United States Patent

Hollister et al.

[15] **3,676,623**

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[54] CIRCUIT INTERRUPTER

[72] Inventors: **Robert H. Hollister; Garlington C. Wilburn,** both of South Boston, Va.; **Kurt G. Green,** Golden Bridge, N.Y.

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

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[52] **U.S. Cl.** ..... **200/146 R,** 200/168 A

[51] **Int. Cl.** **H01h 33/12**

[58] **Field of Search** ..... 200/146 A, 146 AA, 146 R, 50, 200/168 A, 168 E

[56] **References Cited**

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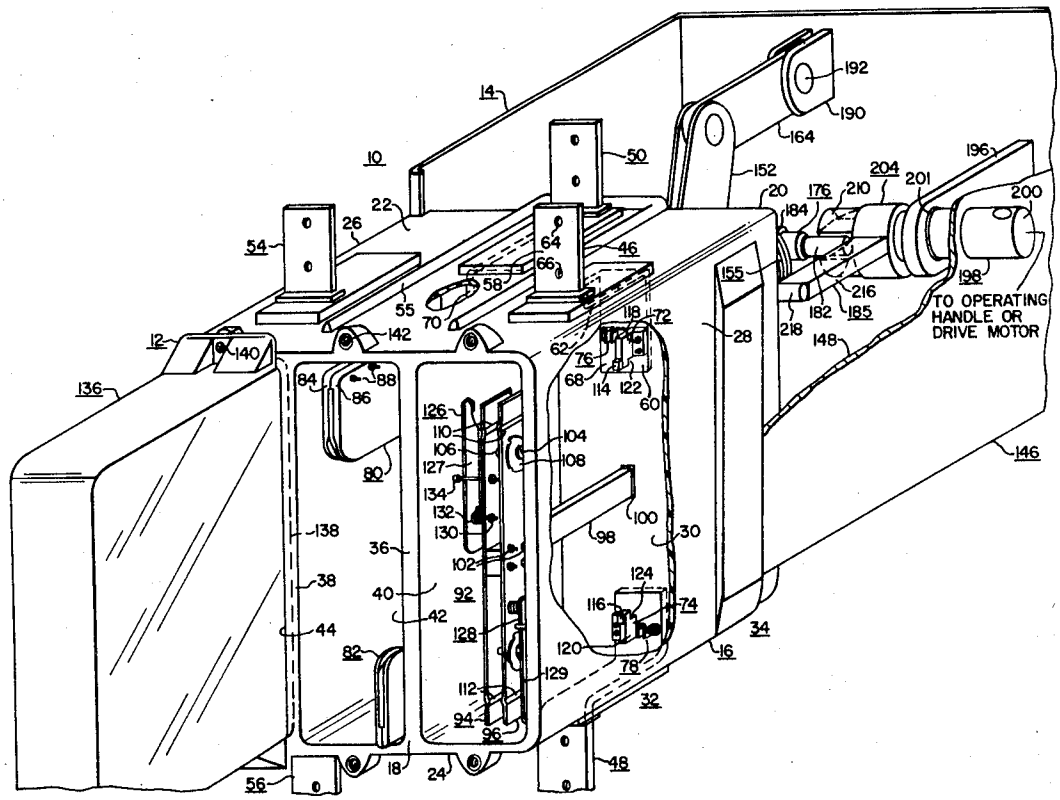
Primary Examiner—Robert S. Macon

Attorney—A. T. Stratton, F. E. Browder and D. R. Lackey

[57] **ABSTRACT**

A circuit interrupter including conductive blade members mounted for movement relative to circuit contacts, with the blade members and circuit contacts disposed in a housing formed of a cast resinous insulation system. Substantially Z-shaped terminals are partially embedded in the cast resinous insulation system, to which the circuit contacts are fixed.

12 Claims, 6 Drawing Figures



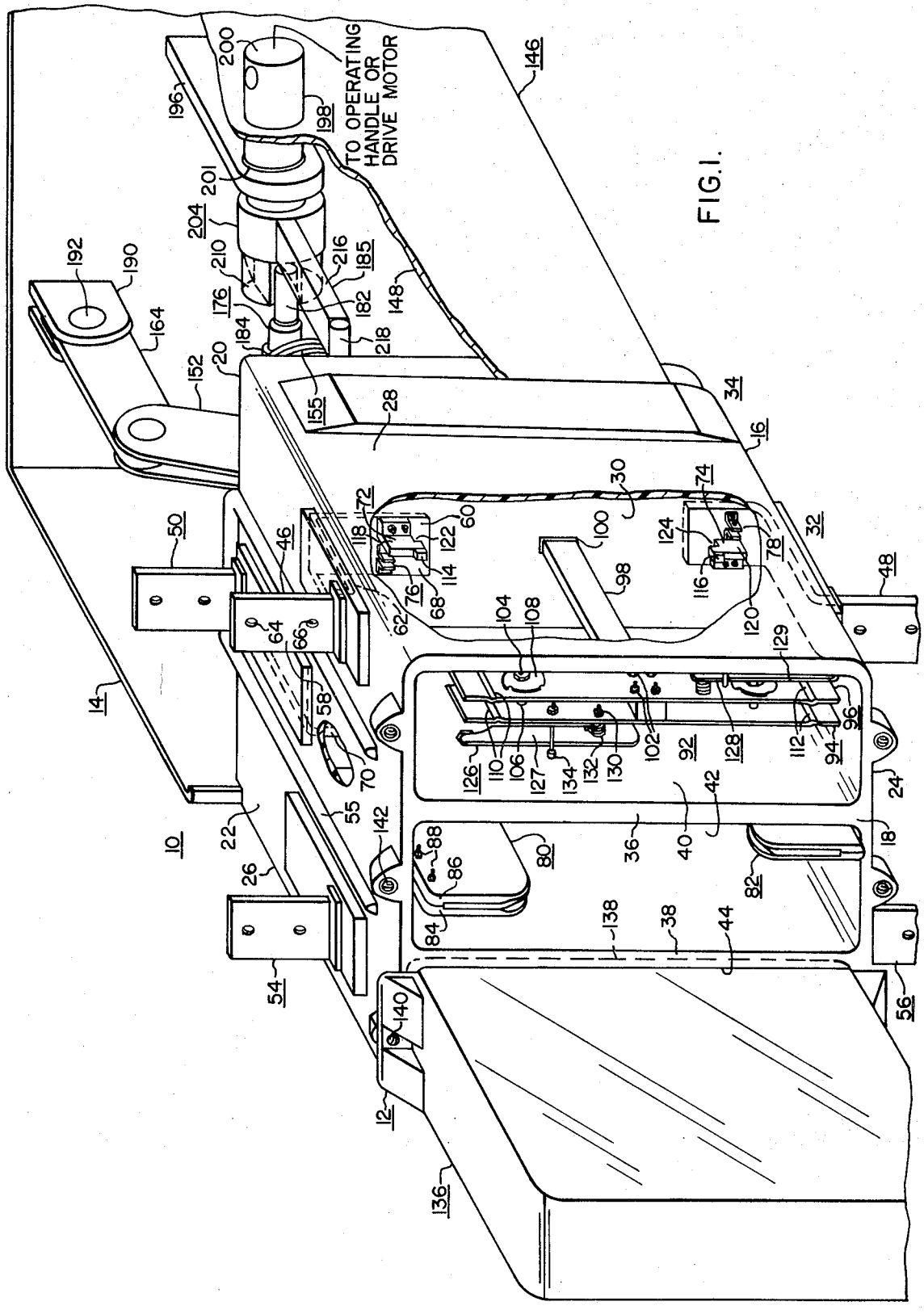


FIG. 1.

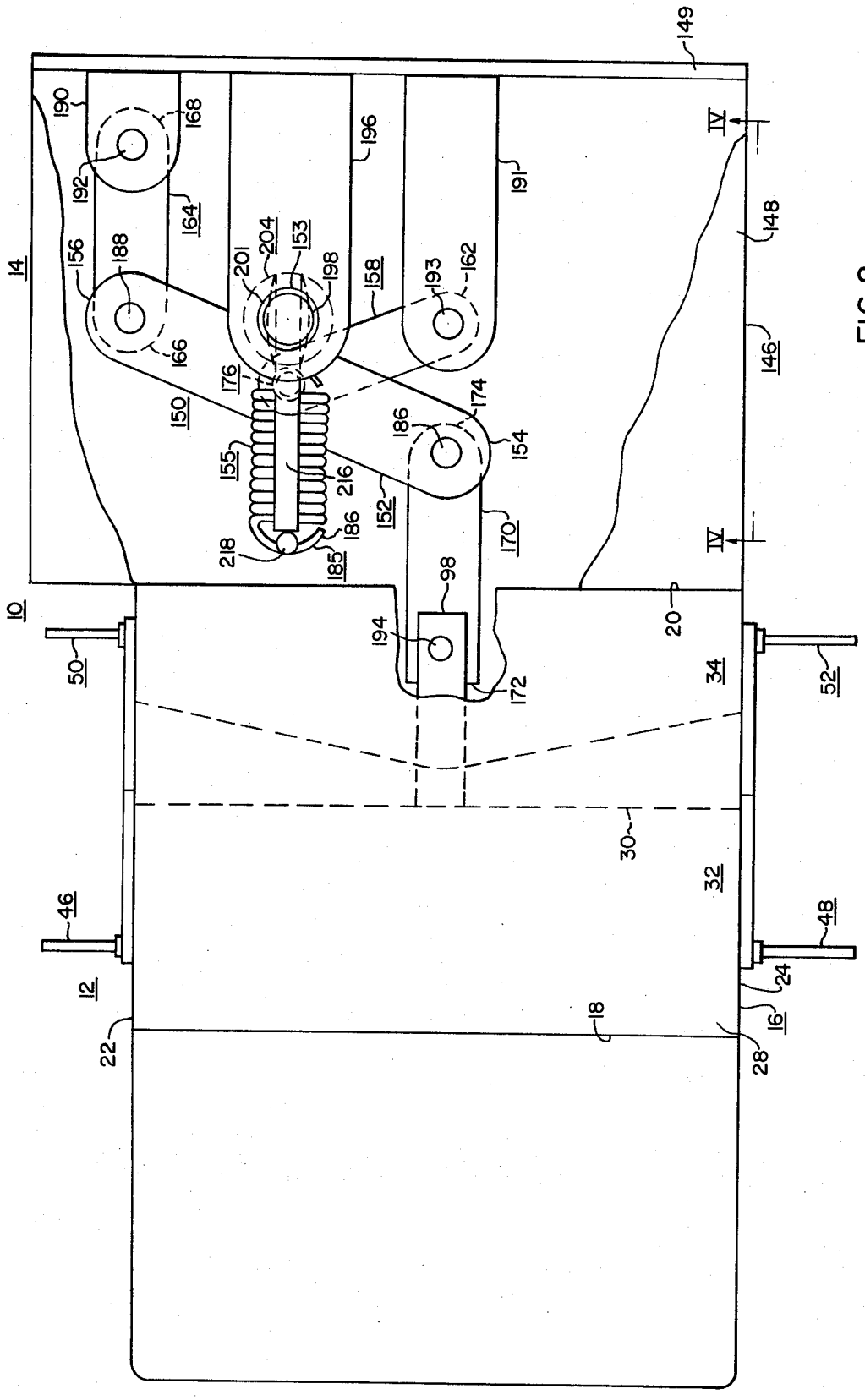

149
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FIG.2.

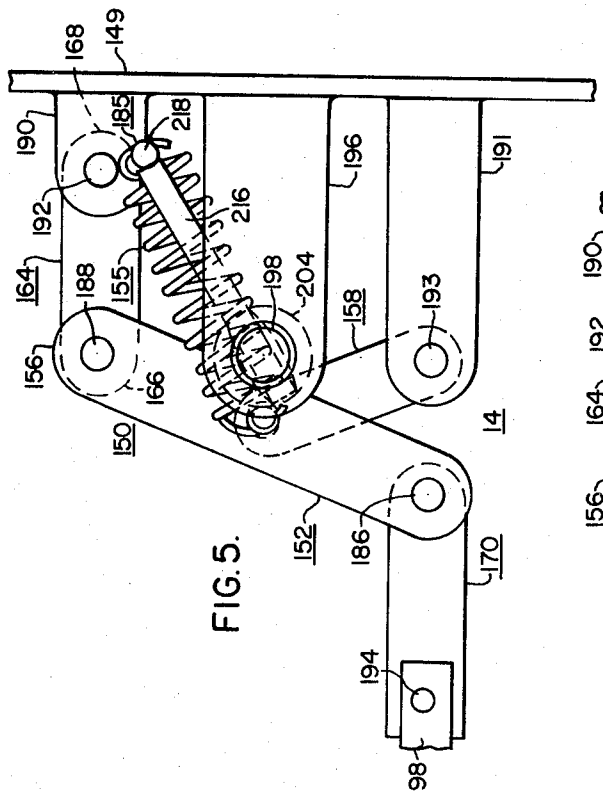

FIG. 5.

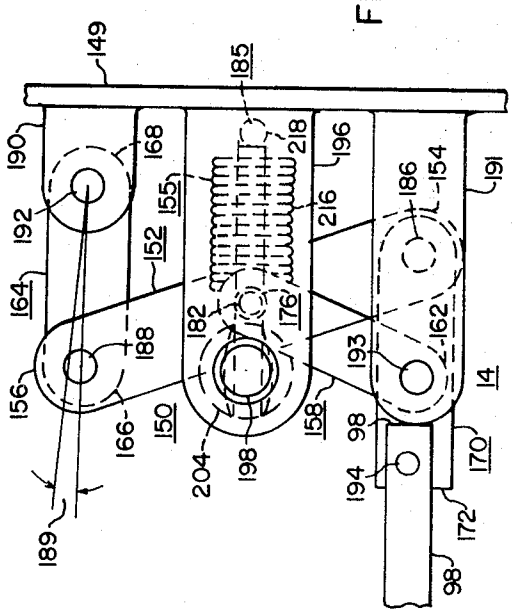

FIG. 6.

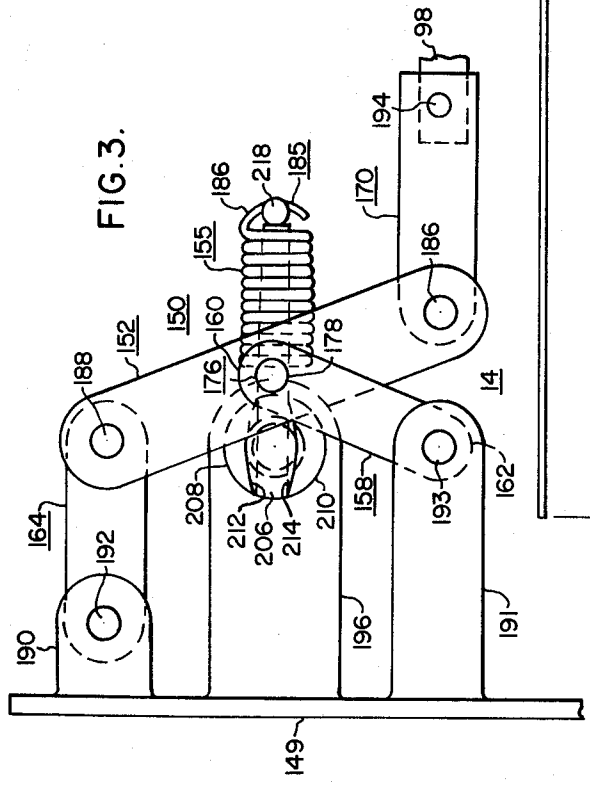

FIG. 3.

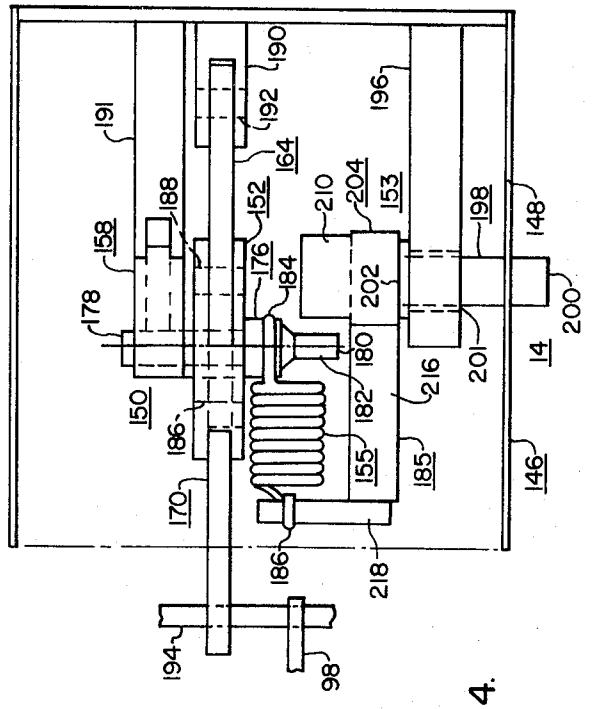

FIG. 4.

CIRCUIT INTERRUPTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates in general to circuit interrupters, and more specifically to circuit interrupters of the movable blade type which are capable of interrupting load current, and closing on a fault.

2. Description of the Prior Art

A disconnect switch of the movable blade type is used to isolate apparatus from a line in which there in no current flowing. When small amounts of magnetizing or charging current is to be interrupted, an air break switch is used, which is basically a disconnect switch with arcing horns. When the switch must interrupt load current, as well as magnetizing and charging currents, and the cost of a circuit breaker with automatic trip and fault interrupting ability is not justified, an interrupter switch is used, which is a disconnect switch with means for confining, controlling and extinguishing an arc, such as arc chutes. U.S. Pat. No. 2,308,026, which is assigned to the same assignee as the present application, discloses an interrupter switch of this type. The interrupter switch thus interrupts load currents within its rating, and it provides the disconnecting switch advantage of a positive, visible air gap isolation for the de-energized equipment.

The increased usage of pad mounted power transformers, which utilize a load break disconnect switch on the primary or high voltage side, and increased application for such a switch in power centers, has made it desirable to develop three-phase interrupter switch with higher load current ratings, higher B.I.L. ratings, higher momentary short circuit withstand ratings, higher magnetizing current ratings, and higher fault close-in ratings. For example, it would be desirable to provide a 15KV, three-phase switch rated 95KV B.I.L., 600 amps normal load current, 40,000 amperes momentary short circuit withstand current, 60 amperes magnetizing current, and 40,000 amperes fault close-in. However, extending the prior art construction to handle the required higher rating results in a substantial increase in the physical size of the apparatus, which is objectionable in most applications, as well as a disproportionate increase in cost. Thus, it would be desirable to provide interrupter switches of the required higher ratings, without substantially increasing the size and cost of such apparatus.

SUMMARY OF THE INVENTION

Briefly, the present invention is a new and improved three-phase circuit interrupter switch, which successfully combines the advantages of cast solid resinous insulation systems with the movable blade type, load-break disconnect construction, to substantially extend the current and voltage ratings of the interrupter switch without an accompanying increase in physical size and manufacturing cost. The housing of the interrupter switch is formed of a high strength, cast solid resinous insulation system, which includes a plurality of integrally formed inner and outer wall portions which provide separate phase compartments, disposed side-by-side, and each having inner closed ends, in which movable conductive blade members and associated arcing and main contacts are disposed. The physical size of the housing is reduced by the high puncture strength of the cast solid resinous insulation system, while maintaining the necessary air clearances between exposed terminals, by utilizing first and second substantially Z-shaped terminals per compartment, each having first and second spaced parallel portions and a connecting portion. The connecting portions of the first and second terminals are embedded in opposite outer walls of the compartment, and their first parallel portions are partially embedded in the inner wall which forms the closed end of the compartment, such that one surface is exposed and substantially co-planar with the inner end. The second parallel portions extend outwardly from the housing, with the required air clearance being provided by staggering the terminals, while still providing conductive terminal surfaces within the three compartments, to which the main and arching contacts are fixed, which are co-planar. An operating mechanism connected to the movable conductive blade members provides high speed opening and closing of the switch while utilizing a rugged but low cost arrangement requiring a single spring.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be better understood and further advantages and uses thereof more readily apparent, when considered in view of the following detailed description of exemplary embodiments, taken with the accompanying drawings, in which:

FIG. 1 is a perspective view, partially cut away, of an interrupter switch constructed according to the teachings of the invention;

FIG. 2 is a partial, right side elevational view of the interrupter switch shown in FIG. 1, with its operating mechanism shown in the open switch position;

FIG. 3 is a partial, left side elevation view of the operating mechanism shown in FIG. 2, illustrated in the open switch position;

FIG. 4 is a view of the operating mechanism shown in FIG. 2, taken in the direction of arrows IV—IV, shown in the open switch position;

FIG. 5 is a right side elevational view of the operating mechanism shown in FIG. 2, during a charging cycle, preparatory to closing the switch; and

FIG. 6 is a right side elevational view of the operating mechanism shown in FIG. 2, with the operating mechanism being in the closed switch position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, and FIG. 1 in particular, there is shown a perspective view of a circuit interrupter or interrupter switch assembly **10**, including a new and improved three-pole interrupter switch **12** and new and improved operating mechanism **14** for spring opening and spring closing the contacts of the interrupter switch **12**.

The interrupter switch **12** includes a housing **16** formed of a high strength, resinous insulation system. The resinous insulation material selected must be a good electrical insulator, weather resistant, crack resistant, rigid but not brittle, it must possess a high physical strength at ambient and elevated temperatures, and it should have a coefficient of thermal expansion which closely matches that of metallic inserts embedded therein. Housing **16** is preferably cast, instead of molded, because of the superior strength of the cast resinous insulation systems compared with molded systems. In general, the highly filled epoxy cast resin systems will provide the desired characteristics, with the filler being selected to closely match the coefficient of thermal expansion of the filled resin system to that of metallic inserts. A finely divided inorganic non-friable filler which includes beryllium aluminum silicate has been found to be excellent in providing a high strength casting which closely matches the coefficient of thermal expansion of copper, but other finely divided fillers, such as quartz or silica may be used. The selected filler should also include a material which will provide arc and track resistance such as finely divided alumina trihydrate ($Al_2O_3 \cdot 3H_2O$).

Housing **16** has a plurality of integrally formed outer and inner and wall portions which define first and second open ends **18** and **20** respectively, including outer top and bottom portions **22** and **24**, respectively, and connecting outer sidewall portions **26** and **28**. An inner wall **30** is disposed intermediate the first and second ends **18** and **20** of the housing, perpendicular to the sidewall portions **26** and **28**, with wall **30** dividing the housing **16** into first and second major portions **32** and **34**, respectively. First and second spaced, parallel inner wall portions **36** and **38** extend from the first end **18** of the housing **16** to the intermediate inner wall portion **30**, with their major surfaces being perpendicular to the top and bot-

tom portions 22 and 24, respectively, dividing the first major portion 32 of the housing 16 into first, second and third compartments 40, 42 and 44, respectively, each having an open end at end 18 of the housing 16, and a closed end defined by the inner wall portion 30. The three compartments 40, 42 and 44 are thus spaced in side-by-side relation, and when covers are provided for their open ends, they provide fully closed, insulated compartments for the three poles of a three-phase interrupter switch.

Each of the compartments 40, 42 and 44 have first and second substantially Z-shaped terminals for attaching main and auxiliary stationary contacts thereto, with compartment 40 having first and second terminals 46 and 48, respectively, compartment 42 having first and second terminals 50 and 52, respectively, and compartment 44 having first and second terminals 54 and 56, respectively. The second terminals 52 of the second compartment 42 is shown in FIG. 2, which is a right side elevational view of the interrupter switch assembly 10 shown in perspective in FIG. 1.

Each of the substantially Z-shaped terminals, such as terminal 46 of the first compartment 40, has first and second spaced parallel end portions 58 and 60, respectively, and an interconnecting portion 62, with the spaced parallel end portions 58 and 60 extending outwardly from opposite sides of the interconnecting portion 62.

It is important to note that each of the substantially Z-shaped terminals are partially embedded in the cast resinous insulation system of the housing 16, with the interconnecting portions of the first terminals 46, 50 and 54 being embedded in the top portion 22, and the interconnecting portion of the second terminals 48, 52 and 56 being embedded in the bottom portion 24. The thickness dimension of the top and bottom portions 22 and 24, respectively, may be increased where the terminals are embedded, as illustrated, to provide the required insulation about the terminals, without making it necessary to use the same thickness for the overall wall portion. This arrangement also increases the creep dimensions between the terminals. Additional rib members may be provided between terminals to further increase the creep dimensions such as rib 55. The cast solid resinous systems have excellent electrical strength in puncture, enabling the terminals to be spaced relatively close together in the solid insulation system, compared with the required clearance in air, for any specified B.I.L. voltage rating.

The first end portions of the first terminals 46, 50 and 54 extend perpendicularly outward from the top portion 22, and the first end portions of the second terminals 48, 52 and 56 extend perpendicularly outward from the bottom portion 24, with the outwardly extending end portions on both the top and bottom portions being staggered to provide the required air clearance between them for the specified B.I.L. voltage rating. For example, the upper terminals 46 and 54 associated with the two outer compartments 40 and 44 may be oriented in a similar manner, starting with the first end portions near the first end 18 of the housing 16, and extending toward the second end 20, while the remaining upper terminal 50 starts with the first end portion near the second end 20 of the housing 16, and extends toward the first end 18. The bottom terminals may be similarly oriented, as illustrated in FIGS. 1 and 2.

While the terminals are oriented differently to stagger their outwardly extending end portions, which end portions of the bottom and top terminals are adapted for connection to a source of high voltage alternating potential, and to the electrical apparatus to be isolated, respectively, such as by openings 64 and 66 in the first end portion of the upper terminal 46, it is important to note that all of the terminals have their second end portions partially embedded in the intermediate wall portion 30, such that one of the surfaces of the second end portion is substantially co-planar with the surface of wall portion 30 which faces the first end 18 of the housing 16. Thus, regardless of the orientation of the terminals, they all have a surface on their second end which is co-planar with a surface of inner wall portion 30, and thus co-planar with one another. The terminals, 46, 54, 48 and 56 which start near the first end 18 of the housing 16 extend toward the second end 20, have their second ends partially embedded in wall portion 30 such that the innermost surface of the second end, i.e, the end adjacent to the intermediate connecting portion of the Z-shaped terminal, is co-planar with the surface of wall portion 30 which faces the first end 18 of the housing 16, such as the innermost surface 68 of the second end of terminal 46. The terminals 50 and 52 which start near the second end 20 of the housing 16 and extend toward the first end 18 have their ends partially embedded in wall portion 30 such that the outermost surface of the second end is co-planar with the surface of wall portion 30 which faces the first end 18 of the housing 16, such as the outermost surface 70 of the second end of terminal 50.

The contact structure of interrupter switch 12 is essentially of the knife-blade type, and it may either be of the hinged single-break type, or of the rectilinearly movable double-break type. For purposes of example, the double-break type is illustrated, and since each pole of the interrupter switch 12 is similarly constructed, only the contact members of the first pole associated with the first compartment 40 are illustrated in FIG. 1.

More specifically, the pole associated with compartment 40 of interrupter switch 12 includes first and second stationary main break contact members 72 and 74 formed of copper, alloys thereof, or any other suitable electrical conductor, fixed to the co-planar surfaces of the second ends of terminals 46 and 48, respectively, and first and second stationary auxiliary or arcing contact members 76 and 78, also formed of copper, or the like, which are also fixed to the co-planar surfaces of the second ends of terminals 46 and 48, respectively.

Arc chute units are disposed to enclose the auxiliary or arcing contacts 76 and 78, but which are not shown in the first compartment 40, but which are illustrated extending outwardly from like auxiliary contacts of the second compartment 42. Specifically, first and second arc chute units 80 and 82 are disposed to enclose the upper and lower auxiliary or arcing contacts of each pole, with each arc chute unit, such arc chute unit 80, having first and second insulating plates 84 and 86 formed of a gas evolving arc extinguishing material, such as high molecular weight polyoxymethylene, as disclosed in U.S. Pat. No. 3,059,081, which is assigned to the same assignee as the present application, or any other suitable arc extinguishing material, as distinguished from an arc tracking material, may be used. The first and second insulating plates 84 and 86 are joined along two sides such as by a plurality of nut and bolt assemblies 88, and are constructed to provide a slot 92 between them for receiving the end of an auxiliary arcing blade contact, as will hereinafter be described.

A movable contact assembly 92 is disposed in compartment 40, which includes two spaced, generally parallel, main blades 94 and 96, formed of copper, or the like, which blades are supported by and mounted for rectilinear movement on, an insulating actuating rod or member 98, which extends to and is mechanically linked with the operating mechanism 14 through an opening 100 disposed through the inner wall portion 30. Blades 94 and 96 are suitably fixed to member 98, such as with a plurality of nut and bolt assemblies 102.

Alignment of the blades 94 and 96, and the desired spacing between them, is maintained by bolts, spacer sleeves, and cup-shaped spring washers disposed near both ends of the assembly, such as bolt 104, spacer sleeve 106, and spring washer 108.

The blades 94 and 96 each have inward projections for making good electrical contact with the main break contacts 72 and 74, such as projections 110 at the upper end of the blade assembly and projections 112 at the lower end, which projections contact the break contacts 72 and 74 adjacent to, but spaced from special arcing contacts 114 and 116, such as generally in the area indicated at 118 for break contact 72, and area 120 for break contact 74. The major arcing upon breaking an electrical circuit with the interrupter 12 is directed to auxiliary arcing contacts as will be hereinafter ex-

plained, but arcing upon closure, and a small amount of arcing upon opening, may occur at the main contacts. This small amount of arcing is directed to special contacts **114** and **116** formed of arc resisting materials, such as alloys of silver and tungsten. Contacts **114** and **116** extend outwardly toward end **18** of the housing, contacting special arc resisting contacts (not shown) which are brazed to the inner surfaces of blades **94** and **96**, before the blades make contact with areas **118** and **120** of the break contacts **72** and **74**, respectively. The special arcing contacts on the blade continue past contacts **114** and **116**, into the cut-out portions **122** and **124**, respectively, of the main contacts **72** and **74**, to remove these slightly higher resistive paths from the circuit when the interrupter switch is closed. The special arcing contacts on the blades and break contacts also break last, absorbing any arcing of the main contacts at this time.

The major arcing upon breaking the electric circuit is directed to auxiliary stationary contacts **76** and **78**, and to auxiliary blade contact assemblies **126** and **128**, which have blade members **127** and **129**, respectively. Blade members **127** and **129** engage and disengage the auxiliary stationary contacts **76** and **78**, respectively, which stationary contacts are surrounded by arc chutes formed of arc extinguishing material, as hereinbefore described. The auxiliary blade members **127** and **129** are mounted to blades **94** and **96**, respectively, at opposite ends of the movable blade assembly **92**, and since the auxiliary blade contact assemblies are of like construction, only auxiliary contact assembly **126** is described in detail.

Auxiliary blade contact **127** of contact assembly **126** is mounted to blade **94** by a pivot bolt, which extends through the auxiliary blade contact **127**, through a spacer sleeve (not shown) which is surrounded by coil spring **132**, and through an aperture in blade **94**. The spring **132** biases the blade **127** against a stop **134**.

In the operation of the interrupter switch assembly associated with compartment **40**, when the actuating or connecting rod **98** is moved perpendicularly inward by the operating mechanism **14**, the arcing contacts **114** and **116** on the main break contacts are first engaged by the special arcing contacts of the blade members, and then the projections **110** and **112** on the blade contacts **94** and **96** engage the surfaces **118** and **120** of the break contacts **72** and **74**, respectively. Substantially simultaneously with the engagement of the main blade members and the break contacts, the auxiliary blades **127** and **129** make contact with the auxiliary stationary contacts **76** and **78**. When the connecting rod **98** is moved perpendicularly outward by the operating mechanism **14**, the main blades **94** and **96** are disengaged, with the special alloy contacts parting last, while the auxiliary blades **127** and **129** are retained by the stationary auxiliary contacts **76** and **78**, by inwardly turned ends on the auxiliary contact fingers, which are designed to hold the auxiliary blade contacts until a predetermined force is exerted to separate the contacts. Thus, even though the main switch blades are in an open position, absorbing any small arcing at its special alloy arcing contacts which parted last, the circuit is still maintained through the auxiliary stationary blade contacts. Once a predetermined clearance is established between the opening main blade contact assembly **92** and the break contacts **72** and **74**, the springs, such as spring **132**, are charged to the point of overcoming the grip of the stationary auxiliary contacts on the auxiliary blade contacts, and the springs propel the auxiliary blade contacts **127** and **129** through their associated arc chutes with a snap action, extinguishing the arc due to the gas evolving materials of which the arc chutes are formed, while confining the arcs to the chutes.

The interrupter switch **12** is completed by transparent covers formed of a suitable resinous insulation system, such as polyester, polycarbonate, or epoxy system, with a cover **136** being shown in place over the open end of compartment **44**. The covers provide the function of completely enclosing the energized contacts of the poles, while enabling the position of the switch to be visually determined. When the interrupter switch is of the pivoted type having a hinge and a single break contact, the blade contact may still be at an elevated potential when the switch is open. When this type of contact structure is used, the covers, such as cover **136**, also provide the function of placing solid insulation between the blade contacts in their open positions. The insulating value of the covers is enhanced by constructing the covers such that their open ends, such end **138** and of **136**, extend for a predetermined dimension into the open ends of their associated compartment. The covers may be attached to end **18** of the housing by screws disposed through apertures in the covers, which threadably engage tapped metallic inserts embedded in the housing, such as screw **140** and insert **142**.

As hereinbefore stated, the construction of the interrupter switch **12** may be double break, as illustrated, or pivoted, and any type of operating mechanism which will properly actuate the movable blade assembly may be used. When a double break type interrupter switch is used, a rectilinear, reciprocating motion must be imparted to each of the connecting rods to open and close the contacts of the poles. Operating mechanism **14** is a new and improved mechanism for imparting the required rectilinear reciprocating motion to the connecting rods, such as rod **98**, which mechanism is rugged and reliable and which may be manufactured for a relatively low cost. Operating mechanism **14** is best shown in FIGS. **2**, **3** and **4**, which are right and left hand elevations, and a view looking upwardly from the bottom of the operating mechanism, respectively, which views illustrate the operating mechanism of the switch in the open position.

More specifically, operation mechanism **14** broadly includes a metallic housing **146**, linkage means **140** operatively connected to the plurality of movable blade contacts, operating shaft means **153**, and a spring member **155** having first and second ends **184** and **186** which are linked to the linkage means **150** and the operating shaft means **153**, respectively. The linkage means **150** and operating shaft means **153** are arranged to charge the spring member **155**, regardless of the circumferential direction of the outside force applied to the operating shaft means, and to release the stored energy to provide a quick make when the interrupter switch is open, and a quick break when the interrupter switch is closed.

More specifically, housing **146** includes side wall portions **148** and a connecting back support plate **149**, with the sidewall portions **148** being joined to the back or second end **20** of the switch housing **16**, such as by mounting bolts disposed through apertures in bent edges of the side wall portions, which extend into threaded apertures disposed in the switch housing **16**.

The linkage means **150** includes a first link **152** having first and second ends **154** and **156**, respectively, a second link **158** having first and second ends **160** and **162**, respectively, a third link **164** having first and second ends **166** and **168**, respectively, a fourth link **170** having first and second ends **172** and **174**, respectively, and a pin member **176**. Pin member **176** is fixed to the first link **152**, extending perpendicularly through its midpoint, having a first end **178** which extends outwardly from one side of the link, to which the first end **160** of the second link **158** is pivotally secured, and a second end **180** which extends perpendicularly outward from the other side of the link, having a cylindrical portion **182** which extends inwardly from its extreme end **180** for a predetermined dimension, and a larger diameter between cylindrical portion **182** and link **152**, to which end **184** of the spring member **185** is linked. Pin member **176**, instead of being a one piece construction, may be formed of two or more parts, if desired.

The first end **154** of the first link **152** is pivotally secured to the second end **174** of the fourth link **170**, via shaft **186**, and the second end **156** of the first link **152** is pivotally fixed to the first end **166** of the third link **164**, via shaft **188**. The second end **168** of the third link **164** is pivotally fixed to a support **190** via shaft **192**, with the support **190** being fixed to the back plate **149**, such as be welding. The first end **172** of the fourth link **170** is connected to the plurality of connecting rods con-

nected to the movable blade members of the interrupter switch **12**, via rod member **194**. The second end **162** of the second link **158** is pivotally fixed to a support **191** via a shaft **193**, and support **191** is fixed to the back support plate **149**.

Operating shaft means **153** includes a support member **196** and operating shaft **198**. Support member **196** is fixed to the back plate **149**, such as by welding, and it includes an opening containing a bearing **201**, through which the operating shaft **198** is rotatably supported. Operating shaft **198** has first and seconds ends **200** and **202**, respectively, with end **200** extending through an opening in the side wall portion **148**. End **200** is adapted for connection to an operating handle (not shown), for manual actuation of the operating mechanism, or it may be connected to suitable drive means, such as a gear motor, as required by the specific application.

The second end **202** of the operating shaft **198** has a coaxially extending cylindrical projection **204** fixed thereto, with the extreme end of the coaxial projection **204** having a slot **206** formed therein, best shown in FIG. **3**, which slot extends completely between opposite sides of the cylindrical projection, dividing a predetermined length of the cylindrical projection **204** into first and second segments **208** and **210**, respectively. The inner walls **212** and **214** which define slot **206** are bowed or curved slightly to increase the width of the slot **206** at the center thereof, for purpose which will be hereinafter explained.

A crank arm or rotatable support **185** for end **186** of the coil spring **155** is disposed to rotate with the operating shaft **198**. Crank arm **185** includes a first support member **216** which is fixed to and extends perpendicularly outward from the cylindrical projection **204**, and a second support member **218**, which has an axis disposed parallel with the axis of the operating shaft **198**, and which extends toward the first linkage **152** such that end **186** of the spring member **155** may be looped thereover, and secured by a circumferential slot formed in support member **218**.

The operating mechanism **14** is shown in the open switch position in FIGS. **2**, **3** and **4**, with the spring member uncharged. Rotating the operating shaft **198** in either circumferential direction will charge the spring and then close the interrupter switch with the stored energy in the spring. Once the interrupter switch is closed, rotation of the operating shaft **198** in either circumferential direction will charge the spring **155** and then open the switch with the stored energy in the spring, thus providing the quick make and quick break required to obtain the high load current, short circuit withstand current, and fault close in ratings desired of such switches for pad mounted power transformers and power center applications.

More specifically, FIG. **5** is a right side elevational view of the operating mechanism **14**, illustrating the charging of the spring member **155** while in the process of closing the interrupter switch. When operating shaft **198** is turned in either circumferential direction, the slotted cylindrical projection **204** also turns, and surface **182** of pin **176** will no longer be aligned with one of the openings to the slot **206**, but will now ride on and be restrained by the outer surface of one of the segments **208** or **210**, with the specific segment depending upon which circumferential direction the operating shaft is turned. As the operating shaft is turned, the crank arm **185** is also moving, moving the coil spring member **155** about pin **176** and increasing the distance between the center lines of pin **176** and support **218**, to extend and charge the spring member **155**. This action continues, increasing the energy stored in the spring as the rotational angle is increased. When the slotted cylindrical projection is rotated 180°, the other end of the slot **206** reaches the projection **182** on the pin member **176**, and pin **176** is pulled, with a snap action, through the slot **206**, which pivots link **152** on pin **188** to the position shown in FIG. **6**. However, it should be noted that the center line of pin **188** is not fixed, but is free to move, since the end **156** of the first link is pivotally fixed to link **164**, which in turn is pivotally linked to support member **190**. Thus the center of shaft **188** is free to move, as illustrated by the angle **189** in FIG. **6**, which prevents the linkage means **150** from locking in either the open switch or the closed switch position. Link **152** is guided to its new operating position by the pin **176** and slot **206**. The midpoint of link **152** is also fixed to the end of link **158**, which has its other end pivotally fixed to support **191**. Thus, the midpoint of link **152**, and pin **176** is moved through an arc of a circle having a radius which extends from the center line of pin **176** to the center line of pin **193**. The curve sides of the slot **206** have a radius selected to allow the cylindrical end **182** of pin **176** to move smoothly through the slot **206**.

In opening the interrupter switch **12**, rotary motion of the operating shaft **198** in either circumferential direction for 180° will charge the spring **155** and then release the stored energy, to change the operating mechanism **14** from the position shown in FIG. **6** back to that shown in FIG. **2**.

In summary, there has been disclosed a new and improved interrupter switch assembly, having a new and improved interrupter switch capable of higher current and voltage ratings, achieved by a new and improved housing and terminal construction which permits extending the switch ratings without a concomitant increase in the physical size and cost of the apparatus. Also disclosed is a new and improved operating mechanism for providing a quick make and quick break for the interrupter switch portion of the assembly, essential to increasing the switch current ratings, with the operating mechanism being rugged, and reliable, but which may be manufactured for a relatively low cost.

We claim as our invention:

1. A circuit interrupter comprising:

a housing formed of a resinous insulation system, said housing having a plurality of integrally formed outer and inner wall portions defining first and second open ends, including outer top, bottom and side wall portions, an inner wall portion disposed intermediate the first and second ends which divides said housing into first and second major portions, and a plurality of spaced, parallel inner wall portions which extend from the first end of the housing to said intermediate inner wall portion, perpendicular to the top and bottom outer wall portions, dividing the first major portion of said housing into a plurality of compartments each having an open and a closed end,

each of said compartments having first and second substantially Z-shaped terminals each having first and second spaced parallel portions which extend outwardly from opposite sides of a connecting portion,

the connecting portions of said first and second Z-shaped terminals being embedded in the top and bottom portions, respectively, of said housing, with one of its parallel portions extending outwardly from the housing and the other partially embedded in the intermediate wall portion such that a surface thereof is substantially co-planar with the surface of the intermediate wall portion which defines the closed end of the associated compartment,

first and second main contact members disposed in each of said compartments, fixed to said co-planar surfaces of said first and second Z-shaped terminals, respectively,

blade contact means disposed in each of said compartments,

and actuating means connected to each of said blade contact means for moving said blade contact means into and out of engagement with at least one of said main contact members in each of said compartments.

2. The circuit interrupter of claim **1** including first, second and third compartments, and wherein the outwardly extending ends of the Z-shaped terminals on both the top and bottom portions of the housing are staggered, to increase their clearance, with alternate terminals extending toward one end of the housing, and the remaining terminal extending toward the other end.

3. The circuit interrupter of claim **1** including transparent covers disposed to enclose the open ends of the compartments, with the covers extending into the open ends of the compartments for a predetermined dimension.

4. The circuit interrupter of claim 1 wherein the actuating means is disposed adjacent to the second major portion of the housing, with said actuating means being connected to the blade contact means through link members disposed through openings in the intermediate wall of the housing.

5. The circuit interrupter of claim 4 wherein said first and second main contact members are both break contacts, with the actuating means imparting substantially rectilinear movement to the link members to move the blade contact means into and out of engagement with the first and second main contact members.

6. The circuit interrupter of claim 5 including first and second auxiliary contact members disposed in each compartment, fixed to the co-planar surfaces of the first and second Z-shaped terminals, respectively, first and second arc chute units associated with said first and second auxiliary contact members, respectively, and first and second arcing contact members pivotally and resiliently fixed to each of the blade contact means, oriented to engage said first and second auxiliary contact members when the circuit interrupter is closed, and to draw arcs through first and second arc chute units when the circuit interrupter is opened.

7. The circuit interrupter of claim 1 wherein the actuating means includes linkage means connected to the blade contact means, operating shaft means, and a spring member connected between said linkage means and said operating shaft means, said linkage means and said operating shaft means being arranged to charge said spring members and release the stored energy therein, in response to a predetermined rotation of said operating shaft means, providing a quick make when the circuit interrupter is open, and a quick break when the circuit interrupter is closed.

8. The circuit interrupter of claim 7 wherein the linkage means includes an outwardly projecting pin member and the operating shaft means includes a cylindrical projection, the end of which is slotted to divide at least a portion of the outer surface of the cylindrical projection into two segments, said pin member and cylindrical projection cooperating when the operating shaft is rotated, to charge the spring member and restrain the linkage by the pin member riding on the outer surface of one of the segments of the cylindrical projection, releasing the stored energy in the spring member to actuate the linkage means and connected blade contact means when the slot in the cylindrical projection is aligned with the pin member.

9. The circuit interrupter of claim 8 wherein the pin member and cylindrical projection are arranged such that 180° rotation of the operating shaft means in either circumferential direction charges the spring member and releases the stored energy, to actuate the linkage and blade contact means.

10. The circuit interrupter of claim 8 wherein the linkage means includes a first link having first and second ends, with the pin member being fixed to substantially its midpoint, means pivotally fixed to the first end of the first link for actuating the blade contact means, a second link having one end pivotally fixed to the midpoint of said first link and its other end pivotally fixed to a support, and a third link having one end pivotally fixed to the second end of said first link and its other end pivotally fixed to a support.

11. The circuit interrupter of claim 10 wherein the sides of the slot in the cylindrical projection are bowed outwardly to enable the pin to pass therethrough as it pivots about the end of the second link which is pivotally fixed to the support.

12. The circuit interrupter of claim 8 wherein one end of the spring member is attached to the outwardly projecting pin of the linkage means, and the operating shaft includes a shaft member connected coaxially to the cylindrical projection, and a support spaced from the centerline of the shaft member to which the other end of the spring member is attached.

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