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(11) **EP 0 933 794 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
19.09.2001 Bulletin 2001/38

(51) Int Cl.7: **H01H 27/00**

(21) Application number: **99101984.5**

(22) Date of filing: **01.02.1999**

(54) **Electric safety switch**

Elektrischer Sicherheitsschalter
Interrupteur de sécurité électrique

(84) Designated Contracting States:
CH DE ES FR GB IT LI

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(30) Priority: **02.02.1998 IT VI980017**

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(43) Date of publication of application:
04.08.1999 Bulletin 1999/31

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(56) References cited:
EP-A- 0 707 329 **EP-A- 0 727 797**
EP-A- 0 778 595 **DE-C- 3 943 376**
DE-C- 4 338 910

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Description**Technical field**

[0001] The present invention relates to an electric safety switch, especially for electric power supply circuits for machines and industrial plants.

Background art

[0002] Electric switches of the above-mentioned type are known, which comprise essentially a casing with at least two slots for inserting an actuating key of pre-defined shape, at least a couple of electric contacts placed in the casing and displaceable between a closed position, when the actuator is connected, and an open position when the actuator is disconnected, a cam placed inside the casing and operatively connected to the electric contacts to displace and commute them, said cam being pivotable around a first axis when inserting the actuator in one of the slots.

[0003] The switch is provided with blocking means to prevent cam rotation and subsequent movement of electric contacts, and elastic means adapted to maintain the blocking means in a stopping position of the cam when the actuator is disconnected from the casing.

[0004] Normally, the switch casing is fixed to a stationery part of the machine or plant, for instance to a control cubicle frame, while the key actuator is fixed on a moving part, like the cubicle door.

[0005] By means of this configuration, opening the cubicle door will commute the electric contacts inside the casing and open the electric power supply circuit of the machine or plant.

[0006] Moreover, because of the particular cam shape and of the actuator inserting opening, electric commuting of the contacts cannot be achieved by using a simple screw driver, a wire or a sharp object, but only with an actuator of special shape coupled to the switch.

[0007] A drawback of this known safety switches lies in the relatively complex and miniaturised cam blocking mechanisms, especially if there are more than one actuator input opening, which reduce mechanical strength and switch reliability.

[0008] Additionally, the actuator input detecting mechanisms are subject to sudden displacements and are susceptible of rupture especially if they are guided in a translating movement.

[0009] Examples of safety switches of the above mentioned type are described in the following patent documents: EP-A-553885, WO-A-9524726, US-A-5516993, US-A-5622253, EP-A-175156, EP-A-605820, US-A-4395608, US-A-5420385, EP-A-117396, EP-A-345656, US-A-4963706, US-A-5587569, EP-A-507820, US-A-4695684, DE-A-4338910, EP-A-0727797.

[0010] The blocking means of those known switches generally comprise one or more slides placed at the cam sides and able to move along linear guiding means,

see e.g. DE-A-4338910. The slides interact together and with the cam by means of inclined planes which produce high friction forces and are subject to seizures due to dirt settled on the sliding surfaces. Moreover, such slides are subject to high wear. Mutually disposed multiple disc solutions also are subject to seizures because of the dirt on the contact surfaces, see e.g. EP-A-0727797. In particular, the simultaneous rotation of the discs caused by their reciprocal seizure prevents proper functioning of the switch.

[0011] Other examples of switches provide only one input opening for the actuator, thus limiting flexibility in the use of the device.

[0012] From EP-A-0 707 329 a safety switches is known which comprises all the features mentioned in the preamble of the attached claim 1. In this known safety switch there is provided a blocking means comprising a pair of lever elements rotary mounted on the cam to move against the reaction force of springs having one end lodged in appropriate seats of the cam. In this arrangement the cam is a rather complicated assembly formed by five parts which are interconnected with respect to each other and are difficult to mount. Moreover, each lever element has a locking portion which co-operates with the axis of the cam that is non-rotatably mounted in the casing. The locking portion of each lever element is a locking groove disposed in the passage of the axis and the co-operating surfaces of the lever element and of the axis must be extremely precise in order to avoid large angular position errors on the periphery of the cam.

Description of the invention

[0013] The main object of the present invention is to eliminate, or at least to reduce, the above-mentioned drawbacks by providing a safety switch with high flexibility of use, reliability and long operating life.

[0014] A particular object is to provide a safety switch which is substantially not dirt sensitive.

[0015] Another object of the invention is to provide a safety switch with a simplified structure, and a limited number of parts, so as to be easy to assemble and economically advantageous.

[0016] The above mentioned objects and others which will be better clarified hereafter are achieved by means of a safety switch in accordance with the attached claim 1. Thanks to the claimed arrangement it is possible to prevent seizure risks and the typical wear of the slides of the prior art.

[0017] Preferably, the second pivot axis of the lever element is substantially parallel to the cam pivot axis. This produces an important simplification and consequently more reliability and longer operational life.

[0018] Advantageously every lever element has an actuating portion that interacts with the actuator. Moreover, the actuation portion of each lever element is provided with rounded edges that face each of the casing

openings to operate smoothly with the actuator at the moment of the introduction in the casing.

[0019] To this end, the cam is provided with at least one engagement element, preferably positioned on one lateral side of the cam and it is constituted by a radial protrusion.

Brief description of the drawings

[0020] Further advantages and aspects of the invention will become more evident from the detailed description of a preferred, non-limitative, embodiment of a safety switch, hereafter shown by way of non-limitative example by means of the accompanying drawings, in which:

Fig. 1 shows a partial-section side schematic view of a safety switch according to the invention;

Fig. 2 shows the switch of Fig. 1, in a second operational position:

Fig. 3 shows an enlarged-scale side view of a detail of Fig. 1 in a first operational position;

Fig. 4 shows an enlarged-scale side view of a detail of Fig. 1 in a second operational position;

Fig. 5 shows an exploded perspective view of a detail of Fig. 1.

Description of an embodiment

[0021] With reference to the mentioned figures, the switch according to the invention globally referenced as 1, comprises a casing 2 composed of a lower body 3 and upper head 4, adapted to be reciprocally coupled and fixed to a fixed part of a machine or plant, for example to a control cubicle frame.

[0022] The lower body 3 contains a first pair of fixed contacts respectively referenced as 5, 5', for example placed serially on the electric power line of the machine, and a second series of fixed contacts 6, 6', for example placed in series on the electric power line of an optical and/or acoustic alarm.

[0023] Two pairs of mobile contacts respectively referenced as 7, 7' and 8, 8' united by respective links 9, 10 are mounted on a shaft 11 slidably guided along a longitudinal axis V by appropriate seats.

[0024] Thus, contacts 7, 7', 8, 8' can be displaced between a closed position of contacts 5, 5' and simultaneous opening of contacts 6, 6', as shown in Fig. 1, and an open position of contacts 5, 5' and simultaneous closing of contacts 6, 6', as shown in Fig. 2.

[0025] A compression spring 13 operates on the lower extremity 12 of the moving shaft 11 to push the upper extremity 14 of the shaft 11 against a cam external profile, globally referenced as 15.

[0026] Cam 15 is pivotally mounted on a first rotation axis H defined by a pin 16 inserted in the head 4 and is provided on its periphery with a pair of appropriately shaped hollows 17, 17'.

[0027] The head 4 is provided with two slots 18, 19 made on two adjacent faces of the head 4, for insertion of an actuator 20, having the shape of a key, along two mutually perpendicular directions A and B. The key-shaped actuator 20 can be solidarily coupled to a fixed machine part, for instance a cubicle door, and has an end part 21 of special shape interrupted in its centre to cooperate at the input and output with cavities 17, 17' of cam 15.

[0028] Thus, by closing the cubicle door, the actuator will be inserted in the slot 18 or 19 made in the head 4, interacting with cam 15 to make it rotate. Cam 15, in turn, operates on the upper extremity 14 of the shaft 11, thus displacing the latter in translation and changing the switch position.

[0029] The switch is provided with blocking means, globally referenced with 22, for preventing rotation of the cam and consequent movement of the contacts, and elastic means. 23, for example constituted by compression springs, acting on the blocking means 22 to keep them in a position in which the cam 15 is blocked when the actuator is disconnected from the head 4.

[0030] According to the invention, the blocking means comprise at least one lever element 24 pivotally coupled on a second axis K, distal from the first one and positioned so as to actuate cam 15.

[0031] Axis K is preferably parallel to axis H so that the movements of the lever elements 24, 24' occur in a direction substantially perpendicular to the cam rotation axis H.

[0032] More particularly, two lever elements 24, 24' are provided, arranged at the opposite faces of cam 15 and pivotally connected on a pin 25 coinciding with axis K.

[0033] Each lever element 24, 24' comprises an actuating portion 26, 26' for interacting with the actuator and a blocking portion 27, 27' for interacting with cam 15.

[0034] More particularly, each actuating portion 26, 26' has rounded edges 28, 28' and 29, 29' facing their respective slots 18, 19 in the head 4, to slidably interact with actuator 20 when it is inserted.

[0035] Advantageously, cam 15 is provided with engagement elements. Preferably, the engagement elements are positioned on the lateral faces of the cam 15 and are constituted by a radial protrusion 30 extending from an axial hub 31 solidarily fixed to the cam.

[0036] Actuating portions 26, 26' and blocking portions 27, 27' extend from the respective central portions 32, 32' of the lever element provided with respective sleeves 33, 33' which can be inserted in the pivot pin 25.

[0037] Opportunely, the distance between axes H and K and between the central portions 32, 32' of the lever elements 24, 24' are dimensioned so as to allow the passage of the key-shaped actuator 20 when the latter is introduced in the head 4 through the slot 18.

[0038] Each blocking portion 27, 27' of the lever elements 24, 24' is provided with a groove 34, 34' substantially counter-shaped with respect to the radial protrusion

sion 30 of the cam 25 to selectively engage therein and prevent the rotation of the cam 15.

[0039] Moreover, every groove 34, 34' is provided with conical tapers 35, 35' which tend to bring the radial protrusion 30 back to a pre-defined angular position by bringing back the cam to its initial position.

[0040] Thus, the grooves 34, 34' have both functions of blocking the cam and bringing it back to the centre when the actuator 20 is disconnected from the slot. This enables making the slots with a large clearance and guaranteeing return of the cam in its initial position when the actuator 20 is extracted from the head 4.

[0041] Even if the safety switch according to the invention has been described with reference to the embodiment illustrated in the drawing figures, it is evident that it is susceptible to numerous modifications and variations falling within the protective scope defined in the appended claims and intended to be equally protected.

Claims

1. Electric safety switch, comprising:

a casing (2, 3, 4) with at least two slots (18, 19) for the insertion of a key-shaped actuator (20) having pre-defined shape;

at least one pair of electric contacts (5, 5', 6, 6', 7, 7', 8, 8') disposed in the casing (3) and movable between a closed position, when said actuator (20) is inserted, and an open position, when said actuator is disinserted;

a cam (15) mounted inside the casing (4) and operatively connected with the contacts to activate their displacement and commutation, said cam being rotatable around a first axis (H) by inserting the actuator in the casing;

blocking means (22) for preventing the rotation of the cam (15) and the consequent movement of the contacts;

elastic means (23) acting on said blocking means for maintaining them in a cam blocking position when said actuator is disinserted from the casing;

said blocking means (22) comprising at least one lever element (24, 24') pivotally connected around a second axis (K) distal with respect to the first one (H) and positioned in such a way to act on a lateral face of the cam (15),

characterised in that said at least one lever element (24, 24') is pivotally connected around said second axis (K) distally and independently from said cam (15), said cam (15) being provided with at least one engagement element (30) positioned on a lateral face of the cam (15), said at least one lever element (24, 24') being provided with a blocking portion (27, 27') adapted to selectively engage said

engagement element (30) to prevent the rotation of the cam (15).

2. Electric switch according to claim 1, **characterised in that** said second pivot axis (K) is substantially parallel to the cam rotation axis (H).

3. Electric switch according to claim 1, **characterised in that** said at least one lever element (24, 24') is provided with an actuating portion (26, 26') for interacting with the actuator (20).

4. Electric switch according to claim 3, **characterised in that** said actuating portion (26, 26') is provided with rounded edges (28, 29, 28', 29') facing each of the slots (18, 19) to slidably interact with the actuator (20) when it is inserted in the casing.

5. Electric switch according to claim 1, **characterised in that** said engagement element is a radial protrusion (30) extending from an axial hub (31) unitary fixed to the cam (15).

6. Electric switch according to claims 3 or 4, **characterised in that** said actuating portion (26, 26') and said blocking portion (27, 27') extend from a central portion (32, 32') of the lever element, pivotally connected around said second axis (K) to said casing (4).

7. Electric switch according to claim 5, **characterised in that** said each blocking portion (27, 27') is provided with a groove (34, 34') substantially counter-shaped with respect to said radial protrusion (30) of said cam.

8. Electric switch according to claim 7, **characterised in that** said groove (34, 34') is provided with conical tapers (35, 35') adapted to bring the radial protrusion (30) in a predetermined angular position bringing said cam back to its initial position.

9. Electric switch according to any one or more of the preceding claims, **characterised in that** it is provided with a pair of lever elements (24, 24') on opposite sides of said cam, interacting simultaneously and symmetrically with respective radial protrusions (30) formed on the lateral faces of the cam.

Patentansprüche

1. Elektrischer Sicherheitsschalter mit

einem Gehäuse (2, 3, 4) mit mindestens zwei Schlitz (18, 19) zum Einführen einer schlüsselförmigen Betätigungsvorrichtung (20) mit einer vorbestimmten Form, mindestens einem

Paar in dem Gehäuse (3) angeordneter elektronischer Kontakte (5, 5', 6, 6', 7, 7', 8, 8'), die beweglich sind zwischen einer geschlossenen Position, wenn die Betätigungsvorrichtung (20) eingeführt ist und einer offenen Position, wenn die Betätigungsvorrichtung nicht eingeführt ist, einer Nocke (15), die innerhalb des Gehäuses (4) angeordnet ist und funktional verbunden ist mit den Kontakten, um deren Bewegung und Umschaltung zu bewirken, wobei dieser Nocken drehbar ist um eine erste Achse (H) durch Einführen der Betätigungsvorrichtung in das Gehäuse; Blockiereinrichtungen (22) zur Verhinderung der Drehung des Nockens (15) und der folgenden Bewegung der Kontakte, elastischen Einrichtungen (23), die auf die Blockiereinrichtungen wirken, um diese in einer Position zu halten, in der der Nocken blockiert ist, wenn die Betätigungsvorrichtung nicht in das Gehäuse eingeführt ist,

wobei die Blockiereinrichtungen (22) mindestens ein Hebeelement (24, 24') umfassen, das schwenkbar an eine zweite Achse (K) montiert ist mit Abstand zu der ersten (H) und so angeordnet, daß es auf eine seitliche Fläche des Nockens (15) wirkt,

dadurch gekennzeichnet, daß

dieses mindestens eine Hebeelement (24, 24') schwenkbar an diese zweite Achse (K) montiert ist mit Abstand und unabhängig zu dem Nocken (15), wobei dieser Nocken (15) mit mindestens einem Eingriffselement (30) versehen ist, das auf einer seitlichen Fläche des Nockens (15) angeordnet ist, wobei dieses mindestens eine Hebeelement (24, 24') mit einem Blockierabschnitt (27, 27') versehen ist, der ausgestaltet ist, um dieses Eingriffselement (30) wahlweise zu erfassen, um die Drehung des Nockens (15) zu verhindern.

2. Elektrischer Sicherheitsschalter gemäß Anspruch 1, **dadurch gekennzeichnet, daß** die zweite Schwenkachse (k) im wesentlichen parallel ist zu der Drehachse (H) des Nockens.
3. Elektrischer Sicherheitsschalter gemäß Anspruch 1, **dadurch gekennzeichnet, daß** mindestens ein Hebeelement (24, 24') mit einem Betätigungsabschnitt (26, 26') vorgesehen ist zur Beaufschlagung mit der Betätigungsvorrichtung (20).
4. Elektrischer Sicherheitsschalter gemäß Anspruch 3, **dadurch gekennzeichnet, daß** der Betätigungsabschnitt (26, 26') mit runden Kanten (28, 29, 28', 29') versehen ist, die jedem der Schlitze (18, 19) gegenüber liegen, um gleitend die Betätigungsvorrichtung (20) zu beaufschlagen, wenn die in das Gehäuse eingeführt ist.

5. Elektrischer Sicherheitsschalter gemäß Anspruch 1, **dadurch gekennzeichnet, daß** das Eingriffselement als radialer Vorsprung (30) ausgebildet ist, der sich von einer radialen Nabe (31) erstreckt, die einstückig an dem Nocken (15) befestigt ist.
6. Elektrischer Sicherheitsschalter gemäß Anspruch 3 oder 4, **dadurch gekennzeichnet, daß** der Betätigungsabschnitt (26, 26') und der Blockierabschnitt (27, 27') sich von einem zentralen Abschnitt (32, 32') des Hebelements erstrecken, das schwenkbar um die zweite Achse (K) an das Gehäuse (4) montiert ist.
7. Elektrischer Sicherheitsschalter gemäß Anspruch 5, **dadurch gekennzeichnet, daß** jeder der Blockierabschnitte (27, 27') mit einer Nut (34, 34') versehen ist, die im wesentlichen entsprechend geformt ist zu dem radialen Vorsprung (30) der Nocke.
8. Elektrischer Sicherheitsschalter gemäß Anspruch 7, **dadurch gekennzeichnet, daß** die Nut (34, 34') versehen ist mit konischen Schrägen (35, 35'), die so ausgestaltet sind, daß der radiale Vorsprung (30) in eine vorbestimmte Winkelstellung gebracht wird, so daß der Nocken wieder in seine Ausgangsstellung zurück gebracht wird.
9. Elektrischer Sicherheitsschalter gemäß einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, daß** ein Paar Hebeelemente (24, 24') vorgesehen sind an gegenüberliegenden Seiten des Nockens, die simultan und symmetrisch mit den jeweiligen radialen Vorsprüngen (30) zusammen wirken, die auf den seitlichen Flächen des Nockens gebildet sind.

Revendications

1. Commutateur électrique de sécurité comprenant :
 - un boîtier (2, 3, 4) présentant au moins deux fentes (18, 19) pour l'insertion d'un actionneur (20) en forme de clé qui possède une forme prédéfinie ;
 - au moins une paire de contacts électrique (5, 5', 6, 6', 7, 7', 8, 8') disposés dans le boîtier (3) et pouvant se déplacer entre une position fermée, lorsque ledit actionneur (20) est inséré, et une position ouverte, lorsque ledit actionneur est retiré ;
 - une came (15) montée à l'intérieur du boîtier (4) et reliée fonctionnellement aux contacts pour activer leur déplacement et leur commutation, ladite came pouvant être tournée autour d'un

premier axe (H) par l'insertion de l'actionneur dans le boîtier ; des moyens de blocage (22) destinés à empêcher la rotation de la came (15) et le mouvement consécutif des contacts ;

des moyens élastiques (23) qui agissent sur lesdits moyens de blocage pour les maintenir dans une position de blocage de la came lorsque ledit actionneur est retiré du boîtier;

lesdits moyens de blocage (22) comprenant au moins un élément formant levier (24, 24') monté pivotant autour d'un deuxième axe (K) distant du premier (H) et positionné de manière à agir sur une face latérale de la came (15),

caractérisé en ce que ledit au moins un élément formant levier (24, 24') est monté pivotant autour dudit deuxième axe (K) à distance et indépendamment de ladite came (15), ladite came (15) étant munie d'au moins un élément d'engagement (30) positionné sur une face latérale de la came (15), ledit au moins un élément formant levier (24, 24') étant muni d'une portion de blocage (27, 27') adaptée pour engager sélectivement ledit élément d'engagement (30) pour empêcher la rotation de la came (15).

2. Commutateur électrique selon la revendication 1 **caractérisé en ce que** ledit deuxième axe pivot (K) est sensiblement parallèle à l'axe de rotation (H) de la came. 30
3. Commutateur électrique selon la revendication 1 **caractérisé en ce que** ledit au moins un élément formant levier (24, 24') est muni d'une portion d'actionnement (26, 26') destinée à coopérer avec l'actionneur (20). 35
4. Commutateur électrique selon la revendication 3 **caractérisé en ce que** ladite portion d'actionnement (26, 26') est munie de bords arrondis (28, 29, 28', 29') qui sont dirigés vers chacune des fentes (18, 19) pour coopérer par coulissement avec l'actionneur (20) lorsqu'il est inséré dans le boîtier. 40 45
5. Commutateur électrique selon la revendication 1 **caractérisé en ce que** ledit élément d'engagement est une protubérance radiale (30) qui fait saillie sur un moyeu axial (31) fixé à la came (15) en un seul tenant. 50
6. Commutateur électrique selon les revendications 3 ou 4 **caractérisé en ce que** ladite portion d'actionnement (26, 26') et ladite portion de blocage (27, 27') font saillie sur une portion centrale (32, 32') de l'élément formant levier, qui est relié audit boîtier (4) en pouvant pivoter autour dudit deuxième axe (K). 55

7. Commutateur électrique selon la revendication 5 **caractérisé en ce que** chaque portion de blocage (27, 27') est munie d'une gorge (34, 34') qui a une forme sensiblement complémentaire de ladite protubérance radiale (30) de ladite came. 5

8. Commutateur électrique selon la revendication 7 **caractérisé en ce que** ladite gorge (34, 34') est munie de surfaces inclinées coniques (35, 35') adaptées pour placer la protubérance radiale (30) dans une position angulaire prédéterminée qui ramène ladite came à sa position initiale. 10

9. Commutateur électrique selon l'une ou plusieurs des revendications précédentes **caractérisé en ce qu'il** est muni d'une paire d'éléments formant levier (24, 24') placés sur les deux côtés opposés de ladite came et qui coopèrent simultanément et symétriquement avec des protubérances radiales respectives (30) formées sur les faces latérales de la came. 15 20 25

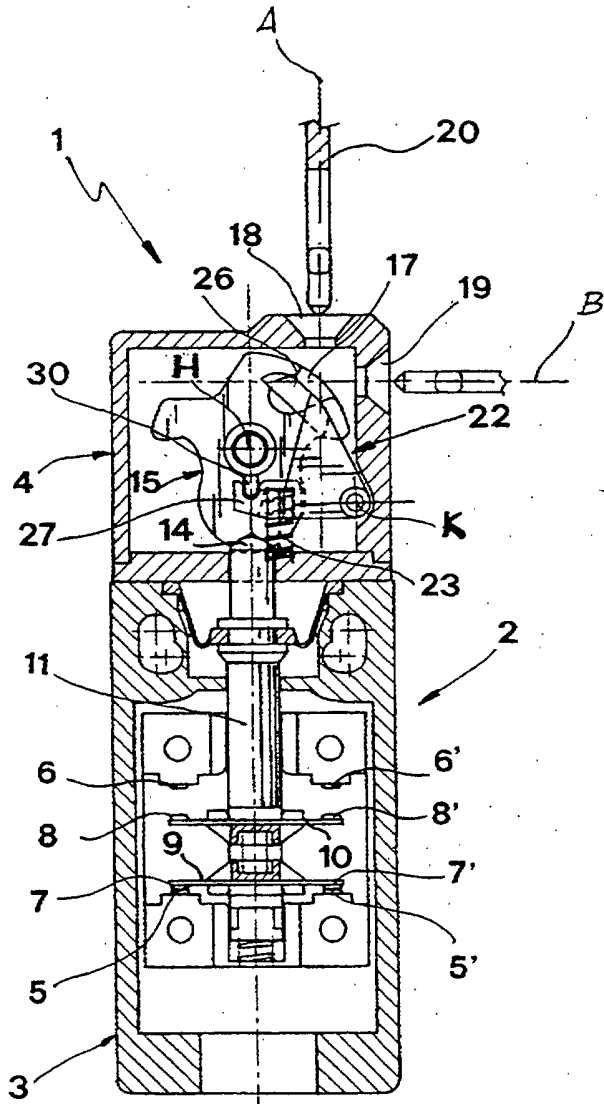


Fig. 1

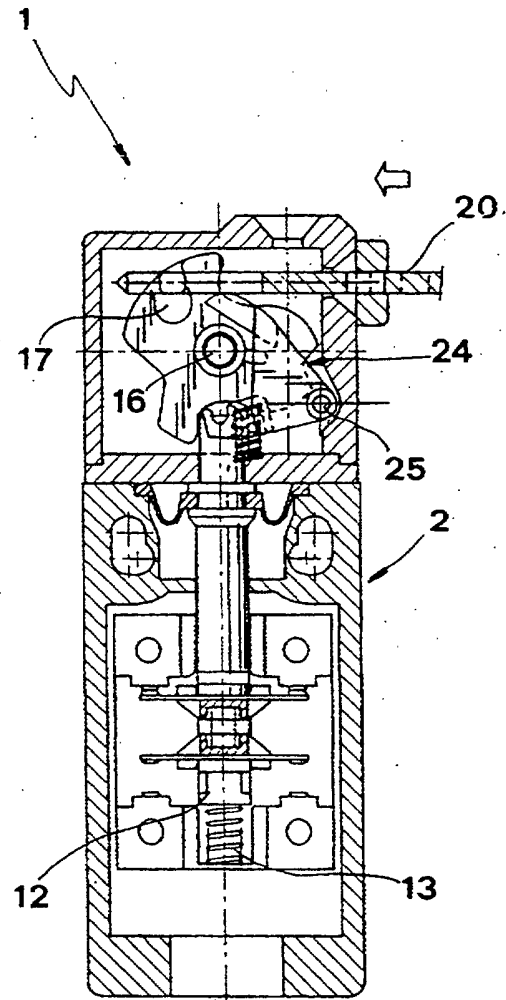


Fig. 2

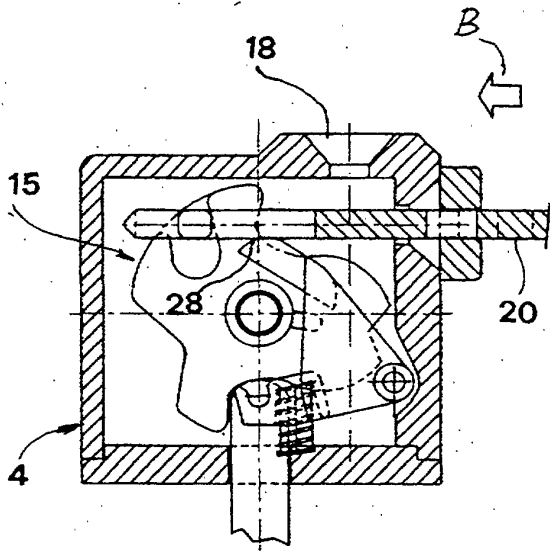


Fig. 3

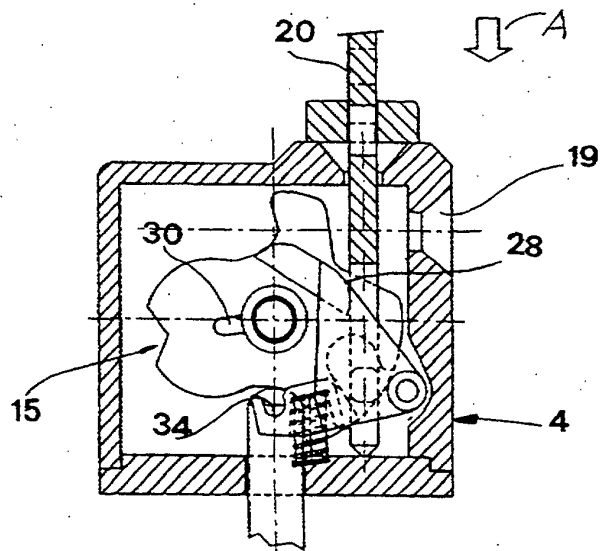


Fig. 4

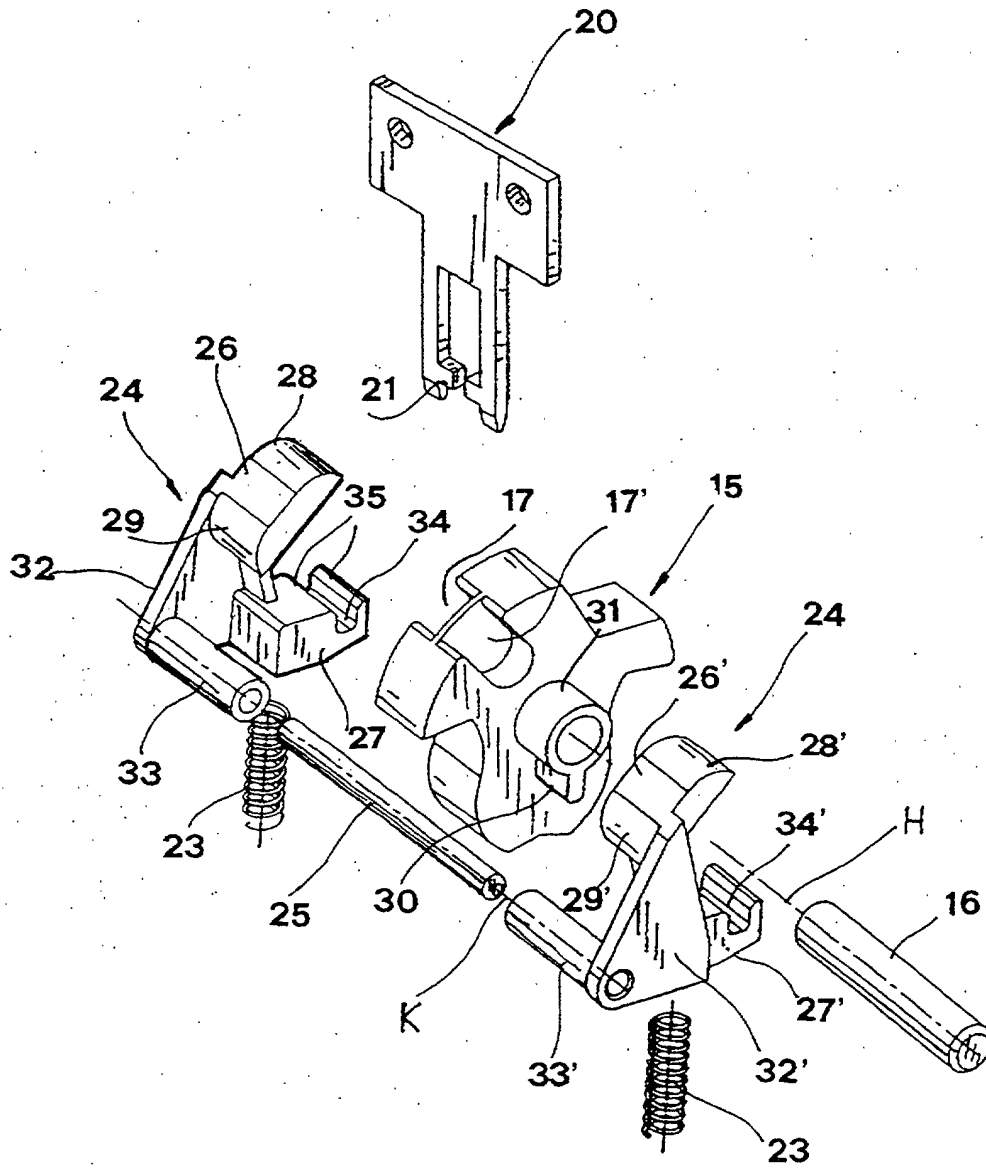


Fig. 5