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(54) A spring-operated energy accumulation control for medium and high-voltage circuit breakers

(57) A spring-operated energy accumulation control for medium and high-voltage circuit breakers.

A first shaft (30) carrying a partially toothed ratchet wheel (31) that can rotate about its longitudinal axis and a second shaft (32) having its axis parallel to and eccentric with respect to the axis of the first shaft (30) and carrying the first end of a crank (33) that rotates around the second shaft axis, the said toothed wheel (31) is associated with a ratchet device (34) and carries a dragging means (38) and a blocking means (39) to bring it to a halt against a closing release device (44); the toothed wheel carries also means (40) for connecting the free end of a closing spring (41) and the said crank (33) carries an opening release device (45) at its second end which is linked to the first end of a manoeuvering bar (46) that in association with the lever mechanisms (47, 48, 49, 51, 52), the transmission shaft (50) and the opening spring (53) cause the closing and opening of a circuit breaker pole (54).

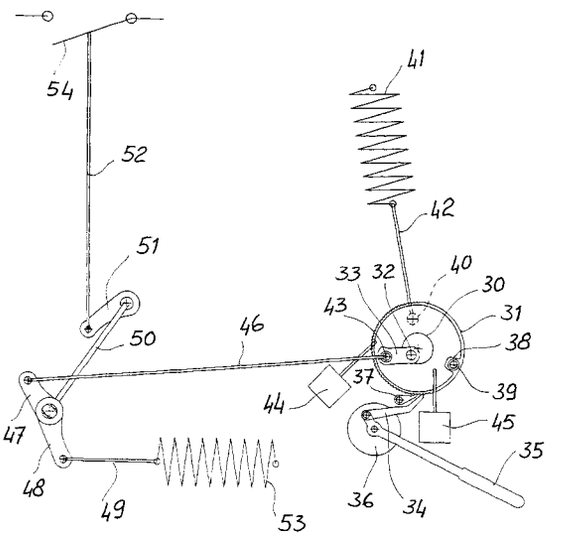

Fig. 6

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Description

[0001] The present invention concerns a spring-operated energy accumulation control for medium and high-voltage circuit breakers, hereinafter to be referred to more simply as spring-operated control, and, more particularly, concerns a power device of the said spring-operated control.

[0002] The technical field of such spring-operated controls is that of medium and high-voltage circuit breakers, either in SF6 gas, under vacuum or based on other circuit breaking principles and either in frontal or lateral versions.

[0003] The operating principle of the power mechanism of known spring-operated controls will be described hereinafter by reference to the appended Figures 1, 2, 3, 4 and 5, which illustrate the said mechanism in a schematic manner.

[0004] Figure 1 shows that, using either the crank 4 or the motor 5, the shaft 6 can be made to rotate in the direction of the arrow 7, so that, in its turn, it will cause the rotation of the crank 8; passing its bottom dead centre position, the said crank 8 completes the tensioning of the closing spring 2 and comes to a stop when the roller 9 of the cam 10 comes into contact with the closing release device 11 (Figure 2).

[0005] Given the constant profile of the cam 10, the lever 12 will remain stationary during this phase and the pole 1 of the circuit breaker will therefore remain open. During the tensioning of the closing spring 2 the ratchet wheel 13 ensures that the tensioning will proceed in one direction only.

[0006] Turning now to Figure 3, it can be seen how either a manual or an electrical action will cause the release of the device 11. Under the action of the closing spring 2 and the crank 8 the cam 10 rotates in the direction of the arrow 7 and thus causes the closing lever 12, the shaft 14 and the crank 15 to rotate in the direction of the arrow 16.

[0007] At this point the traction bar 17, the cranks 18, 19 and 21, the transmission shaft 20 and the bar 22 will bring about the closing of the pole 1 of the circuit breaker, this at the expense of the energy accumulated in the closing spring 2, at the same time commencing the tensioning of the opening spring 3. At the end of this phase, the lever 12 remains set by means of the opening release device 23 in contact with the roller 24.

[0008] It can be seen from Figure 4 that the cam 10 completes its movement regulated by the damper 25, while the crank 8, after passing its top dead centre position, makes it possible to recuperate the residual energy in the closing spring by means of the ratchet wheel 13.

[0009] At this point the pole 1 of the circuit breaker is closed, the opening spring 3 is tensioned, the closing release device 23 is set and the closing spring 2 is slack and therefore conserves only residual energy.

[0010] It will readily be understood that an opening action, be it manual or electrical, will unblock the opening release device 23, thus permitting the lever 12 to rotate in the direction of the arrow 16. At this point the energy accumulated in the opening spring 3, acting through the rotating shafts 14 and 20, the lever mechanisms 15, 17, 18, 19, 21 and 22 and the opening damper 26, will bring about the opening of the pole 1 of the circuit breaker.

[0011] At the end of this phase the pole 1 of the circuit breaker and the control will again find themselves in the condition described in Figure 1, with the sole difference that the crank 8 has moved forward due to the accumulation of residual energy in the closing spring 2.

[0012] For the purposes of realizing an opening-closing-opening cycle (hereinafter referred to as the O-C-O cycle), the starting position is the one illustrated by Figure 4, i.e.:

- the circuit breaker pole 1 is closed:
- the opening spring 3 is tensioned;
- the opening release device 23 is set.

[0013] The cycle is realized by repeating the phases described in Figure 2 and as now briefly recapitulated:

using either the crank 4 or the motor 5, the shaft 6 is made to rotate (in the direction of the arrow 7) until the crank 8, after passing its bottom dead centre position, completes the tensioning of the closing spring 2 and comes to a stop when the roller 9 of the cam 10 comes into contact with the closing release device 11.

[0014] In the condition illustrated by Figure 5 the situation is as follows:

- the circuit breaker pole 1 is closed:
- the opening spring 3 is tensioned;
- the opening release device 23 is set;
- the closing spring 2 is tensioned;
- the closing release device 11 is set.

[0015] Using only the energy accumulated in the control, the circuit breaker is ready to perform a first opening (O) by unblocking the opening release device 23.

[0016] In this condition the control still has the energy - in the tensioned closing spring 2 - for performing a further closing (C) and opening (O) cycle.

[0017] Although it is both functional and reliable, the control described above has as its principal drawback the constructional complexity that essentially derives from a very large number of components, including - for example - the presence of at least two shafts, at least two cams and one or two dampers. This leads to further drawbacks that are constituted by the cost of the control, its size and its poor flexibility when it has to be adapted to the various configurations and the different conditions in which it may have to be used. Over and above this, maintenance of the control and its overhaul while in

service may create some operational difficulties.

[0018] The spring-operated energy accumulation control for medium- and high-voltage circuit breakers constituting the object of the present invention overcomes the aforesaid drawbacks and the power device of the proposed control as characterized in the claims comprises of a first shaft, which is fixed in the control housing and carries a partially toothed ratchet wheel (hereinafter referred to more simply as "toothed wheel") that can rotate about its longitudinal axis; a second shaft, likewise fixed in the control housing and having its axis parallel to and eccentric with respect to the axis of the first shaft, that carries the first end of a crank that rotates around the second shaft axis, the said toothed wheel being associated with a ratchet device and carrying also a dragging means capable of rotating the said crank into a desired position; the toothed wheel also carries a blocking means to bring it to a halt against a closing release device and a means for connecting the free end of a closing spring of which the other end is anchored to the base of the control; the said crank carries an opening release device at its second end, the said second end also being linked to the first end of a manoeuvering bar that, in its turn, is linked by its other end to known lever mechanisms, the transmission shaft and the opening spring for closing and opening the circuit breaker pole.

[0019] Furthermore, a latch is associated with the said toothed wheel to engage a toothed portion of the said wheel, thus permitting the wheel to rotate only in one direction.

[0020] Known auxiliary contacts of the circuit breaker position indicator are controlled by the said release device associated with the second end of the crank.

[0021] The control also comprises a mechanical means for preventing the carrying out of erroneous manoeuvres when the circuit breaker is closed.

[0022] The principal mode of functioning of the various parts included in the power device of the control forming the object of the present invention will now be described.

[0023] The toothed wheel is made to rotate by means of the ratchet device engaging with the toothed portion of the wheel to permit the means linked to the closing spring to rotate until it goes beyond its lower dead centre position, thus making the said spring tensioned; the tensioning of the closing spring comes to an end when the said blocking means comes to rest against the closing release device; once the tensioning of the spring has come to an end, the toothed portion of the said wheel is situated outside the action of the ratchet device; in this phase the crank is still in line with the said manoeuvering bar and in this position the known lever mechanisms, transmission shaft and opening spring keep the circuit breaker open. From this condition either a manual or an electrical action will cause the unblocking of the closing release device, thus liberating the toothed wheel, which will now be able to rotate under the action of the closing spring and, during the said rotation, the dragging means will remain in contact with the second end of the crank until the release means associated with the second end of the said crank comes to a halt against the said opening release device and thus bars the further progress of the crank; during this rotation the crank will drag the said manoeuvering bar, which - in its turn - will move the known lever mechanisms and transmission shaft to close the circuit breaker and, at one and the same time, tension the opening spring. The crank will remain in this position, while the toothed wheel will continue its rotation until the means linking it to the closing spring reaches its top dead centre position. The toothed wheel recuperates the residual energy of the closing spring and comes to a halt in a non-return position established by the point where the ratchet device and the latch engage with the toothed portion of the wheel. At this stage the circuit breaker pole is closed, the opening spring is tensioned, the opening release device is set, while the closing spring is slackened and conserves only residual energy. From this condition an opening action will unblock the aperture release device, thus freeing the crank, which can now rotate in the direction contrary to the toothed wheel to open the circuit breaker pole by means of the opening spring, the transmission shaft and the known lever mechanisms.

[0024] The principal advantages of the present invention derive from the fact that the power device of the control is made up of a small number of parts, that no regulation of any the various parts is needed during the assembly phase, that all the control organs are mounted on a single base plate, which renders assembly easy and ensures good access the various parts. Other advantages of the present invention are constituted by the fact that all the components of the kinematic chain that bring about the closing and the opening of the circuit breaker work in tension and are arranged in one and the same action plane without any shafts that transfer the action onto other planes, an arrangement that assures also absence of play and transverse components in torsion or bending in the supports, the housing and the cross bars of the control and the circuit breaker with almost complete absence of vibrations while the circuit breaker is being operated. This makes it possible to avoid the use of dampers in the opening and closing phases and leads to a compact and economic supporting structure. Further advantages of the present invention are provided by the fact that the opening and closing times of the circuit breaker are constant, that the danger of undesired operations of the circuit breaker is eliminated, that the opening and closing release devices are identical and require only a minimal release energy, and that it is impossible to modify the control position when maneuvering in the direction opposite to the circuit breaker pole.

[0025] The invented spring-operated energy accumulation control for medium and high-voltage circuit breakers will now be described in greater detail together with

various phases of the opening and closing cycle with reference to an example and the help of drawings in which

[0026] Figures 6 to 11 are schematic views showing the control in different operating phases.

[0027] Figure 6 shows the shaft 30 that carries the partially toothed wheel 31 and is also provided with an eccentric extension 32 on which there is mounted a first end of the crank 33. The figure indicates that the said wheel is partially toothed and can therefore engage with the ratchet device 34, which can be moved by means of the lever 35 or the electric motor 36 and also continuously engages with the latch 37. The figure further indicates that the wheel 31 is provided with a dragging tooth 38 that receives a blocking roller 39; the wheel 31 is also provided with the pin 40 extended through the surface thereof upto passing throug a housing plate (not shown) bearing a circular opening wherein the pin moves in order to connect the free end of the closing spring 41 with the toothed wheel 31 by means of the bar 42 positioned beyond said housing plate. At its other end the said crank 33 carries a release roller 43. The figure also shows a closure release device 44 and an opening release device 45, against which - as will be explained later - there come to a halt, respectively, the blocking roller 39 and the release roller 43. The said other end of the crank is also rotatably connected with the first end of the manoeuvering bar 46 that has its other end connected to the lever mechanisms 47, 48, 49, 51, 52, the transmission shaft 50 and the opening spring 53 to close the circuit breaker pole 54, which in the figure is shown in its open position.

[0028] The functioning of the power device will now be explained by reference to Figures 6 to 11.

[0029] Figure 6 shows the control in its rest position, i.e. with the closing spring 41 slack, the opening spring 53 slack and the circuit breaker pole 54 open. In this condition the crank 33 is in line with the manoeuvering bar 46, so that the open position of the circuit breaker pole 54 is stable and invariable in time with the service manoeuvres. This position is reached in a gradual manner at the end of the opening manoeuvre without there being any need for a damping device.

[0030] At this point - as can be seen in Figure 7 - the toothed wheel 31 is made to rotate in an anti-clockwise direction (arrow F), either manually by means of the lever 35 or electrically by means of the motor 36, via the ratchet device 34, which engages with the toothed rim of the wheel 31, to enable the connecting pin 40 of the closing spring 41 to rotate beyond its bottom dead centre and thus to tension the said closing spring 41; the tensioning of the closing spring terminates when the said blocking roller 39 comes to rest against the closure release device 44; once the tensioning of the closing spring 41 has been completed, the toothed rim of the wheel 31 is outside the action range of the ratchet device 34; it can be seen from the figure that the crank bar 33 does not undergo any displacement in this phase and it therefore remains in line with the manoeuvering bar 46, so that the lever mechanisms 47, 48, 49, 51, 52, the transmission shaft 50 and the opening spring 53 likewise do not undergo any change of position and therefore keep the circuit breaker pole 54 open.

[0031] As can be seen from Figure 8, a subsequent action, which may be either manual or electrical, unblocks the closure release device 44, thus freeing the toothed wheel 31 and allowing it to rotate under the action of the closing spring 41. During this rotation the dragging tooth 38 is in contact with the other end of the crank 33 until the release roller 43 comes to rest against the said opening release device 45 to restrain the crank 33; during this rotation the crank 33 drags the manoeuvering bar 46 and thus displaces the lever mechanisms 47, 48, 49, which in their turn tension the opening spring 53 and - at one and the same time - cause the transmission shaft 50 to rotate in the direction of the arrow F', thus rotating the lever mechanisms 51 and 52 and closing the circuit breaker pole 54. In this phase the crank 33 remains in the said position, where it is retained by the opening release device 45, while the toothed wheel 31 continues its rotation until the pin 40 for connecting the closing spring 41 attains its upper dead centre position.

[0032] As shown in Figure 9, the toothed wheel 31 recuperates the residual energy of the closing spring 41, coming to a halt in a non-return position defined by the engagement of the ratchet device 34 and the latch 37 with the toothed rim of the wheel 31. At this point the circuit breaker pole 54 is closed, the opening spring is tensioned, the opening release device 45 is set and the closing spring 41 is slack and conserves only some residual energy.

[0033] From this condition, as shown in Figure 10, an opening action, be it manual or electrical, will unblock the opening release device 45, thus freeing the crank 33 and enabling it to rotate in a clockwise direction to open the circuit breaker pole 54 via the opening spring 53, the lever mechanisms 47, 48, 49, 51, 52 and the shaft 50.

[0034] At the end of this action the circuit breaker pole 54 and the control will once again find themselves in their initial positions (as described in Figure 6) except for the more advanced position of the toothed wheel 31 due to the recovery of the residual energy of the closing spring.

[0035] When carrying out an opening-closing-opening (O-C-O) cycle, the starting position of the control is thus as follows (see Figure 9):

- circuit breaker pole 54 closed;
- opening spring 53 tensioned;
- opening release device 45 set.

[0036] When the closing spring 41 becomes tensioned (as described above by reference to Figure 6), the control attains the following condition (see Figure

11):

- circuit breaker pole 54 closed;
- opening spring 53 tensioned;
- opening release device 45 set;
- closing spring 41 tensioned;
- closing release device 44 set.

[0037] When the circuit breaker pole 54 is closed, a mechanical means capable of preventing the accidental unblocking of the closing release device 44 (which is not shown in the figures) makes it impossible to carry out erroneous operations of closing the circuit breaker pole 54 until such time as the operation is triggered by the unblocking of the opening release device 44.

[0038] At this point the circuit breaker - with only the energy accumulated in the control - is ready for carrying out a first opening (O) by means of the unblocking of the opening release device 45, on completion of which it will assume the position shown in Figure 7.

[0039] Subsequently, the control, thanks to the still tensioned closing spring 41, will have sufficient energy for carrying out a further closing-opening (C-O) cycle in accordance with the phases illustrated by Figures 8, 9 and 10.

Claims

1. A spring-operated energy accumulation control for medium and high-voltage circuit breakers that comprises lever mechanisms (18-47, 19-48, 49, 21-51, 22-52), a trasmission shaft (20-50) and an opening spring (3-53) for bringing about the closing of the circuit breaker pole (1-54), **characterized in that** it comprises a first shaft (30) that is fixed in the control housing and carries a partially toothed wheel (31) with ratchet gear devices that rotates around the longitudinal axis of the said shaft; a second shaft (32), likewise fixed in the control housing, which has the axis parallel to and eccentric with respect to the axis of the first shaft (30) and carries a first end of a crank (33) that rotates about the axis of the said second shaft (32); and further **in that** the said toothed wheel (31) is associated with a ratchet device (34) and also carries a dragging device (38) to make the said crank (33) rotate into a desired position; the toothed wheel also carries a blocking means (39) to bring it to a halt against closing release device (44), a means (40) to connect the free end of a closing spring (41) that has its other end fixed to the control base; the said crank (33) carries at its other end a release means (43) to bring it to a halt against an opening release device (45) and is also rotatably connected by means of the said other end to a manoeuvering bar (46) that, in its turn, is associated by means of its own other end with the said lever mechanisms (47, 48, 49, 51, 52), the transmission shaft (50) and the opening spring (53) to close and open the circuit breaker pole (54).

2. A spring-operated energy accumulation control in accordance with Claim 1, **characterized in that** it comprises - associated with the said partially toothed wheel (31) - a ratchet (37) to avoid the wheel (31) rotating in a direction other than the desired one.

3. A spring-operated energy accumulation control in accordance with either of the preceding claims, **characterized in that** the said release means (43) associated with the second end of the said crank (33) controls known auxiliary contacts of the position indicator of the circuit breaker.

4. A spring-operated energy accumulation control in accordance with any one of the preceding claims, **characterized in that** it comprises a mechanical means to prevent the carrying out of erroneous manoeuvres when the circuit breaker is closed.

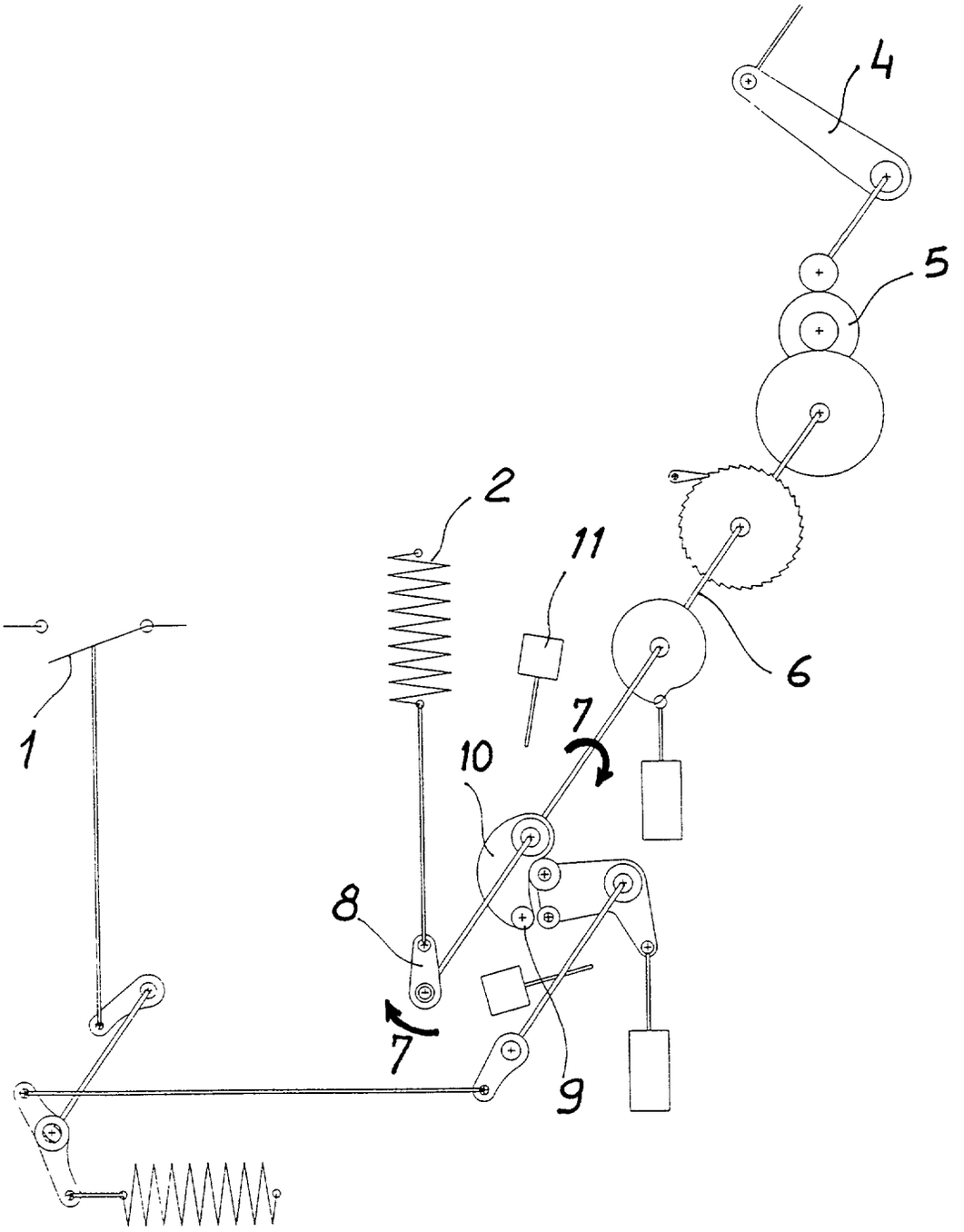

Fig. 1

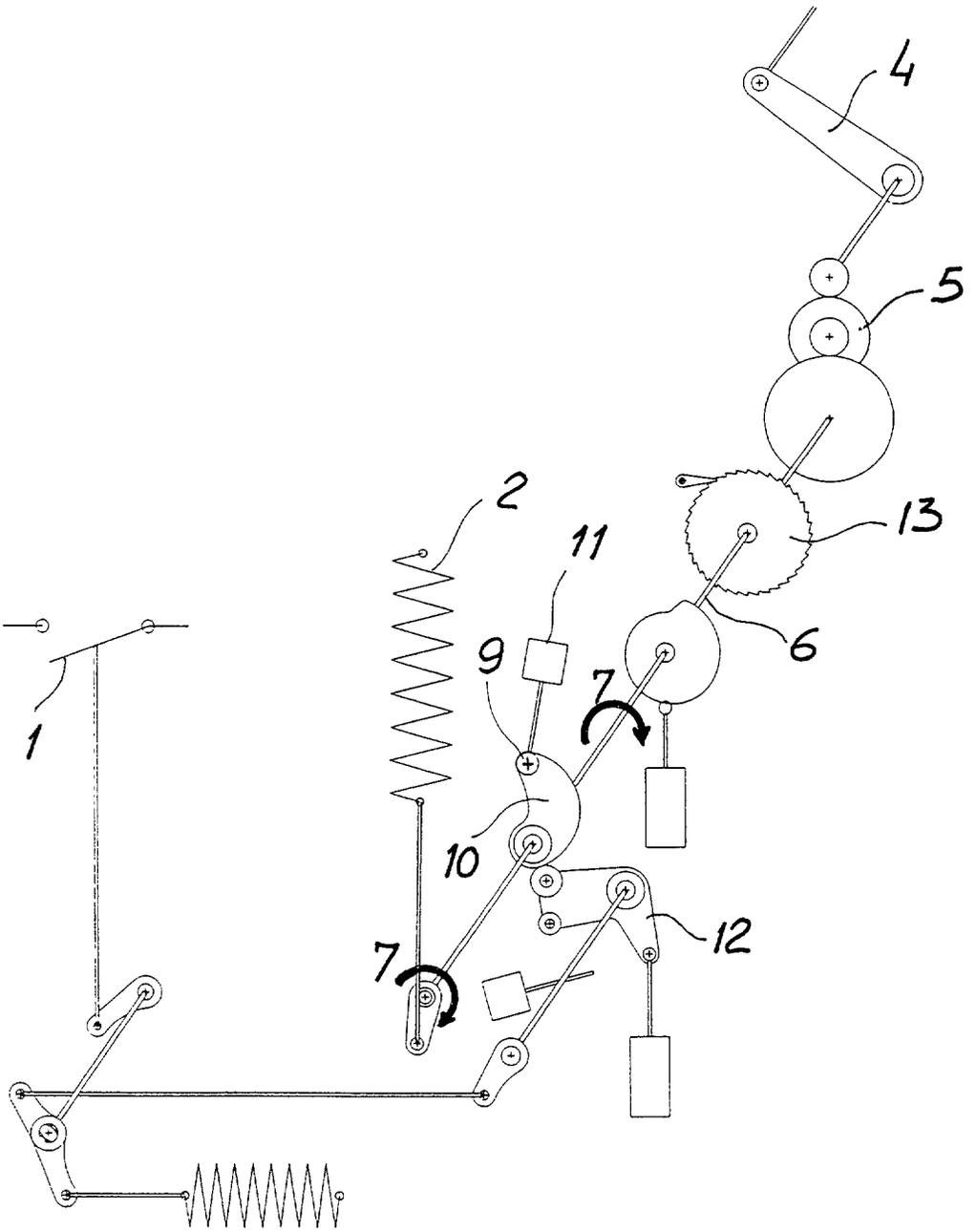

Fig. 2

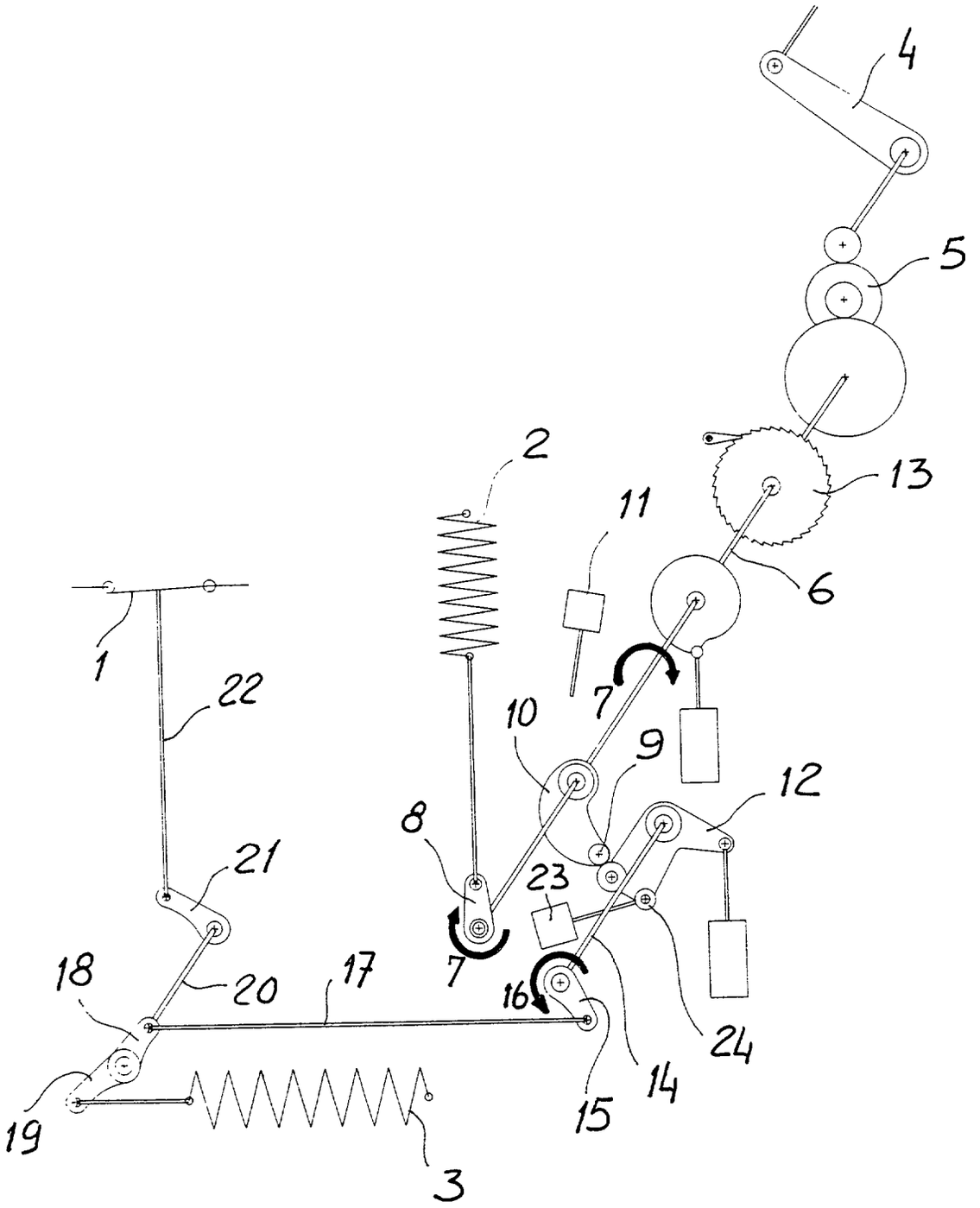

Fig. 3

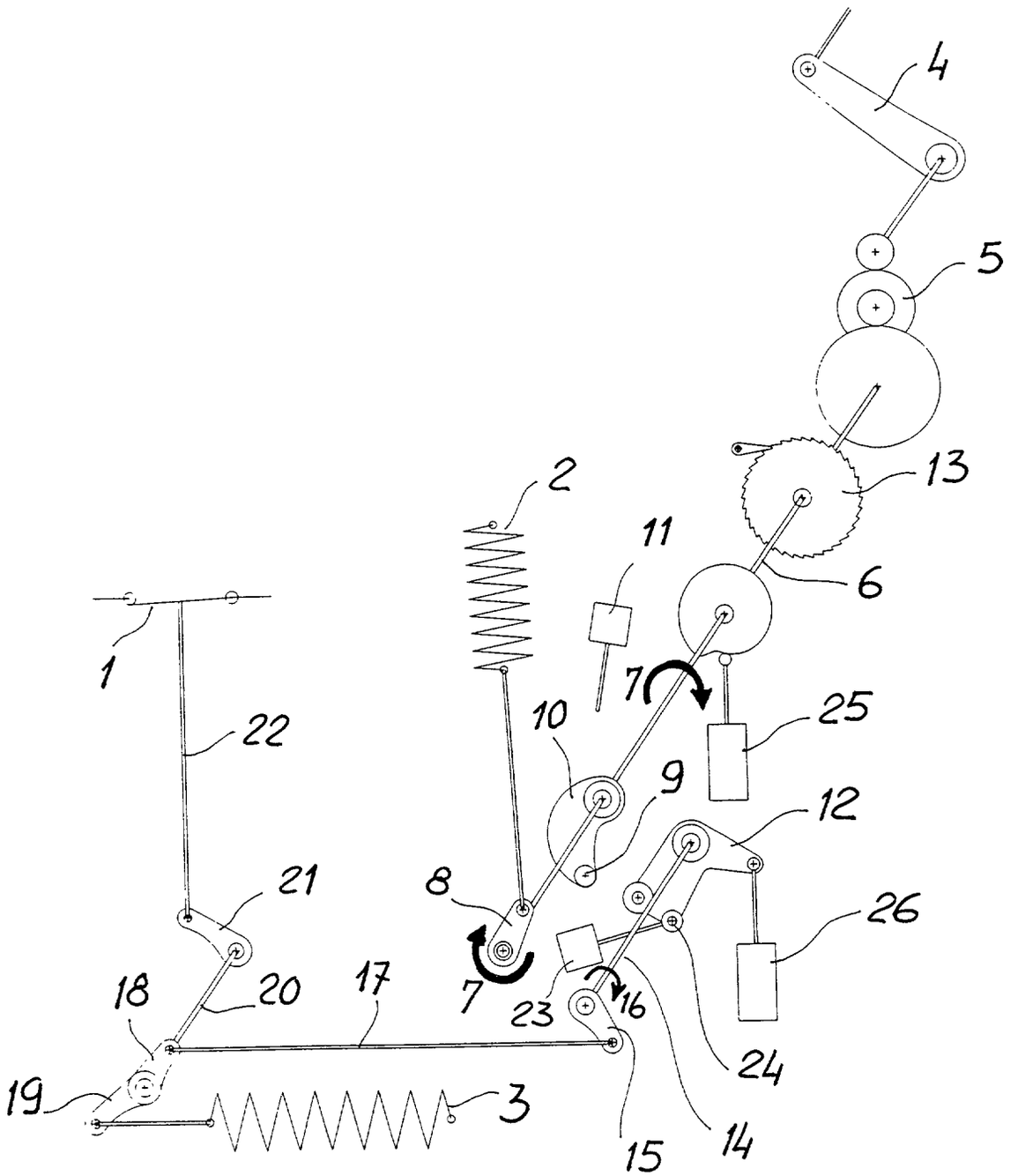

Fig. 4

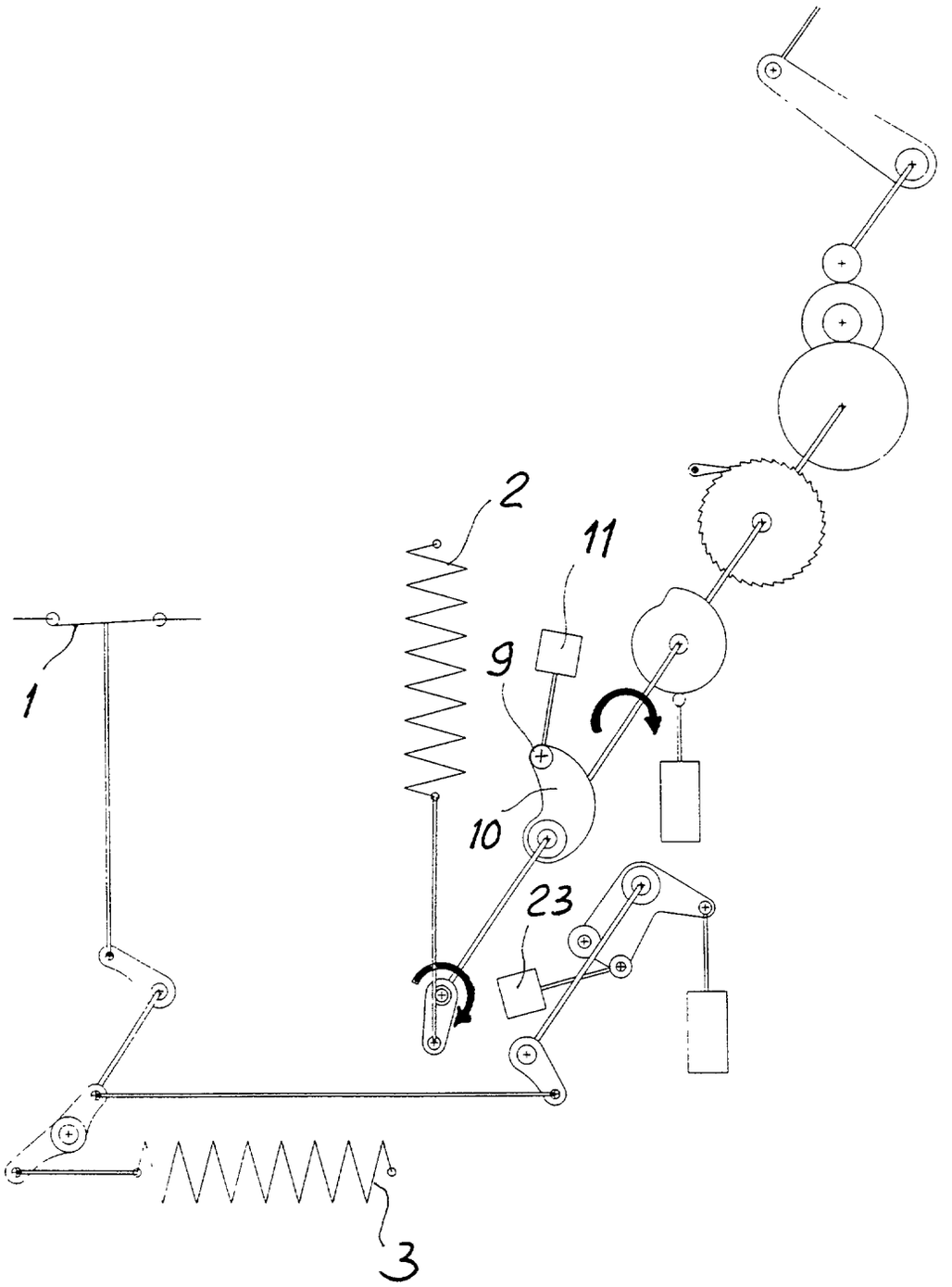

Fig. 5

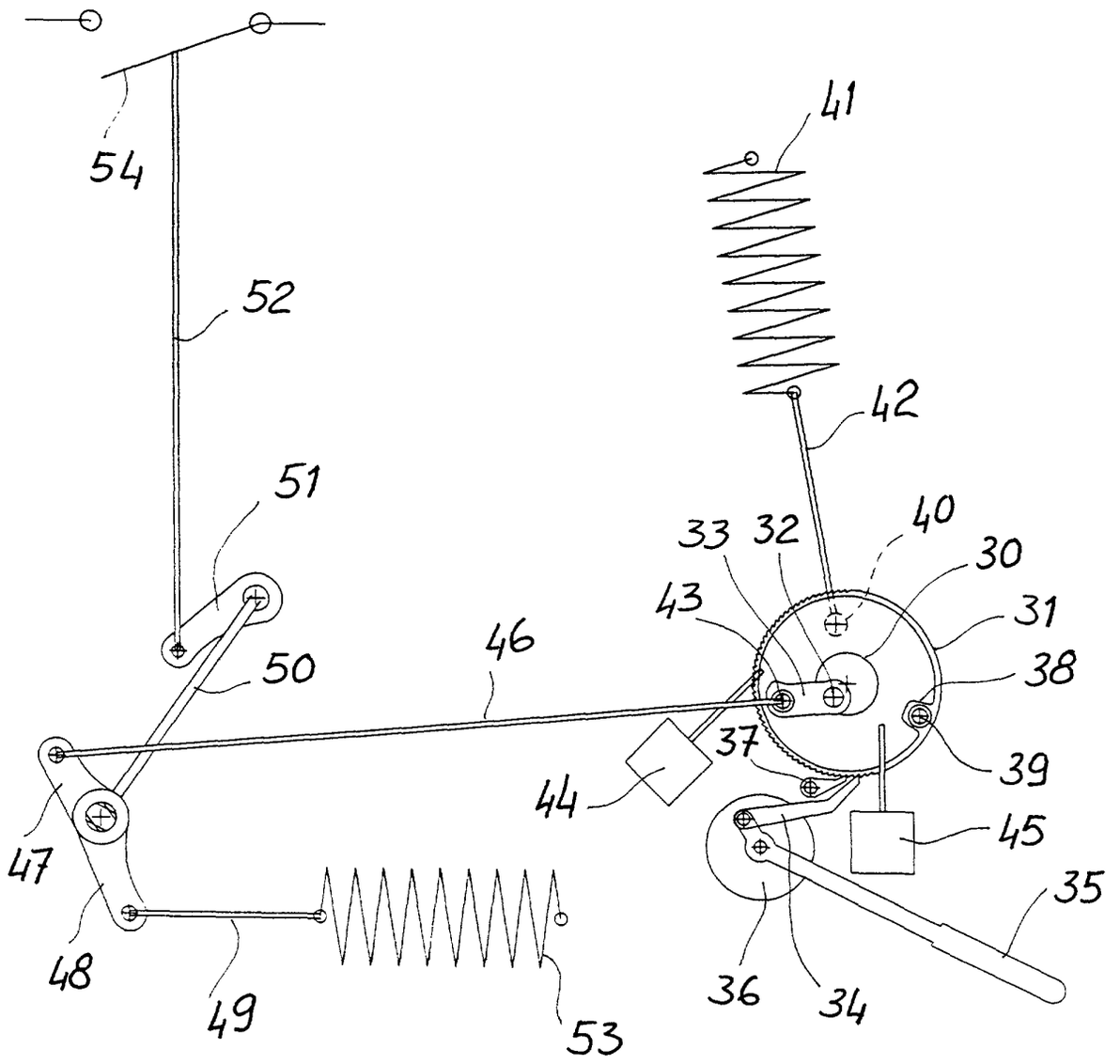
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Fig. 6

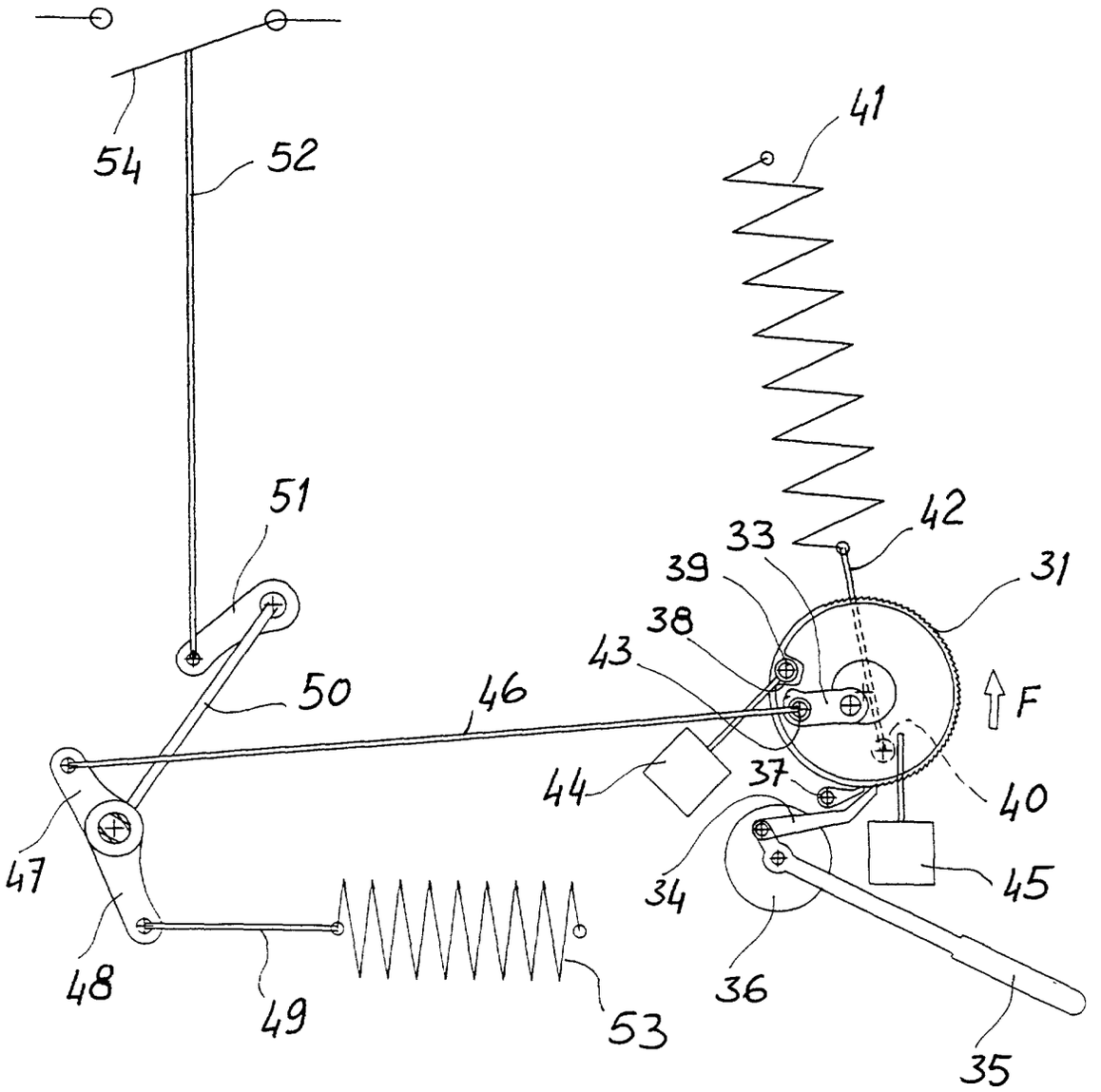

Fig. 7

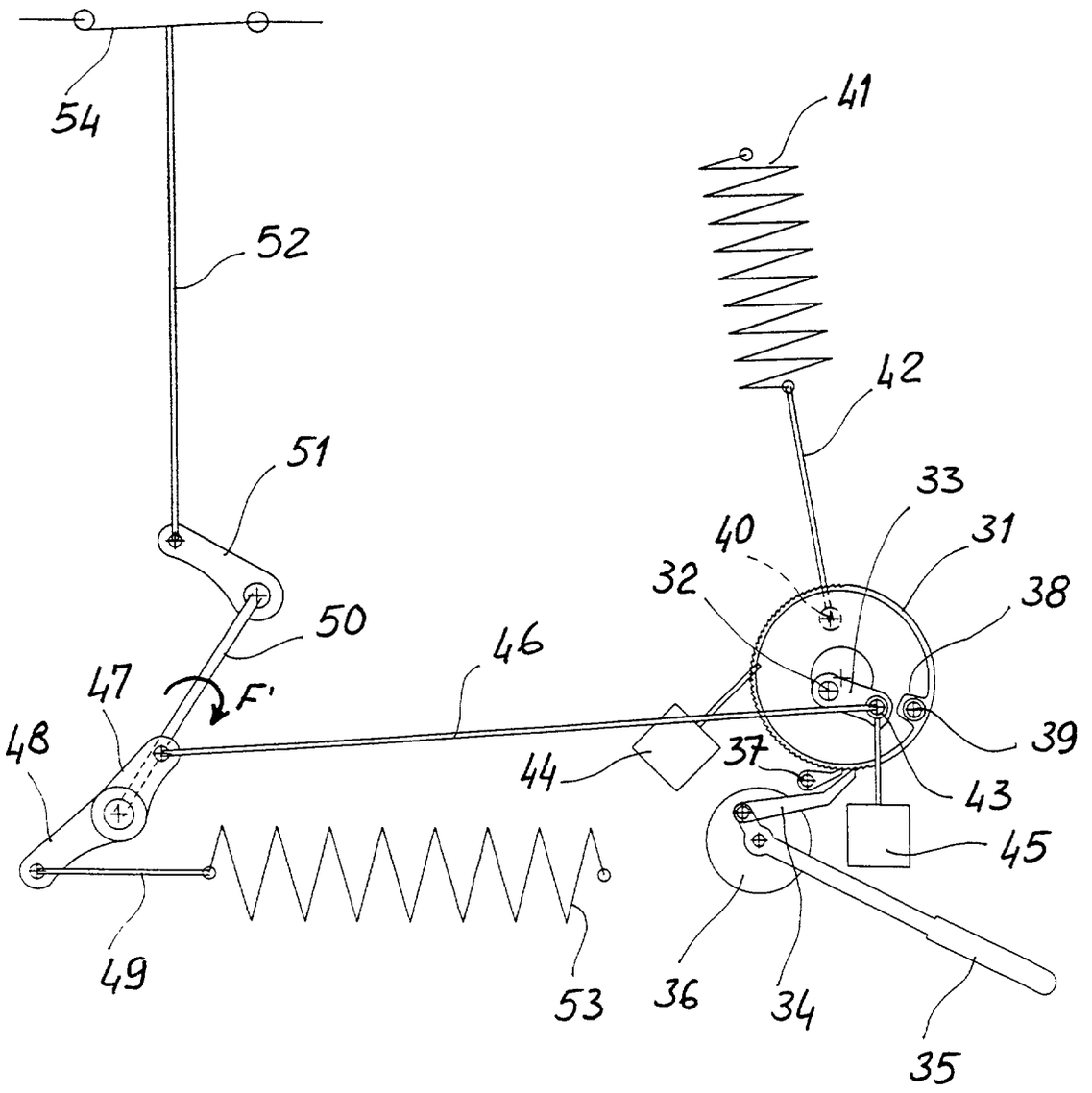

Fig. 8

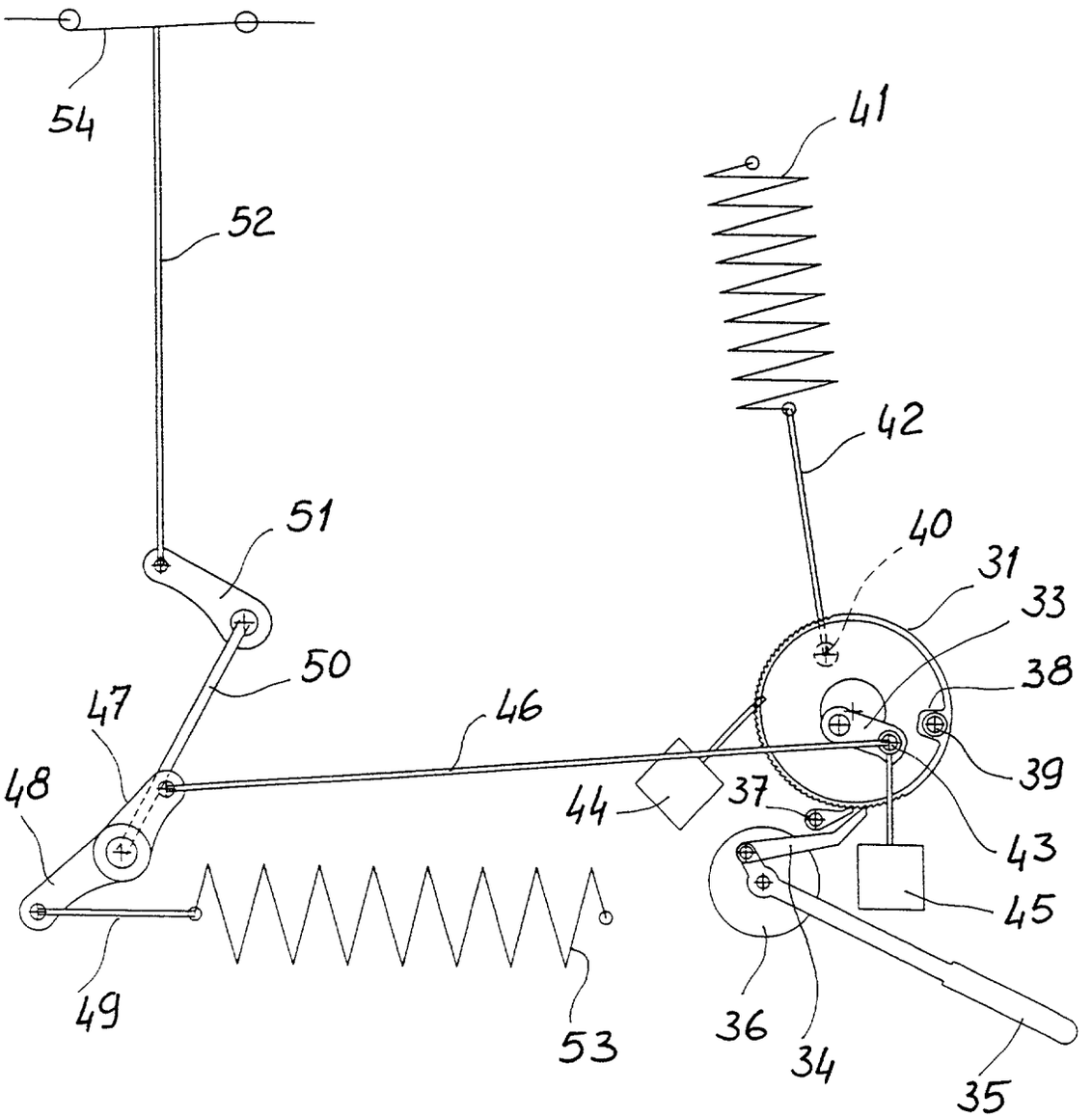

Fig. 9

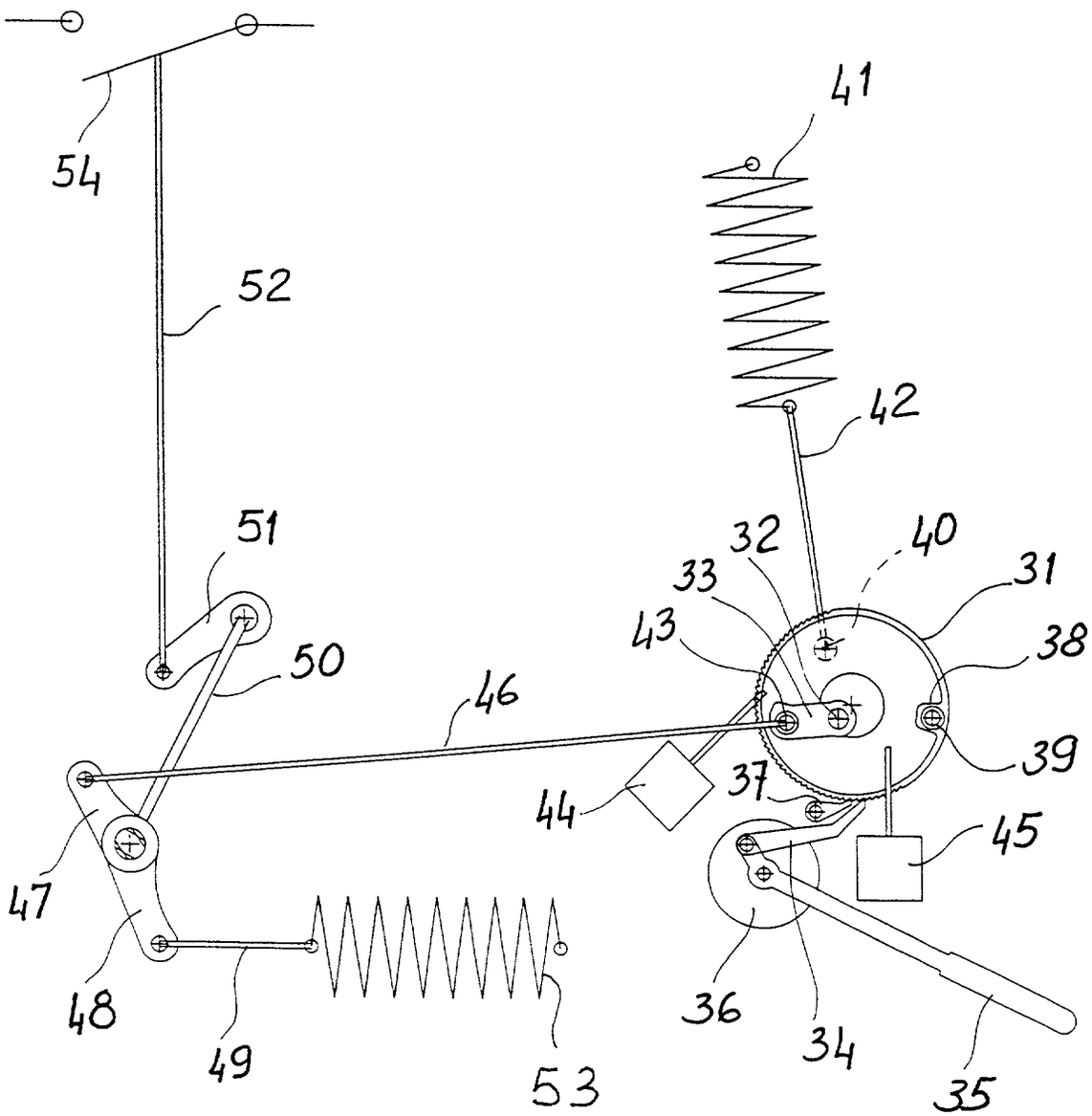

Fig. 10

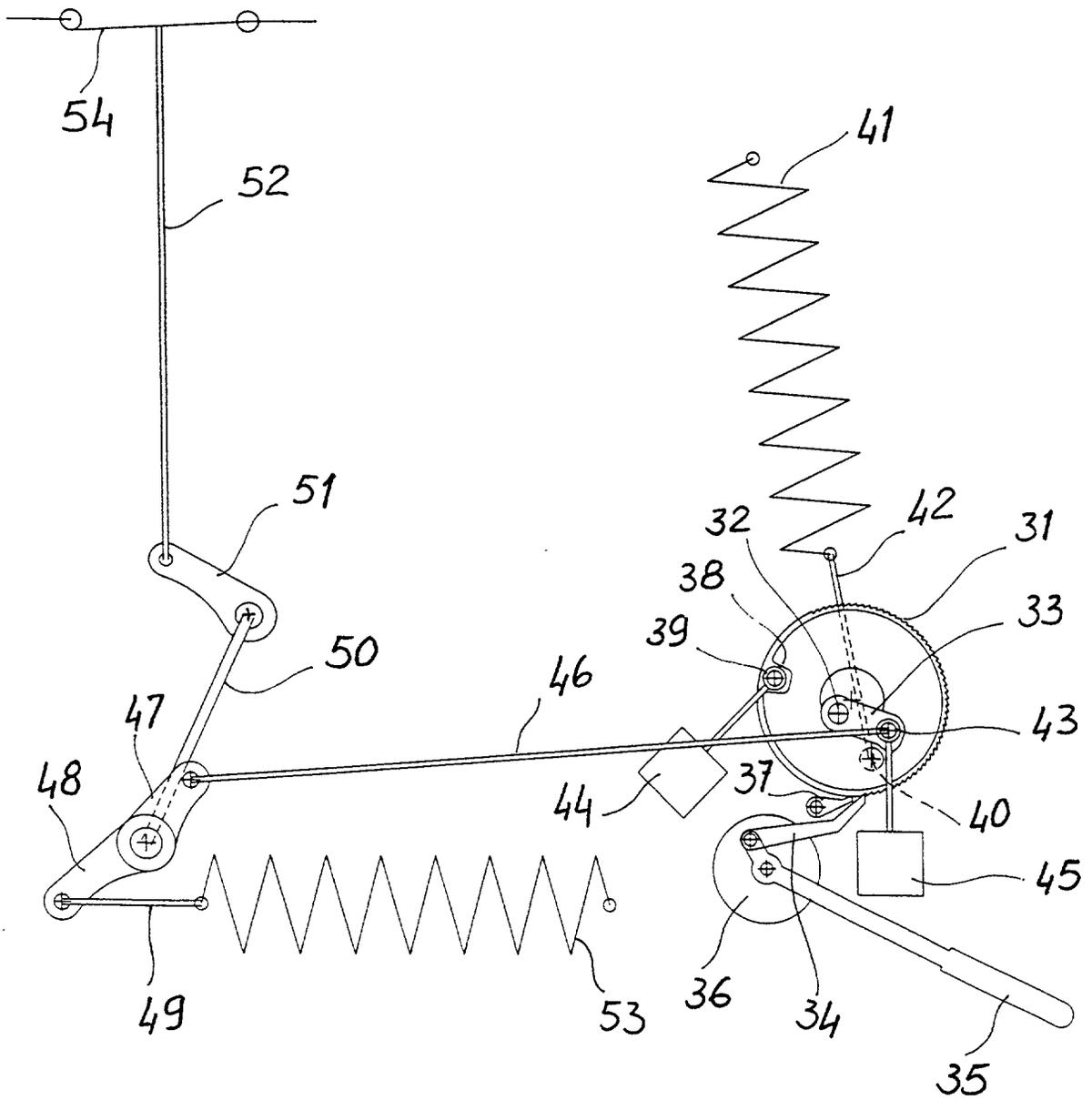

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 01 83 0197

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 August 2001	Overdijk, J

CATEGORY OF CITED DOCUMENTS

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