

Dec. 29, 1953

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2,664,485

HIGH-VOLTAGE CIRCUIT BREAKER

Original Filed Jan. 11, 1947

4 Sheets-Sheet 1

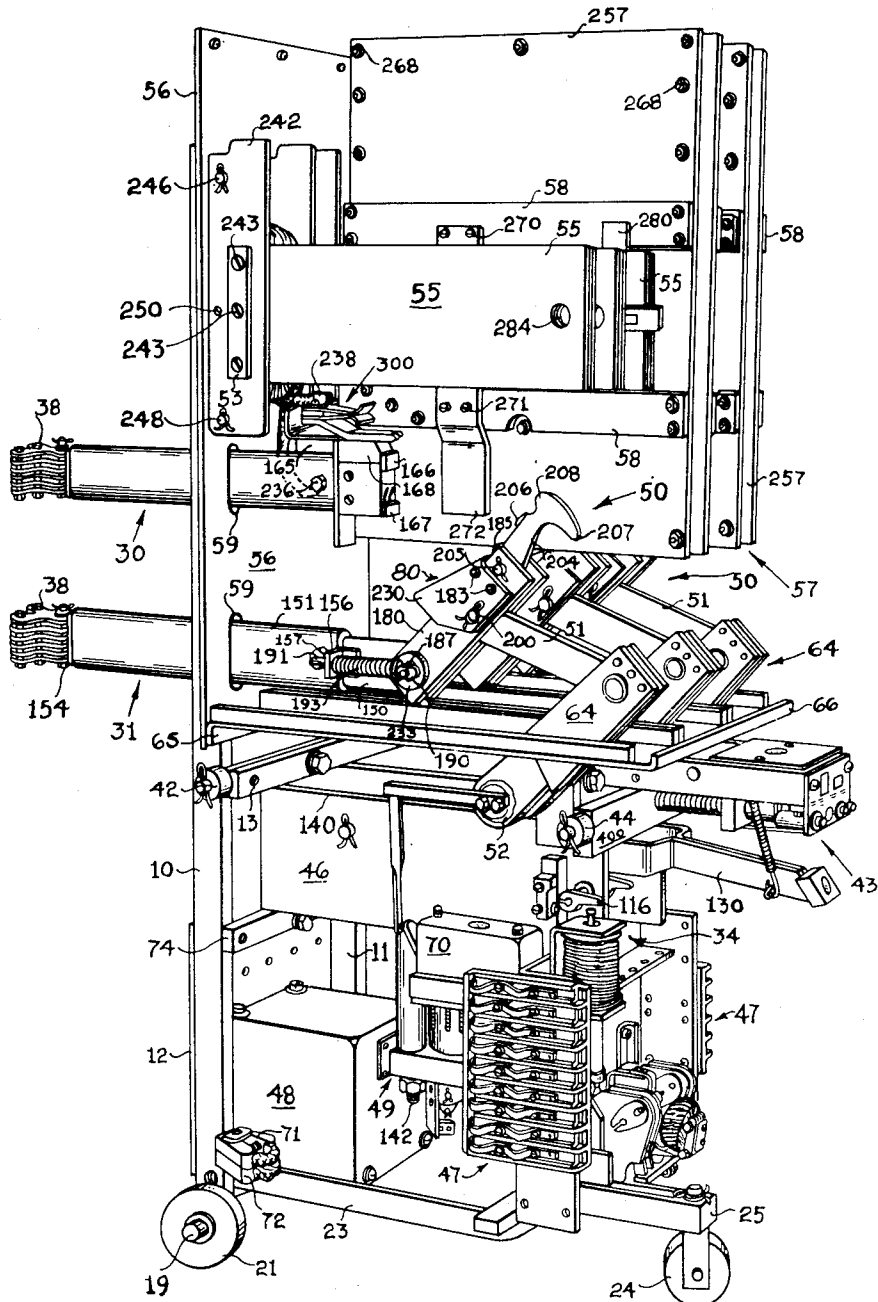


Fig. 1

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4 Sheets-Sheet 2

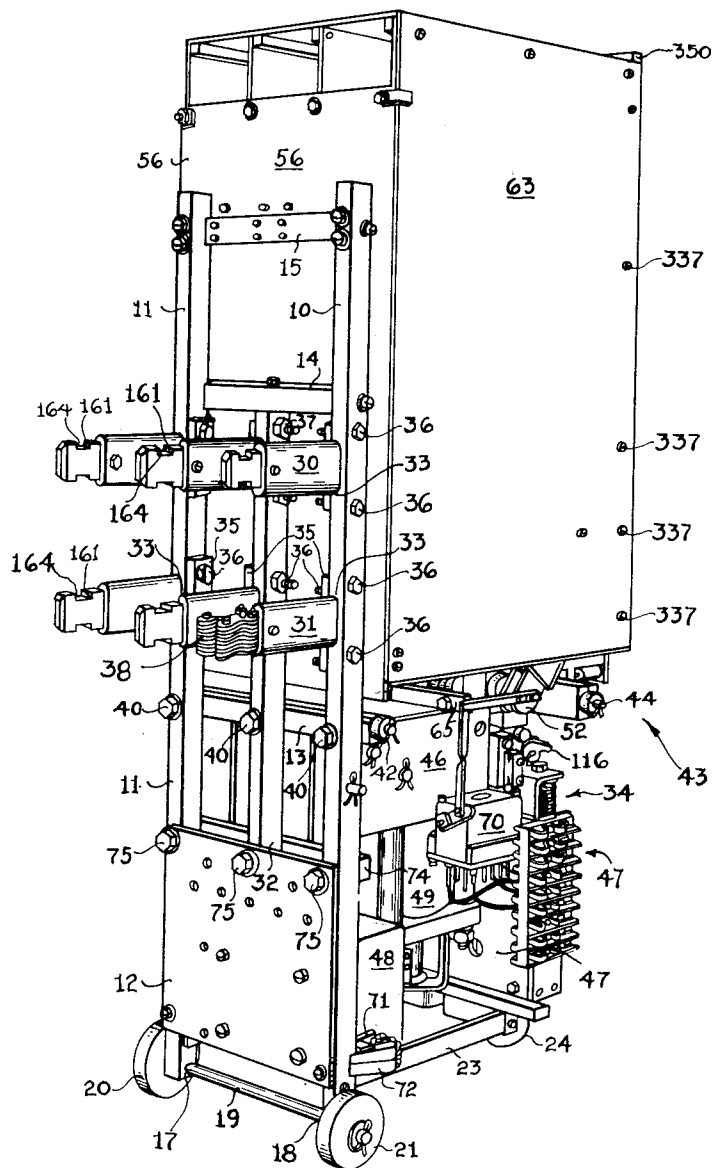


Fig. 2

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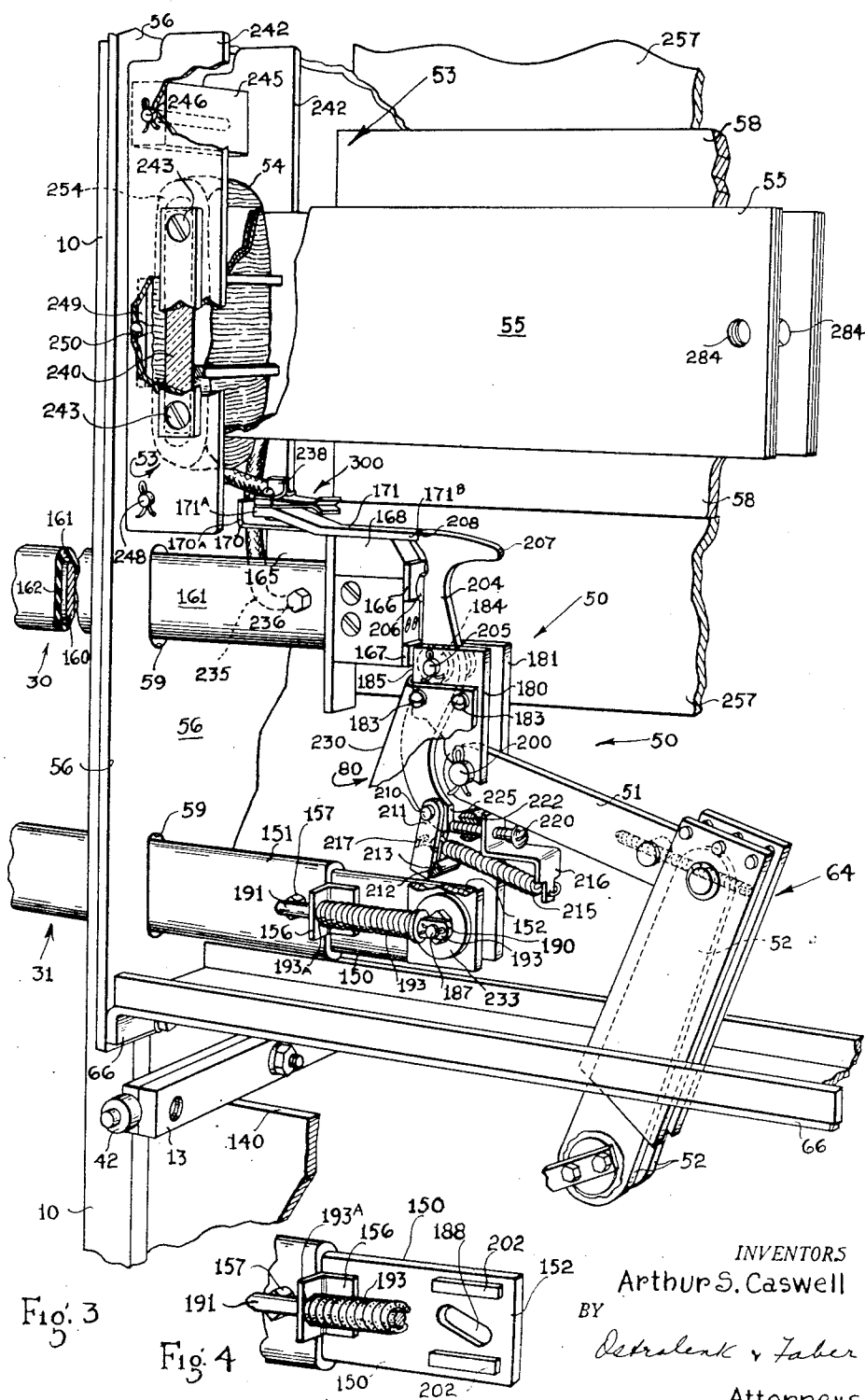
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4 Sheets-Sheet 3



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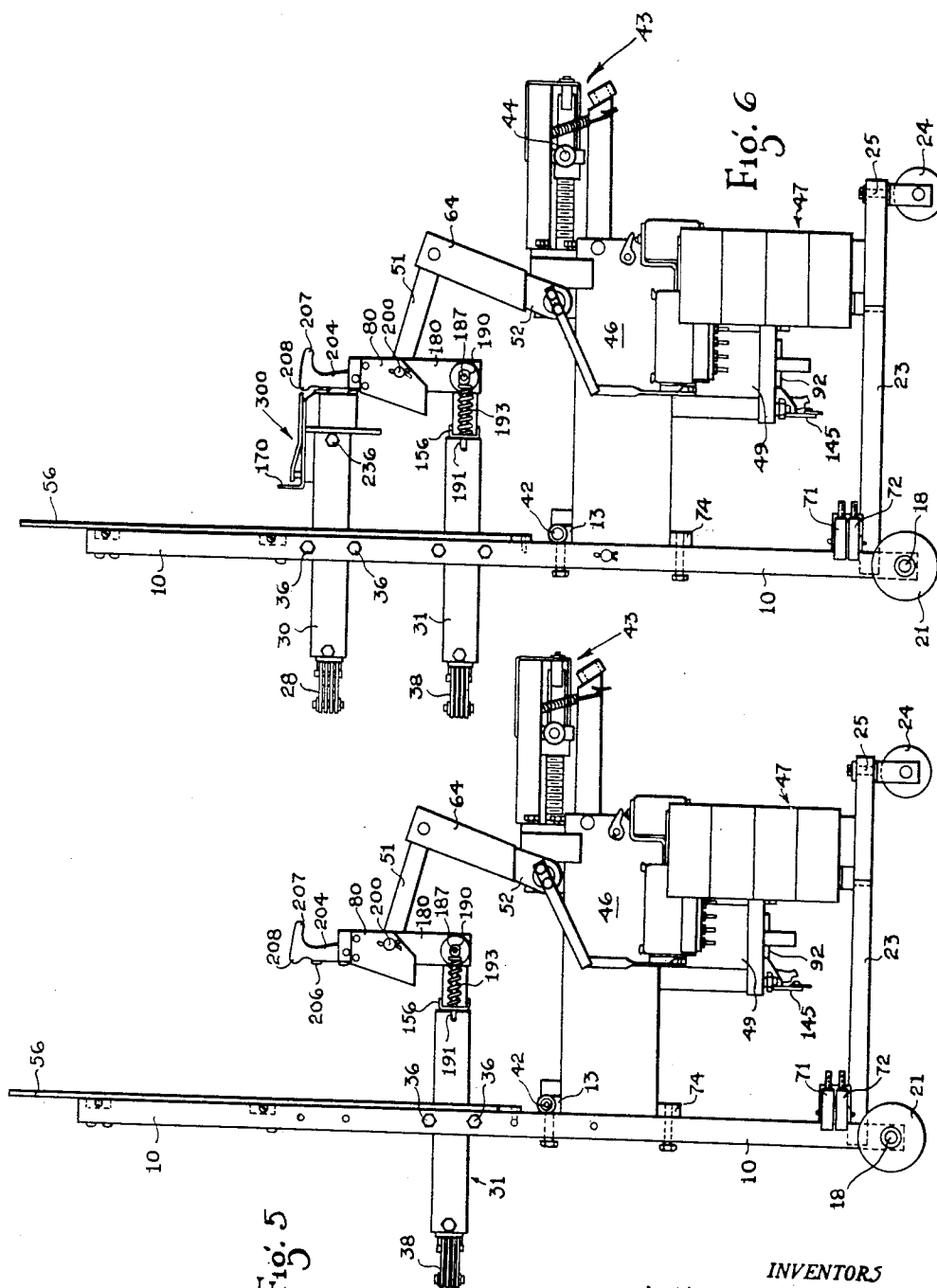


Fig. 5

Fig. 6

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UNITED STATES PATENT OFFICE

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HIGH-VOLTAGE CIRCUIT BREAKER

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Original application January 11, 1947, Serial No.
721,648, now Patent No. 2,613,299, dated Octo-
ber 7, 1952. Divided and this application Au-
gust 26, 1948, Serial No. 46,279

1 Claim. (Cl. 200-168)

1

My present invention, which is a division of U. S. Patent No. 2,613,299 issued October 7, 1952, relates to high voltage high capacity circuit breakers, and more particularly to circuit breakers having an interrupting rating of 50,000 kva. and better in any voltage range between 2300 and 5000 volts and at current ratings of 600 and 1200 amperes.

Essentially my invention is directed to the production of high voltage high capacity air break switchgear in such a manner as to provide the increased interrupting capacity required by means of the simplest elements which are manufactured and assembled by mass production methods in the most economical way.

In order to achieve this result, it has been necessary to design my novel circuit breaker so that the various elements thereof may be manufactured in individual relatively inexpensive sub-assemblies which could then be assembled together into a single unitary circuit breaker by a minimum number of operations.

My novel circuit breaker also by reason of its simplicity of design and economy of operation lends itself to simplified and economical construction, and thus overcomes one of the primary objections to air-break circuit breakers of this rating.

Air circuit breakers of high kva. interrupting capacity have heretofore been very expensive in design and construction utilizing castings and welded parts and have usually been custom-built for a particular job rather than made in a particular grouping or line for particular interrupting capacities.

My novel construction fabricated entirely from sheet or bar stock into many sub-assemblies and using no castings lends itself to mass production manufacturing methods which together with simplicity in design reduce the cost of the high voltage high capacity breaker to a point where its cost compares favorably and at times is even less than many low voltage relatively low capacity circuit breakers.

The upper back connection stud and stationary contact elements constitute a single unit sub-assembly which may readily be mounted on and removed from the back panel.

The lower back connection stud and the movable contact arm with its link each constitute a single unitary sub-assembly which may also as above pointed out be readily mounted on and removed from the circuit breakers. Both the upper and lower back connection members have secured thereto the back disconnect contacts which are part of the same assembly.

2

The mechanism assembly which includes all of the operating members constitutes a single sub-assembly which may readily be mounted on the circuit breaker panel and disconnected therefrom and which may be connected to the movable contact arm by passing a single pin through the connecting link.

The other individual assemblies which may be manufactured separately and individually mounted on and removed from the circuit breaker include the racking and indicator assembly, the control panel assembly and the trip unit assembly. Other assemblies and relays may be added or removed as desired in order to complete the individual circuit breaker.

Outstanding features of my novel circuit breaker include:

1. The simplicity of construction in the vicinity of the contact. Bearings and other cooperating parts required for proper contact pressure are located at or near the contact pivot point. This reduces the momentum of the moving parts resulting in faster opening and lighter duty on the bumper. These parts are also less exposed to make possible the construction of a narrower arc chute.

2. Reduction in the difference of impedance between the main and arc contact current paths sufficiently eliminated the necessity for a shunt contact. The arcing contact alone affords a maximum of protection for the main contact.

3. My novel device makes possible the complete elimination of pigtaills with all of the attendant difficulties involved in the construction operation and maintenance of pigtaills.

4. My novel construction also permits the elimination of a return current loop required to produce a blow-on arc contact. This current loop would not only increase the impedance between the arcing and main contacts but tends to blow ionized gas down to the mains making possible a restrike to the mains. A small insulation barrier has been used to prevent just this condition on some breaker designs. My novel device makes such an insulation barrier unnecessary.

Accordingly an object of my invention is the construction of a high capacity high voltage circuit breaker, capable of interrupting arcs of 50,000 kva. capacity or even better, and economical in design and construction, capable of unit sub-assembly manufacturing operation; and so reduced in cost that its price may compare favorably and at times even be lower than that of many lower capacity lower voltage circuit breakers on the market today.

In actual practice, the commercial circuit breaker hereinafter described, which was designed for 50,000 kva. interrupting capacity has been subjected to four successive tests at 63,000 kva. interrupting capacity although standard practice requires only two successive tests at the full rate interrupting capacity.

The foregoing and many other objects of my invention will become apparent from the following description of the drawings in which

Figure 1 is a side view in perspective, partly broken away showing my novel circuit breaker assembled and mounted on a truck.

Figure 2 is a side, back view, in perspective, showing my novel circuit breaker mounted on a truck with an interphase barrier in position.

Figure 3 is an enlarged side front view in perspective partially broken away showing the lower terminal assembly, upper terminal assembly, the blow-out coil assembly and the movable contact bridge assembly.

Figure 4 is a detail of the construction of the front end of lower terminal of any novel circuit breaker.

Figures 5 and 6 are schematic views illustrating successive steps in assembling my novel circuit breaker.

Referring now to Figures 1, 2 and 3, my novel circuit breaker is shown preferably mounted on a movable truck. The movable truck comprises a back main supporting structure which includes the vertical support members 10 and 11 connected together and interbraced at the lower end by the masonite panel 12 and at the central and upper portion by the cross-bars 13, 14 and 15 which are connected as shown, in any appropriate manner, as for instance by bolts and nuts to the vertical members 10 and 11. The lower ends of the vertical members 10 and 11 are provided with bearings 17 and 18 for the shaft 19 which carries the rear wheels 20 and 21 of the truck. The vertical members 10 and 11 together with the cross bracing elements above described and the wheels 20 and 21 constitute a single unitary member of assembly (as shown in Figure 5).

Certain of the assemblies are standard and require no specific discussion here. Thus, the control panel assembly 47 and the trip unit assembly 48 may be substantially standard units which require no specific description. Also, the control switch contacts indicated generally at 70 of Figures 1 and 2 and the grounding contacts 71, 72 of Figures 1 and 2 may be standard units. The essential elements as above pointed out with respect to these units is the unit assembly arrangement which is possible with the construction herein shown.

The rear end of the operating mechanism assembly 46 is supported on the cross bar 74 which is held by the bolts 75, 75 across the top of the lower panel 12. Cross bar 74 also provides means for supporting additional assemblies.

The individual unit assemblies facilitate storage of parts preparatory to final assembly and thus make it possible to fill orders quickly.

Thus the first sub-assembly which consists of the back panel and the back wheels 20 and 21 is essentially a simple flat member which may readily be stored and does not take up any substantial amount of space (see also Figure 5 as well as Figures 1 and 2).

Heretofore, the difficulty encountered in pre-manufacture of sub-assemblies in anticipation of future orders resided in the fact that the main frame of the circuit breaker or other switch gear

usually was as big as the circuit breaker itself, so that the manufacture and especially the storage of the main frame presented the same problem as the storing of an entire circuit breaker. No real economy was effected by pre-manufacture of the main frame since the entire circuit breaker could be stored just as readily.

By means of my novel device, the back panel and the rear wheels of the truck which constitute a single flat structure may readily be stored awaiting specific orders for assembly of specific circuit breakers.

The truck structure is completed by means of a lower or bottom platform 23, which carries a front wheel 24 in the front swivel 25 (Figures 6, 1 and 2). The bottom platform 23 is secured at the rear end to the lower end of the vertical members 10 and 11 above the bearings 17 and 18 for the rear wheel. The bottom platform 23 in connection with the back panel from the vertical supporting members 10 and 11 and their interbracing structure and taken together with the rear wheels 20 and 21 and the front swivel wheel 24 comprises the truck or mounting for the circuit breaker. Thus the bottom platform 23 and the front swivel wheel 24 constitute a single sub-assembly which may readily be stored without requiring any additional space and which may readily be attached by two screws to the lower end of the vertical members 10 and 11.

This type of unitary sub-assembly construction which may readily be interconnected with other elements in order to make a complete truck, facilitates modification and variation of sub-assemblies in order to meet the specific orders.

Thus in the event various control elements must be multiplied to a substantial extent in the final circuit breaker thus requiring perhaps a custom built lower platform 23, this lower platform 23 may be built to the unique specifications of the customer and may then be combined with the standard back panel construction which is kept in stock. However, the entire truck construction including the first and second sub-assemblies above described are built in full anticipation of all requirements to which the particular circuit breaker may be put, so that particular custom made back or bottom portions of a truck will be required only in exceptional cases. The upper terminal assembly 30, and the lower terminal assembly 31 for each of the three poles is formed from a single bar of copper of rectangular cross section appropriately insulated by phenolic insulation as described more specifically hereinafter in connection with Figure 3. The terminal assembly elements 30, 31 are carried by the vertical supports 10 and 11, as well as the central vertical support 32 which is carried between the lower masonite plate 12, and the upper cross bar 14, as shown in Figure 2.

Each of the vertical members 10, 11 and 32 is recessed at 33, 33 to receive the terminal members and accurately position the same. Each of the terminal members is provided with a side plate or flange 35 hereinafter more specifically described in connection with Figure 2.

Each of the vertical reinforcements 10, 11 and 32 is a rectangular steel member, so that while the recesses 33, 33 are cut out in the vertical reinforcement they are incised only in the portion of the rectangular steel member which is normal to the back panel 56. The legs of each of the rectangular members 10, 11 and 32 carry the bolts 36, 36 which engage the flange members 35 of the terminal element. Thus it will be seen that two

bolts or screws 36 are all that are necessary to secure each of the terminal elements in place, these bolts being locked in secured position by the nut 37 as shown in Figure 2.

Each of the upper and lower terminal assembly members 30 and 31 also carry the spring biased disconnect contact elements 32, 33 also herein-after more specifically described in connection with Figures 1 and 2, but shown also in Patent Number 2,029,028. The intermediate cross bar 13, which is secured to the vertical members 10, 11 and 32 by the bolts 40, also carries at its outer end the wheels 42 on an appropriate shaft extension thereof, the said wheels 42 cooperating with appropriate tracks in the compartment to guide the truck into and out of the compartment properly.

The racking and indicator assembly shown generally at 43 of Figures 1 and 2 also carries the front wheels 44, 44 to ride on the guide tracks of the compartment in which the circuit breaker is housed.

The racking and indicator assembly which is more specifically described in U. S. Patent No. 2,613,299 issued October 7, 1952, is supported from the mechanism assembly. The control panel assembly 47 is supported by the lower platform 23 of the circuit breaker as is also the trip unit assembly 48. The solenoid closing mechanism 49 is a part of the operating mechanism assembly 46.

The movable contact assembly shown generally at 50 of Figures 1 and 3 is connected at its lower end to the lower terminal assembly 31 in the manner hereinafter described, and is provided with a link 51 which is connected to the contact operating arms 52 projecting up from the operating mechanism assembly 46. The movable contact bridge assembly which of course has as many poles as there are upper and lower terminal assemblies, three in the particular instance shown, is provided with contact elements hereinafter more particularly described in connection with Figure 3.

The blow out coil assembly 53 which includes the coil 54 of Figure 3 and the laminated blow out iron legs 55, is mounted on the upper insulating back panel 56 also across the bars 15 and 14 and the upper portion of vertical supporting members 10 and 11 and is supported thereby.

It is spaced from the bars 10, 11, 32, 14, 15 by the upper insulating back panel 56 which panel is secured across the bars 10, 11 and 32 as shown in Figures 2 and 3. Appropriate openings 59, 59 are provided in the panel 56 to permit the terminal members 30 and 31 to project therethrough in a manner shown in Figures 1 and 3.

The arc chute assembly 57 is supported by the blow out assembly 53 and particularly by the laminated legs 55 of the blow out iron which ride between the bracing bars 53, 58 on each side of the arc chute is shown in Figure 1 and as will be more specifically described hereinafter in connection with Figure 1.

Lower terminal assembly

The lower terminal assembly 31 shown in Figures 1, 2 and 3, comprises a bar of copper 150 insulated by an oblong Bakelite tube 151 with a conductive inner lining into which it has been pressed. The front end 152 supports the movable contact bridge assembly 50 in a manner hereinafter specifically described, while the main disconnect contacts 38 are secured to the rear end 154.

The lower terminal 31 has the side flanges 156, 156 secured thereto in any suitable manner, to cooperate with the movable contact arm as shown in Figure 3. In the usual procedure for insulating a terminal bar such as that shown in Figures 1, 2 and 3, phenolic insulation material is wrapped around the bar and tightly pressed thereon. This is a complicated process which must be performed on special machinery and by those having special skills in the field.

In the present construction, instead of wrapping phenolic insulation tightly around the bar 150, the flat tube 151 is used, said tube being provided with a conductive lining 152. This tube is placed over the bar 150 and then pressed into tight engagement with the bar 150 to provide the insulation cover therefor.

The principal reason for wrapping the insulation in the prior art was that no minute air pockets could be permitted since at high voltages these would result in Corona discharge, causing progressive dielectric deterioration and thereby resulting in breakdown of the insulation. Consequently great care was required in the wrapping of the insulation.

I have discovered that by using a sleeve of insulating material and making the inner surface of the sleeve conductive, the sleeve may simply be pressed down around the tube to conform with the contour of the bar and provide a completely engaging surface to surface contact thus according any deleterious effects resulting from any minute air pockets that may remain. Thus where the prior cost of wrapping such bars was in the neighborhood of \$12.00 per bar and it was necessary to send the bar out to be wrapped by special machinery, my invention makes possible the insulation of the bar at the circuit breaker plant at a cost of about \$1.50.

Upper terminal assembly

The upper terminal assembly 30 shown in Figures 1, 2 and 3 also comprises a bar 160 of copper having an insulating sleeve 161 mounted thereover in the same manner as previously described in connection with the lower terminal assembly of Figure 3.

The rear end of the bar 160 has the conformation 164 to receive and hold the main disconnect contacts 38 shown in Figures 1 and 2. The front end of bar 160 has secured thereto the stationary main contact 167 and the stationary arcing contact 166 (Figure 3). The upper end of the front portion of bar 160 has secured thereto the insulating blocks 165 and 163 (Figures 1 and 3), which have secured thereto the insulating plate 170 having the upper slotted extension 170a. Connector 171 is secured in any suitable manner to the insulating blocks 165 and 163 but is insulated from the contact bar 160 and the arcing contact 166 and stationary contact 167.

Connector 171 has a cut away portion at its front end between which, and spaced from either edge, the forward end 203 of the movable contact arm 204 comes to rest when the contacts are in engagement as will be described hereafter.

The position of the arcing tips 206 above the main contacts 167 forms an upward loop in the circuit which tends to initiate a blow out action to start the arc upward when drawn.

In order to protect the lower terminal structure against any possible defect in the arc chute or blow-out mechanism which would tend to drive an arc down, an insulating shield 230 is provided secured to the screws 183 and flared out

to protect the uninsulated portion of the lower terminal bar 156.

Spring 215 ensures that the movable arcing contact will move into engagement with the stationary arcing contact as the contact arm begins to open and before the main contact separates. The arcing contacts will then stay in engagement for a substantial portion of the opening movement depending on the setting of screw 220 (Figure 3).

Since many variations and modifications of my invention should now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosure herein contained, but only by the appended claim.

I claim:

A sub-assembly for circuit breakers comprising a plurality of metallic vertical bars, metallic cross-bracing means for said bars, terminal bars comprising a substantially flat conductor and insulator cover having the general configuration of said conductor and constructed to be slipped over the conductor as a sleeve, said insulator cover being compressible to conform to the shape of said conductor and tightly adhere to the surface of said conductor, said insulator cover having its inner surface lined with conducting material which is in surface-to-surface engagement with

said conducting bar for preventing the formation of minute air pockets, said insulator cover being of phenolic material, said vertical bars each having a recess for supporting said terminal bars, a side plate engaging said terminal bars at said recess; securing means for securing said side plates to said vertical bars for positioning said terminal bars in said recess; and a back flat insulating panel secured to the framework formed by said bars and cross-bracing means.

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