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Cleaveland

[11] **3,793,494**

[45] **Feb. 19, 1974**

[54] **DRAW OUT TYPE VACUUM CIRCUIT BREAKER ASSEMBLY WITH HINGED BARRIER**

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

[22] Filed: **Nov. 15, 1972**

[21] Appl. No.: **306,669**

[52] **U.S. Cl.** ..... **200/50 AA,** 200/144 B

[51] **Int. Cl.** **H01h 9/22**

[58] **Field of Search** .....200/50 AA, 144 R, 144 B, 200/147 R, 166 B, 153 SC; 339/230 R

[56] **References Cited**

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3,409,865	11/1968	Shannon	339/230 R
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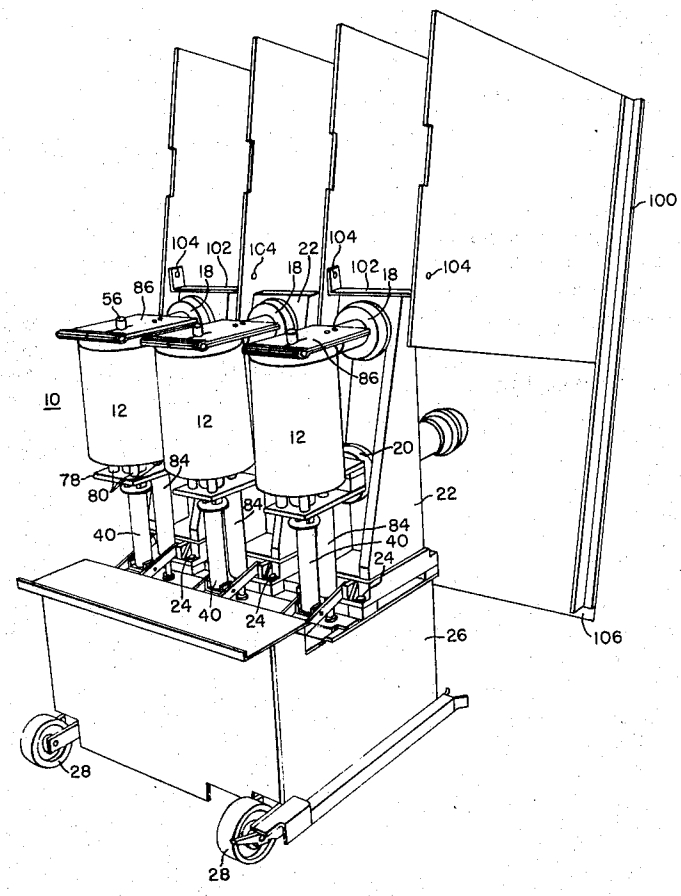
Primary Examiner—J. R. Scott

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[57] **ABSTRACT**

A circuit breaker for metal clad switchgear is provided using vacuum-interrupter elements rather than the usually provided air type circuit interrupter. A rigid mounting for one end of the vacuum-type interrupter elements is provided, together with a connector plate structure for the other end of the vacuum interrupter which permits resilient movement of the interrupter end cap in one direction only. A hinged barrier is provided to facilitate access to the vacuum interrupters without removing the barrier. A porcelain push rod is connected directly between the movable operating rod, coming from the vacuum interrupter, and the breaker operating mechanism, thus providing a porcelain-to-ground insulation path and electrically isolating the operating mechanism from the vacuum interrupter.

12 Claims, 9 Drawing Figures



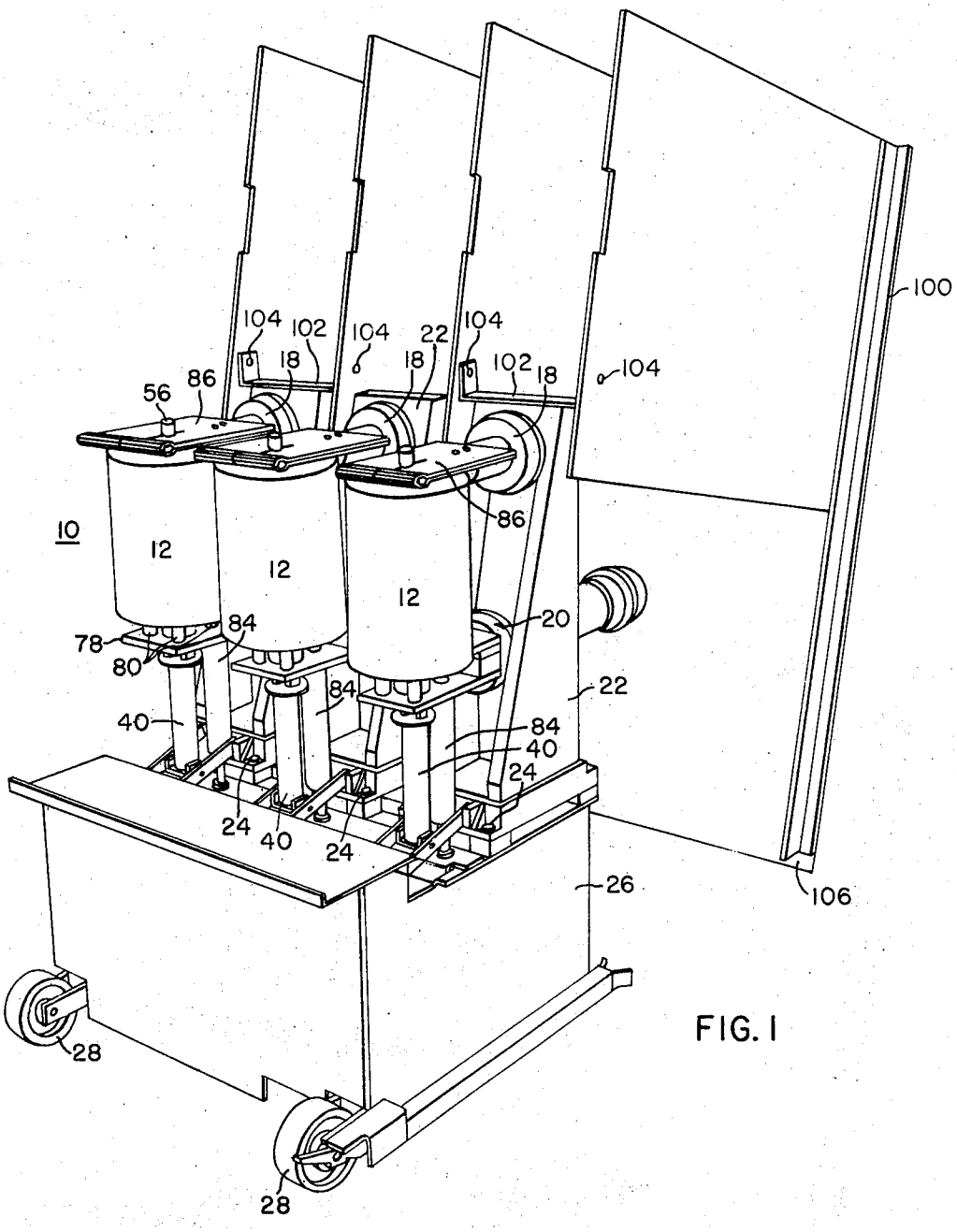

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FIG. 1

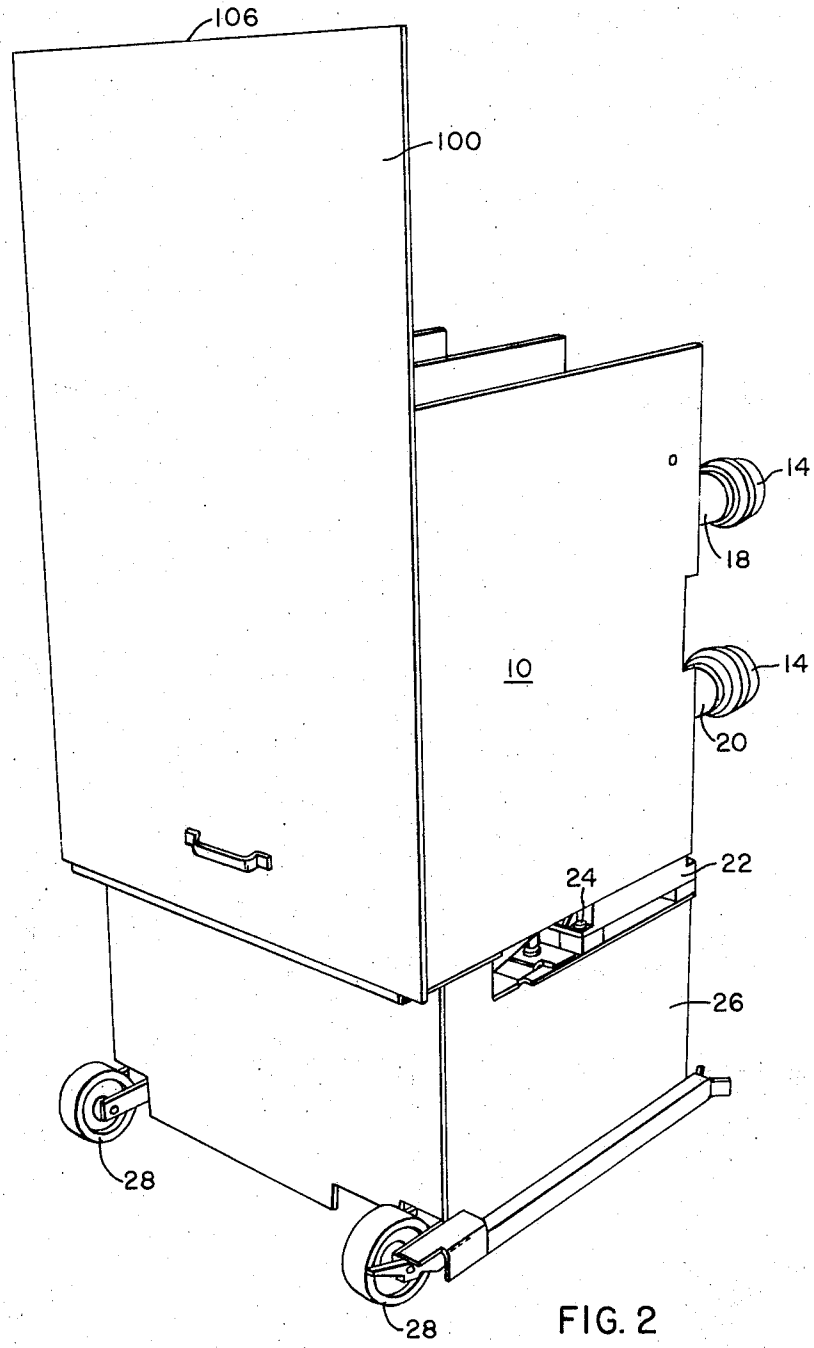


FIG. 2

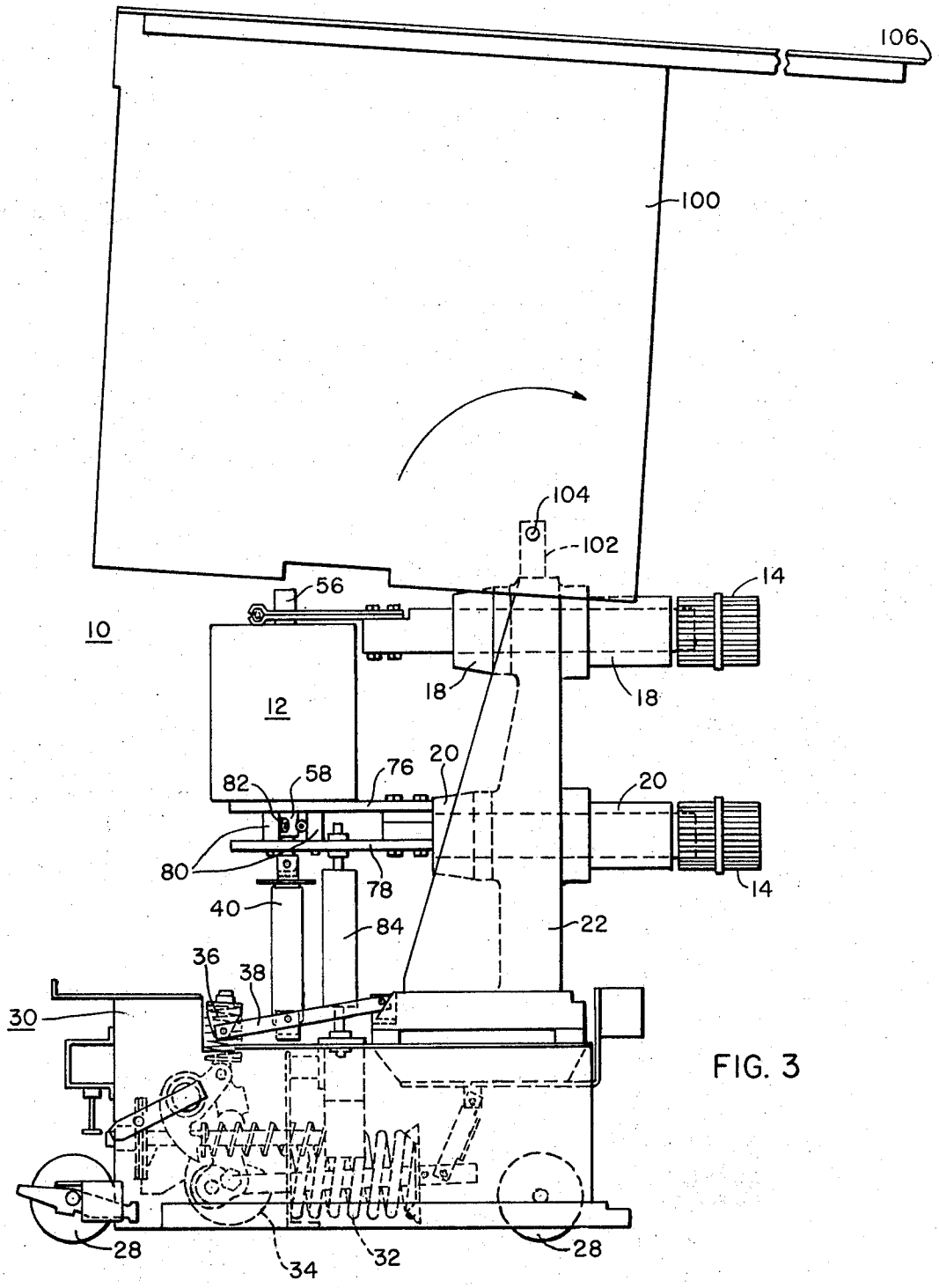

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FIG. 3

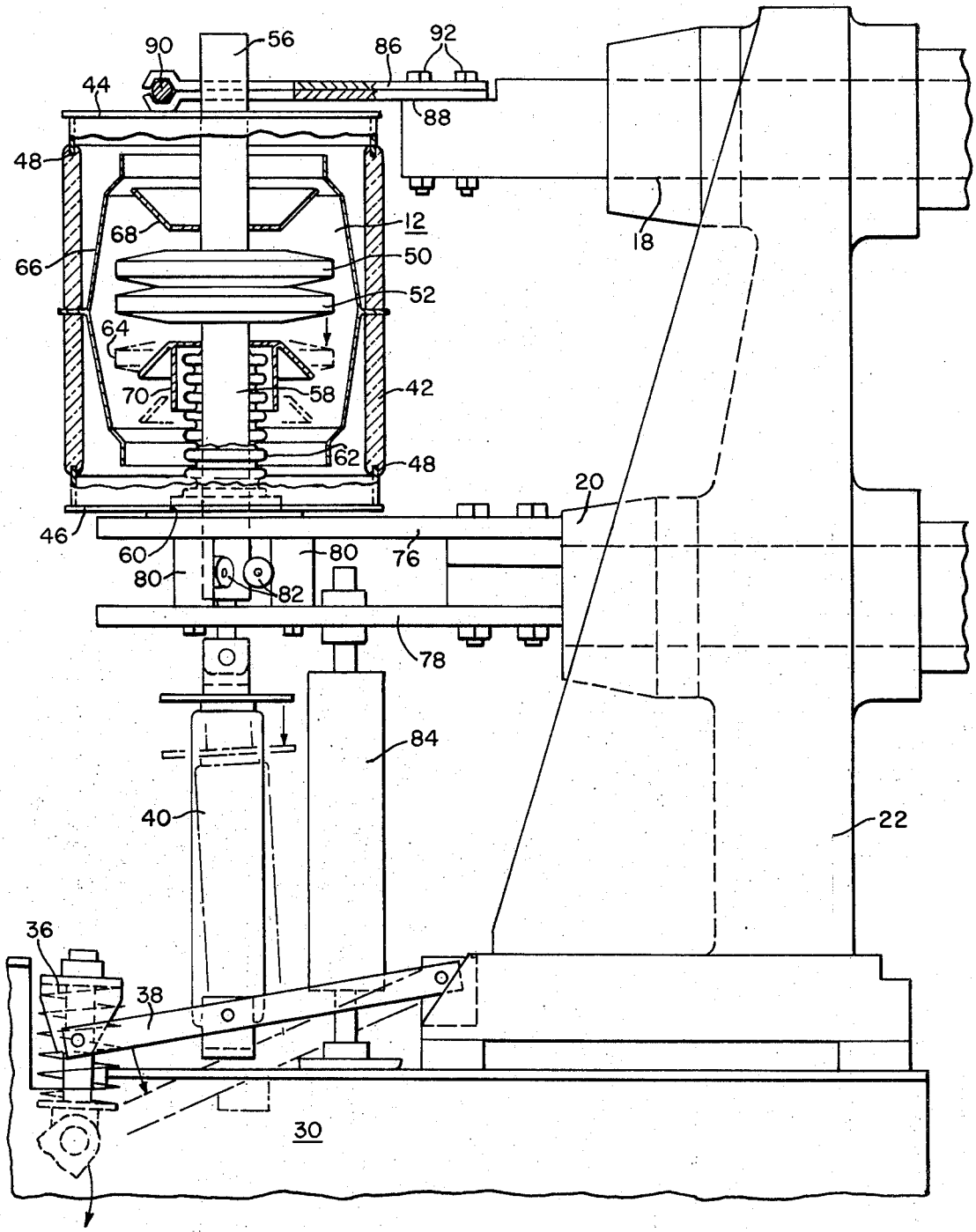

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FIG. 4

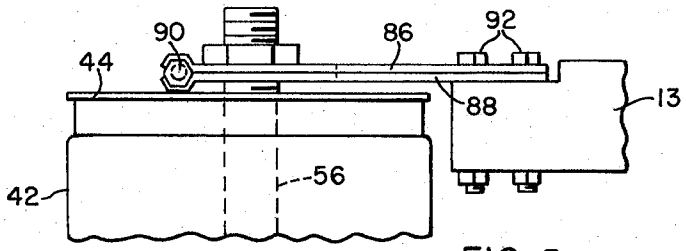


FIG. 5

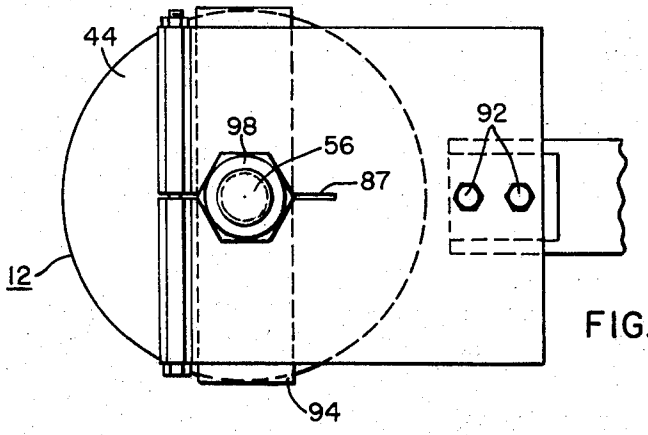


FIG. 7

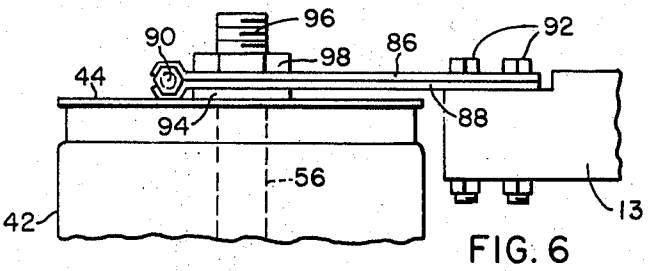


FIG. 6

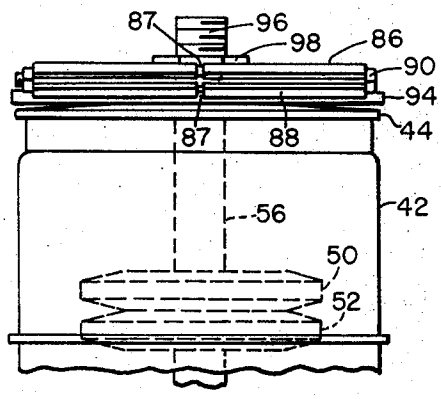


FIG. 9

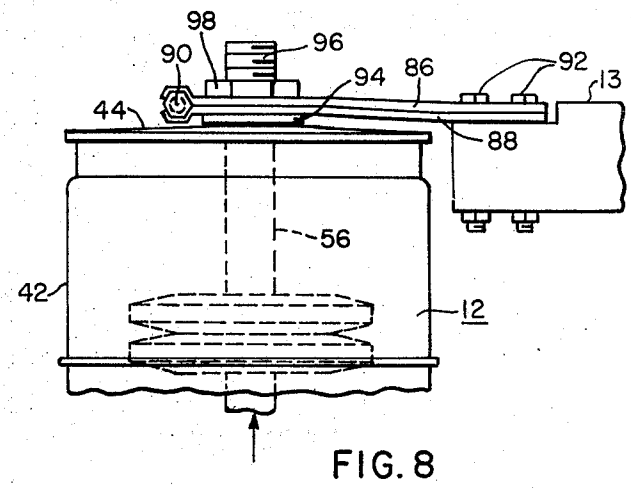


FIG. 8

DRAW OUT TYPE VACUUM CIRCUIT BREAKER ASSEMBLY WITH HINGED BARRIER

BACKGROUND OF THE INVENTION

This invention relates to circuit breakers and more particularly to large-type draw out circuit breakers for metal-clad switchgear which utilizes vacuum interrupters as an electric circuit interrupting element.

As well known by those skilled in the art, metal-clad switchgear has achieved extensive use within the industry. Customarily, magnetic air-break arc-chute structures have been employed, such as set forth in U.S. Pat. No. 3,307,004, issued Feb. 28, 1967, to Samuel A. Bottonari, and assigned to the assignee of the instant application. Such magnetic air-break circuit interrupters are rolled on a movable truck into a cubicle or cell of the metal-clad switchgear enclosure. Metal clad switchgear is built for either indoor or outdoor use, and the surrounding grounded enclosure provides protection to operating personnel.

Vacuum-type circuit interrupters have developed, and are at the present time, of considerable reliability. It is desirable, therefore, to utilize the new-type vacuum interrupter units in the metal-clad switchgear industry to take advantage of their small size and efficient operation. Prior art circuit breakers such as disclosed in U.S. Pat. No. 3,603,753, issued Sept. 7, 1971 to Russell E. Frink and assigned to the same assignee as the instant application, utilizes vacuum interrupter elements for metal-clad switchgear draw-out circuit breakers. In the breaker disclosed in U.S. Pat. No. 3,603,753, a metallic portion of the operating linkage, required to operate the vacuum interrupters, is at line potential.

SUMMARY OF THE INVENTION

According to a preferred embodiment of the present invention, there is provided a draw-out type circuit breaker unit incorporating vacuum-type interrupter elements so that a three-phase interrupter may be moved into or out of a metal-clad switchgear cubicle or housing. The vacuum interrupter units are rigidly mounted to the draw-out breaker assembly. According to the invention, a porcelain push rod is connected at one end directly to the movable contact rod of the vacuum interrupter unit and at the other end to the circuit breaker operating linkage. Thus, the operating linkage is electrically insulated from the vacuum interrupter. This linkage is composed of lever arms that give the correct amount of contact travel and have a spring and overtravel provision that applies contact pressure when the interrupter is closed, even though the contacts have worn down due to arcing. Electrical contact is made between the movable interrupter rod and a stationary lower end connector by multiple spring-loaded rollers. By locating the porcelain push rod in the linkage train after the travel of the operating mechanism has been reduced and by attaching the porcelain push rod directly to the movable contact rod, the performance of the circuit breaker is dramatically improved as compared to the prior art circuit breaker disclosed in U.S. Pat. No. 3,603,753. By thus locating the porcelain push rod, closer to the center of rotation, energy required to accelerate this relatively massive insulating rod has been approximately cut by a factor of four. Also, by attaching the procelain push rod directly to the movable interrupter rod, electrical clearance is improved and all

of the metallic parts of the operating linkage can be kept at ground potential, where there is more space.

The disclosed vacuum circuit breaker assembly also embodies an upper connector between the vacuum interrupter and the upper pole unit conductor, which allows the upper end cap and the stationary interrupter rod, to flex in one direction only, and acts as a stiffener to prevent movement in the opposite direction. This upper connector is rigidly attached to the stationary contact rod of the vacuum interrupter and extends laterally to the outer diameter of the envelope of the vacuum interrupter. In the event that the contacts are welded in the closed position, the connector acts as a stiffener of the end cap and transfers the weld breaking force to the interrupter envelope and the force is then transmitted through the envelope to the rigid interrupter mounting at the opposite end. Thus, the stationary contact and its associated interrupter end cap are prevented from flexing towards the movable contact during the weld breaking operation. That is, the stationary contact rod and the stationary contact end cap can flex in an upward direction only, during circuit closing. This upward movement during circuit closing results in less bounce and a decrease in the force transmitted to the upper breaker stud. If additional stiffness and weld breaking ability is required, a beam, which extends to the outer diameter of the vacuum interrupter housing, can be attached under the upper connector. The stationary contact and the stationary contact end cap cannot move in a downward direction during a weld breaking operation and this stiffness results in the generation of very high forces for breaking welds during circuit interruption. It has been found that vacuum interrupter contact materials may have superior interrupting properties but have the problem of producing very strong welds as the contacts close on high current. It is part of this invention to provide a novel connection to the upper interrupter rod that stiffens the end cap as a weld is broken, but still is resilient as the contacts impact on closing. Thus, without adding more energy to the operating mechanism, and without causing high forces on closing, the force necessary to break welds of this superior contact material is obtained.

The improved vacuum circuit breaker assembly disclosed in this application has a novel pivoting barrier, unlike the barriers used on prior art vacuum circuit breakers. This barrier unlike the barriers utilized on prior art vacuum circuit interrupters is intended to be attached to the circuit breaker assembly at all times, even during shipping of the circuit breaker. The barrier is installed at the factory and can be tilted back for accessibility to breaker parts during maintenance and inspection. The circuit breaker assembly may be lifted with the barrier assembly in place. To obtain access to the vacuum interrupters or other breaker parts, the barrier is pivoted on a hinge point. The pivoting barrier has several advantages such as convenience in obtaining access to the interrupters without disassembling or removing the barrier and the safety feature of the barrier being non-removable for access to the vacuum circuit breaker. There has been a history of fatal accidents where people have removed barriers from the breaker for inspection and have forgotten to reinstall them and have energized the breaker without the barrier in place. With a tilting barrier that is not detachable, this could not happen. Also, with the vacuum circuit breaker assembly in the switchgear cell, the barrier cannot be piv-

oted to expose the vacuum interrupters and other energized parts. To obtain access to the vacuum interrupters and other potentially live parts, the vacuum circuit breaker assembly must be deenergized and removed from its switchgear cell.

BRIEF DESCRIPTION OF THE DRAWINGS

Further advantages will be readily apparent upon reading the following specification taken in conjunction with the drawings, in which:

FIG. **1** is a perspective view of a vacuum-type circuit breaker assembly, with the barrier tilted back for breaker inspection, embodying the features of the present invention;

FIG. **2** is a view similar to FIG. **1** with the barrier shield pivoted to the normal operating position;

FIG. **3** is a side view of the circuit breaker assembly shown in FIG. **1** with the barrier in an intermediate tilted position;

FIG. **4** is a side view partially in elevation and partially in section of a portion of the circuit breaker shown in FIG. **3**;

FIG. **5** is a side view of a portion of the vacuum circuit breaker assembly shown in FIG. **4**;

FIG. **6** is a side view of a portion of the vacuum circuit breaker assembly as shown in FIG. **5** but with an additional stiffening member in place;

FIG. **7** is a top view of the portion of the vacuum circuit breaker assembly shown in FIG. **6**;

FIG. **8** is a side view of a portion of the vacuum circuit breaker assembly immediately after closing of the vacuum breaker contacts showing upward flexing of the stationary end cap; and

FIG. **9** is a front view of that portion of the vacuum circuit breaker shown in FIG. **8.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and more particularly to FIG. **1**, the reference numeral **10** generally designates a horizontal draw-out, three-phase, metal-clad type circuit breaker. As shown, the three-phase breaker assembly comprises three vacuum-type circuit interrupter elements **12** positioned generally vertically between pairs of horizontally extending conductor terminal members **18** and **20.** The conductor members **18** and **20** are supported by an insulating pole support **22.** The pole supports **22** may be formed of porcelain or other suitable electrically insulating materials. Conductors **18** and **20** have plug on type conductors **14,** attached to their ends, opposite the vacuum interrupters. When the circuit breaker **10** is positioned in a switchgear cell (not shown), connectors **14** make electrical contact with mating studs (not shown).

The three insulating pole supports **22** are bolted at **24** to a lower metal frame support **26.** The lower metal frame support **26** is mounted upon wheels **28** and is adapted for insertion into and withdrawal from a metal clad switchgear structure. As can best be seen by FIG. **3,** a stored energy operating mechanism **30** may be provided within the lower framework **26** of the circuit breaker assembly **10.** Reference may be had to U.S. Pat. No. 3,183,332 issued May 22, 1965 to Russell Frink et al. for a typical stored energy operating mechanism **30** which may be used. The stored energy operating mechanism **30** is contained within frame **26.** The operating mechanism **30** comprises a closing spring **32** in which energy is stored by compressing the spring **32,** for closing the circuit breaker **10.** By following the teaching of the present invention, the size of closing spring **32** required, as compared with prior art U.S. Pat. No. 3,603,753, can be dramatically reduced. Once the stored energy of spring **32** is released, cam **34** is rotated and vacuum interrupter **12** is closed. As the cam **34** moves from the open to the closed position, the anti-bounce spring assemblies **36** are raised. As the anti-bounce spring assemblies **36** move to the closed position, they move operating lever assemblies **38** and the porcelain operating rods **40** thus closing the vacuum interrupters **12.** Near the end of operating rods **40** stroke, the contacts **50** and **52** in the interrupter **12** touch and the springs **36** are compressed. As these springs **36** are compressed the correct contact pressure is generated in the interrupter and this force prevents the contacts from bouncing.

Referring now to FIG. **4,** there is shown a portion of the circuit breaker **10.** The vacuum interrupter **12** is shown partially in section, illustrating its internal construction. The vacuum type circuit interrupter **12** comprises a highly evacuated envelope **42** formed of glass or suitable ceramic material and a pair of metallic end caps **44** and **46** closing off the ends of the insulating envelope **42.** Suitable seals **48** are provided between the end caps **44** and **46** and the insulating envelope **42** to render the envelope **42** vacuum tight. The vacuum in the envelope **42** under normal operating conditions, is lower than 10^{-4} Torr to assure the mean free path of electrons will be longer than the potential breakdown distance within the tubular envelope **42,** and thus high dielectric strength is obtained.

Disposed within the insulating envelope **42** are a pair of electrodes or contacts **50** and **52.** The upper contact **50** is stationary and is secured to a conducting rod **56** by a suitable means, such as welding or brazing. The conducting rod **56** is secured at its upper end to the stationary end cap **44** by suitable means, such as welding or brazing. The lower contact **52** is movable and is joined to a conducting rod **58.** The electrically conducting rod **58** is suitably mounted for movement along the longitudinal axis of the tubular insulating envelope **42.** The movable rod **58** projects through an opening **60** in the bellows end cap **46.** As shown in FIG. **4,** flexible metal bellows **62** is secured in sealing relationship at its respective opposite ends to movable rod **58** and the opening **60** in the bellows end cap **46.** The flexible metal bellows **62** provides a seal about the rod **58** to allow for movement of the rod **58** without impairing the vacuum inside the insulating envelope **42.**

The porcelain operating rod **40** links the conducting rod **58** to the operating mechanism **30.** The operating mechanism **30** is provided for driving the movable contact **52** upward into engagement with the stationary contact **50** so as to close the interrupter **12.** The operating means **30** is also capable of returning the contact **52** to its open position as indicated by the phantom lines **64** in FIG. **4** so as to open the interrupter **12.** Once contacts **50** and **52** are separated, there is an arcing gap formed therebetween. When contacts **50** and **52** of vacuum interrupter **12** are opened at the beginning of a circuit interruption, a metallic arc initiates between the separated contacts **50** and **52** and serves as the vehicle for current conduction until the arc is extinguished. In an alternating current circuit the arc is usually extinguished near the first current zero of the alternating

current wave. The arc that is established across the arcing gap between the contacts **50** and **52** when they are opened and also when they are closed vaporizes and melts some of the contact material. The vapors and particles are dispersed from the arcing gap toward the inside of envelope **42.** The internal surfaces of the insulating envelope **42** are protected from the condensation of the arc generated metallic vapors and particles thereby by means of a tubular metallic shield **66.** The tubular metallic shield **66** is supported on the insulating envelope **42** and is preferably electrically isolated from both end caps **44** and **46.** This shield **66** acts to intercept and condense arc generated metallic vapors before they can reach the insulating envelope **42.** To reduce the chances of metallic vapors or particles bypassing the main shield **66,** end shields **68** and **70** are provided. To prevent the bellows **62** from being bombarded by the arc generated metallic vapors or particles, a portion of end shield **70** surrounds the bellows **62.**

Two rigid conducting plates **76** and **78** extend from the end of conductor **20.** Conducting plates **76** and **78** have openings through which the movable conducting rods **58** can pass. A plurality of multiplicity of conducting spacers **80** are provided between plates **76** and **78.** Spring loaded conducting rollers **82** are disposed between the movable conducting rod **58** and the conducting rod spacers **80,** to provide a conducting path therebetween. Thus, a continuous current path is established from the movable conducting rod **58** through the spring loaded rollers **82,** through the spacers **80,** through the conducting plates **76** and **78,** into conductor **20.**

A porcelain tie rod **80** may be provided between the frame **26** for operating mechanism **30** and the plate **78** to increase the rigidity of the structure comprising members **76, 78** and **80.** As discussed previously, a porcelain operating rod **40** is provided to directly connect the movable conducting rod **58** to the operating mechanism **30.** By coupling the porcelain rod **40** directly to the operating rod **58,** several advantages over prior art vacuum breakers as described in U.S. Pat. No. 3,603,753 are achieved. By placing the porcelain operating rod **40** in the linkage train after the travel of the operating mechanism **30** has been reduced a relatively massive moving body, the porcelain operating rod **40,** is moved closer to the center of rotation. Thus, energy required to accelerate the porcelain operating rod **40** has been reduced by approximately a factor of **4,** since the distance to the center of rotation was cut in half. By making this change, the size of the closing spring **32** necessary to operate the breaker **10** is reduced, and wear and tear on the operating mechanism **30,** during operation, is reduced. By connecting the porcelain operating rod **40** directly to the movable operating rod **58,** the entire operating lever assembly **38** is kept at ground potential. By keeping all of the operating assembly **38** at ground potential, electrical clearance from the operating mechanism **30** to energized parts is improved.

Another advantage of connecting the porcelain operating rod **40** directly to the movable conducting rod **58** is that the force supplied to the operating rod is very nearly linear. That is, the operating force applied is generally parallel to the longitudinal axis of the vacuum interrupter **12.** By applying a linear force with a very small transverse component to the conducting rod **58,** stress on the vacuum interrupter guide bearings and the bellows **62** is reduced. An operating linkage with operating rod **40** is placed or disposed to operate linearly and parallel to the axis of the interrupter and connected directly to the moving conducting rod **58,** where there is little or no rotational inertia and very little stroke allows the insulating operating rod **40** to be made of relatively heavy porcelain. If the operating rod **40** were in the linkage train closer to the end of the operating lever assembly **38** as shown in prior art U.S. Pat. No. 3,603,753, it would have high rotational inertia and be moving at a much higher velocity and require higher levels of energy than an operating rod **40** placed as shown in the instant application. By placing operation rod **40** shown in the instant application, the size of spring **32** can be reduced over the prior art size and electrically superior porcelain rather than lighter weight plastic can be used for the material of the rod **40.** These higher velocities and higher energy levels required in prior art breakers might necessitate the use of an insulating material other than porcelain for the operating rod **40.** Other advantages of near linear motion of the operating rod **40** are that it allows the use of a simple control mechanism for transferring current from the movable conducting rod **58** to conductor **20** and that it simplifies guiding and reduces friction in the guides of the movable conducting rod **58.** With the operating linkages **38** at high potential and close to the interrupter as in prior art the side forces on the movable rod **58** are greater.

Electrical connection is made to the top stationary rod **56** of the vacuum interrupter **12** by means of two clamping plates **86** and **88.** As can be seen in FIGS. **5, 6** and **8** Clamping plates **86** and **88,** of the general type described and claimed in copending application Ser. No. 172,075 filed Aug. 16, 1971 by Norman Davies, are secured to the stationary rod **56** by means of a clamping bolt **90** and they are secured to the left hand portion **13** of upper terminal member **18** by bolts **92.** As can best be seen in FIG. **7** and FIG. **9,** plates **86** and **88** have a slot **87.** As bolt **90** is tightened, slot **87** tends to collapse and connector plates **86** and **88** come into high pressure engagement with stationary rod **56.**

Vacuum interrupter **12** has butt-type contacts **50** and **52** which are closed at high speed. In order to reduce contact bounce and to reduce the impact forces on the upper conductor member **18** and on the porcelain pole unit **22** flexibility or resilience must be provided in the interrupter clamping plates **86** and **88.** As can best be seen in FIG. **8** which shows the vacuum interrupter **12** shortly after contact engagement, the clamping plates **86** and **88** act as leaf springs to provide this resilience. As can be seen in FIG. **8** and FIG. **9,** the stationary end cap **44** bows in an upward direction to allow for slight upward movement of the stationary contact upon initial contact engagement. This upward flexing of the stationary end cap **44** also reduces the tension force in the envelope **42** and is taken up in the resilient clamping members **86** and **88.** Although upward flexing of the stationary end cap **44** during initial contact engagement is desirable, to prevent contact bounce and to reduce the resulting force on the pole unit **22,** downward flexing of the end cap **44** during circuit interruption is undesirable, since this increases the weld break problem by decreasing the forces necessary to break welded contacts. As the operating mechanism **30** applies a downward thrust on the movable rod **58,** the non-moving stationary rod **56** must react in the opposite di-

rection to generate enough force to break contact welds. On the present mounting scheme, the reaction cannot come from the upper pole unit terminal member **18** since the upper clamping plates **86** and **88** are flexible for reasons given hereinbefore. By forming the ends of clamping plates **86** and **88** which are held by the clamping bolt **90** into a generally C-shaped configuration and by extending the C-shaped portion of clamping plates **86** and **88** to the outer diameter of the vacuum interrupter **12**, downward flexing of stationary end cap **44** during circuit interruption can be reduced or eliminated. If additional stiffness of the stationary rod **56** from movement in the downward direction is desired, a cross beam **94** as illustrated in FIGS. **6** through **9** can be provided. Stiffening of the stationary end cap by the clamping plates **86** and **88** and/or the cross beam **94** results in the generation of high forces for breaking welds. Thus, the end cap **44** is stiffened in one direction, it can flex in an upward direction as desired but downward movement is limited by the clamping plates **86** and **88** and/or the cross beam **94.** The reaction force necessary to hold the stationary contacts against slight downward movement during circuit interuption is transferred through compression of the ceramic envelope **42** of the vacuum interrupter **12** to the lower end cap **46** which is held rigidly to conducting plates **76.** The envelope **42** is very strong in compression. Such a construction by providing an upper terminal mounting that is flexible in one direction only can double or triple the weld breaking forces on welded contacts **50** and **52** in a vacuum interrupter **12** without adding to the energy supplied by the operating mechanism **30.** As shown in FIGS. **6** through **9,** when it is desired to add a cross beam **94** for additional stiffness, the top portion **96** of stationary rod **56** is threaded and a nut **98** is used to force the clamping plates **86** and **88** tightly against the stiffening cross beam **94.** Note that the stiffening cross beam **94** extends in the phase-to-phase or side-to-side direction and not from front to back, this is necessary to allow the clamping plates **86** and **88** to act as leaf springs and to take up flexing of the end cap **44** in the upward direction.

An electrically insulating barrier **100** which can be pivoted in a clockwise direction as shown in FIGS. **1** to **3,** to expose the vacuum interrupters **12,** is also provided. The barrier **100** is pivotally fastened to the pole support **22** by means of U-shaped brackets **102** and pins **104.** The vacuum-type circuit breaker is shipped from the factory completely assembled with the main barrier assembly **100** in place. The breaker **10** may be lifted and moved with the barrier **100** on the breaker. In order to either tilt the barrier **100** back or to remove the barrier **100** from the breaker it is necessary that the breaker **10** be removed completely from the switchgear cell. This is a safety feature intended for the protection of operating personnel. To gain access to the vacuum interrupters **12** after the breaker **10** has been removed from the switchgear cell, the barrier **100** is rotated around pivot pins **104** until the upper edge **106** of the barrier **100** comes to rest on the floor behind the breaker **10.** The barrier cannot be removed or tilted around pins **104** while the circuit breaker **10** is in the switchgear cell. The switchgear cell is constructed so that when the breaker **10** is positioned therein, the upper edge **106** of barrier **100** is in close proximity to the top of the cell and any appreciable rotation of barrier **100** is prevented. The barrier **100** has several advantages over prior art insulating barriers for use on vacuum circuit breakers **10.** One advantage is that the barrier **100** is generally non-removable yet quick and easy access can be had to the vacuum interrupter **12** after the breaker **10** is removed from the switchgear cell. Also the breaker **10** can be crane-lifted and moved with the barrier **100** in place on the breaker **10.** Also the barriers can be shipped on the breaker and thereby eliminate crating for separate shipment.

I claim:

1. A horizontal draw-out type vacuum circuit interrupter for metal clad switchgear comprising:

a plurality of vacuum-type circuit interrupters mounted in a side-by-side relationship wherein each of said vacuum type circuit interrupters comprises,

an insulating envelope being highly evacuated and having a tubular shape,

a first end cap sealing one end of said insulating envelope,

a second end cap sealing the other end of said insulating envelope,

a stationary contact disposed within said insulating envelope,

a movable contact disposed within said insulating envelope movable between a first position in engagement with said stationary contact and a second position spaced from said stationary contact to establish an arcing gap therebetween,

a movable conducting rod connected to said movable contact and passing through said first end cap,

a stationary conducting rod connected to said stationary contact and passing through and connected to said second end cap;

an upper terminal member associated with each vacuum interrupter and horizontally disposed with respect to the longitudinal axis of said vacuum interrupter;

a resilient terminal connector disposed between each vacuum interrupter and associated upper terminal member, each of said resilient terminal connectors being electrically connected at one end to said stationary conducting rod of said vacuum interrupter and at the respective opposite end to said upper terminal member;

a rigid lower terminal member associated with each vacuum interrupter and horizontally disposed with respect to the longitudinal axis of said vacuum interrupter;

a rigid terminal connector disposed between each vacuum interrupter and associated lower terminal member, each rigid terminal connector being connected at one end to said first end cap of said vacuum interrupter and at the respective opposite end to said rigid lower terminal member;

conducting means electrically connecting said movable conducting rod to said rigid terminal connector;

an operating mechanism for the simultaneous operation of all the vertically disposed vacuum-type circuit interrupters.

2. A horizontal draw-out type circuit interrupter for metal clad switchgear comprising:

a plurality of vacuum-type circuit interrupters mounted in a side-by-side relationship wherein each of said vacuum circuit interrupters comprises,

a stationary contact,

a movable contact movable between a first position in engagement with said stationary contact and a second position spaced from said stationary contact to establish an arcing gap therebetween,

a highly evacuated tubular insulating envelope having said stationary contact and said movable contact disposed therein,

a conducting movable rod connected to said movable contact,

a stationary conducting rod connected to said stationary contact;

an upper terminal member associated with each vacuum interrupter and horizontally disposed with respect to the longitudinal axis of said vacuum interrupter;

a resilient terminal connector disposed between each vacuum interrupter and associated upper terminal member, each of said resilient terminal connectors being electrically connected at one end to said stationary conducting rod of said vacuum interrupter and at the respective opposite end to said upper terminal member;

a lower terminal member associated with each vacuum interrupter and horizontally disposed with respect to the longitudinal axis of said vacuum interrupter;

a rigid terminal connector disposed between each vacuum interrupter and associated lower terminal member, each of said rigid terminal connectors being rigidly connected at one end to said vacuum interrupter and at the respective opposite end to said lower terminal member;

roller contact means for electrically connecting said movable conducting rod to said rigid terminal connector;

an operating mechanism for the simultaneous operation of all the vertically disposed vacuum type circuit interrupters.

3. A vacuum-type draw-out circuit breaker as claimed in claim **2**, including: an insulating operating rod mechanically connected between said conducting movable rod and said operating mechanism to electrically insulate all parts of said mechanical operating mechanism from said vacuum interrupter.

4. The combination as claimed in claim **3**, wherein said insulating operating rod comprises porcelain, and said insulating operating rod is directly connected to said movable operating rod.

5. A vacuum-type circuit breaker as claimed in claim **2**, including: a stationary end cap for said vacuum interrupter, said stationary end cap attached in vacuum tight relationship with said stationary conducting rod and said highly evacuated insulating envelope, stiffening means to provide stiffness for said stationary end cap and allowing said stationary end cap to flex substantially in one direction only.

6. The combination as claimed in claim **5**, wherein said stiffening means comprises: a cross beam extending to the outer perimeter of said highly evacuated insulating envelope, said cross beam positioned in close proximity to said stationary conducting rod and said cross beam lying in a plane generally parallel to the plane defined by the longitudinal axis of said plurality of vacuum type circuit interrupters.

7. The combination as claimed in claim **5**, wherein said stiffening means comprises: a formed portion on the end of said resilient terminal connector, said formed portion extending to the outer diameter of said highly evacuated insulating envelope and said formed portion associated with each of said vacuum interrupters lying in a common plane defined by the formed portions associated with said plurality of vacuum type circuit interrupters.

8. The combination as claimed in claim **7**, wherein: said formed portion is C-shaped; said resilient terminal connector is slotted and has an opening there-through located on the slot through which said stationary conducting rod passes; including, a clamping bolt, disposed in the C-shaped formed portion of said resilient terminal connector, extending to the outer diameter of said highly evacuated insulating envelope; and said clamping bolt retained in the C-shaped portion so that as said clamping bolt is tightened the slotted portion of said resilient terminal connector is forced into high pressure engagement with said stationary conducting rod.

9. A horizontal draw-out type vacuum circuit interrupter for metal clad switchgear comprising;

a plurality of vacuum type circuit interrupters mounted in a side-by-side relationship, wherein each of said vacuum type circuit interrupters comprises an evacuated housing, a pair of relatively separable contacts disposed within said evacuated housing, a first vacuum interrupter terminal means electrically connected to one of said pair of contacts and having a first terminal outside of said evacuated housing, and a second vacuum interrupter terminal means electrically connected to the other of said pair of contacts and having a second terminal outside of said evacuated housing;

an upper terminal member associated with each vacuum interrupter and horizontally disposed with respect to the longitudinal axis of said vacuum interrupter;

a resilient terminal connector disposed between each vacuum interrupter and associated upper terminal member and being electrically connected at one end to said first vacuum interrupter terminal and at the opposite end to said upper terminal member;

a lower terminal member associated with each vacuum interrupter and horizontally disposed with respect to the longitudinal axis of said vacuum interrupter;

a rigid terminal connector disposed between each vacuum interrupter and associated lower terminal member and being electrically connected at one end to said second vacuum interrupter terminal means and at the opposite end to said lower terminal member;

an operating mechanism for the simultaneous operating of all the vertically disposed vacuum type circuit interrupters; and including,

a truck for said draw-out type vacuum circuit interrupter, a housing for said operating mechanism mounted on said truck, insulating support means connected between said housing and said lower terminal member to rigidly support said lower terminal member with respect to said housing.

10. The combination as claimed in claim **9**, wherein said insulating support means comprises a porcelain rod.

11. A horizontal draw-out type vacuum circuit interrupter for metal clad switchgear comprising;

a plurality of vacuum type circuit interrupters mounted in a side-by-side relationship, wherein

each of said vacuum type circuit interrupters comprises an evacuated housing, a pair of relatively separable contacts disposed within said evacuated housing, a first vacuum interrupter terminal means electrically connected to one of said pair of contacts and having a first terminal outside of said evacuated housing, and a second vacuum interrupter terminal means electrically connected to the other of said pair of contacts and having a second terminal outside of said evacuated housing;

an upper terminal member associated with each vacuum interrupter and horizontally disposed with respect to the longitudinal axis of said vacuum interrupter;

a resilient terminal connector disposed between each vacuum interrupter and associated upper terminal member and being electrically connected at one end to said first vacuum interrupter terminal means and at the opposite end to said upper terminal member;

a lower terminal member associated with each vacuum interrupter and horizontally disposed with respect to the longitudinal axis of said vacuum interrupter;

a rigid terminal connector disposed between each vacuum interrupter and associated lower terminal member and being electrically connected at one end to said second vacuum interrupter terminal means and at the opposite end to said lower terminal member;

an operating mechanism for the simultaneous operation of all the vertically disposed vacuum type circuit interrupters; and including, an insulating barrier means being manually movable between a raised position and an operating position said insulating barrier means being pivotable around an axis fixed with respect to said vacuum interrupters, a portion of said insulating barrier being disposed between said vacuum interrupters when said insulating barrier means is in the operating position during operation of said circuit breaker to increase the insulating characteristics between different potential parts within said circuit interrupter.

12. The combination as claimed in claim **11**, including:

a truck for said draw-out type vacuum circuit interrupter;

said insulating barrier means being pivotally mounted to said truck;

a switchgear cell into which said truck is inserted for operation of said draw-out type vacuum circuit interrupter;

stopping means rigidly connected to said insulating barrier means and being disposed in close proximity to said switchgear cell when said truck is inserted in said switchgear cell to substantially prevent said insulating barrier means from being manually pivoted to a raised position.

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