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BUSHING SUPPORT

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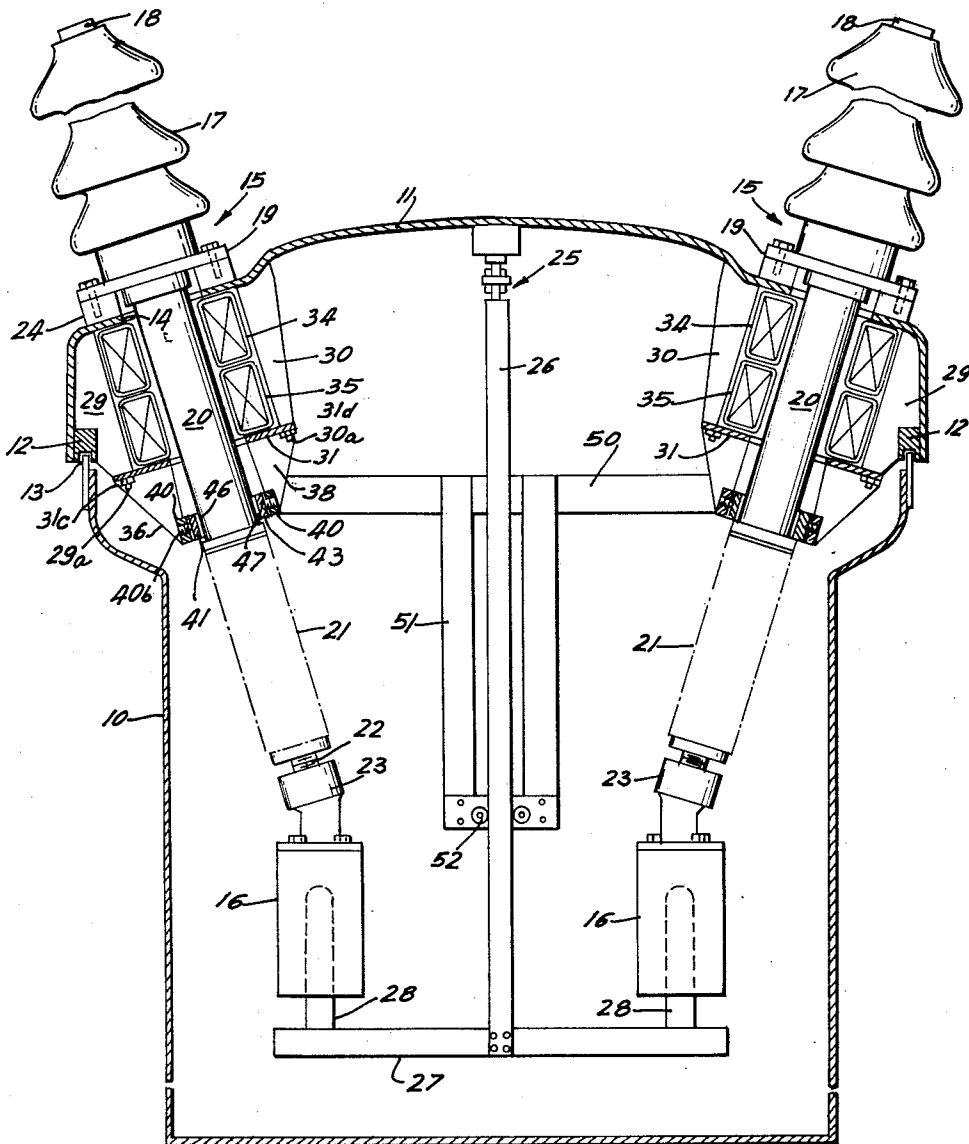


FIG. 1.

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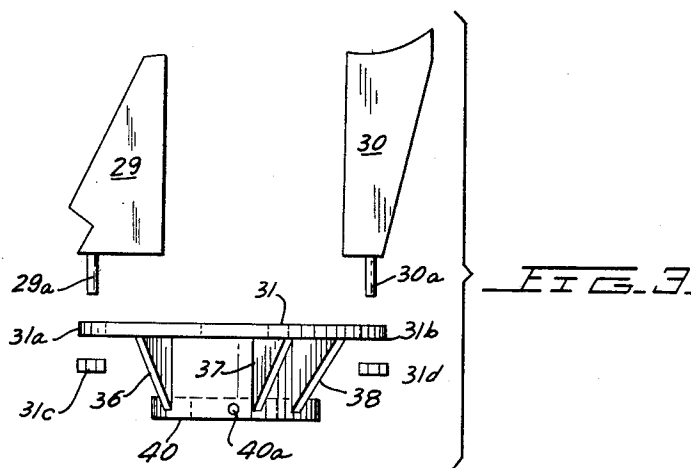
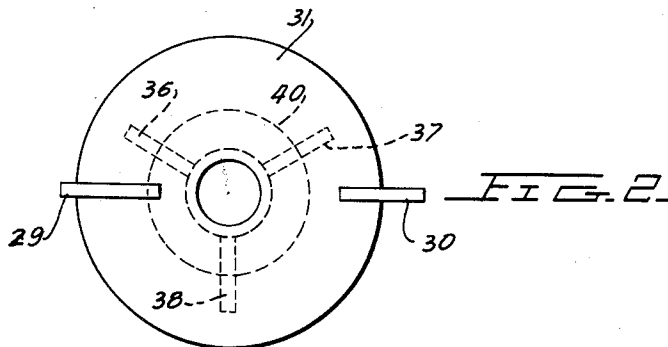
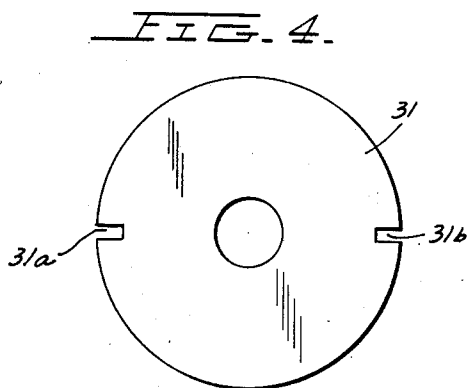
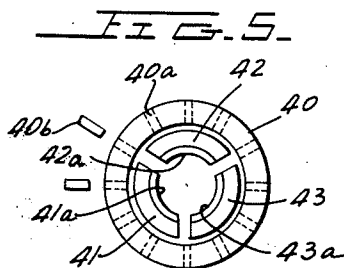
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BUSHING SUPPORT

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2 Sheets-Sheet 2



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3,071,672

## BUSHING SUPPORT

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7 Claims. (Cl. 200-150)

This invention relates to a bushing support structure, and more specifically relates to a bushing support for elongated bushings which carry the interrupter of an oil circuit breaker and are subjected to substantial cantilever forces whereby the support structure engages the bushing below the main pivotally supported area, and further serves to carry current transformers.

Entrance bushings used in oil circuit breakers are well known to the art and generally have a comparatively high slenderness ratio for their portions extending below the mounting flange of the oil tank. A typical construction showing this is in copending application Serial No. 67,125, filed November 3, 1960, in the name of James R. McCloud, entitled "Three-phase Oil Circuit Breaker," and assigned to the assignee of the instant invention.

As will be seen from the above noted copending application, the interrupter structure of the oil circuit breaker are carried within an oil filled tank at the end of respective entrance bushings.

To obtain sufficient dielectric strength, the interrupter structure is carried considerably below the top of the oil-containing tank so that a relatively long cantilever length exists from the top of the tank which carries the bushing to the bushing load comprised of the interrupter.

During operation of the interrupter, extremely high forces may be applied laterally thereto due to the reaction of oil and gas jets emitted from one side of the interrupting unit. This horizontal component of force on the interrupter imparts substantial cantilever forces to the relatively long bushing length between the interrupter and its support at the top of the oil tank. As a result of these high forces, the bushing may be permanently deformed so that the unit cannot thereafter operate satisfactorily and may require a bushing replacement.

Even if the bushing is not permanently deformed and returns to its normal position after forces subside, there can still be a misalignment between the interrupting element and its cooperating contact while the circuit breaker is opening or closing, as where the bushing is caused to oscillate and its oscillation has not subsided before reclosing of the contacts when the breaker is operated in this mode.

Furthermore, it is possible that if there is an elastic deformation of the bushing during the contact opening and while the movable bayonet-type contacts are still within the interrupter, the bayonet contacts may be permanently bent so that they cannot thereafter re-enter the interrupter structure when the breaker is reclosed.

The essence of the present invention is to provide a novel support structure for the above noted type of entrance bushing which provides improved rigidity against the cantilever forces. It will be recognized that while the application describes the invention in connection with the entrance bushing of an oil circuit breaker, the support structure can be utilized in any application wherein the bushing has a relatively long cantilever length where substantially high impact forces may be applied to the free end of the bushing.

In the present invention the bushing, which will also be seen to serve the function of supporting the current transformers for the bushing, is supported at the top of the tank by the bushing flange in the usual manner, but includes an extending portion which rigidly grips the bushing at a portion below the flange mount. Accord-

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ingly, the new point of pivotal motion for the bushing will be this lower clamped section so that the cantilever length of the bushing is substantially decreased.

In addition to this, and since means are now provided to clamp to a lower portion of the bushing, the support means may further be modified to serve as a support for current transformers which are to be carried within the circuit breaker tank for monitoring the current through the bushing. That is to say, provision for mounting the current transformer is inherently provided when a lower portion of the bushing is provided with support structure means.

In addition to the foregoing, it is also possible to cause a brace means to extend to the adjacent bushing support of the same phase whereby the two bushing supports of the interrupter associated with the same phase will be caused to deflect laterally with one another. If this bracing means is then caused to operate as the guide for the motion of the movable bayonet contacts, the movable contacts will then be caused to move along with the bushings being supported whereby the movable contact will always move with the interrupter structures so that even if there is deflection, the movable contact will always be aligned with the interrupters. This additional bracing feature is preferably used in combination with the novel support structure mentioned above, although it can be used independently of such support structure.

Accordingly, a primary object of this invention is to provide a novel support means for elongated bushings.

Another object of this invention is to reduce the cantilever deflection of the entrance bushing of an oil circuit breaker.

A further object of this invention is to provide a novel support structure for entrance bushings which are flange-mounted wherein additional support means is rigidly connected from the flange mounting to an axially displaced position of the bushing.

A further object of this invention is to mechanically connect the first and second entrance bushing of an oil circuit breaker by a bracing means, and to carry the lift rod guide of the circuit breaker from this bracing means whereby the movable contact will be deflected along with the interrupter structures carried by the bushings.

These and other objects of my invention will become apparent from the following description when taken in connection with the drawings, in which:

FIGURE 1 shows a side cross-sectional view of a typical oil circuit breaker having bushings which are supported in accordance with the present invention.

FIGURE 2 is a top view of the mounting structure of FIGURE 1.

FIGURE 3 is a side view of the mounting structure of FIGURE 1.

FIGURE 4 is a top view of the support plate of FIGURES 1, 2 and 3.

FIGURE 5 is a top view of the bushing clamping structure of FIGURES 1, 2 and 3.

Referring now to FIGURE 1, I have shown portions of an oil circuit breaker of the type set forth in above noted copending application Serial No. 67,125 and reference is made thereto for details of the general structure of the circuit breaker.

As is seen in FIGURE 1, the oil circuit breaker is comprised of a metallic tank 10 having a top frame 11. The top frame 11 is connected to tank 10 by means of ring 12 welded to top frame 11 and having a gasket receiving groove 13 therein which receives the upper portion of tank 10 in the manner shown in aforementioned application Serial No. 67,125. The top frame 11 is then securely bolted to tank 10 in any desired manner.

The top frame 11 is provided with an aperture 14 which receives an entrance bushing generally shown as

entrance bushing 15 which carries an interrupter structure 16 at the lower end thereof. The entrance bushing 15 is comprised of an upper porcelain surface 17 having a terminal 18 to which electrical connection may be made. A conductor extends centrally of bushing 15 and is connected to terminal 18 so that electrical connection may be made to stationary contact means contained within interrupter 16.

The bushing 15 is further comprised of a flange 19, an external metal sleeve 20, which is at ground potential and is immediately below flange 19, and a porcelain body 21 at the lower end. A terminal 22 then extends from porcelain body 21 and is connected to the aforementioned conductor connected to terminal 18 where terminal 22 is electrically and mechanically connected to adapter 23 of interrupter 16.

In order to secure bushing 15 to top frame 11, the standard means for this has been to provide a mounting ring 24 which is welded to top frame 11 for receiving flange 19 in the bolted relation as shown.

An operating mechanism (not shown) which operates through a system of linkages partially shown as linkages 25 and which are fully described in copending application Serial No. 67,125 is connected to a lift rod 26 which terminates with a cross bar 27 which carries movable bayonet-type contact 28 which moves into and out of engagement with the stationary contacts carried within interrupter 16. The system is shown in the engaged position in FIGURE 1, it being apparent that when lift rod 26 is rapidly moved downwardly it will cause bayonet contact 28 to clear interrupter 16 in order to de-energize the electrical circuit including bushing 15.

During this operation, and in order to extinguish the arc generated by the separating contacts within interrupter 16, there will be a strong blast of oil and gas emerging from interrupter 16 which causes a substantial force to be applied in the transverse direction to the axis of bushing 15. This causes a cantilever force which, in the past, operated over the length extending from interrupter 16 to flange 19. Because of this, the aforementioned problems of permanent deformation or failure of the movable contact such as contact 28 to align with interrupter 16 during a rapid reclosing operation were caused.

In accordance with the present invention, a novel supporting structure is provided whereby the bushing 15 is additionally supported at an axially removed point from flange 19 so that the cantilever length of the bushing is decreased.

The support structure of the invention includes plates 29 and 30 best seen in FIGURES 1, 2 and 3 which are welded to, or are an integral part of top frame 11. Plates 29 and 30 have extending studs 29a and 30a extending therefrom which fit into slots 31a and 31b of plate 31 as shown in FIGURES 1, 3 and 4. Thus, plate 31 can be removably connected to supports 29 and 30 by nuts 31c and 31d which threadably engaged studs 29a and 30a respectively as shown in FIGURES 1 and 3.

As clearly shown in FIGURE 1, ring 31 serves as a seat for current transformers 34 and 35, this function previously having been performed by separate support means.

The lower surface of ring 31 has three extending plates 36, 37 and 38 welded thereto as best shown in FIGURES 2 and 3. The ends of plates 36, 37 and 38 receive a support ring 40 secured thereto as by welding as shown in FIGURES 2, 3 and 5.

Ring 40 then has a plurality of tapped openings extending therethrough such as opening 40a of FIGURES 3 and 5 which receives a threaded bolt such as bolt 40b of FIGURES 1 and 5.

Internal ring sectors 41, 42 and 43, seen in FIGURES 1 and 5, are then positioned in ring 40 and have insulating sectors 41a, 42a and 43a respectively secured to their outer faces.

The ring sectors 41, 42 and 43, as shown in FIGURE 1,

are driven toward sleeve 20 of bushing 15 by tightening the bolts such as bolt 40b around the periphery of disk 40 to rigidly engage and support the bushing. The insulating disk sectors act as both electrical insulation for sleeve 20 and a mechanical shock absorbing material.

Since a rigid support is now provided at the lower portion of bushing 15, it is clear that the cantilever length is now shortened to the length between interrupter 16 and the ring support members 41, 42 and 43. Accordingly, substantially less deflection of the bushing will occur during interrupting conditions. Furthermore, by providing the insulating liners 41a, 42a and 43a of some desired flexible material, mechanical shock will be damped throughout the apparatus.

In addition to the novel structure set forth above, it is further possible to cause a brace member 50 to extend from support member 38 to which it may be attached in any desired manner to the similar support structure of the interrupter of the same phase as shown. This brace member 50 may then serve as the support for guide 51 of lift rod 26 which is constructed in the usual manner to carry guide rollers such as rollers 52 which control the lateral position of crossbar 27.

With this novel additional bracing and in the event that the forces applied to interrupter 16 are sufficient to cause motion at ring 41, this same motion will be imparted to contact 28 because of the same movement of guide 51. Accordingly, both interrupter and movable contact will execute substantially the same motion so that there will be at least a smaller degree of misalignment between the members during a second operation, or during the time of removal of movable contact 28 from interrupter 16.

Clearly, such a bracing system including brace 50 could be directly applied to prior use structures in the absence of the support system including plates 29, 30, 32 and 33, whereby the two entrance bushings of the same phase are provided with braces such as brace 50 which is connected to the bushings so as to cause the movable contact carried by the lift rod to move in accordance with the motion of the interrupters during cantilever force conditions.

Although this invention has been described with respect to its preferred embodiments it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of this invention be limited not by the specific disclosure herein but only by the appended claims.

What is claimed is:

1. A support means for an elongated bushing; said elongated bushing having flange means thereon for mounting said elongated bushing to a support surface; one end of said bushing having a load connected thereto; said load being operable to exert a force on said one end of said bushing at an angle to the axis of said bushing; said support means comprising relatively rigid means having a first portion thereof connected to said support surface and a second portion thereof connected to said elongated bushing at a point between said flange and said one end of said bushing; said support means including a support platform; said support platform receiving a current transformer thereon encircling said bushing; said second portion of said support means being axially displaced along said bushing from said support platform.

2. A support means for an elongated bushing; said elongated bushing having flange means thereon for mounting said elongated bushing to a support surface; one end of said bushing having a load connected thereto; said load being operable to exert a force on said one end of said bushing at an angle to the axis of said bushing; said support means comprising relatively rigid means having a first portion thereof connected to said support surface and a second portion thereof connected to said elongated bushing at a point between said flange and said

one end of said bushing; said second portion of said support means including a plurality of ring segments receivable about the circumference of said bushing; said ring segments having an interior surface lined with a resilient material; said support means including a support platform; said support platform receiving a current transformer thereon encircling said bushing; said second portion of said support means being axially displaced along said bushing from said support platform.

3. In an oil circuit breaker; a support means for an entrance bushing; said entrance bushing having a portion thereof connectible to the top frame of said oil circuit breaker; one end of said entrance bushing passing through said top frame and having an interrupter structure secured thereto and immersed in oil within said oil circuit breaker; said support means comprising a relatively rigid means having a first portion thereof connected to said top frame and a second portion thereof connected to said entrance bushing at a point between said portion of said entrance bushing connectible to said top frame and said one end of said entrance bushing; said support means including a support platform; said support platform receiving a current transformer thereon encircling said bushing; said second portion of said support means being axially displaced along said bushing from said support platform.

4. In an oil circuit breaker; a support means for an entrance bushing; said entrance bushing having a portion thereof connectible to the top frame of said oil circuit breaker; one end of said entrance bushing passing through said top frame and having an interrupter structure secured thereto and immersed in oil within said oil circuit breaker; said support means comprising a relatively rigid means having a first portion thereof connected to said top frame and a second portion thereof connected to said entrance bushing at a point between said portion of said entrance bushing connectible to said top frame and said one end of said entrance bushing; said second portion of said support means including a plurality of ring segments receivable about the circumference of said bushing; said ring segments having an interior surface lined with a resilient material, said support means including a support platform; said support platform receiving a current transformer thereon encircling said bushing; said second portion of said support means being axially displaced along said bushing from said support platform.

5. In an oil circuit breaker; a support means for an entrance bushing; said entrance bushing having a portion thereof connectible to the top frame of said oil circuit breaker; one end of said entrance bushing passing through said top frame and having an interrupter structure secured thereto and immersed in oil within said oil circuit breaker; a movable contact for said interrupter structure; said movable contact being carried by a lift rod; said lift rod having its motion guided by a guide means operatively connected thereto; said guide means being connected to and supported by said top frame; said support means comprising a relatively rigid means connected from said guide means to a portion of said entrance bushing below said top frame; said support means

causing said movable contact to execute a motion substantially like the motion of said interrupter structure due to cantilever forces on said entrance bushing.

6. In an oil circuit breaker; a support means for an entrance bushing; said entrance bushing having a portion thereof connectible to the top frame of said oil circuit breaker; one end of said entrance bushing passing through said top frame and having an interrupter structure secured thereto and immersed in oil within said oil circuit breaker; a movable contact for said interrupter structure; said movable contact being carried by a lift rod; said lift rod having its motion guided by a guide means operatively connected thereto; said guide means being connected to and supported by said top frame; said support means comprising a relatively rigid means connected from said guide means to a portion of said entrance bushing below said top frame; said support means causing said movable contact to execute a motion substantially like the motion of said interrupter structure due to cantilever forces on said entrance bushing; said support means being further constructed to have a first portion thereof connected to said top frame and a second portion thereof connected to said entrance bushing at a point between said portion of said entrance bushing connectible to said top frame and said one end of said entrance bushing.

7. In an oil circuit breaker; a support means for an entrance bushing; said entrance bushing having a portion thereof connectible to the top frame of said oil circuit breaker; one end of said entrance bushing passing through said top frame and having an interrupter structure secured thereto and immersed in oil within said oil circuit breaker; a movable contact for said interrupter structure; said movable contact being carried by a lift rod; said lift rod having its motion guided by a guide means operatively connected thereto; said guide means being connected to and supported by said top frame; said support means comprising a relatively rigid means connected from said guide means to a portion of said entrance bushing below said top frame; said support means causing said movable contact to execute a motion substantially like the motion of said interrupter structure due to cantilever forces on said entrance bushing; said support means being further constructed to have a first portion thereof connected to said top frame and a second portion thereof connected to said entrance bushing at a point between said portion of said entrance bushing connectible to said top frame and said one end of said entrance bushing; said support means being further operable to support a current transformer encircling said bushing.

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