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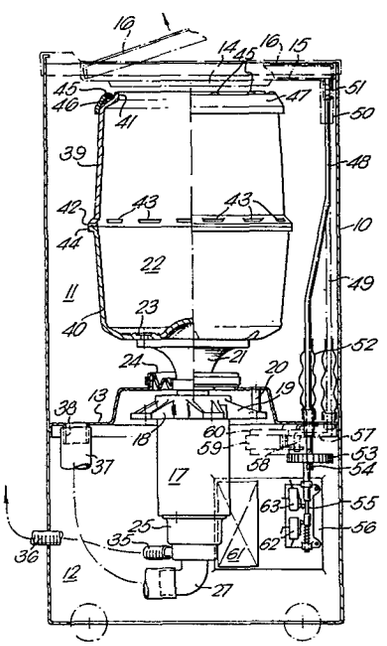
(54) Rotary washing drying or tumbling machine.

(57) The invention relates to a rotary washing drying or tumbling machine and is specifically applied to a spin dryer. The spin dryer employs a DC permanent magnet motor (17) which drives directly a spinning plastic drum (22) attached to one end of the motor shaft and a plastic pump (25) attached to the other end of the motor shaft.

The motor is switched on and off by a microswitch (62) operated by an operating rod (48), by movement of the lid (16), and the rod (48) also operates a second microswitch (63) so that when the motor is switched off the second microswitch (63) shorts out the motor windings so as to produce regenerative current for braking. The regenerative current is also used to operate an interlock to prevent the lid being opened whilst the motor is still rotating.



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Rotary washing drying or tumbling machine

This invention relates to a rotary washing, drying, or tumbling machine of the kind in which an electric motor is arranged to drive a spinning drum.

An object of the invention is to provide an improved machine which is capable of very high speeds of rotation and at the same time can be made light in weight and with relatively few parts.

The invention relates to a rotary washing, drying or tumbling machine comprising an electric motor capable of producing regenerative voltage arranged to drive a spinning drum and means to so connect the motor when it is switched off that regenerative or electro-dynamic braking of the motor takes place as the motor slows down. Motors capable of producing regenerative voltage include D.C. permanent magnet motors, induction or series wound motors and commutator motors.

The invention is characterised by this, that the regenerated voltage is also used to control an interlock so as to prevent a door or window in the machine being opened until rotation of the drum has ceased or virtually ceased.

Preferably a switch is included in the machine which is operated by opening and closing the door or window and arranged so that in one position of the switch a supply voltage is applied to the motor to drive it and in a second position of the switch the motor is shorted out so as to produce regenerative voltage to assist in braking and the regenerative voltage is also applied to a relay or other device controlling said interlock.

The switch preferably comprises a pair of micro-switches operated by cam surfaces on a rod or the like so that when one microswitch is in its ON position the other microswitch is in its OFF position. The rod, or the like, may be in turn operated by a connecting rod engaged with the lid or door.

The interlock itself preferably has means to ensure that if the relay or other device fails to operate, or regenerative voltage is not applied to it for any reason the door or window will still not open without further action from the user.

In the accompanying drawings:

Figure 1 is an elevation with parts in section of a spin dryer embodying the present invention;

Figure 2 is a scrap section through a portion of the plastic drum of the spin dryer;

Figure 3 is a vertical section through a pump and the lower end of a DC permanent magnet motor;

Figure 4 is a diagrammatic layout of the electrical components used in the spin dryer;

Figure 5a is a plan view of an electrical switch used in the spin dryer; and

Figure 5b shows the same switch in a different operative position;

Figure 6 is an electrical circuit diagram showing the interconnection of the electrical components of the spin dryer;

Figure 7 is a side elevation of the interlock and catch mechanism;

Figure 8 is an underplan of the same mechanism looking upward in the direction of arrow 8; and

Figure 9 is a detail view of a solenoid and its operating arm for the interlock mechanism.

The spin dryer in Figure 1 is enclosed in a conventional rectangular casing 10 divided into two chambers 11 and 12 by a partition 13, the chamber 11 being sealed from the chamber 12 so as to prevent any water flowing into the chamber 12 which contains among other things the electrical components of the spin dryer.

The casing 10 has an aperture 14 in its upper face 15

and a hinged door 16 which closes the aperture 14 when the spin dryer is in use.

The spin dryer is driven by a DC permanent magnet electric motor 17 which has its permanent magnet made of sintered ferritic material so as to provide a small compact powerful DC electric motor.

The motor 17 is supported by a mounting assembly 18 which has a number of radially extending fingers 19 attached to a portion of casing 13 by resilient mountings 20. Attached to the drive shaft at the upper end of motor 17 is a mount 21 for a plastic drum 22. The drum 22 is screwed as at 23 to the mount 21 and is directly driven by the motor 17. A conventional rubber seal or gaiter is provided at 24 so as to prevent flow of water through from the upper chamber 11 to the lower chamber 12 and there is an additional rubber seal in the motor shaft.

At the lower end of the motor 17 is mounted a one piece pump 25 moulded in two halves and ultrasonically welded together and is shown in more detail in Figure 3. The pump comprises a housing 26 and an integral intake 27 moulded from plastic material and a plastic rotor 28 carried on a shaft 29 supported in sealed bearings 30 and including a rubber seal 31 to prevent any flow of water from the pump into the motor. The pump shaft 29 has a key 32 which engages in a slot 33 in the motor shaft 34.

Thus it is seen that the pump is directly driven by the DC motor and the spin dryer is also directly driven by the motor shaft at its opposite end. No gearing is required and no pulleys or band drives are embodied in the drive to the pump.

The pump outlet is shown at 35 in Figure 1 and leads to a conventional flexible pipe 36 which may be led away to the normal sink or drain.

The inlet 27 of the pump is connected by a flexible pipe 37 to a drain outlet 38 formed in casing 13.

As is conventional in spin dryers when the dryer is in use water collects in the lower portion of the upper chamber 11 and flows through the drain 38 and pipe 37 to the inlet 27 of the pump 25 and then through the outlet 35 and flexible pipe 36 away to drain. The drum 22 is the subject of our copending patent application No. 8226309. It comprises two cup shaped mouldings 39 and 40. The upper moulding 39 has a round aperture 41 in one end to receive the clothes to be spun dried, and a flange 42 at its lower end. It also has slots 43 for flow of water which is centrifugally expelled from the drum during operation.

The lower cup shaped portion 40 also has a flange 44 at one end and is closed at the other end and provided with holes through which the screws 23 extend which attach the drum to the drum mount 21. The two portions of the drum are joined by spin friction welding as described in our copending application. Integrally moulded with the upper portion 39 are rivets 45 which extend through holes 46 in a balance ring 47 which is a dense metallic dyecasting attached by the plastic rivets 45 to the drum. The dyecasting may for instance be made of material known as Mazak 3 which is a dense metal alloy. Alternatively a very dense plastic ring could be used.

The main portion of the drum is moulded from polypropylene without the use of glass filling.

Because of the powerful DC permanent magnet motor employed and the lightweight drum construction this machine is capable of operating at speeds of the order of 3000 rpm and of reaching full speed in about 7 seconds.

The electrical circuit, which will be described in detail later, is operated basically by two operating rods 48 and 49. Rod 48 is engaged in a tubular moulding 50 on the underside of the casing and is moved by a post

51 attached to the lid 16. When the lid is closed the post 51 moves the rod 48 downwardly. The rod 48 passes through a flexible sealing gaiter 52 and through the partition 13 and has its lower end a knurled plastic wheel 53 engaged on a thread 54. This provides for adjustment of the switch operating arm in a vertical direction. The plastic wheel 53 in turn engages the operating rod 55 of a switch 56.

The other rod 49 is used to operate the safety interlock mechanism which will be described in detail later. The upper end of the rod 49 operates the safety interlock in the lid of the machine and the lower end has a cranked arm 57 the end 58 of which is engaged in a hole in a pivoted arm 59 forming part of a solenoid 60.

Also mounted in the lower portion of the cabinet is an interference supression circuit and AC/DC conversion circuit mounted on a circuit board 61. The switch 56 carries two microswitches 62 and 63. As seen in Figure 4 one of the microswitches 62 is a motor switch and the other microswitch 63 is a brake switch.

The diagrammatic representation of the electrical components in Figure 4 also includes the circuit board 61, the motor 17 and the solenoid 60 with its operating arm 59. Also included is a terminal block 64 and earthing post 65. These components are shown in the form of an electrical circuit diagram in Figure 6. Mains AC voltage is applied across the terminals marked L and N to the terminal block 64 and if the microswitch 62 which operates the motor is closed and the fuse 66 is in place power will be applied across the radio interference suppresser circuit 67 and thence to the bank of full wave diode rectifiers 68 so as to produce 220 to 240 volts DC across the 0.1 microfarad capacitor 69. Assuming that microswitch 63 is open the current

will be applied via solenoid 60 to motor 17.

When the current flows through the solenoid 60 it causes the arm 59 to move so as to turn the cranked arm 57 and thus via the rod 49 operate the interlock in the lid of the spin dryer so as to prevent the spin dryer lid being opened during operation of the machine.

This corresponds to the position of the switches 62 and 63 shown in Figure 5b, the motor switch 62 being closed and the brake switch 63 being open circuit. This is achieved by the movement of the switch rod 55 which has a portion 70 of reduced diameter into which one or other of the wheels 71 and 72 on the respective arms 73 and 74 of switches 62 and 63 will enter according to the position of the switch rod 55.

As can be seen in Figures 5a and 5b the rod 55 is biased to its upper position normally by a spring 75 but when the lid is closed the rod is pushed downwardly to the position shown in Figure 5b in which as mentioned, the motor switch is closed and the brake switch is open.

At the end of the spin drying period the user of the spin dryer will attempt to open the lid. Opening the lid a small amount will cause rod 48 to move upwardly, being biased by spring 75, and this will cause switch rod 55 to move from the position shown in Figure 5b to that shown in Figure 5a in which the motor switch 62 goes open circuit and the brake switch 63 is closed. As can be seen from Figure 6 opening the motor switch 62 removes the supply voltage from the rectifiers and therefore removes the DC voltage from the motor 17 but simultaneous closing of microswitch 63 short circuits the windings of motor 17 and thus the regenerative current set up as the motor slows down will flow through the motor coils causing a braking effect. It will also flow through the coil of solenoid 60 so as to maintain the arm 59 in a position in which the interlock remains operated so as to prevent

the lid being opened further.

Thus regenerative current is used both for braking and for control of the interlock. Until the motor has slowed down very considerably and has almost stopped the current in solenoid 60 derived from the regenerative current from the motor will hold the interlock in a position to prevent the lid being opened.

The action of the primary catch and safety interlock system incorporated into the lid and underside of the top of the casing will now be described. The underside 15 of the casing has an aperture 15a and the lid 16 carries a primary catch 85 and an interlock post 82. The primary catch 85 cooperates with a catch plate 86 on one edge of aperture 15a in conventional fashion. The interlock post 82 carries two projections, an upper projection 83 and a lower projection 84.

Cooperating with the interlock post 82 is an interlock mechanism which is carried by a sleeve 76 mounted on a downwardly projecting cylindrical portion 77, the sleeve 76 being integrally connected to an interlock arm 78. The arm 78 carries at its outer end an upper extension 79, a lower safety hook 80, shown best in Figure 8. The arm 78 is biased to the right as seen in Figure 8 by a spring 86 attached to a post 87.

The interlock operating arm 49 shown in Figure 1 and previously described has a lateral projection 49a at its upper end which engages in a slot 76a in the sleeve 76.

When the interlock is not operative the arm 78 occupies the position marked A in Figure 8, being biased to the right as shown in Figure 8 by the spring 86. In this position the interlock is completely clear of the interlock post 82 so that the lid can be lifted once the primary catch 85 has been disengaged by the initial raising of the lid.

When the interlock solenoid operates the arm 59 causes the interlock rod 49 to turn through a small angle which in turn causes the arm 78 to be turned through the same angle to the position marked B in Figure 8, the hook 80 being resilient springs passed the interlock post 82 during this movement.

In this position the lid cannot be raised because any attempt to raise it will result in the lower projection 84 engaging the upper extension 79 on the arm 78.

When the lid is raised so as to cause the motor to switch off it only lifts a small amount at which point the interlock prevents it being opened further. The interlock is held with the arm in position B by the regenerative current through the solenoid 60 which maintains the arm 59 in the position to keep the interlock operative.

When the motor is slowed right down and has almost stopped the current will be insufficient in the solenoid to maintain this position and the arm 59 will cause rod 49 to move through a small angle and this in turn will cause the interlock arm 78 to move back to the position A under the influence of spring 86.

If the interlock is operative but there is a failure of the solenoid or another failure which results in the spring 86 attempting to move the interlock arm towards the position A in Figure 8 then the hook 80 will engage against interlock post 82 and this will bring the longer lower extension 81 into line above the upper projection 83 on the interlock post 82 as shown at position C. In this position it is impossible to open the lid. Further action is then necessary on the part of the user involving closing the lid again starting the motor and repeating the operation to attempt to open the lid. The lid cannot be opened in this position unless the interlock solenoid is operating properly.

Claims:

1. A rotary washing, drying, or tumbling machine comprising an electric motor (17) capable of producing regenerative voltage arranged to drive a spinning drum (22) and means (55, 70, 74, 63) to so connect the motor when it is switched off that regenerative or electro-dynamic braking of the motor takes place as the motor slows down, characterised by this, that the regenerated voltage is also used to control an interlock (78, 79, 82, 83, 84) so as to prevent a door or lid, or window in the machine being opened until rotation of the drum has ceased or virtually ceased.

2. A machine according to claim 1 characterised by this, that a switch (62, 63) is included in the machine which is operated by opening and closing said door or window and arranged so that in one position of the switch a supply voltage is applied to the motor (17) to drive it and in a second position of the switch the motor is shorted out so as to produce the regenerative voltage to assist in braking, and the regenerative voltage is also applied to a relay (60) or other device controlling said interlock so as to prevent the door or lid or window being opened while the machine is slowing down.

3. A machine according to claim 2 characterised by this, that said switch comprises a pair of microswitches (62, 63) operated by a rod (55) or the like so that when one microswitch is in its ON position the other microswitch is in its OFF position.

4. A machine according to claim 3 characterised by this, that the rod (55), or the like, is in turn operated by a connecting rod (48) engaged with the lid or door.

5. A machine according to any of claims 2 to 4 and characterised by this, that the interlock itself has means (78, 79, 82, 83, 84) to ensure that if the relay or other device fails to operate, or regenerative

voltage is not applied to it for any reason, the door or window will still not open without further action from the user.

6. A machine according to any of claims 1 to 5 characterised by this, that said motor is a DC permanent magnet motor.

7. A machine according to claim 6 characterised by this, that said permanent magnet is provided by a sintered ferritic compound material.

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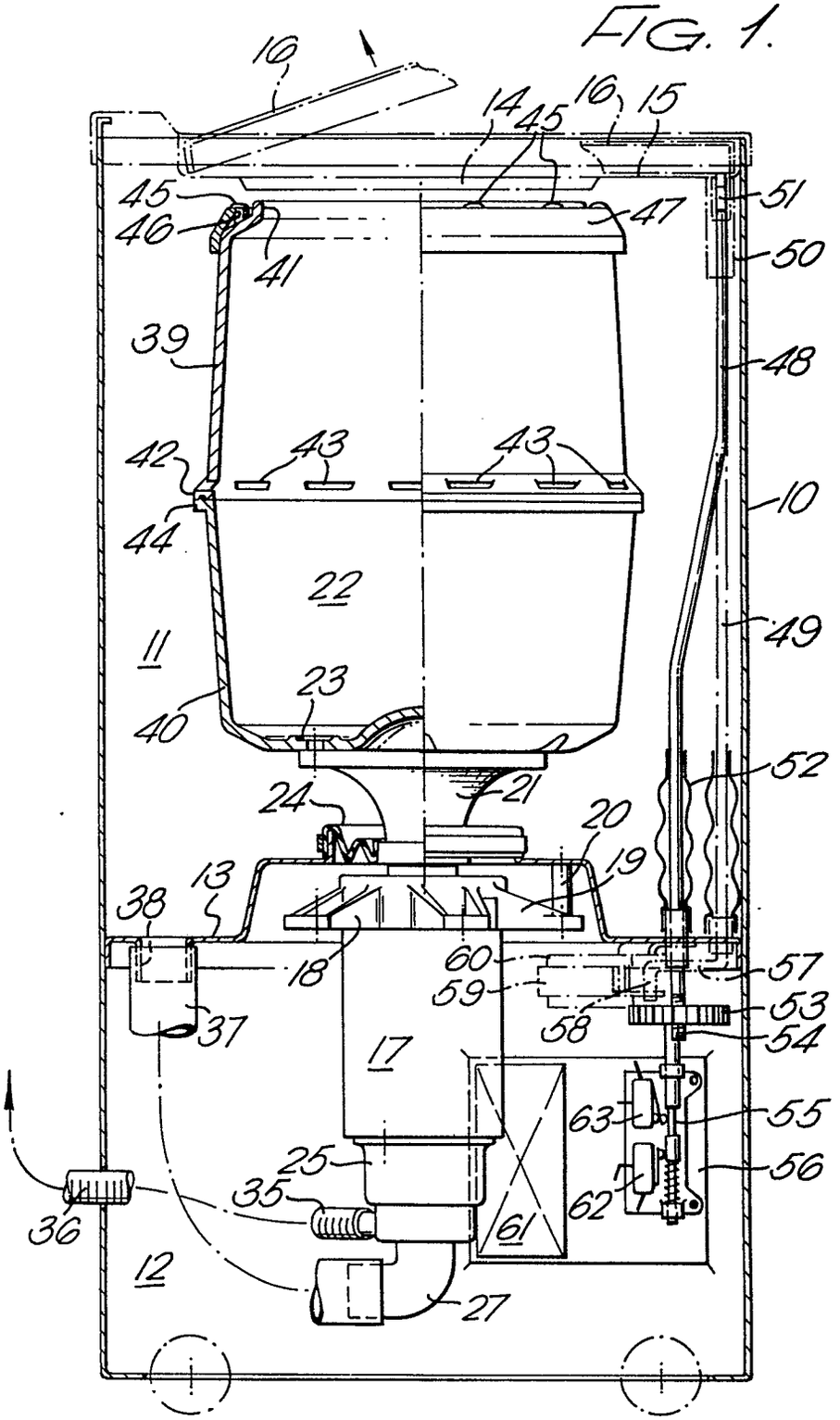
FIG. 1.



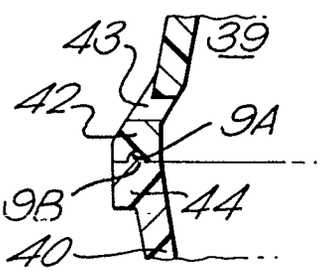


FIG. 2.

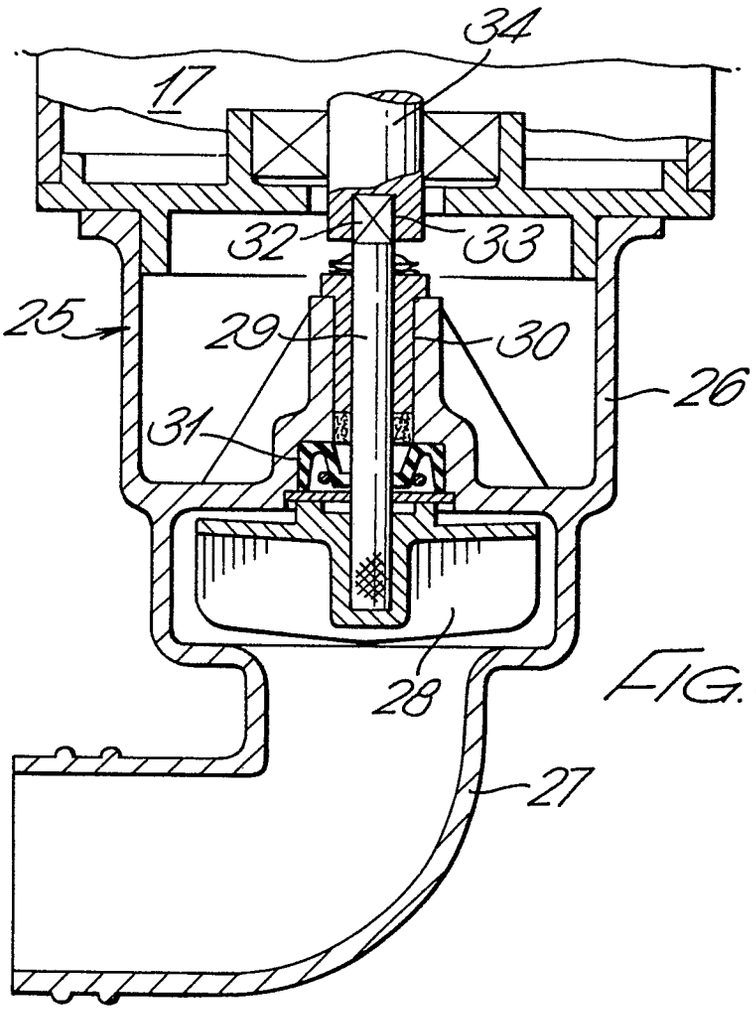


FIG. 3.

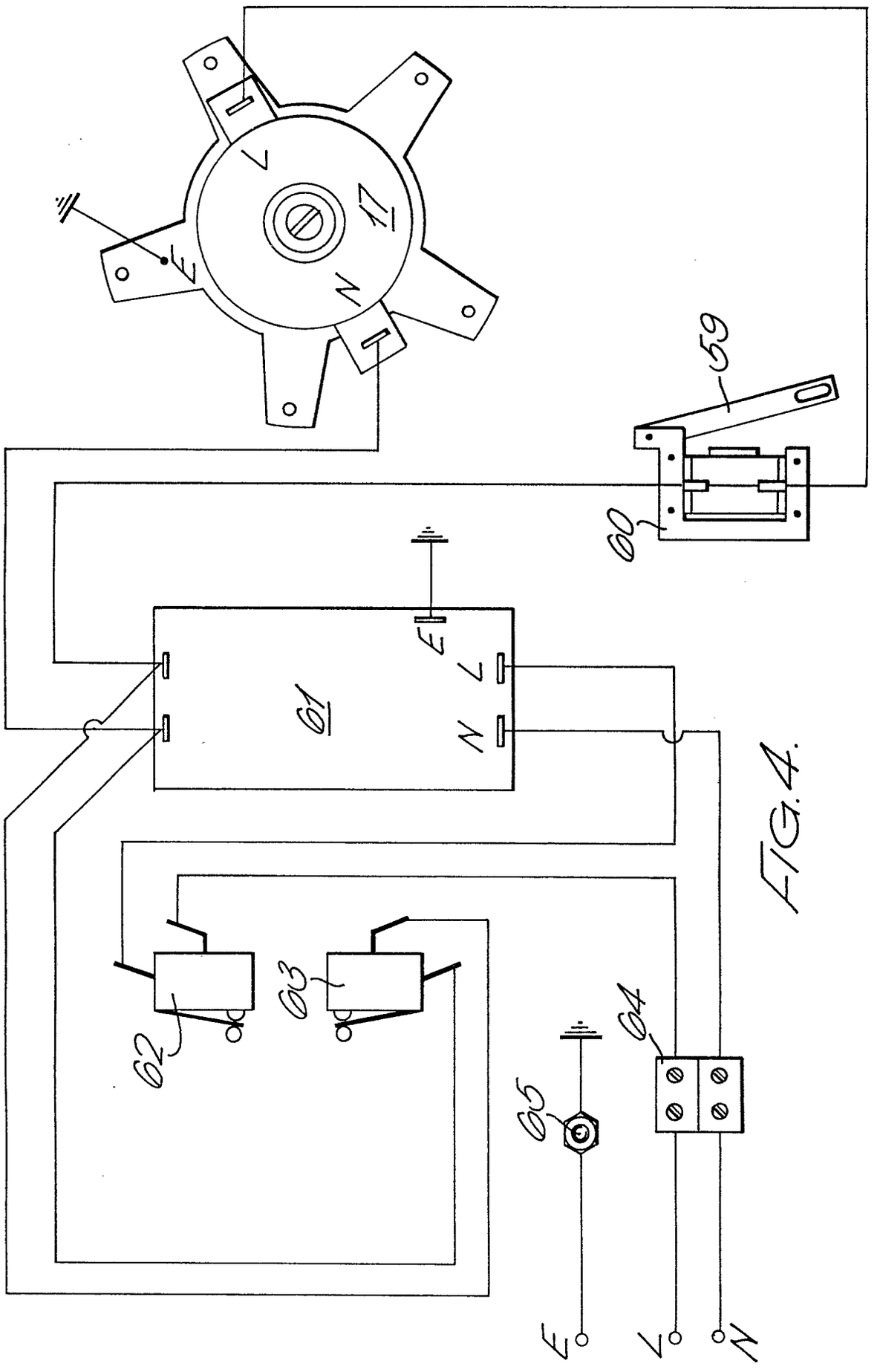


FIG.4.

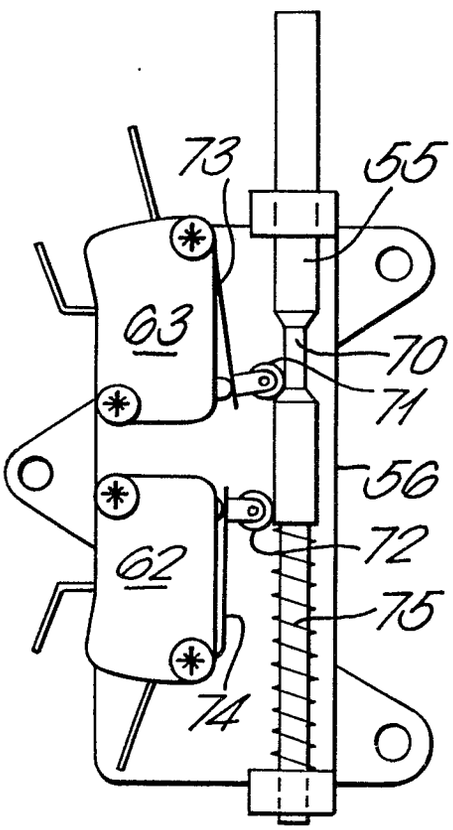


FIG. 5A.

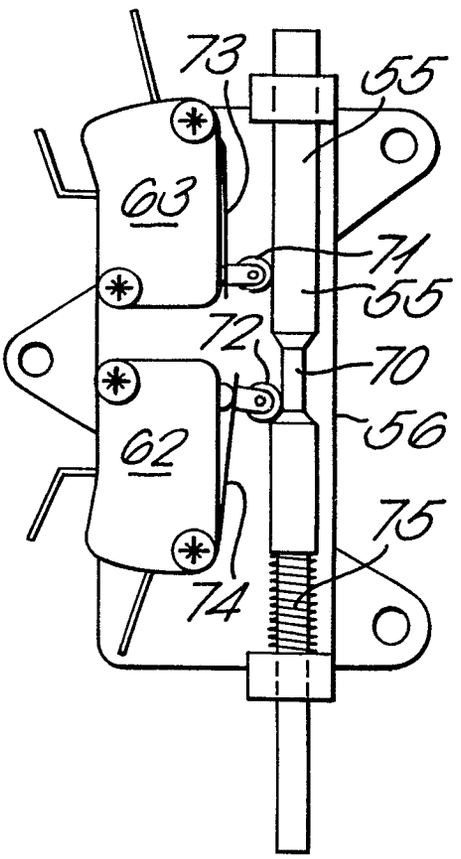


FIG. 5B.

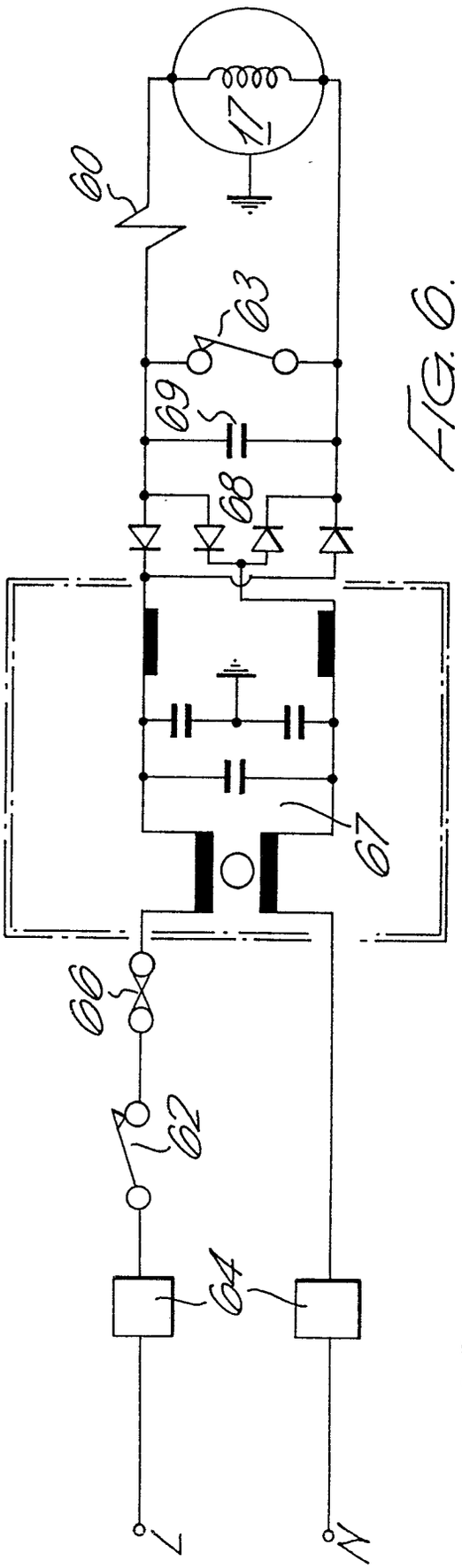


FIG. 6.

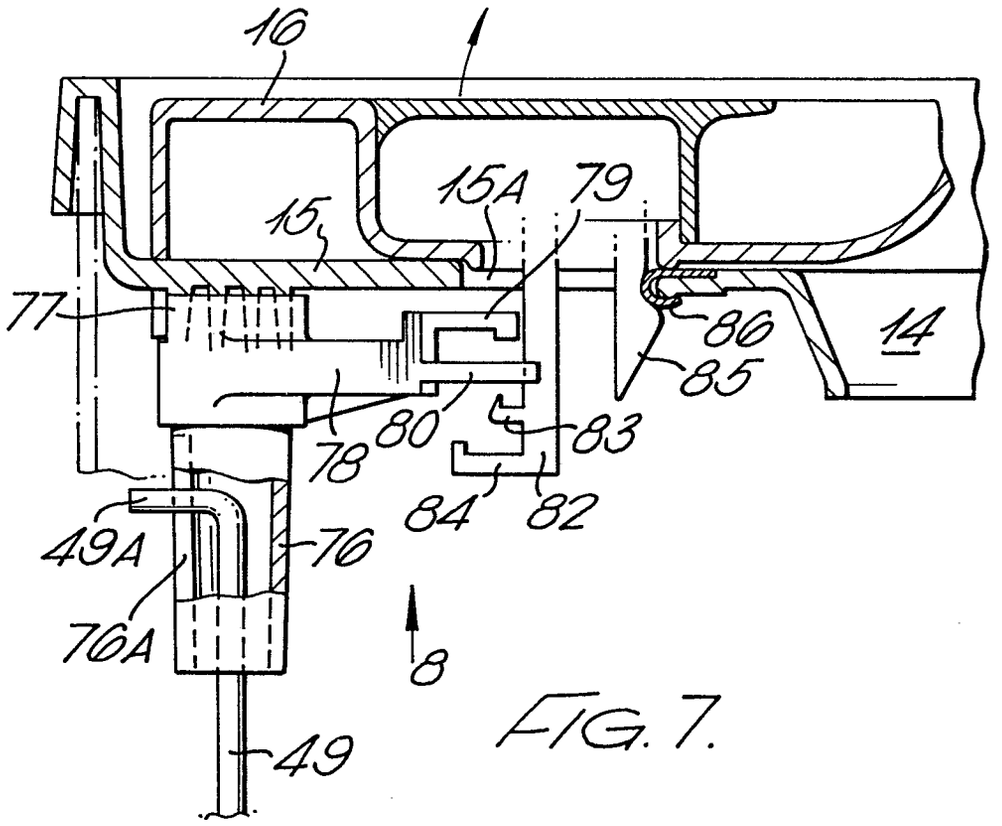
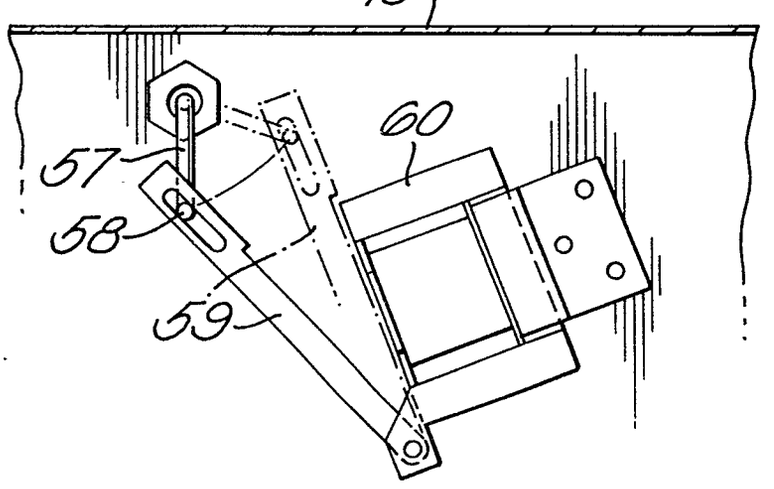


FIG. 7.

FIG. 9.



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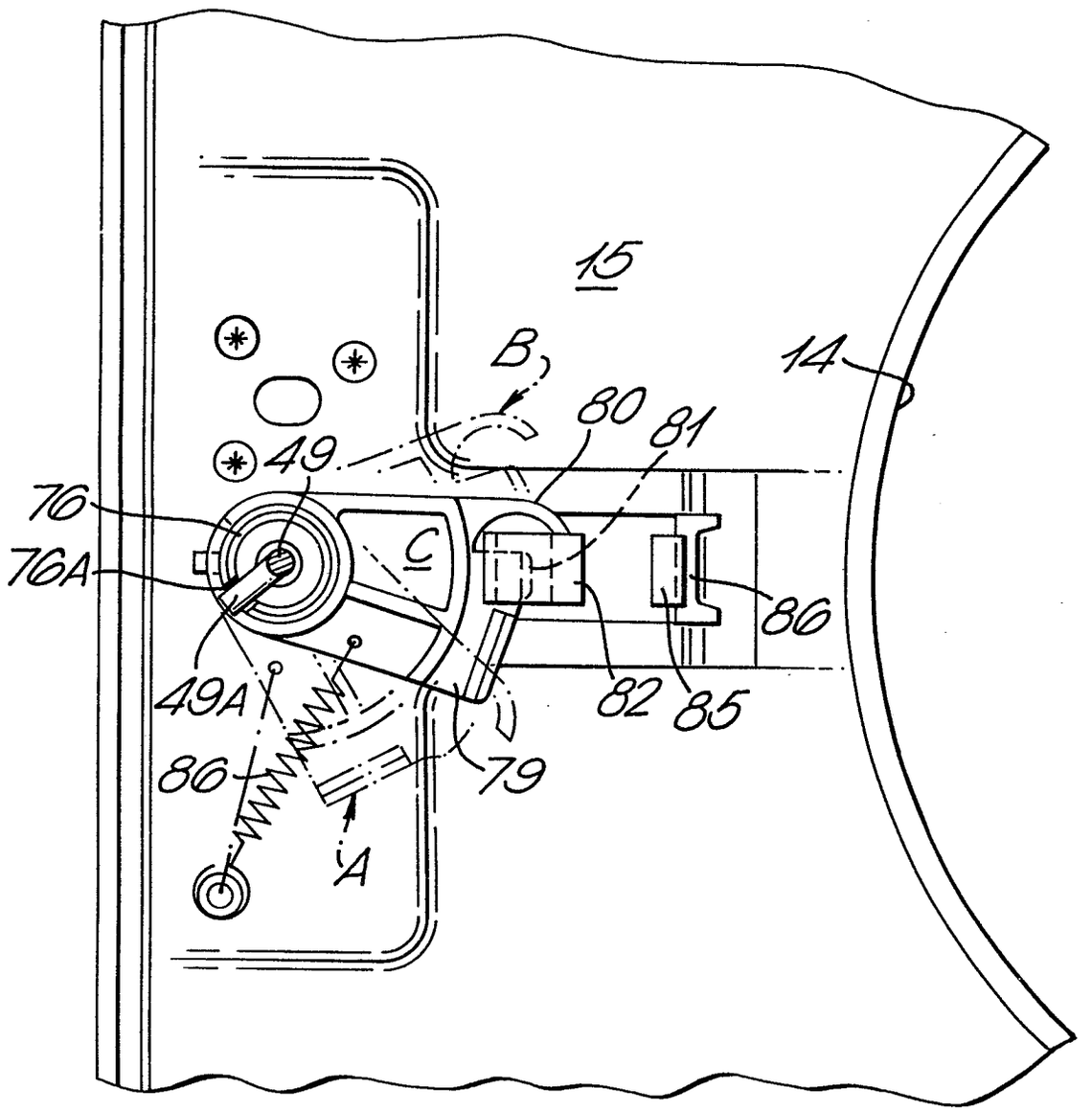

FIG. 8.