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Frewe et al.

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[54] **MULTI-POLE VACUUM SWITCHING APPARATUS**

[75] Inventors: **Wolfgang Frewe; Hans-Jurgen Lendt,** both of Berlin, Germany

[73] Assignee: **Siemens Aktiengesellschaft,** Munich, Germany

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **200/144 B;** 200/144 R; 200/305

[51] **Int. Cl.** **H01h 33/66**

[58] **Field of Search** ..... 200/144 B, 168 R, 166 L, 200/168 H

[56] **References Cited**

UNITED STATES PATENTS

3,305,657	2/1967	Roxburgh et al.	200/144 B
3,440,378	4/1969	Baird	200/144 R
3,560,682	2/1971	Kohler et al.	200/144 R
3,684,849	8/1972	Zubaty	200/144 R

Primary Examiner—Robert S. Macon

Attorney, Agent, or Firm—Kenyon & Kenyon Reilley Carr & Chapin

[57] **ABSTRACT**

A vacuum switching apparatus includes at least two switching vessels arranged side by side and operable by an actuator device. Insulating partitions are situated between the switching vessels and are formed by insulator members which each enclose a switching vessel and are arranged side by side with a spacing therebetween. One application of the invention is in three-phase vacuum contractors for voltages of up to about 10 kV.

4 Claims, 2 Drawing Figures

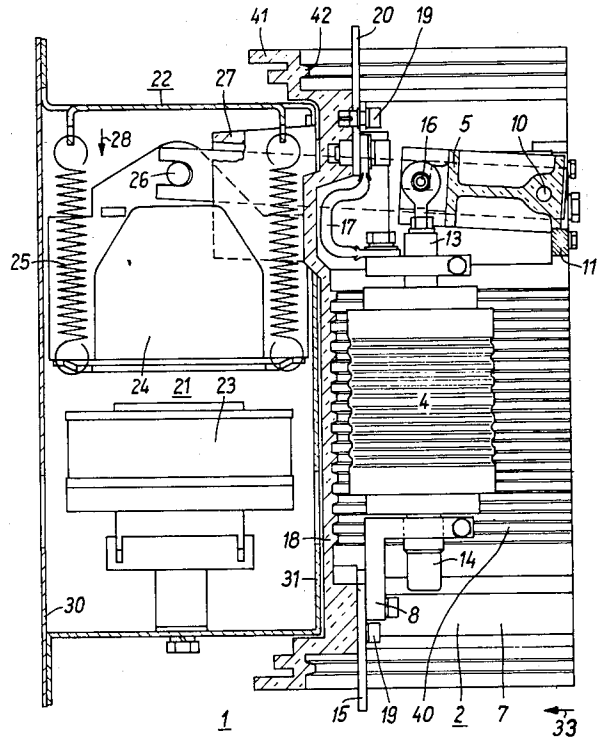


Fig. 1

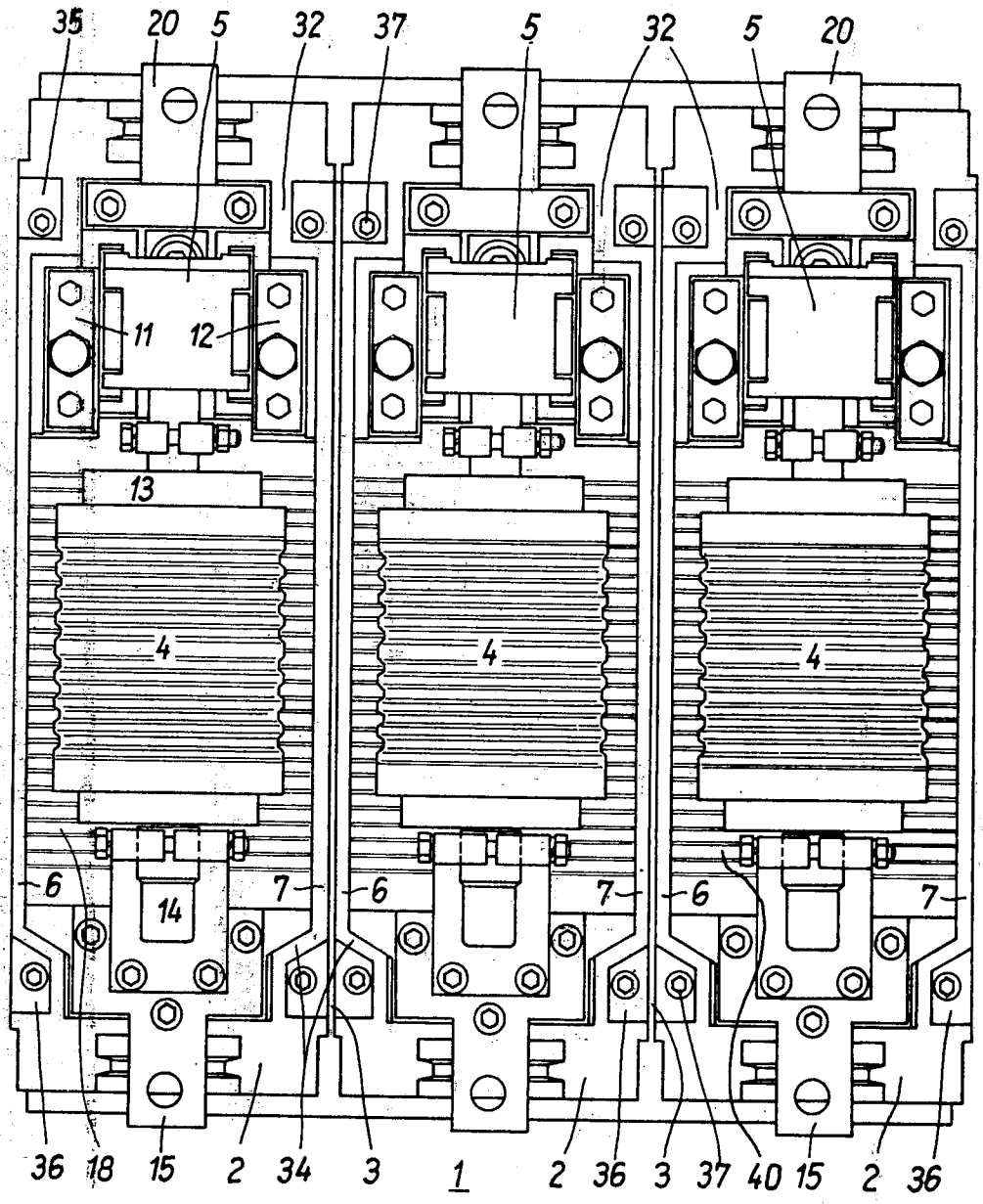
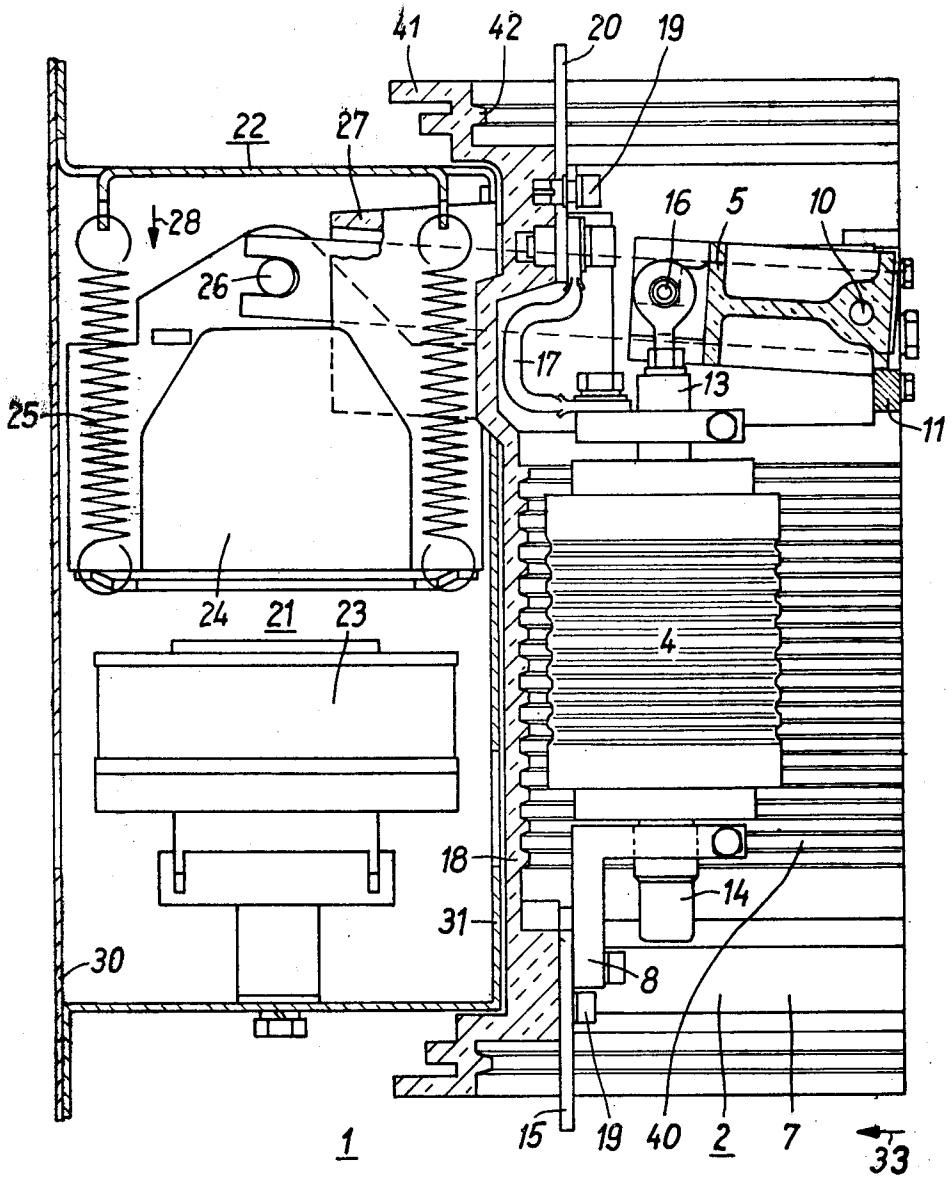

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Fig. 2


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MULTI-POLE VACUUM SWITCHING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to multi-pole vacuum switching apparatus, and more particularly to such apparatus having switching vessels arranged side by side and operated by an actuator device, with a partition of insulating material situated between the switching vessels.

2. Description of the Prior Art

Vacuum switching apparatus is known to provide, among other things, the advantage of smaller dimensions when compared with other switch gear, particularly switch gear having contacts operating in air. In the switching apparatus presently known, however, the space saving is not as great as the small dimensions of the vacuum vessels themselves would lead one to expect. This is caused, particularly in multi-pole switching apparatus, by the fact that a sufficient insulation distance must be kept between the external, voltage-carrying parts of the switching vessels. It is already known to arrange partitions of insulating material between the vacuum switching vessels of multi-pole vacuum switch gear. These partitions make it possible to reduce the distance between the switching vessels to a certain extent.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide multi-pole vacuum switching apparatus with minimum spacing between the switching vessels.

It is another object to provide multi-pole vacuum switching apparatus having adequate leakage paths between the apparatus parts.

These and other objects are achieved by the present invention which includes a vacuum switching apparatus having at least two switching vessels arranged side by side and operable by an actuator device. Insulating partitions are situtated between the switching vessels and are formed by insulator members which each enclose a switching vessel and are arranged side by side with a spacing therebetween. One application of the invention is in three-phase vacuum contractors for voltages of up to about 10 kV.

According to the invention, insulator members forming the partitions each enclose a switching vessel and are arranged side by side with spacing. The spacing of the switching vessels can thereby be reduced to an extent which cannot be made smaller because of the prescribed minimum spacings between the connecting bars of the switching equipment. Essential here is the gap remaining between the insulating members, which particularly contributes to an increase of the leakage paths.

The insulator members can be provided with ribs in order to create additional leakage paths. The insulator members can furthermore be made of U-shaped design and attached with their center part to a supporting structural part of the switching apparatus. With this design of the insulator members, the switching vessels are enclosed on almost all sides, except for the open front side of the insulator members. The actuator device of the switching apparatus can be located in a box-like housing to which the insulator members are attached, the members designed to overhang the housing with

ribbed ends. Overall, leakage paths of such length are achieved whereby the spacings of the switching vessels can be reduced to less than one-half, as compared to known arrangements.

Passage openings, accessible from the front, can be formed through drawn-in bosses in the sidewalls of the insulator members for the fastening elements of the insulator members. The attachment points are thereby located so far inward that the insulator members can be brought closely together down to a spacing required for the formation of the leakage paths.

For actuating each switching vessel, a lever of insulating material can be provided which is brought through an extension of the central part of the insulator member and protrudes into the space between the side walls. An interruption of the leakage paths by metallic parts is thereby avoided. The lever of insulating material can be pivoted in the side walls of the insulator members. The insulator member can also be used for attaching the connecting bars in such a manner that the connection points are provided at the upper and the lower end of each insulator member. At the same time one obtains thereby clearly visible current paths which extend in the vertical direction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a three-pole vacuum contactor in a view onto the three switching vessels arranged side by side illustrative of the present invention; and

FIG. 2 shows a cross section through the vacuum contactor according to FIG. 1 in the region of one switching vessel.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1 and 2 there is shown a three-pole vacuum contactor 1 designed for a nominal voltage of 10 kV. Three identical insulator members 2 are arranged side by side in such a manner that there always remains a space 3 between two adjacent insulator members. It is to be noted with respect to the FIGS. 1 and 2 that identical numerals are used to indicate identical parts of the vacuum contactor 1. The insulator members 2 are of essentially U-shaped design and each enclose one switching vessel 4. For operation, i.e., for switching the switching vessels 4 on and off, there serves in each case a lever 5 consisting of insulating material, of which only the front end is visible in FIG. 1. Each lever 5 is pivoted in the side walls 6 and 7 of the associated insulator member 2 by means of a pin 10, shown in FIG. 2. The engagement points of the bearing pins 10 in the side walls 6 and 7 are covered by the cover plates 11 and 12.

The switching vessels 4 have connecting studs 13 and 14 arranged in the axis of the switching vessel, of which the lower connecting studs 14 serve at the same time for clamping each switching vessel in a stationary clamping member 8 which is connected with a connector member 15. The upper connecting studs 13 are movable in the direction of the axis of the switching vessels 4 and are connected with the lever 5 by means of a pin 16. The connecting studs 13 are connected by means of a flexible conductor ribbon 17 to an upper connector member 20. The connector members 15 and 20 are located at the upper and the lower end, respectively, of the central parts 18 of the insulator members 2 and are fastened by screws 19.

An electromagnetic actuator device **12** is schematically shown in FIG. **2** and serves for operating the levers **5**. Actuator device **21** is located in a box-like housing **22** consisting of sheet steel. The actuator device **21** is laid out in the usual manner for operation with an auxiliary voltage, for example, 220 volts a.c. In FIG. **2**, a stationary magnet part **23** and a movable magnet part **24** are shown, which latter part **24** is held in the rest position shown by return springs **25**. A rod **26**, which constitutes the common drive member of the levers **5**, is connected with the movable magnet part **24**. To this end, each lever **5** engages with a fork-shaped end over the rod **26**. The levers **5** each extend through a ring-shaped extension **27** of the insulator members **2**, which project into the housing **22**. The extensions **27** thereby create leakage paths between the grounded housing **22** and the actuator device **21** located therein, respectively, and the high-voltage part of the contactor **1**, of which the switching vessels **4** and the connecting bars **15** and **20** are a part.

As may be seen from FIG. **2**, the lever **5** is swung about the bearing pin **10** in the direction of the arrow **28** when the movable magnet part **24** is pulled down. The stud **13** of the switching vessels **4** then also moves in the direction of the arrow **28** under the influence of the atmospheric pressure and thereby closes the contacts of the switching vessel.

The box-like housing **22** can be fastened with its wall **30** to a frame or another support. The opposite wall **31** of the housing **22** serves as the attachment surface of the insulator members **2**. For mounting, the insulator members **2** are each provided with four drawn-in bosses, of which two bosses **32** are situated at the upper end and two further bosses **34** at the lower end. These drawn-in bosses extend over the depth of the side walls **6** and **7** in such a manner that in the central part **18**, clamping surfaces **35** and **36**, accessible from the front with a passage opening for a suitable fastening element, are generated in the direction of the arrow **33**, i.e., with the usual mounting of the vacuum contactor **1**. In FIG. **1**, screws **36** are shown with an internal hexagon head as the fastening elements.

As shown in the Figures, the side walls **6** and **7** of the insulator members **2** are provided on their inner sides with ribs **40**. At the upper and the lower end, the insulator members **2** extend overall beyond the housing **22** and overhang the same. The overhanging ends are provided with external ribs **41** and internal ribs **42**. The leakage paths between the connector elements and the housing **22** are thereby increased to the required length. At the same time, a satisfactory electrical separation between the low-voltage part (actuator device **21**) and the high-voltage part (switching vessels **4** with the connector parts) is obtained.

It will be seen from FIG. **1** that the switching vessels **4** are arranged side by side with relatively small spacing. Due to the accommodation of each switching vessel **4** in a separate insulator member **2** and the insulator cross section which is essenU-shaped and therefore presents three continuous insulating surfaces, the leakage paths are increased to such an extent that the spacings of the connector elements **15** and **20** can be matched to the permissible minimum spacings. In this fashion, the smallest possible design is achieved.

Although the above description is directed to the preferred embodiment of the invention, it is noted that other variations and modifications will be apparent to those skilled in the art, and, therefore, may be made without departing from the spirit and scope of the present invention.

What is claimed is:

1. In a multi-pole vacuum switching apparatus including at least two vacuum switching vessels which are arranged side by side; an actuator device for operating the vacuum switching vessels; and, wherein the improvement comprises providing at least two insulator members corresponding to and enclosing respective ones of said switching vessels, said insulator members being completely independent of each other and disposed one adjacent the other so as to conjointly define an insulating space therebetween, said insulator members being of approximately U-shaped configuration and being fastened at the mid-wall thereof to the actuator device of the switching apparatus, said actuator device including a box-like housing, and an actuator disposed in said housing for actuating the vacuum switching vessels, each of said U-shaped insulator members being mounted to said housing at said mid-wall, each of said U-shaped insulator members having an extension formed thereon at said mid-wall thereof, said actuator having actuator levers made of insulating material for corresponding ones of the switching vessels, each of said levers being brought through said extension of the associated insulator member so as to protrude into the space between the side walls of the associated insulator member, the inner wall surface of each of said insulator members having ribs formed thereon, the upper and lower portions of each insulator member each defining an inwardly facing surface and an outwardly facing surface, each of said surfaces having ribs formed thereon, said ribbed upper and lower portions extending over said box-like housing, and conductor bars for each of the switching vessels for respectively conducting current to and current away from the switching vessel, said conductor bars being mounted respectively on the upper and lower portions of the associated insulator member.

2. The improvement of claim **1**, said insulator members being mounted to said housing by fastening elements, the side walls of said U-shaped insulating members being drawn-in to define passage openings for rendering said fastening elements accessible from the front side of the apparatus.

3. The improvement of claim **1** comprising a pivot pin connected between the side walls of an insulator member for pivoting said lever on said pivot pin between said side walls.

4. The improvement of claim **3**, said insulator members being mounted to said housing by fastening elements, the side walls of said U-shaped insulating members being drawn-in to define passage openings for rendering said fastening elements accessible from the front side of the apparatus.

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