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(54) **Electromagnetic control device for remotely controlling electric switches and the like.**

(57) An electromagnetic control device for remotely controlling electric switches, contactors, and the like, utilizing partly movable and partly fixed internal core electromagnets (7,8) with a direct engagement slide or bar (35) with the switch toggle adapted for actuating said toggle in the on and off modes, and an engagement lug or lever for directly controlling the toggle of an electric limit switch provided for supplying said electromagnets, as well as a rocker lever linkage associated with a display window for monitoring the on/off positions and the automatic mode of operation, and a safety device effective to automatically shut off, through a microswitch, the power supply to the electromagnets (7,8).

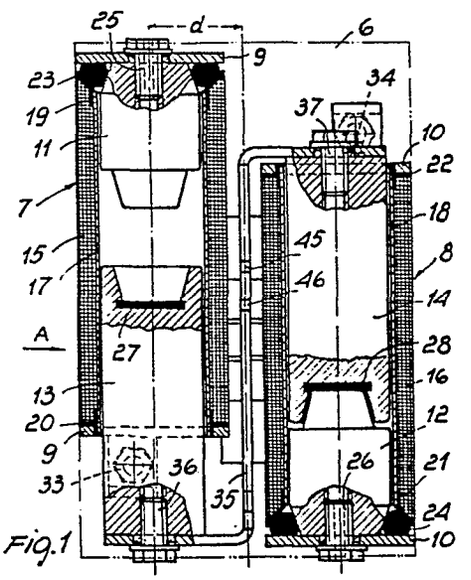

Fig.1

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This invention relates to an electromagnetic device for remotely controlling electric switches, contactors and the like, and in particular low voltage switches of the boxed design type.

Various types of electromagnetic controls for remotely controlling switches of the boxed or open design type, so constructed as to also enable their manual operation in a safe condition and to allow the automatic operation of the switch in the event of overloads or a short. Some of these types utilize a single electromagnet of a size suiting the operation which requires the maximum amount of energy (shutting off of the switch), but this solution has in actual practice some serious shortcomings, as is well known to the expert in the art. Other types of electromagnetic controls utilize two electromagnets, each electromagnet being equipped with two cores (or keepers), of which one at least is movable; with said movable cores, there is associated a linkage including levers which are connected to a slide engaged with the control handle or rod of the switch. The movement of said movable cores in the opposite direction results in the closing or opening, and resetting or cocking of the control.

These controls with two electromagnets also exhibit , in practice, several drawbacks and limitations, such as, above all, appreciable efficiency losses due to the presence of a lever

drive and to the friction between the levers and control slider, fairly important overall dimensions, and the impossibility of adjusting them, with a few and simple replacements of control component parts, to the various power values and various dimensions of the switches to be controlled.

Thus, this invention sets out to provide an electromagnetic control device of limited bulk, which can be attached and removed with great ease, without requiring additional work on the apparatus whereto it is attached, and to utilize the same component parts of the control in order to fit it to any switch rate (from 100 to 1,000 A) by a mere mounting expedient and by just changing the number of the ampere-turns, as the switch rate varies, in that the energy required for operating the switch varies.

Within that general aim, it can be arranged that the device according to this invention allows manual operation on the field, with the exclusion or overriding, at the same time, of the remote electric operation capability and with mechanical monitoring of the on and off positions, as well as of the position of automatic operation of the switch.

It can be further arranged that the device of this invention is of an extremely simple construction, and at the same time capable of ensuring, within much reduced bulk dimensions, a high operation efficiency, with consequent economical and practical advantages over other

known devices.

It is further possible to arrange that the control device of this invention affords direct application of the operating power to the switch without involving the use of transmissions or linkages of a special design or the storing of energy.

It is further possible to arrange that the control device of this invention is a quick action one allowing tripping times below 100 ms, while retaining small dimensions, for the purposes of emergency change-over in operation.

It is further possible to arrange a device according to the invention which, when it is desired to gain access to the inner parts of the control by removing the cover, can cut out or override the remote electric operation of the control, with the attendant advantage of providing a control device which is simple and compact, of a limited cost which does not affect appreciably the cost of the apparatus whereto it is incorporated, thus allowing an easier and more economical application of the device to the remote control of non-monitored places or automatisms, and where emergency change-over is needed.

According to one aspect of the present invention, there is provided an electromagnetic device for remotely controlling electric switches, contactors, and the like, utilizing partly movable and partly fixed internal core electromagnets,

characterized in that it comprises at least two electromagnets which are arranged with their longitudinal axes parallel to each other and with the respective cores at opposite locations, at least one of said electromagnets being intended for the closing operation and at least another for that of opening the switch, the movable cores of said electromagnets being interconnected mechanically by transmission means which, by virtue of the opposite location of the cores, produce the away movement of two cores in one electromagnet while the cores of the other electromagnet are moved toward each other, said transmission means being in engagement with the control lever or toggle of said switch, there being also provided circuit means controlled by said transmission means to automatically control the current supply to one of the electromagnets while the other is operative, said circuit means being in communication with the remote control station.

It will be apparent that the device is so constructed as to be easily and readily applicable and removable to and from the apparatus to which it is to be applied, without requiring modifications of the latter and above all as easily and readily adaptable to the various dimensions and power of the switch to be operated, relatively to the energy required for operating the switch.

The constructional and operational features of the electromagnetic control according to the

invention are described in detail hereinafter, with reference to a preferred and not limitative embodiment thereof and to the accompanying illustrative drawings, where:

Figure 1 is a diametrical axial section showing the main parts of the control according to the invention, and in particular the two electromagnets as interconnected by a transmission bar;

Figure 2 is a side view, taken in the direction of the arrow A, of the parts shown in Figure 1;

Figure 3 is a front view of the front inner part of the inventive control;

Figure 4 is a mid-sectional view, taken along the line B-B, of the control shown in Figure 3;

Figure 5 is a sectional view of a detail of Figures 3 and 4; and

Figure 6 shows diagramatically the feeding or supplying circuit, and related control pushbuttons, of the control according to this invention.

With reference to the drawing figures, and in particular to Figures 1 to 4, the electromagnetic control according to this invention comprises a box-like body 1, which is open at the rear and closed at the opposite end by a plate 6, wherewith a cover 2 is associated which is secured to the plate 6 as by three screws 3,4,5 (Figures 3-4); on the load-bearing plate 6, and specifically on its side facing inwardly with respect to the box-like body, there are arranged two electromagnets 7 and 8, whereof, for example, the one indicated at 7 is

intended for closing and the other for opening and re-cocking (i.e. resetting to the rearmost or initial position of the related movable core) the switch after each automatic operation thereof.

Each electromagnet comprises a magnetic circuit 9, and respectively 10, of iron and of substantially C-like shape, including respectively the fixed cores (or keepers) 11 and 12 and movable cores 13 and 14; all such cores are mounted inside the respective energization coils 15 and 16, which are so dimensioned as to supply the magnetic energy required for operating the switch in the on and off modes, respectively.

The coils 15 and 16 are structurally identical to each other and comprise an electric circuit wound on tubular metal supports 17, and respectively 18, at the opposite ends whereof there are arranged insulating clamping ring nuts 19-20 and 21-22; the ring nuts 20 and 22 comprise cylindrical bodies which are butt inserted into the respective tubular support or holder of the electric circuit and have a shoulder abutting against the cylindrical rim of the magnetic circuit thereby, with the cylindrical portion of the ring nut inserted into the cylindrical body of the electric circuit, a perfect centering of one end of the coil is achieved to the axis of the respective magnetic circuit.

The opposite ring nuts 19-21 comprise cylindrical bodies having a frusto-conical flared portion which protrudes outwardly from the tubular supports 17-18 such as to allow the assembling and fastening of the

coil ends to the magnetic circuits 9-10 with the interposition of an O-ring 23, and respectively 24, and the clamping thereof between the arcuate portion of the respective magnetic circuit, at the fixed core 11, and respectively 12, and the conical surface of the ring nut. The clamping is effected through the screws, respectively 25 and 26, which are also used for securing the fixed cores to the respective magnetic circuit.

The C-like magnetic circuits 9 and 10 are attached to the supporting plate 6 through screws not shown in the drawings.

The fixed keepers 11 and 12 have a cylindrical shape, and are terminated in a truncated cone, whilst the movable keepers 13 and 14 terminate in a conical recess adapted for accommodating the respective truncated cones of the fixed cores 11 and 12, whereon said movable cores end their strokes by striking them in a dampened mode as allowed by the respective elastic pads 27 and 28, formed from rubber or any other similar material.

The arcuate ends of the magnetic circuits, respectively indicated at 29-30 and 31-32, form the mounts whereby the control is attached to the switch. The attachment is made by means of two screws 33 and 34 which are mounted on the ends 30 and 31 of the magnetic circuits, whereas the other two ends 29 and 32 are simply brought to rest thereon.

The two movable cores 13 and 14 are rigidly linked to each other through a plate-like slide or bar 35

having its opposite ends folded to a right angle in opposite directions and connected, through the screws 36-37, to the head of the movable cores.

The slide 35 has a quadrangular slit 38, to the opposite edges whereof two reinforcing snugs 39-40 (Figure 4) are rigidly connected between which snugs the control lever 41 of the switch to be operated is inserted.

The rigid interconnection of the movable cores by means of said transmission slide or plate 35 causes the two movable cores to act as mutual guides during their movement with respect to each other, the actuating force being applied to the lever 41 of the switch to be operated (no further illustrated), rather than in the shift plane of the latter, with an arm or offset "d" (Figure 1) with respect to the axis of the slide, which offsetting is significant both structure-wise and operation-wise.

The transmission slide or bar 35 is thus enabled to travel parallel to the axes of the coils, through the unobstructed space left between the close-together coils and in a perpendicular plane to the load-bearing plate 6.

On the load-bearing plate 6, on the opposite side to that supporting the electromagnets 7 and 8, there is pivoted at 42 (Figures 3-4) a lever 43 operated by the transmission slide 35 through its lug 44 becoming engaged in the yoke 45-46 which projects from the slide 35; thus, the slide entrains the lever 43-44 in its linear reciprocating motion.

Said lever 43 is, moreover, formed with two widening portions 43a and 43b carrying two opposite adjusting screws 47 and 48, wherebetween is inserted the lever 49 for operating an electric end-of-travel change-over switch 50, attached to the load-bearing plate 6. Thus, the translatory movement of the slide 35 drives the lever 49 and the preset adjustment of the screws 47-48 causes that actuation to occur at each travel end of the transmission slide 35. The change-over switch 50 is provided with an insulating covering cap 51, adapted to prevent the accidental establishment of an electric contact by the operator upon removal of the cover 2.

On one side of the change-over switch 50, there is provided a terminal board 52 whereto are connected the necessary internal and external electric connections for supplying the coils as well as the connections leading to the pushbuttons 74 and 75, which connections are shown diagramatically in Figure 6.

Said pushbuttons 74 and 75 are normally remotely located with respect to the switch to be changed-over, and may be of any desired type, including a type responsive to the magnitude or occurrence of certain parameters.

Also on the load-bearing plate 6, there are provided a manual actuating device for the control, and accordingly the switch itself, and a safety device effective to cut off the electric supply to the control either during the manual operation and the

inspection of the control.

In particular, for manual control, a lever 53 (Figures 3,4,5) is provided which is pivoted to the pin 54 carried by two supports 55 and 56 attached to the plate 6 by means of screws or rivets, which lever engages,with its yoke-like end 57 and the pin 58 rigid therewith, in the groove 59 of the slide 35.

The lever 53 is terminated at its other end in a hole 60, wherethrough a manual actuation rod 61 is inserted for manually operating the control, and accordingly the switch, on the spot.

To the lever 53 and pin 54, there is keyed an insulating sector 62 which serves the function of indicating,by means of the letters I and 0, visible through the window 63 of the cover 2 (Figure 3),the switch on and off positions, respectively. The automatic cut-in position is indicated by the letters I and 0 becoming visible, as explained hereinafter.

In fact, the sector 62 can slide axially on the pin 54, and is held in the position shown in Figure 5 by means of the spring 64, thereby the two holes, respectively 60 in the lever 54 and 65 in the sector 62, cannot remain aligned and do not allow the rod 61 to be inserted.

The end 66 of the sector 62 contacts the lever 67 of a microswitch 68 attached to the plate 6 by means of the metal support or holder 69 with two screws; the microswitch 68 is covered by an

insulating cap intended to prevent accidental electric contacts by the operator upon removal of the cover 2.

Together with the microswitch, there is blocked to the support 69 also a lever 70, whereon there acts a biasing or pressing pin spring 71.

The two electromagnets 7 and 8 are arranged for DC operation; the device may also be fed with AC current by including rectifying or Graetz bridges 72 and 73 (Figure 3), one for each coil, which will supply to said coils a rectified direct current adequate for actuating the control.

The control device described hereinabove operates as follows. To provide the closure (Figure 6), with the end-of-travel change-over switch 50 and microswitch 68 already preset for supplying the closure coil 15, the pushbutton 74 is brought to close, thereby the coil 15 is energized which causes a quick and effective attraction of the movable core 13 toward the fixed core 11. That action is transmitted through the slide 35 and snug 40 to the lever 41 of the switch, which is then moved upwards to produce a fast (less than 100 ms) closure of the switch. The movable core 13 ends its travel in abutment against the fixed core 11 through its dampening pad or bumper 27.

At the end of the travel of the movable core 13, the slide 35 operates, through the yoke 45-46 and lever or lug 44, the lever 49 of the end-of-travel or limit switch 50, to thus cut off the power supply to

the coil 15 and switch the power supply over to the opening coil 16. The movable core 13, being made rigid to the movable core 14 through the slide 35, during its movement entrains the core 14 along and moves it away from the fixed core 12.

During its stroke movement, the movable core 13 also entrains, through the slide 35, the lever 53 which, by pivoting about the pin 54, actuates the indicator 62, which brings the character I into view through the window 63 cut through the cover 2.

To open the switch the following procedure (Figure 6) is followed: the pushbutton 75 is closed such as to energize the opening coil 16, which results in a quick and effective attraction or drawing of the movable core 14 toward the fixed core 12, from which it had been removed during the preceding closing operation.

This action is transmitted, through the slide 35 and snug 39, to the lever 41 of the switch, which is thus moved downwards to open the switch. Again, the movable core 14 ends its stroke by abutting the fixed core 12 with the dampening pad 28.

At the stroke end, again through the slide 35, the yoke 45-46 and lever or lug 44, the lever 43 is operated of the travel limit switch 50 to cut off the power supply to the coil 16 and switch the supply over to the closing coil 15.

During its stroke, the movable core 14 entrains through the slide 35 the lever 53 as well which,

again by pivoting about the pin 54, actuates the indicator 62, which brings the character 0 into view, also through the window 63 cut through the cover 2.

To operate in the manual mode through the pull-out lever 61 (Figures 3,4,5), the lever 61 is introduced, after displacing the sector 62 against the bias of the spring 64 (Figure 5), into the two holes 60 and 65; thus, it becomes possible, by moving the lever 61 downwards or upwards, to close and open the switch, inasmuch as that action is transmitted (through the lever 53 and pin 58) to the slide 35, and consequently to the actutaing lever 41 of the switch.

The displacement of the sector 62 along the axis of the pin 54 operates the lever 67 of the microswitch 68, thus cutting off the power supply to the control and preventing any inadvertent remotely controlled electric operations while the manual operation is going on.

Finally, to inspect the control, it is not necessary to disassemble the equipment whereon it is mounted; it will be sufficient to remove the cover 2 after threading out the screws 3,4,5 and to remove the cover by pulling it toward the operator.

This operation allows the pin spring 71 to apply its action to the lever 70 which, by rotation, acts at all times on the lever 67 of the microswitch 68, to cut off the electric supply to the control and prevents, in this case too, any inadvertent remotely controlled electric operations while the

switch is being inspected.

Obviously, to the invention as described with reference to a preferred embodiment thereof, there may be applied structurally and functionally equivalent variations and modifications without departing from the purview of this inventive concept.

Thus, for example, instead of two electromagnets only, more than two may be provided with more than one transmission bar. Moreover, instead of a rigid transmission bar, suitable transmission links may be provided, such as racks coupled with pinion gear trains, or articulated lever systems.

CLAIMS

1. An electromagnetic device for remotely controlling electric switches, contactors and the like, utilizing partly movable and partly fixed internal core electromagnets, characterized in that it comprises at least two electromagnets (7,8) which are arranged with their longitudinal axes parallel to each other and with the respective cores (11-13, 12-14) at opposite locations, at least one of said electromagnets (7,8) being intended for the closing operation and at least another for that of opening the switch, the movable cores (13,14) of said electromagnets (7,8) being interconnected mechanically by transmission means (35) which, by virtue of the opposite location of the cores (11-13,12-14), produce the away movement of two cores in one electromagnet while the cores of the other electromagnet are moved toward each other, said transmission means (35) being in engagement with the control lever (41) or toggle of said switch, there being also provided circuit means (50,15,16) controlled by said transmission means (35) to automatically control the current supply to one of the electromagnets (7,8) while the other is operative, said circuit means (50,15,16) being in communication with the remote control station.

2. A device according to Claim 1, characterized in that said electromagnets (7,8) are arranged in side-by-side positions and that said transmission means comprise a bar (35) placed between the electro-

magnets (7,8).

3. A device according to Claims 1 and 2, characterized in that it comprises a box-like body (1) with a cover (2) which can be opened and a support plate (6) therein, whereto said electromagnets (7,8) are attached, and that said circuit means comprise an end-of-travel or limit switch (50) having a control lever (49) operated through said transmission bar (35), as well as a rocker lever linkage (53) associated with visual indicator means (63) indicating the closed-open and automatic cut-in positions, adapted to enable the actuation of the control through a pull-out lever (61), with said linkage (53) for manual actuation there being finally associated a safety device (51) adapted for automatically cutting off, through a microswitch (68), the power supply to the electromagnets (7,8) either during the manual actuation of the control or upon withdrawal of the protective cover (2) for inspection of said control.

4. A device according to Claim 1, characterized in that said means of engagement with the control lever (41) of the switch comprise a slit (38) formed on one side of said transmission bar or slide (35) and reinforced by opposite snugs (39, 40) or the like, wherebetween said control lever (41) is freely inserted.

5. A device according to Claim 1, characterized in that said other actuation means of the lever (49) of said limit switch (50) comprise

a yoke (45-46) or the like, also formed on said transmission slide (35), wherein there is inserted the end of a lever (42 and 14) oscillating about a fixed pivot pin, which lever includes screw engagement means adjustable for engaging with the actuating lever (49) of said limit switch (50), supplied through a terminal board (52) and connected to the coils of said electromagnets (7,8).

6. A device according to Claim 1, characterized in that said oscillating lever linkage for manually operating the control comprises a lever pivoted (53) centrally to said support plate (6), having, at one end (57), a member of engagement with a slot or slit (59) formed in said transmission slide (35), and at the opposite end, an axial hole (60) adapted for receiving a control lever (61) of the manually operated pull-out type, with said protective cover (2) closed.

7. A device according to Claims 1 and 4, characterized in that on said lever pivoted (53) centrally on said support plate (6) and provided with a hole (60) for the manual operation rod (61), there is keyed an insulated sector (62) carrying usual visual indications of the closed and open switch positions, which sector is provided with a hole (60) for the passage of said manual control lever or rod (61) and is mounted slidably, against a biasing spring (64), along the axis of the pivot of said lever (53) to be driven through said lever or

rod (61), such as to permit, at each axial movement of the insulated sector (62), the actuation of a microswitch (68) adapted for cutting off the power supply to the entire control during the manual control operation, the movement of said sector (62) being produced automatically as said lever (61) is inserted into the holes (60-65) of the sector (62) and of the oscillating lever pivoted (53) on the load-bearing plate (6), which holes are held offset by said biasing or return spring (64).

8. A device according to Claims 1, 4 and 5, characterized in that between the openable cover (2) of the box-like body (1) and the end of the slidable insulated sector (62) there is interposed a lever (67) oppositely located to a biasing or pressing spring (71), adapted for automatically actuating said safety microswitch (68) upon removal of the cover (2) to enable inspection operations of the inner parts of said control.

9. A device according to the preceding claims, characterized in that said movable cores (13-14) of each electromagnet (7,8) are provided at the heads thereof with elastic pads (27,28) adapted for dampening the impacts against the respective fixed core (11, 12) during the opening and closing operations.

10. An electromagnetic device for remotely controlling electric switches and the like, according to the preceding claims, characterized in that it comprises substantially C-like magnetic circuits (9,10) adapted to enable a quick replacement of the coils (15,16) with others having different dimensions in

accordance with the rate of the switch types whereto the control is to be applied.

11. A device according to the preceding claims, characterized in that it comprises a rectifying bridge for each coil (15,16) adapted to supply a rectified DC current where the power supply is an AC power supply.

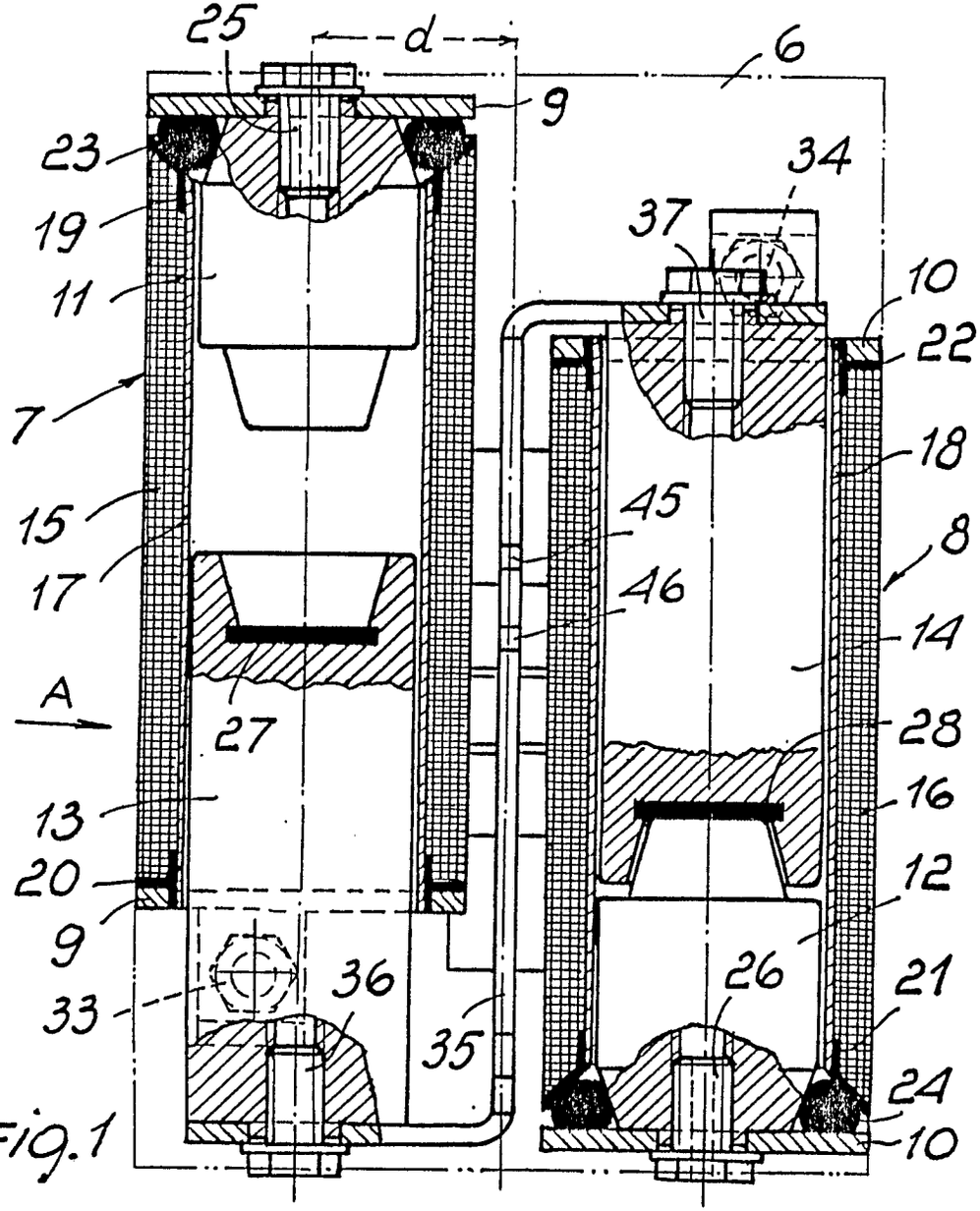

Fig.1

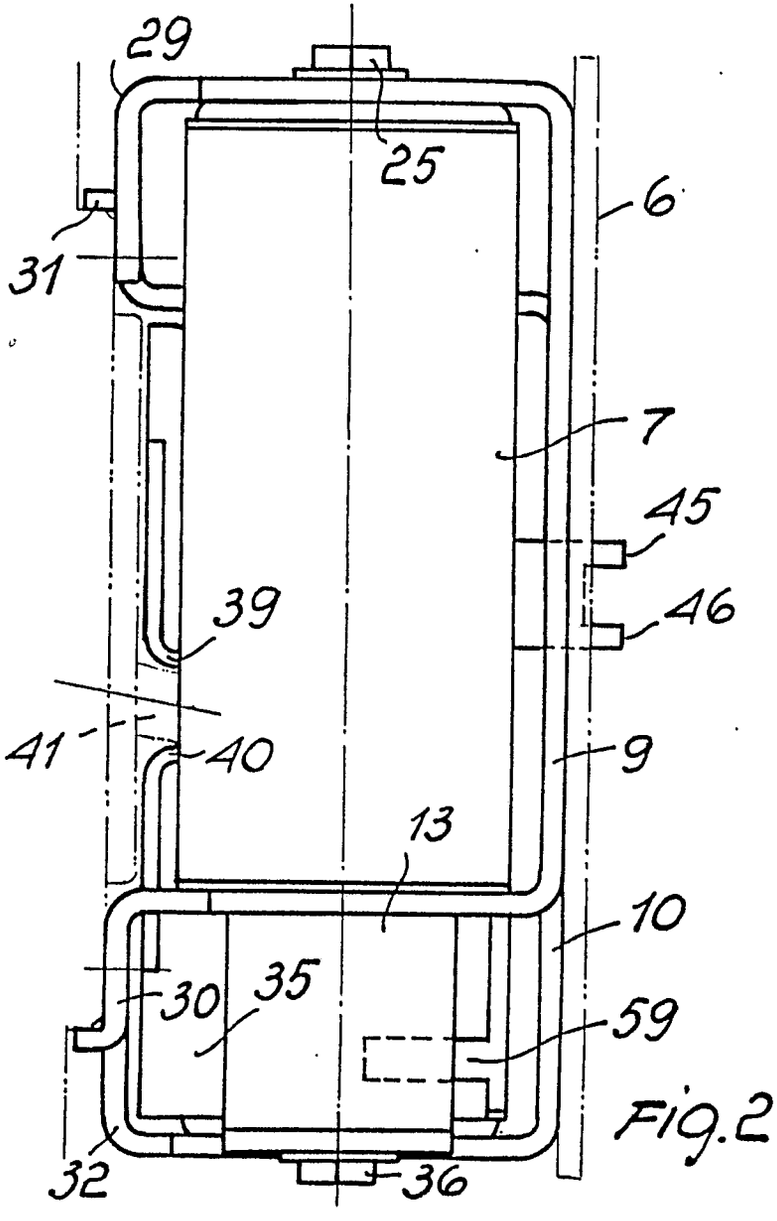

Fig.2

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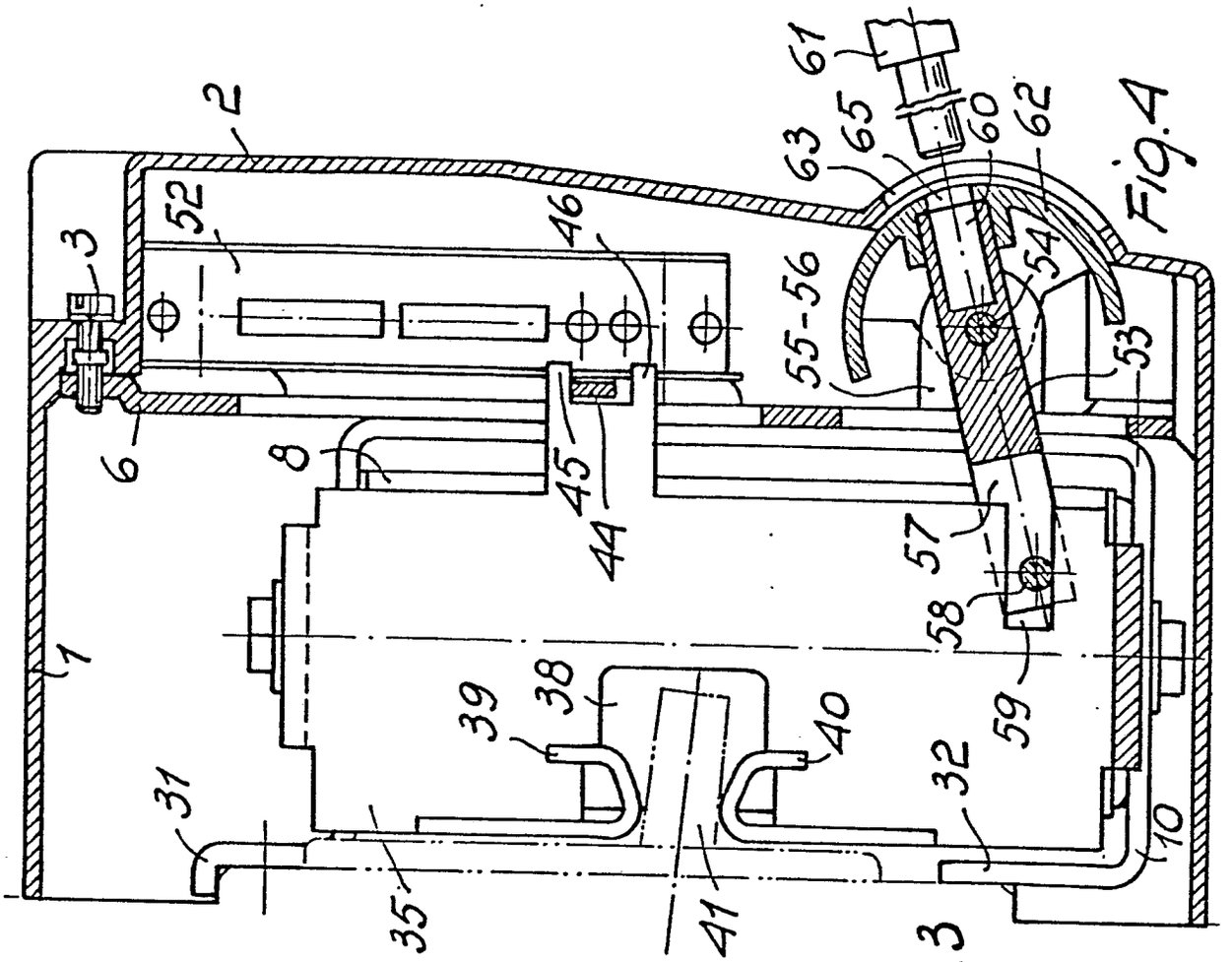

Fig.4

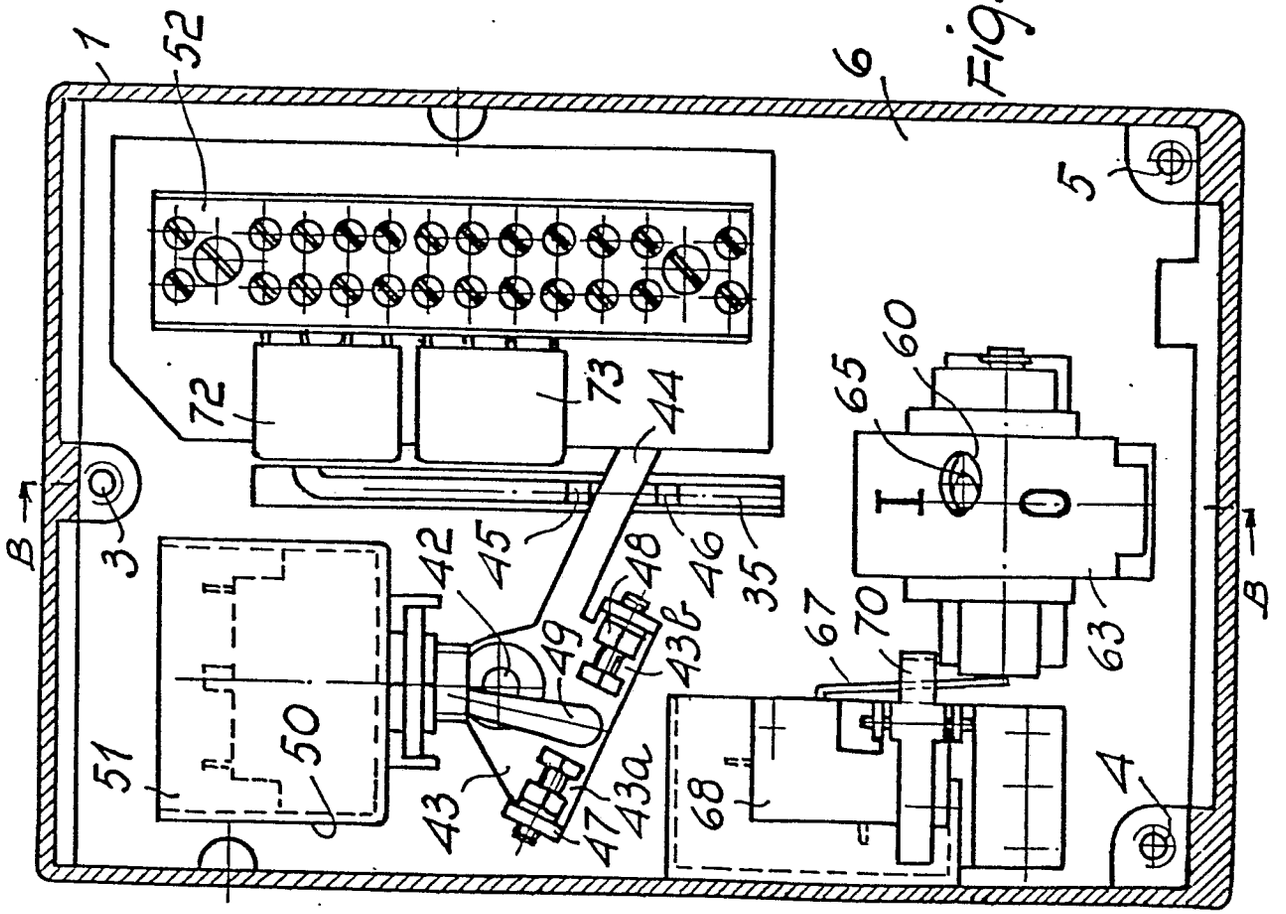

Fig.3

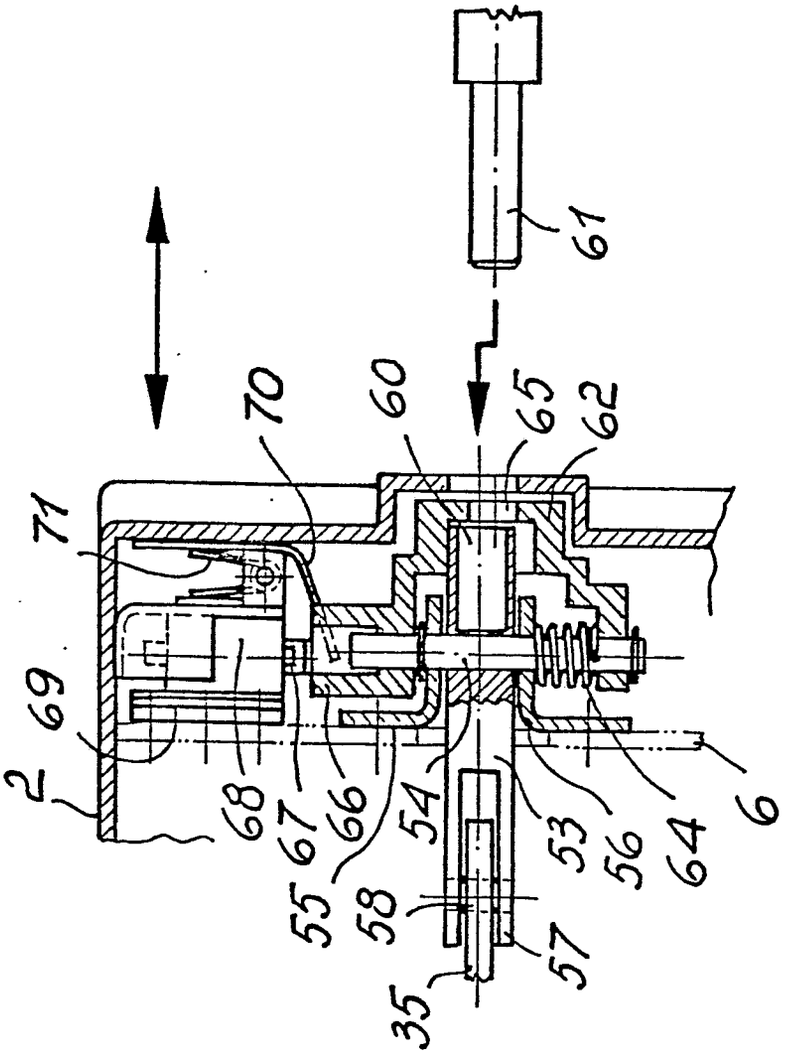
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Fig. 5

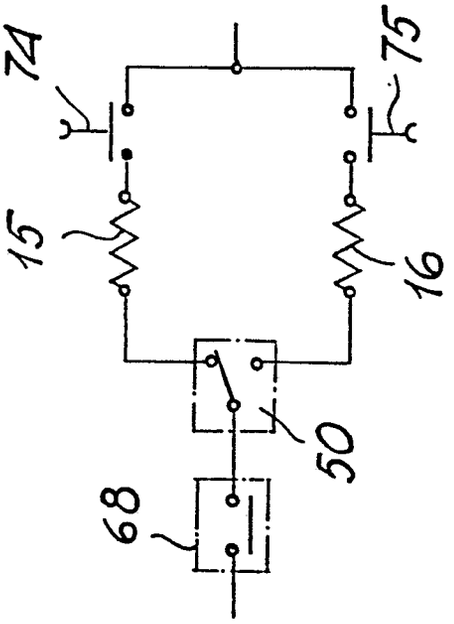
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Fig. 6

European Patent Office

0039758

Application number

EP 81 10 0457

EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	US - A - 3 893 050 (WESTINGHOUSE)	1,3,11
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	US - A - 3 211 955 (WESTINGHOUSE) * Column 2, lines 40-52; column 5, lines 61-75; column 6, lines 1-62; column 8, lines 22-51 *	1,3
	--	
	US - A - 3 069 518 (CONTROLLIX CORP.)	1,3,5
	--	
	US - A - 3 435 390 (AUTOMATIC SWITCH COMP.) * Column 1, lines 23-25; column 2, lines 43-46; column 3, lines 35-42; column 4, lines 5-7 *	1,2

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

H 01 H 3/28

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

H 01 H 3/28
71/68
33/38
3/22
33/28
71/66
51/12
51/14
51/16

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20-08-1981	DESMET