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(71) Applicant: ASEA AB
S-721 83 Västeras(SE)

(72) Inventor: Ekwall, Olle
Plommonstigen 27
S-771 00 Ludvika(SE)

(72) Inventor: Sköld, Leif
Notgardsvägen 20
S-771 00 Ludvika(SE)

(74) Representative: Boecker, Joachim, Dr.-Ing.
Rathenauplatz 2-8
D-6000 Frankfurt a.M. 1(DE)

(54) **Operating device for circuit breakers.**

(57) Operating device for circuit breakers comprising an opening spring (1) and a closing spring(2), which preferably are both of the spirally wound flat rod or ribbon type and exert a torsional moment on each one of two shafts (3, 4) which are aligned. The shaft (3) of the opening spring (1) is connected to the circuit breaker via a lever (31). The closing spring (2) is mounted in a rotatable cylinder (21) and can be tensioned by rotating the cylinder (21) by means of a motor (22). The shaft (4) of the closing spring (2) is kept locked by a closing latch (8) which hooks up one of the arms of a star wheel (6). Closing of the circuit breaker and simultaneous tensioning of the opening spring (1) are performed by releasing the closing latch (8), whereby another one of the arms of the star wheel (6) engages a carrier latch (53) on the shaft (3) of the opening spring (1) and rotates this through an angle corresponding to one step on the star wheel (6). The carrier latch (53) is thereafter disengaged, whereby the shaft (3) of the opening spring (1) is hooked up on an opening latch (7) and the circuit breaker is ready for an opening operation. Immediately after the disengagement, the next arm of the star wheel (6) is hooked up on the closing latch (8), and the motor (22) is able to tension the closing spring (2) again.

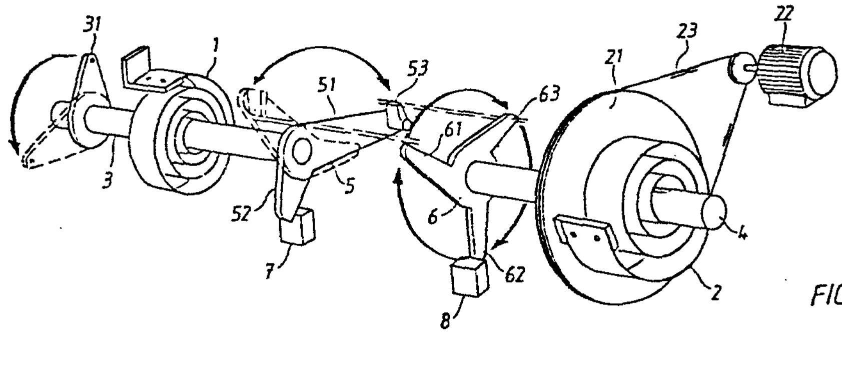

FIG.1

Croydon Printing Company Ltd.

-Ing. Dipl.-Ing. Joachim Boecker

6 Frankfurt/Main 1
Rathenauplatz 2-8
Telefon: (06 11) *28235
Telex: 4 189 066 itax d

ASEA AB
S-721 83 Västeras/Sweden

Operating device for circuit breakers

The invention relates to an operating device for circuit breakers according to the precharacterising part of claim 1. The operating device is primarily intended for metal-enclosed circuit breakers, insulated with sulphurhexafluoride (SF_6) gas, but it may be used for other types of circuit breakers as well.

The opening operation of puffer type SF_6 circuit breakers requires considerable operating energy. Since, in addition, short operating times are required, the movable parts of the operating device should be designed with as little a mass as possible. It is known to use for such operation pneumatic or hydraulic operating devices with pressurized gas as energy accumulator. However, such operating devices with associated compressors, pumps and other auxiliary equipment are relatively expensive. Normally, therefore, mechanical operating devices working without compressed air are preferred.

Most of the prior art designs of such mechanical operating devices include helical springs as energy accumulating means (see e.g. GB-A-1,273,014). Such springs require large space in relation to the energy they can store. This means that an operating device with such springs considerably increases the floor or ground surface required for the system consisting of the circuit breaker and the operating device. This is particularly true of SF_6 circuit breakers of the kind encapsulated in an earthed metal enclosure in the form of cylindrical tanks positioned near the floor or the ground, and in which the operating device, which is usually in the form of a cubicle, is placed adjacent the circuit breaker. Another drawback with many operating devices having helical closing springs is that a not-insignificant energy loss takes place during the power transmission from the closing spring to the circuit breaker, since the linear movement of the spring is first transformed into a rotating movement which is then transformed back into a linear movement in the circuit breaker. Furthermore, such operating devices must normally be provided with dampers for taking up the remaining kinetic energy on reaching the end positions.

Operating devices with a spirally wound flat rod as closing spring are already known per se. In such a device described in DE-B-1 064 598, a mechanism consisting of a cam disc and a plurality of shafts and links is used for the connection between the spring and the circuit breaker. Such a design requires large space.

The invention aims at developing an operating device of the above-mentioned kind which requires less space in the horizontal plane than comparable prior art designs and which is especially suitable for use for SF_6 circuit breakers with an earthed metal tank enclosure.

To achieve this aim the invention suggests an operating device for circuit breakers according to the introductory part of claim 1, which is characterized by the features of the characterizing part of claim 1.

Further developments of the invention are characterized by the features of the additional claims.

Since the two force-transmitting shafts of the operating device according to the invention are arranged aligned with each other and provided with an connection mechanism of the kind stated in claim 1, the operating device can advantageously be placed below the circuit breaker, which eliminates the need of special floor or ground space for the operating device.

An exceedingly suitable embodiment of the invention is characterized in that both the opening spring and the closing spring of the operating device are of the spirally wound flat rod or ribbon type. With such springs an extremely compact embodiment of the operating device, in relation to its operating energy storing capacity, is achievable.

Since the transmission between the operating device and the circuit breaker takes place by direct connection without chains or the like and with a minimum of link connections, the energy losses in the transmission will be small.

The invention will now be described in greater detail with reference to the accompanying drawings showing - by way of example - in

Figure 1 schematically in perspective view of an operating device according to the invention;

Figure 2 movement curves for the two power transmitting shafts of the operating device;

Figure 3 an embodiment of the connection mechanism of the shafts in an end view in its first fixed position corresponding to the open position of the circuit breaker;

Figure 4 the embodiment of the connection mechanism of Figure 3 in its second fixed position corresponding to the closed position of the circuit breaker.

The operating device shown in Figure 1 is built into a mechanism housing (not shown) and comprises an opening spring 1 and a closing spring 2. Both springs are of the spirally wound flat rod or ribbon type, and each spring exerts a torsional moment on a corresponding shaft, namely, an operating shaft 3 and a driving shaft 4, respectively. The shafts 3 and 4 are aligned with each other, and their confronting ends are provided with a connection mechanism comprising a star wheel 6 fixed on the driving shaft 4 and a two-armed carrier 5 fixed on the operating shaft 3. One arm 51 of the carrier 5 supports a carrier latch 53 which cooperates with the star wheel 6, the second arm 52 being arranged to cooperate with an opening latch 7.

The operating shaft 3 is connected to the circuit breaker by way of a lever 31 and a linkage (not shown). When the circuit breaker is closed, the opening spring 1 is tensioned and its shaft 3 hooked up on the opening latch 7. This position of the shaft, which corresponds to the closed position of the circuit breaker, is shown in unbroken lines in Figure 1. On giving an opening impulse, the opening latch 7 is released, and the opening spring 1 rotates the shaft 3 so that the circuit breaker is opened. This causes the shaft 3 to assume the end position shown in broken lines in Figure 1, which thus corresponds to the open position of the circuit breaker. Thus, the operating shaft 3 operates back and forth between the two shown fixed positions.

The closing spring 2 has its inner end fixed to the driving shaft 4 and its outer end fixed to a member 21 rotatable on the driving shaft 4, said member 21 suitably consisting of a wheel or a cylindrical drum surrounding the spring 2. The spring 2 can be tensioned by rotating the drum with the aid of a motor 22 via a suitable transmission means, for example a belt 23. The shaft is kept locked by a closing latch 8 which hooks up one of the arms of the star wheel 6. Closing of the circuit breaker takes place by releasing the closing latch 8, whereby another one of the arms of the star wheel 6 engages with the carrier latch 53 of the operating shaft 3 and rotates the latter through an angle corresponding to one step of the star wheel 6, which represents the movement of the entire operating shaft. When the carrier arm 52 has passed the opening latch 7, the carrier latch 53 is disengaged by an disengaging projection 9 (Figure 4) fixedly arranged in the mechanism housing. The operating shaft 3 with its tensioned opening spring 1 then assumes a hooked-up position, and the circuit breaker is ready for an opening operation. Immediately after disengagement of the carrier latch 53, the next arm of the star wheel 6 is hooked up on the closing latch 8, and the motor 22 is able to tension the closing spring 2 again.

The star wheel 6 may have two, three, four or more arms, depending on whether the operating shaft 3 with its spring 1 has been designed for a torsional angle of 180°, 120°, 90°, etc.

To clarify the mode of operation of the operating device, Figure 2 shows functions of the torsional angle of the operating shaft 3 and for the three arms 61-63 of the star wheel 6 plotted against the time t during three successive closing and opening operations. The movement curve of the operating shaft 3 is drawn in unbroken line, whereas the curves for the arms 61, 62 and 63 are drawn in dashed, dash-dotted and double dotted dashed lines, respectively.

The star wheel 6 has three fixed positions per turn, namely, $\alpha = 0^{\circ}$, $\alpha = 120^{\circ}$, and $\alpha = 240^{\circ}$. The rotation always takes place in the same direction.

The operating shaft 3 has two fixed positions, namely, $\alpha = \alpha_1$, which corresponds to the open position of the circuit breaker, and $\alpha = \alpha_2$, which corresponds to the closed position of the circuit breaker. The operating shaft 3 rotates back and forth between these two positions.

Upon a closing operation, the closing latch 8 is released at the time t_1. The star wheel 6 then starts rotating and the arm 61 engages the carrier latch 53 at $\alpha = \alpha_1$. Thereafter, the two shafts rotate synchronously during the closing operation. At $\alpha = \alpha_3$, the carrier latch 53 is disengaged when it passes the above-mentioned fixed disengaging projection 9. The operating shaft 3 then turns and is hooked up in the angular position $\alpha = \alpha_2$ (at time t_2) whereas the star wheel 6 continues to rotate and is hooked up in the angular position $\alpha = 240^{\circ}$, which corresponds to 120° for the next arm 62. After this, the device is ready to make an opening operation, which in the example shown is performed between times t_3 and t_4. In addition, the drive motor 22 starts and tensions the closing spring, the device then being ready for the next closing operation. This time the arm 62 engages the carrier latch 53, and the procedure is repeated.

Figures 3 and 4 show in more detail an embodiment of the connection mechanism between the two shafts 3, 4, namely, when the system (circuit breaker and operating device) is in the open position (Figure 3), and when the system is in the closed position (Figure 4). In the embodiment according to Figures 3 and 4, the star wheel 6 is provided with four arms 61-64, but otherwise this embodiment does not differ from the one shown in Figure 1. Of the parts shown in Figures 3 and 4 which are included in the coupling mechanism, the car-

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rier latch 5 and the opening latch 7 are positioned in a rear plane, whereas the star wheel 6, the closing latch 8 and the carrier latch 53 are positioned in an front plane.

In the example shown, the latch means 7 and 8 consist of roller-type ratchets, which can be released by an opening and closing magnet, respectively (not shown). The carrier latch 53 consists of two cascade-connected roller-type ratchets 53, 54, which are released when a sliding surface 55 on the smaller latch 54 contacts the stationarily arranged disengaging projection 9.

The free end portion of the carrier arm 52 is provided with a spring-loaded locking flap 56, which is arranged so that the arm 52 can pass freely past the opening latch 7 by the back way.

Each one of the springs 1 and 2 may consist of a plurality of spiral spring elements arranged adjacent each other.

CLAIMS

1. An operating device for circuit breakers with an opening spring (1) which exerts a torsional moment on an operation shaft (3) connected to the movable contact of the circuit breaker, with a closing spring (2) which exerts a torsional moment on a driving shaft (4), with a tension device (22, 23) for tensioning the closing spring (2), with a closing latch means (8) for limiting the rotation of the driving shaft (4) upon each closing operation and for locking the driving shaft (4) when the closing spring (2) is tensioned, and with a connection device (5, 6) for interconnecting the shafts for closing of the circuit breaker and simultaneous tensioning of the opening spring (1), characterized in that the two shafts (3, 4) are aligned, that the connection device (5, 6) comprises a star wheel (6) fixed to the driving shaft (4), that the closing spring (2) consists of a spiral spring arranged around the driving shaft (4) and wound from a flat rod or ribbon, and that said connection device is provided with at least two arms (61, 62), which are arranged, upon closing of the circuit breaker, to cooperate with a carrier latch (53) mounted on the operating shaft (3).

2. Operating device according to claim 1, characterized in that the opening spring (1) also consists of a spiral spring wound from a flat rod or ribbon.

3. Operating device according to any of the preceding claims, characterized in that the inner end of the closing spring (2) is fixed to the driving shaft (4) and the outer end thereof is fixed to a wheel or drum (21) which is rotatable about the driving shaft (4) and connected to the tension device (22, 23).

4. Operating device according to any of the preceding claims, c h a r a c t e r i z e d in that the driving shaft (4) only has one direction of rotation, whereas the operating shaft (3) is rotatable back and forth between two fixed positions, which correspond to the closed and open positions of the circuit breaker, respectively.

5. Operating device according to any of the preceding claims, c h a r a c t e r i z e d in that the connection device (5, 6) comprises a two-arm carrier (5) fixed to the operating shaft (3), one arm (51) of said carrier supporting the carrier latch (53), the other arm (52) of said carrier being arranged to cooperate with an opening latch (7) for locking the operating shaft (3) in the closed position of the circuit breaker.

6. Operating device according to any of the preceding claims, c h a r a c t e r i z e d in that the connection device (5, 6) comprises a disengaging member (9), fixedly arranged in the operating device housing, for releasing the carrier latch (53) and disengaging the operation shaft (3) from the driving shaft (4) at the final stage of the closing operation.

7. Operating device according to any of claims 5 and 6, c h a r a c t e r i z e d in that the disengaging member (9) is positioned in such a way in relation to said opening latch (7) that the operating shaft (3) at the final stage of the closing operation is moved past that fixed position which corresponds to the closed position of the circuit breaker, before the carrier latch (53) is released.

8. Operating device according to any of claims 5 to 7, c h a r a c t e r i z e d in that the free end portion of the carrier arm (52), arranged for cooperation with the

opening latch (7) is provided with a spring-loaded locking flap (56).

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FIG.1

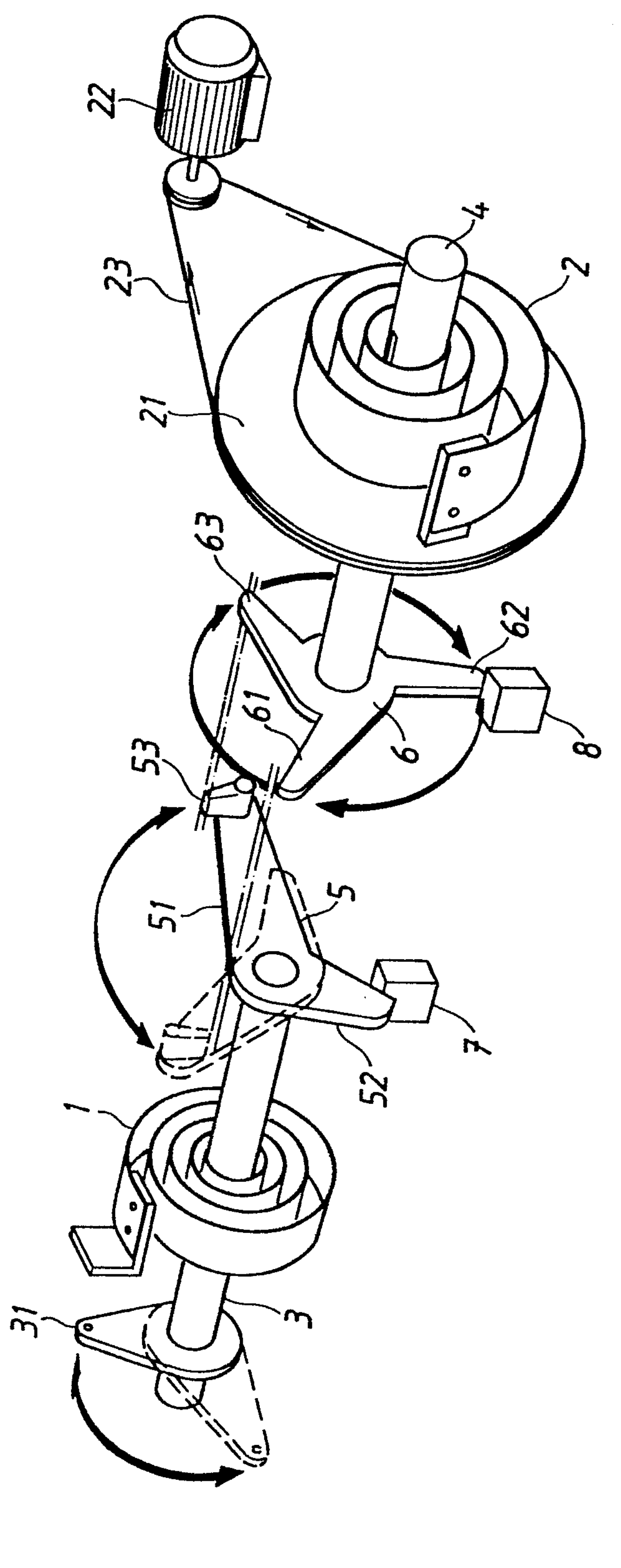

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FIG. 2

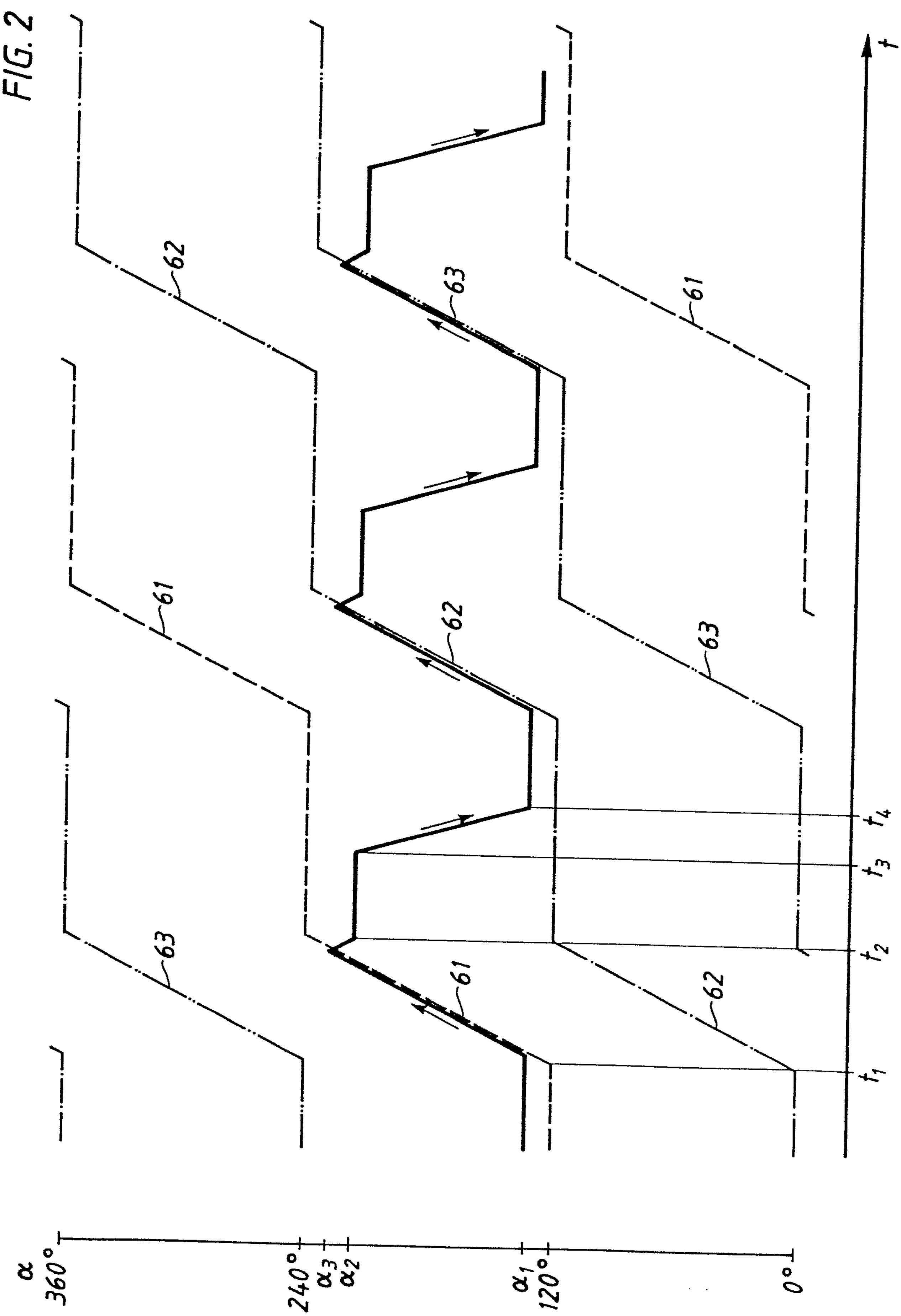

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FIG. 3

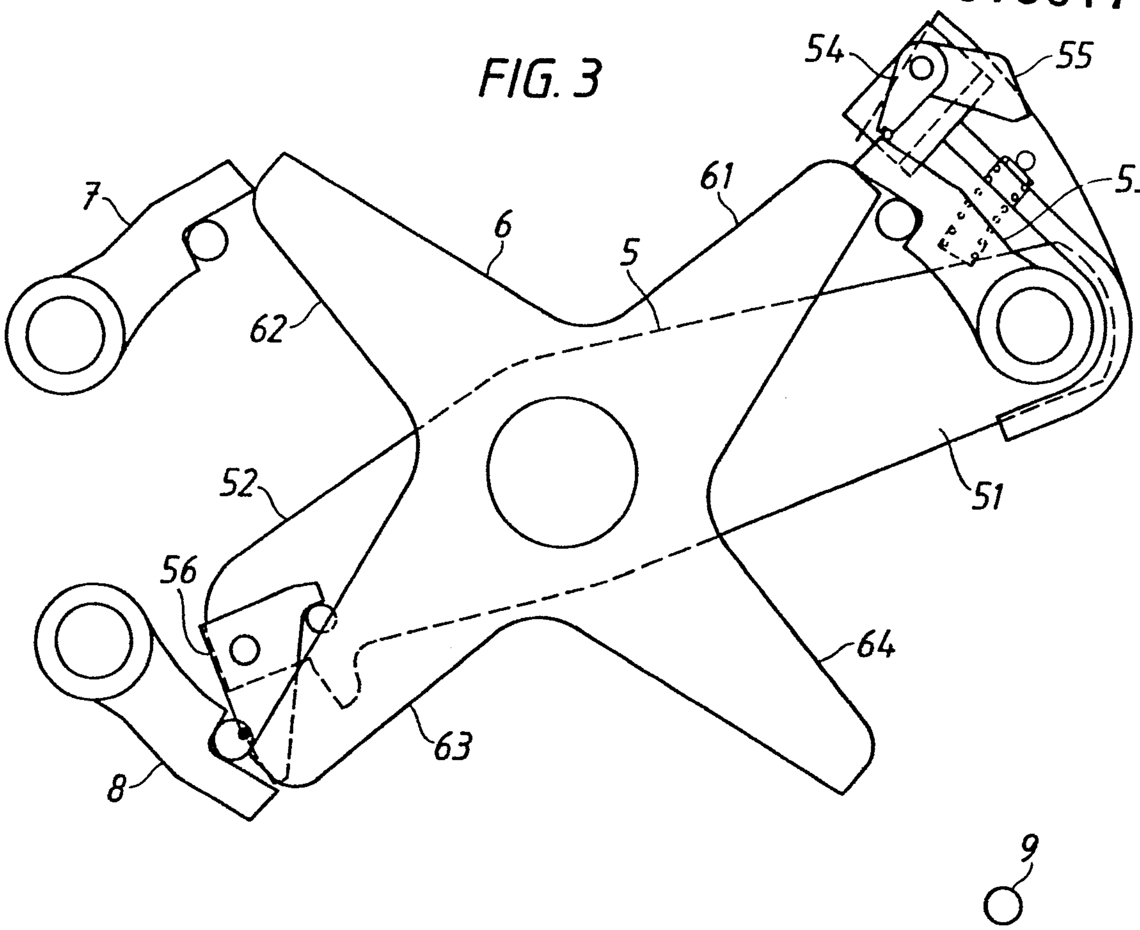

FIG. 4