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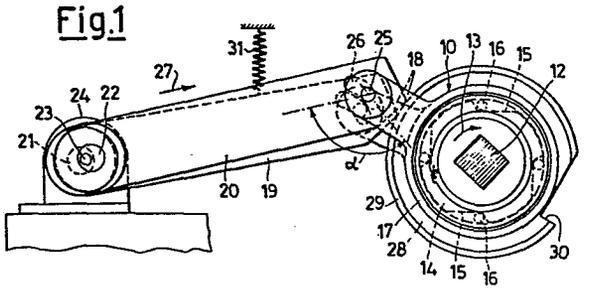
(54) Device for controlling the rotation of a shaft through a preselected angle.

(57) A device for controlling the rotation of shaft (12) through a preselected angle narrower than 360°. On the shaft there are mounted two fresh-wheels (10,11) one at least of which is actuatable by a lever (18) to which a predominantly rectilinear reciprocation is impressed. The connection between the lever (18) and the outer ring (17) of the free-wheel is embodied by a pin (25) integral with the ring and engaged by a slot (26) formed in the vicinity of the free end of the lever. The slope of the slot is such that in the thrust stroke of the lever it causes the lever end to approach a cylindrical race (29) of a disc (28) keyed to the shaft (12) beside the free wheel. In a determined position this race is cut away by a hollow space (30) so that when the lever end arrives in registry with the hollow space, it can be depressed and thus it prevents the drive transfer for the free-wheel ring.

Fig.1



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DEVICE FOR CONTROLLING THE ROTATION OF A SHAFT THROUGH A PRESELECTED ANGLE . -

This invention relates to a device for controlling the rotation of a shaft through a preselected angle narrower than 360°. More particularly, this device is intended to be employed in an electric switch for loading the closure springs thereof.

These closure springs act between a fixed point of the switch casing and a disc integral with a shaft which, through appropriate linkages, actuates the movable contacts of the switch concerned.

When the line conjoining said fixed point and the point at which the springs are fastened to the disc integral with the shaft passes through the axis of the shaft and the point where the springs are attached to the disc are situated, relative to the shaft, on the same side as the fixed point, the springs are unloaded and, to load them, it is required that the shaft and the disc be rotated through an angle which is slightly wider than 180° and that the disc be latched in such a position, in which the springs are loaded to a maximum. To have the movable contacts snapping into the closure position, the disc must be unlatched, so that the springs are set free and can display their bias thus

snappingly rotating the disc and the shaft towards their starting position.

It is apparent that the angle through which the shaft must be rotated to bring the springs from the unloaded condition to the condition of maximum load must be very accurate if it is desired that the springs may reliably attain the loading position and, if it is desired, on the other hand, that the stopping abutment be, in turn, not too heavily loaded as to make its unlatching by a preselected force too difficult at the prescribed instant of time.

Inasmuch as the rotation of the shaft during the spring loading stage requires not negligible forces, there is used to control such a rotation a device which causes the shaft to be rotated stepwise through sequentially ordered small angles until reaching the preselected total angle. A conventional control device of this kind generally comprises two free-wheels secured to the shaft which must be rotated and at least a lever actuated by appropriate motive means for being reciprocated along a virtually rectilinear path and capable of acting upon either free-wheel to cause the shaft to be rotated through a small angle during its advance stroke, whereas during the return stroke of the lever the second free-wheel prevents the return rotation of the shaft. Also two levers can be provided, each of which is associated to each free-wheel and acting with a phase shift on the free-wheel in such a way that, when either lever

goes along an advance stroke, the other goes along its return stroke.

As the preselected total angle of rotation for the shaft is attained, the motive means are stopped but, due to their inertia, they cannot be stopped instantaneously and can thus bring about a further rotation of the shaft and originate the shortcomings indicated above. Another possibility is that the motive means are stopped too early.

An object of the present invention is to provide a control device for the rotation of a shaft through a preselected angle which is capable of reliably carrying out the stoppage of the shaft as soon as the desired angle of rotation is attained even if the motive means cannot be stopped instantaneously.

This object is achieved by the device according to the invention which comprises two free-wheels mounted on the shaft to be rotated and at least a thrust lever connected with the outer ring of either free-wheel which can be rotated in both directions, said lever being actuated by motive means so as to bring about a substantially rectilinear reciprocation, said device being characterized in that the connection between said thrust lever and the outer ring of said free-wheel is embodied by a pin integral with the outer ring and engaged by a shaped slot formed in the vicinity of the lever end, in that the general trend of said slot is in a direction which forms with the direction of motion of the lever an

angle which is wider than 90° and narrower than 180° and in that the lever end insists upon the peripheral surface of a circular disc keyed to the shaft to be rotated beside the free-wheel, said disc having, at a preselected angular location, a hollow space which is depressed relative to its circular periphery, resilient means being further provided which tend to lift the lever end above the periphery of said disc.

By the device according to this invention, the result is that the thrust lever, in its advance stroke, can transfer its drive to the pin integral with the free-wheel only if its end rests on the periphery of the disc integral with the shaft, whereas, as soon as this contact is discontinued because the depressed hollow space is reached, the thrust lever, while being permitted to continue its reciprocations, cannot drive to rotation any longer the outer ring of the free-wheel, so that the shaft is reliably stopped in the desired angular position as determined by the location of said hollow space.

Of course, if respective thrust levers are associated to both free-wheels, the connection between these and the outer rings of the free-wheels must be embodied just in the same way as hereinbefore described for the case of a single lever. If so, the circular disc and its respective hollow space may be used for both thrust levers.

In both cases, the disc can be made as an entity with the driven portion of the free-wheel(s) which is in-

tegral with the shaft to be rotated.

The foregoing and other features of the control device according to the invention and the advantages stemming therefrom will become apparent in greater detail from the ensuing description of an exemplary embodiment thereof given with reference to the accompanying drawings, wherein :

FIGURE 1 is a side elevational view of a device having two free-wheels and two respective actuation levers,

FIGURE 2 is a plan view of the same device,

FIGURE 3 is a view akin to that of FIGURE 1 but with the device in the end of stroke position, and

FIGURES 4 and 5 diagrammatically show the closing spring of a switch to which the device in question has been applied, in the unloaded and the loaded configuration, respectively.

The device is shown only diagrammatically in the drawings but in a manner which is sufficient to make its operability understandable and to indicate the means necessary for such operability.

In the example shown herein, by way of example, the subject matter is the application of the device to an electric switch (not shown because it is not a part of the invention) for loading the closing spring(s) of the switch in question. It is understood,at any rate, that the device can find profitable uses in other cases in which a shaft must be rotated, starting from an angular starting position, along a single sense of rotation and

through a preselected angle narrower than 360°.

A device of the kind referred to herein generally comprises two free-wheels, generally indicated at 10 , 11 and mounted on the shaft 12 which must be rotated in the direction of the arrow 13 about its axis through a preselected angle which is narrower than 360° from a preselected starting position.

The free-wheels 10, 11 are equal to one another and their construction is conventional. It is sufficient to note that each of them comprises a portion 14 keyed to the shaft 12 (indicated in dotted lines in FIGURES 1 and 3), said portion 14 has, formed peripherally thereof, wedge-shaped hollow spaces 15, in each of which a friction roller, 16, is freely inserted. Around such a portion 14, with the rollers 16 inserted in the wedge-shaped seatings 15, a ring 17 is mounted with its actuation arm 18.

The operation of such a free-wheel mechanism is as follows.

If the ring 17 is rotated in a direction (corresponding to the direction 13 in which it is desired to have the shaft 12, whereon the free-wheel is mounted, driven to rotation)so that the rollers 16 are caused to roll along the thrust into the restricted section of their wedge-shaped seatings 15, the rotary motion,through said rollers 16 is transferred to the portion 14 keyed to the shaft 12, so that these latter are driven to rotation. If, conversely, the ring 17 is rotated in the

reverse direction, the rollers 16 are positioned in the deeper portion of their seatings 15 and cannot transfer their drive to the portion 14: in this direction of rotation the ring 17 turns idly.

In view of the foregoing, the device provides, in the case in point, two levers 19, 20, which are connected, in a manner which will be explained in more detail hereinafter, to the actuation arms 18 of the respective free-wheels 10, 11. At their opposite ends, the levers 19,20 are mounted on two eccentrics 21, 22, which are keyed, with an angular shift of 180° relative to one another, to a drive shaft 23 actuated by a motive unit 24 so as to be rotated always in the same direction of rotation.

Thus, the two levers 19, 20 are driven to a virtually rectilinear reciprocation and, while either lever is advanced, the other is pushed backwards, and vice versa.

The result is that, apart from the dead ends of the stroke, at every instant the ring of either free-wheel is rotated in the direction of the arrow 13, whereas, at the same time, the ring of the other free-wheel is rotated in the reverse direction. The ring which is rotated in the direction of the arrow 13 drives to rotation the shaft 12 in the same direction, whereas the ring which is rotated in the reverse direction turns idly.

It is apparent that two free-wheels are required: as a matter of fact, in the idle rotation stage of the ring of either free-wheel, the shaft could concurrently be rotated backwards, especially when so urged by an extern-

al force, unless it is retained in the angular position it has reached, or even thrust farther on in the desired direction of rotation by the agency of the second free-wheel. In the former case, a second free-wheel is enough, the idle ring of which is held steady by an appropriate connection with a fixed structure. The second case, instead, is the one considered in the example shown in the drawings, wherein the second free-wheel also is equipped with its respective control lever and thus actively contributes towards the shaft advance.

A device such as described hereinbefore is already known. In such a conventional device the control lever(s) was merely pivoted to the actuation arms of the respective free-wheels. Thus, the free-wheels are necessarily actuated not only until such time as the motive unit is active, but until such time as it is finally stopped after a transitional inertial motion period which is started at the instant of time when the motive unit is switched off. As a result, the actual angle by which the shaft was caused to be rotated with the known device could not accurately established beforehand.

The object of the improvements provided by the present invention is exactly to offset this defect.

These improvements essentially consist of a particular connection between the control or thrust levers, 19, 20 and the actuating arms 18 of the respective free-wheels 10, 11. Inasmuch as this connection is the same for both the free-wheels, only the one relative to the

free-wheel 10 will be described hereinafter.

As best seen in the drawings, the arm 18 carries a pin 25 and the thrust lever 20, rather than being merely pivoted about such pin, displays a slot 26 in which the pin 25 is engaged. The slot 26 is arcuate but its general trend is in a direction which forms with the predominantly rectilinear direction of motion of the lever 20 an angle, which is indicated with alpha in FIGURE 1 and which, in any case, must be wider than 90° and narrower than 180°.

As a result of this connection between the lever 20 and the arm 18, when the thrust lever 20 is moved forward in the direction of the arrow 27, it tends, with its free end, to be depressed, that is, to approach the free-wheel 10 without pushing forward the pin 25 and thus also the arm 18 integral with the ring 17 in the direction of the arrow 13. For having the thrust transferred to the pin 25, it is required that the free end of the lever 20 may find an abutment which prevents its depression.

To this purpose, beside the free-wheel 10 a circular disc 28 is provided, having a peripheral cylindrical track 29, the disc being keyed to the shaft 12. By virtue of the presence of such a cylindrical track 29, the free end of the lever 20 is prevented from being lowered so that it transfers the thrust onto the pin 25 which is engaged by its slot 26, so that, when the lever is moved forward in the direction of the arrow 27, the ring 17 of the free-wheel is rotated in the direction of the

arrow 13 and, through the rollers 16 transfers the rotary drive to the portion 14 and thus to the shaft 12. The unitary angle of rotation is a function of the forward stroke of the lever 20 as originated by the eccentric 22.

This forward rotation in the desired direction is continued in small sequential steps, with the motive unit 24 in action, until the free end of the lever 20 can rest on the cylindrical track 29.

To discontinue the forward rotation of the shaft 12 irrespective of the stoppage of the motive unit 24, it is sufficient to remove the supporting surface for the free end of the control lever.

To this purpose, the disc 28 and its track 29 have, in the desired angular position, a hollow space 30.

As soon as the shaft 12 and its disc 28 integral therewith have been rotated, starting from a certain starting angular position, through a total angle such that the free end of the thrust lever 20 enters the hollow space 30 and thus does no longer rest on the track 29 of the disc 28, it is no longer possible to transfer the drive from the lever 20 to the arm 18 of the ring 17 of the free-wheel so that the lever carries out an idle stroke. The shaft 12 is automatically stopped in the desired angular position, whereas the lever 20 can be moved forward idly until the motive unit 24 is finally stopped.

To prevent the free end of the lever 20 from fall-

ing due to its own weight down to the bottom of the hollow space 30, the lever 20 is biased by a spring 31 which tends to lift the lever itself.

What has been described above with reference to the free wheel 10 and to its control lever 20 is identically valid for the free-wheel 11 and its relevant control lever 19, but the reciprocation of the latter takes place in a sense which is opposite to that of the lever 20.

In the example shown of two control levers 19, 20, a single disc 28 with a cylindrical track 29 and a hollow space 30 may serve for both levers, said disc being keyed to the shaft 12 to be rotated, between the two free-wheels 10, 11. From the constructional standpoint, the disc 28 can also be made so as to make up an entity with the portions 14 of the free-wheels which are secured to the shaft.

Obviously, in the practical construction of the device as described above, the depth of the hollow space 30 in the disc 28, the shape of the slot 26 in the levers 19, 20 and the reciprocation stroke of the latter must be properly coordinated with each other in order that a correct operation of the device may be obtained.

More particularly, the slots 26 must be such as to make possible, when the relative pins 25 are in desired end of stroke position, to carry out the entire stroke of the respective levers 19, 20 without any interferences, either upwards and downwards. In its turn, the

hollow space 30 must be so shaped as to be capable of receiving in its interior the free ends of the levers 19, 20 during their idle runs without any interferences.

FIGURES 4 and 5, read together with FIGURE 2, show the application of the device for loading the closing spring of an electric switch.

The shaft 12 on which the control device is active, carried, keyed thereto, two discs 32, 33 and, therebetween, a cam 34 having an appropriate outline and an idle follower 35. To a point 38 of the disc 33 is anchored either end of a spring 36 to be preloaded, the other end of which is secured to a fixed point 37. FIGURES 2 and 4 are illustrative of the condition in which the spring 36 is unloaded, because the point 38 wherein the spring 36 is secured to the disc 33 is situated, relative to the axis of rotation of the disc, on the same side as the fixed anchoring point 37. To preload the spring 36, it is necessary to have the shaft 12 and the disc 33 rotated, for example, in the direction of the arrow 13, so as to bring the point 38 to the opposite side of the axis of rotation relative to the fixed point 37.

In order that the spring 36 may, at a later time, cause the disc 33 and thus also the shaft 12 to be rotated just by spring bias still in the same direction as the arrow 13, it is required that the line conjoining the points 37 and 38 be shifted slightly beyond the axis of rotation.

In this position, the spring 36 is preloaded substantially to the most and it is necessary to provide to latch the shaft 12 on completion of the preloading step. To this purpose, a stop 39 is provided, which, entering an appropriate hollow space of the profile of the cam 34, is intended to abut the idle follower 35 (see FIGURE 5). To clear the spring 36, it suffices, then, properly to shift this abutment 39 (see position of FIGURE 4).

It is apparent that the advantage achieved by the device according to this invention is important. Inasmuch that a preselected total angle of rotation is warranted (in the case in point slightly wider than 180°) of the shaft 12 as being rotated by the device, it is sure that the spring 36 may reach the correct preloading position and that the disc 33 is not stopped, possibly, at a position wherein the line conjoining the points 37, 38 where the spring is fastened, has not overtaken the center of rotation: if so, the result would be a rotation of the shaft 12 in a direction contrary to the expected one as the spring 36 is cleared, that is as the stopping abutment 39 is removed.

In addition, the stopping abutment 39 is prevented from being loaded too much and becoming too heavily wedged between the cam profile 34 and the roller 35, thus making difficult, or even impossible, to clear it with the required force. Such an event could occur if the shaft 12 should be rotated by the device which con-

trols its rotation through an angle wider than the preselected width.

CLAIMS :

1. A device for controlling the rotation of a shaft through a preselected angle narrower than 360°, comprising two free-wheels mounted on said shaft, at least a thrust lever connected to the external ring of either free-wheel and rotatable in both the directions of rotation, and motive means adapted to impress to said lever a predominantly rectilinear reciprocation, characterized in that the connection between the thrust lever and the outer ring of the respective free-wheel is embodied by a pin integral with the ring and engaged by a shaped slot formed in the vicinity of the lever free end, that the predominant orientation of said slot is in a direction which forms with the direction of movement of the lever an angle wider than 90° and narrower than 180° and that beside the free-wheel a circular disc is keyed to the shaft, the peripheral surface of said disc being adapted to have the free end of the lever abutting thereon, said disc having at a preselected angular position a hollow space at a lower level than its peripheral surface and adapted to receive the lever free end therein, resilient means being further provided which tend to lift the lever free end away of the disc peripheral surface.

2. A device according to Claim 1 having two thrust levers associated to the free-wheels, characterized in that both levers are connected to the rings of the respective free-wheels by a pin-and-slot connection and that the circular disc and its respective hollow space

are mounted between the two free-wheels and its periphery serves as an abutting surface for both levers.

3. A device according to Claim 1, characterized in that the circular disc is constructed as a single entity with the driven portions of the two free-wheels keyed to the shaft to be rotated.

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Fig.1

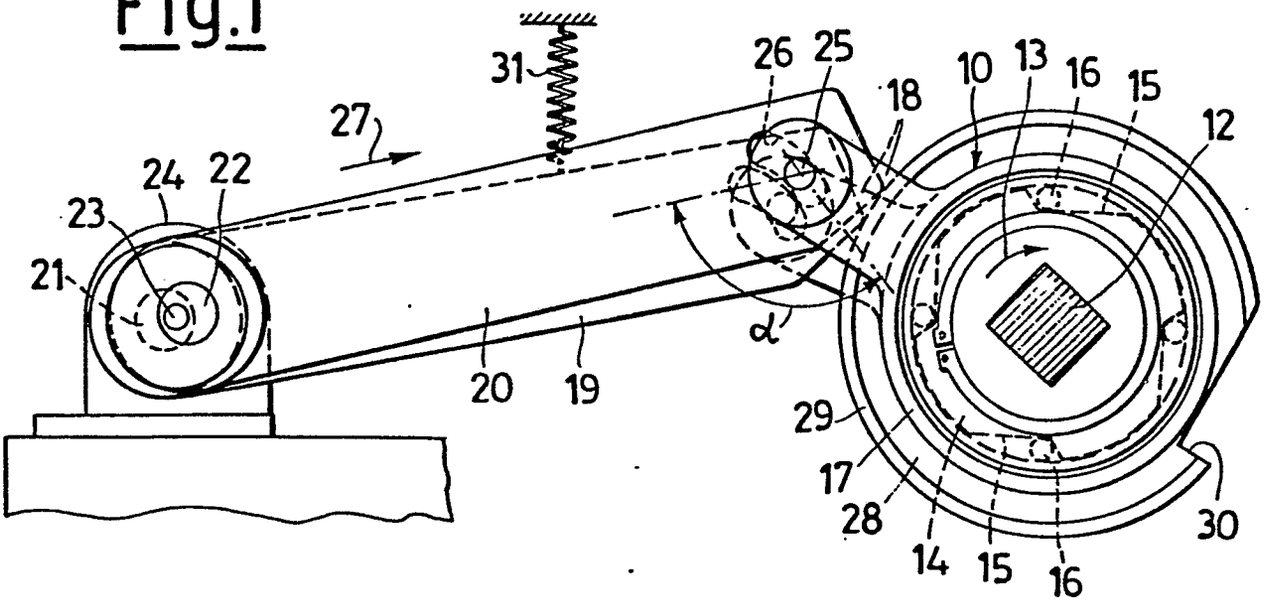

Fig.2

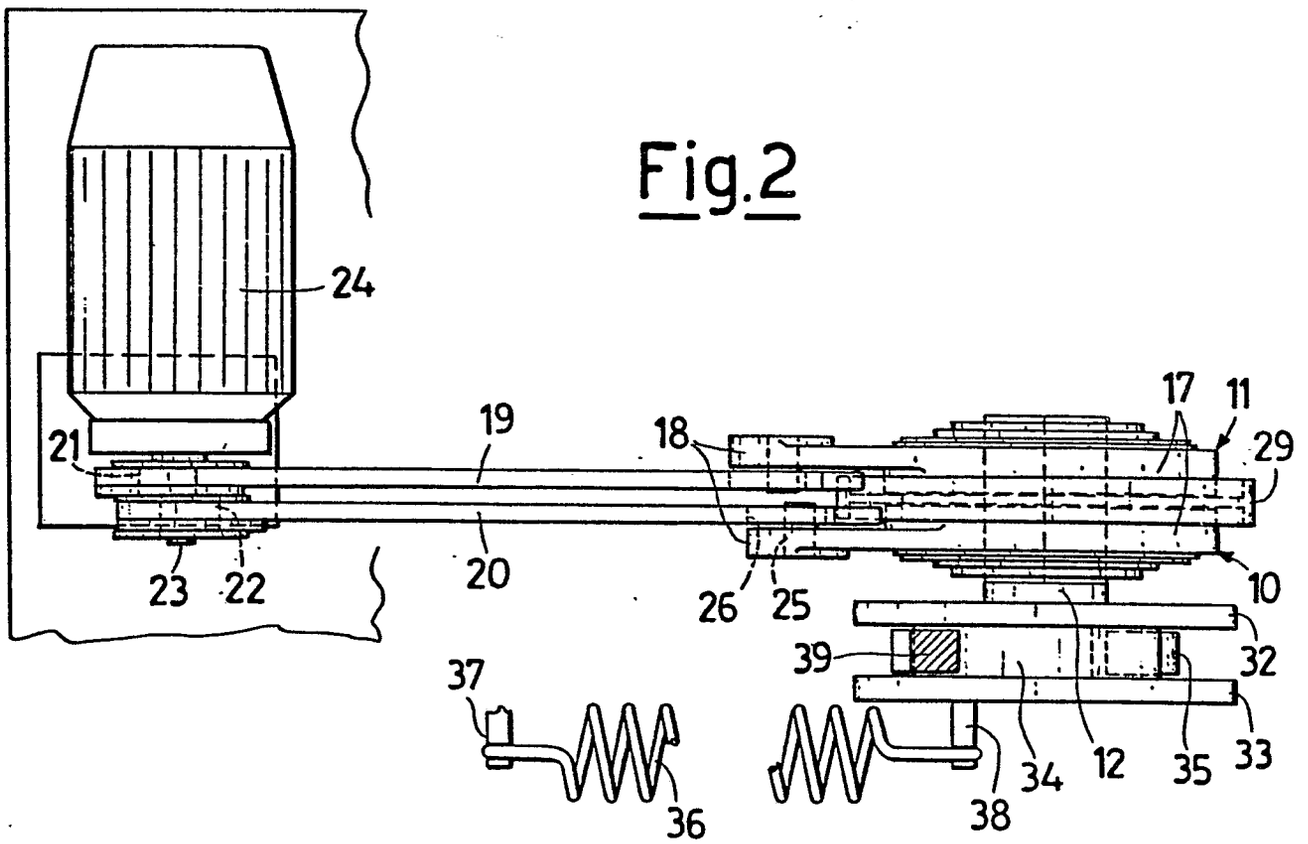

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Fig.3

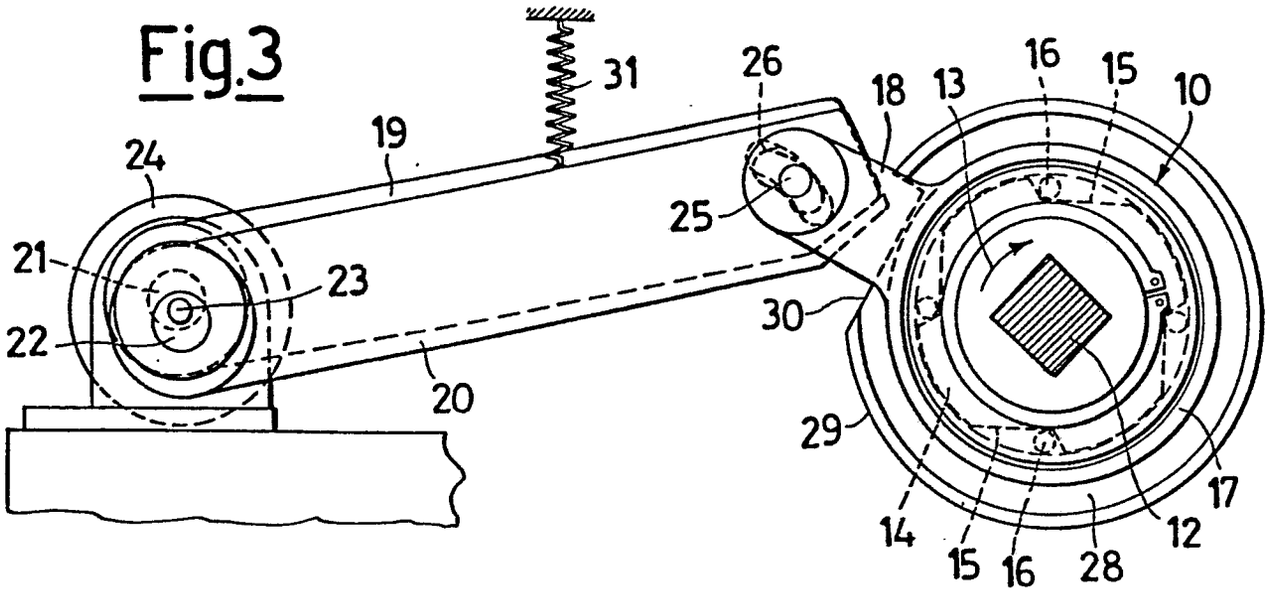

Fig.4

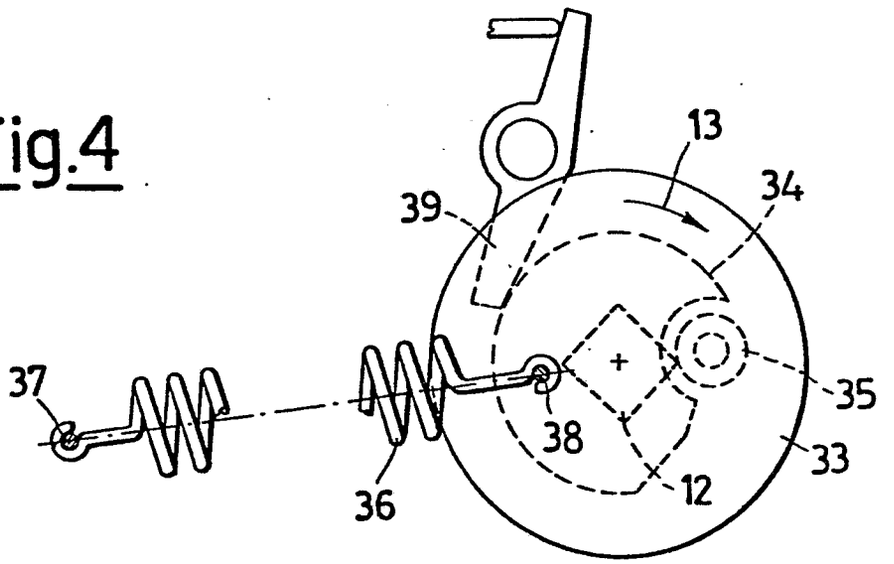

Fig.5