Sept. 30, 1969 S. BEDDOE 3,470,341

VACUUM SWITCH WITH LIQUID FILLED BELLOWS OPERATION

Filed Sept. 30, 1966 2 Sheets-Sheet 1

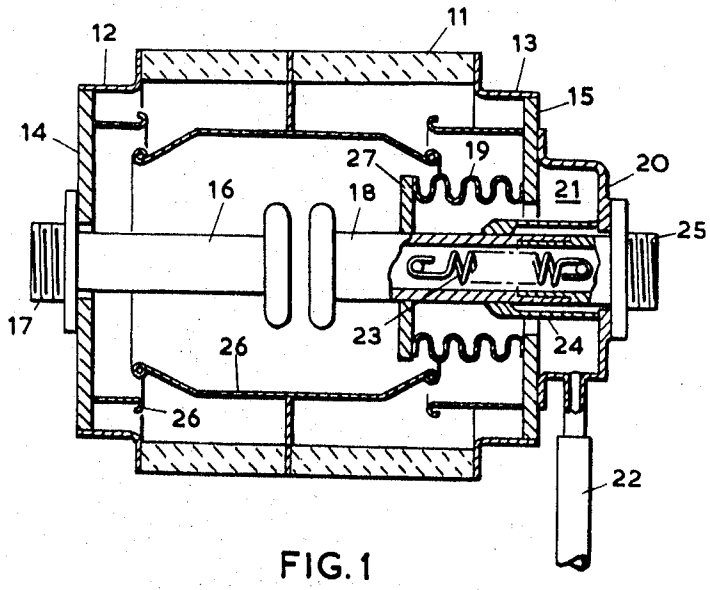

FIG. 1

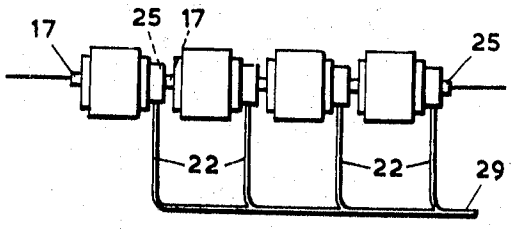

FIG. 3

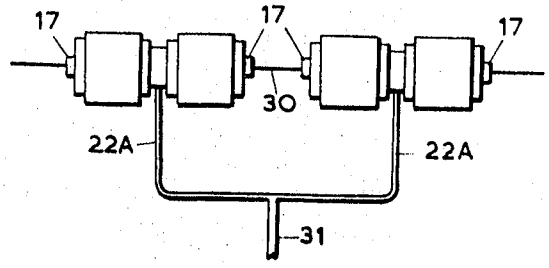

FIG. 4

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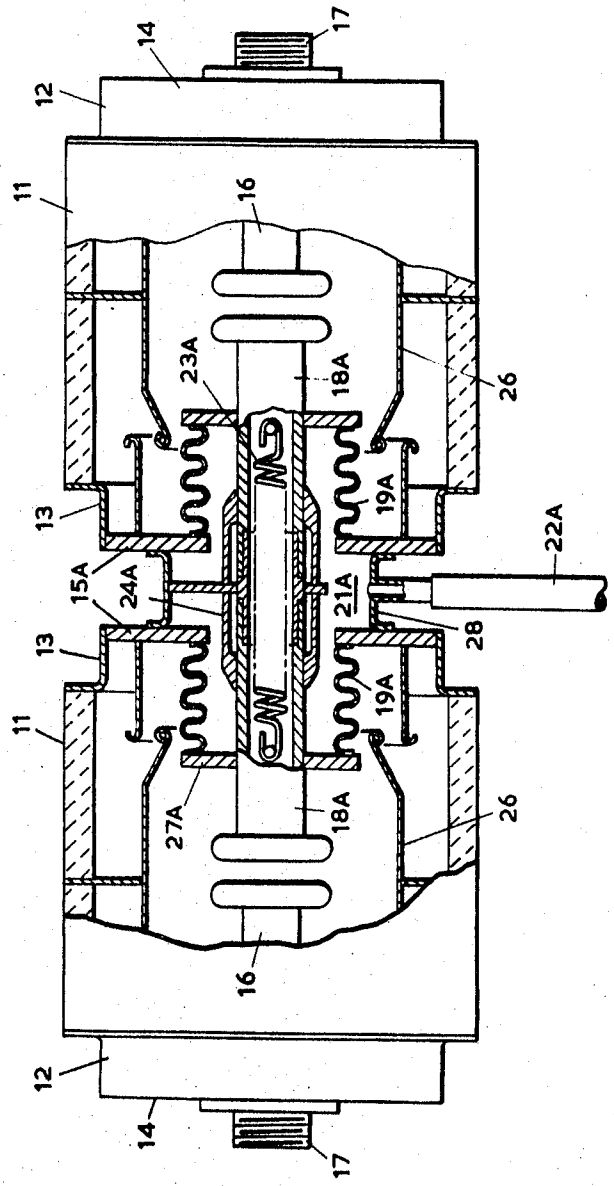

FIG. 2

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VACUUM SWITCH WITH LIQUID FILLED BELLOWS OPERATION

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Int. Cl. H01h 9/30, 33/66
U.S. Cl. 200—144 4 Claims

ABSTRACT OF THE DISCLOSURE

A vacuum switch having a pair of contacts in an evacuated casing; a bellows interconnects one of the contacts and the casing, and forms part of the wall of the evacuated casing, and of a closed chamber outside the evacuated casing. Insulating liquid is supplied to the closed chamber, both to move the contact between open and closed positions, and to damp oscillations in the bellows and contact system, thus preventing contact bounce. The liquid may be transformer oil.

This invention relates to electric switchgear.

According to this invention, a vacuum switch has a movable contact sealed to the casing by bellows or the like, and the movable contact is moved between the open and closed positions by means of a fluid pressure applied to the bellows or the like.

Embodiments of this invention will now be described by way of example with reference to the accompanying drawings, of which:

FIG. 1 is a section through a first embodiment of vacuum switch in accordance with the invention,

FIG. 2 is a view similar to FIG. 1 of a second embodiment,

FIG. 3 shows an arrangement including a number of vacuum switches of the first embodiment arranged in series, and,

FIG. 4 shows an arrangement including a number of vacuum switches of the second embodiment arranged in series.

Referring to FIG. 1, the vacuum switch includes a casing, including a cylindrical insulator **11** bonded to end members **12**, **13** one at each end, the end members being sealed in turn to end plates **14**, **15**. It will be understood that the interior of the casing operates at a high vacuum.

One end plate **14** has a fixed electrode means or contact **16** secured to it, and is provided with a terminal **17** for connection in an external circuit.

The movable contact **18** is in the centre of the other end plate **15**, and is connected to it by a flexible metal bellows **19** extending between the end plate **15** and a flange **27** on the contact stem. The bellows **19**, together with part of the end plate **15**, the flange **27**, and an end housing **20**, defines a closed chamber **21** which is supplied with an insulating liquid through a pipe **22** of insulating material. The liquid, which may for example be transformer oil, serves two purposes; first, increase of the pressure of the liquid causes closing of the contacts, and decrease of the pressure allows them to open; and secondly the liquid provides damping of oscillations which have been found to occur in the bellows and which limit their useful life.

Opening of the contacts, on decrease of the liquid pressure, is ensured by a tension spring **23** between the interior of the hollow movable contact **18** and the end housing **20**. A sliding connection is provided between the movable contact **18** and the end housing **20** by resilient

fingers **24**, which serve both as a guide for movement of the contact and to convey the current to the terminal **25** on the end housing.

The usual shields **26** are provided to protect the insulator **11** from metal deposition due to arcing between the contacts **16**, **18**.

In operation, an increase of pressure is produced in closed chamber **21**, by suitable means (not shown), for example by a valve controlling a supply of the liquid under pressure to pipe **22**. This increase causes the bellows **19** to extend, so that the movable contact **18** is brought into engagement with fixed contact **16**.

Referring now to FIG. 2, there is shown a vacuum switch which in many respects is similar to that of FIG. 1, similar parts being identified by the same reference numerals. The vacuum switch of FIG. 2, however, has two breaks in series. Instead of a single end plate **15** associated with the movable contact **18** and connected to a terminal **25**, the two endplates **15A** of a pair of identical vacuum switch units for engagement or mutual cooperative relationship are connected together by a cylindrical electrical conductor **28** and the two movable contacts **18A** are electrically connected "back-to-back." The movable contacts **18A** are connected to the endplates by respective bellows **19A**, and the bellows together with endplates **15A** and conductor **28** define a closed chamber **21A**. This is supplied with liquid, in a similar manner to that described with reference to FIG. 1, through a pipe **22A** of insulating material and the opening force is provided by a tension spring **23A** connected between the hollow movable contacts **18A**. The movable contacts are connected by a bridging finger-type connection **24A**, located symmetrically by inter-connection with the conductor **28**. In an alternative a pair of tension springs may be provided between a central member, carried for example by the conductor **28**, and the respective movable contacts **18A**.

The operation is similar to that of the switch of FIG. 1, that is, on application of pressure to chamber **21A** through pipe **22A** the movable contacts **18A** make contact with the fixed contacts **16**, and on decrease of the pressure the spring **23A** causes both pairs of contacts to break.

It will be understood that the contacts **16**, **18**, **18A** may be of any known or convenient form, and in particular the contacts **16** need not be rigidly fixed, and are preferably resiliently mounted, although referred to as the fixed contacts, as is well in the art.

Referring to FIG. 3, a number of vacuum switches as described with reference to FIG. 1 are shown connected in series, the terminal **17** of one being connected, as shown, to the terminal **25** of the next. The pipes **22** of each switch are connected to a common supply line **29** for simultaneous operation of the switches.

In FIG. 4, two vacuum switches as described with reference to FIG. 2, each switch having two units, are shown connected in series, one terminal **17** of each switch being connected by a conductor **30** to the other switch, and the other terminals forming the terminals for connection in an external circuit. The pipes **22A** are connected to a common supply line **31**.

Instead of the bellows **19**, **19A** shown, there may be provided suitable equivalent constructions, for example built-up constructions incorporating flexible metal bellows or diaphragms.

I claim:

1. A vacuum switch having two breaks in series, comprising a first evacuated casing; a second evacuated casing; a first pair of contacts relatively movable into and out of engagement, within said first evacuated casing, said first pair of contacts including a first movable contact which is movable relative to said first evacuated casing; first bellows means connecting said first movable

contact and said first evacuated casing; a second pair of contacts relatively movable into and out of engagement within said second evacuated casing, said second pair of contacts including a second movable contact which is movable relative to said second evacuated casing; second bellows means connecting said second movable contact and said second evacuated casing; means electrically interconnecting said first movable contact and said second movable contact; means including said first bellows means and said second bellows means and defining a closed chamber; and means to supply an insulating liquid to said closed chamber, whereby variation of the presure of said insulating liquid causes movement of the pressure of said first and second pairs of contacts into and out of engagement.

2. A vacuum switch as claimed in claim 1, said evacuated casings comprising an end plate having a central aperture; said bellows means being sealed to said end plate around said central aperture and to said contacts; said contacts comprising a stem; a fixed electrically-conducting member in which said stem is slidable; and terminal means electrically connected to said fixed electrically-conducting member.

3. A vacuum switch as claimed in claim 2, comprising also end housing means secured to said end plate and to said fixed electrically-conducting member; said end plate, said bellows means, and said end housing means each defining part of the boundary of said closed chamber.

4. A vacuum switch as claimed in claim 3, comprising also resilient current-carrying finger means secured to said end housing means and resiliently engaging said stem.

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U.S. Cl. X.R.

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