



(19)

Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 900 901 A2

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
10.03.1999 Bulletin 1999/10

(51) Int. Cl.<sup>6</sup>: E05B 47/06, E05B 55/00

(21) Application number: 98115570.8

(22) Date of filing: 19.08.1998

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE  
Designated Extension States:  
AL LT LV MK RO SI

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(30) Priority: 08.09.1997 IT BO970541

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### (54) Device for adjusting the trip mechanism of an electric lock

(57) A device for adjusting the trip mechanism of an electric lock that comprises a latch (12) and a reset plunger (5), the mechanism comprising an electromagnet which is composed of at least one coil (22), which forms a seat inside which a ferromagnetic core (24) is guided, the core being actuated by a spring against a keeper (28) which is pivoted in a rocker-like fashion and

a ratchet system (9) for actuating the latch (12), the device further comprising a pivot which is rotatably supported inside the lock and is provided with a cam which is operatively associated with the keeper so as to adjust its position with respect to the ratchet system.

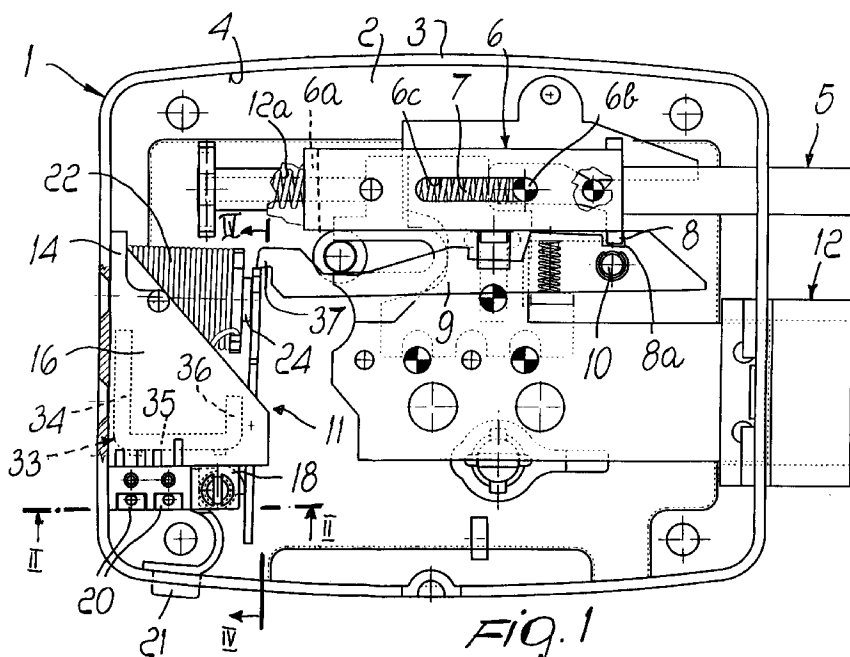


Fig. 1

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## Description

[0001] The present invention relates to a device for adjusting the trip mechanism of an electric lock.

[0002] Conventional electric locks have a latch and a so-called reset plunger provided with a tang which is guided in a slot of an element (slider) which is slideable inside the casing of the lock and can be blocked by means of a trip mechanism comprising a ratchet system actuated by an electromagnetic unit. The reset plunger is operatively coupled to the slider through a spring which remains compressed when the reset plunger, in the door closure position, abuts against the jamb, while the ratchet system keeps the slider blocked.

[0003] When the ratchet system is released by activating the electromagnetic unit, the compressed spring acts on the slider; as it moves, said slider draws the latch into the casing, thus allowing the door to open. It is possible to open an electric lock manually, acting with a handle or key on the ratchet system, which releases the slider and causes the retraction of the latch indirectly, by means of the compressed spring of the reset plunger, exactly as occurs with an electromagnetic actuation.

[0004] It has been observed that the perfect operation of the lock is often compromised by the fact that considerable voltage drops occur along the electrical line that carries voltage to the electromagnetic unit. Accordingly, the voltage across the electromagnetic unit is no longer sufficient to activate the trip mechanism. Similar shortcomings have been found due to the manufacturing tolerances of the mechanical and electrical components of the lock, which cause the operation of the trip mechanism to be unreliable.

[0005] The aim of the present invention is to provide an adjustment device which, by acting on the trip mechanism of an electric lock, allows to obviate the above drawbacks.

[0006] Within the scope of this aim, an object of the present invention is to provide a device which is easy to install inside the lock and can be adjusted with simple actions also by nonexpert personnel.

[0007] This aim, this object and others which will become apparent hereinafter, are achieved by a device for adjusting the trip mechanism of an electric lock that comprises a latch and a reset plunger, said mechanism comprising an electromagnet which is composed of at least one coil, forming a seat inside which a ferromagnetic core is guided, said core being actuated by a spring against a keeper which is pivoted in a rocker-like fashion and a ratchet system for actuating said latch, characterized in that it comprises a pivot which is rotatably supported inside said lock and is provided with a cam which is operatively associated with said keeper so as to adjust its position with respect to said ratchet system.

[0008] Further characteristics and advantages of the present invention will become apparent from the following detailed description of a preferred embodiment

thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a plan view of the inside of an electric lock provided with the device according to the invention;

Figure 2 is a sectional view of the adjustment device, taken along the plane II-II of Figure 1;

Figure 3 is a view which is similar to Figure 2 but shows the device during assembly;

Figure 4 is a sectional view, taken along the plane IV-IV of Figure 1;

Figure 5 is a sectional view, taken along the plane V-V of Figure 2;

Figures 6 and 7 are views of the region for the mutual engagement of the keeper and of the ratchet system in two different adjustment positions of the device.

[0009] With reference to the above figures, 1 designates the casing of the electric lock, which is composed of a bottom 2 surrounded by a wall 3 which delimits the compartment 4 for containing the actuation elements of the lock, which are not described in great detail since they are fully conventional.

[0010] The actuation elements comprise the so-called reset plunger 5, whereon a slider 6 is slidably associated. A spring 7 acts between a flap 6a of the slider and a pin 6b which is driven through a slot 6c of the slider.

[0011] When the door where to the lock is applied is in the closed position, the reset plunger 5 lies inside the casing because it abuts against the jamb, and the slider 6 is engaged, by means of a tooth 8, in the notch 8a of a lever 9 which is pivoted on a pivot 10. The lever 9 forms, together with an electromagnetic unit 11, a resettable trip mechanism which is adapted to retain or release the slider 6. By activating the electromagnetic unit 11, the lever 9 can rotate, allowing the tooth 8 to disengage from the notch 8a and allowing the slider 6 to slide on the reset plunger 5 and draw into the lock with it the latch 12 where to it is coupled in the sliding direction. The retraction of the latch into the lock causes the compression of the return spring 12a, which is weaker than the spring 7 and which, when the door is open, pushes out the latch 12 and the reset plunger 5 and thus resets the trip mechanism.

[0012] The electromagnetic unit comprises a body 13 which is formed by molding plastic material and is composed of a base 14 (Figure 4), which is substantially rectangular and is fixed to the inner face of the wall 3 of the casing, and of a pair of walls 15 and 16, which protrude at right angles to the base from the two longitudinal sides thereof.

[0013] The walls 15, 16 are shaped like a right-angled trapezoid in which the longer parallel sides lie on the base and the vertical sides are connected by a transverse wall 17 which reaches a level that lies below the top of the flaps 15 and 16.

[0014] Two flaps 18 and 19 protrude outward from the transverse wall 17, and below the flaps there is a block provided with terminals 20 for connection to the wires of the electrical power supply and a cable passage sleeve 21.

[0015] A flat region is formed on the upper face of the base in order to arrange a cylindrical coil 22 of an electromagnet, which is connected to the terminals 20.

[0016] The coil 22 forms a cylindrical cavity 23 in which the core 24, constituted by a cylinder made of ferromagnetic material, is arranged together with a spring (not shown) which actuates the core toward the outside of the coil 22 to act on the keeper of the electromagnet.

[0017] The keeper is constituted by a plate 28 which is shaped so that the end of one of its arms 29 is operatively associated with the core 24, while the opposite arm 30 rests on the flaps 18 and 19.

[0018] The plate 28 is pivoted in a rocker-like manner in the flaps 15 and 16 of the body 13. For this purpose, two tabs 31 and 32 protrude outward from the longitudinal sides of the plate 27 and engage recesses of the flaps 15 and 16. The keeper 28 is adapted to assume two positions: in one of said positions, it engages a tooth 37 which is formed at the end of the lever 9, so as to prevent its rotation and ensure the engagement of the tooth 8 of the slider 6 in the notch 8a of the lever 9. In the other position, determined by the electromagnetic attraction of the coil 22, the keeper 28 oscillates into the position for disengaging the tooth 37 from the keeper 28, allowing the rotation of the lever 9 and the sliding of the slider 6, which drags along the latch 12 in the direction for retraction into the lock, allowing the door to open. The coil 22 is spaced from the transverse wall 17, so that a space remains between the coil and the wall in which a ferromagnetic element 33 is meant to be placed; said element 33 is adapted to form a preferential circuit for the lines of force of the magnetic flux generated by the coil 22.

[0019] The element 33 is constituted by a plate made of ferromagnetic material which is bent so as to have a first portion 34, which is fixed to the base 14 and lies between the coil 22 and the wall 17, a second portion 35, which lies at right angles to the first portion adjacent to the transverse wall 17, and a third portion 36 which runs from the end of the second portion toward the coil below the keeper 28. Substantially, therefore, the element 33 is shaped like a letter U lying on the base 14.

[0020] The operation of the lock is fully conventional. In the door closure position, the elements of the lock are in the position shown in Figure 1, except for the reset plunger 5 which, by abutting against the door jamb must be assumed to lie inside the casing 1. In this position, the spring 7 is compressed between the pin 6b and the flap 6a of the slider 6.

[0021] It is evident that the actuation of the trip device of the lock is greatly affected by the position of the keeper 28 with respect to the tooth 37. If the engagement between the keeper 28 and the tooth 37 is like the

one shown in Figure 6, the disengagement force that the electromagnet must have in order to disengage the keeper 28 is smaller than the force required by an engagement such as the one shown in Figure 7 and therefore the disengagement of the keeper in the case of Figure 6 can occur with a lower voltage.

[0022] In order to correct the position of the keeper 28 with respect to the tooth 37 and compensate for variations in the supply voltage of the electromagnet or also for machining tolerances which, as mentioned, can cause the disengagement of the keeper 28 from the tooth 37 to be critical, the present invention proposes an adjustment device which consists of a pivot 39 which is rotatably supported in holes 40 and 41 of the flaps 18 and 19.

[0023] A diametrical slot 42 is formed in the end of the pivot 39 that is rotatably supported in the flap 18; two mutually opposite teeth 43, formed inside a ring 44 applied to the pivot 39, engage in said slot.

[0024] The ring 44 has a radial cam 45 whose radius gradually increases over the angle that it covers.

[0025] The end of the pivot 39 that engages in the hole 41 of the flap 19 forms a head 46 which has a knurled region composed of equidistant axial teeth, which are adapted to couple to complementary teeth formed in the wall of the hole 41.

[0026] The engagement of the teeth of the head 46 between the teeth of the hole 41 locks the rotation of the pivot 39 and therefore of the cam 44.

[0027] In order to axially retain the pivot 39 in the holes 40 and 41 a stop element is provided which consists of a pair of elastic tabs 47 and 48 which protrude from diametrical positions of the pivot 39 and are separated from the knurled head 46 by respective cutouts 49 and 50 of the pivot 39.

[0028] The tabs 47 and 48 are hook-shaped, so that by becoming narrower during the insertion of the pivot in the holes 40 and 41 of the flaps 18 and 19 they can be accommodated in the cutouts 49 and 50. After the pivot 39 has been inserted so as to lock the ring 44 below the flap 18, the flaps 47 and 48 open out above the flap 19, preventing extraction of the pivot 39.

[0029] The diameter of the cam 44 is such that its profile protrudes out of the plane that passes through the edges of the flaps 18 and 19 directed toward the keeper 28. In this manner, the keeper 28, due to the thrust of the core 24 whereon the return spring arranged inside the coil 22 acts, instead of resting on the edges of the flaps 18 and 19, continues to rest on the peripheral region of the cam 44 and, depending on the angular orientation of said cam, assumes a position in which its end 29 is more or less spaced from the coil 22, as shown in Figures 6 and 7.

[0030] In particular, when the excitation voltage of the electromagnet is low, for example due to a voltage drop of the supply line, the keeper 28 is orientated so that the tip 51 of the tooth 37 rests on the end of arm 29 (Figure 6). In this manner, the attraction force of the electromag-

net must be sufficient to overcome only the friction between the tooth and the keeper.

[0031] Conveniently, the side 52 of the tooth 37 that is meant to rest against the keeper 28 forms an acute angle  $[\alpha]$  with respect to the plane that is perpendicular to the keeper. Accordingly, a small undercut forms between the tip 51 and the keeper 28, and in order to move beyond it the lever 9 must rise very slightly and therefore a higher attraction force of the electromagnet is necessary.

[0032] From the above description it is evident that if the lock is supplied with a voltage within the specifications, the cam 44 is adjusted so as to position the keeper 28 with respect to the tooth 37 as shown in Figure 7.

[0033] On the other hand, if the lock is supplied with a voltage lower than the specifications, the cam 44 is adjusted so as to move the keeper 28 into the position of Figure 6 to ensure the activation of the trip mechanism.

[0034] It should be observed that the angular retention of the cam 44 is ensured by the interlocking between the teeth of the knurled region of the head 46 and those of the hole 41. In order to adjust the cam 44 into the chosen angular position, a screwdriver is inserted in the slot 42 and turned, causing the stepwise rotation of the head 46 in the hole 41.

[0035] Advantageously, the head 46 has a diametrical slit forming two halves which can be moved mutually closer to allow a more flexible coupling between the teeth of the head 46 and those of the hole 41.

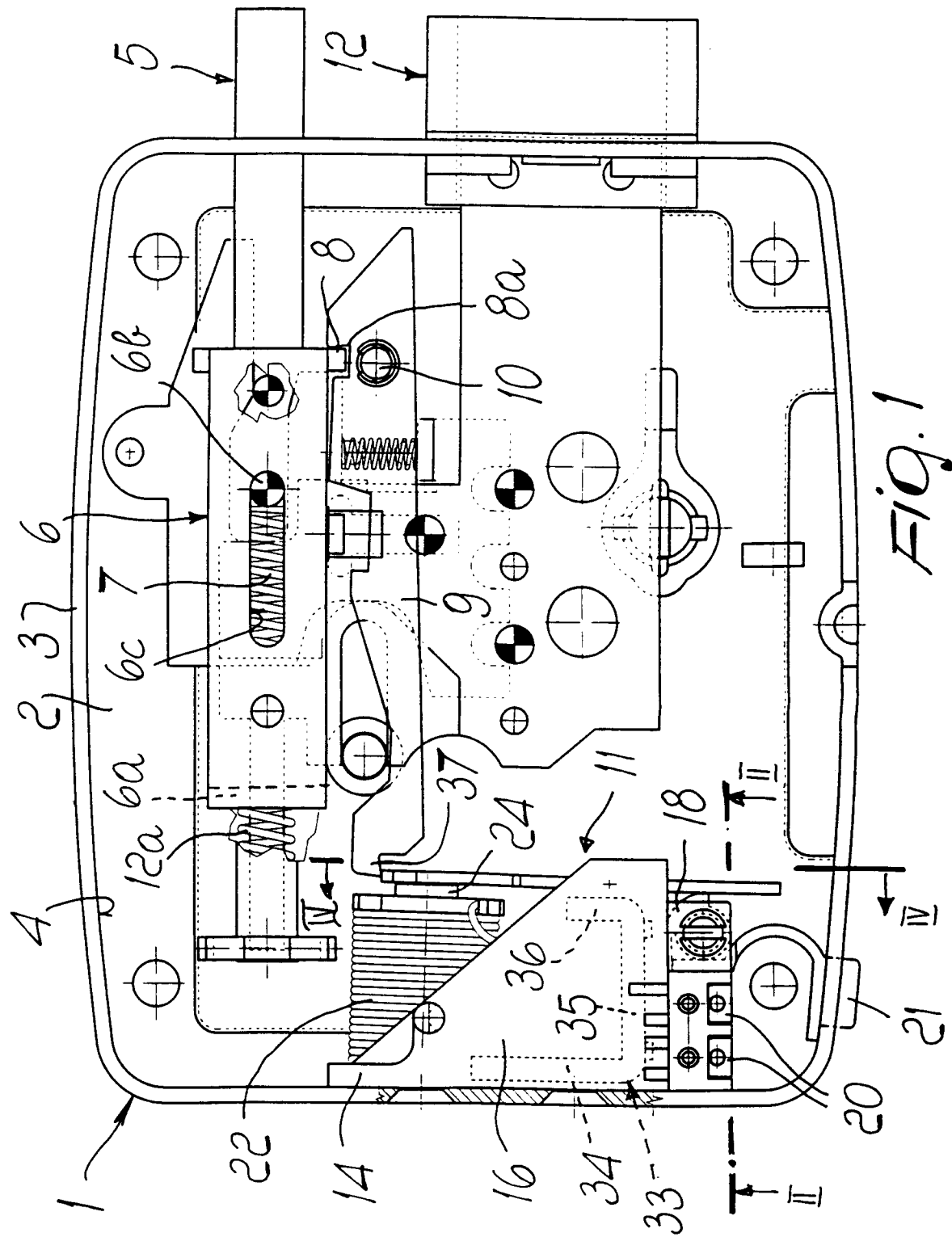
[0036] The disclosures in Italian Patent Application No. BO97A000541 from which this application claims priority are incorporated herein by reference.

[0037] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

## Claims

1. A device for adjusting the trip mechanism of an electric lock that comprises a latch (12) and a reset plunger (5), said mechanism comprising an electromagnet which is composed of at least one coil (22), forming a seat inside which a ferromagnetic core (24) is guided, said core being actuated by a spring against a keeper (28) which is pivoted in a rocker-like fashion and a ratchet system (9) for actuating said latch (12), characterized in that it comprises a pivot (39) which is rotatably supported inside said lock and is provided with a cam (45) which is operatively associated with said keeper (28) so as to adjust its position with respect to said ratchet system (9).

2. A device according to claim 1, characterized in that said pivot (39) is rotatably supported in holes (40, 41) of a pair of flaps (18, 19) which protrude from a body (13) for supporting the coil (22), a diametrical slot (42) being formed in one end of said pivot (39), two mutually opposite teeth (43) engaging in said slot, said teeth being formed inside a ring (44) which is applied to the pivot (39) and is provided with a radial cam (45) which protrudes angularly with a gradually increasing radius.
3. A device according to claim 2, characterized in that the end of said pivot (39) that is furthest from the one provided with said slot (42) forms a head (46) which has a knurled region composed of equidistant axial teeth which are suitable to couple to complementarily shaped teeth formed in the wall of the hole (41) for supporting said end, so as to rotationally lock said pivot (39) and therefore said cam (45).
4. A device according to claim 3, characterized in that, in order to axially retain the pivot (39) in said supporting holes (40, 41), a stop element is provided which consists of a pair of elastic tabs (47, 48) which protrude from diametrical positions of the pivot (39) and are separated from the knurled head by respective cutouts (49, 50) of the pivot (39), said tabs (47, 48) being hook-shaped so that during the insertion of the pivot (39) in said holes (40, 41) said tabs are accommodated in said recesses (49, 50), while after the pivot (39) has been inserted, said tabs (47, 48) open out in order to engage a respective wing (19) for supporting said pivot (39) and to prevent said pivot from slipping out.
5. A device according to claim 3, characterized in that said head (46) has a diametrical slit which is suitable to form two halves which can be moved mutually closer.



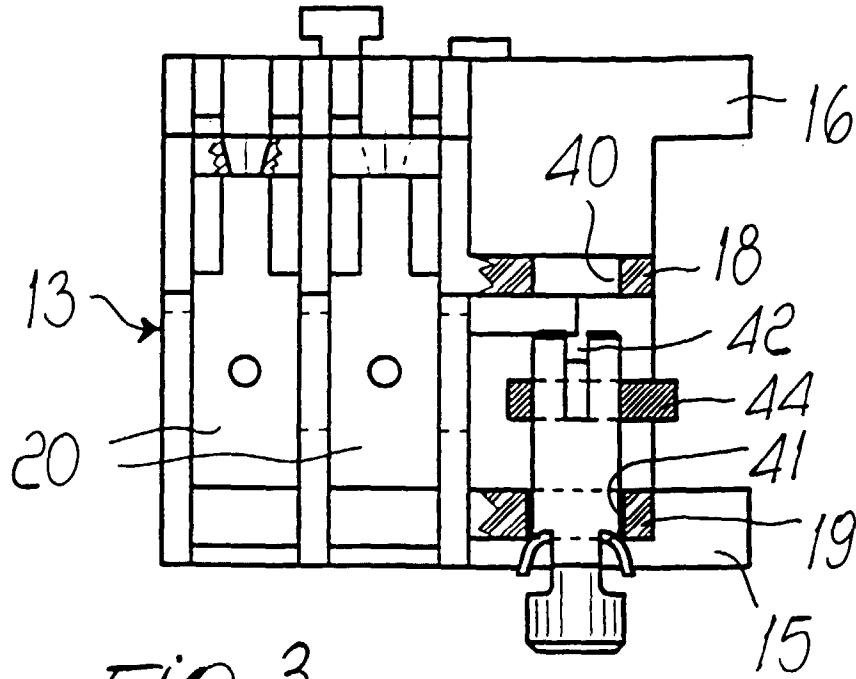


Fig. 3

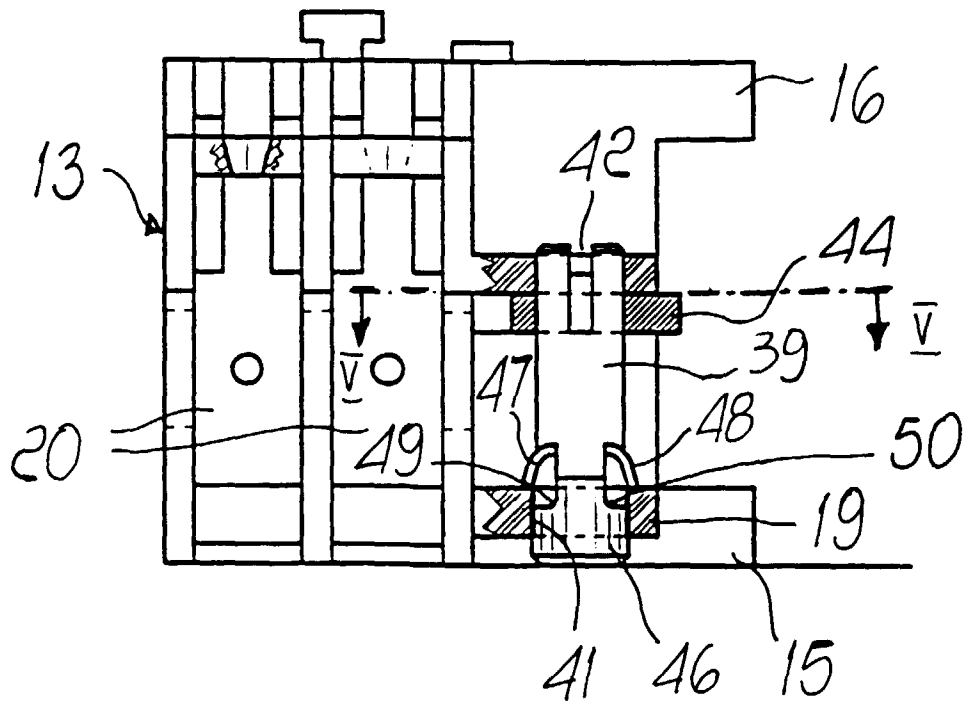


Fig. 2

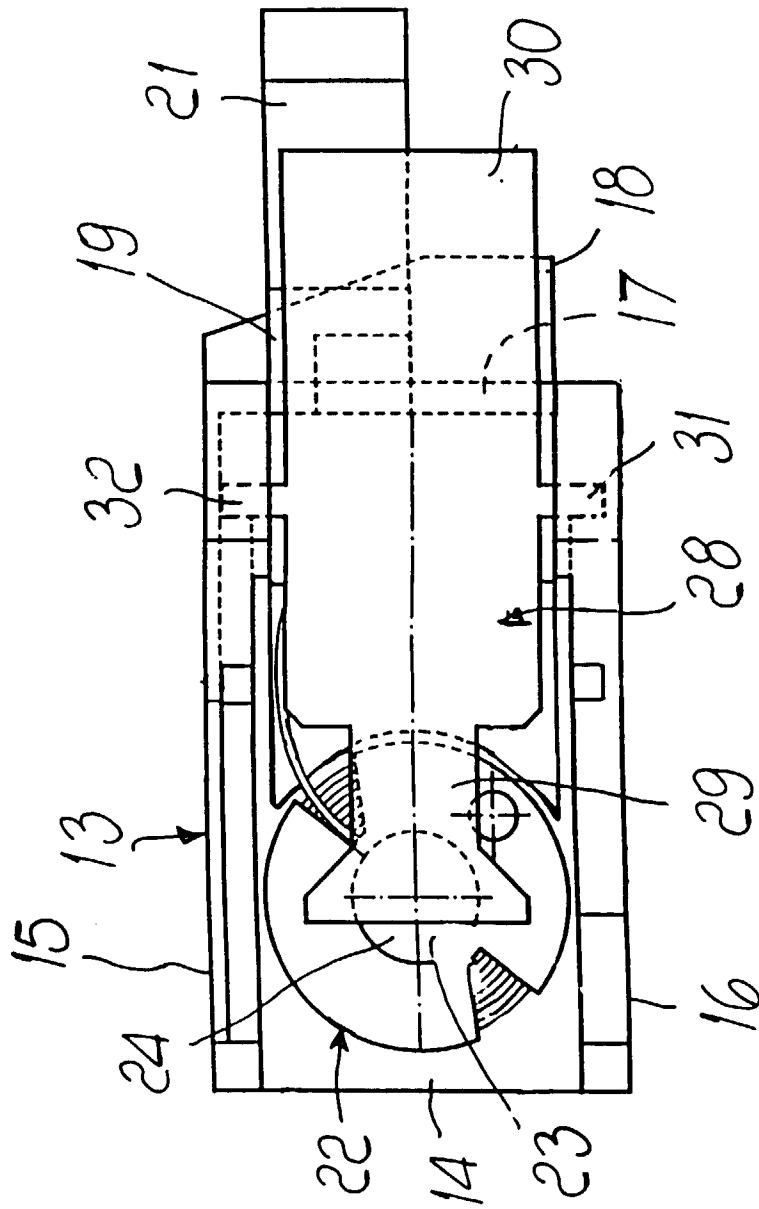
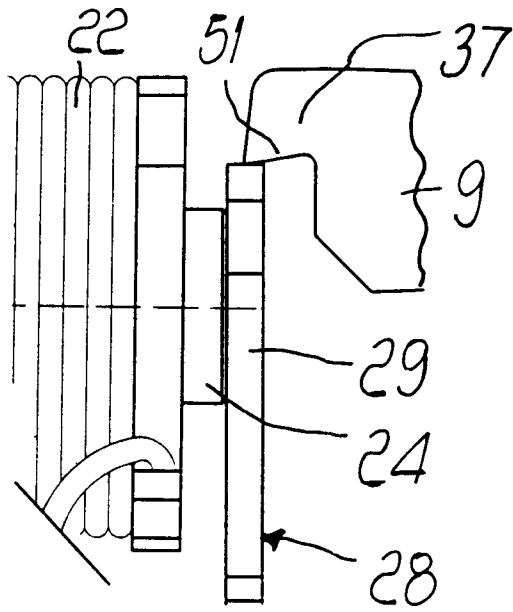
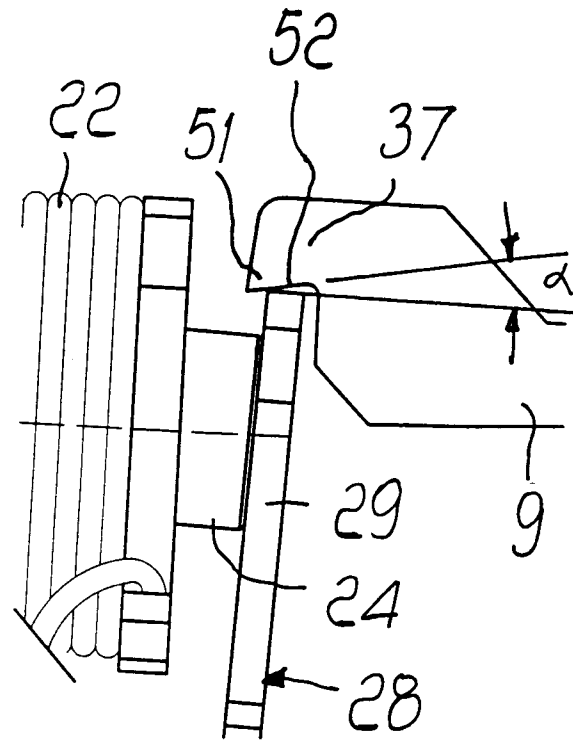


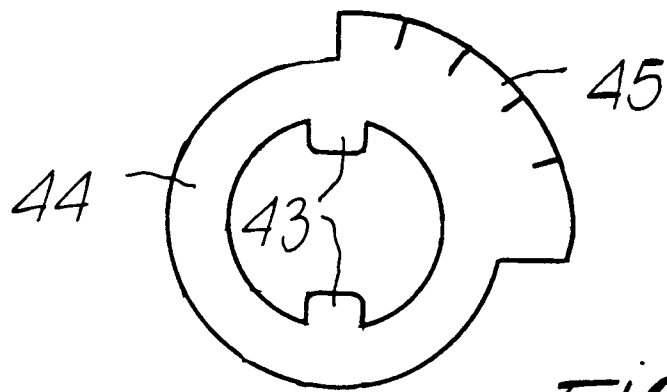
Fig. 4



*Fig. 6*



*Fig. 7*



*Fig. 5*