

May 22, 1945.

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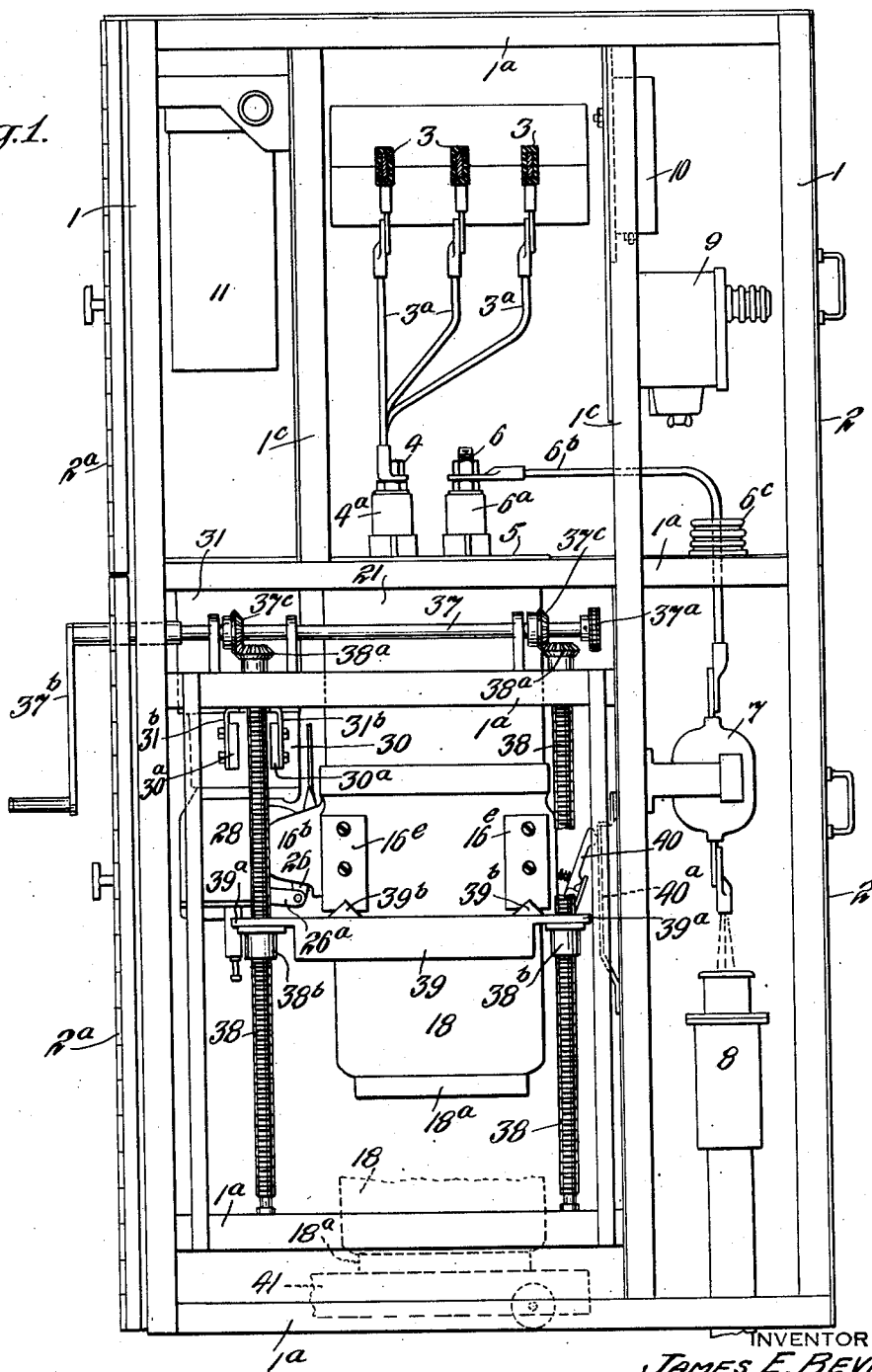
2,376,471

SWITCHGEAR FOR EXPLOSIVE ATMOSPHERES

Filed Feb. 25, 1943

3 Sheets-Sheet 1

Fig. 1.



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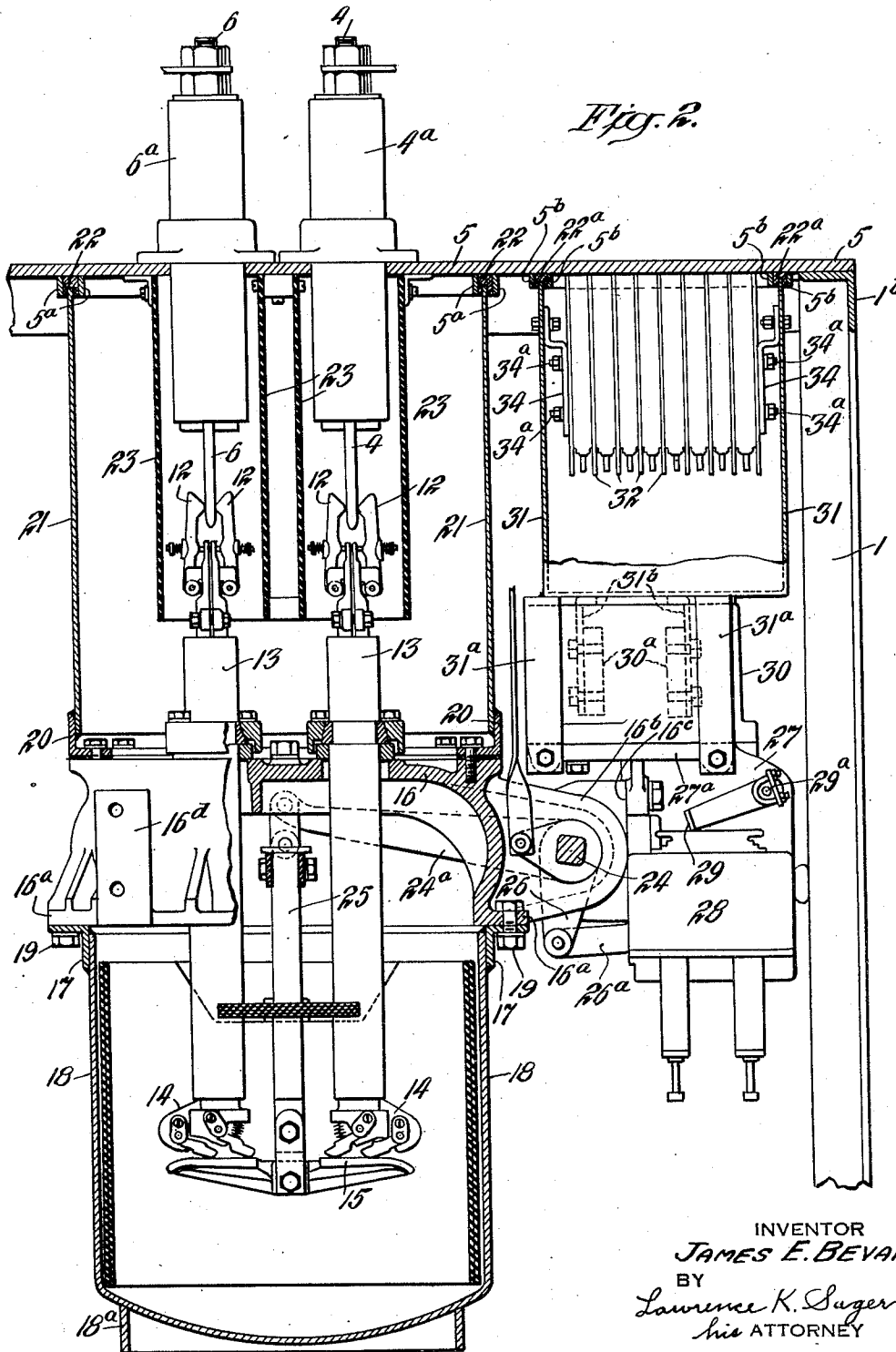


Fig. 2.

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3 Sheets-Sheet 3

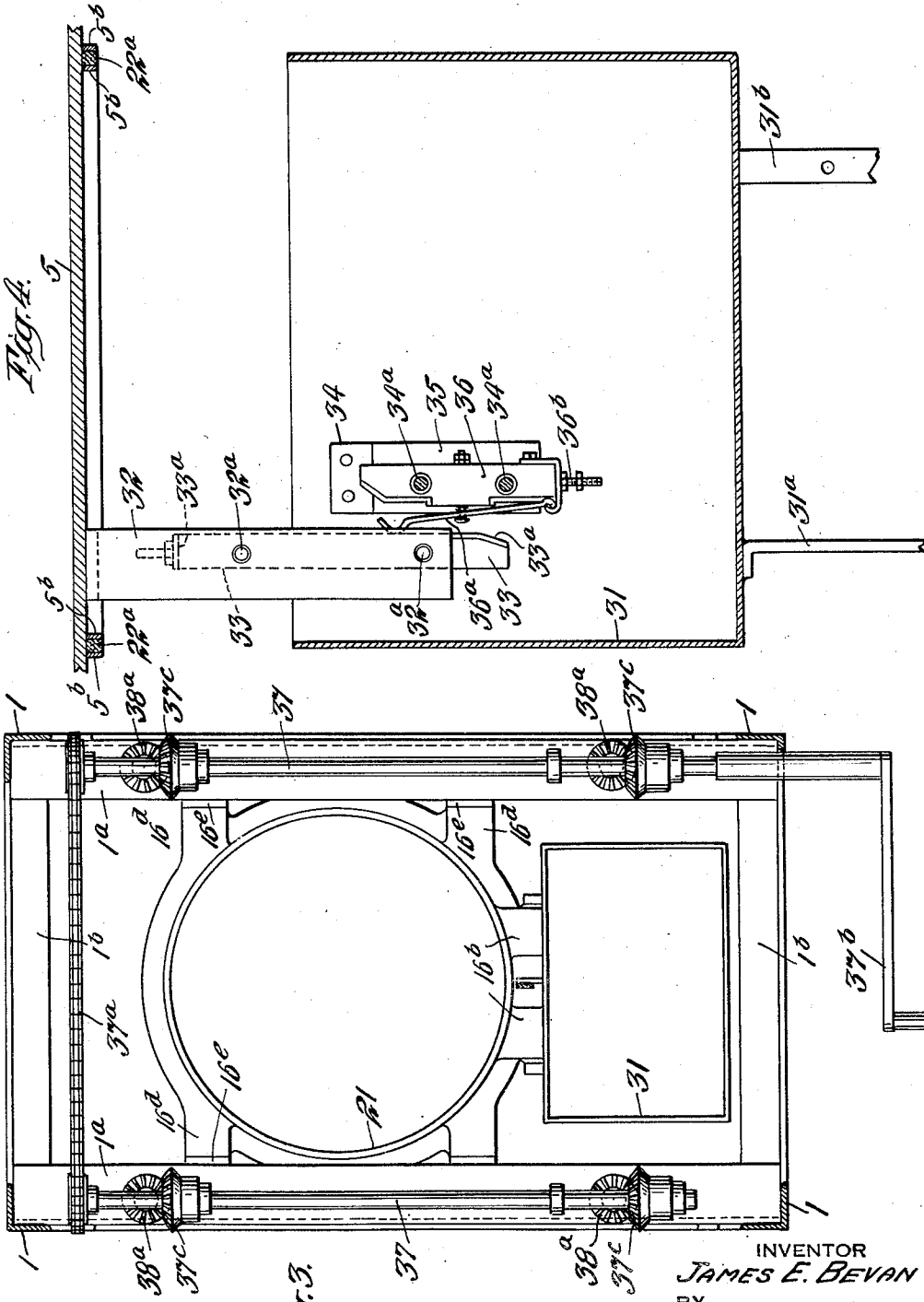


Fig. 3.

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UNITED STATES PATENT OFFICE

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SWITCHGEAR FOR EXPLOSIVE ATMOSPHERES

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mesne assignments, to Realty and Industrial
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Application February 25, 1943, Serial No. 477,035

10 Claims. (Cl. 200—150)

This invention relates to improved switchgear for use in hazardous locations which are subject to explosive atmospheres, such as in chemical and oil refining plants and similar industries.

The main object is to provide equipment which may be utilized safely in such hazardous locations. In previous structures it has been endeavored to enclose circuit making and breaking parts in more or less gas-tight enclosures; but in view of the fact that such structures cannot be made gas-tight throughout and in view of changes of temperature causing the structures to breathe, explosive mixtures are likely to enter the enclosed structures and thereby be subject to explosion upon the making of a spark within the enclosures. By the present invention various interrelated separable contacts are submerged in oil so that any arcing which occurs upon the separation of contacts is quenched in oil baths; and the various parts are so related that when the parts are moved from their normal operating position to the test position, or entirely disconnected for inspection or repair of the parts, the separation of all of the contacts necessary for such test or inspection will occur in oil baths. Consequently even if some gases of an explosive character should be present above the oil in the oil tanks, any arcing at the contacts will be quenched within the oil and not subject such gases to ignition. Another object of the invention is to so relate the parts required to be moved when the breaker is moved to test position or removed for inspection or repair, that all of the oil enclosures will be moved simultaneously as a unit. Another object is, during the movement to test position, to permit certain of the contacts to be separated in oil while other contacts are maintained closed in their oil baths for permitting test operations; and likewise provide for separation of the latter contacts in oil when the breaker is to be entirely removed from any circuit connections. Another object is to provide means for cooling hot gases which may pass from the circuit breaker to the external atmosphere so that they will be ineffective in causing explosions in the outside atmosphere. Other objects and advantages will be understood from the following description and accompanying drawings which show a preferred embodiment of the invention.

Fig. 1 is a side elevation of the apparatus contained within one of the cubicle units, the side plate of the cubicle being removed; Fig. 2 is an enlarged vertical section of a portion of the apparatus of Fig. 1 looking from the rear of Fig. 1;

Fig. 3 is a top plan view of a portion of the apparatus of Fig. 2, various parts not being shown for clearness of the drawing; and Fig. 4 is a vertical section of the oil tank and secondary disconnects showing the tank lowered to test position, the section being taken at right-angles to the corresponding parts shown in Fig. 2.

Referring to Figs. 1 and 3, the main supporting frame is shown as made up of four upwardly extending angle irons 1, one at each corner of the cubicle. There are provided several supporting angle irons 1a which extend crosswise of the cubicle at the sides thereof, as well as cross-connecting angle irons 1b which extend along the front and rear portions of the cubicle. There are also additional vertically extending angle irons 1c positioned at opposite sides of the cubicle for supporting the various portions of the apparatus in conjunction with the other portions of the frame. These various supports are riveted or welded together to provide a strong supporting frame in the usual manner. The frame and apparatus are enclosed by plates at the sides, by removable plates 2 at the rear and by hinged doors 2a at the front.

The cubicle is divided in different sections for the location of different portions of the apparatus as shown in Fig. 1. Three bus bars 3 are shown in the upper middle section and these pass through side openings in a series of similar cubicles which may be stacked side by side. The leads 3a are connected to the bus bars and are connected to three conductors 4 which pass through insulating bushings 4a. These bushings are supported by a horizontally extending plate 5 which in turn is supported by the frame. Three similar bushings 6a are similarly supported on the plate 5 and contain conductors 6 from which the connecting leads 6b extend through insulated bushings 6c downwardly through one or more current transformers 7 in a lower rear section of the cabinet. The leads continue therefrom through a pot-head 8 and thence downwardly from the cabinet to the apparatus to be supplied with energy. In an upper rear section is located a potential transformer 9 and a fuse box 10 of the explosion proof type. In the upper front section is located an enclosing oil tank 11 which contains control and overload relays and a main switch for the control circuits. This oil tank is oil filled to immerse all these parts in oil and the tank is downwardly removable from its cover plate for inspection and repair of the parts independently of the apparatus to be later described. The main bus bars are insulated with Bakelite

tubing and the exposed connections between the parts are thoroughly taped and varnished so that no live metal parts are exposed to the atmosphere, although in the drawings some such metal parts are shown exposed for clearness of illustration.

Referring to Fig. 2, the lower ends of the conductors 4 and 6 form the fixed contacts of the primary disconnecting switches. These fixed contacts are slidably engaged by yieldable contacts 12 which form the upper terminals of conductors which pass downwardly within the insulators 13. At the lower ends of these insulators are located the yieldable contacts 14 which are fixed to the lower ends of the conductors contained within the insulators 13. A bridging conductor 15 is provided for each pair of contacts 14 and is adapted to close the circuit between them when in the raised position shown in Fig. 2. The insulators 13 are supported in their fixed position on the top of the cast steel head 16 of the circuit breaker by clamping means which form sealed joints between the insulators and the head.

The enclosing head 16 extends downwardly in circular form and is adapted to withstand very high internal pressures. The lower circular edge 16a extends outwardly to form a side flange to which is bolted at its underside the outwardly extending portion of a circular angle-shaped member 17 of rolled steel which can be deflected slightly under pressure where it engages the flange 16a for securing some venting area between the engaging surfaces under high pressures resulting from opening the breaker under the stress of a short-circuit. There is no gasket between these engaged surfaces and instead of attempting to make this a sealed joint, the object is to permit the escape of gases from the enclosure under high pressures; and by making these machined engaging surfaces unusually wide, the escaping gases passing outwardly between them are forced to pass between the comparatively large areas of the opposing flanges through the small crevices between the opposing surfaces which results in cooling such gases before they reach the outside atmosphere. In this manner the possibility of the escaping gases igniting any explosive gases of the outside atmosphere is avoided. The oil tank 18 of the breaker is of cylindrical form with a dome-shaped bottom and is thereby adapted to withstand high internal pressures. A circular downwardly extending flange 18a is provided at the bottom of the tank for supporting the breaker when removed from the cubicle. The upper rim of the tank is welded to the downwardly extending portion of the angle iron 17 thereby forming a sealed joint therewith; and in order to permit the removal of the tank from the head the outwardly extending side of the angle iron 17 is secured to the flange 16a by bolts 19.

The top of the cast steel head 16 is provided at its outer portion with a circular machined top surface to which is bolted the inwardly extending side of a circular rolled steel angle iron 20 with an intervening gasket between the parts. The lower end of a sheet steel cylinder 21 is welded to the upwardly extending side of the angle iron 20 for forming an oil tank for immersing the primary disconnecting contacts 4, 6 and 12 in oil when the parts are in their normal operative positions. The upper edge of the cylinder 21 engages a ring 22 of felt or other suitable material for forming a sealed joint between the top of the cylinder 21 and the plate 5, the latter being provided with downwardly extending rings 5a for retaining

the ring 22 in place when the tank 21 is moved downwardly. Partitions 23 of insulating material are secured at their upper ends to the plate 5 and extend downwardly for enclosing and insulating the sets of disconnecting contacts from each other. As shown in Fig. 2, the steel head 16 of the breaker is provided at one side with an integral outward extension 16b which forms a bearing housing for the main actuating shaft 24 of the breaker. This bearing is sealed for preventing the escape of gases and oil from the circuit breaker and may be of the form shown in Heiman Patent No. 2,290,560 granted July 21, 1942. A pair of arms 24a are fixed to the shaft 24 and extend within the breaker and are connected at their inner ends to the insulating rods 25 which carry at their lower ends respectively the bridging contacts 15 of the breaker. A downwardly extending arm 26 is fixed to the operating shaft 24 and the breaker is brought to closed position by the actuation of links 26a connected to the arm 26 and which are in turn actuated by a suitable solenoid operated circuit closing mechanism. Such mechanisms may be of various forms, such as shown in the said Heiman patent for example, and as they form no part of the present invention, are not particularly shown or described. The mechanism is supported by a cast frame 27 which is bolted to the vertically extending face 16c of the bearing housing. The trip coils of the breaker are covered by an enclosure 28 secured to the frame 27 and are adapted to raise the trip bar 29 upon the occurrence of an abnormal condition and turn the trip shaft 29a for automatically opening the breaker.

The frame 27 is provided with an upper horizontally extending portion 27a which forms a support for the enclosing frame 30 of the solenoid which actuates the mechanism for closing the breaker. The frame 27 and enclosing frame of the breaker also support another oil tank 31. This oil tank is provided with a pair of downwardly extending supporting legs 31a, the lower ends of which are bolted to the frame 27. The back portion of this tank is provided with another pair of downwardly extending supporting legs 31b extending in planes at right-angles to the plane of the legs 31a and are bolted to side lugs 30a formed on the rear side of the solenoid frame 30. The tank 31 is of rectangular form and its upper edge normally seats against sealing strips 22a of felt or other suitable material. These strips are retained in position in channels formed by metal strips 5b extending downwardly from the plate 5.

The oil tank 31 is for the purpose of immersing in oil the secondary disconnecting controlling contacts, not only when the parts are in their normal operating position but also when in the test position. These secondary disconnecting contacts are variously connected with the various controlling and trip relays and with other circuits as customary in apparatus of this character but as the particular connections and circuit relationships form no part of the present invention, they need not be particularly disclosed. However, all the inter-connections are protected within explosion proof conduits. The disconnects are enclosed by vertically extending insulating partitions 32. The fixed secondary disconnects are supported from the plate 5 as shown in Fig. 4 by means of the insulating partitions 32. A pair of through bolts 32a extend horizontally through the insulating partitions and carry a series of strips 33 of insulating ma-

terial spaced from each other and between the insulating partitions. On the edge of the strips 33 are mounted conducting strips 33a having bolts at their respective upper ends to which the leads from the various control circuits are connected. The movable secondary disconnects are supported by brackets 34 secured to the inside of the tank as shown in Fig. 2. A pair of through rods 34a support a series of vertically extending insulating partitions 35, as shown in Fig. 4. Between these partitions are a series of vertically extending strips 36 of insulating material. On the edges of the strips 36 are respectively mounted a series of yieldable contacts 36a which respectively engage the contacts 33a in the normal operating position and in the test position of the parts. The movable contacts 36a are respectively connected to the conductors leading to the control apparatus, as by means of the bolt and nut connection 36b at the lower ends of the contacts. Any desired number of such fixed and movable secondary contacts may be provided and another set of such cooperating contacts may be mounted in the right-hand portion of the tank if desired. Fig. 4 shows the tank 31 lowered to the test position.

It will be apparent from the foregoing that when the circuit breaker is in its uppermost position, as shown in Fig. 2, not only are the main circuit breaker contacts immersed in oil, but the primary disconnects 4, 6 and 12 and the secondary disconnects 33a and 36a are likewise immersed in oil. It follows that any arcing which may occur between any of these contacts will take place within oil baths and thereby prevent the possibility of any sparks or arcing taking place in the outside atmosphere which might be of an explosive character. The most severe arcing is, of course, likely to take place at the main circuit breaker contacts and special provision, as already explained, is made for cooling the hot gases before they are expelled therefrom to the outside atmosphere. Any suitable interlocking means may be provided so that the circuit breaker cannot be lowered without first opening the circuits at the main circuit breaker contacts. It follows from the foregoing description that when the circuit breaker is lowered, the oil tank 21 of the primary disconnects and the oil tank 31 of the secondary disconnects are lowered therewith, together with the movable contacts of all the disconnects. In moving to the test position, the movable contacts 12 will be separated from the stationary contacts 4 and 6; and the secondary disconnects will maintain engagement with the fixed contacts of the secondary disconnects, as shown in Fig. 4, which provides means for testing and checking operations when the breaker is in the test position. Further downward movement of the circuit breaker and the parts mounted on and supported thereby results in the circuits of the secondary disconnects being broken and all of the parts may then be removed as a unit for further inspection, adjustment or repair. It is apparent that by this unitary relationship of the circuit breaker to the movable primary and secondary disconnects and the oil tanks therefor, immersion of all such contacts in the oil filled tanks is insured when the unit is in the normal operating position; and when the unit is lowered to test position, the primary disconnects are separated under oil while the secondary disconnects are still maintained in contact under oil; and when the unit is lowered from the test position for removal as a

whole, the separation of the secondary disconnects occurs under oil in the oil tank 31.

The mechanism for raising and lowering the circuit breaker, together with its associated parts already described, is shown in Figs. 1 and 3. At each upper side of the movable unit is mounted a horizontally extending operating shaft 37 operatively connected at their rear ends by a chain 37a and sprocket wheels. The shafts 37 are supported in bearings carried by angle irons at each side of the frame of the cubicle. One of the shafts 37 is adapted to be operated by a crank 37b connected at the front end of its shaft and removable therefrom and adapted to be operated from the outside of the cubicle. Each of the shafts 37 is provided with a pair of bevel gears 37c which respectively engage four bevel gears 38a on the upper ends of four vertically extending screw shafts 38, two at each side of the cubicle. These shafts are journaled in bearings at their upper and lower ends provided by side portions 1a of the supporting main frame. On each of these vertical screw shafts 38 is positioned a traveling nut 38b. At each side of the cubicle is a saddle bar 39. Each of these bars has an extending lip 39a at its front and rear ends which seat respectively on top of the nuts 38b and are suitably connected thereto so that the nuts will not turn with their shafts 38. It is apparent that when the crank 37b is turned, the vertical screw shafts 38 will be rotated simultaneously and cause the nuts 38b to move upwardly or downwardly with a corresponding movement of the two side saddle bars 39.

At opposite sides of the circuit breaker head 16 and at the front and rear portions thereof, as shown in Fig. 3, are formed extensions 16d. These extensions are machined flat on their vertical sides and support vertically extending plates 16e which are bolted thereto and support the movable circuit breaker unit as a whole, including all of the parts already described as forming the removable unit. The bottom edge of each of the plates 16e is indented with inclined surfaces, as shown in Fig. 1 and respectively receive projections 39b with inclined sides on the top of the saddle bars 39 at the front and rear portions of each of them. It follows that the saddle bars 39 support the removable unit and in turn are supported by the nuts 38b and screw shafts 38. The inclined engaging surfaces between the projections 39b and the supports of the circuit breaker aid in properly positioning the breaker so that the movable contacts of the primary disconnects and of the secondary disconnects will engage their fixed contacts when the breaker is raised to its upper position.

Fig. 1 shows the removable unit in its uppermost position corresponding with the position of the parts shown in Fig. 2. When it is desired to lower the parts to the test position already referred to, the crank 37b is turned and as the nuts 38 move downwardly, the breaker and all parts movable therewith are lowered to the test position. A yieldable contact 40 is mounted on the rear of the circuit breaker head and in the normal operating position of the parts, it engages a vertically extending ground connection 40a mounted on the main frame of the cubicle. When the movable unit is lowered to the test position, this ground connection is maintained. When it is desired to remove the breaker and its associated parts from the cubicle, the saddle bars 39 are lowered by further turning of the crank 37b. A truck 41 may be introduced into the cubicle at

the floor level to receive the removable unit when lowered. When the supporting flange 18a engages the truck, the lowering of the saddle bars 39 may be continued so as to release the projections 39b from the plates 16e, after which the truck and movable unit may be removed from the cubicle for inspection or repair. In replacing the movable unit within the cubicle and in bringing the parts to the test and operative positions, the reverse manner of operation is followed.

Although a particular embodiment of the invention has been disclosed, various modifications may be made for adaptation to particular conditions without departing from the scope of the invention.

I claim:

1. The combination of a main supporting frame, a circuit breaker having supports on opposite sides thereof, disconnecting switches having fixed contacts supported by said frame and having movable contacts carried by and movable with said circuit breaker, raising and lowering mechanism for the breaker mounted on said frame and having a cross-support on each side of the breaker for removably engaging said supports on the opposite sides of the breaker whereby the breaker may be raised and lowered by said mechanism and said cross-supports lowered from said side supports of the breaker when the breaker has attained its lowest position, said side supports of the breaker and said cross-supports having inclined engaging surfaces for positioning the breaker and said movable contacts in relation to the said fixed contacts of the disconnecting switches for facilitating the engagement of the contacts of said switches when the breaker is raised to its upper position.

2. A circuit breaker comprising an enclosing head having an outwardly extending circular flange, a circular angle shaped member capable of being deflected having an outwardly extending portion removably secured to said flange and a downwardly extending portion, a cylindrical oil container secured with a sealed joint to said downwardly extending portion, and the faces of said flange and of said outwardly extending portion directly engaging each other for permitting the escape of gases between said faces under pressure from within the breaker for cooling the gases in their passage between said faces to the outside atmosphere, said outwardly extending portion being capable of slight deflection for permitting the escape of the gases.

3. The combination of an oil circuit breaker, a plurality of primary disconnecting fixed contacts above said circuit breaker, a plurality of primary disconnecting movable contacts supported by and movable with the circuit breaker, said movable contacts engaging said fixed contacts when the circuit breaker is in its upper position, a common oil container for immersing all of said contacts in a common oil bath and supported by and movable downwardly with said circuit breaker, and a fixed support for said fixed contacts, also forming a cover for said oil container when the breaker is in its upper position.

4. The combination of an oil circuit breaker having an enclosing head and an oil tank removable from said head, a plurality of primary disconnecting fixed contacts above said head, a plurality of primary disconnecting movable contacts supported by and movable with the circuit breaker, said movable contacts engaging said fixed contacts when the breaker is in its upper position, and a common oil container for immers-

ing all of said contacts in a common oil bath and supported by and movable downwardly with said head, the said head forming the bottom portion of said container.

5. The combination of an oil circuit breaker, a series of fixed secondary disconnecting control contacts, a series of movable secondary disconnecting control contacts adapted to engage said fixed contacts when the breaker is in its upper position, and a common oil container for immersing all of said contacts in a common oil bath and supported by and movable downwardly with said circuit breaker, said movable secondary contacts being supported by and movable with said container.

6. The combination of an oil circuit breaker having an enclosing head and an oil tank removable from said head, mechanism for controlling the closing and opening of the breaker, a supporting frame for said mechanism directly connected to and supported by said head, a series of fixed secondary disconnecting control contacts, a series of movable secondary disconnecting control contacts adapted to engage said fixed contacts when the breaker is in its upper position, and a common oil container for immersing all of said contacts in a common oil bath and supported by said frame and movable downwardly with said breaker and frame, said movable secondary contacts being supported by and movable with said container.

7. The combination of an oil circuit breaker, a plurality of primary disconnecting fixed contacts above said circuit breaker, a plurality of primary disconnecting movable contacts supported by and movable with the circuit breaker, said movable contacts engaging said fixed contacts when the breaker is in its upper position, a common oil container for immersing all of said contacts in a common oil bath and supported by and movable downwardly with said circuit breaker, a series of fixed secondary disconnecting control contacts, a series of movable secondary disconnecting control contacts adapted to engage said fixed secondary contacts when the breaker is in its upper position, and a common oil container for immersing all of said secondary contacts in a common oil bath and supported by and movable downwardly with said circuit breaker, said movable secondary contacts being supported by and movable with said container.

8. The combination of an oil circuit breaker having an enclosing head and an oil tank removable from said head, a plurality of primary disconnecting fixed contacts above said head, a plurality of primary disconnecting movable contacts supported by and movable with the circuit breaker, said movable contacts engaging said fixed contacts when the breaker is in its upper position, a common oil container for immersing all of said contacts in a common oil bath and supported by and movable downwardly with said head, the said head forming the bottom portion of said container, a series of fixed secondary disconnecting control contacts, a series of movable secondary disconnecting control contacts adapted to engage said fixed secondary contacts when the breaker is in its upper position, and a common oil container for immersing all of said secondary contacts in a common oil bath and supported by and movable downwardly with said circuit breaker, said movable secondary contacts being supported by and movable with said container.

9. The combination of a main frame, an oil circuit breaker supported by said frame, a plurality of primary disconnecting fixed contacts

above said circuit breaker, a plurality of primary disconnecting movable contacts supported by and movable with the circuit breaker, said movable contacts engaging said fixed contacts when the breaker is in its upper position, bushings for insulating and supporting said fixed contacts, a fixed plate mounted on said frame for supporting said bushings, and a common oil container for immersing all of said contacts in a common oil bath and supported by and movable downwardly with said circuit breaker, said plate forming the top cover for said oil container when the breaker is in its upper position.

10. The combination of a main frame, a circuit breaker supported by said main frame, a plurality of primary disconnecting fixed contacts above said circuit breaker, a plurality of primary disconnecting movable contacts supported by and movable with the circuit breaker, said movable contacts engaging said fixed contacts when the breaker is in its upper position, bushings for insulating and supporting said fixed contacts, a

fixed plate mounted on said frame for supporting said bushings, a series of fixed secondary disconnecting control contacts, a series of movable secondary disconnecting control contacts adapted to engage said fixed secondary contacts when the breaker is in its upper position, a common oil container for immersing all of said primary disconnecting contacts in a common oil bath and supported by and movable downwardly with said circuit breaker, said plate forming the top cover for said oil container when the breaker is in its upper position, and a common oil container for immersing all of said secondary disconnecting control contacts in a common oil bath and supported by and movable downwardly with said circuit breaker, said movable secondary contacts being supported by and movable with said last named container, said plate also serving as the cover of said last named oil container when the breaker is in its upper position.

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