# United States Patent

**Luehring**

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[54] **MULTI-POINT TO COMMON POINT DEAD TANK SWITCH HAVING VACUUM INSULATED CONTACTS AND VACUUM INSULATED TERMINALS**


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[52] **U.S. Cl.** ..... **200/144 B,** 200/145

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

[58] **Field of Search** ..... 200/144 B, 145 R



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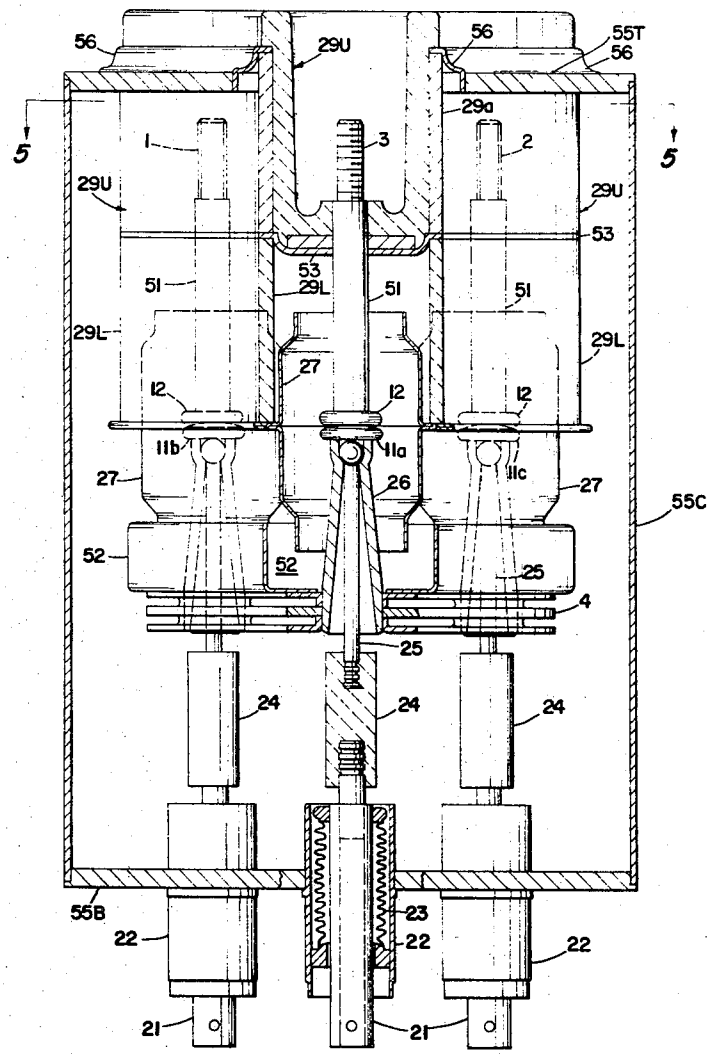
[57] **ABSTRACT**

A vacuum switch has means for selectively opening or closing one or more of plural contact sets each having a stationary contact and a relatively movable contact. Terminals for the stationary contacts are provided within an electrically dead tank which provides the vacuum enclosure for the contacts and also for terminal conductors.


**4 Claims, 5 Drawing Figures**



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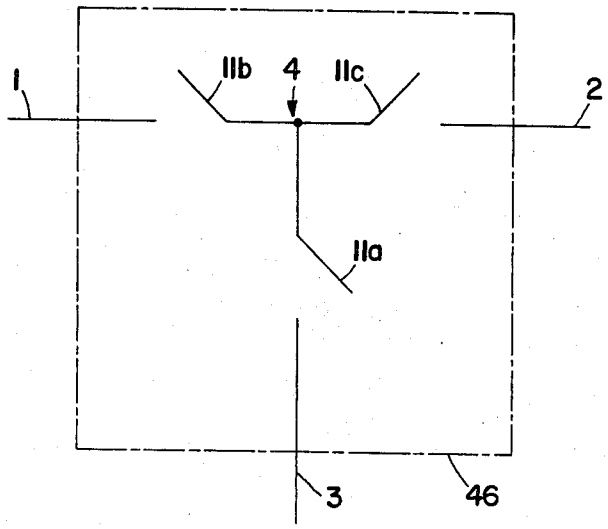


Fig. 1

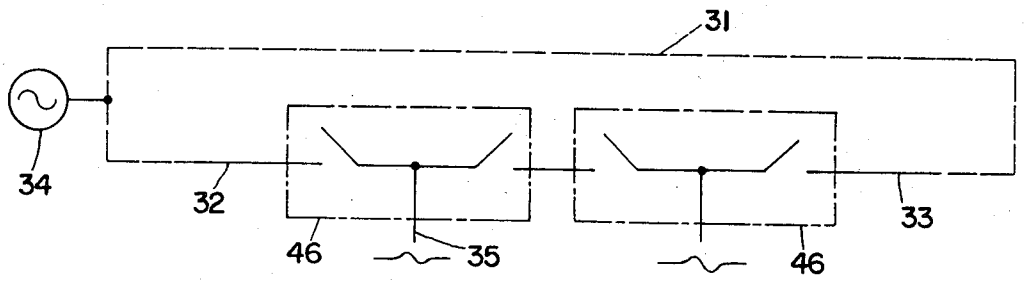


Fig. 3

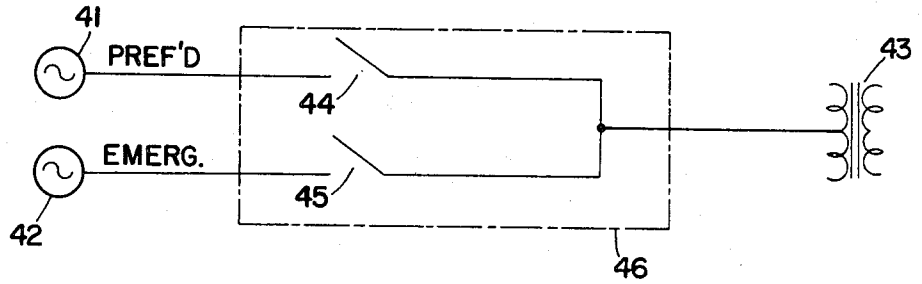


Fig. 4

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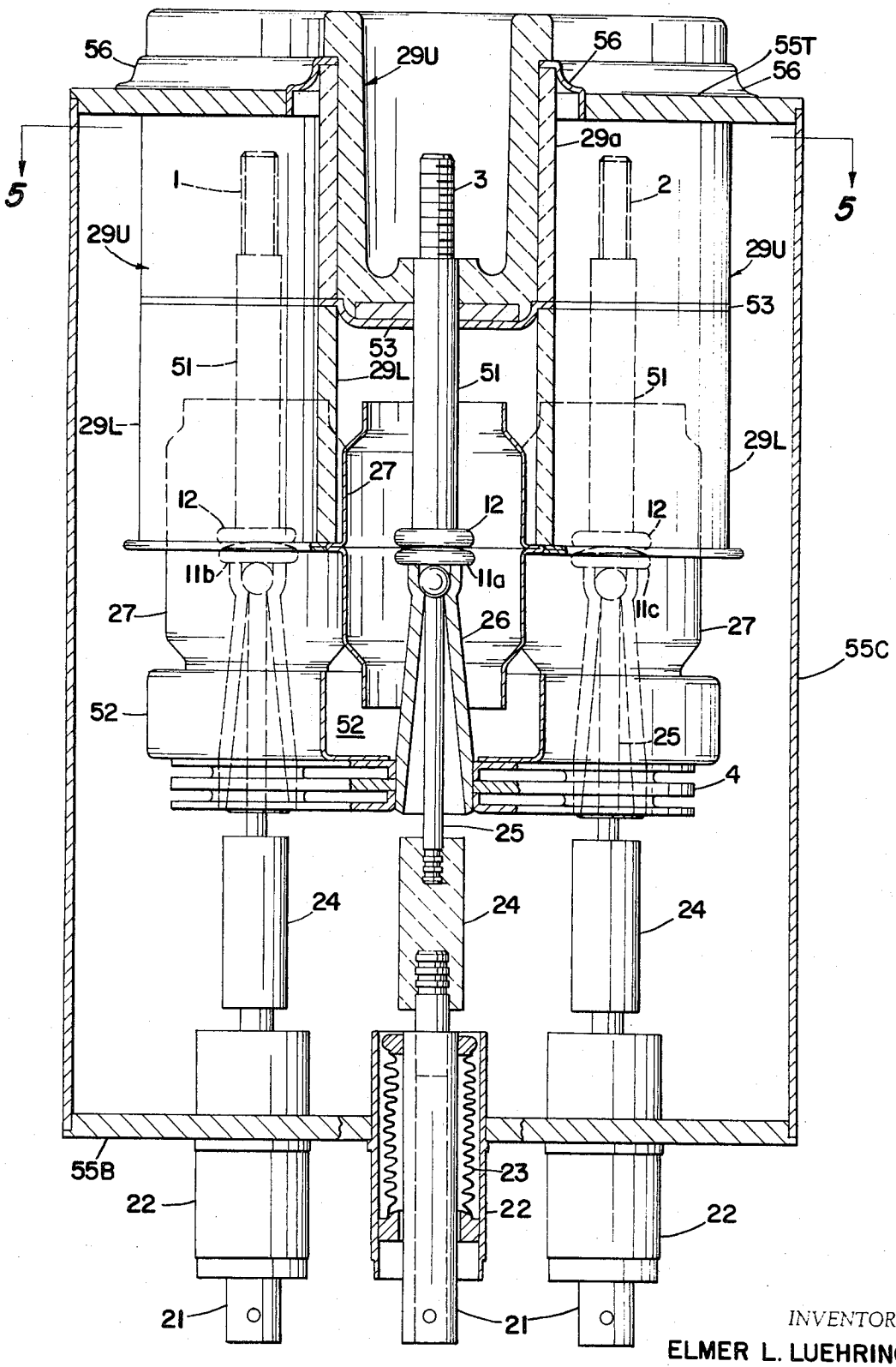


Fig. 2

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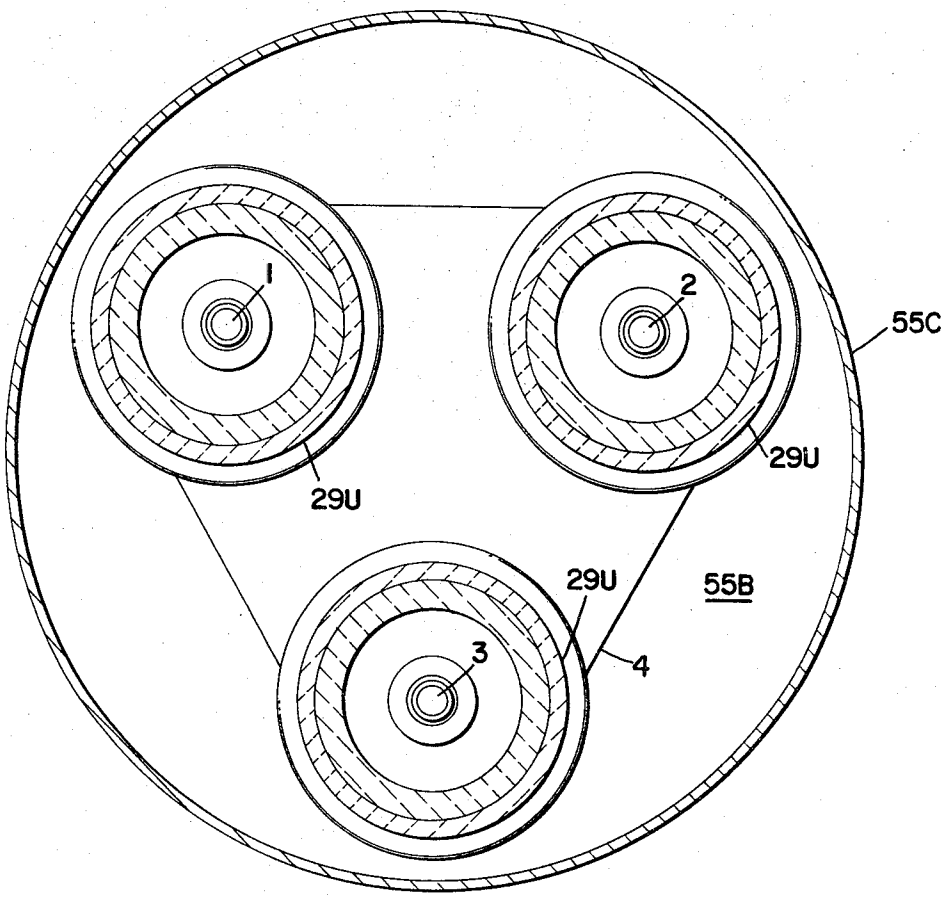


Fig. 5

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# MULTI-POINT TO COMMON POINT DEAD TANK SWITCH HAVING VACUUM INSULATED CONTACTS AND VACUUM INSULATED TERMINALS

## BACKGROUND OF THE INVENTION

The present application relates to high voltage power switch-gear and is believed to have particular significance in connection with that type of switch which uses high vacuum as insulation. However, the invention can also have utility in connection with switches having fluid (e.g., oil or a gas other than air) insulation.

While there may be unsuccessful exceptions, heretofore, vacuum switches capable of interrupting high currents (e.g., above 100 amperes) at high rms voltage (e.g., above 1 KV) have typically been two-terminal devices. Each such device has had its own (usually insulating material) enclosure for a single pair of separable contacts. Conventionally, a metal condensing shield is included within the (e.g., evacuated) insulating material envelope and one of the contact members is movable through a bellows. Such a switch is difficult to enclose to be safe from accidental environmental interferences, pollutants, rain-wetting, and, particularly, water immersion.

Although many prior attempts have been made to provide a "dead-tank" (e.g., an electrical-ground-surfaced) vacuum switch, the prototypes heretofore have failed, primarily because of conduction to ground during interruption.

An object of the present invention is to provide simple and inexpensive means for overcoming the abovementioned difficulties.

## BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages will become apparent and the invention may be better understood from consideration of the following description taken in connection with the accompanying drawings, in which:

FIG. **1** is a simplified schematic diagram for describing, as a preferred embodiment of the invention, a three point/common point (or three-way) switch;

FIG. **2** is an elevational view in cross-section of a vacuum switch operable for the arrangement suggested by FIG. **1**;

FIG. **3** is a schematic illustration of a loop circuit wherein devices according to the invention are useful;

FIG. **4** is a simplified schematic diagram of an arrangement for selectively providing power from a normally preferred source or from an emergency source, as for a hospital; and

FIG. **5** is a cross-section taken on the line **5**—**5** of FIG. **2**.

## DESCRIPTION OF THE EMBODIMENTS

In FIG. **1**, dashed line block **46** represents the outline of a three-way switch having terminals **1**, **2** and **3**. A fourth point or part **4** is an internal connection. Three switch gaps have stationary contacts associated with **1**, **2** and **3** and have respective movable contacts **11***b*, **11***c*, **11***a*. Whenever contacts **11***a*, *b* and *c* are all open, the internal connection or terminal **4** is isolated.

In FIG. **2**, like-functioning parts are like-numbered as in FIG. **1**. Though the entire switch apparatus can be tilted around to operate at any angle (e.g., to provide lowermost, thus rain-shielded, line terminals) an up-side-down arrangement of a three-legged stool is somewhat analogous to the FIG. **2** showing of movable contacts **11***a*, *b* and *c* each cooperable with a common conductive material wobble plate **4**.

Operating rods **21** extend through grounded lower guides **22** each sealed by its own resilient metal (or other material) bellows **23**.

Each operating rod **21** cooperates through its own insulating material section **24** with an upper rod portion **25** for moving the respective contact, **11***a*, *b* or *c*, while the upper end of the respective bellows **23** moves and the bellows preserves the vacuum.

Means for selectively moving or wobbling the conductive plate **4** include plural universal, e.g., ball and socket, joints



each preferably quite near to the point of associate contact separation. As shown, each rod section **25** terminates in a ball mating with a socket at the top of a respective movable contact support member **26** mechanically, and electrically, associated with the conductive wobble plate **4**.

Plural, electrically floating, condensing shields **27**, in cooperation with other baffles, serve to completely "hide" the contact pairs (**11***a*–**12**, **11***b*–**12**, etc.) from ground, and to hide each from remote terminals. That is, the contact pair associated with terminal **1** is hidden from terminal **2**, and from terminal **3**. A separate, preferably ceramic, insulating material shield cylinder **29L** not only supports but isolates each (presumably metal) shield **27** from any "foreign" source of current. For example, if there is any contact metal vapor stream, it is stopped by shielding means which surrounds the particular contact set. An associate terminal lead rod **51** associates each fixed contact **12** with a respective (e.g., threaded) terminal **3**, **2** or **1**, surrounded, respectively, by upper insulative cylinder means indicated generally as **29U**.

A metallic shield cup means **52** is used to prevent metallic vapor from reaching a grounded surface out the bottom end of shield **27**, and a separate metal terminal flange **53**, a different one in cooperation with each of the (as shown, three) lower insulating cylinders **29L**, prevents metallic vapor from reaching a grounded surface at the top end of shield **27**.

As previously intimated, and later more fully explained, the switch can thus be provided with a substantially completely enclosing dead or grounded tank. The tank could take many forms but it is assumed to have a bottom plate, **55B**, a cylinder side wall, **55C**, and a top, **55T**, with circular adapter seals **56** provided to preserve the vacuum while making a semi-flexible connection between, for example, a rigid metal tank top **55T** and preferably ceramic terminal insulation **29**.

For operation, all control rods **21** could be pulled to "opened" position simultaneously, but that is only occasionally contemplated. Instead, as just one rod, such as that associated with contact **11***a*, is pulled, the wobble plate **4** pivots about a line through the mating points of the other contacts, **11***b* and **11***c*.

It is not necessary that there be a three-legged arrangement. There might be only two legs (outside terminals) or (for standardization and for ease of making connections) there could be three legs with the contacts of one leg always held closed (as by a spring means) as might be found useful for the arrangements about to be described in connection with FIGS. **3** and **4**.

FIG. **3** is a one-line diagram of a loop system **31**, **32**, **33** such as might be used for underground distribution of energy from a source **34**. Each tap, such as **35** from the loop as to a residence or transformer, requires a similar switch having at least two breaks (switch gaps) associated with a common point. For each such tap, the three-gap switch of FIG. **2** can be employed or there might be a two-gap switch at each such location and still it would in no-wise escape the scope of the present invention so far as the prior art permits.

FIG. **4** illustrates application of a two (or three) gap common point switch for switching between an ordinarily preferred power source **41** and an emergency source **42**, as for supplying a hospital or large public building, represented in the schematic merely by the transformer symbol **43**. In any event, and whether the switching is automatic (e.g., by preferred source voltage sensing) or manual, the switch gap **44** would be normally closed and switch gap **45** would be normally open while switch **44** would open and switch **45** close if preferred source voltage is lost at the load, or ahead of the load if an automatic transfer back is desired.

## SUMMARY OF OPERATION AND ADVANTAGES

There is thus provided apparatus of the class described providing many advantages.

In considering actual operation, and referring to FIG. **2** as an example, suppose that the contact pairs are all closed, and

that it is desired to open contact pair 11*a*–12 and that its opening starts. As contact 11*a* is moved to open position (e.g., full-open being a ¼-inch gap), the conductive plate 4 and all parts rigidly connected to it will revolve substantially about a line through mating points of contacts 11*b* and 11*c*. Any arc products from contacts 11*a*–12 move away from the contacts and condense on associate shield 27.

With the assumed sequence of operation, of contact pair 11*a*–12 opening while the other contact pairs are closed, arcing is preferential between contact 11*a* and 12. Associate shield 27 is conductively isolated from any other source of current by insulator shield 29. Thus, there will be no arcing to metal shield 27, and no current will flow through it, because two arcs in series would be required to maintain a circuit through 27. With the equilateral spacing assumed (see FIG. 5), two arcs in series would require a greater voltage than the single arc at contact gap and the two arcs cannot start because preceded by the single arc path.

This affords a novel switch design wherein not only open gap insulation but also terminal-to-terminal (or conductor) and also contact-to-ground insulation comprises high vacuum, or some inert fluid if that be desired. There is thus provided a switch design useful even in submersible applications wherein the outside of the switch is at ground potential and whereby electrical connection may readily be made from concentric neutral cables (not shown) with solid insulation so as to completely contain the electric field.

And there is provided a versatile switch of simple design having three (or two, or any plural number of) terminals capable of use for switching branch circuits and loop circuits within common vacuum chamber means.

Arrangements according to the invention can have other uses than those described. For example, with simultaneous operation of operating rods, a plural-break switch can be achieved for series application to raise the operating voltage rating of a single enclosure, and this may be possible primarily because of present invention novelty in isolating the (as disclosed, inner) shield for any contact set from that of any other contact set.

While I have illustrated and described particular embodiments, various modifications may obviously be made without departing from the true spirit and scope of the invention intended to be defined only by the appended claims taken with all reasonable equivalents.

I claim:

1. In a high voltage electrical switch, the combination of
an outer tank means which forms a substantially single enclosure protected against ambient and for containing substantially no air,
plural contact sets located within the tank means and each comprising a relatively stationary contact and a relatively movable contact,
plural operating rods at least partly insulative and arranged for selectively moving each of the movable contacts each selectively independent of position or movement of any other,
an internal common member electrically in circuit with all movable contacts,
plural terminal connectors each associated with a respective one of the stationary contacts,
plural shielding means each spacingly surrounding a respective stationary contact with said shielding means being electrically isolated each from the other.

2. In a high voltage switch, the combination of claim 1 further characterized by
the internal common connection member being plate-like, and
there being movable contact support members which interconnect the operating rods with the movable contacts and with the internal common connection member through universal joints.

3. In a high voltage switch, the combination of claim 1 further characterized by
the switch being a plural way to common point vacuum switch with the plural contact sets insulated, at least in part, from one another, and each from any terminal connector with which it is not most directly associated by the common vacuum environment of the common enclosure, while the terminal connectors are in part so insulated from one another also.

4. In a high voltage switch, the combination of claim 2 further characterized by the universal joints being between the operating rods and the movable contacts and comprising ball and socket means.

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