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(54) Device for releasing the contacts of differential switches.

(57) This device comprises:
- a first lever (7,7a,7b) having a first arm (7) actuated by the release device, and a second arm (7a) acting on an engagement element (10),
- a second lever having a first arm (11,11a) engageable with said engagement element (10) and a contrast arm (11e) acting on a biasing spring (3),
- a third lever rigidly associated with a resetting knob and having a first arm loading said spring upon each resetting and a second arm (12) in contact with the contrast arm and connected to a pusher rod (13) for actuating a release lever (14),
- a connecting rod (15) pivoted to the knob (1) and said contrast arm (11e) for keeping the second lever in position after each resetting, so that upon each actuation of the first lever (7), the second lever (11,11a,11e) is disengaged from the engagement element (10) and can rotate freely, the third lever (12,12a,12b) rotates under the thrust of the preloaded spring (3) and the connecting rod (13) moves towards the switch release lever (14), thus causing contact opening.

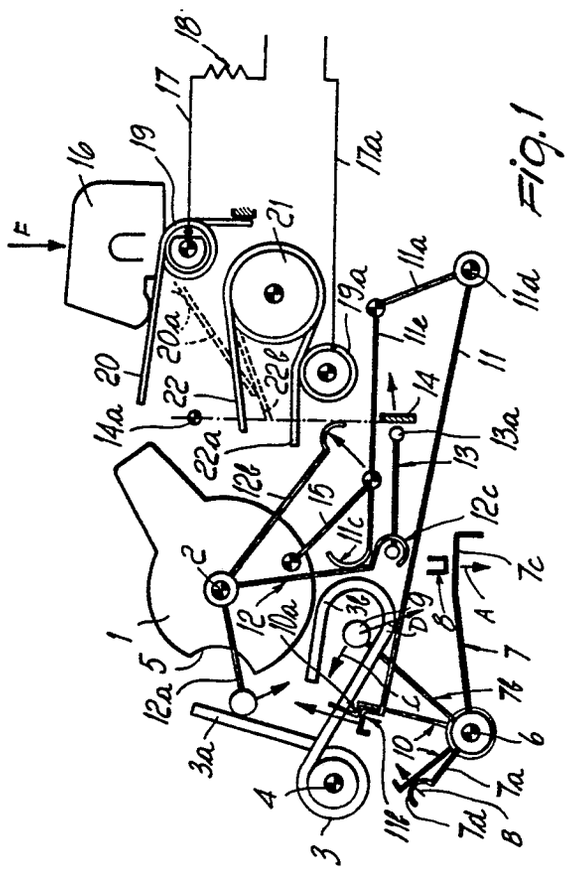

Fig.1

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DEVICE FOR RELEASING THE CONTACTS OF DIFFERENTIAL SWITCHES

The present invention relates to a release device for opening the contacts of an electric switch upon a differential current exceeding a given threshold in the electric system.

As is known, in differential switches, which are normally constituted by a movable-contact switch associated with a differential current detector, there is a particular release device which, as it has to be actuated by a very weak signal, must be very sensitive and therefore cause release forces and strokes having a limited value. Said release device is normally constituted by a conveniently guided pin or small piston, which is actuated with a preset translatory stroke when differential currents are detected in the electric system by a detection device inserted therein. During its stroke, the release piston transmits the release to a mechanism which causes the opening of the contacts of the switch.

The aim of the present invention is to provide a release device, insertable in a differential switch, structured so that under the action of the release pin it is capable of transmitting a conveniently amplified release force and stroke to the conventional release lever provided in the switch, thus causing the safe opening of the contacts.

Another object of the invention is to provide a release device which is safely reliable, can be reset after each intervention, has small dimensions and a modest cost.

Not least object is to provide a release device of the above described type, structured so as to have an adjustable stroke and therefore suitable for opening the contacts of different types of electric switches.

This aim, as well as these and other objects which will become apparent from the following description, are achieved by a device for releasing the movable contacts of differential switches, as defined in the appended claims.

The invention is now described in greater detail according to a preferred but not exclusive embodiment thereof, with reference to the accompanying drawings, given only by way of non-limitative example wherein:

figure 1 is a schematic view of the mechanism constituting the release device according to the invention, shown in reset position;

figure 2 is a view of the same device of figure 1 shown after the release stroke of the mechanism for opening the contacts of a switch, while

figure 3 is a view of the same device ready for resetting.

With reference to the above figures, the device according to the invention comprises a supporting frame (not illustrated for the sake of clarity) substantially having the form of a U-shaped body between the opposite walls whereof various actuation lever systems, a cylindrical spring and a knob are pivoted.

More precisely, the release device, in the reset position of figure 1, comprises a knob 1 for manual resetting the device after each release, which knob is freely pivoted on a pivot 2 rigidly associated with the two opposite walls of the frame. To the side of the knob 1 there is a cylindrical helical spring 3, coiled on a pivot 4 parallel to the pivot 2 of the knob, and one end 3a of said spring is intended to be pushed outwards and tensioned by a lever rigidly associated with the knob, as will become apparent hereinafter; the opposite end of the spring 3 is folded to an arc 3b and is intended to enter a recess 5 provided peripherally to the knob 1, after the release of the device, as will also become apparent hereinafter.

Below the knob and the spring, an oscillating lever element is mounted about a pivot 6 and has three mutually angularly spaced arms 7-7a-7b; the arm 7 is arranged so as to have its end 7c at a short distance from an ordinary release device 8, of the vertically translatable piston or pin type, actuated by a differential current detector device.

The stroke of the release piston 8 according to the arrow A (figure 1), due to a differential current in the electric circuit, is such as to cause a downward rotation of the lever 7 which rotates the arm 7a according to the arrow 8. The arm 7b of the oscillating lever is directed towards the curved part 3b of the spring 3 and has, at its end, a resting element 9 intended to be moved, according to the arrow C, when the device is reset, i.e. after the action of the release device 8 on the lever arm 7, while, upon the release, said element 9 is moved according to the arrow D.

Coaxially to the oscillating lever with three arms 7-7a-7b there is pivoted another oscillating element 10, having the shape of a triangular plate or the like, one side whereof is arranged in contact with the end 7d of the arm 7a, while the opposite side ends with a step 10a which has the function of retaining, when the device is reset, the end of a lever which substantially constitutes the means for retaining the device in a set position (figure 1).

This retention or latching lever is constituted by two arms 11-11a, arranged at an angle to each other and pivoted to the supporting frame at 11d. The arm 11 has, at its free end, a step 11b shaped so that it can engage the step 10a of the lever 10

and can be freely released following a rotation of the lever 10 caused by the arm 7a due to the lowering of the arm 7 according to the arrow A.

Another arm 11e of the retention lever is pivoted to the end of the arm 11a and is directed towards the arc-shaped part 3b of the spring, its end 11c is arranged in contact, always with the device in reset position (figure 1), with a lever associated with the knob; this lever is constituted by an element with three arms 12-12a-12b which are coaxial to the knob 1 and angularly spaced so that the arm 12a has its end in contact with the end 3a of the spring, that the arm 12 is in contact with the end 11c of the lever 11e and that the arm 12b can open an electric test circuit which will be explained hereinafter.

A release connecting rod 13 is pivoted to the free end 12c of the arm 12 and has such a length and is guided so as to have its free end 13a proximate to the ordinary release lever 14 of a mechanism for opening the contacts of a switch, after each intervention of the release device 8 on the lever 7. The lever 14 is pivoted to the frame at 14a.

Finally, between the knob 1 and the contrast arm 11e there is a connecting rod 15 which has the purpose of guiding and then keeping in stable position the arm 11e when the device is reset as in figure 1 and then rotating said arm 11e upwards after each actuation of the release device 8 (figure 2).

The operation of the release device as above described with reference to the figures can be briefly summarized as follows.

Starting from the device in a set position, as in figure 1, it can be seen that the release lever 7 is not in contact with the release device 8, the engagement lever 11 is retained by the lever 10 and the knob 1 is rotated clockwise so that the arm 12a keeps the spring 3 loaded by acting on the end 3a of said spring. The set configuration of the device is thus the one shown in figure 1.

When the release piston 8, due to a differential current occurring in the electric circuit or system, moves downwards according to the arrow A (figure 1), the lever 7 is pushed downwards; its opposite arm 7a, by rotating clockwise according to the arrow B, thus causes an also clockwise rotation of the lever 10; the rotation of the lever 10 causes the disengagement of the engagement lever 11 therefrom so that said lever 11 remains free to move upwards; the upward movement is caused by the fact that the spring 3, already compressed by the arm 12a, can now cause a partial anticlockwise rotation of the arms 12-12a-12b, as the arm 12 is no longer prevented from rotating by the arm 11e. In these conditions (figure 2) the release rod 13 is pushed by said arm 12 against the lever 14 of the release mechanism which thus causes the opening of the contacts of the switch.

Simultaneously to the movement of the arm 7, the arm 7b is moved clockwise, moving its resting pin 9 according to arrow D into contact with the inner arc of the curved end 3b of the spring 3 (figure 2). Meanwhile the knob rotates anticlockwise, as the connecting rod 15 has moved from the position of figure 1 to the position of figure 2 and therefore its rotation about the axis 2, on which a return spring (not shown) is provided, is no longer prevented.

In released position the device assumes the configuration illustrated in figure 3.

As shown by said figure 3, when the device has been released by the release device 8 or when the knob 1 has been manually rotated anticlockwise until the position of figure 3 it is impossible to close the contacts of the switch since the lever 14 of the contact release mechanism is forced by the connecting rod 13 to remain in the position shown in figure 3.

This condition is maintained until resetting, i.e. until the arm 11, pushed by the connecting rod 15 and by acting on the arm 12, returns the release rod 13 to its rearward position, as in figure 1. Another auxiliary function performed by the mechanism is that of returning the release device 8 to its initial resting conditions, since at the end of the release operation the arc-shaped end 3b of the spring 3, after the rotation of the knob to its resting position, as shown in figure 3, is accommodated within the cam recess 5 of said knob so that said part 3b of the spring keeps the arm 7b raised according to the arrow C, allowing the lever 7 to return the release device 8 to closed position and keep it there until the mechanism resetting operation is performed. When resetting is performed, by rotating the knob 1 clockwise, the curved end 3b of the spring protrudes from the recess 5, leaving the arm 7b free to rotate according to the arrow D and consequently leaving the arm 7 free to lower to disengage the release device 8, as shown in figure 1.

Still according to the invention, an auxiliary test circuit, actuatable by means of a button 16 according to the arrow F, is associable with the release device for differential switches as described above.

Said test circuit has a circuit including two conductors 17-17a. with power supply through an adapted resistor 18, the ends of the conductors being connected to two cylindrical taps 19-19a; a spring is wound around the tap 19 and acts as flexible conductor 20 which, by means of the push-button 16, pressed according to the arrow F, can be elastically moved to the position 20a (figure 1), while a portion of flexible conductor is in contact with tap 19a and comprises a spring wound around

a cylindrical body 21 which ends with two protruding ends 22 and 22a, the one 22a being in contact with tap 19a. The end 22a of the conductor in contact with tap 19a is arranged so that it can be spaced, i.e. disconnected, from tap 19a, by the arm 12b which is rigidly associated with the knob, so as to cutoff the test circuit regardless of the time for which the button 16 is kept closed.

In fact, since the purpose of the test circuit is to cause the intervention of the release device 8 by simulating the flow of a differential current for an extremely short time, by pressing the button 16 according to the arrow F, the end of the conductor 20 is caused to move into contact with the conductor 22 and both conductors mutually in contact are caused to move further, as indicated by the reference numerals 22b-22a in the figures.

The test circuit is thus closed and the release device 8 is accordingly actuated, causing the opening of the contacts of the switch.

After opening of the contacts, the configuration of the mechanism is the one of figure 3 (and of figure 2) and in particular the arm 12b has raised the end 22a, removing it from contact with tap 19b and thus interrupting the flow of current in the test circuit. This in practice avoids damage to the resistor 18 which, for reasons of space and cost, can thus be dimensioned, for thermal purposes for a much smaller dissipatable power than the one required if the flow of current in the circuit were prolonged, i.e. independently from the fact that the button 16 is kept pressed for a long time or not.

Finally, since the release rod 13, which causes the release of the lever 14 of the contact opening mechanism with its stroke and its pushing force, is stably associated only at one end (i.e. at the end 12c of the arm 12), it is possible and easy to replace it with other rods having different shapes and lengths, adapted for the release of other kinds of known switches.

It is also obvious that the invention as described above is in practice susceptible to structurally and functionally equivalent modifications and variations without thereby abandoning the scope of the protection of the invention as described and claimed hereafter.

Where technical features mentioned in any claim are So followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. A device for releasing the movable contacts of switches upon a differential current exceeding a preset threshold, characterized by:
- a supporting frame on which a knob (1) is pivoted for resetting the device after each release action,
- a first lever (7,7a,7b) which oscillates about a pivot (6) which is parallel to a knob rotation pivot (2), said first lever being shaped so as to have three angularly spaced arms, one first arm (7) being opposed to a release pin (8) of a known differential current detector device, one second arm (7a) being intended to actuate an engagement element (10) which oscillates about the same pivot (6) as said first lever upon each action of said release device on said first arm (7), and one third arm (7b) being intended to keep said first (7) arm engaged with said release device until the device for releasing the movable contact is reset,
- a second lever (11,11a,11e) having substantially two arms and oscillating about a pivot (11d) which is fixed to the supporting frame, a first arm (11,11a) of said second lever being engageable with, and disengageable from, said oscillating engagement element (10) for keeping the device for releasing in a set position, a second contrast arm (11e) of said second lever being shaped so as to contrast a spring (3) adapted to be indirectly biased by said knob (1) during the resetting operation,
- a third lever (12,12a,12b) with at least two angularly spaced arms, kinematically connected to said knob (1), one first arm (12a) of said third lever being intended to load said spring (3) upon each resetting operation and the second arm (12) of said third lever acting on the contrast arm (11e) of said second lever and being connected to a pusher rod (13) for actuating a release lever (14) of a mechanism for opening the contacts of the switch, and
- a connecting rod (15) pivoted on said knob (1) and on said contrast arm (11e) of said second lever, for retaining the second lever in position after each resetting operation, the dimensions of said multiple-arm levers and their pivoting position on the supporting frame being selected so that, with the device set, upon each actuation of said first arm (7) of said first lever by said release device (8), one arm (11) of the second lever is released from the oscillating engagement element (10), thus causing the free rotation of the arms (11,11a,11e) of said second lever so as to allow the arms (12,12a,12b) of the third lever, which is kinematically connected to the knob (1), to rotate under the thrust of the preloaded spring (3) and thus allow the movement of the connecting rod (15) towards the switch release lever (14), thus causing the opening of its contacts.

2. A device according to claim 1, characterized in that said control knob (1) is peripherally provided with a recess intended to accommodate a portion (3b) of said spring (3) for restoring the initial position of the release device, by keeping said first release arm (7) of said first lever pressed in contact with the release device (8) after each contact release and opening operation, releasing said arm (7) after resetting upon rotation of the knob (1).

3. A device according to claim 1, characterized in that said pusher rod (13) is pivoted to the free end (12c) of the second arm (12) of said second lever and is of interchangeable type.

4. A device according to claim 1, characterized in that it is associable with a test circuit, adapted to simulate a differential current, wherein, by means of a pushbutton (16), the flexible ends (20,22,22a) of the conductors (17,17a) of said circuit are placed in mutual contact, thus causing actuation of said release device, said test circuit being opened, immediately after the release, by a third arm (12b) of said third lever acting on and mutually spacing said flexible ends of the conductors, independently from the position of said push button (16).

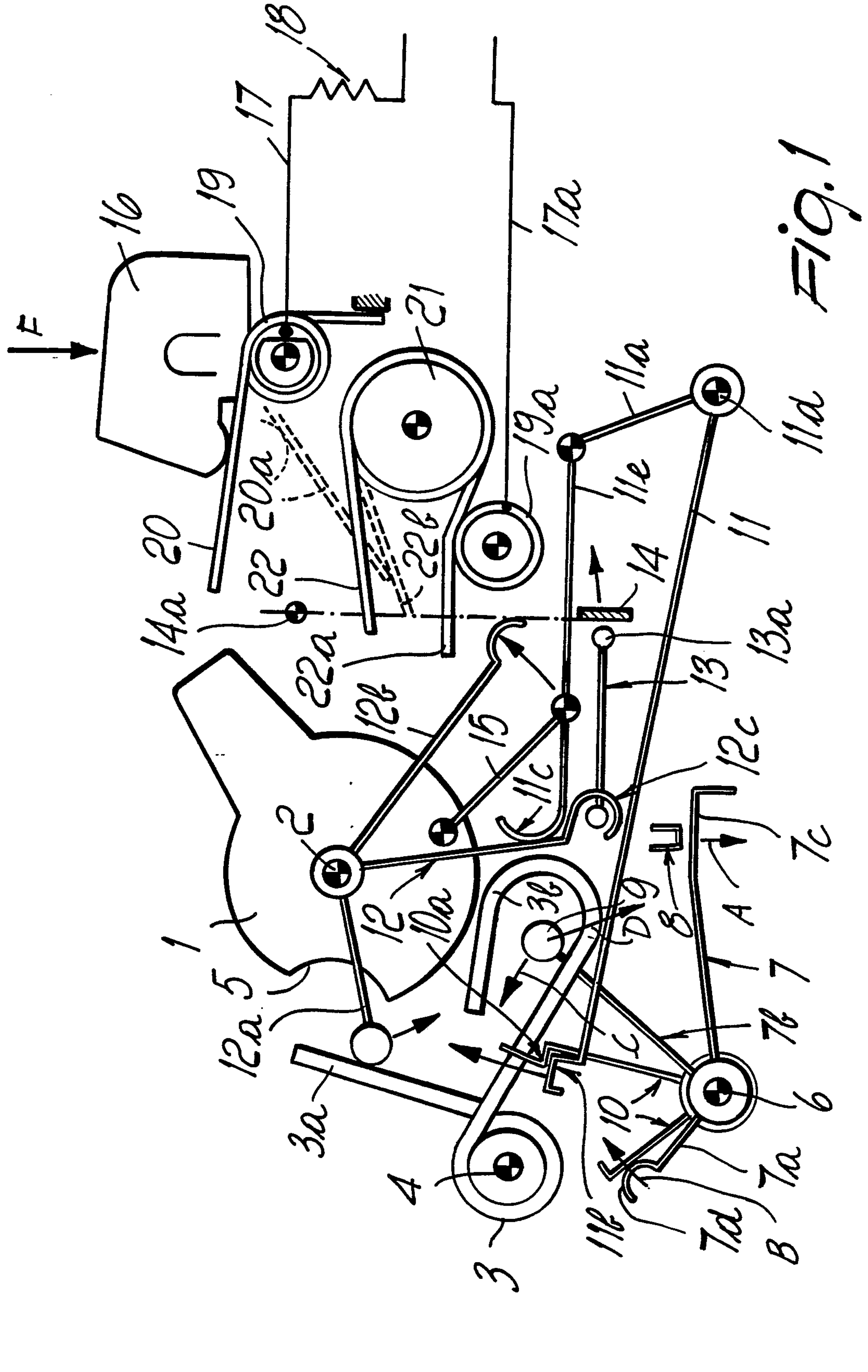

Fig. 1

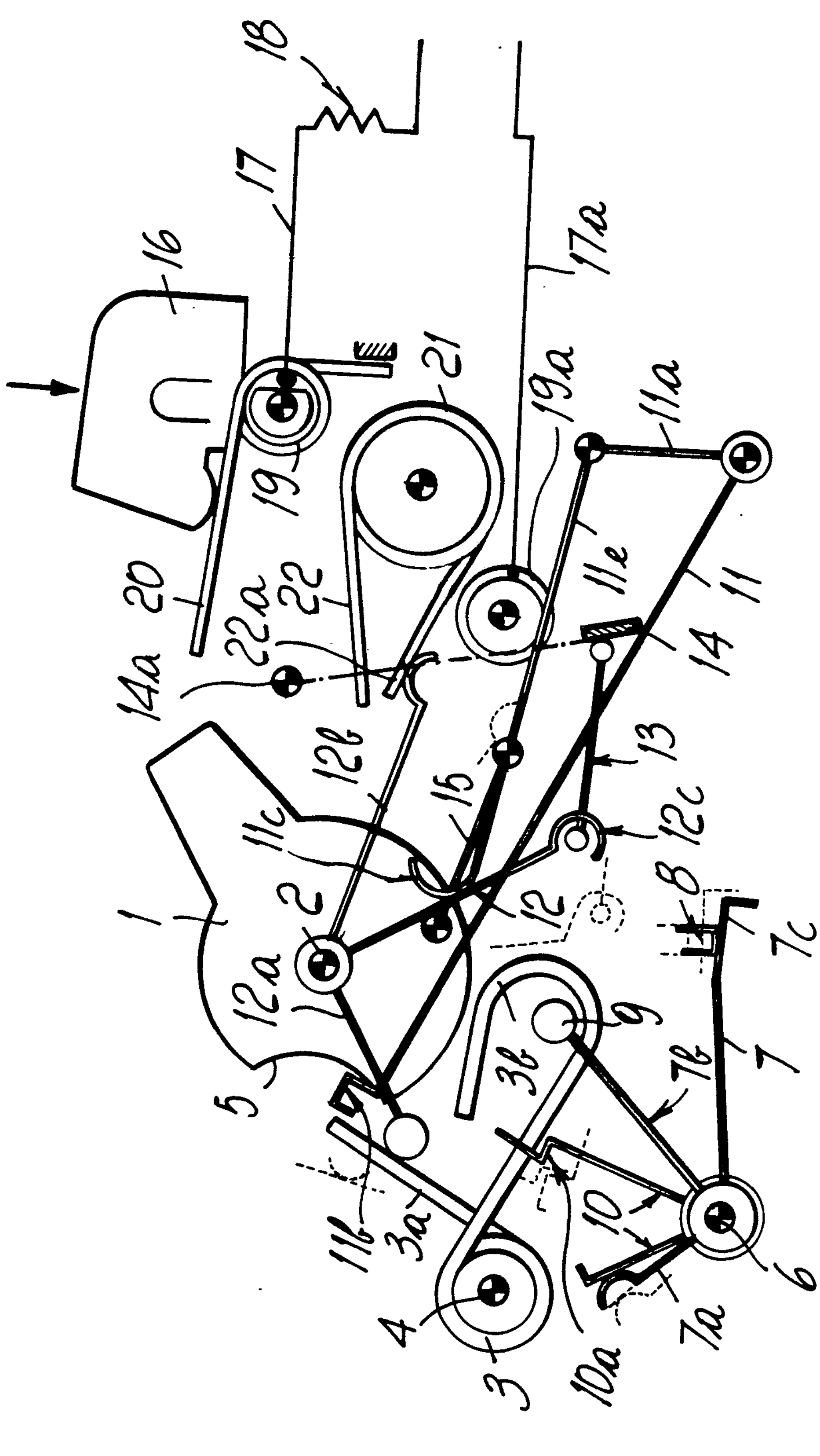
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Fig.2

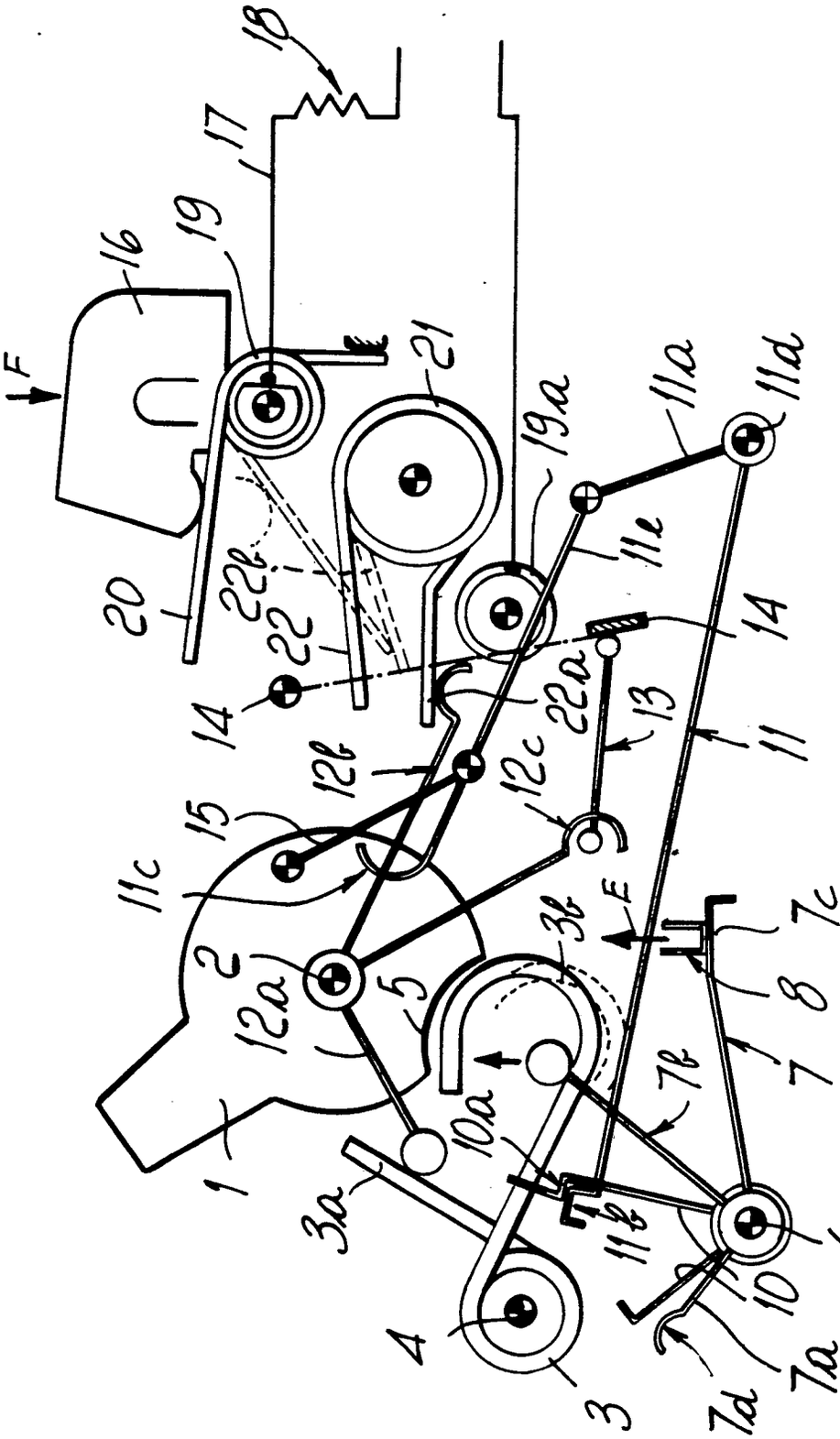
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Fig. 3