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(54) **High-voltage circuit breaker for high currents**

Hochspannungsschalter für hohen Nennstrom

Disjoncteur à haute tension à courant nominal élevé

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Description

[0001] The present invention relates to a circuit breaker for high-voltage currents.

[0002] As it is known, circuit breakers for high-voltage currents must be actuated quickly and promptly. In order to meet this requirement, the use of direct actuators of the electromechanical type would entail devices of unacceptable size; accordingly, systems for accumulating mechanical energy are generally used. Energy accumulation occurs over a few hundred seconds. Energy is then used and delivered over a few tens of milliseconds.

[0003] This solution in any case entails using complex, expensive and bulky devices which cannot be integrated with the circuit breaker poles they must operate. In particular, if the energy is accumulated in steel springs, which have a great mass, it is not possible to connect them directly to the movable assembly of the pole of the circuit breaker, because their mass would significantly limit the speed and the operation time of the circuit breaker, unacceptably penalizing its performance.

[0004] In such situations it is necessary to resort to stroke multiplier mechanisms interposed between the spring and the movable element of the circuit breaker, which further complicate the actuation mechanisms and make it practically impossible to integrate it with the pole of the circuit breaker.

[0005] As regards the poles of circuit breakers, in the conventional art the use of porcelain insulators leads to great limitations. This solution necessarily entails using two porcelain insulators equipped with aluminum flanges (which are cemented to the insulator in a complicated manner), which respectively contain the arcing chamber and the insulating drive rod; the entire unit is assembled by means of plates and covers which are expensive and bulky.

[0006] Patent application nr. FR-A-2589001 discloses a mechanism for operating circuit-breaker and suitable for causing a circuit-breaker to perform a rapid opening-closing-re-opening cycle. A first spring is coaxially arranged around an operating rod that moves the movable contacts of the circuit breaker. A second spring is arranged around a cylinder that surrounds the first spring.

[0007] Patent application nr. EP 788126 discloses a switch for hieh-voltage current, which is provided with a movable contact that can be actuated by means of an actuation rod made of insulating material. The actuation rod accommodates a spring, which is operatively connected between the actuation rod and the body of the insulator that accommodates the switch.

[0008] Patent nr. US-5504289 discloses a switching mechanism for a high voltage circuit breaker. The disclosed mechanism comprises a first spring and a second spring that is positioned coaxially with the first spring. An operating rod member is operatively associated to said springs and to the movable contacts of the circuit breaker.

[0009] Main aim of the present invention is to provide a circuit breaker for high-voltage currents which allows to eliminate the complicated stroke multiplying mechanisms required to transmit motion to the movable parts of the pole of the circuit breaker.

[0010] Within the scope of this aim, an object of the present invention is to provide a circuit breaker for high-voltage currents which allows to reduce the energy required to transmit motion to the movable contacts of said circuit breaker so as to improve its performance in terms of speed and promptness of intervention.

[0011] Another object of the present invention is to provide a circuit breaker for high-voltage currents with a pole having a smaller number of components, a reduced weight and, insulation levels being equal, smaller size.

[0012] Further but not last object of the present invention is to provide a circuit breaker for high-voltage currents which is highly reliable, has reduced testing times, is relatively easy to manufacture and at competitive costs.

[0013] This aim, these objects and others which will become apparent hereinafter are achieved by a circuit breaker for high-voltage currents according to the following claim 1.

[0014] Further characteristics and advantages of the present invention will become apparent from the following detailed description of preferred but not exclusive embodiments. of the circuit breaker according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figures 1, 2 and 3 are partially sectional views of a first embodiment of the circuit breaker according to the invention; and

Figure 4 is a partially sectional view of a second embodiment of the circuit breaker according to the invention.

[0015] With reference now in detail to Figures 1, 2 and 3, the circuit breaker according to the invention comprises a pole which is constituted by an insulator 4, by fixed contacts 1 and by movable contacts 2. An electric power tap 3 protrudes from the insulator and supports a movable contact holder 10 by means of an intermediate flange 11.

[0016] Inside the insulator 4 of the pole there are provided elastic means which are conveniently constituted by two springs 6 and 7, respectively for opening and for closure, which are made of insulating material. Advantageously, in the opening spring 6 one end is connected to a movable drive rod 5, which is also made of insulating material and which, by actuating the movable contacts 2, allows to open and close the circuit breaker, and the other end is fixed to the flange 11. In the closure spring 7, one end is coupled to sliding support means 12 which are connected, by means of a tube 13, to circuit breaker actuation means 8, and the other end is connected to the flange 11. In particular, the tube 13 is coupled to the drive rod 5 through engagement means 16 which are fixed to the tube 13 and have a pawl that engages a slot formed in the rod 5.

[0017] The circuit breaker actuation means 8, according to the present invention, comprise a gearmotor 31, a worm screw 36, two electrical engagement devices 34 and 35, and two engagement means 19 and 20 and are directly connected to the flange 9 of the insulator 4 by means of the flange 14. In this manner they are rigidly coupled to the base of the insulator 4.

[0018] Starting from the conditions of Figure 1, in which the circuit breaker is open and the closure spring 7 is loaded, i.e., is tensioned, the energization of the electromagnet 35 releases the engagement means 19: in this manner, the closure spring 7 can move freely and moves upward the tube 13 which, by being coupled to the drive rod 5 through the engagement means 16, also moves the rod 5 in its upward movement. The rod 5, by actuating the movable contacts 2, closes the circuit breaker and loads, by compressing it, the opening spring 6 which is rigidly coupled thereto.

[0019] At the end of the actuation, as shown in Figure 3, the pawl of the engagement means 16 is released by the stroke limiter 17 and the drive rod 5 engages the engagement means 20; in this manner, the opening mechanism is made independent of the closure mechanism.

[0020] The gearmotor 31 starts by means of the stroke limiter switch 32 and can reload the closure spring 7 which, at the end of its loading, engages the engagement means 19; the wheel of the gearmotor disengages from the worm screw 36 and the gearmotor stops due to the stroke limiter 33.

[0021] Opening of the contacts, which can be performed if necessary also during the reloading of the closure spring, occurs by energizing the electromagnet 34. In this manner, the engagement means 20 are released and the opening spring 6, as it is released, pushes down the rod 5, which opens the contacts.

[0022] With the circuit breaker according to the invention it is possible to perform quick opening-closure-opening with the following sequence.

[0023] Starting from an operating condition in which the circuit breaker is closed and the closure and opening springs are loaded, the following occurs:

> the engagement means 20 are released by energizing the electromagnet 34; since the opening spring 6 is now free to move, it elongates and pushes down the drive rod 5, which opens the circuit breaker and engages the engagement means 16. In this situation, the circuit breaker is open, the opening spring 6 is released and the closure spring 7 is loaded.

[0024] By energizing the electromagnet 35, the engagement means 19 are released and the circuit breaker, as described above, closes. In this situation, the opening spring is loaded and the insulating rod 5 is engaged with the engagement means 20.

[0025] By re-energizing the electromagnet 34, the circuit breaker reopens.

[0026] Auxiliary contacts 18 of the insulator are switched at each actuation.

[0027] A second embodiment of the circuit breaker according to the invention is now described with reference to Figure 4. In this embodiment too, the opening and closure springs, now designated by the reference numerals 3 and 4, are contained in the insulator 5 of the pole of the circuit breaker and are made of insulating material. In particular, in the opening spring 3 one end is fixed to a flange 30 and the other end is fixed to an insulating rod 50 which, by actuating the movable contacts 2, allows to open and close the circuit breaker. In the closure spring 4, one end is fixed to the flange 30, while the other end is connected to a system constituted by a linkage 61 and a lever 62.

[0028] In this embodiment, the actuating means comprise two electric engagement devices 39 and 41 and a gearmotor 42. Starting from the situation shown in Figure 4, in which the circuit breaker is open,the closure spring 4 is loaded (compressed) and the opening spring 3 is released, energization of the electrical engagement device 40 releases the kinematic chain 62, 61 and 4. The closure spring 4 is released and, by elongating, pushes the lever 62 which, by means of the linkage 63 and the levers 64 and 65, moves upward the rod 50, which causes the closure of the contacts and the loading (by compression) of the opening spring 3.

[0029] At the end of the closure actuation, the lever 64 engages the electrical engagement device 41; at the same time, the lever 66 disengages the lever 64 from the lever 62, making the opening mechanism independent of the closure mechanism. The gearmotor 42 can thus reload the closure spring 4. At the end of the loading action, the spring 4 engages the electrical engagement device 40 and the gearmotor 42 disengages from the lever 62 by means of a disengagement device 43.

[0030] The opening of the contacts, which can be performed if necessary also during reloading of the closure spring, occurs by energizing the electrical engagement device 41, which releases the lever 64. The opening spring 3 is no longer retained and is released, pushing the rod 50, which opens the contacts.

[0031] According to this embodiment, it is possible to perform quick opening-closure-opening by means of the following sequence:

> starting from a condition in which the circuit breaker is closed, the closure spring 4 and the opening spring 3 are loaded and as described above, the following occurs:
>
> -- the electrical engagement device 41 disengages the lever 64 and the opening spring 3 is released, allowing the circuit breaker to open;
> -- the lever 64 engages the linkage 63;
> -- the electrical engagement device 40 releases the lever 62, the spring 4 is released and allows to close the circuit breaker and reload the open-

ing spring 3; at the same time, the lever 64 disengages from the linkage 63;
-- the electrical engagement device 41 disengages the lever and the circuit breaker reopens.

[0032] Another advantage of the circuit breaker according to the invention is the fact that the insulator of the pole is monolithically made of composite material coated with polymeric material. Accordingly, this allows to reduce the number of components of the pole, its weight and, insulation levels being equal, its size.

Claims

1. A circuit breaker for high-voltage currents which comprises a vertical rod-like insulator (4), at least one arching chamber arranged inside said insulator and containing fixed contacts (1) and movable contacts (2), said movable contacts being connected to actuation means (5, 50) for opening and closing the circuit breaker, said circuit breaker comprising first and second elastic means (3, 4, 6,7) for opening and for closing respectively, said circuit breaker further comprising means (19,20,31,34,35,36, 39, 41, 42) for actuating the circuit breaker, which are coupled to the base of said insulator, said first and second elastic means being associated to an operating rod (5, 50), which moves the movable contacts of the circuit breaker, so as to be arranged coaxially directly around said operating rod, said first and second elastic means being coaxially arranged one directly around the other **characterised in that** said first and second elastic means are made of insulating material and are arranged inside said insulator.

2. The circuit breaker according to claim 1, **characterized in that** said first and second elastic means comprise a first spring (6) and a second spring (7) for opening and closure respectively.

3. The circuit breaker for high-voltage currents according to claim 2, **characterized in that** the first spring works by compression and the second spring works by traction.

4. The circuit breaker according to claim 2, **characterized in that** the first spring is connected to an insulating rod (5) for the actuation of the movable contacts for opening the circuit breaker, said rod being also connected to the second spring by means of a tube (13) and engagement means (16) for closing the circuit breaker, said engagement means being fixed to the tube and comprising a pawl which engages a slot formed in the insulating rod.

5. The circuit breaker according to claim 1, **characterized in that** said means for actuating the circuit breaker comprise means (19, 20) for the engagement/disengagement of said actuation means, said engagement/disengagement means being actuated by means of two electromagnets (34, 35).

6. The circuit breaker according to claim 2, **characterized in that** said first and second springs both act by compression.

7. The circuit breaker according to claim 6, **characterized in that** the first spring (3) is connected to an insulating rod (5) for actuating the movable contacts for opening the circuit breaker, the second spring (4) being further connected to said rod through linkage means (61) and lever means (62) for closing the circuit breaker.

8. The circuit breaker according to claim 1, **characterized in that** the means for actuating the circuit breaker comprise two electrical engagement devices (39, 41) for engaging/disengaging said actuation means.

9. The circuit breaker according to claim 2, **characterized in that** said means for actuating the circuit breaker comprise a motor (42) for reloading the second spring (4).

10. The circuit breaker according to claim 1, **characterized in that** said insulator is monolithically made of a composite material and has a tubular shape.

11. The circuit breaker according to claim 10, **characterized in that** said insulator is coated with polymeric material.

Patentansprüche

1. Stromunterbrecher für Ströme mit hohen Spannungen, der einen vertikalen stabartigen Isolator (4), mindestens eine Lichtbogenkammer, die innerhalb des Isolators angeordnet ist und die feste Kontakte (1) und bewegliche Kontakte (2) enthält, aufweist, wobei die beweglichen Kontakte mit Betätigungsmitteln (5, 50) zum Öffnen und Schließen des Stromunterbrechers verbunden sind, wobei der Stromunterbrecher erste und zweite elastische Mittel (3, 4, 6, 7) zum Öffnen bzw. zum Schließen einschließt, wobei der Stromunterbrecher ferner Mittel (19, 20, 31, 34, 35, 36, 39, 41, 42) zur Betätigung des Stromunterbrechers einschließt, die mit der Basis des Isolators verbunden sind, wobei die ersten und zweiten elastischen Mittel mit einem Betätigungsstab (5, 50) verbunden sind, der die beweglichen Kontakte des Stromunterbrechers bewegt, so dass sie koaxial direkt um den Betätigungsstab herum angeordnet sind, wobei die ersten und zweiten elastischen Mittel koaxial eines direkt um das andere angeordnet sind,

dadurch gekennzeichnet, dass die ersten und zweiten elastischen Mittel aus Isoliermaterial bestehen und in dem Isolator angeordnet sind.

2. Stromunterbrecher nach Anspruch 1, **dadurch gekennzeichnet, dass** die ersten und zweiten elastischen Mittel eine erste Feder (6) und eine zweite Feder (7) zum Öffnen bzw. Schließen einschließen.

3. Stromunterbrecher nach Anspruch 2, **dadurch gekennzeichnet, dass** die erste Feder durch Kompression wirkt und die zweite Feder durch Traktion wirkt.

4. Stromunterbrecher nach Anspruch 2, **dadurch gekennzeichnet, dass** die erste Feder mit einem Isolierstab (5) zur Betätigung der beweglichen Kontakte zum Öffnen des Stromunterbrechers verbunden ist, wobei der Stab auch mit der zweiten Feder mittels eines Rohrs (13) und eines Verbindungsmittels (16) zum Schließen des Stromunterbrechers verbunden ist, wobei das Verbindungsmittel am Rohr befestigt ist und eine Klaue einschließt, die in einen Schlitz eingreift, der im Isolierstab ausgebildet ist.

5. Stromunterbrecher nach Anspruch 1, **dadurch gekennzeichnet, dass** die Mittel zur Betätigung des Stromunterbrechers Mittel (19, 20) zum Verbinden/Lösen des Betätigungsmittels einschließen, wobei die Verbindungs-/Lösungsmittel mittels zweier Elektromagnete (34, 35) betätigt werden.

6. Stromunterbrecher nach Anspruch 2, **dadurch gekennzeichnet, dass** die ersten und zweiten Federn beide durch Kompression wirken.

7. Stromunterbrecher nach Anspruch 6, **dadurch gekennzeichnet, dass** die erste Feder (3) mit einem Isolierstab (5) zum Betätigen der beweglichen Kontakte zum Öffnen des Stromunterbrechers verbunden ist, wobei die zweite Feder (4) ferner über ein Gestänge (61) und ein Hebelmittel (62) mit dem Stab verbunden ist, um den Stromunterbrecher zu schließen.

8. Stromunterbrecher nach Anspruch 1, **dadurch gekennzeichnet, dass** die Mittel zum Betätigen des Stromunterbrechers zwei elektrische Verbindungseinrichtungen (39, 41) zum Verbinden/Lösen des Betätigungsmittels einschließen.

9. Stromunterbrecher nach Anspruch 2, **dadurch gekennzeichnet, dass** die Mittel zur Betätigung des Stromunterbrechers einen Motor (42) zum erneuten Belasten der zweiten Feder (4) einschließen.

10. Stromunterbrecher nach Anspruch 1, **dadurch gekennzeichnet, dass** der Isolator monolithisch aus einem Verbundmaterial gefertigt ist und die Form eines Rohrs aufweist.

11. Stromunterbrecher nach Anspruch 10, **dadurch gekennzeichnet, dass** der Isolator mit polymerem Material beschichtet ist.

Revendications

1. Un disjoncteur pour des courants à haute tension, comprenant un isolateur (4) analogue à une tige, vertical, au moins une chambre de formation d'arc, agencée à l'intérieur dudit isolateur et contenant des contacts fixes (1) et des contacts mobiles (2), lesdits contacts mobiles étant reliés à des moyens d'actionnement (5, 50) pour ouvrir et fermer le disjoncteur, ledit disjoncteur comprenant des premiers et deuxièmes moyens élastiques (3, 4, 6, 7) respectivement pour ouvrir et fermer, ledit disjoncteur comprenant en outre des moyens (19, 20, 31, 34, 35, 36, 39, 41, 42) pour actionner le disjoncteur, qui sont couplés à la base dudit isolateur, lesdits premiers et deuxièmes moyens élastiques étant associés à une tige d'actionnement (5, 50), qui déplace les contacts mobiles du disjoncteur, de sorte à être agencés en étant orientés coaxialement autour de ladite tige d'actionnement, lesdits premiers et deuxièmes moyens élastiques étant agencés coaxialement l'un dirigé autour de l'autre, **caractérisé en ce que** lesdits premiers et deuxièmes moyens élastiques sont formés de matériau isolant et sont agencés à l'intérieur dudit isolateur.

2. Le disjoncteur selon la revendication 1, **caractérisé en ce que** lesdits premiers et deuxièmes moyens élastiques comprennent un premier ressort (6) et un deuxième ressort (7) pour produire l'ouverture et la fermeture, respectivement.

3. Le disjoncteur pour des courants à haute tension selon la revendication 2, **caractérisé en ce que** le premier ressort fonctionne par compression et le deuxième ressort fonctionne par traction.

4. Le disjoncteur selon la revendication 2, **caractérisé en ce que** le premier ressort est connecté à une tige d'isolation (5) pour l'actionnement des contacts mobiles pour ouvrir le disjoncteur, ladite tige étant également connectée au deuxième ressort, au moyen d'un tube (13) et de moyens (16) de mise en prise pour fermer le disjoncteur, lesdits moyens de mise en prise étant fixés au tube et comprenant un cliquet s'engageant dans une fente, formée dans la tige isolante.

5. Le disjoncteur selon la revendication 1, **caractérisé en ce que** lesdits moyens d'actionnement de dis-

joncteur comprennent des moyens (19, 20) pour l'engagement/le désengagement desdits moyens d'actionnement, lesdits moyens d'engagement/de désengagement étant actionnés par deux électroaimants (34, 35).

6. Le disjoncteur selon la revendication 2, **caractérisé en ce que** lesdits premiers et deuxièmes ressorts agissent tous deux par compression.

7. Le disjoncteur selon la revendication 6, **caractérisé en ce que** le premier ressort (3) est connecté à une tige isolante (5) pour actionner les contacts mobiles pour ouvrir le disjoncteur, le deuxième ressort (4) étant en outre connecté à ladite tige par des moyens de timonerie (61) et des moyens de levier (62) pour fermer le disjoncteur.

8. Le disjoncteur selon la revendication 1, **caractérisé en ce que** les moyens pour actionner le disjoncteur comprennent deux dispositifs de contact électrique (39, 41), pour engager/désengager lesdits moyens d'actionnement.

9. Le disjoncteur selon la revendication 2, **caractérisé en ce que** lesdits moyens d'actionnement du disjoncteur comprennent un moteur (42) pour recharger ou solliciter le deuxième ressort (4).

10. Le disjoncteur selon la revendication 1, **caractérisé en ce que** ledit isolateur est réalisé monobloc, en un matériau composite, et est de forme tubulaire.

11. Le disjoncteur selon la revendication 10, **caractérisé en ce que** ledit isolateur est revêtu d'un matériau polymère.

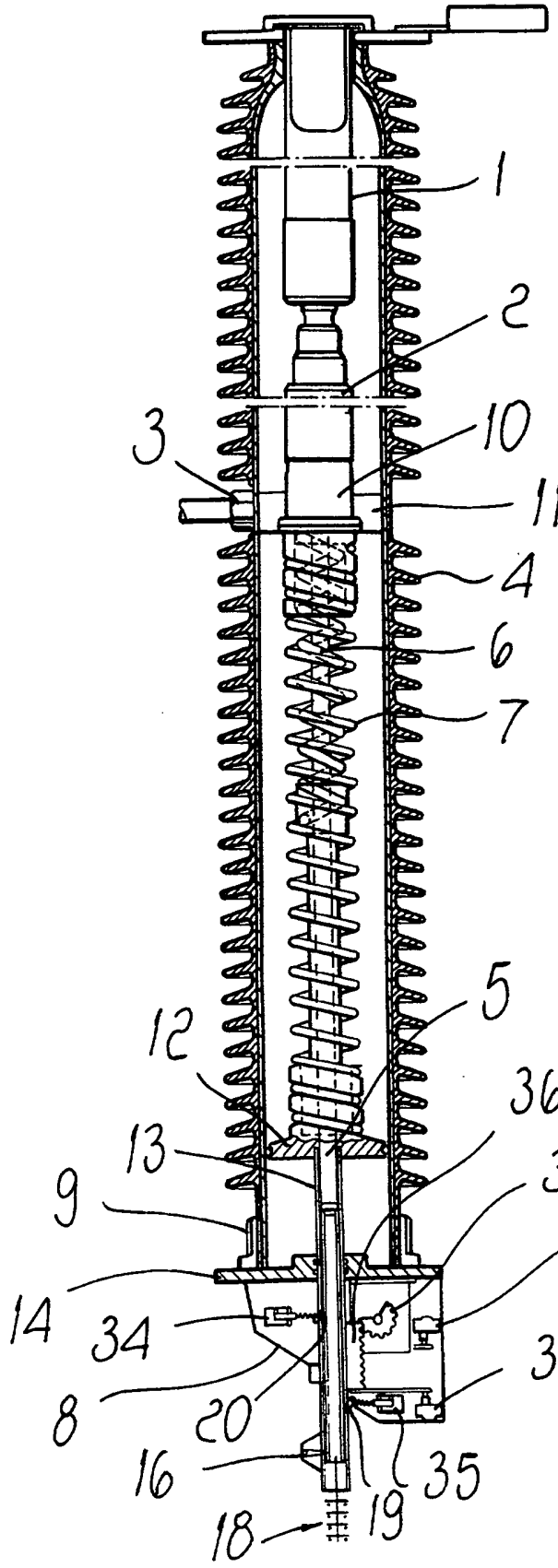

Fig. 1

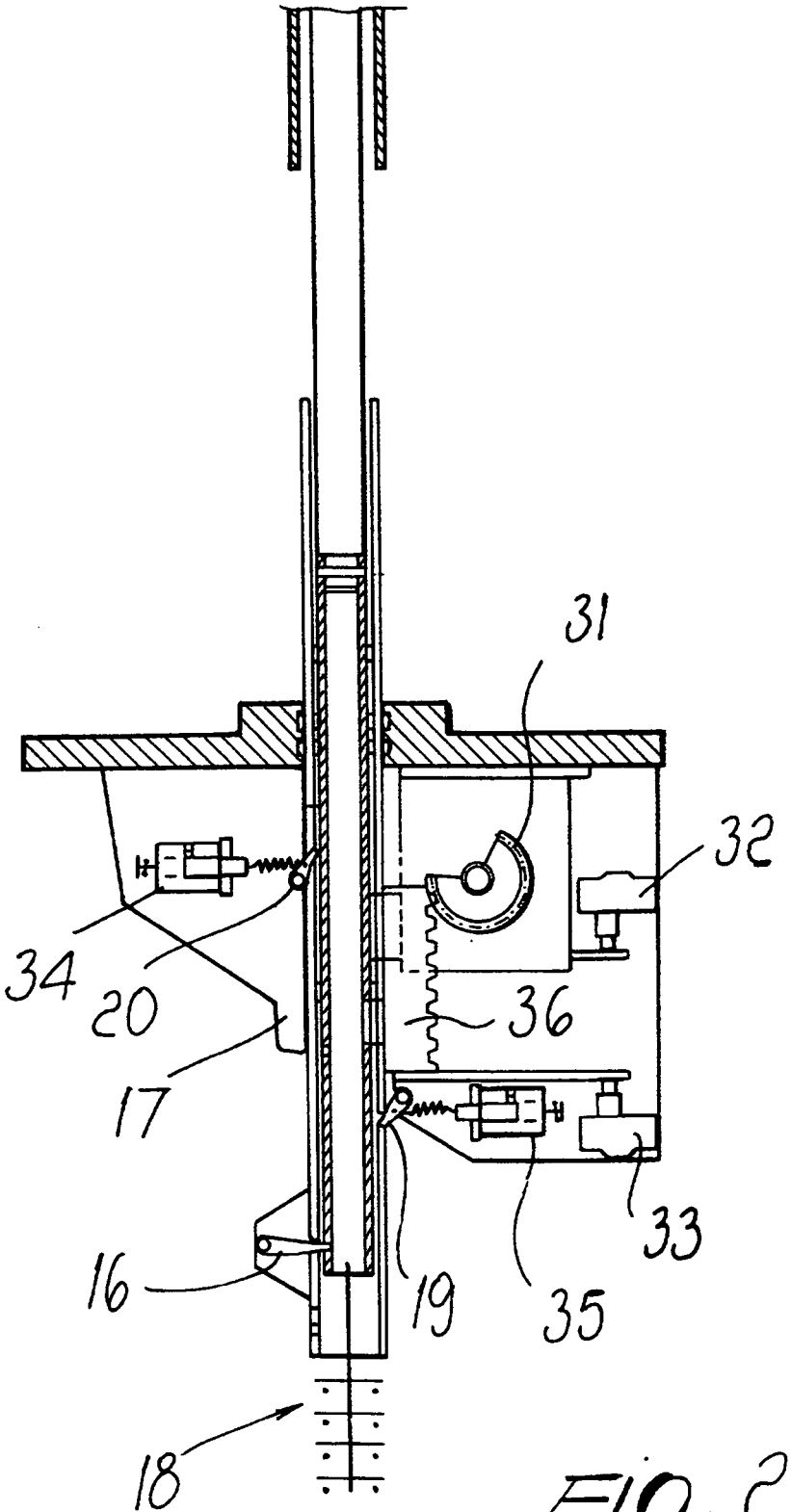

Fig. 2

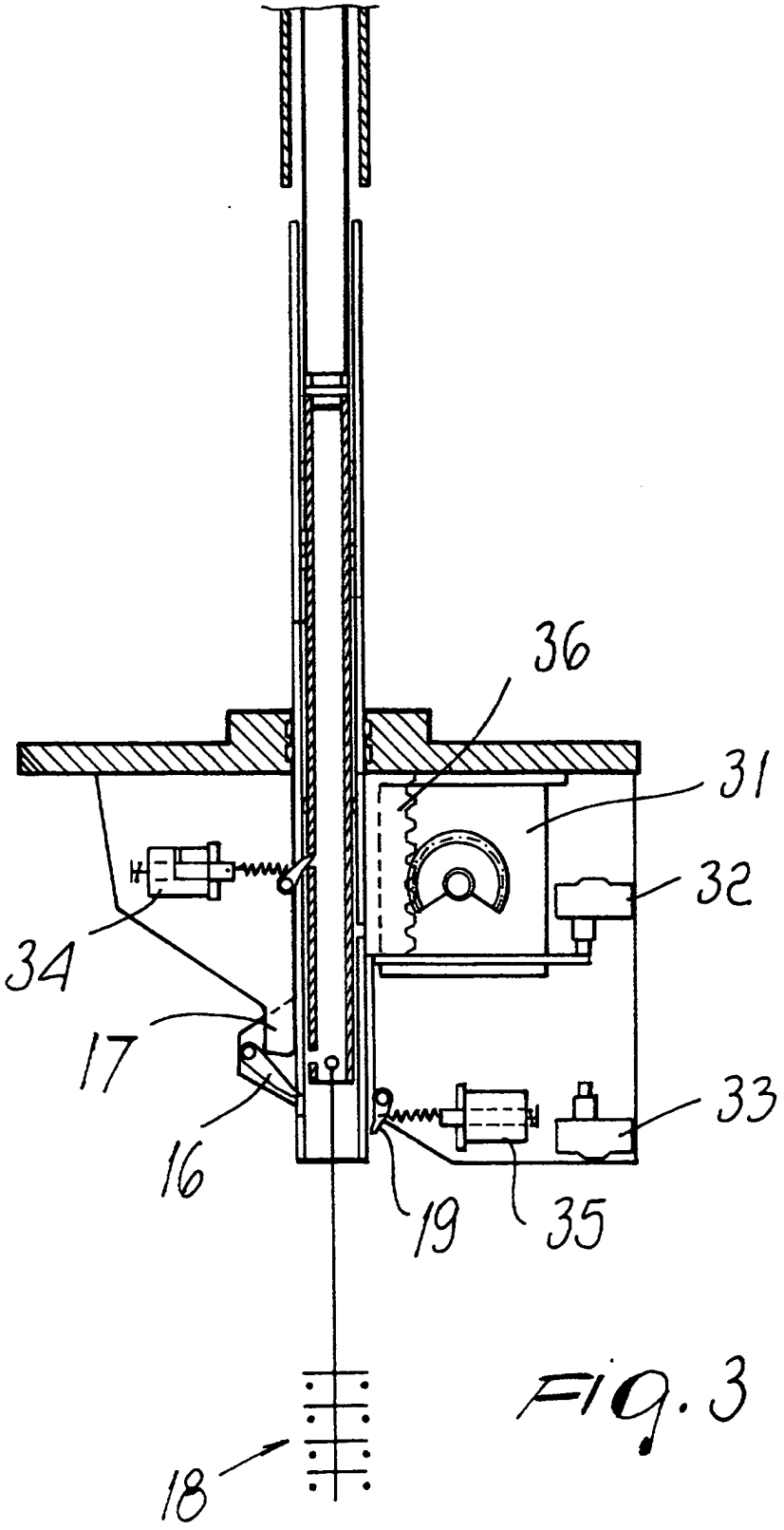

Fig. 3

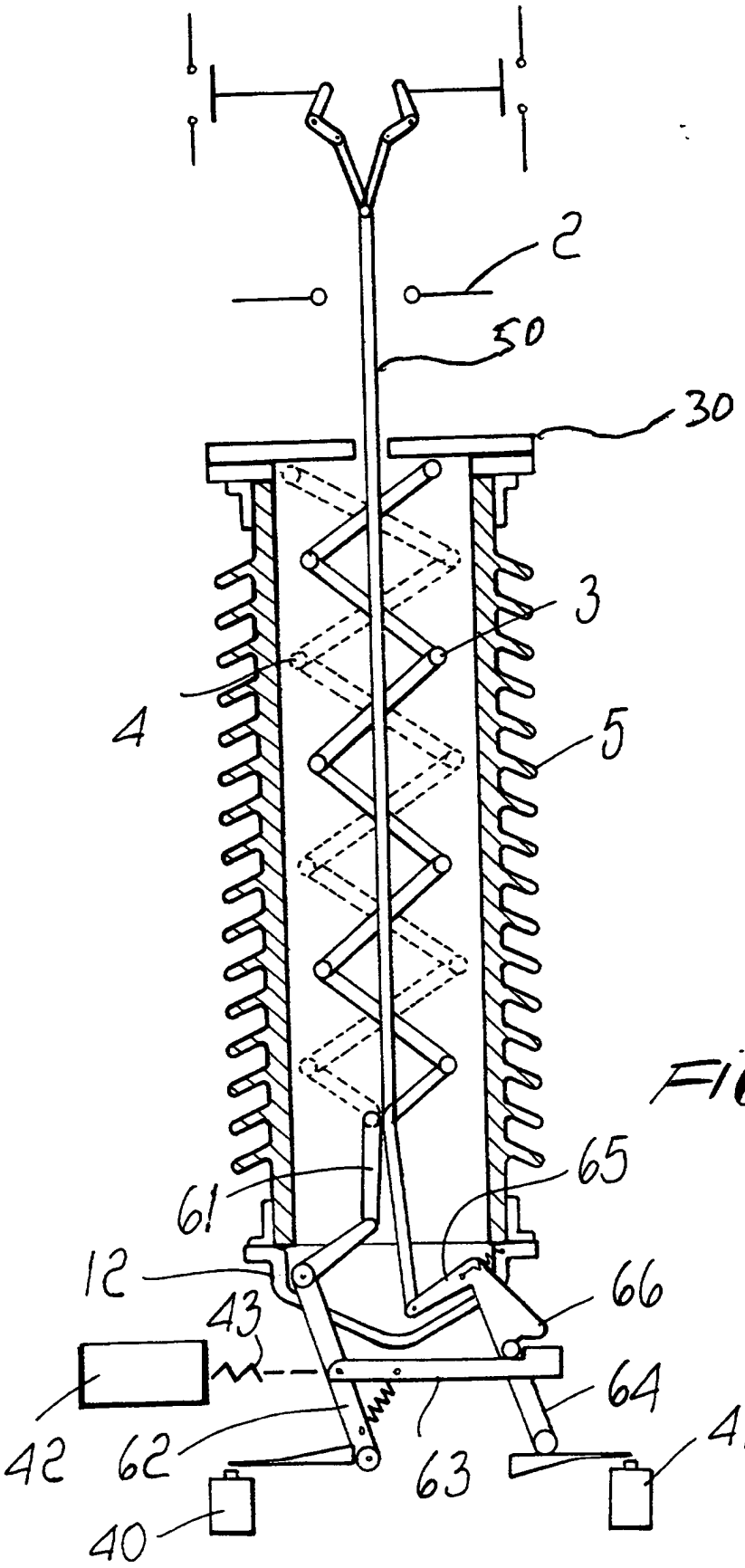

FIG. 4