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(54) **A compact circuit breaker mechanism.**

(57) The present invention describes a compact operating mechanism with cams for a switching device with, preferably, a tripolar insulating rod. The said mechanism is so designed that the force on and the speed of the said tripolar insulating rod is continually increasing with time till the end of the operation. The said mechanism consists of cams mounted on a shaft which is rotated under the

influence of springs which have crossed their dead points. This shaft with cams then moves against rollers mounted on the cranks of a slider and crank arrangement of links, where the function of the slider is being served by the tripolar insulating rod. All the operations after the closing springs have crossed their dead points are high speed in nature. A latching arrangement is used to keep the mechanism in closed position till opening.

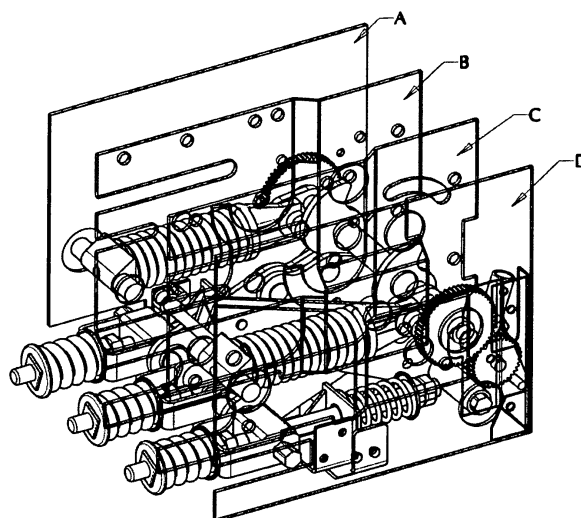


Figure 1

Description

Field of Invention

[0001] The present invention relates to a compact circuit breaker mechanism for a switching device with, preferably, a tripolar insulating rod, which is used to deliver the output to the switching device.

Background of the Invention

[0002] Circuit breakers are automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Circuit breakers are made in varying sizes, from small devices that protect an individual household appliances upto large switchgear designed to protect high voltage circuits feeding an entire city. The part of circuit breakers connected in one phase is called the pole and a circuit breaker suitable for three phase system is called a triple-pole circuit breaker. Each pole of the circuit breaker comprises one or more interrupter or arc-extinguishing chambers. The interrupters are mounted on support insulators. The interrupter encloses a set of fixed and moving contacts, the moving contacts can be drawn apart by means of operating links of the operating mechanism. The operating mechanism provides the necessary energy for opening and closing of contacts of the circuit breakers.

[0003] The limitations of conventional drive designs due to their mechanical nature are that they have relatively high complexity. There is an inherent tendency towards impact operation with high operating noise levels. There is also a high, transient auxiliary power requirements and limited condition-monitoring scope.

[0004] US 4,001,742 (Jencks et. al) discloses a circuit breaker including an operating mechanism having powerful mechanism springs to achieve the requisite contact pressures for high current carrying capacity. A single crank of a rotary handle through a relatively small arc of 120° resets the operating mechanism via a reciprocating slide and a latching mechanism, while loading the mechanism springs. Return of the handle to its original position shifts the line of action of the springs so as to abruptly straighten a toggle and achieve rapid closure of the circuit breaker contacts. The latching mechanism is equipped with plural circuit breaker tripping capabilities.

[0005] US 5,731,560 (Nebon et al) discloses a mechanism for a multipole circuit breaker mechanism with high currents and high electrodynamic strength comprising a toggle device associated with a trip hook and a switching bar, an opening ratchet cooperating with the hook to perform loading and tripping of the mechanism respectively in the locked or unlocked position of the ratchet. The opening ratchet comprises disengageable actuating means causing self-locking of the catch in the presence of a short circuit current exceeding a calibration threshold defined by flexible means. The catch is in the shape of a half-moon to move the opening ratchet to the unlocked

position to being about the tripping of the mechanism.

[0006] The above patents have inherent disadvantages related to compactness and ease of functionality. The existing mechanisms used bigger volume for the same functions. Also, insulation is not part of the existing mechanism. Further, the linkages used in the prior art are complex.

[0007] The present invention seeks to overcome the limitations mentioned above and to provide an improved compact circuit breaker mechanism

Summary of the Invention

[0008] The circuit breaker mechanism as disclosed in this specification comprises of three sub-assemblies, namely, the pumping/charging system, the crank and connecting rod system and the contact pressure and slider system.

[0009] The pumping system is used to charge the main driving springs. The driving springs are compression type springs mounted and guided between the shaft on which the cams are mounted (camshaft) and the frame of the mechanism such that the spring gets compressed and decompressed when the camshaft rotates. Thus in order to compress and thus charge the driving springs the camshaft needs to be rotated. This is achieved by the pumping or charging system.

[0010] The pumping system comprises a ratchet and pawl mechanism and a set of gears and a handle mounted on the same shaft as the ratchet wheel. The handle is given a downward stroke of 60° and the ratchet wheel along with the gear mounted on the ratchet shaft also turns by the same angle. When the camshaft rotates the length of the driving springs changes thereby charging/discharging said springs. The charging of the springs produces an opposing force which tries to discharge the stored energy which requires the camshaft and the ratchet wheel to rotate in the opposite direction than that of the handle. However, the locking pawl blocks this rotation, thus keeping the springs charged till they cross the toggle line. Once the driving springs cross the toggle line, the camshaft instead of being rotated by the ratchet wheel and the handle is now rotated by the driving springs (as they discharge) and the breaker begins closing.

[0011] The cam and slider crank system are activated once the closing springs have crossed the toggle line. The slider and crank system consists of two crank assemblies on either side of a latch. The crank assemblies consist of two crank plates assembled with a roller and roller-pin between them, also assembled on the crank is a connecting rod with the help of a connecting pin.

[0012] The slider assembly consists of one slider and three assemblies of the moving contact and contact pressure spring with washers and nuts. The slider being used to support the three contact pressure springs and moving contacts is made of an insulating material. The assembly is so made that the contact pressure spring is assembled between two washers wherein one washer is supported

by the moving contact and the other washer rests on the slider while the moving contact goes through the slider, the spring and washers and is fastened with the help of the nut.

[0013] The moving contact is allowed to slide in the slider. Tightening or loosening the nut (35) changes the distance between the 2 washers thereby compressing / decompressing the contact pressure spring. The hexagonal apertures on the slider show where the slider rod would be assembled.

[0014] Accordingly, the compact circuit breaker mechanism of the present invention comprises: a handle assembly including a handle; a driving spring charging system comprising: at least one driving spring mounted between a camshaft and a fixed frame of the circuit breaker; motion transferring means coupled with the handle assembly and the camshaft, such that, every stroke of the handle rotates the camshaft in a direction opposite the direction of the handle rotation thereby charging said driving spring; a locking mechanism for preventing reverse direction rotation of the camshaft due to the resisting force caused by the charging driving spring; a crank and slider assembly comprising: a crankshaft; a latch mechanism assembled on said crank shaft but moving independently of said crankshaft; at least two crank assemblies assembled on said crank shaft, each on either side of said latch mechanism, each of said crank assembly including at least two crank plates coupled to each other, a connecting rod is provided such that one end of said connecting rod is slidably assembled intermediate said at least two crank plates and the other free end has provision to be assembled with a slider rod; opening spring assemblies provided at the outer sides of the crank assemblies positioned independent of the crank shaft but integrally connected to a moving support, which is assembled on the slider rod, said opening spring being configured to be charged or discharged from the instant the circuit breaker starts closing or opening depending on the direction of movement of the crank assembly on the crankshaft; and a slider assembly comprising: a slider and moving contact assemblies with pressure springs to close and open the circuit breaker, the slider assembly adapted to move as one unit when the slider moves in a direction indicating closing of the circuit breaker.

Brief Description of the drawings

[0015]

Fig 1 shows the complete operating mechanism of the circuit breaker according to this invention.

Fig 2 shows the different sub-assemblies of the circuit breaker in accordance with this invention.

Fig 3 shows the pumping system/charging system of the circuit breaker according to this invention.

Fig 4 shows the mechanism of operation of the handle and the driving spring being in the uncharged state.

Fig 5 shows the mechanism of operation of the handle and the driving spring being partially charged.

Fig 6 shows the mechanism of operation of the handle and the driving spring being fully charged.

Fig 7 shows the driving spring having crossed the toggle line and the rotation of the handle by the driving spring.

Fig 8 shows the cam and slider crank system of the circuit breaker according to this invention.

Fig 9 shows the slider and crank system without the cam and camshaft

Fig 10 shows the opening spring assembly of the cam and slider crank system

Fig 11 shows the crank shaft assembly with latch roller and opening spring.

Fig 12 shows the contact pressure and slider system

Fig 13 shows the assembly consisting of the individual subassemblies of the contact pressure and slider system.

Fig 14 shows the assembly of Figure 13 along with a half moon bar assembly

Fig 15 shows the direction of motion of the slider when the driving springs are being discharged.

Fig 16 shows that closing sequence of the circuit breaker mechanism with a half moon bar mechanism

Fig 17 shows the circuit breaker in a nearly closed position but the driving springs are not completely discharged.

Fig 18 shows the circuit breaker in the closed state.

Fig 19 shows the contact pressure and sliding system where individual insulators are used on the moving contacts before the contact pressure springs.

[0016] Figs 20 and 21 shows the assembly of the individual subassemblies of the contact pressure and slider system with individual insulators used on the moving contacts before the contact pressure springs.

Detailed Description of the Invention

[0017] Figure 1 and 2 disclose the complete operating mechanism of the circuit breaker according to this invention. The parts A, B, C and D are assembled together so as to form a rigid assembly, which serves as the frame or the base for the mechanism to function. These four parts in themselves do not move but serve as the support on which all other moving parts of the mechanism are assembled. For the sake of clarity, the complete assembly is divided into three sub-assemblies, which are explained as follows.

[0018] The three sub-assemblies are:

1. The pumping system (or) the charging system
2. The crank and connecting rod system
3. The contact pressure and slider system

These sub-assemblies are individually dealt with below.

1. The pumping system (or) the charging system

[0019] Figure 3 illustrates the pumping system used to charge the main driving springs 1. The driving springs 1 are compression type springs mounted and guided between the shaft 2 on which the cams 3 are mounted (camshaft) and the frame of the mechanism such that the spring 1 gets compressed and decompressed when the camshaft 2 rotates. Thus in order to compress and thus charge the driving springs 1 the camshaft is required to be rotated. This is achieved by the pumping system as illustrated in Figure 3.

[0020] The pumping system consists of a ratchet 5 and pawl 6, 7 system and a set of gears 9, 10 along with a handle 8 mounted on the same shaft as the ratchet wheel. When the handle 8 is given a downward stroke of 60 degrees the ratchet wheel 5 turns by the same angle and so does the gear 9 mounted on the ratchet shaft 4. This gear 9 is always meshed with the gear 10 on the camshaft 2, such that, whenever the ratchet 5 rotates the camshaft 2 also rotates by an angle, which is dictated by the gear ratio. As already described, when the camshaft 2 rotates, the length of the driving springs 1 changes thereby charging /discharging it. In the present case the camshaft 2 rotates in a direction, which causes the driving springs 1 to get charged. Since the driving springs 1 are being charged they produce an opposing force, which tries to discharge the stored energy. In order for the springs to discharge, the camshaft 2 and the ratchet wheel 5 have to rotate in a direction opposite to that produced by the handle 8, but the locking pawl 6 blocks this rotation thus keeping the springs 1 charged till they cross the toggle line. The driving and locking pawls 7 & 6 are spring loaded so as to always remain in contact with the ratchet wheel 5.

[0021] The gear ratio is so chosen that 5 strokes of 60 degrees of the handle 8 (in effect 300 degrees rotation of the ratchet wheel 5) would cause a 186 degree turn of the camshaft 2 (i.e. the springs 1 would just be pushed

beyond the toggle line when being charged). Once the springs 1 are beyond the toggle line they are no longer prevented from discharging as the pawls 6 & 7 no longer block the rotation of either the camshaft 2 or the ratchet 5, and the mechanism is set into motion till the driving springs 1 are completely discharged.

[0022] The main driving springs 1 are mounted between the camshaft 2 and the frame of the circuit breaker. The fixed ends of the springs are mounted on parts such that the springs are allowed to swivel in the frame as indicated in Figure 3. The camshaft 2 has two cams 3 assembled on it in order to move two synchronized crank assemblies (described further down). Whenever the camshaft 2 rotates, the length of the driving spring 1 changes thereby charging/discharging it. Thus, in order to charge the main driving springs 1, the camshaft 2 should be rotated in the clockwise direction as shown in the figure.

[0023] The pumping system is used to rotate the camshaft 2. The pumping system is made up of a ratchet wheel 5 and pawl 6, 7 system. And this pumping system is integrated with the camshaft 2 by the use of a gear 9 and pinion 10. Thus when ever the ratchet wheel 5 rotates the gear 9, which is also mounted on the same shaft, rotates. This gear 9 now causes the pinion 10, which is mounted on the camshaft 2, to rotate. Thus, in effect, whenever the ratchet 5 rotates, the camshaft 2 rotates and vice-versa.

[0024] The handle 8 is mounted on the ratchet shaft 4 such that it is free to rotate on the ratchet shaft independently. It is only when the handle moves down (clockwise direction) that the driving pawl 7 engages with the teeth of the ratchet wheel 5 and causes it to rotate through a certain angle. This rotation of the ratchet causes the camshaft 2 to also rotate through a certain angle (this angle is decided by the gear ratio) and causes the driving spring 1 to be charged. Now the spring 1 being charged will produce a resisting force causing the camshaft and in turn the ratchet to rotate in a direction opposite to that of the handle, but this action is prevented by the locking pawl 6 (which is spring mounted to always remain in contact with the ratchet wheel). Thus for every stroke of the handle the ratchet turns and in turn the camshaft turns and the driving springs are charged and the handle is returned to its initial position by the use of springs. This action is repeated till the spring is compressed till its most compressible state.

[0025] In figure-4 the driving springs 1 are in their lowest energy state. Also shown in figure 4 is the direction of rotation of the handle 8 and the direction of rotation of the camshaft 2. The camshaft 2 can only rotate in the anti-clockwise direction due to the presence of the locking pawl 6.

[0026] In figure-5 the driving springs 1 are partially charged as the spring length in figure-5 is less than that in figure-4.

[0027] In figure-6 the spring length is the minimum possible (i.e. the spring is compressed to its maximum possible

sible extent and thus completely charged). Also the driving springs 1 cannot discharge by causing the cam shaft 2 to rotate in the clockwise direction. Also the gear ratio is so chosen that the last few degrees of the last charging stroke are utilized in pushing the driving springs 1 beyond the toggle line. Thus ensuring that the driving springs 1 start discharging and keep the camshaft 2 rotating in the anticlockwise direction.

[0028] In figure-7, the driving springs 1 have crossed the toggle line and the camshaft 2, instead of being rotated by the ratchet wheel 5 and the handle 8, is now rotated by the driving springs 1 (while they discharge) and the breaker begins closing. It should be noted that once the cam shaft 2 begins rotating the ratchet wheel 5 also rotates but this motion is not transferred to the handle 8 as the pawls 6 and 7 do not block the rotation of the ratchet wheel 5 in the clockwise direction due to their free wheeling nature and the camshaft 2 always rotates in the same direction whether it is being rotated by the driving springs 1 or the ratchet wheel 5.

2. The crank and connecting rod system

[0029] The cam and slider crank system come into the picture once the closing springs 1 have crossed the toggle line. This condition is depicted in Figure 8.

[0030] In figure-8 we can see that the closing springs 1 have crossed the toggle line and the cam 3 is now in contact with the roller 14, which is mounted on the crank 12 with the help of a roller pin 13. Thus when the cam 3 rotates under the influence of the closing springs 1, it moves against the roller 14, the roller 13 being mounted on the crank 12 causes it to rotate about the crankshaft 18 as axis.

[0031] The crank and slider system is composed of various sub-assemblies. Each of these assemblies is dealt with individually below.

[0032] The slider and crank system without the cam and camshaft is shown in the figure-9. The assembly shown in figure 9 consists of two crank assemblies 11 on either side of the latch 19. The crank assemblies 11 and the latch 19 are mounted on the crank shaft 18 with spacers 17 used to keep them apart. They are assembled such that the crank assemblies 11 move together when the crank shaft 18 moves but the latch 19 is free and moves independently on the crank shaft 18.

[0033] The crank assemblies 11 consist of two crank plates 12 assembled with a roller 14 and roller pin 13 between them. Also assembled on the crank 12 is a connecting rod 15 with the help of a connecting pin 16. The free end of the connecting rod 15 will be assembled in the slider rod 27 (fig 11) with the help of a bush 20, which allows the connecting rod to rotate on the hexagonal slider rod.

[0034] The opening spring assembly is as shown in figure-10. It consists of an opening spring 23 (helical compression spring), which is constrained between two end plates 25 using the load and locking nuts 24 as in the

case of the contact pressure spring assembly. One of the end plates 25 is supported on the opening spring moving support 21, this end of the spring 23 moves the instant the breaker starts closing as the opening spring moving support 21 is assembled on the hexagonal slider rod 27 by making use of the hexagonal slot in the opening spring moving support 21. The other end of the opening spring 23 is supported on the opening spring fixed support 22. The opening spring fixed support 22 is firmly fixed on the frame of the breaker. Therefore, once the breaker starts closing the opening spring (23) is compressed between the moving end plate and the fixed end plate and thereby is charged. The opening spring moving support (21) slides through the hole in the opening spring fixed support (22).

[0035] In figure-11 we can see the crank and connecting rod assembly (from figure-9); the opening spring assembly (from figure-8 & 10) all assembled together using the slider rod 27. Also assembled on the slider rod is the latch roller 26 with the help of a roller pin 30 (shown in hidden lines in the picture). This roller pin 30 is mounted on two side plates 29, which are assembled on the slider rod with a spacer 28 between them. So the latch roller 26 is free to rotate on the roller pin 30.

[0036] From figure-11 it is clear that any rotation of the crank assembly 11 on the crankshaft 18 is transferred to the slider rod 27 via the connecting rod 15. Any motion of the connecting rod 15 causes all parts mounted on it to move, thus when the connecting rod 15 moves, the latch roller 26 also moves and so does the opening spring support 21 thereby causing the opening spring 23 to be charged/discharged depending on the direction of motion of the slider rod 27 which in turn depends on the direction of rotation of the crank assembly 11 on the crankshaft 18.

3. The Contact Pressure and Slider System

[0037] In figure-12 we see the slider assembly. The slider assembly consists of one slider 31 and three assemblies of the moving contact 32 and contact pressure spring 33 with washers 34 and nuts 35. The slider 31 being used to support the three contact pressure springs 33 and moving contacts 32 is made of an insulating material. The assembly is so made that the contact pressure spring 33 is assembled between two washers wherein one washer is supported by the moving contact and the other washer rests on the slider while the moving contact goes through the slider, the spring and washers and is fastened with the help of the nut 35 as shown in the figure-12. The moving contact 32 is allowed to slide in the slider 31. Tightening or loosening the nut 35 changes the distance between the 2 washers thereby compressing/decompressing the contact pressure spring 33. The hexagonal apertures on the slider 31 show where the slider rod 27 would be assembled. The assembly is so made that when the slider 31 moves in the direction indicated by the arrow the contact pressure springs 33 and the moving contacts 32 move as one body. However when

the motion of the moving contacts 32 is restricted (by the fixed contacts), the slider 31 can still move as the moving contacts 32 are free to slide in the slider 31 and the contact pressure springs 33 get compressed and thus charged thereby producing the required contact pressure. Similarly when the slider 31 moves in a direction opposite to that indicated, initially only the slider 31 moves and once the contact pressure springs 33 discharge, the moving contacts 32 also start to move with the slider 31 as if the entire assembly is one body.

[0038] Figure-13 shows the assembly consisting of the individual sub-assemblies discussed above. The crank and connecting rod assembly, the opening spring assembly and the slider assembly are all assembled with the slider rod.

[0039] In figure-14 is shown the assembly, which was shown in figure-13 but with the addition of the half moon bar assembly 36, which is assembled in the frame of the circuit breaker (between plates C and D shown in figures 1 & 2). The half moon bar 36 is a steel shaft that is split lengthwise. It is shown in greater detail in the lower part of figure-14. The half moon bar 36 is spring loaded to always turn in the anticlockwise direction (indicated by the circular arrow in the figure) about the axis of rotation indicated in the figure. The overlap between the latch and the half-moon bar is about 1 to 1.5mm.

[0040] The half moon bar 36 can only rotate through a certain angle as it has end projections that are constrained within slots in the frame (In plates C & D). It serves as a part of the latch 19 to hold the breaker in the closed position, and also to open the circuit breaker. The functioning of the half moon bar 36 is explained in the closing sequence of the circuit breaker.

[0041] In figure-15 it is shown that the cam 3 has made contact with the roller 14 that is mounted on the crank 12. As the cam 3 rotates under the influence of the driving springs 1, which are discharging, it pushes the roller 14 and thus the crank 12 rotates in the indicated direction about the crankshaft 18 as axis and causes the connecting rod 15 to move. The connecting rod 15 being connected to the slider 31 causes it to progressively move away from the crankshaft 18 in the indicated direction. It is to be remembered that there being two cams and thus two crank and slider assemblies in synchronized motion the same action is taking place at both cam roller interfaces.

[0042] The closing sequence is explained below with the aid of Figures 16-18.

[0043] In figure-16 we can see that the closing spring 1 has crossed the toggle line and as a result the cam 3 has come into contact with the roller 14 on the crank 12. This causes the crank 12 to rotate in the indicated direction about crankshaft 18 as axis; this in turn moves the connecting rod 15 and causes the slider 31 to move away from the crankshaft 18 (in the indicated direction). While these events are taking place, the latch 19 (shown in hidden lines) which is spring loaded so as to always remain in contact with the latch roller 26 tries to move in

the indicated direction and rests on the latch roller 26. The spring loaded half moon bar 36 too tries to turn in the indicated direction but is restricted by that the presence of the latch 19 and so rests with its flat face against the latch 19. At the same time due to the motion of the slider

31 the opening spring 23 is getting compressed and so produces an opposing force, which tends to move the slider 31 towards the crankshaft 18. But this force being much less than the force driving the slider 31 away from the crankshaft 18, the net effect is that the slider 31 moves away from the crankshaft 18.

[0044] The figure-17 shows the circuit breaker in a nearly closed position but the driving springs 1 are not completely discharged and the cam 3 is still in contact with the roller 14. When this is happening the slider 31 has moved further away just enough for the latch 19 (which is spring loaded) to move into place while resting against the latch roller 26. Now since the latch 19 has moved down the spring-loaded half moon bar 36 is free to rotate as the latch 19 is no longer blocking its rotation and so it rotates such that its cylindrical portion is now in contact with the latch 19 instead of the flat portion like in figure-16. A gap is also formed between the nut 35 on the moving contact 32 and the slider 31 indicated by the arrows in the figure-17. This gap exists because the moving contact 32 comes into contact with the fixed contact before the slider 31 stops moving. Thus the slider 31 moves in relation to the moving contact 32 (It is to be noted that before the moving contact 32 was stopped by the fixed contact, the moving contact 32 and the slider 31 moved as if they were one body) and the contact pressure spring 33 gets compressed by the distance indicated on the figure-17 and charged. It should also be noted that the opening springs 23 are also charged while the breaker is closing as the slider 31 is moving and so is the slider rod 27 and so is the opening spring support (21 not shown in figure). The distance before contact between the moving contact 32 and a fixed contact is about 12mm.

[0045] In figure-18 we see the circuit breaker in the closed state. The cam 3 is no longer in contact with the roller 14 (mounted on the crank 12) and thus the crank 12 is no longer experiencing any force due to the cam 3. The contact pressure springs 33 and the opening springs 23 (both helical compression springs) are compressed and charged and have a tendency to expand and thus produce a force which tries to move the slider 31 in the direction indicated by the arrow in figure-18 for this to happen, the slider 31 and thus the latch roller 26 have to move towards the crankshaft 18. But this motion is blocked by the latch 19 which is resting against the latch roller 26. Thus in effect the linear motion of the slider 31 is transformed into rotational motion of the latch 19 about the crankshaft 18. So for the slider 31 to move towards the crankshaft 18, the latch 19 has to rotate in a clockwise direction with the crankshaft 18 as axis. But this rotation of the latch 19 is blocked by the half-moon bar 36 as the latch 19 is resting against the cylindrical portion of the

half-moon bar 36. Thus we see that in order for the circuit breaker to open (i.e. the slider 31 to move back) we need to rotate the half-moon bar 36 in a clockwise direction such that the latch 19 faces the flat portion of the half-moon bar 36 and is now free to rotate in the clockwise direction about the crankshaft 18 as axis, which now gives place for the latch roller 26 and thus the slider 31 to move towards the crankshaft 18 and thus allows the contact pressure springs 33 and the opening springs 23 to discharge and open the circuit breaker.

[0046] In the above explanation the concept of the circuit breaker with a single tri polar insulating rod was illustrated. Another alternative to the single tripolar insulating rod is the concept in which we use individual insulators on the moving contacts before the contact pressure springs. This concept is illustrated below.

[0047] In figure-19, 19a we see the contact pressure and slider assembly in 2 different views. This assembly consists of a slider 31 and an assembly of the moving contact 32 and contact pressure spring 33 with washers 34 and nuts 35. The slider, which is being used to support the contact pressure spring 33 and moving contact assembly 32, is made in the shape of a U with hexagonal cuts where the slider rod 27 is assembled. The moving contact assembly 32 is made up of the insulating cap 37, the moving contact 38 and the threaded connector 39 into which fits the moving shaft of the vacuum bottle. It can be observed that the moving contact 38 and the threaded connector are embedded in the insulating cap 37 and thus are in effect one body, so whenever the moving contact 38 experiences any motion or force the same is experienced by the entire moving contact assembly 32.

[0048] The assembly is so made that the contact pressure spring 33 is assembled between two washers 34 wherein one washer is supported by the moving contact 38 and the other washer rests on the slider 31 while the moving contact 38 goes through the slider 31, the contact pressure spring 33 and washers 34 and is fastened with the help of the nut 35 as shown in the figure-19.

[0049] The moving contact 38 is allowed to slide in the slider 31. Tightening or loosening the nut 35 changes the distance between the 2 washers 34 thereby compressing/decompressing the contact pressure spring 33. The hexagonal apertures on the slider show where the slider rod 27 would be assembled. The assembly is so made that when the slider moves in the direction indicated by the arrow the contact pressure springs and the moving contacts move as one body. However when the motion of the moving contact assembly 32 is restricted (by the fixed contacts in the vacuum bottle), the slider 31 can still move as the moving contact 38 is free to slide in the slider 31 and the contact pressure springs 33 get compressed and thus charged thereby producing the required contact pressure. Similarly when the slider 31 moves in a direction opposite to that indicated, initially only the slider 31 moves and once the contact pressure spring 33 discharge, the moving contact 38 also start to move with the slider (31) as if the entire assembly is one body.

[0050] Figure-20 shows the assembly consisting of the individual sub-assemblies discussed above. We see the crank and connecting rod assembly, the opening spring assembly and the contact pressure spring and slider assembly all assembled on the slider rod 27. The slider 31 is assembled with the opening spring support 21 inside it as shown in figures 20 and 21. Spacers 40 are utilized to keep the three contact pressure spring and slider assemblies apart at appropriate distances. This is more clearly visible in the figure-21. Also assembled on the slider rod 27 are slider blocks 41 which slide in slots in the end plates of the frame (A) and (D) (from figures 1 and 2). The latch roller 26 assembly also fits in between the slider 31. Apart from this variation the functioning (i.e. the opening and closing) of the circuit breaker remains the same.

Claims

1. A compact circuit breaker mechanism comprising:

a handle assembly including a handle (8) ;
a driving spring charging system comprising:

at least one driving spring (1) mounted between a camshaft (2) and a fixed frame of the circuit breaker;
motion transferring means coupled with the handle assembly (8) and the camshaft (2), such that, every stroke of the handle rotates the camshaft in a direction opposite the direction of the handle rotation thereby charging said driving spring (1) ;
a locking mechanism for preventing reverse direction rotation of the camshaft (2) ;

a crank and slider assembly comprising:

a crankshaft (18) ;
a latch mechanism (19) assembled on said crank shaft (18) but moving independently of said crankshaft;
at least two crank assemblies assembled on said crank shaft (18), each on either side of said latch mechanism, each of said crank assembly including at least two crank plates (12) coupled to each other, a connecting rod (15) is provided such that one end of said connecting rod is slidably assembled intermediate said at least two crank plates (12) and the other free end has provision to be assembled with a slider rod (27) ;
opening spring assemblies provided at the outer sides of the crank assemblies positioned independent of the crank shaft (18) but integrally connected to a moving support (21), which is assembled on the slider

rod (27), said opening spring (23) being configured to be charged or discharged from the instant the circuit breaker starts closing or opening depending on the direction of movement of the crank assembly on the crankshaft (18) ; and

a slider assembly comprising:

a slider and moving contact assemblies with pressure springs (33) to close and open the circuit breaker, the slider assembly adapted to move as one unit when the slider moves in a direction indicating closing of the circuit breaker.

2. The circuit breaker mechanism as claimed in claim 1, wherein the said slider (31) is a single tripolar insulating slider.
3. The circuit breaker mechanism as claimed in claim 1, wherein the slider is an individual insulator provided on the moving contacts assembly before the contact pressure springs (33).
4. The circuit breaker mechanism as claimed in claim 1, wherein said motion transferring means comprises of a ratchet (5) and pawl (6,7) arrangement synchronized with the stroke of the handle (8) said ratchet and pawl arrangement (5,6,7) configured to transfer the motion of the handle (8) to the camshaft (2) by means of a gear and pinion arrangement (9,10).
5. The circuit breaker mechanism as claimed in claim 1, wherein the handle (8) is moved five times in a clockwise downward direction to charge said driving spring (1), each stroke being 60°.
6. The circuit breaker mechanism as claimed in claim 1, wherein the fixed end of the spring (1) is mounted such that they are allowed to swivel in the frame.
7. The circuit breaker mechanism as claimed in claim 1, wherein said at least two crank plates (12) are assembled with a roller (14) and roller pin (30) between them
8. The circuit breaker mechanism as claimed in claim 7, wherein, when the driving spring (1) is completely charged, a cam (3), rotating under the influence of the charging driving spring (1), is provided to contact said roller (14) mounted on said crank plates (12), thereby causing said crank plates to rotate about the crankshaft axis.
9. The circuit breaker mechanism as claimed in claim 1, wherein the opening spring (23) is mounted between a fixed end plate and a moving end plate (25)

such that during the closing of the circuit breaker the opening spring is compressed between the moving end plate and the fixed end plate and is thereby charged.

10. The circuit breaker mechanism as claimed in claim 9, wherein the fixed end (23) is supported on the fixed support (22), which is fixed on the frame of the breaker, and the moving end plate is supported on the moving support (21).
11. The circuit breaker mechanism as claimed in claim 1, wherein the driving spring (1) and the opening springs (23) are helical compression type springs.
12. The circuit breaker mechanism as claimed in claim 1, wherein the contact pressure springs (23) are mounted between two end plates (25) by means of fasteners, wherein tightening or loosening of said fasteners changes the distance between the two end plates thereby compressing or decompressing the contact pressure springs.
13. The circuit breaker mechanism as claimed in claim 1, wherein the slider rod (27) is a hexagonal rod with provisions for mounting a latch roller (26) and pin assembly, the connecting rods (15), the moving supports of the opening spring assemblies, and the slider.
14. The circuit breaker mechanism as claimed in claim 13, wherein said latch roller pin (30) is mounted on two side plates (29) which are assembled on the slider rod with a spacer (28) between them, such that the latch roller (26) is free to rotate on said roller pin (30).
15. The circuit breaker mechanism as claimed in claim 1, wherein a half-moon bar mechanism is provided on the frame of the circuit breaker said half-moon bar mechanism (36) being in connection with the latch mechanism to hold the circuit breaker in the closed position and to also open the circuit breaker.

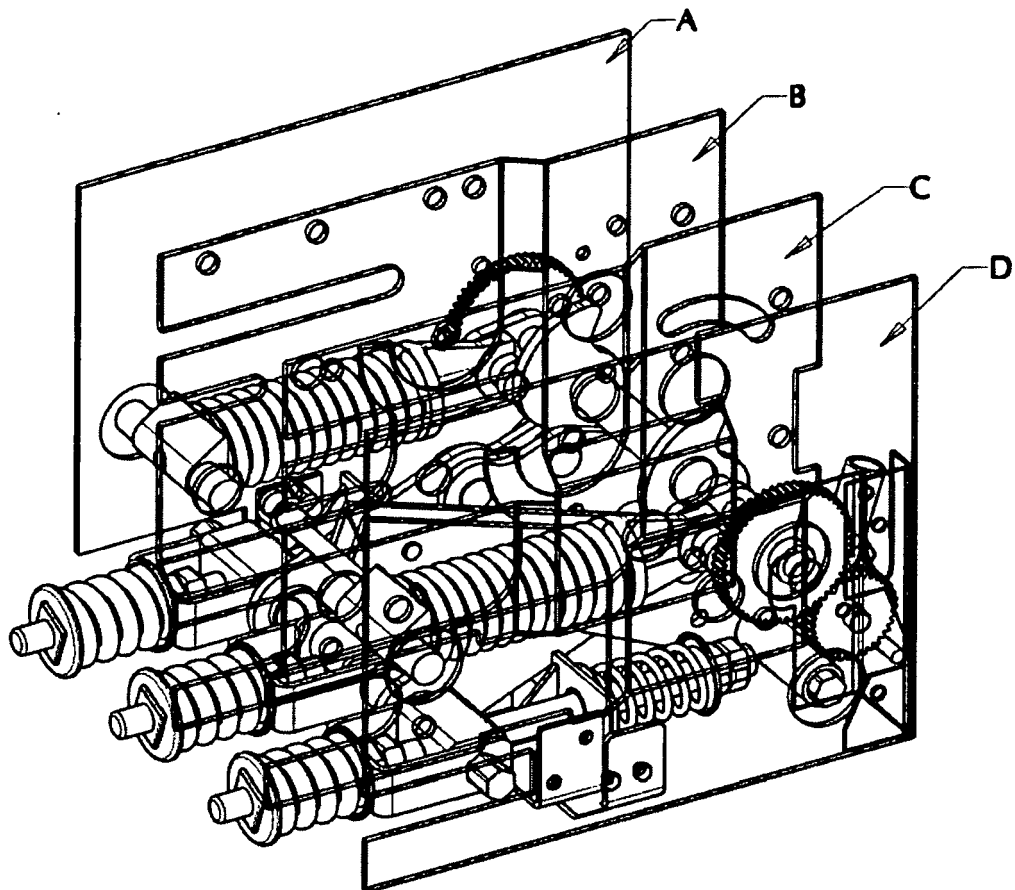


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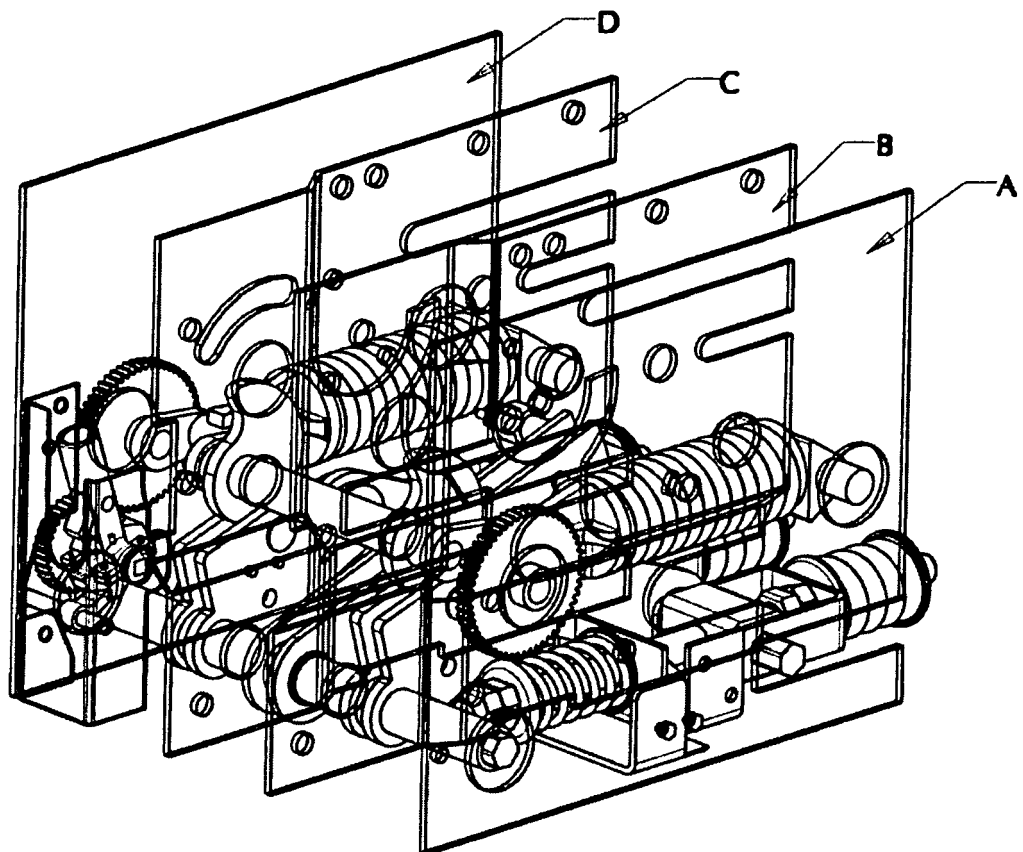


Figure 2

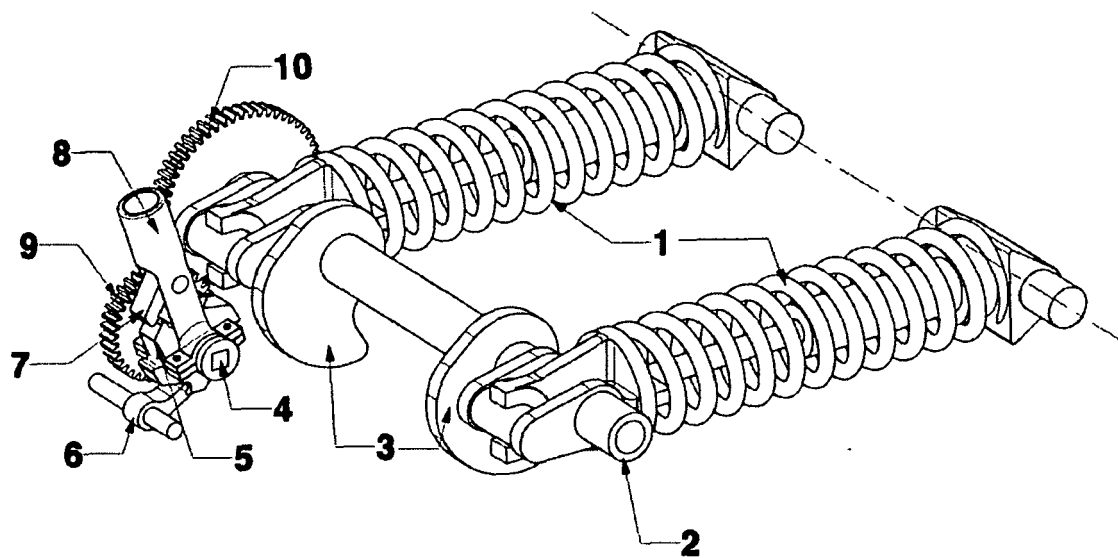


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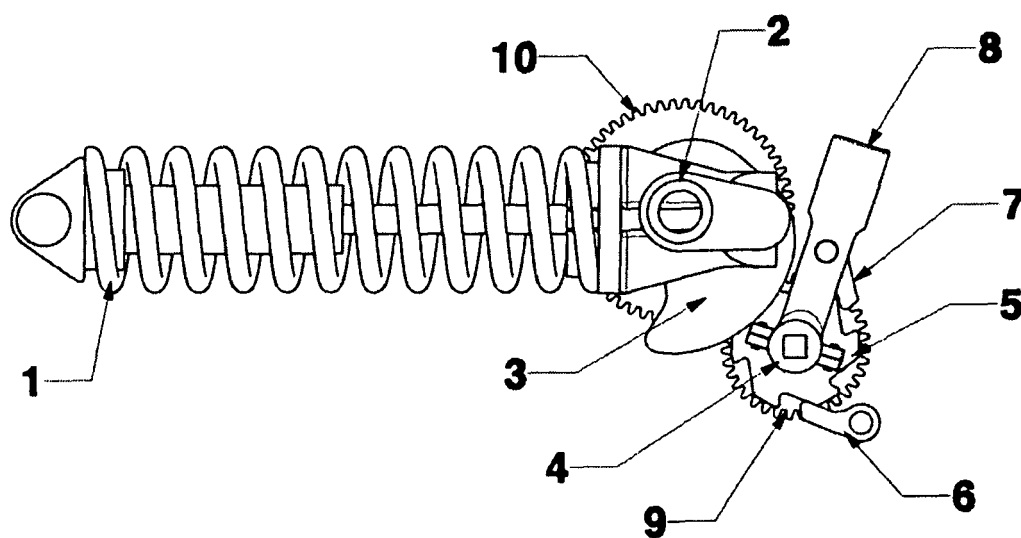


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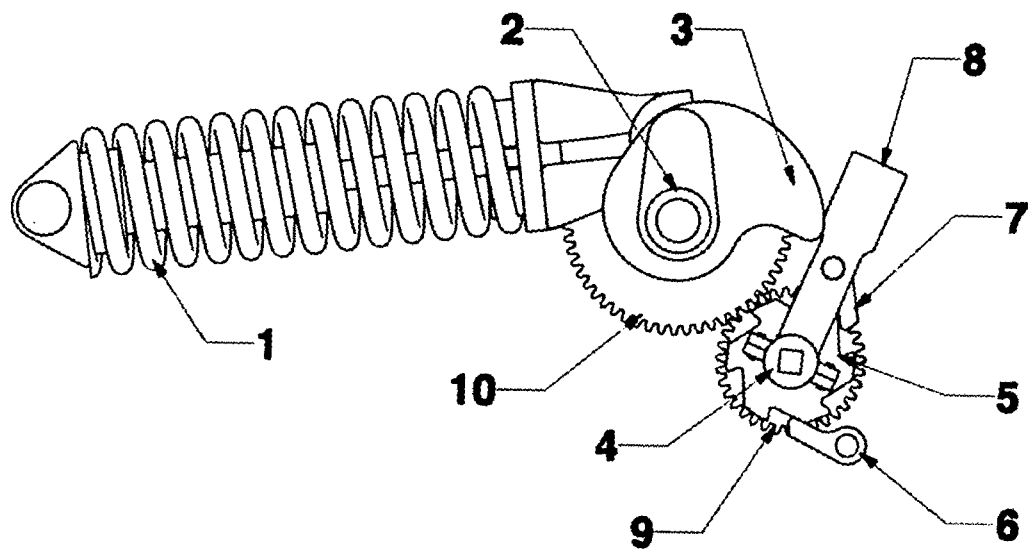


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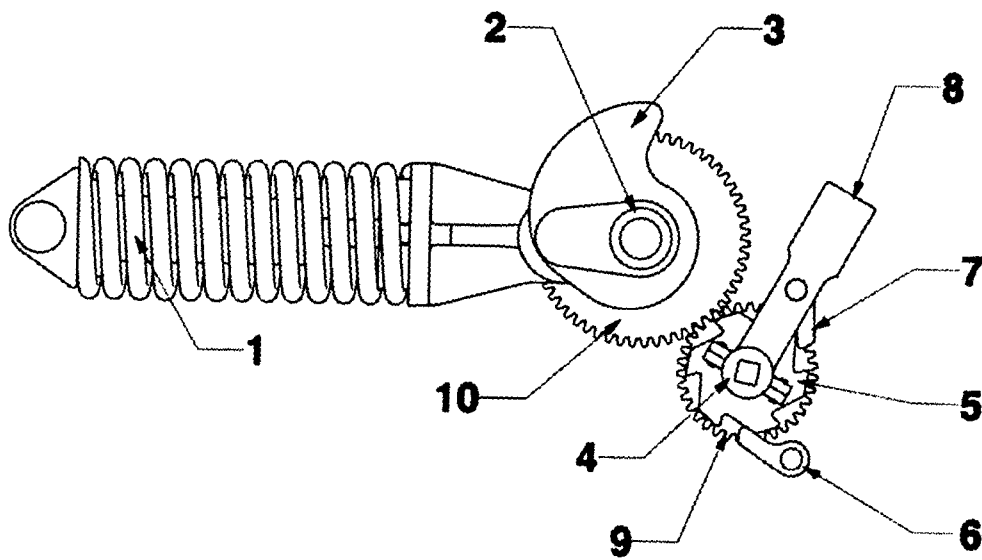


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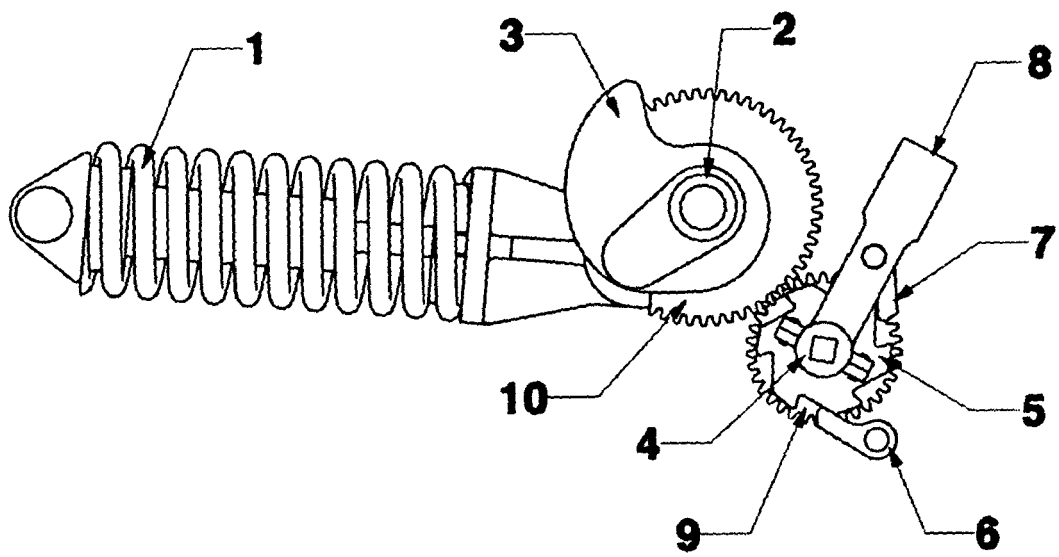


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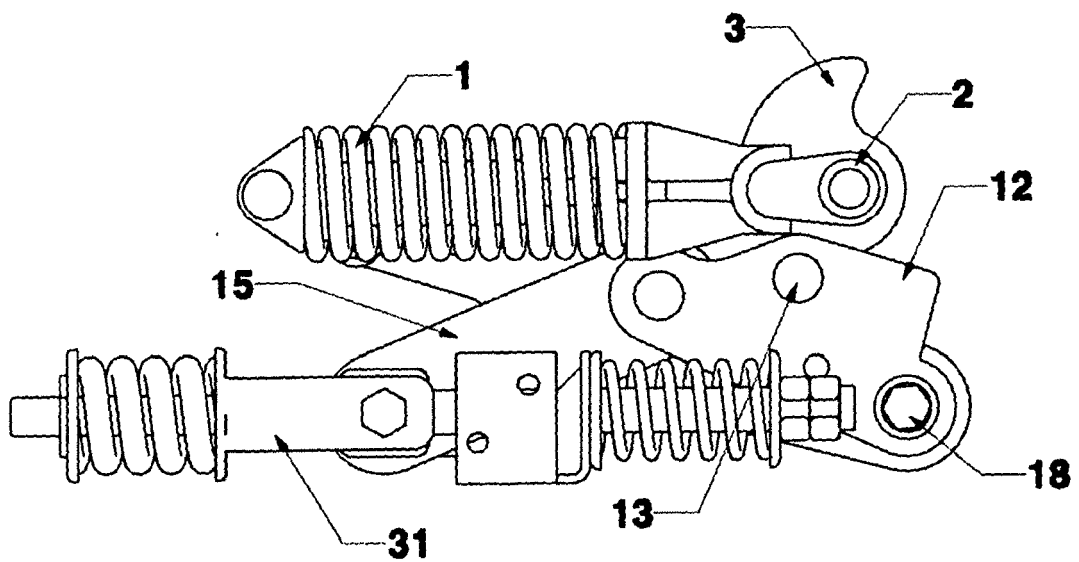


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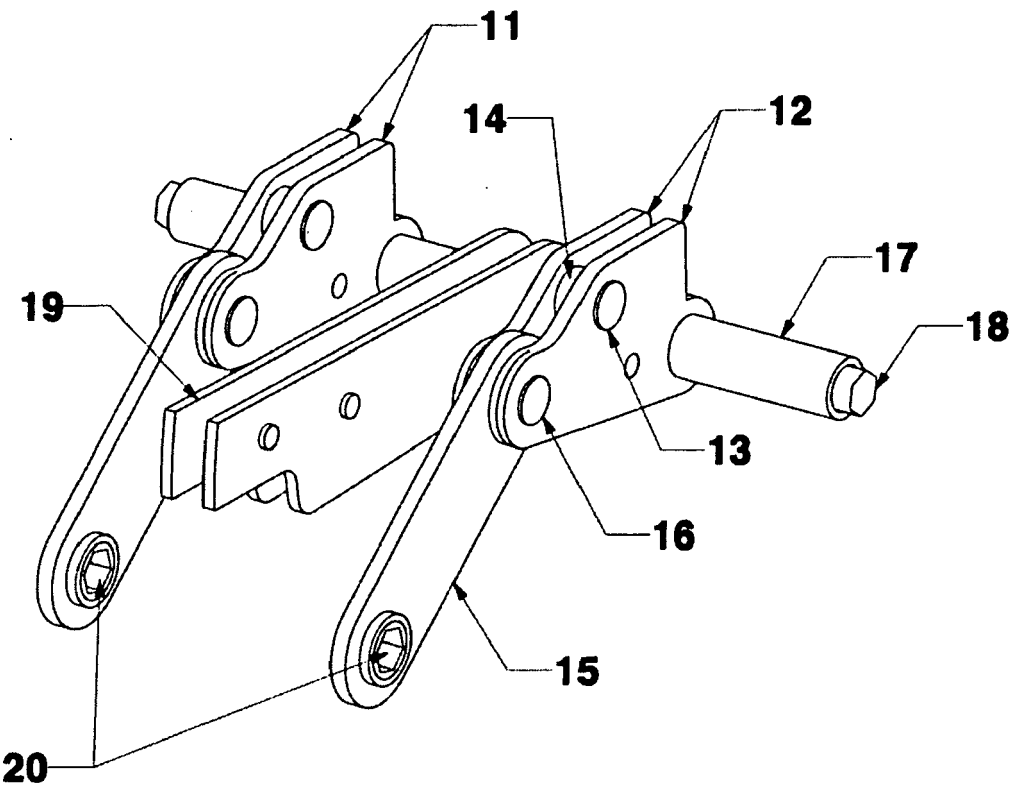


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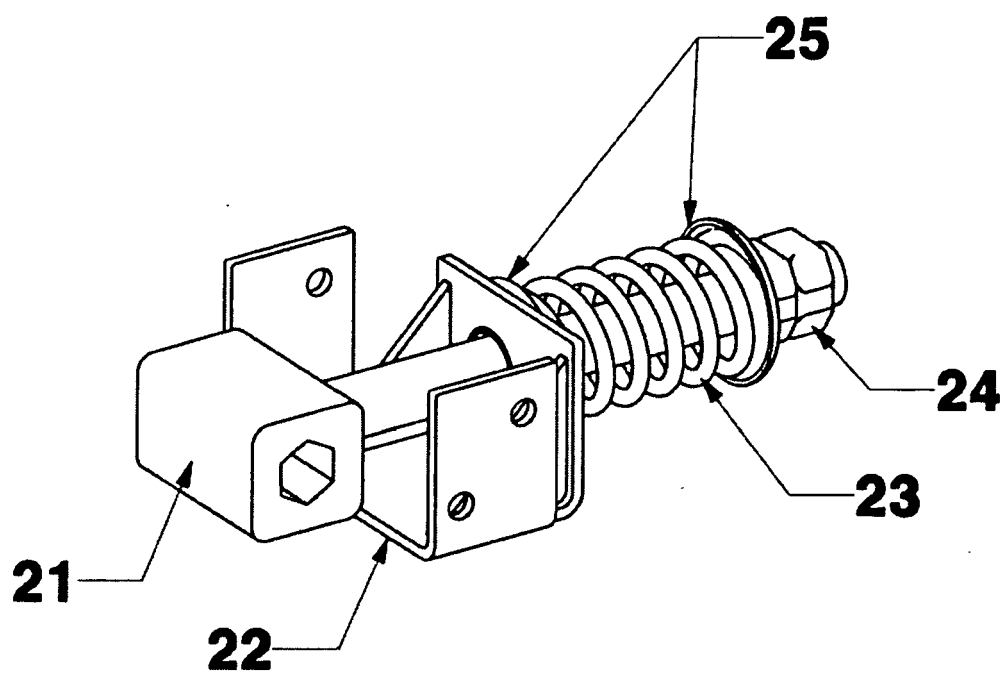


Figure 10

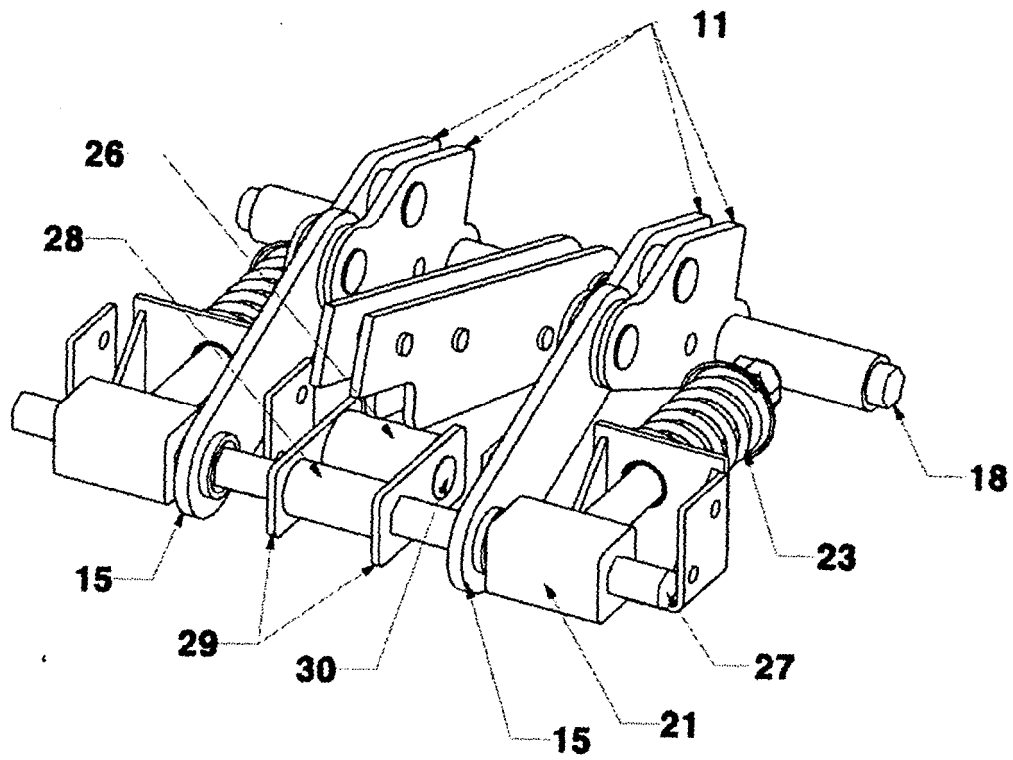


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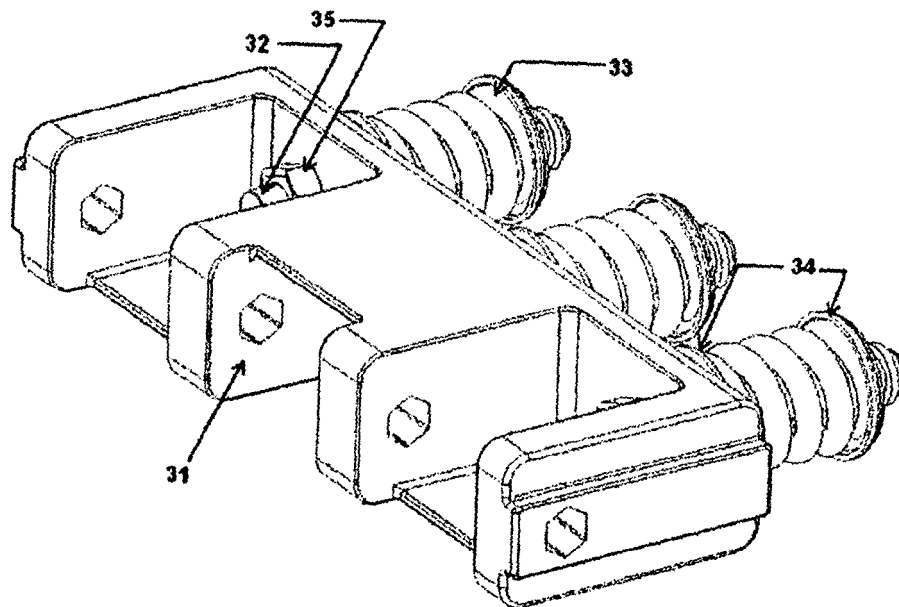


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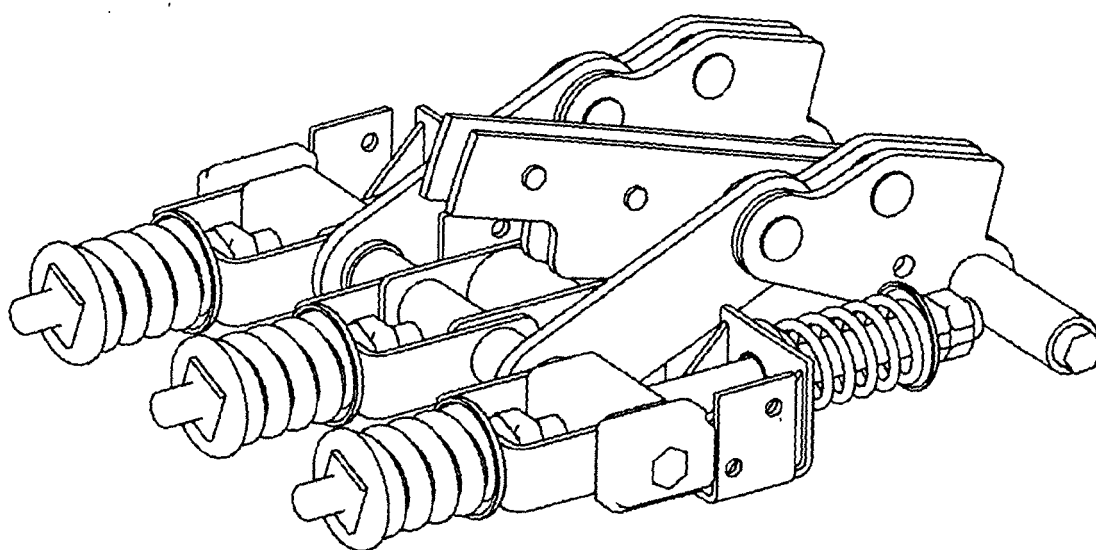


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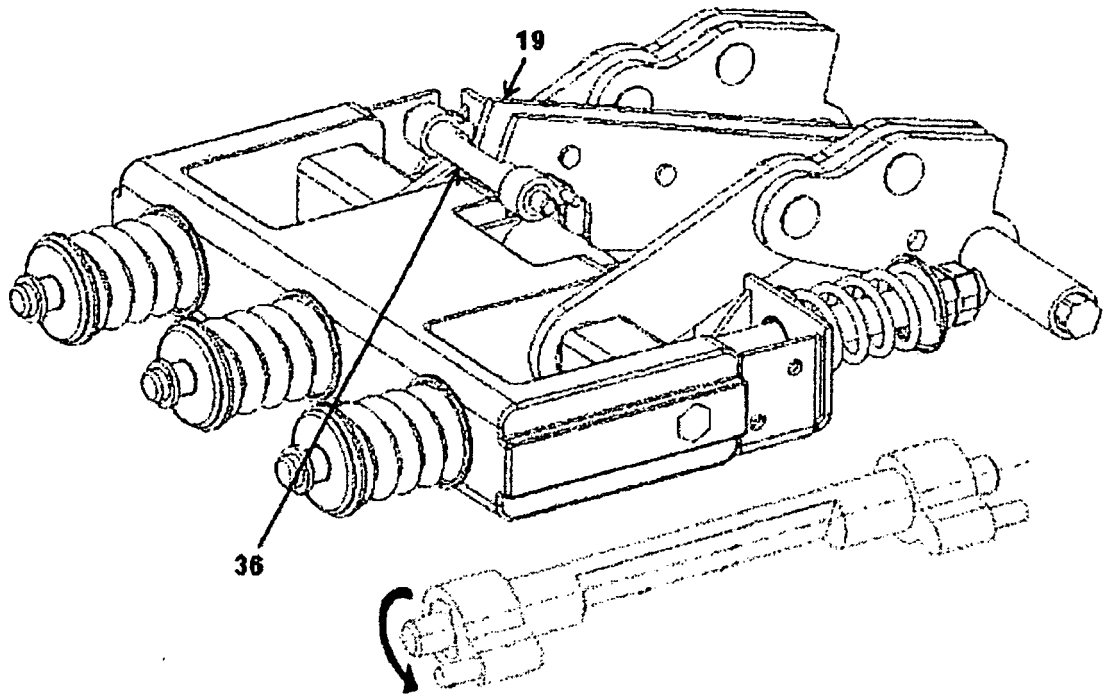


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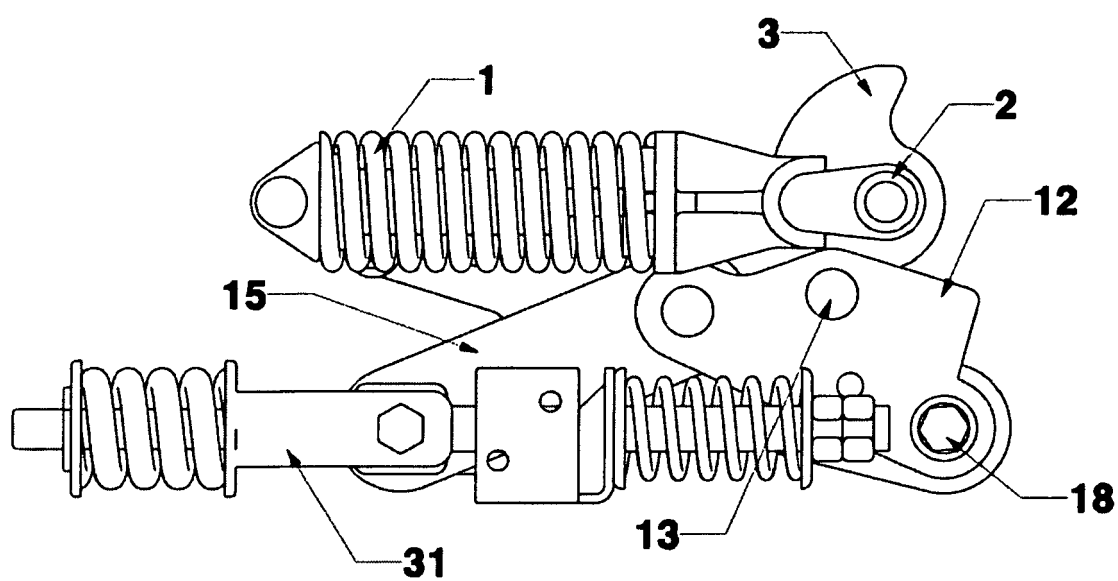


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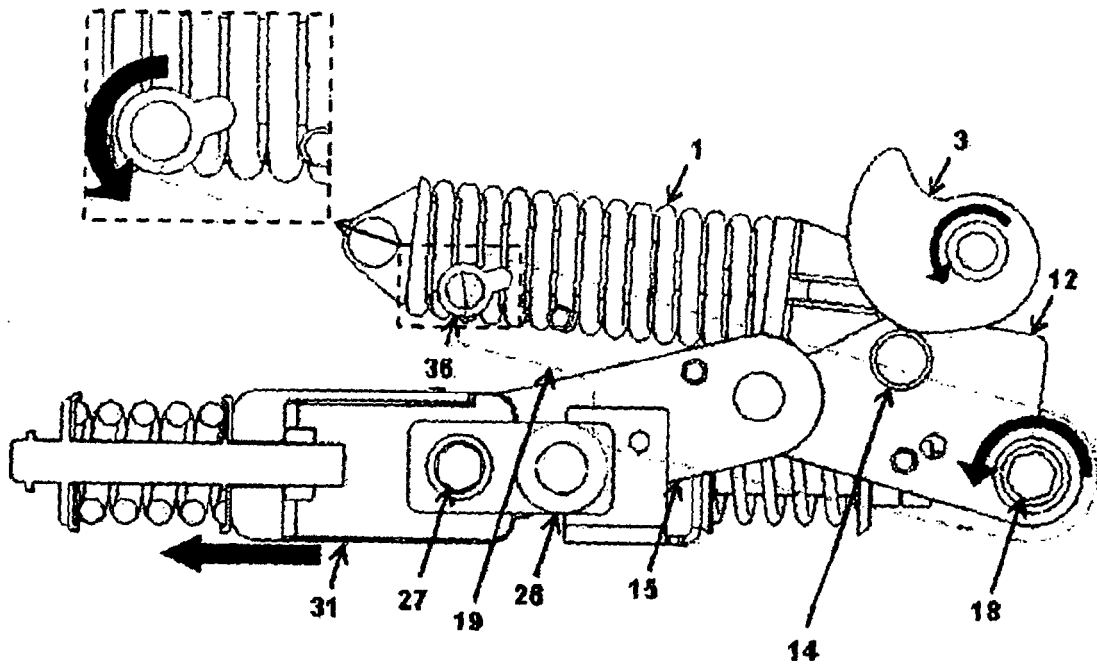


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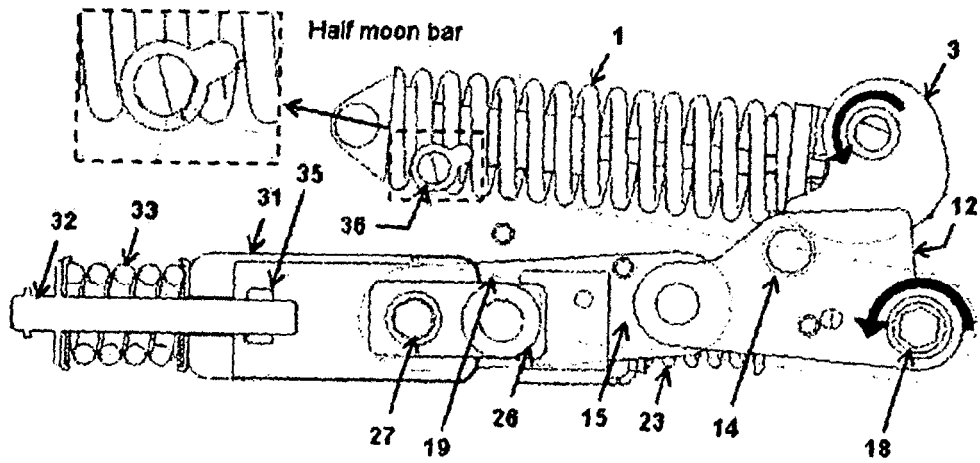


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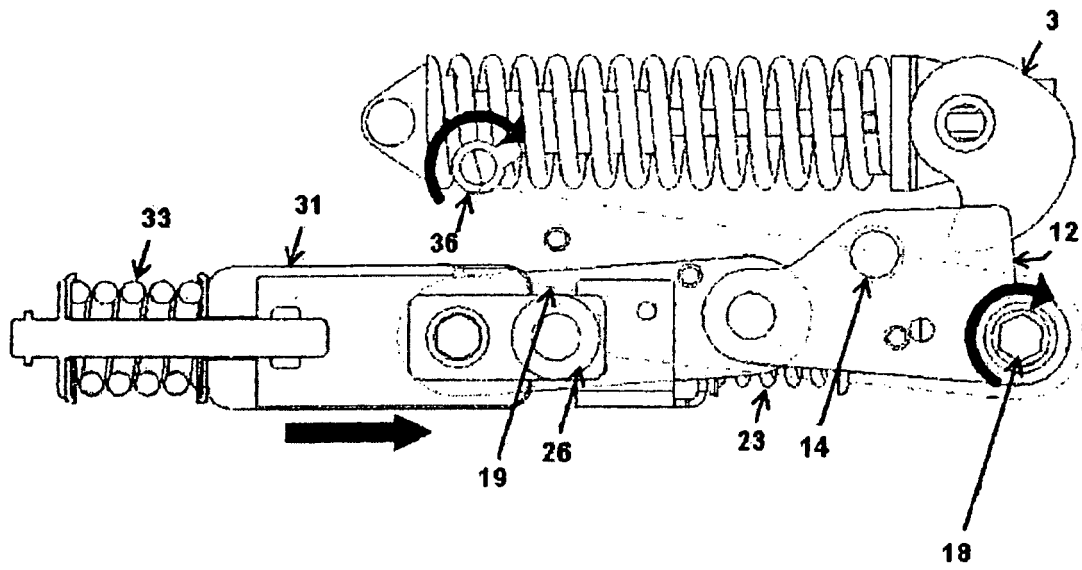


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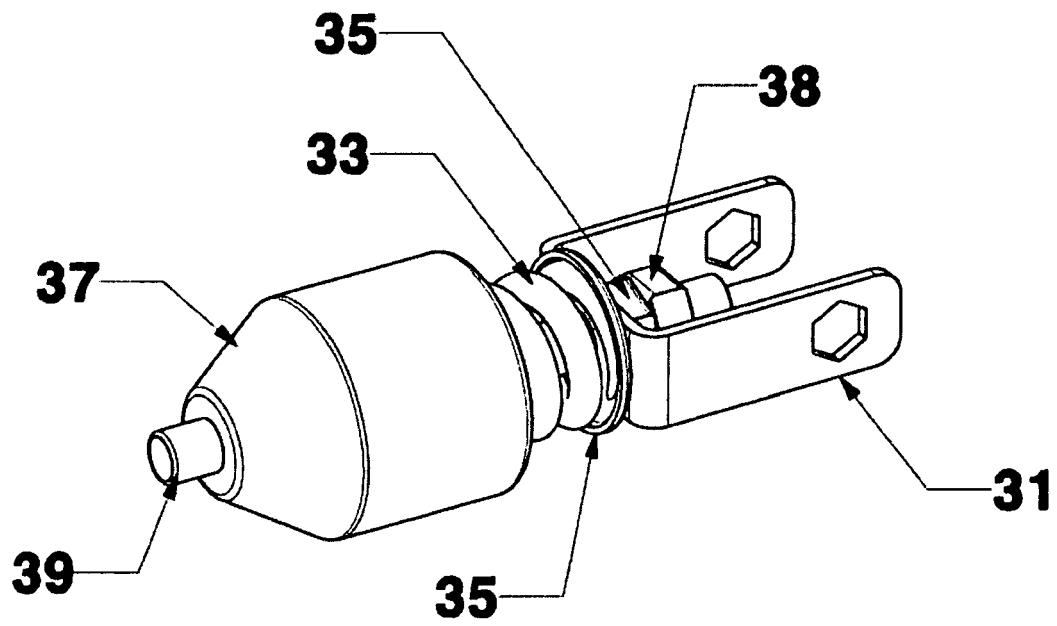


Figure 19

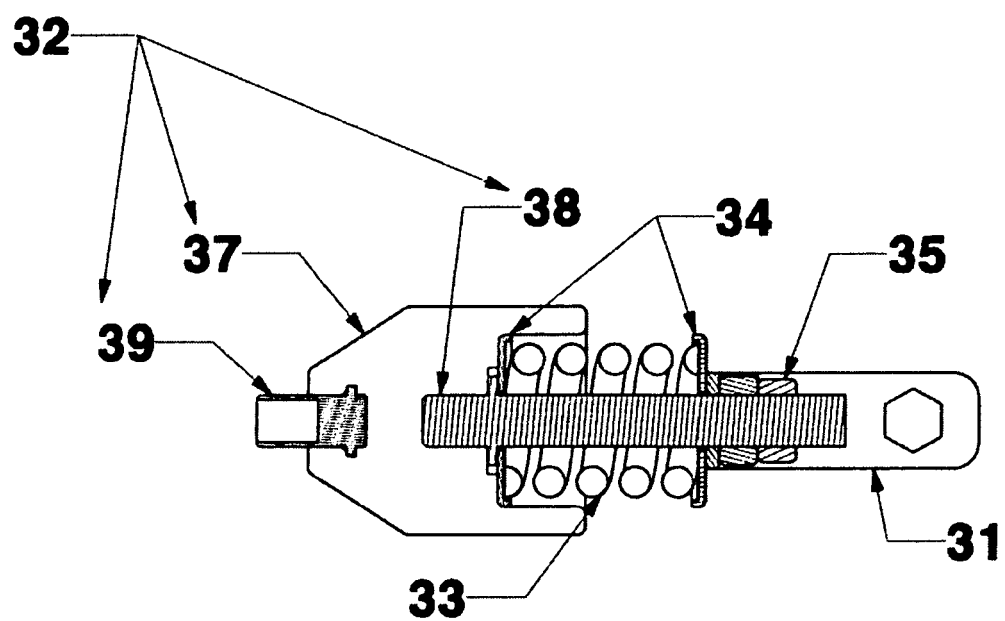


Figure 19 a

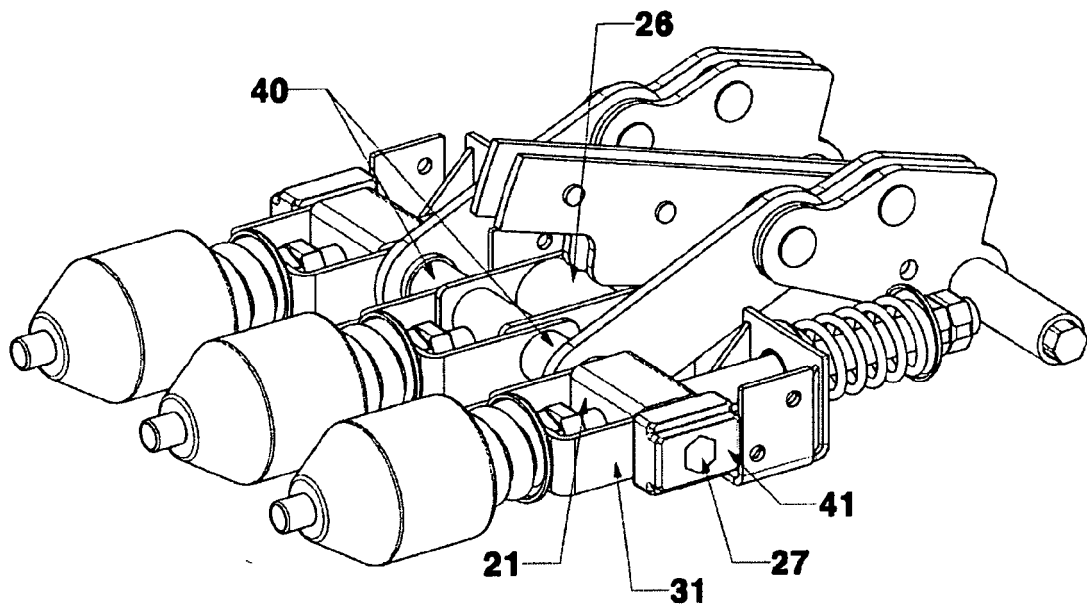


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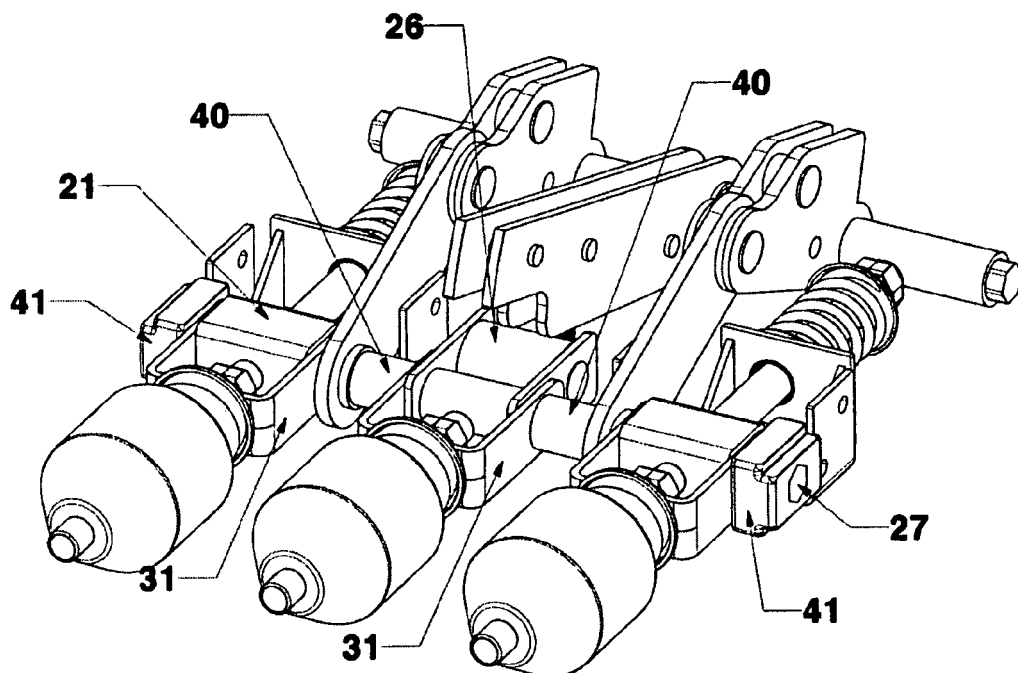


Figure 21

REFERENCES CITED IN THE DESCRIPTION

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