United States Patent [19]

Cherry et al.

[11] **3,814,881**

[45] **June 4, 1974**

[54] **VACUUM INTERRUPTERS ENCLOSED IN VACUUM HOUSINGS**

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[73] Assignee: **Westinghouse Electric Corporation**, Pittsburgh, Pa.

[22] Filed: **July 21, 1972**

[21] Appl. No.: **273,885**

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

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

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

[56] **References Cited**

UNITED STATES PATENTS

1,720,413	7/1929	Greenwood	200/144 B
1,801,736	4/1931	Greenwood	200/144 B

FOREIGN PATENTS OR APPLICATIONS

1,223,833	3/1971	Great Britain	200/144 B

Primary Examiner—Robert S. Macon

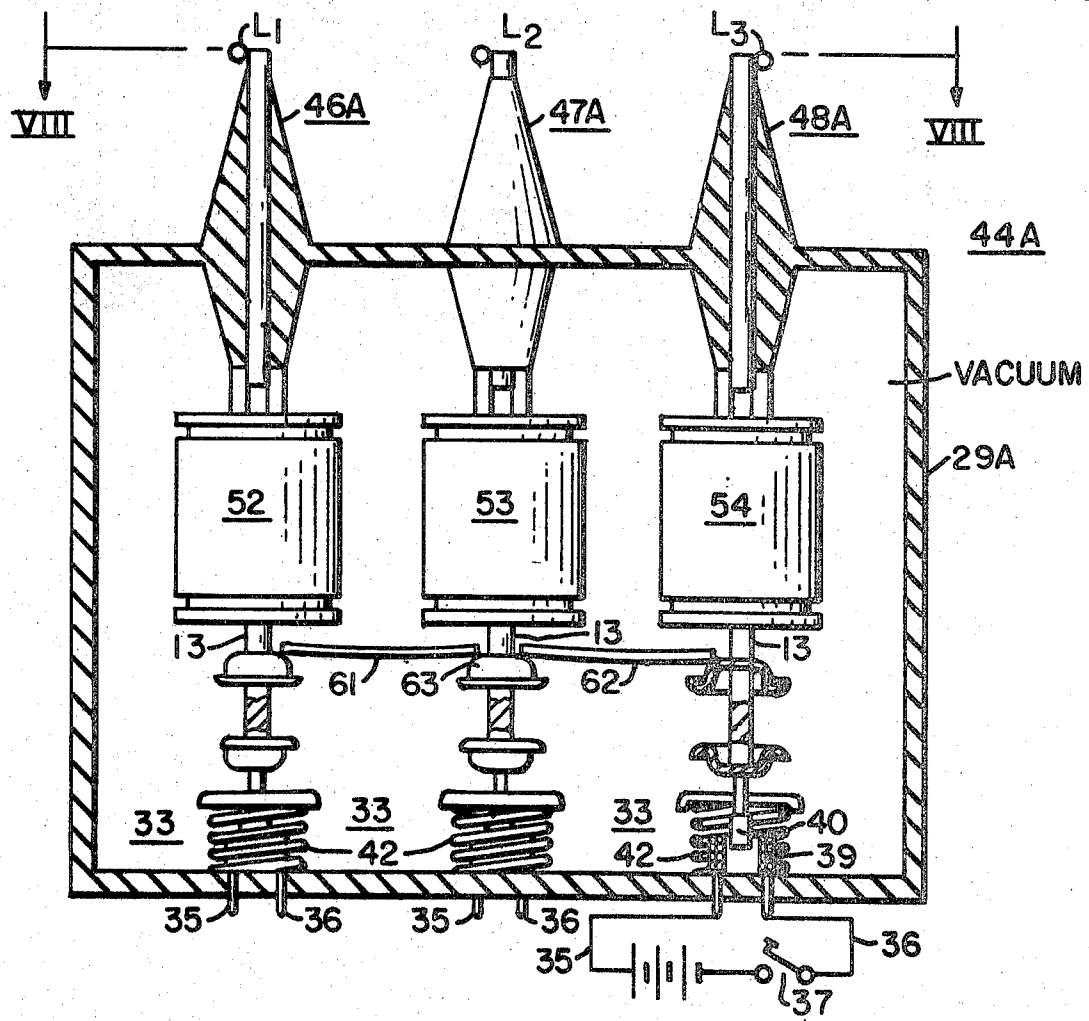
Attorney, Agent, or Firm—W. R. Crout

[57] **ABSTRACT**

A vacuum-type interrupter is enclosed within a vacuum environment, or housing to enable a better voltage-withstand between the live parts and the outer housing walls. Preferably, the outer housing is formed of metal, and is grounded, with terminal bushings extending through the grounded outer metallic housing. For other applications, however, when desired, the housing may, if desired, be of insulating material. In this latter event, the terminal leads require no conventional-type terminal-bushings for their accommodation.

The operating mechanism may either be disposed externally of the outer housing, or the operating mechanism for the vacuum interrupter may be disposed internally of the outer housing.

5 Claims, 8 Drawing Figures



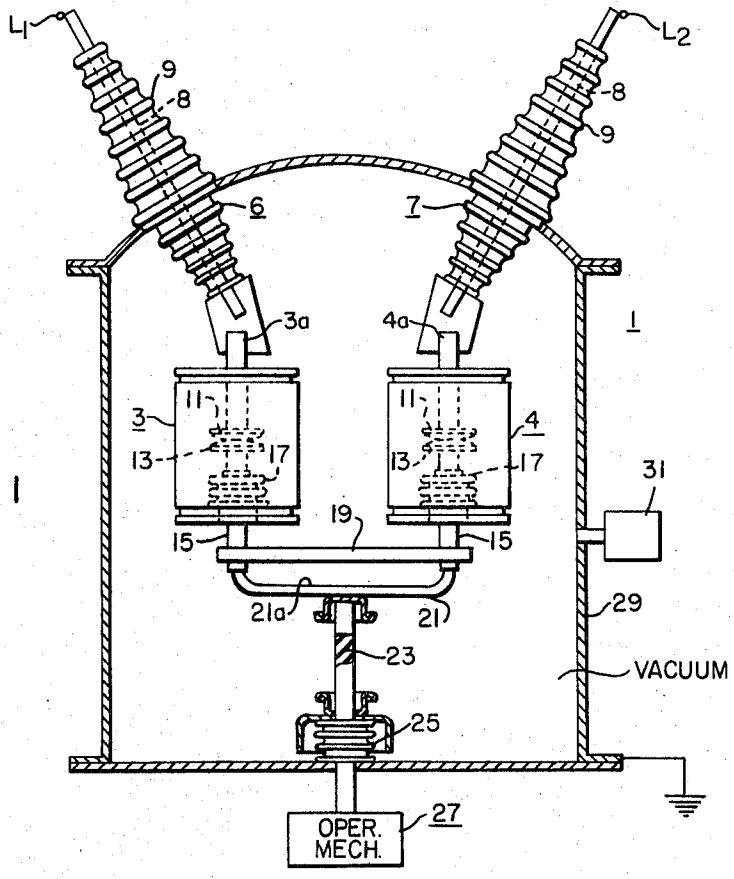


FIG. 1

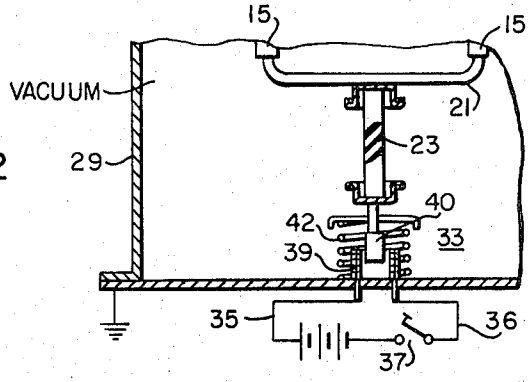


FIG. 2

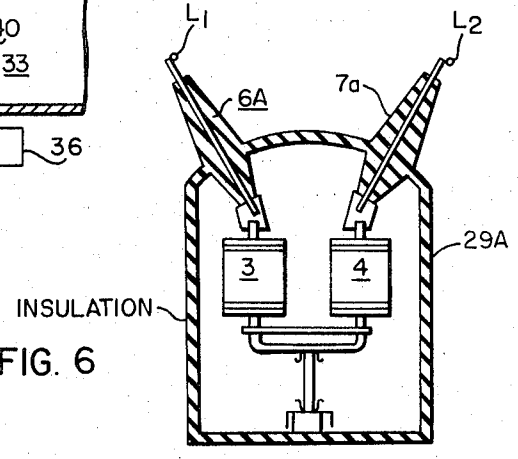


FIG. 6

FIG. 4

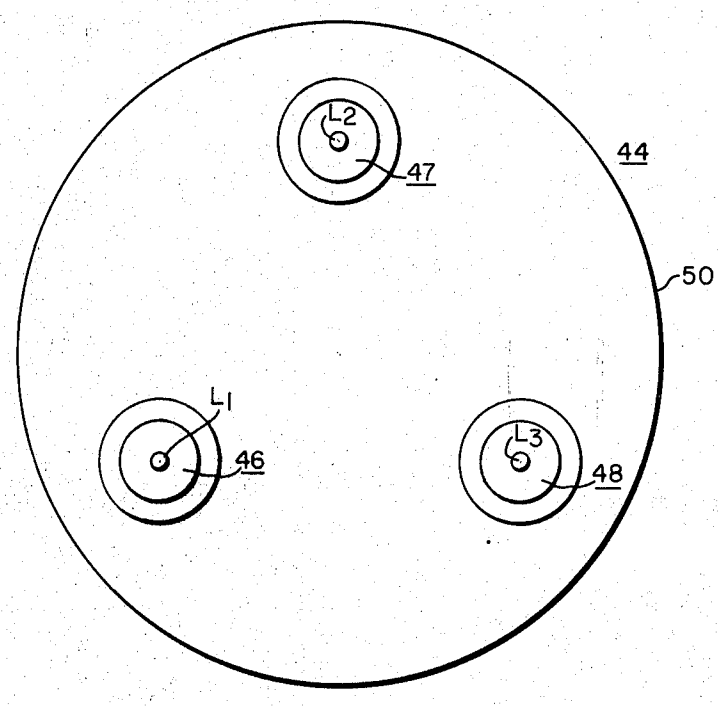


FIG. 3

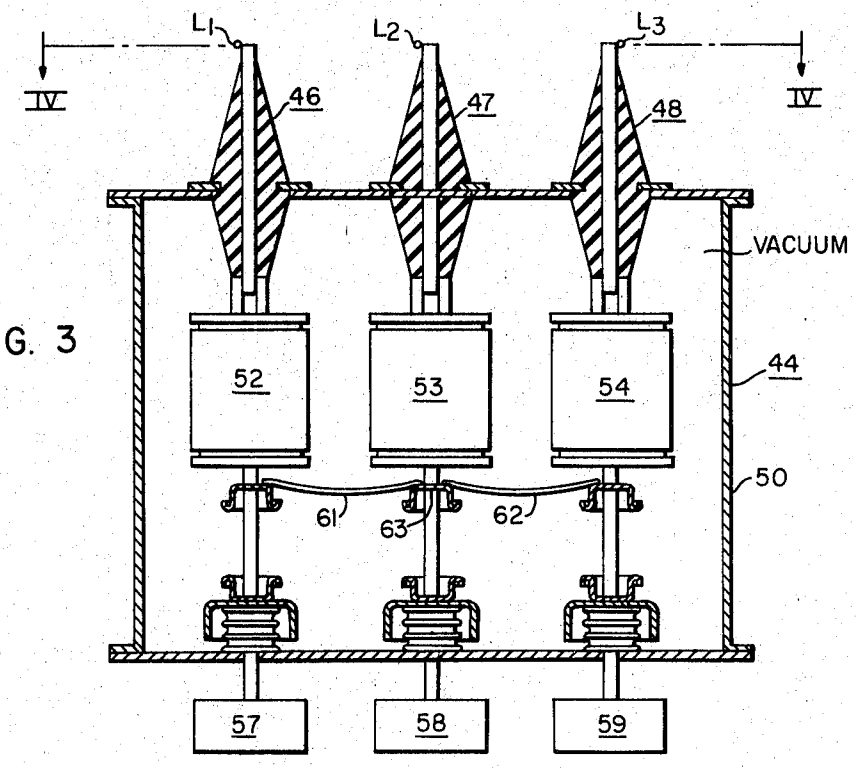
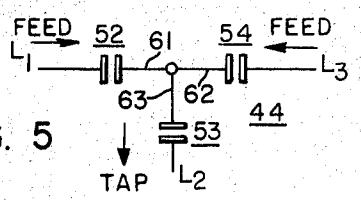


FIG. 5



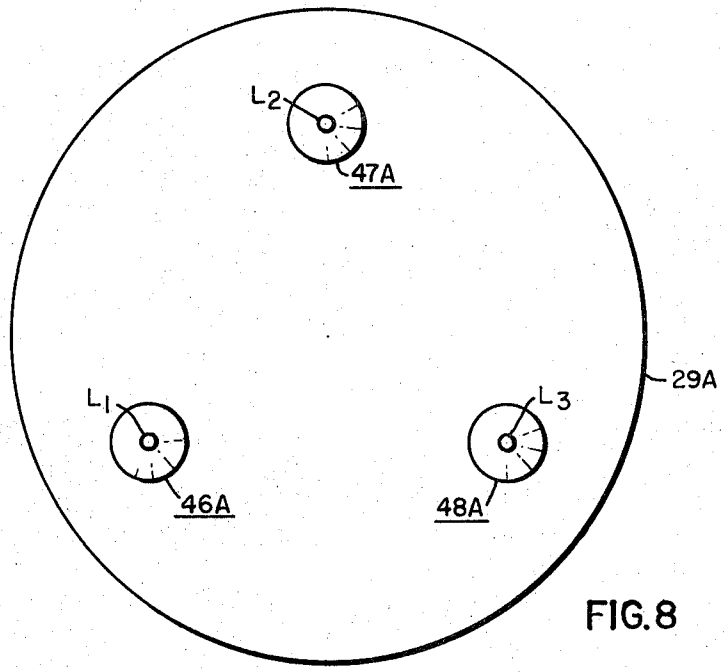
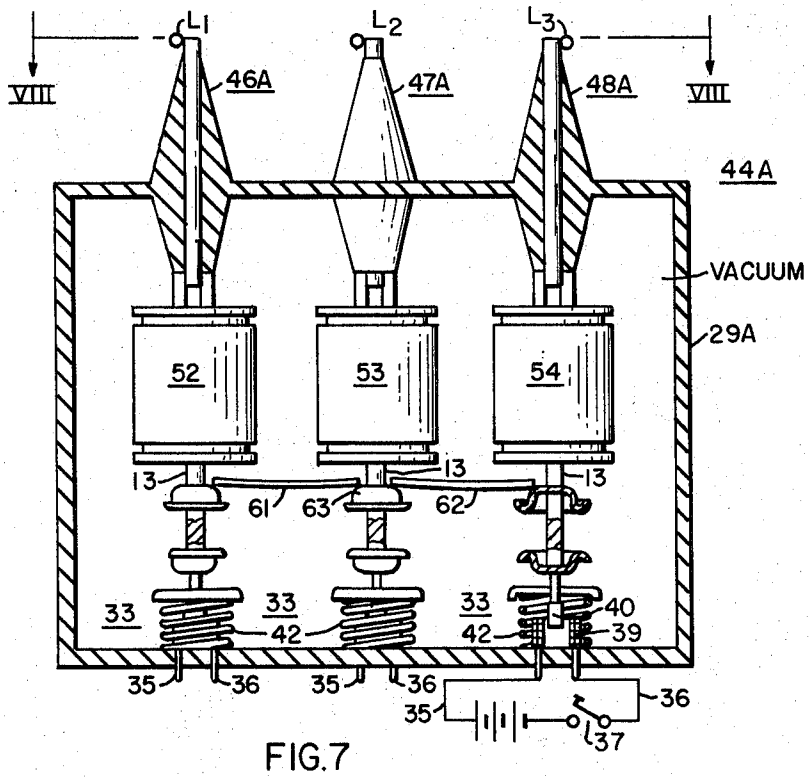

L2
47A
29A
L1
46A
L3
48A

FIG.8


L1
L2
L3
VIII
46A
47A
48A
VIII
44A
VACUUM
29A
52
53
54
13
13
13
61
63
62
33
33
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42
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FIG.7

VACUUM INTERRUPTERS ENCLOSED IN VACUUM HOUSINGS

CROSS-REFERENCES TO RELATED APPLICATIONS

Reference may be made to United States patent application filed Oct. 30, 1970, Ser. No. 85,512 by Richard E. Kane and Frank L. Reese, entitled "High-Voltage Circuit Interrupter Incorporating Series Vacuum-Interrupter Elements", and assigned to the assignee of the instant application.

BACKGROUND OF THE INVENTION

As well known by those skilled in the art, the disposition of vacuum-interrupter elements within an oil casing has been recognized. See, for example, United States patent issued April 21, 1931 to Talma Greenwood issued as U.S. Pat. No. 1,801,736. Also, reference may be made to Greenwood U.S. Pat. No. 1,720,413, issued July 9, 1929, also showing a vacuum interrupter disposed interiorly within an oil tank, which is grounded, and the operating mechanism being of an electrical nature, with the wires for the mechanism extending through the casing walls.

In United States patent application filed Oct. 30, 1970, Ser. No. 85,512, by Richard E. Kane and Frank L. Reese, entitled "High-Voltage Circuit-Interrupter Incorporating Series Vacuum-Interrupter Elements", there is illustrated and described series vacuum-interrupter elements disposed within a gaseous environment, such as sulfur-hexafluoride (SF_6) gas. In the aforesaid Kane arrangement, a generally ladder-like operating mechanism is provided to simultaneously effect the opening and closing movements of the plurality of movable contact elements disposed within the several series vacuum "bottles".

SUMMARY OF THE INVENTION

In accordance with the present invention, there is proposed the "packaging" of a vacuum interrupter within a vacuum enclosure, or casing, in place of having the vacuum interrupter "bottle" disposed within air, gas (such as sulfur-hexafluoride (SF_6) gas, for example, or solid insulation encapsulant. There results many advantages by such a method of vacuum packaging.

Accordingly, it is a general object of the present invention to provide an improved vacuum-type circuit interrupter in which the enclosing housing is evacuated.

A more specific object of the present invention is to dispose one or more vacuum-interrupter "bottles" within an evacuated enclosure, and to effect their operation by a mechanism, which may be disposed either within the evacuated enclosure, or externally thereof, as desired.

Another object of the present invention is the provision of an improved vacuum-type circuit interrupter in which the vacuum-interrupter elements, either provided singly, or provided in multiple plural series arrangement, are disposed within an evacuated housing.

Still a further object of the present invention is to provide an improved tank-type circuit-interrupter with grounded metallic walls, having terminal-bushings extending therein, and providing one or more vacuum

"bottles" disposed internally of the metallic grounded housing.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view taken through a vacuum-type circuit interrupter embodying the principles of the present invention, with the contact structure being illustrated in the closed-circuit position;

FIG. 2 is a fragmentary view of the circuit-interrupter of FIG. 1, illustrating a modification thereof, in which the operating mechanism is electrical, and is disposed internally of the evacuated metallic housing;

FIG. 3 is a second modification of the invention, in which three vacuum "bottles" are disposed within an evacuated housing, each having its own separate mechanism for "T" tap switching purposes, the contact structure being illustrated in the closed-circuit position;

FIG. 4 is a top plan view of the circuit-interrupter of FIG. 3 taken along the line IV—IV of FIG. 3, looking in the direction of the arrows;

FIG. 5 is a diagrammatic view of the circuit connections for the "T" tap switch of FIGS. 3 and 4;

FIG. 6 illustrates a further modification in which an insulating housing is utilized and,

FIGS. 7 and 8 illustrate a further modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings, and more particularly to FIG. 1 thereof, the reference numeral 1 generally designates a vacuum-type circuit interrupter. As shown in FIG. 1, it will be noted that there is provided a pair of series-related vacuum interrupter bottles 3, 4, each having its upper stationary contact terminal 3*a* or 4*a* connected to the lower end of a terminal bushing 6 or 7 of rather conventional style. As well known by those skilled in the art, the terminal-bushings 6, 7 comprise a terminal-stud 8, extending longitudinally through an insulating body 9. Reference may be made to U.S. Pat. Nos. 3,222,625, 3,001,004 and 3,001,005 for the description of such a type of terminal-bushing structure.

As shown in FIG. 1, each vacuum "bottle" 3, 4 generally comprises a stationary contact 11, cooperable with a movable contact 13, the latter being actuated by a movable contact stem 15 extending through a bellows 17, and actuated by an external cross-bar 19. The cross-bar 19 is actuated by a bridging member 21, to the intermediate portion 21*a* of which is secured an operating rod 23, preferably formed of insulating material. The operating rod 23 extends through a bellows 25, and is mechanically connected to an external operating mechanism, indicated by the reference numeral 27.

During the opening and closing operations, as will be obvious, the operating rod 23 is moved linearly in a vertical direction, upwardly to close the breaker 1, and downwardly to open the breaker 1. This will, of course, effect simultaneous opening and closing motions of the movable contacts 13 into and out of contacting engagement with the stationary contacts 11 in a manner well known by those skilled in the art.

The outer casing **29**, which is preferably metallic and grounded, is maintained in an evacuated condition, as by a vac-ion pump **31**, or if desired, by a getter.

There are many advantages resulting from the aforesaid method of enclosing the vacuum-interrupter "bottles" **3, 4**. Some of these are that the vacuum-interrupter lengths, and spacings between the interrupters **3, 4** are shorter, than those in air for two or more vacuum interrupters, which work in combination with one another. Additionally, the movable terminal temperatures are not critical, since oxidation will not take place in a vacuum. Since the outer chamber **29** and the mechanism **27** are grounded, the structure is simpler and safer than conventional-type breakers and switches. The concept permits putting two or more vacuum interrupters **3, 4** in a vacuum to get high-voltage interruption, as illustrated in FIG. **1**.

FIG. **2** illustrates a modification of the arrangement of FIG. **1** in which the operating mechanism **33** is of a solenoid type, and is provided internally of the casing **29**. It is electrical, and the wires for energizing the same are indicated by the reference numerals **35** and **36**. The actuating switch for the solenoid is designated by the reference numeral **37**. Upon closing the switch **37**, the solenoid **39** is energized and effects a downward motion of the solenoid plunger **40** into the winding **38**, and effects downward opening movement of the movable contacts **13**. Upon deenergization of the solenoid **39**, a spring **42** may effect a reclosure of the movable contacts **13** in an obvious manner.

With reference to FIGS. **3–5** of the drawings, it will be noted that in this modification of the invention there is provided a "T" tap-switching arrangement **44**, as diagrammatically illustrated in FIG. **5** of the drawings. Three terminal bushings **46–48** extend through the outer grounded metallic housing **50**, and the three vacuum "bottles" **52–54** are disposed interiorly thereof, with each having its own separate operating mechanism. The mechanisms are diagrammatically illustrated by the reference numerals **57–59**. The operation of the vacuum bottles **52–54** will appear obvious in view of the previous description relevant to FIGS. **1** and **2**.

To effect a switching arrangement, it is merely necessary to actuate the particular desired mechanism **57–59** to consequently effect closure of the selected vacuum-interrupter contacts **13** within the selected switch bottle **52–54**. Reference is again directed to the diagrammatic view of FIG. **5** in this connection.

FIG. **4** illustrates more clearly how the vacuum bottles **52–54** and bushings **46–48** may be located in a desired arrangement with adequate spacing between the "bottles".

From the foregoing description it will be apparent that there has been provided an improved vacuum-type circuit interrupter, in which the vacuum "bottles" are disposed within an evacuated environment. Although certain of the modifications illustrate the casings to be grounded and of metal, the casing **29A**, in the modification of FIGS. **6** and **7**, is of insulating material, and there would then not be required a conventional-type of terminal bushing.

There are many advantages to be obtained by the use of the foregoing arrangement.

1. Vacuum interrupter lengths and spacings between interrupters are shorter than those in air for two or more vacuum interrupters which work in combination with one another.
2. Movable terminal temperatures are not critical since oxidation will not take place in vacuum.
3. Since the chamber and the mechanisms are grounded, the structure is simpler and safer than conventional breakers and switches.
4. Concept permits putting 2 or more V.I.'s in vacuum to get high voltage interruption.
5. If the mechanism is incorporated into the vacuum chamber, the force required to overcome the atmospheric pressure on the bellows is eliminated.

Although there has been illustrated and described specific structures, it is to be clearly understood that the same were merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art without departing from the spirit and scope of the invention.

We claim as our invention:

1. A selecting switch for changing electrical connections comprising, in combination, a molded resinous insulating evacuated casing having a plurality of resinous-type insulating terminal bushings extending out of the upper cover portion thereof, a vacuum-interrupting unit supported at the lower end of each of the plurality of resinous-type terminal bushings, each vacuum-type interrupting unit having a relatively stationary contact and a cooperable movable contact making separable contacting engagement within the evacuated enclosure, means electrically connecting the several movable contacts together, and a separate operating mechanism for each vacuum-type interrupting unit for selectively operating the respective movable contact thereof according to the switching intentions of the operator.

2. The switch combination according to claim **1**, wherein three insulating terminal bushings are provided, and also three vacuum-type interrupting units are disposed within the evacuated insulating resinous casing thus constituting a "T"-tap selecting switch.

3. The combination according to claim **1**, wherein the operating means is of the solenoid type and disposed within the interior of the evacuated resinous casing.

4. The combination according to claim **3**, wherein a solenoid-coil is disposed interiorly of the evacuated resinous casing, spring means are provided to bias each respective movable contact to the closed-circuit position, and electrical switching means are disposed externally of the evacuated resinous casing for operating the internally-located solenoids.

5. The combination according to claim **1**, wherein the movable contact for each of the vacuum-type interrupting units is actuated by a solenoid-type operating mechanism, the solenoid of which is disposed interiorly within the evacuated resinous insulating casing.

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