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(54) ROTARY SWITCH

(57) Rotary switch (1) comprising:
- a spindle (4) rotatable between a first position and a second position;
- a spring (7) biasing the spindle into the second position (e.g., the OFF position);
- a lock disk (10) rotatable with the spindle;
- a latch (19) moveable between a retracted position and a latching position, the latch locking the lock disk and the spindle in the first position (e.g., the IN position).

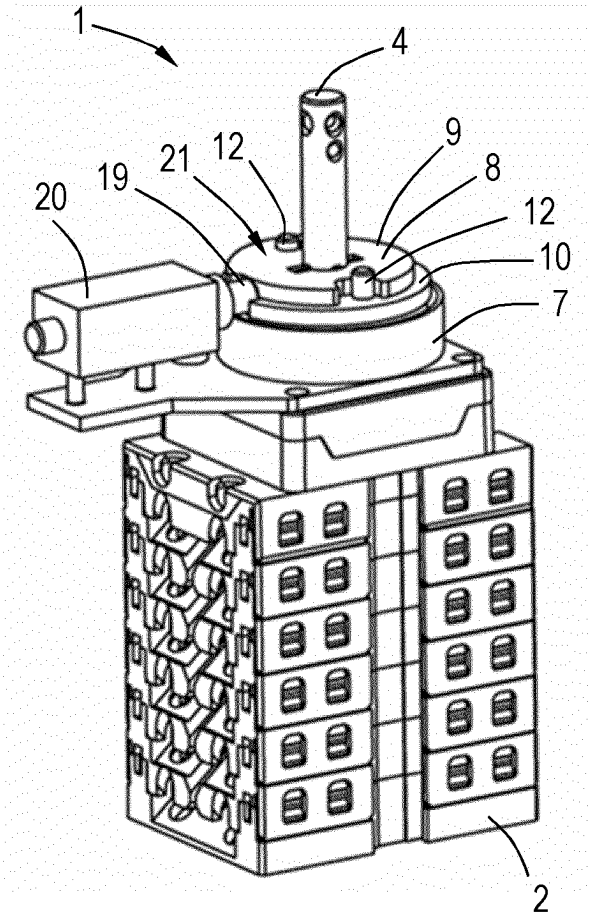

Fig.2

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Description

[0001] The invention relates to a rotary switch, in particular a rotary switch for switching high power DC or AC currents. Rotary switches typically comprise an insulating housing with stationary contacts accessible and a spindle which is rotatable within the housing and which carries one or more rotary contact bridges electrically connecting pairs of stationary contacts in at least one position of the switch, the so-called IN position, and disconnecting them in another position, the so-called OFF position. Such switches make it possible to switch between the IN position, allowing passage of a current, and the OFF position, interrupting the current. Such rotary switches are typically hand operated. An example of a rotary switch is disclosed in WO 2009/121744. In practice, it was found that there is a need for a switch which can be switched fast, safely and reliably, allowing remote switching by a simple and economical control unit as well as switching by hand.

[0002] The object of the invention is achieved with a rotary switch comprising:

- a spindle rotatable between a first position, e.g., an IN position, and a second position, e.g., an OFF position;
- a spring biasing the spindle into the second position;
- a lock disk rotatable with the spindle;
- a latch moveable between a retracted position and a latching position, the latch locking the lock disk and the spindle in the first position.

[0003] This allows very fast switching to the second position, typically the OFF position.

[0004] The latch can for example be moveable by a solenoid and/or by hand. Using a solenoid makes it possible to provide a plurality of rotary switches with a control unit centrally switching a plurality of the rotary switches to the OFF position.

[0005] In a particular embodiment, the lock disk has a recess receiving the latch in the latching position to lock the lock disk and the spindle. This can be a recess matching the latch or a recess having any suitable shape allowing the latch to lock the spindle.

[0006] In a specific embodiment, the spring can be a spiral torsion spring, with one end connected to the lock disk and one end connected to a housing of the rotary switch. For instance, the inner end of the spiral torsion spring closest to the spindle, can be connected to the lock disk, while the other end can be connected to the housing, or the other way around.

[0007] The rotary switch may further comprise a pusher disk fixed to the spindle, the pusher disk comprising an outline profiled to abut the latch when the latch is in the latching position. The pusher disk can be rotatable relative to the lock disk between a first position with the outline abutting the latch when the latch is in the latching position, and a second position. The outline of the pusher disk can be configured to gradually push the latch from the latching position to the retracted position when the pusher disk is moved to the second position. For example, the pusher disk can have a chamfered edge gradually pushing the latch from the latching position to the retracted position when the pusher disk is moved to the second position. In this respect "chamfered" means that the edge makes an angle with the radial direction and a blunt angle with adjacent contour sections of the pusher disk.

[0008] In a specific embodiment, the pusher disk is moveable between the aforementioned first position with the chamfered edge being at one side of the latch receiving recess in the lock disk, and the aforementioned second position with the chamfered edge being at an opposite side of the recess. In the first position, the point of the chamfered edge closest to the spindle, abuts the latch. In the second position, the latch is pushed out of the recess and the recess is fully covered by the pusher disk.

[0009] The pusher disk and the lock disk will typically be essentially parallel and aligned. The lock disk may for example be mainly circular, while the pusher disk may have a circular main part with a smaller diameter and an extension with a larger diameter, e.g., corresponding to the diameter of the lock disk, with the chamfered edge bridging the main part and the extension.

[0010] The pusher disk may for example comprise a rotation limiter limiting relative rotation of the lock disk and the pusher disk, for example over an angular range of about 5 - 45 degrees, between the afore mentioned first and second positions. Such a rotation limiter can for example comprise one or more catch pins fixed to the lock disk, and one or more recesses in the contour of the pusher disk, the recesses receiving the catch pins. The recesses can be curved to allow movement of the one or more catch pins with the lock disk. Alternatively, the catch pin or pins can be part of the pusher disk and be moveably received in recesses of the lock disk.

[0011] The rotary switch may further comprise a case or cap encasing the spring and the lock disk, the latch and, if present, the solenoid and/or the pusher disk.

[0012] The rotary switch may also comprise a manual control element, such as a knob or handle for manually rotating the spindle.

[0013] The rotary switch will typically comprise an insulation housing with stationary contacts accessible for connection to external conductors. The spindle may carry one or more rotational contacts bridging pairs of stationary contacts when the spindle is in the IN position. Such a housing may for example comprise a stack of switch modules or decks. The housing may for example comprises a rectangular shape, at least when viewed in the direction of the longitudinal axis, e.g., in top view. The stationary contacts can be accessible from two opposite, e.g., substantially parallel sides. This makes it possible to use a plurality of such switches arranged side by side, e.g., on a rail, a panel or similar support. The switch is particularly suitable for use in the field of solar energy.

[0014] The invention is further explained with reference to the accompanying drawings showing exemplary embodiments.

Figure 1: shows in perspective view a rotary switch according to the present invention;
Figure 2: shows the switch of Figure 1 without a cap;
Figure 3: shows the switch of Figure 1 in exploded view;
Figures 4A-D: show consecutive steps of switching the switch, viewed in top view.

[0015] Figure 1 shows a rotary switch 1 with a rectangular insulating housing 2 made of a number of stacked modules 3. The rotary switch 1 is a switch according to WO 2009/121744, herewith incorporated by reference. Each module 3 encases a set of stationary contacts and a central circular recess (not shown). The switch 1 also has a spindle 4 extending centrally along a longitudinal central axis of the rotary switch 1. The spindle 4 carries a number of rotary contact bridges (not shown) each contact bridge being received in the circular recess of the respective housing modules 3, typically one rotary contact bridge per housing module 3. The spindle 4 can be rotated about its longitudinal axis between an IN position where at least one of the rotary contact bridges contacting the stationary contacts of the respective housing module, and an OFF position where this contact is broken.

[0016] The housing 2 comprises openings 5 giving access for external conductors to the stationary contacts at two opposite side faces of the housing 2.

[0017] The rotary switch 1 comprises a cap 6 on top of the housing 2. The spindle 4 projects through the cap 6. The cap 6 covers a latch and release mechanism with a spiral torsion spring 7 for biasing the spindle 4 to the OFF position and a latch 19 for locking the spindle 4 in the IN position against the biasing action of the spiral torsion spring 7. Figures 2 and 3 show the same rotary switch 1 without the cap 6 to show the various components of the latch and release mechanism. The spiral torsion spring 7 is a spring of the mainspring type as typically used in mechanical clock-works: a spirally wound leaf spring with all windings in the same plane. Other types of springs can also be used, if so desired.

[0018] On top of the spiral torsion spring 7 is an assembly 8 comprising an upper pusher disk 9 and a lower lock disk 10. The spiral torsion spring 7 has an inner end (not shown) connected to the lock disk 10 and an outer end 11 connected to the housing 2.

[0019] The pusher disk 9 is rotatable relative to the lock disk 10. This rotation is limited by a rotation limiter, in this embodiment comprising two oppositely arranged catch pins 12 extending upward from the top side of the lock disk 10 in a respective recess 13A or slot 13B of the contour of the pusher disk 9. The recesses 13A, 13B have a width allowing relative movement of the catch pins 12 within the respective recess. The recesses 13A, 13B limit the possible movement of the respective catch pins 12 and, consequently, of the pusher disk 9 relative to the lock disk 10. In this embodiment, the maximum angle of rotation of the pusher disk 9 relative to the lock disk is 10 about 20 degrees.

[0020] The lock disk 10 has a diameter corresponding to the outer diameter of the spiral torsion spring 7. The pusher disk 9 is fixed to the spindle 4 and has a main part 15 with a diameter smaller than the diameter of the lock disk 10 and a radial extension 16 with a larger diameter corresponding to the diameter of the lock disk. The radial extension 16 has one end with a radially extending edge 17 and an opposite end with a chamfered edge 18 (see Figures 4A-D).

[0021] The latch and release mechanism further comprises a latch 19 and a solenoid 20 configured to move the latch 19 between a retracted position and a latching position. The lock disk 10 has a radial recess 21 for receiving the latch 19 in the latching position (Figure 4A). The thickness of the lock disk 10 is less than the diameter of the latch 19, so the latch 19 partly projects above the top surface of the lock disk 10.

[0022] Figure 4A shows the rotary switch 1 in top view without the cap 6. In the embodiment of Figure 4A, the pusher disk differs with the one of Figures 2 and 3, in that the slot 13B here is an open recess.

[0023] In Figure 4A the spindle 4 is in the IN position and the latch 19 is in the latching position. In this latching position the latch 19 is received in the radial recess 21 of the lock disk 10. The segment of the latch 19 projecting above the lock disk 10 abuts the chamfered edge 18 of the pusher disk 9. The spiral torsion spring 7 biases the spindle 4 to the OFF position, but the latch 19 locks the lock disk 10 and the pusher disk 9 with the spindle 4 in the IN position against the biasing action of the spiral torsion spring 7. If the solenoid 20 is activated, the latch 19 is retracted and removed from the radial recess 21 of the lock disk 10. The spiral torsion spring 7 pulls the lock disk 10 with the pusher disk 9 and the spindle 4 to the OFF position, as shown in Figure 4D.

[0024] The spindle can be turned back into the IN position of Figure 4A by hand against the action of the spiral torsion spring 7. In that position, the latch 19 is again received in the recess 21.

[0025] The latch and release mechanism can also be operated manually. To this end, starting from the position shown in Figure 4A a user can rotate the spindle 4, which is typically provided with a knob or grip facilitating manual operation. If the spindle 4 is rotated the chamfered edge 18 of the pusher disk 9 pushes against the part of the latch 19 projecting from the surface of the lock disk 10. This pushing force pushes the latch 19 into its retracted position (Figure 4B). The catch pins 12 and the recesses 13 of the rotation limiter, and the chamfered edge 18 are configured such that the catch pins 12 reach their terminal position within the associated recess 13 just when the latch 19 is pushed out of the radial recess 21.

[0026] When the latch 19 is in its retracted positon, the lock disk 10 is released and rotates relative to the pusher

disk 9 until the catch pins 12 are at the opposite end of the associated recess 13. The radial recess 21 is now out of reach for the latch 19 (Figure 4C). The spiral torsion spring 7 pulls the lock disk 10 further to the OFF position. The catch pins 12 move the pusher disk 9 and the spindle 4 with the lock disk, until the spindle 4 is in the OFF position, as shown in Figure 4D.

[0027] The latch and release mechanism is placed on top of a rotation control module 22 of the rotary switch 1. Such a rotation control module typically comprises a set of spring elements rapidly forcing the spindle into predefined positions during switching. A suitable example of such a rotation control module is disclosed in WO 2009/121744. The spiral torsion spring 7 of the latch and release mechanism is sufficiently strong to overcome counterforces generated by the spring elements of the rotation control module 22.

[0028] The words "lower', "upper" and "top" refer to relative positions of the components of the switch as shown in the figures with the spindle in a vertical position. In practice, the switch may be used in any position.

Claims

1. Rotary switch (1) comprising:

   - a spindle (4) rotatable between a first position and a second position;
   - a spring (7) biasing the spindle into the second position;
   - a lock disk (10) rotatable with the spindle;
   - a latch (19) moveable between a retracted position and a latching position, the latch locking the lock disk and the spindle in the first position.

2. Rotary switch according to claim 1, wherein the first position is an IN position with at least one pair of stationary contacts of the rotary switch being bridged by a rotary contact bridge, and wherein the second position is an OFF position with none of the stationary contacts being contacted by a rotary contact bridge.

3. Rotary switch according to claim 1 or 2, wherein the lock disk (10) has a recess (21) receiving the latch (19) in the latching position to lock the lock disk (10) and the spindle (4).

4. Rotary switch according to claim 1, 2 or 3, wherein the spring is a spiral torsion spring (7), with one end connected to the lock disk (10) and one end connected to a housing (2) of the switch.

5. Rotary switch according to any preceding claim, wherein the latch (19) is moveable by a solenoid (20) and/or by hand.

6. Rotary switch according to any one of the preceding claims, comprising a pusher disk (9) fixed to the spindle (4), the pusher disk comprising a chamfered edge abutting the latch when the latch is in the latching position, wherein the pusher disk is rotatable relative to the lock disk between a first position with the chamfered edge (18) abutting the latch (19) when the latch is in the latching position, and a second position;
   wherein the chamfered edge is configured to gradually push the latch from the latching position to the retracted position when the pusher disk (9) is moved to the second position.

7. Rotary switch according to claim 5, comprising a rotation limiter limiting relative rotation between the lock disk (10) and the pusher disk (9), for example over an angular range of about 5 - 45 degrees.

8. Rotary switch according to claim 6, wherein the rotation limiter comprises one or more catch pins (22) fixed to one of the lock disk (10) or the pusher disk (9), and one or more recesses (13A, 13B) in the contour of the other one of the pusher disk or lock disk, the recesses receiving the catch pins the recess(es) being curved to allow movement of the catch pin(s).

9. Rotary switch according to any preceding claim, comprising a case or cap (6) encasing the spring (7), the lock disk (10) and the latch (19) and optionally the solenoid (20) and/or the pusher disk (9).

10. Rotary switch according to any preceding claim, comprising a manual control element, such as a knob or handle for manually rotating the spindle (4).

11. Rotary switch according to any one of the preceding claims, comprising a stack of switch modules.

12. Rotary switch according to any one of the preceding claims, wherein the rotary switch (1) comprises a rectangular shape, wherein the stationary contacts are accessible from two opposite sides.

13. Rotary switch according to any preceding claims, wherein the solenoid (20) is responsive to a control unit controlling a plurality of rotary switches.

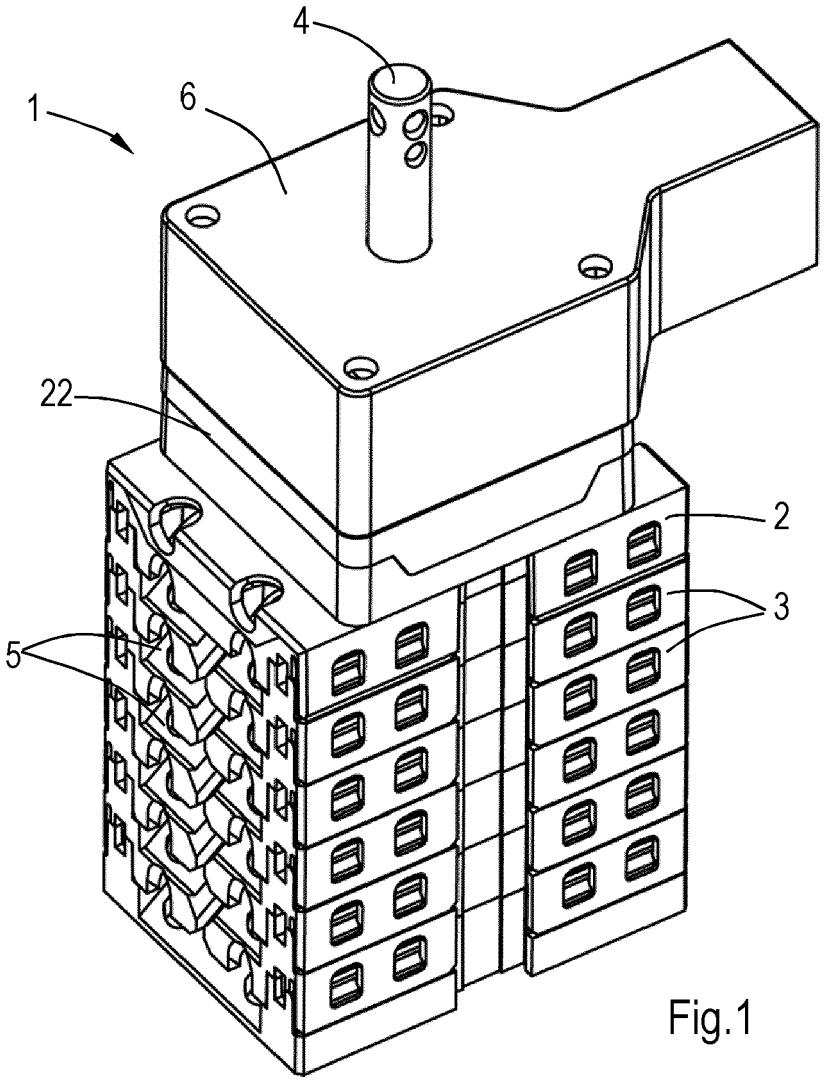

Fig.1

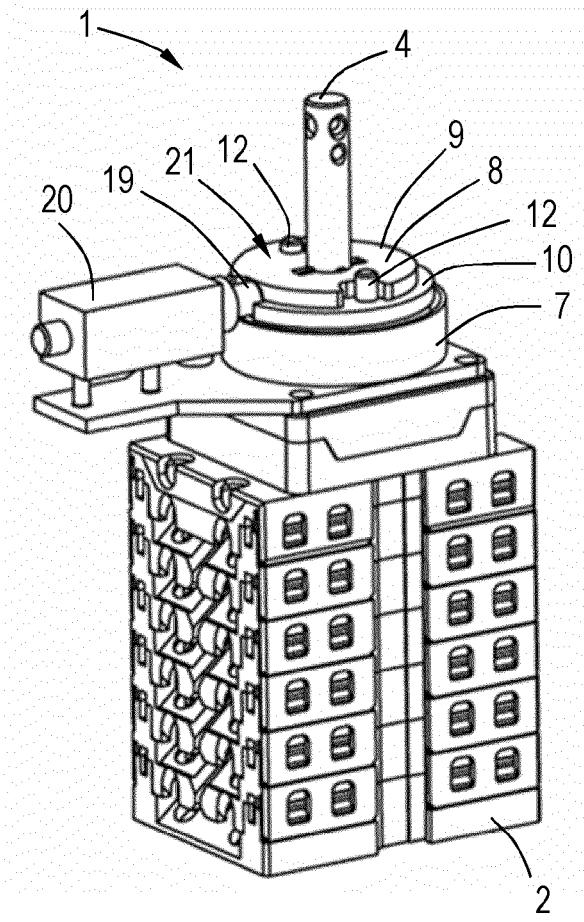

Fig.2

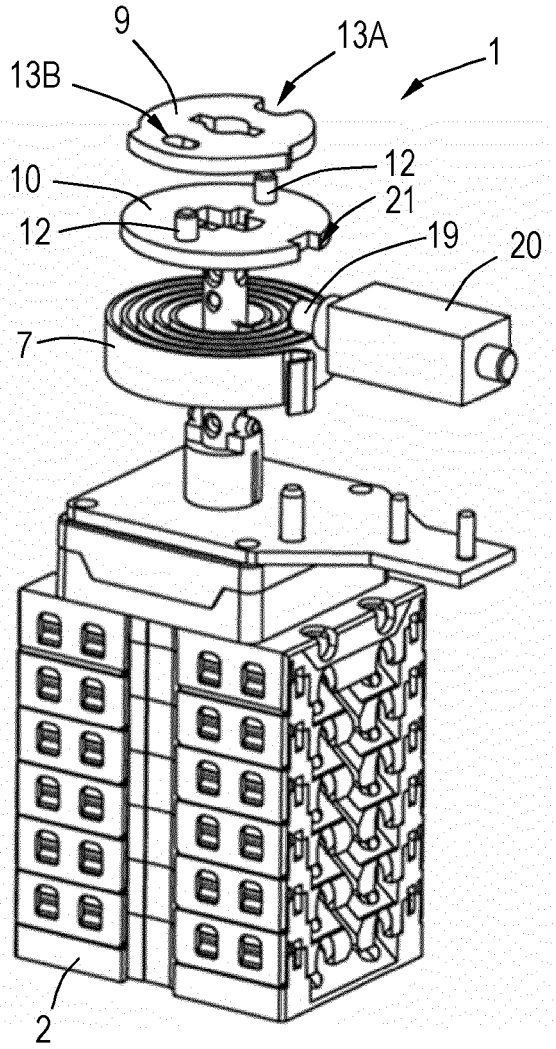

Fig.3

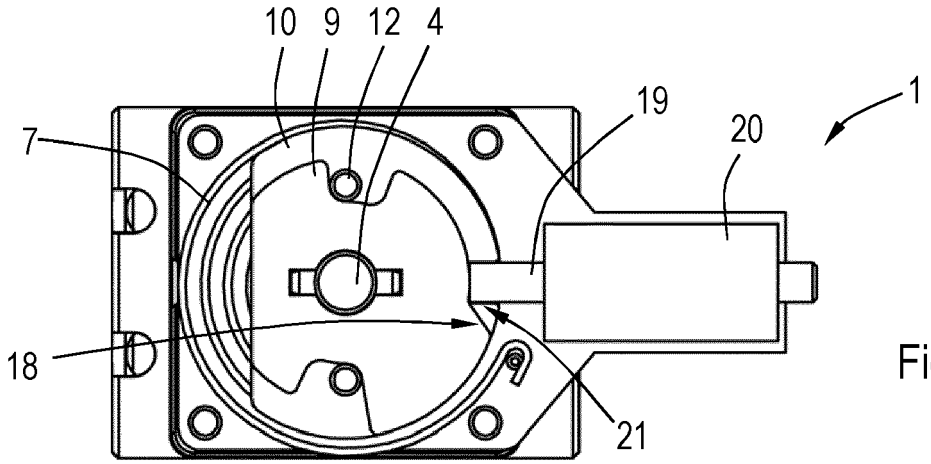

Fig.4A

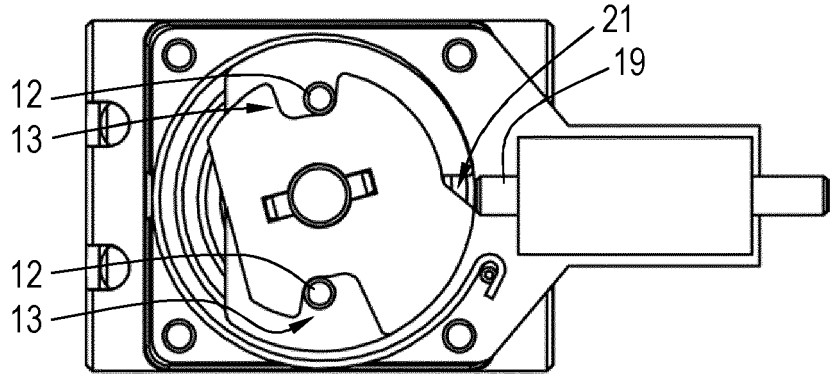

Fig.4B

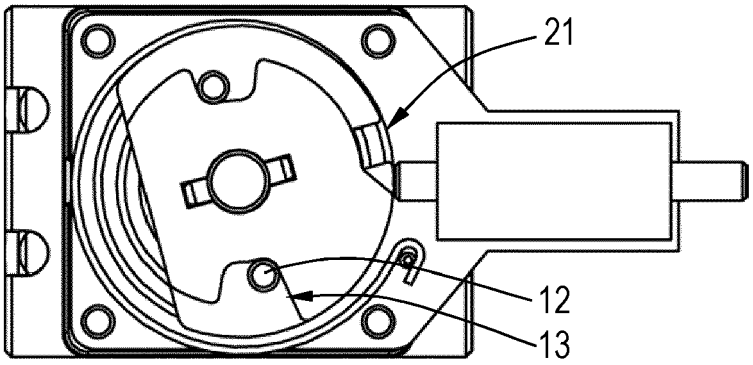

Fig.4C

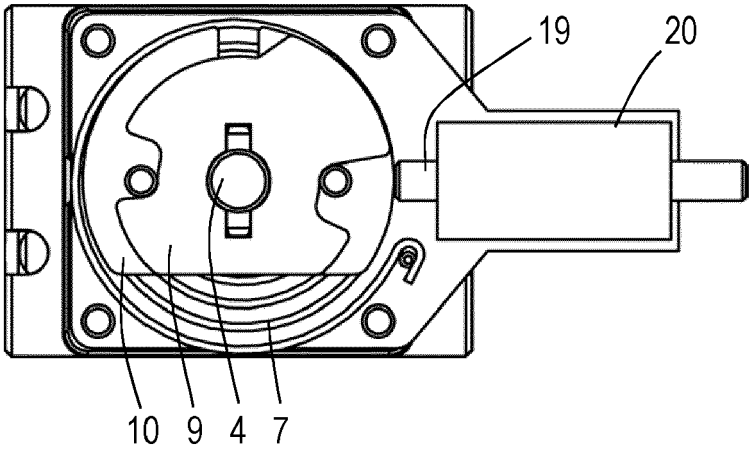

Fig.4D

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EUROPEAN SEARCH REPORT

Application Number
EP 19 21 4539

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A	* page 3, paragraph 0028 - page 7, paragraph 0054; figures 1A-3 *	1-4,6-12	

TECHNICAL FIELDS SEARCHED (IPC)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 May 2020	Pavlov, Valeri

CATEGORY OF CITED DOCUMENTS

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