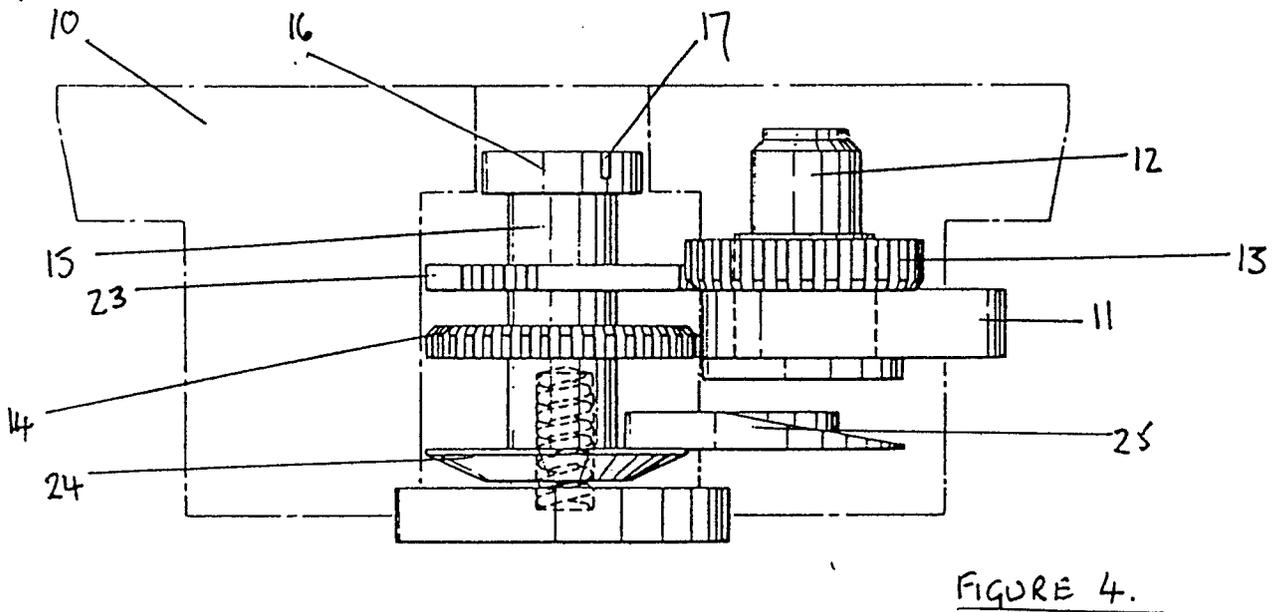
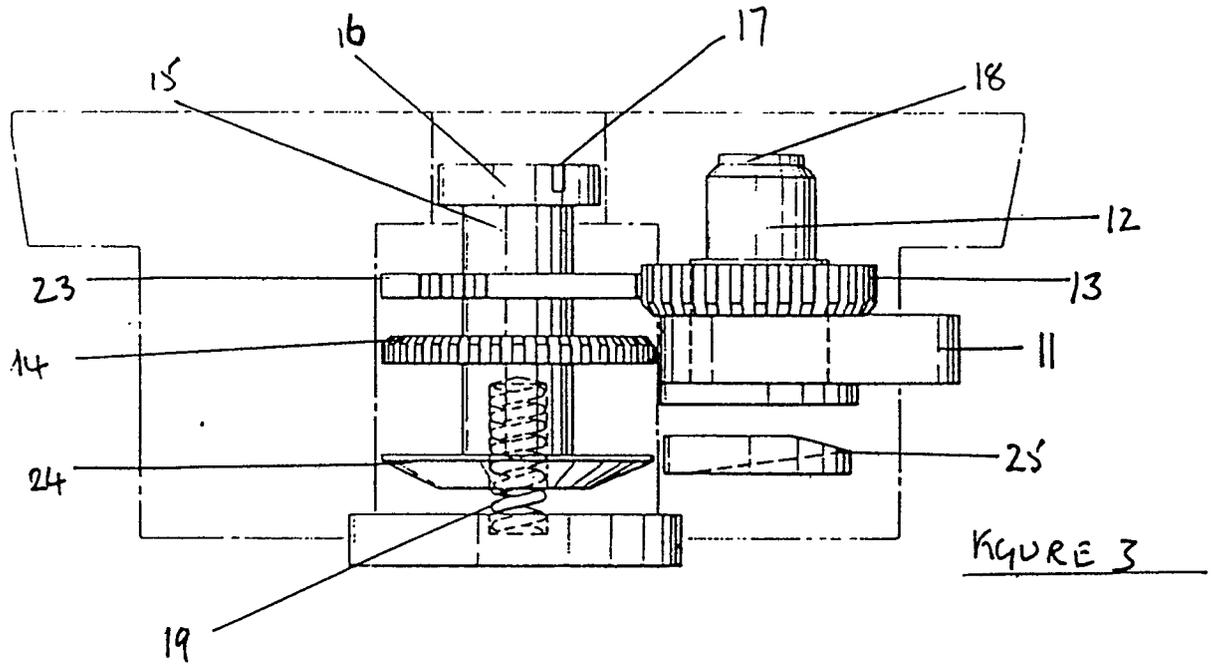
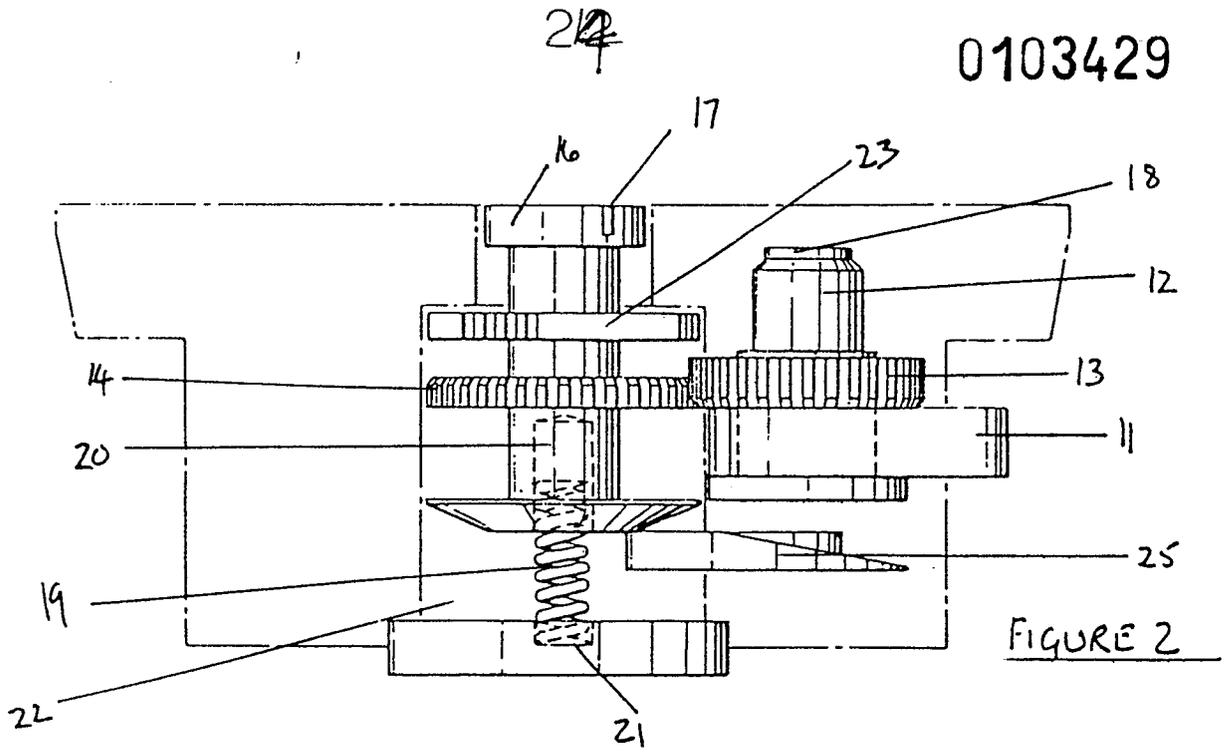


FIGURE 5



3/7

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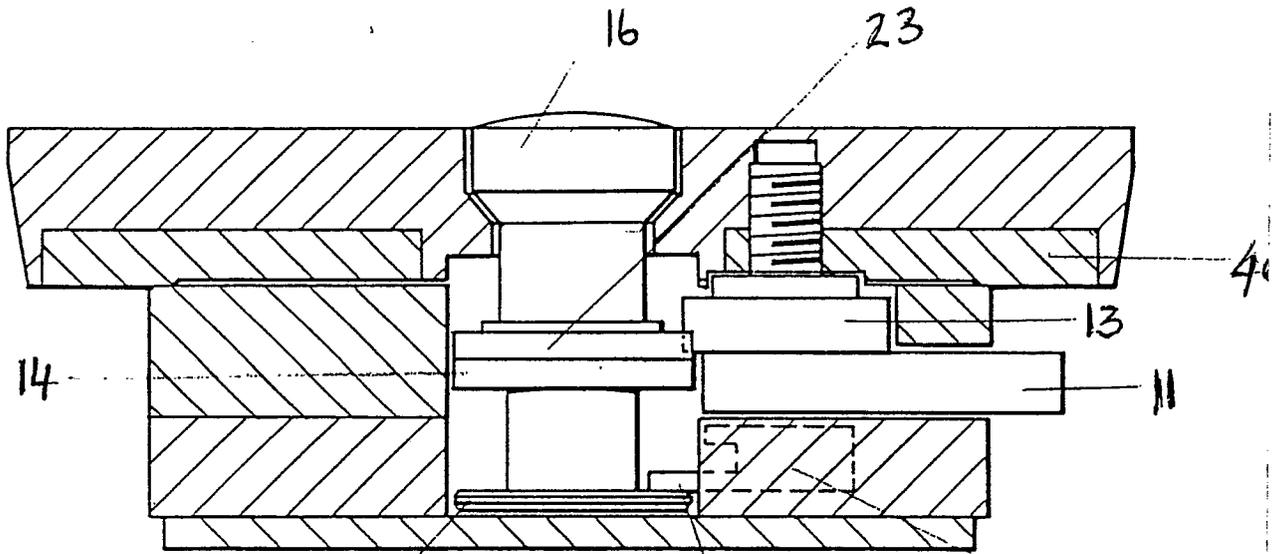


Fig. 6.

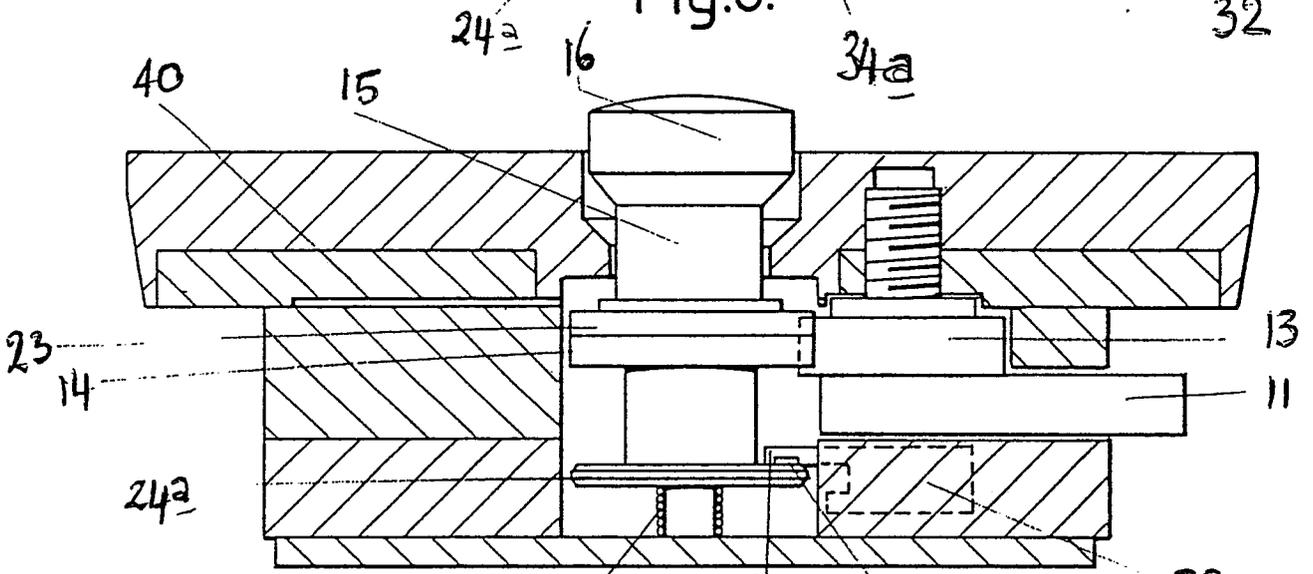


Fig. 7.

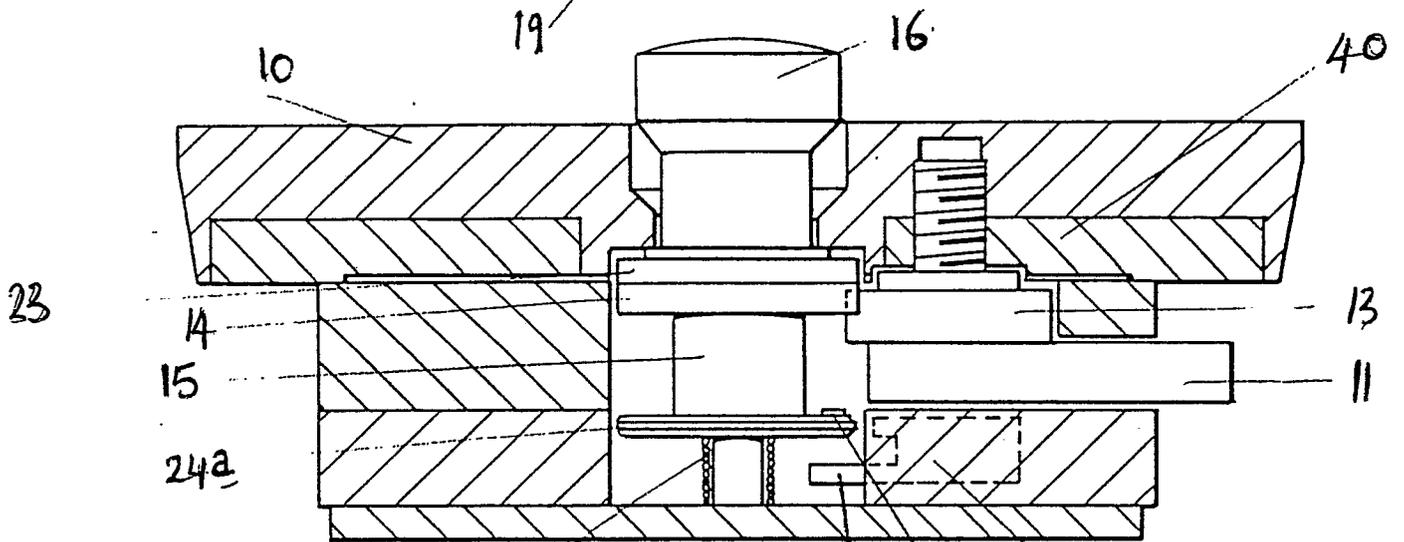


Fig. 8.

4/4

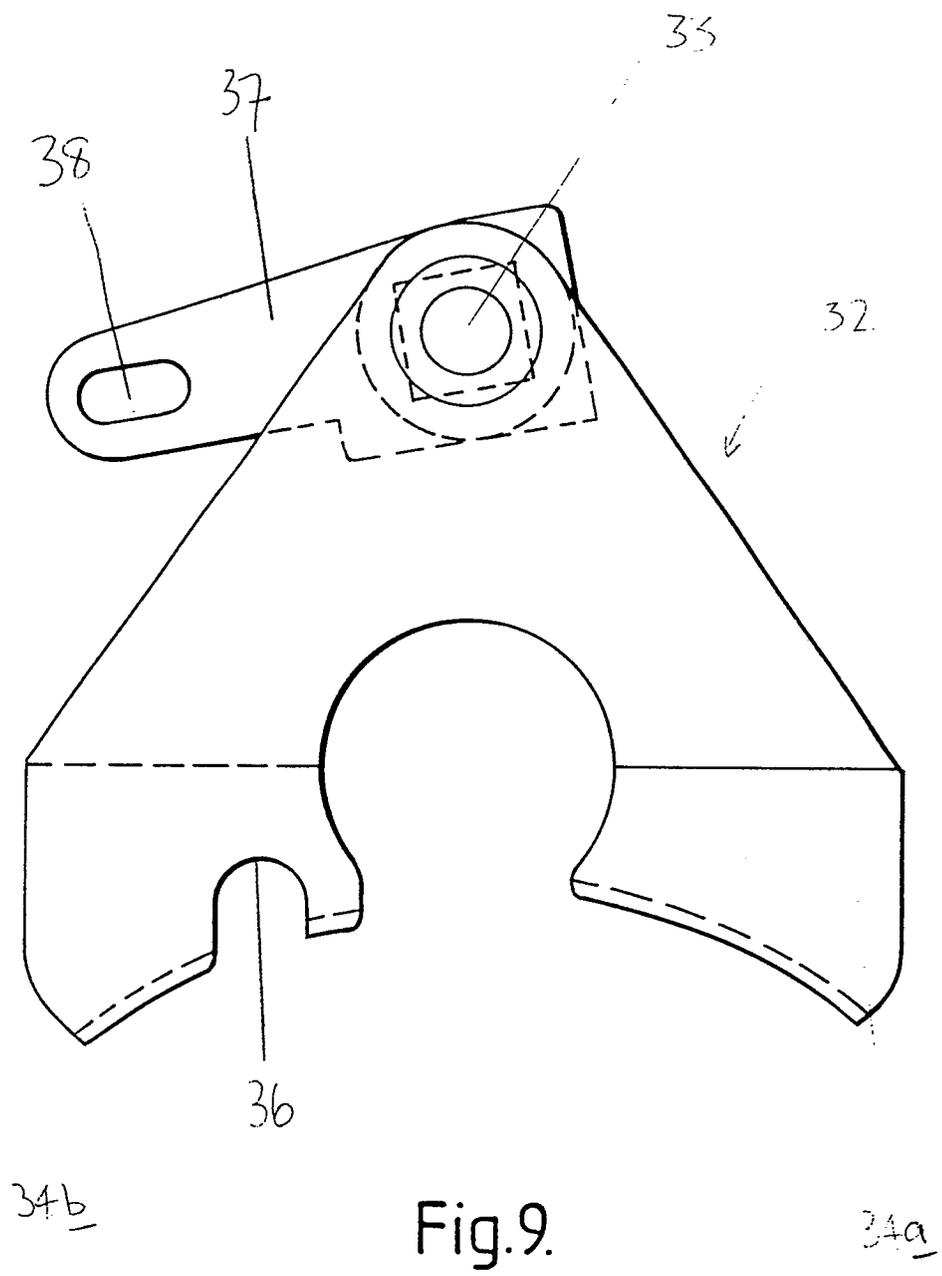


Fig.9.