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(54) Medium voltage switch with three positions insulated in sulphur hexafluoride.

(57) A medium voltage operating-isolating switch with three positions insulated in sulphur hexafluoride comprising a set of three poles, each pole comprising a fixed contact (14) and a mobile contact (26), the fixed contact carrying an associated male arcing contact (17) and the mobile contact being arranged on a pivoted arm (25) rotatable between a first closed position in engagement with the fixed contact, a second isolated position and a third earthed position. The mobile and fixed contacts of the set of three poles are arranged on three insulating base support elements (11) fixed to a single support beam (12), a relative cylinder (13) which pumps the sulphur hexafluoride into the insulating nozzle (15) being associated via an insulated lever with each of the arms carrying the mobile contacts, a metal draining element (44) being provided between each of the insulating support elements and the pumping cylinders.

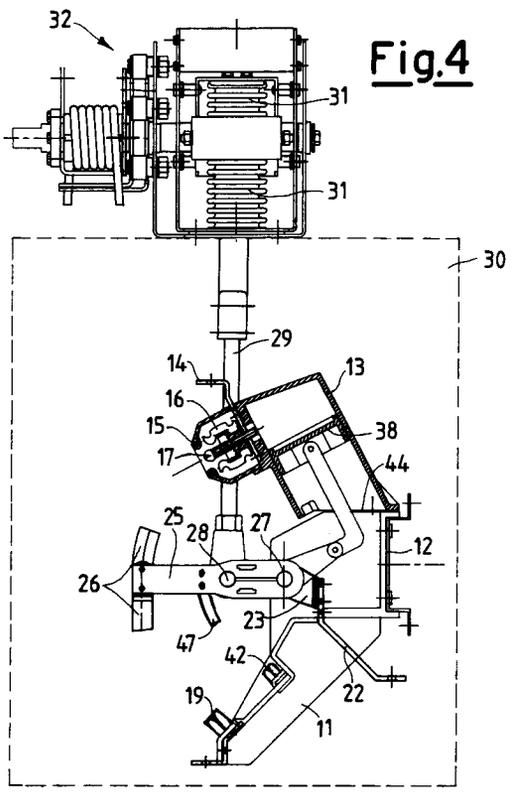

Fig.4

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This invention relates to a medium voltage operating-isolating switch with three positions insulated in sulphur hexafluoride. Various types of so-called on-load isolating switches or alternatively operating-isolating switches in SF_6 for medium voltages up to 24 kV are known. Current regulations and safety requirements, which are increasingly applicable, state that in addition to inaccessibility of the devices unless the switch is open, sufficient visibility of the position assumed by the isolator or rather of all the isolating elements present on the electrical panel must be provided when the switch is closed. Switches of current construction and use do not offer this possibility, for example in switches of rotary contact type it is possible to earth the user but without the simultaneous possibility, when in the isolated position, of drainage between the part under tension and the user, so that a stray current can accidentally discharge onto this latter. In addition if a fuse is present this cannot be earthed simultaneously upstream and downstream. In this respect to achieve this latter earthing, which is necessary for any safe replacement of the fuse, a further separate parallel device must be provided for earthing that region upstream or downstream of the fuse which is not earthed. In other line contact switches with non-visible isolation, a visible isolator with a three-position rotary blade contact (isolated, closed and earthed) is combined with the operating switch, and both have to be operated both for putting the switch on-load and for earthing the user. For earthing the fuse a further separate device is in fact provided for earthing upstream and downstream of the fuse.

Although other line contact switches have a visible isolator for earthing, they have to comprise a second device which is also visible and comprises a second inspection door. If a fuse is present, this second device is doubled for earthing upstream and downstream of the fuse.

In addition in known medium voltage isolating switches there is the problem of positioning those constituent parts of the switch (insulators, contacts etc.) which are not directly mounted on the main body of the isolating switch and have to be arranged in a predetermined position on the external support frame and suitably insulated from this frame.

Furthermore, known rotary and straight-movement switches both suffer from said general problems of visibility or non-visibility of the electrical connections. In particular, in rotary isolating switches it is not possible to see the positions which the contacts assume inside, and worse still, as the inspection door is to the side of the first pole switch, it is not possible to see the next two pole switches to its side. In straight-movement types, such as vertical types, the isolation of the three poles can be observed in two separate different positions.

An object of the present invention is to provide a medium voltage operating-isolating switch with three positions insulated in sulphur hexafluoride which solves the aforesaid problems in terms of positioning, single operation and constructional simplicity of the pole switch with or without a fuse.

A further object is to provide a switch with maximum possible visibility of isolation or effective earthing.

A further but not final object is to provide a switch the component parts of which do not require special positioning within the containing frame, but instead can be directly mounted away from it before insertion.

These objects are attained according to the present invention by a medium voltage operating-isolating switch with three positions insulated in sulphur hexafluoride as claimed in claims 1-13.

In further currently known switches, cylinder-piston pumping devices are associated with the moving contacts arranged on a relative arm by means of hinged levers, to feed fluid onto the cooperating contacts or into the insulating nozzle containing the so-called tulip element.

In this case the contacts and pumping device are arranged one after the other but at a certain distance apart, because of which during its operation the pumping element can be soiled with carbon-containing residues and consequently discharge to earth, in addition to having the drawbacks of the previously described switches.

In addition to the aforesaid objects, a further object is to provide a switch in which there is a reduced possibility of the formation of carbon-containing residues, with the danger of possible discharges to earth.

These objects are attained according to the present invention by an operating-isolating switch as claimed in claims 14-20.

The structural and operational characteristics and the advantages of a switch according to the present invention will be more apparent from the description given hereinafter by way of non-limiting example with reference to the accompanying schematic drawings, in which:

Figure 1 is a front view of an electrical panel comprising three switches according to a first embodiment of the present invention;

Figure 2 is a side schematic sectional view of a first embodiment of the switch forming the panel of Figure 1;

Figure 3 is a side schematic sectional view of a second embodiment of the switch forming the panel of Figure 1;

Figure 4 is a partly sectional side view of Figure 5 in the direction of the arrow F;

Figure 5 is a front view of Figure 4;
Figure 6 is a further enlarged view similar to that of Figure 4 but in a different operating position;
Figure 7 is a front detail of Figure 6;
Figures 8 and 9 are a schematic representation of a switch according to the invention with and without fuses respectively;
Figure 10 is a front view of a further electrical panel comprising three switches according to the present invention;
Figure 11 is a front view of an embodiment of the switch forming the panel of Figure 10 without fuses and in the isolated position;
Figure 12 is a front view of an embodiment of the switch forming the panel of Figure 10 provided with fuses, in the earthed position;
Figure 13 is a partly sectional side view of the switch embodiment shown in Figure 12;
Figure 14 is a front view of a further electrical panel comprising three switches according to the present invention;
Figure 15 is a front view of the interior of the electrical panel of Figure 14 showing the three switches, one of which is provided with fuses;
Figure 16 is an enlarged sectional detail of the switch of Figure 15 shown in the isolated position;
Figure 17 is a sectional detail on the line XVII-XVII of Figure 16;
Figure 18 is a sectional view similar to that of Figure 16 showing the switch according to the invention in the closed position;
Figure 19 is a sectional view similar to that of Figure 16 showing the switch according to the invention in the earthing position; and
Figure 20 is a partly sectional side view of the set of three poles of the switch of Figure 15.

With reference to Figures 1-7, a medium voltage operating-isolating switch with three positions insulated in sulphur hexafluoride according to the present invention comprises essentially a set of three insulating base support elements or insulators 11 for a set of three poles mounted on a support beam 12. An upper fixed contact 14 with an associated tulip element 16 comprising a male arcing contact 17 and contained in an insulating nozzle 15 are fixed respectively onto each support element 11, which extends upperly into a pumping cylinder 13. The fixed contact 14 is connected in known manner to a respective bus bar 18.

The support element 11 also carries a lower contact 19 connected to an earthing plate 21 via a through insulator 20.

A third intermediate contact 22 is fixed to the support element 11 and is secured to a U-piece 23, in holes 24 of which there is pivoted a T-shaped arm 25 in the form of two spaced-apart facing plates, carrying at its free end a pair of arcing contacts 26. Electrical contact between the U-piece 23 and the arm 25 is ensured by cup springs 45. This assembly forms a moving contact which is connected via a through insulator 43 to a current inlet or outlet. The pivoting is provided by a shaft 27 of insulating material which passes through each of the three poles, is supported on the support elements 11, and supports the cup springs 45 in addition to the U-pieces 23 and the arm 25.

The arm 25 is also connected to and its position controlled by a second insulating shaft 28, which also passes through all three arms of the moving contacts to act as a pivot. The arm 25 is rotated by two insulating rods 29 which emerge from a sealed metal container 30 containing sulphur hexafluoride and from metal seal bellows 31, and are controlled by a quick snap-engagement mechanism for the three positions, which is indicated overall by 32 and can be operated from the outside of the front of the switch by a rod, not shown. This device converts rotation into a linear movement determining the three operating positions, namely closed, isolated and earthed.

In addition two insulating levers 33 are provided, each having a pair of through holes 34 and 35 through which the shafts 27 and 28 are inserted. The levers 33 are angular and at their free end they are connected by a pin 36 to a pair of second levers 37 which move a piston 38 connected to them by a further pin 39.

A metal draining blade 44 of equivalent shape has to be arranged between the support element 11 and the cylinder 13 to prevent any current circulation and passage between the isolated parts.

Such a structure provides a simple operating-isolating switch without fuses.

If fuses 46 are required to protect a transformer, not shown, a bar 41 joining three contacts 42 on the support elements is mounted in a suitable seat 40 in the lower part of the support element 11 at a sufficient distance from the lower contact 19 to ensure the necessary isolation required by the regulations for the relative class, and is earthed as in the case of the beam 12. In this case the lower contact 19 is completely isolated by eliminating the through insulator 20 and the through insulator 43 and connecting the two contacts 22 and 19 together downstream and upstream of a fuse 46. The fuse outlet is again connected to a through insulator entirely similar to 43.

In a complementary manner each T-shaped arm 25 has to carry a single contact 47 for engagement with said contacts 42.

In this manner on rotating the arm 25 into the earthing position, simultaneous earthing upstream and downstream of the fuse 46 is achieved by the connection between the moving contacts 47 and 26 associated with the contact 22, and the lower fixed

contacts 19 and 42.

Both the switch provided with only the fixed contacts 19 and moving contacts 26 and the switch provided with said contacts and with further fixed contacts 42 and moving contacts 47 are diagrammatically represented in the schematics of Figures 8 and 9 in the isolated position. These schematics again show that earthing can be achieved by a single arm carrying the moving contact, and that if a fuse is present earthing can be achieved both upstream and downstream of the fuse, again by a single arm carrying moving contacts.

With reference to Figures 1 to 3 it can also be seen that in an insulated electrical panel formed from three switches of the present invention, by providing a single door 48 for each switch it is possible to see whether the individual switches are in the isolated position or not. It can also be seen that the upper front part of the panel comprises the seat 49 for inserting the operating lever (not shown) for association with each quick snap-action mechanism 32 which via the linear control represented by the rod 29 switches between the three positions of the moving contacts 26 and optionally 47 of the switch.

If the switch is provided with fuses (Figure 3), according to the present invention the fuses 46 are positioned horizontally in an extractable drawer 50 aligned below the insulators coaxial with the three constituent poles of the switch. This positioning of the fuses allows them to be easily extracted and replaced frontally.

Figures 4 and 6 show how the switch of the present invention can be comfortably assembled in all its essential parts on a rear beam 12 in the workshop. In this respect, when the switch has been assembled and completed on said beam, the beam has merely to be fixed to the interior of the panel structure and the relative conductors connected. This thus eliminates the need for arranging the contacts or special connectors for the insulated support elements in predetermined positions within the panel.

Figures 10-13 show a further medium voltage operating-isolating switch with three positions insulated in sulphur hexafluoride according to the present invention in which the set of three insulating base support elements 11 is arranged transversely to the panel. In this embodiment, equal reference numerals indicate equal elements. Again in this case, the fixed contact 14 is connected in known manner to a respective bus bar, not shown, and the through insulator 20 to an earthing plate, not shown.

The pivoting is achieved by a shaft 27 of insulating material which is inserted through each of the three poles and is supported by the U-pieces 23 and the support elements 11. The arms 25 of the three poles are fixed by pins to the shaft 27, coaxial to which there are also the springs 45.

The arms 25 are rotated by a flanged extension 128 thereto, which is connected to a complementary flange 124 also extending into a shaft portion emerging from a sealed metal container, not shown, containing the sulphur hexafluoride. In an equivalent manner, on the front of the switch there is a quick snap-action mechanism, indicated overall by 32, for engaging the three positions.

Both the switch provided with only the fixed contacts 19 and moving contacts 26 and the switch provided with said contacts and with further fixed contacts 42 and moving contacts 47 are diagrammatically represented in the schematics of Figures 8 and 9 in the isolated position.

With reference to Figures 10-13 it can be seen that the upper front part of the panel comprises inspection doors 48 and seats 49 for the insertion of the operating lever (not shown) to be associated with each quick snap-action mechanism 32 to switch between the three positions of the moving contacts 26 and optionally 47 of the switch.

If the switch is provided with fuses (Figures 12 and 13), according to the present invention the fuses 46 are positioned horizontally in an extractable drawer 50 aligned below the insulators and the three constituent poles of the switch. This positioning of the fuses also allows them to be easily extracted and replaced frontally.

With reference to Figures 14-20, a further compact three-position medium voltage operating-isolating switch insulated with fluid such as sulphur hexafluoride according to the present invention comprises essentially a set of three insulating base support elements or insulators 210, 211 of T-shape with curved arms and a widened base, mounted on two rear support ties 212, for example for the set of three poles.

Each support element is of specular box type and consists of two mutually complementary parts 210 and 211 connected together by connection means which in the illustrated example consist of holes 213 and relative projecting pins 214 on one and the other of the parts 210, 211.

This connection also fixes an upper fixed contact 215 with an associated male arcing contact 216, and a lower contact 217 with an associated male arcing contact 218. The fixed contact 215 is connected in known manner to a respective bus bar 219, whereas the lower contact 217 is connected via a through insulator 220 to an earthing plate 221.

When formed, the support element 210, 211 also carries in a hollow part of its widened base a third intermediate contact 222 which is fixed to the support element 210, 211 by a U-piece 223 closed lowerly and provided with pin extensions 224 on

which there is pivoted a hollow cylindrical support 225 of insulating material for a telescopic arm connected to the intermediate contact 222. The pin extensions 224 lie within the cylinder 225 and are maintained rigid with a first fixed expandable outer cylindrical portion 227 of said telescopic arm. Electrical contact is ensured by cup springs 235 provided within recesses 236 formed in the pin extensions 224 and interacting between the support element 210, 211 and said recesses 236. A second cylindrical portion 228 is slidingly guided within said fixed portion 227 and carries at its free end, rigidly joined to its interior, a tulip contact element 229 acting as a female arcing contact. The outer part of this free end of the second portion 228 is supported within an annular support element 230 which is pivoted at 226 within a first end of two half-arms 231 of insulating material. The other end of the two half-arms 231 is provided with a through hole 232 and is pivoted to the support element 210, 211 in further holes by a central shaft 233, which is also the operating shaft. For engaging the three positions of the switch, a quick snap-action mechanism 237 is connected to the shaft 233 in a lateral position on one side.

The annular support element 230 comprises a front hole 234 constituting the emission portion for the fluid, such as sulphur hexafluoride, which quenches the arc and is contained in the expandable chamber defined by the two portions 227, 228 of the telescopic arm.

This described telescopic arm assembly forms a moving contact which is connected via a through insulator 243 to a current inlet or outlet.

Between that portion of the support elements 210, 211 carrying the upper contact 215 and the remaining portion of the support elements, through holes, which are cut and open towards the outside to separate portions of the support elements, are provided to receive metal draining bars 244 of equivalent shape to the holes for preventing any current circulation and passage between the parts when isolated.

Such a structure forms a simple compact fuseless operating-isolating switch of fluid type which by making the cylinder pumping element for the fluid, such as sulphur hexafluoride, rigid with and incorporated in the moving arm prevents deposition of any carbon-containing residues and hence avoids operational defects and discharges to earth.

If fuses 246 are required to protect a transformer, not shown, U-shaped contact elements 239 of bar form are mounted on the lower part of the support element 210, 211 in correspondence with holes 238. The sides of the contact elements 239 are elastically yieldable and are mounted on the lower support tie 212, with their free ends facing a slot 240 formed centrally in two halves between the two support elements 210, 211. Into this slot 240 there is inserted a free end of an open L-shaped contact element 241 which is fixed in proximity to its other end to the body of the half-arms 231. The other end of the contact element 241 abuts against a contact extension 242 which is inserted radially into the top of the annular support element 230 so that it makes contact with the free end of the second portion 228 of the telescopic arm. This structure ensures that with the switch in the contacts-closed position there is no interference between the contact elements and/or undesirable current passage, whereas when in the earthing position there is simultaneous earthing upstream and downstream of the fuse.

In this case the lower contact 217 is completely isolated by eliminating the through insulator 220 and the through insulator 243 and connecting the two contacts 222 and 217 together downstream and upstream of a fuse 246. The fuse outlet is again connected to a through insulator entirely similar to 243. In all cases each telescopic arm 227, 228 must comprise a contact extension 242 and a contact element 241 rigid with the half-arms 231 for engagement with said bar contact elements 239.

In this manner on rotating the telescopic arm 227 and 228 into the earthing position, simultaneous earthing upstream and downstream of the fuse 246 is achieved by the connection between the moving contacts 229, 242 associated with 222and the lower fixed contacts 217 and 239.

Both the switch provided with only the fixed and moving contacts and the switch provided with said contacts and with further fixed and moving contacts are diagrammatically represented in the schematics of Figure 14 on the front of an electrical panel 250 in the isolated position. These schematics again show that earthing can be achieved by a single arm carrying the moving contact, and that if a fuse is present earthing can be achieved both upstream and downstream of the fuse again by a single arm carrying moving contacts.

With reference to Figure 14 it can also be seen that in an insulated electrical panel formed from three switches of the present invention, by providing a single door 248 for each switch it is possible to see whether the individual switches are in the isolated position or not. In this respect, the shape of the support element 210, 211 makes it easy to distinguish the closed and earthing positions on the empty side of the T-shaped support element.

If the switch is provided with fuses (Figure 16), according to the present invention the fuses 246 are positioned horizontally in an extractable drawer 250 aligned below the insulators coaxially with the three constituent poles of the switch. This positioning of the fuses also allows them to be easily

extracted and replaced frontally.

The switch of the present invention can be assembled in all its essential parts on the two rear ties 212 in the workshop. In this respect, when the switch has been assembled and completed on said ties, it has merely to be fixed on the interior of the panel structure and the relative conductors connected. This thus eliminates the need for arranging the contacts or special connectors for the insulated support elements in predetermined positions within the panel.

In all the switches of the present invention, advantageously each insulated support element and each rotary arm is suitable for use in a switch without or with fuses, so that the additional moving and fixed contacts can then be quickly fitted to them.

Claims

1. A medium voltage operating-isolating switch with three positions insulated in sulphur hexafluoride comprising a set of three poles, each pole comprising a fixed contact and a mobile contact, said fixed contact carrying, within an insulating nozzle, an associated tulip element containing a male arcing contact and being connected to a respective bus bar, said mobile contact being arranged on a pivoted arm rotatable between a first closed position in engagement with said fixed contact, a second isolated position and a third earthed position, characterised in that said mobile and fixed contacts of said set of three poles are arranged on three insulating base support elements fixed to a single support beam, a relative cylinder which pumps said sulphur hexafluoride into said insulating nozzle being associated via an insulated lever with each of said arms carrying said mobile contacts, a metal draining element being provided between each of said insulating support elements and said pumping cylinders.

2. A switch as claimed in claim 1, characterised in that said three arms carrying said mobile contacts comprise two spaced-apart through holes through which a pair of shafts of insulating material are inserted, one of these latter having pivoted to it an insulating rod which emerges from an insulated container containing said sulphur hexafluoride to be connected to a quick snap-action mechanism for engaging said three positions, the other of said pair of shafts carrying a set of three levers for operating the pistons of said cylinders.

3. A switch as claimed in claim 1, characterised in that further contacts can be fitted to said insulating support elements and said arms for earthing fuses associated with said switch.

4. A switch as claimed in claim 1, characterised in that each of said arms consists of two plates pivoted to a relative support element via a U-piece, contact between said two plates of said arms and said U-piece being achieved by springs arranged coaxially on said pivoting shaft.

5. An insulated panel comprising at least one switch in accordance with the preceding claims, characterised by comprising a frontal door for observing the three positions of the constituent elements of the three poles.

6. An insulated panel as claimed in claim 5, characterised by comprising a frontwardly extractable horizontal drawer positioned below said switch and containing three fuses axially aligned with and below said three poles.

7. An insulated panel as claimed in claim 5, characterised by comprising in an upper front position a seat for inserting an operating lever for said quick snap-action mechanism.

8. A medium voltage operating-isolating switch with three positions insulated in sulphur hexafluoride comprising a set of three poles, each pole comprising a fixed contact and a mobile contact, said fixed contact carrying, within an insulating nozzle, an associated tulip element containing a male arcing contact and being connected to a respective bus bar, said mobile contact being arranged on a pivoted arm rotatable between a first closed position in engagement with said fixed contact, a second isolated position and a third earthed position, characterised in that said mobile and fixed contacts of said set of three poles are arranged on three insulating base support elements fixed to a single support beam, a relative cylinder which pumps said sulphur hexafluoride into said insulating nozzle being associated via an insulated lever with each of said arms carrying said mobile contacts, a metal draining element being provided between each of said insulating support elements and said pumping cylinders.

9. A switch as claimed in claim 8, characterised in that said three arms carrying said mobile contacts are of curved shape, and are fixed spaced-apart onto a through shaft of insulating material which is pivoted within each of said three support elements and emerges from an insulated container containing said sulphur

hexafluoride to be connected to a quick snap-action mechanism for engaging said three positions and arranged transversely to said three poles, there being connected to said shaft a set of three levers for operating the pistons of said cylinders.

10. A switch as claimed in claim 8, characterised in that further contacts can be fitted to said insulating support elements and said arms for earthing fuses associated with said switch.

11. A switch as claimed in claim 8, characterised in that each of said arms consists of two plates fixed to said shaft and pivoted to a relative support element via a U-piece, contact between said two plates of said arms and said U-piece being achieved by springs arranged coaxially on said pivoting shaft.

12. An insulated panel comprising at least one switch in accordance with claims 8-11, characterised by comprising a frontwardly extractable horizontal drawer positioned below said switch and containing a set of three fuses arranged parallel to the axis of said three poles.

13. An insulated panel as claimed in claim 12, characterised by comprising in an upper front position a seat for inserting an operating lever for said quick snap-action mechanism.

14. A compact fluid-insulated three-position medium voltage operating-isolating switch comprising a set of three poles, each pole comprising a fixed contact and a mobile contact, the fixed contact carrying an associated male arcing contact and the mobile contact being arranged on a pivoted arm rotatable between a first closed position in engagement with said fixed contact, a second isolated position and a third earthed position, characterised in that said mobile and fixed contacts of said set of three poles are arranged on three insulating base support elements fixed to support ties, each of said arms carrying said mobile contacts being of telescopic type and having said mobile contacts associated with it via an insulated lever connected to an operating rod, within said rotatable arm there being provided a cylinder for pumping the fluid onto said fixed contact, at least one metal draining element being provided on each of said insulating support elements between the portion carrying said fixed contact and the remaining portion of said support elements.

15. A switch as claimed in claim 14, characterised in that said insulating support elements are of box type in the form of two complementary parts which can be fixed together by mutual fixing means.

16. A switch as claimed in claim 14, characterised in that each of said arms consists of a support pivoted to a relative support element by way of a U-piece, said support carrying two mutually expandable cylindrical portions, at least one of the two supporting a tulip contact element, contact between said U-piece and said expandable cylindrical portions being achieved by springs arranged coaxial to a pivot by which said support is pivoted to said U-piece.

17. A switch as claimed in claim 16, characterised in that a free end of said pivoted support is supported in an annular support element pivoted to the ends of half-arms of insulating material which can be caused to rotate into the three positions by an operating shaft passingly fixed to the other end of said half-arms and connected to a quick snap-action mechanism.

18. A switch as claimed in claim 14, characterised in that further contacts can be fitted to said insulating support elements and said telescopic arms in complementary positions for earthing fuses associated with said switch.

19. A switch as claimed in claim 18, characterised in that said further contacts for earthing the fuses are respectively a contact element supported on half-arms pivoted to insulating elements of said telescopic arms, a contact extension which extends from said mobile contacts and bar contact elements fixed to said support elements, said contact element, said contact extension and said bar contact elements being electrically connected together only when in the third earthed position.

20. An insulated panel comprising at least one switch in accordance with claims 14-19, characterised by comprising a frontwardly extractable horizontal drawer positioned below said switch and containing a set of three fuses associated with said three poles.

Fig.3

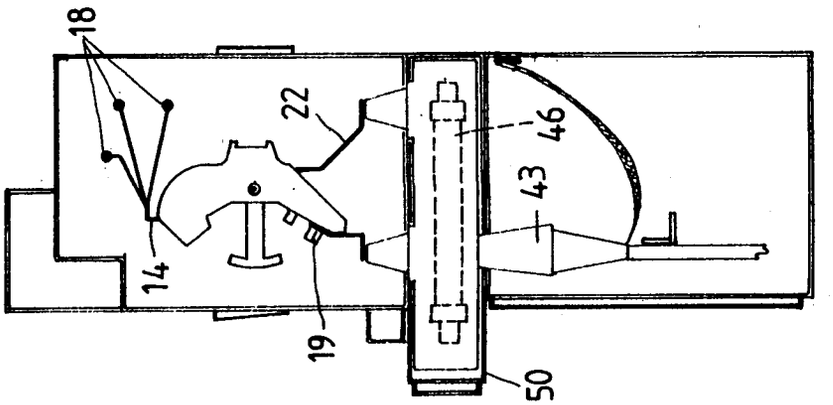

Fig.2

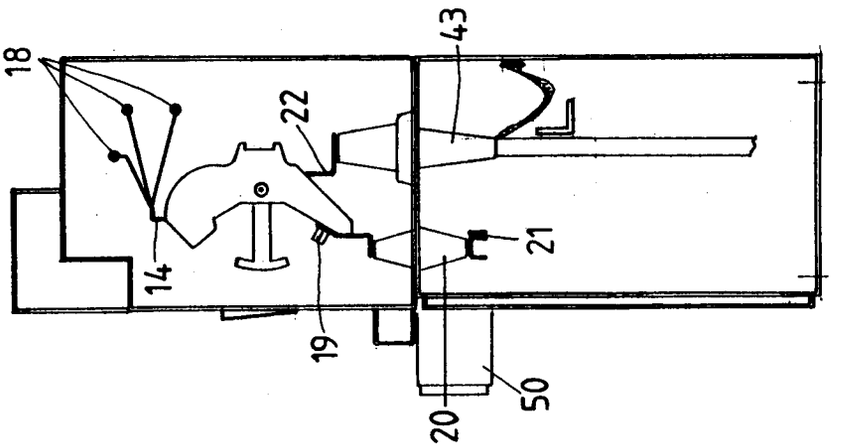

Fig.1

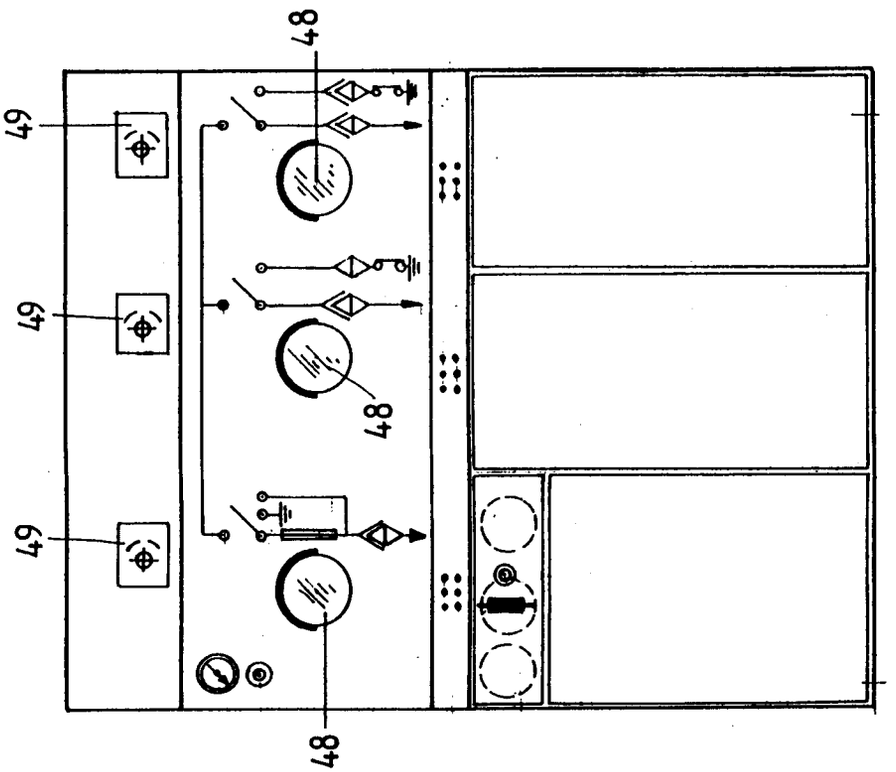

Fig.5

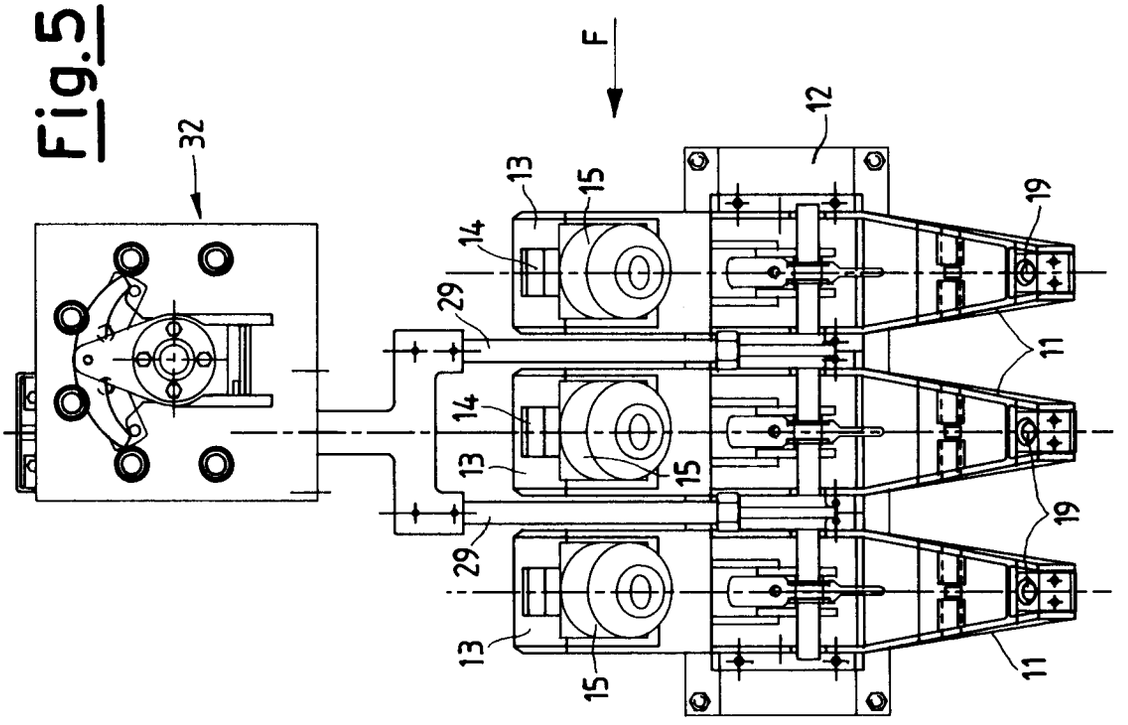
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Fig.4

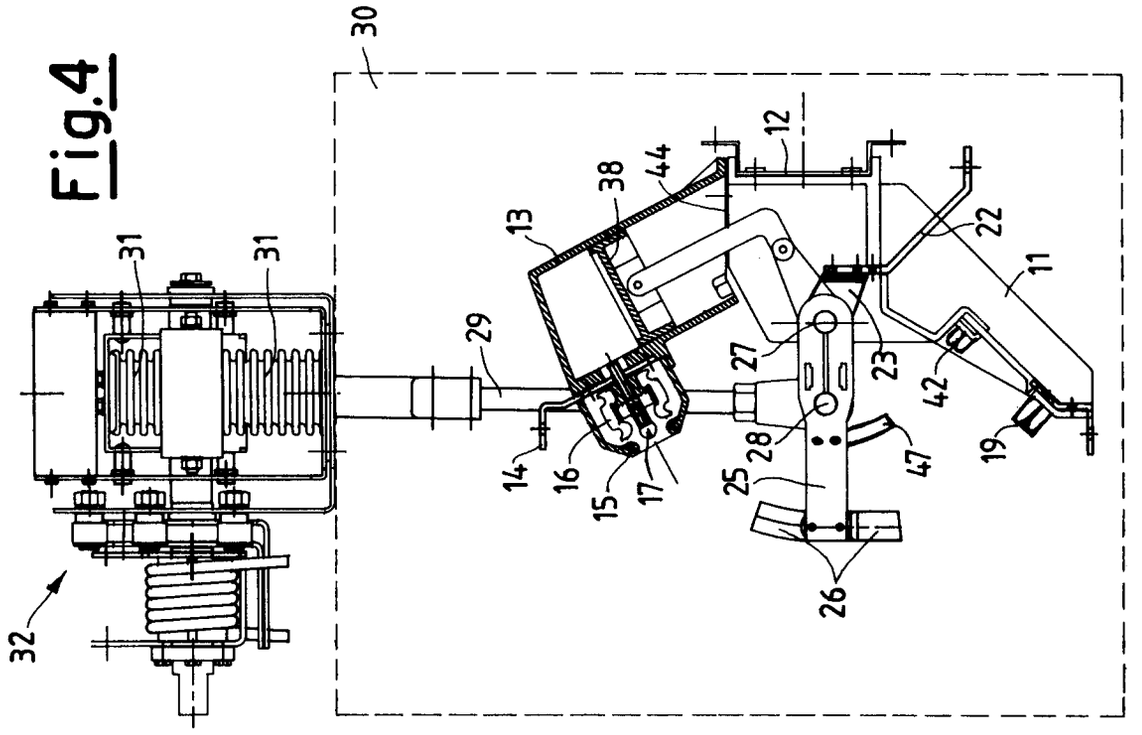
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Fig.7

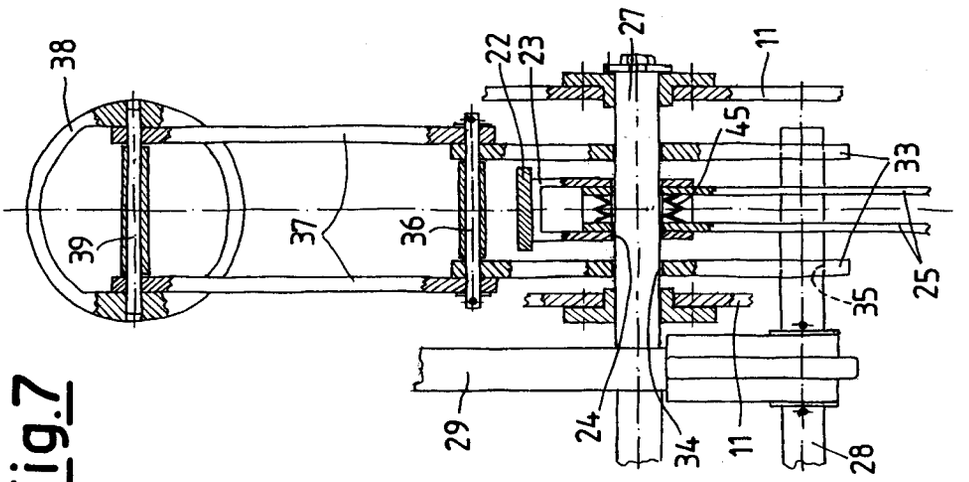
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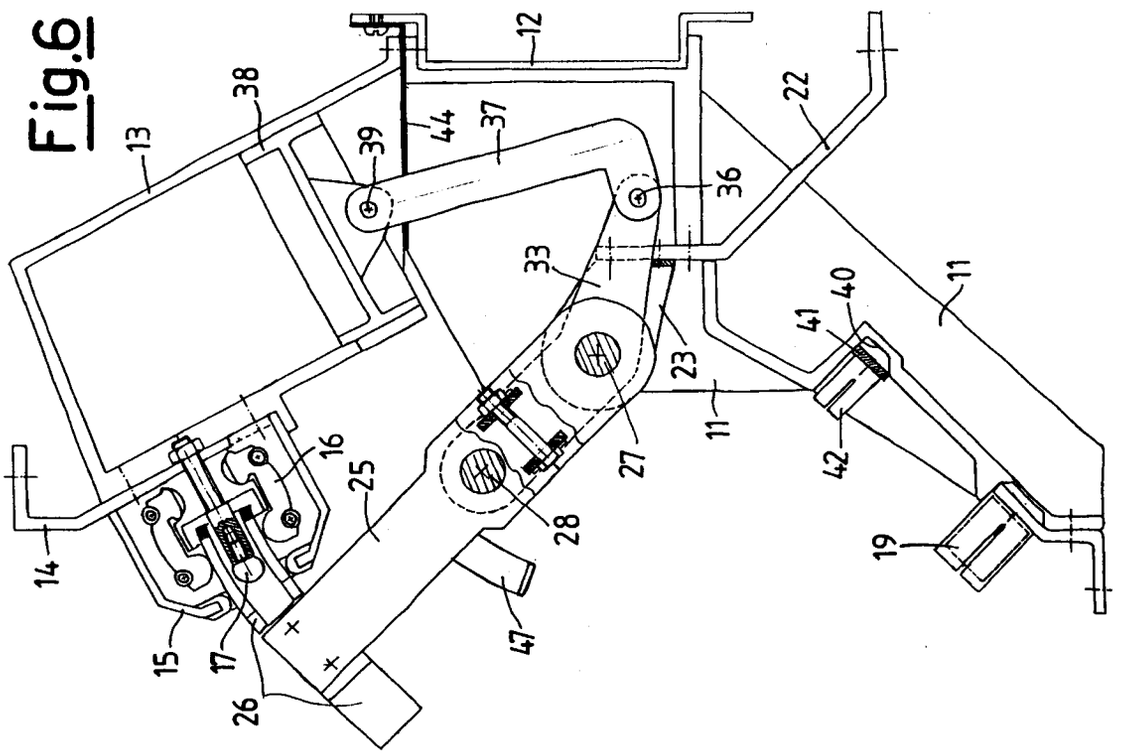
Fig.6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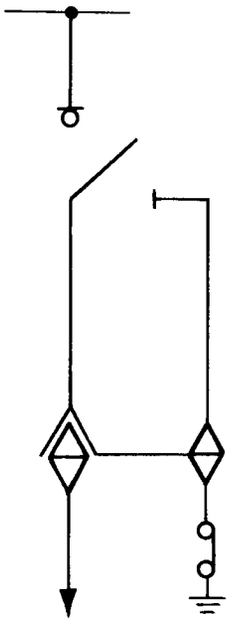

Fig.8

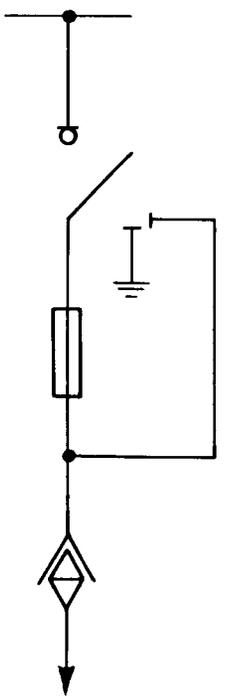

Fig.9

Fig.10

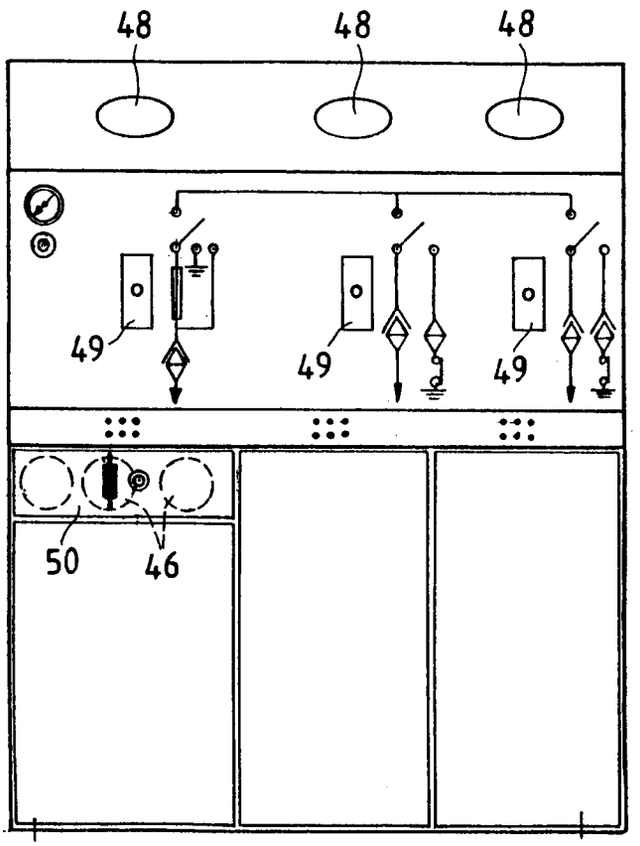

Fig.12

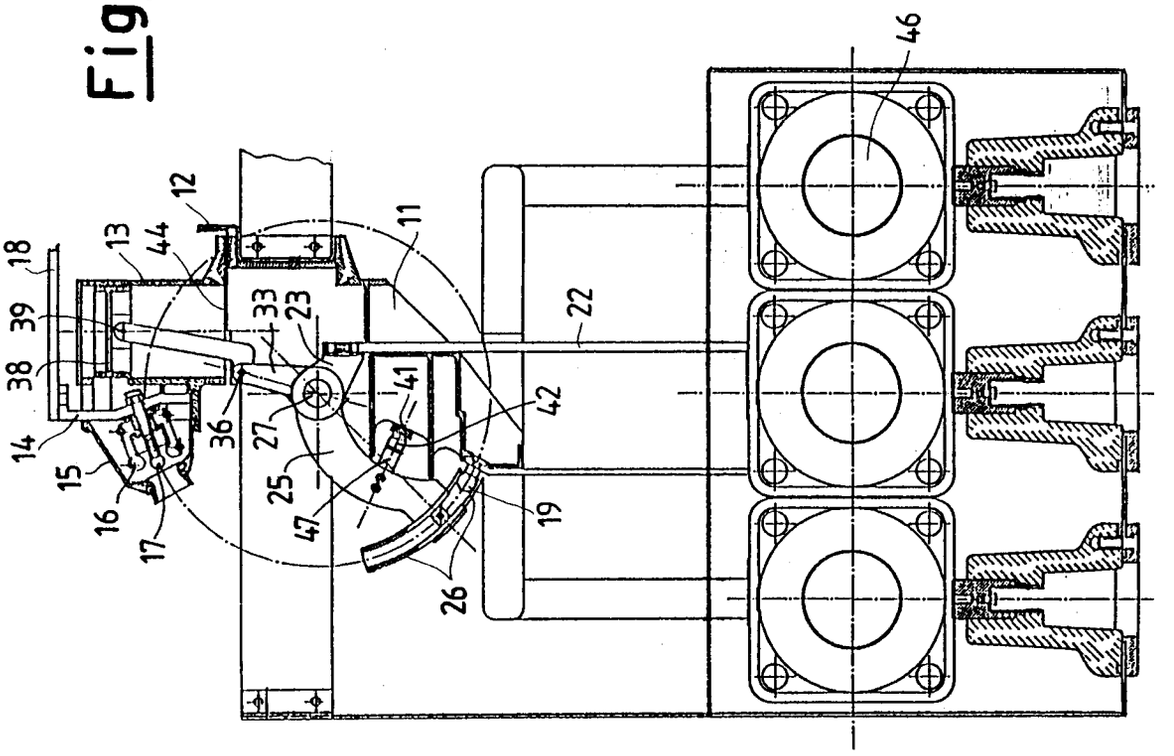
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Fig.11

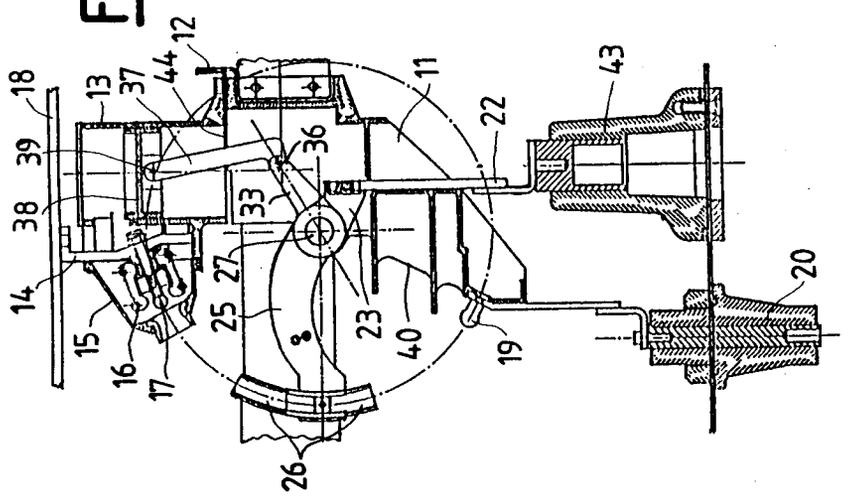
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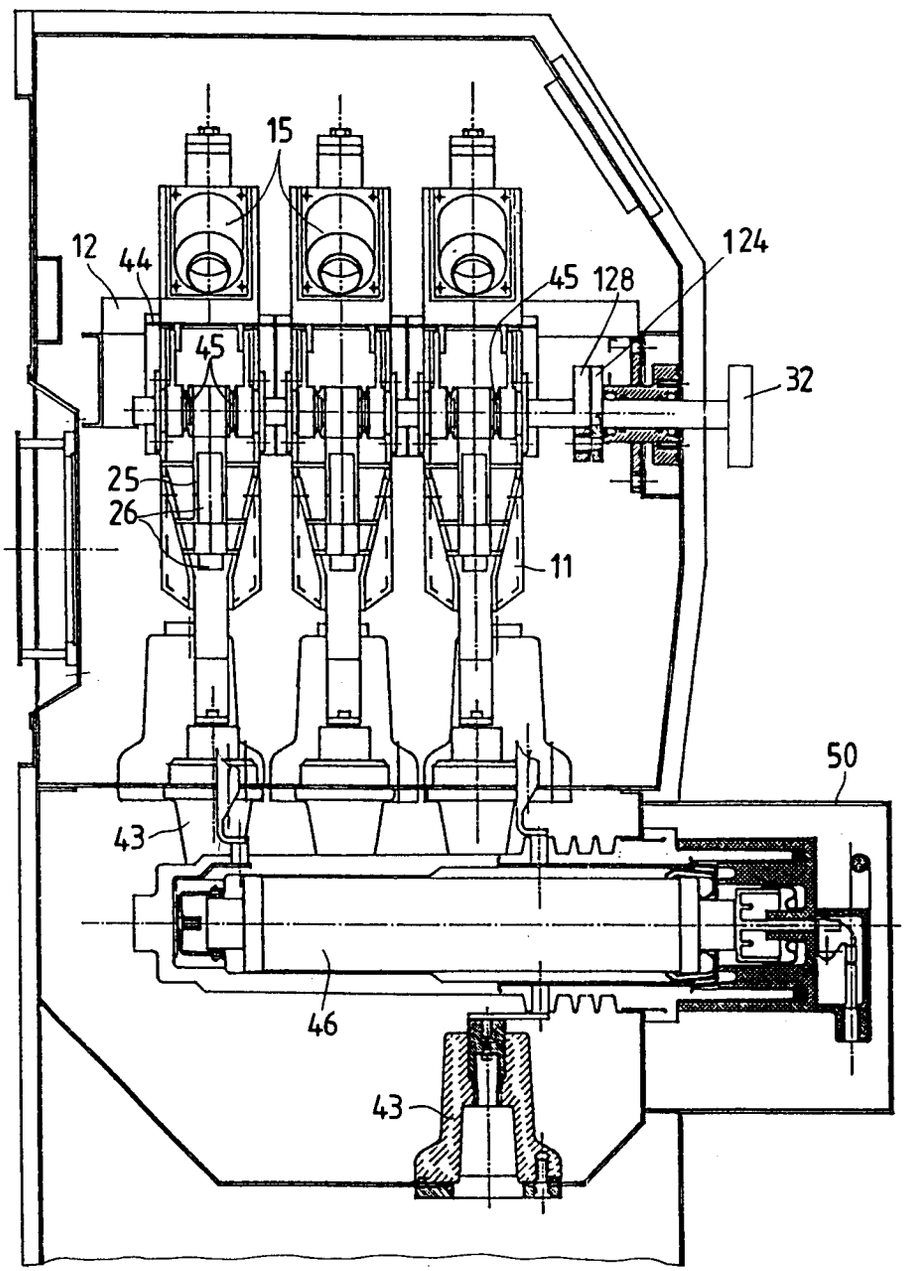
Fig.13



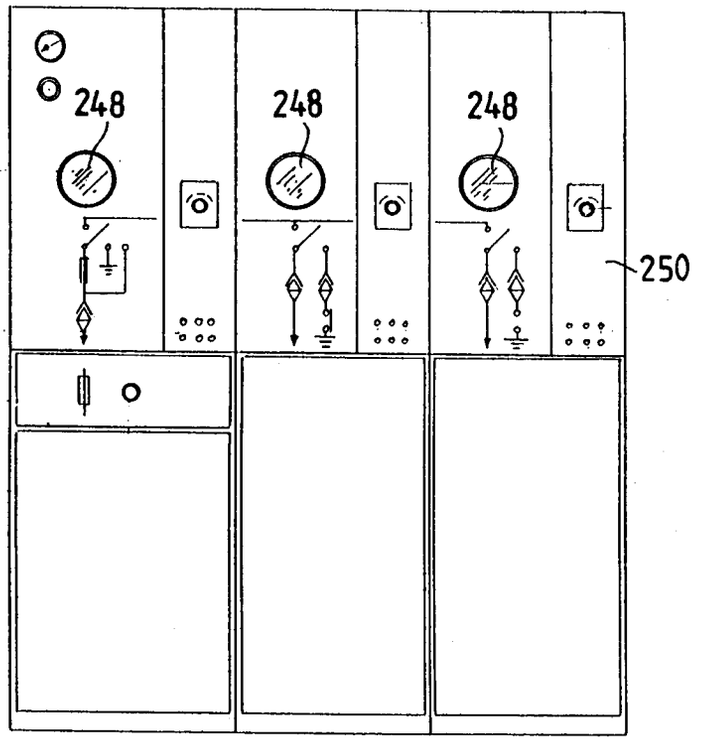

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Fig.14

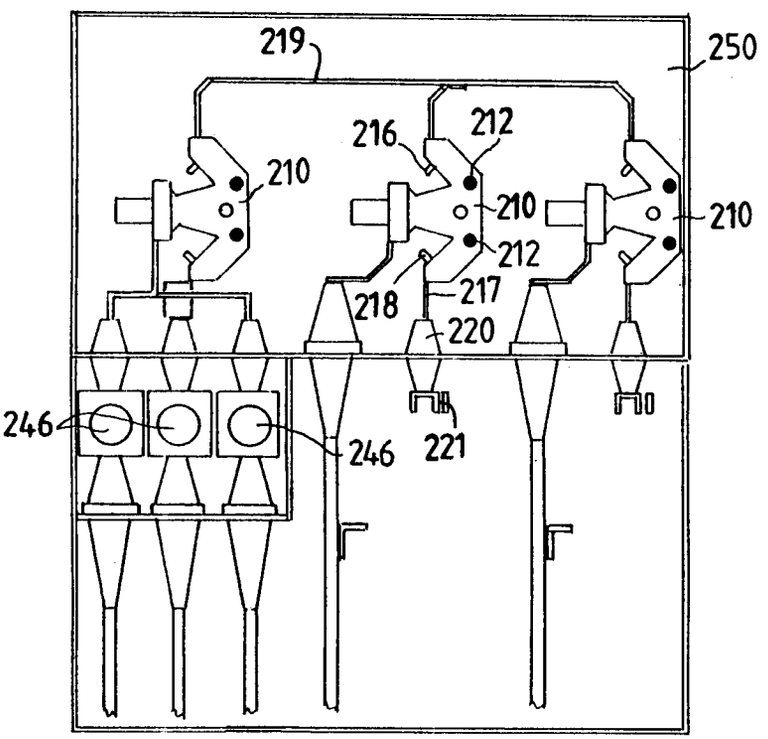
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Fig.15

Fig.16

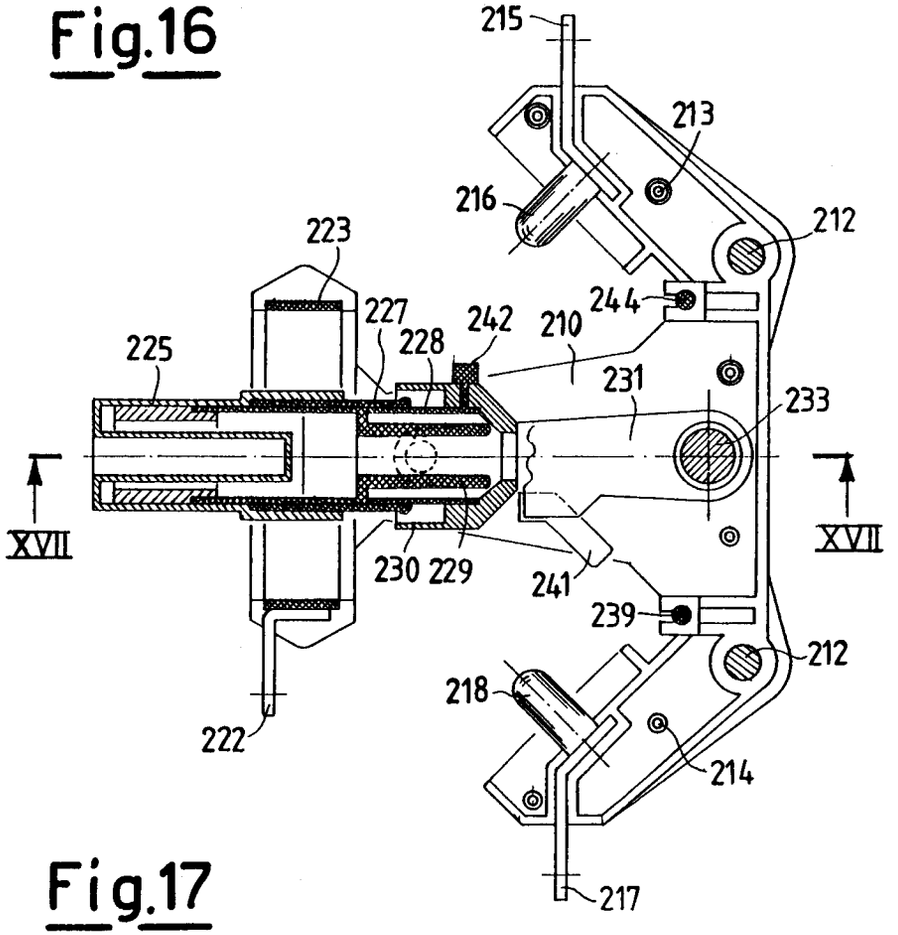
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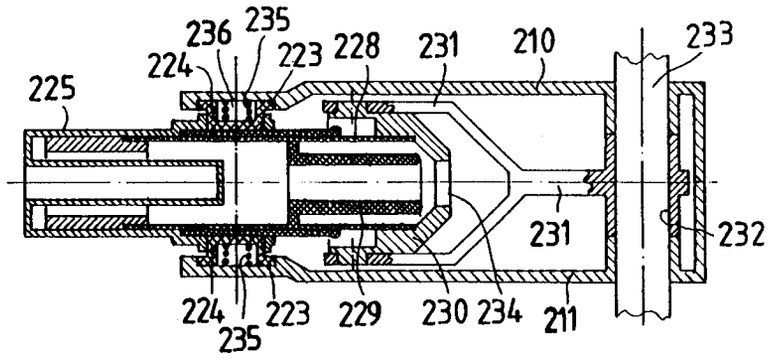
Fig.17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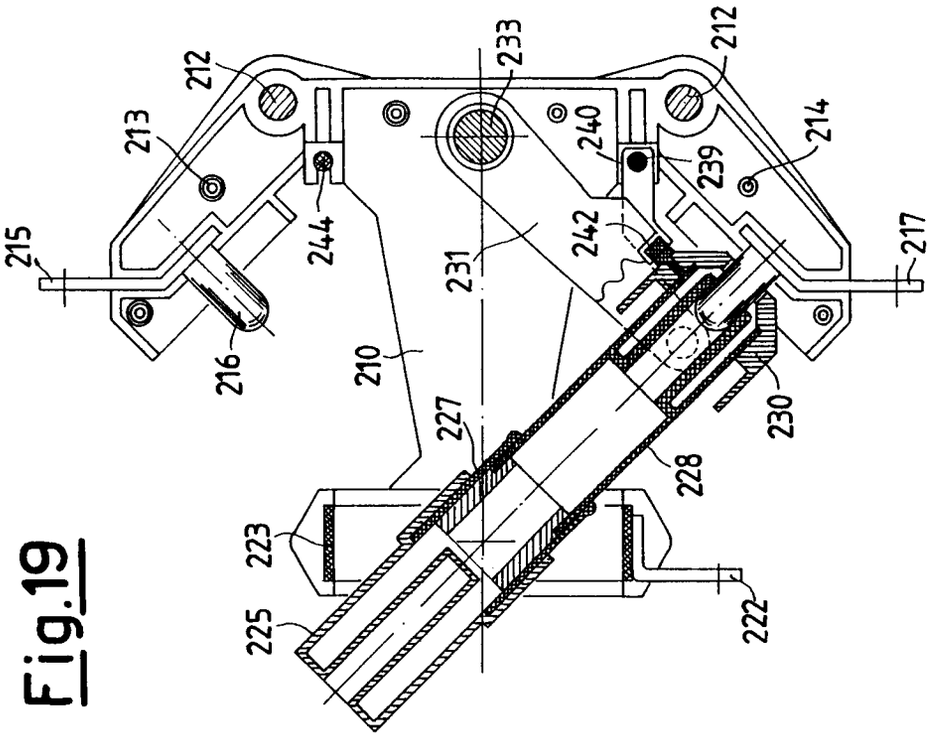
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Fig.19

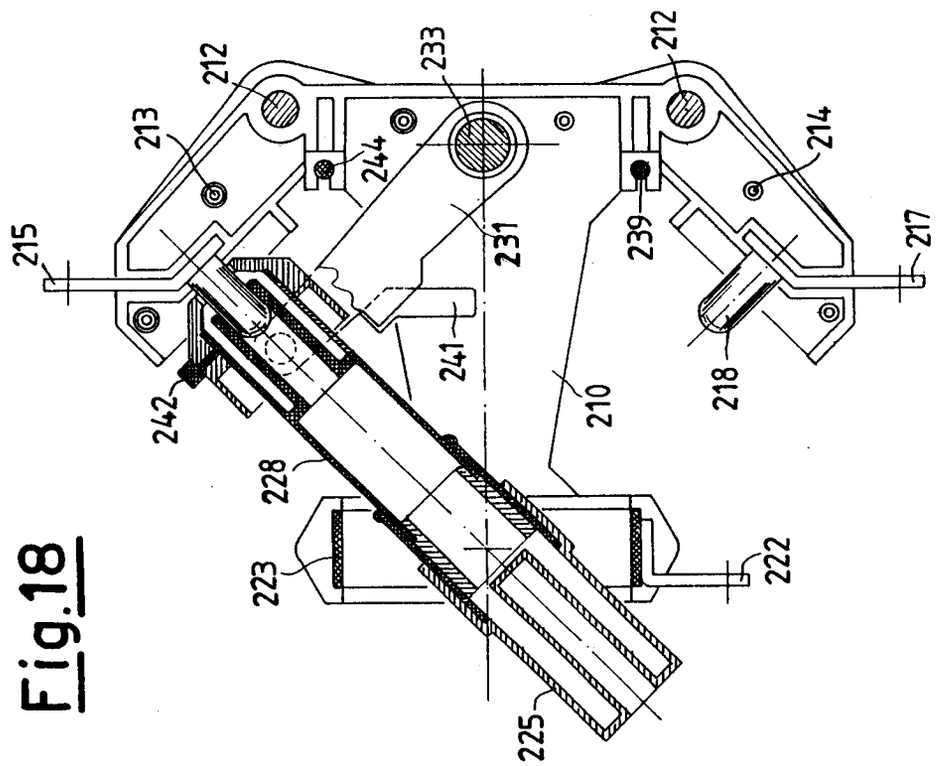
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Fig.18

Fig.20