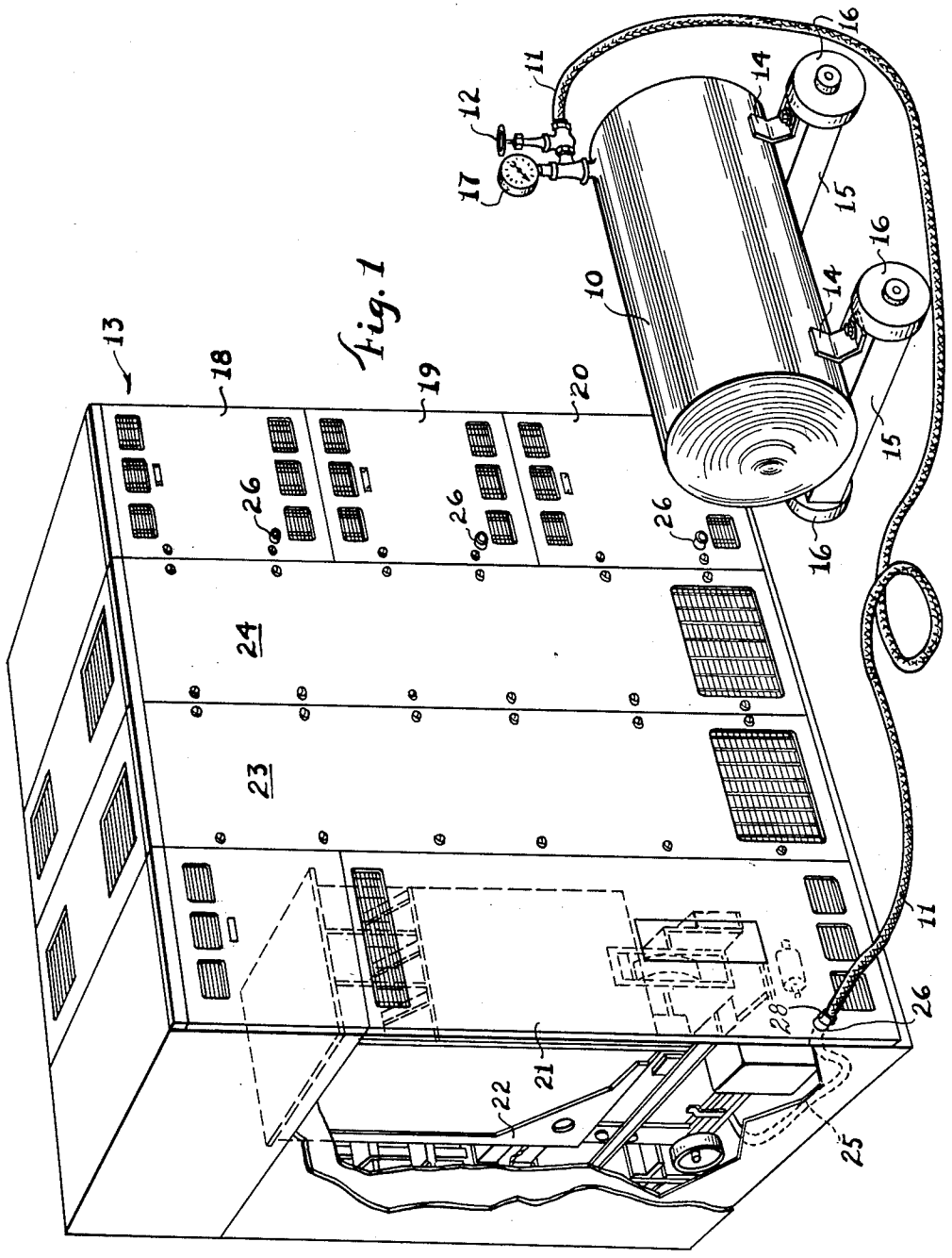
Nov. 24, 1953 J. D. WOOD 2,660,635

AIR OPERATED CIRCUIT BREAKER

Filed Dec. 8, 1948

5 Sheets-Sheet 1



INVENTOR.
Joseph D. Wood
BY
Ostrolenk & Faber
ATTORNEYS.

Nov. 24, 1953 J. D. WOOD 2,660,635

AIR OPERATED CIRCUIT BREAKER

Filed Dec. 8, 1948

5 Sheets-Sheet 2

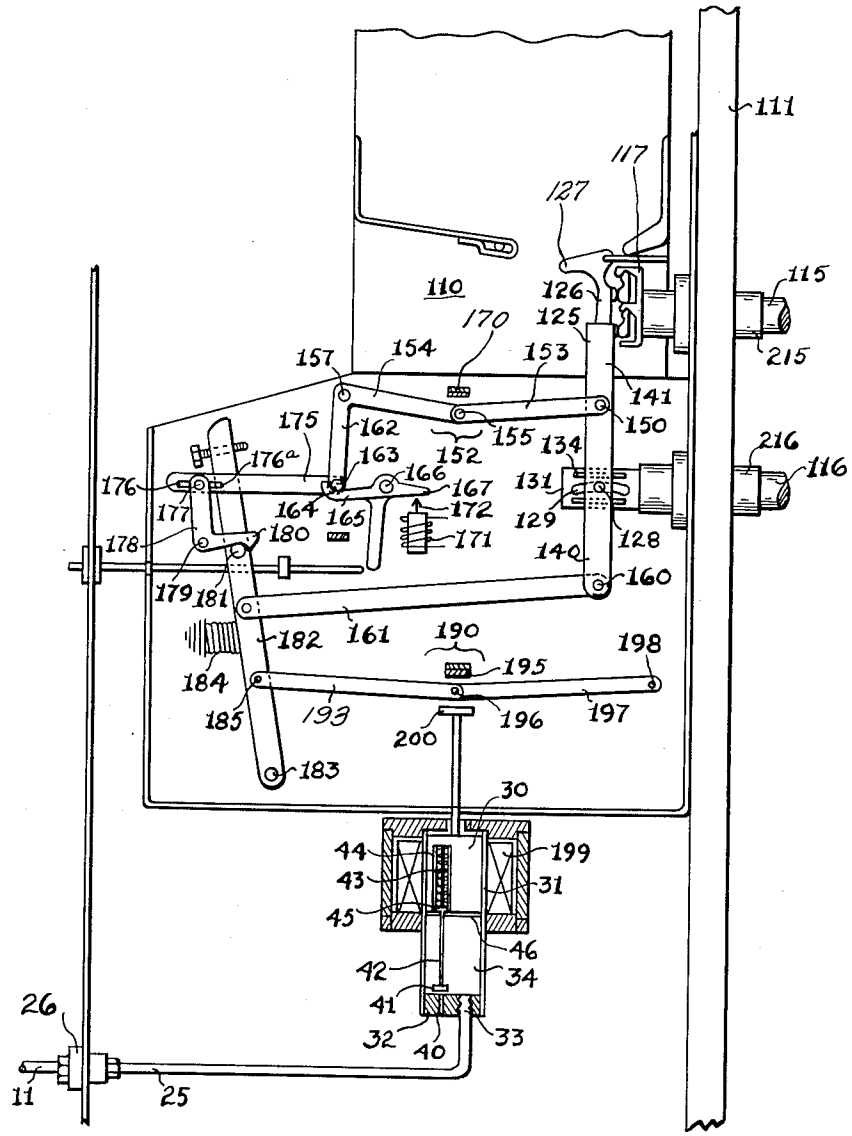


Fig. 2

INVENTOR.

BY Joseph D. Wood

Ostrolenk & Faber

ATTORNEYS.

Nov. 24, 1953 J. D. WOOD 2,660,635

AIR OPERATED CIRCUIT BREAKER

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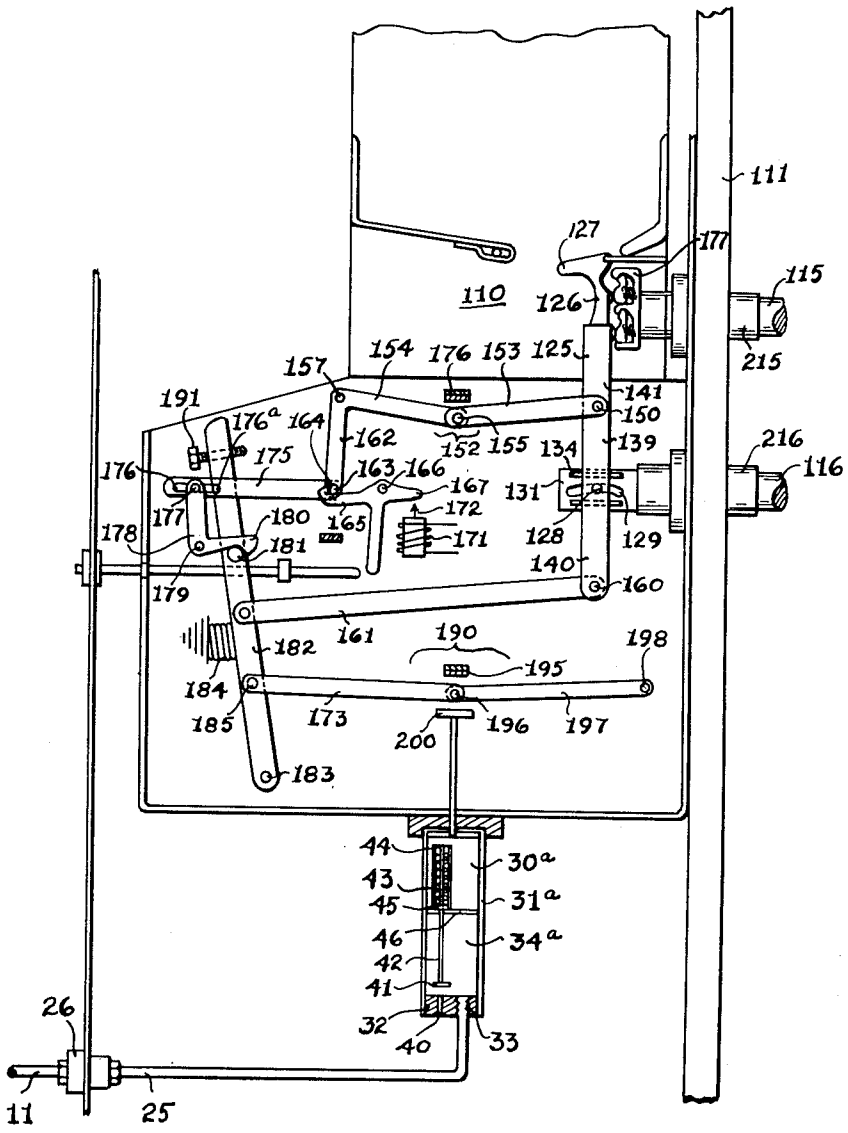


Fig. 3

INVENTOR.
BY Joseph D. Wood
Ostrolenk & Faber
ATTORNEYS.

Nov. 24, 1953 J. D. WOOD 2,660,635

AIR OPERATED CIRCUIT BREAKER

Filed Dec. 8, 1948 5 Sheets-Sheet 4

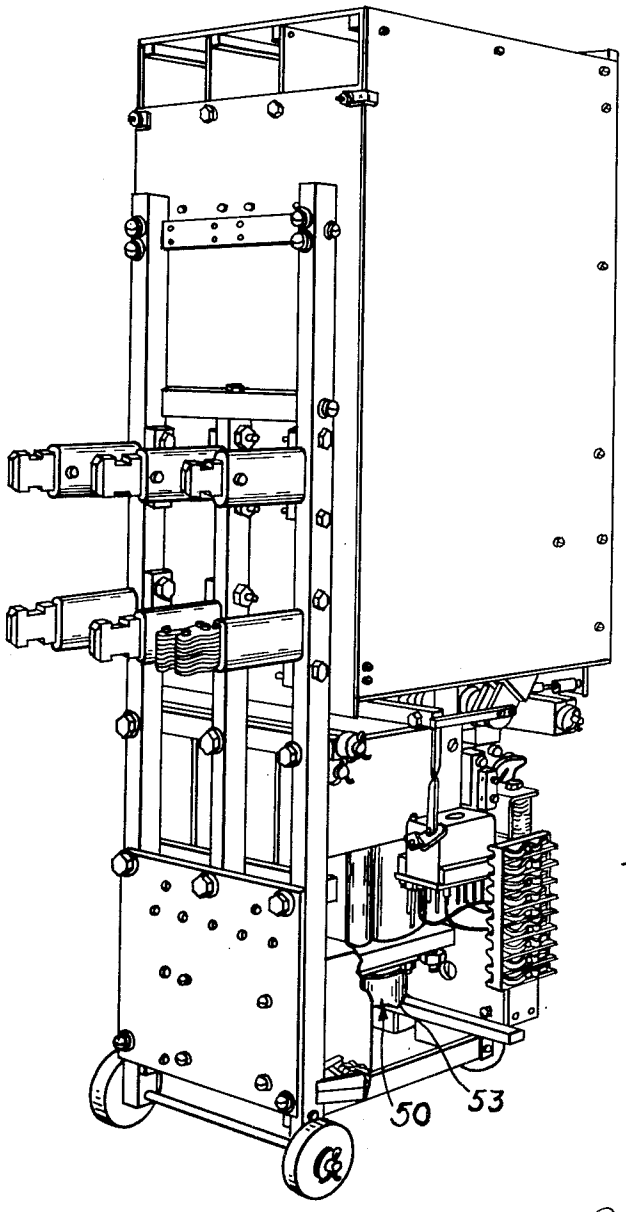


Fig. 4

INVENTOR.
BY Joseph D Wood
Ostrolenk & Faber
Attorneys

Nov. 24, 1953 J. D. WOOD 2,660,635

AIR OPERATED CIRCUIT BREAKER

Filed Dec. 8, 1948 5 Sheets-Sheet 5

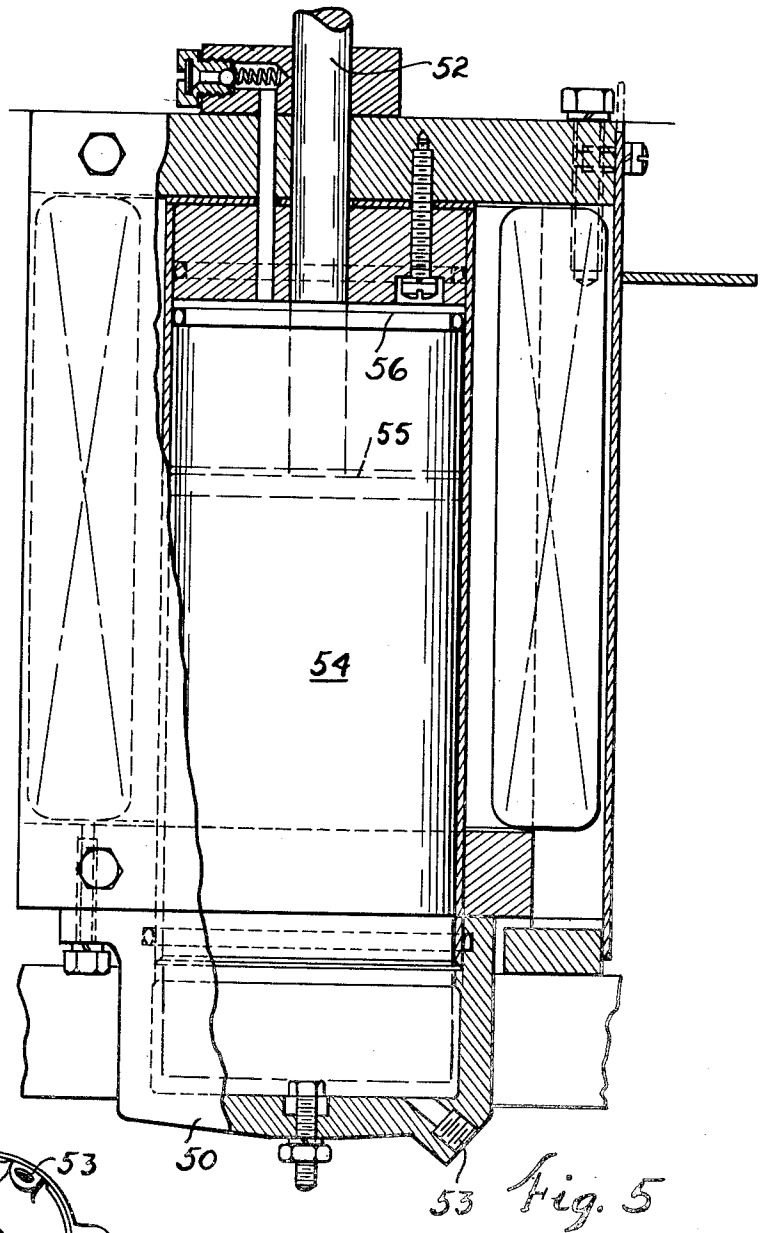


Fig. 5

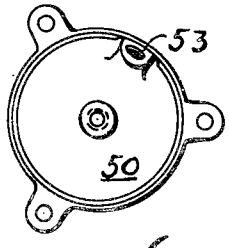


Fig. 6

INVENTOR.
Joseph D. Wood
BY
Ostrander & Faber
ATTORNEYS.

Patented Nov. 24, 1953

2,660,635

UNITED STATES PATENT OFFICE

2,660,635

AIR OPERATED CIRCUIT BREAKER

Joseph D. Wood, Strafford Village, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Application December 8, 1948, Serial No. 64,085

4 Claims. (Cl. 200—81.5)

1

My present invention relates to circuit breakers and more particularly to a portable air operating system for use in connection with a circuit breaker and especially for use in connection with a multiplicity of circuit breakers wherein the portable air operating system may be attached and detached to the particular circuit breaker which it is desired to operate.

Primarily, my invention is directed to auxiliary means to close circuit breakers if for any reason the mechanical or electrical operating means for closing the circuit breaker fails to operate.

If for any reason in the case of solenoid closing breakers the solenoid should fail to operate, it is desirable and in many cases necessary to eliminate the need for an operator to close the breaker manually against a possible short circuit.

My invention contemplates extending the guide tube for the solenoid plunger or armature downwardly in order to form a cylinder in which the solenoid plunger or armature comprises the piston.

A connection is made to the end of the guide tube through a convenient tube or pipe to the opposite end of which a compressed air source may readily be attached when desired. Admission of compressed air into the guide tube will force the solenoid plunger up, thereby operating the circuit breaker to the closed position.

Accordingly, the primary object of my invention is the provision of novel air operating means for a circuit breaker.

Another object of my invention is the provision of auxiliary air operating means for a circuit breaker.

Another object of my invention is the provision of auxiliary operating means for a circuit breaker utilizing the solenoid armature as a piston and its guide tube as a cylinder in an auxiliary compressed air system.

Another object of my invention is the provision of novel air operating means for a circuit breaker which may be made portable and movable from circuit breaker to circuit breaker in a switchboard or a multiplicity of switchboards.

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

Figure 1 is a view in perspective showing the manner of use of my novel portable compressed air system.

Figure 2 is a schematic view showing the operation of my novel auxiliary compressed air operating system in connection with a specific solenoid operating circuit breaker.

2

Figure 3 is a schematic view showing the utilization of my novel compressed air operating system as the primary operator for a circuit breaker.

Figure 4 is a view in perspective of the type of circuit breaker used in Figure 1.

Figure 5 is a detailed vertical cross-section of the solenoid closing mechanism of the circuit breaker of Figure 4.

Figure 6 is a bottom view of the solenoid housing cover of Figure 5.

Referring first to Figure 1, I have here shown a tank 10 having a supply of compressed air with an outlet pipe controlled by the hand operated valve 12. Pressure gauge 17 indicates the operating pressure available for use in the hose 11. The tank 10 may be mounted in any suitable manner for movement from breaker to breaker in the switchboard 13.

I have here shown one method of mounting the tank by means of angle brackets 14 on cross bars 15 which carry the wheels 16. The switchboard 13 comprises a plurality of circuit breaker compartments 18, 19, 20, 21.

Compartment 21 houses a large truck mounted circuit breaker indicated generally at 22 of the general type disclosed in application Serial No. 757,356, filed June 27, 1947, now Patent No. 2,611,838, and application Serial No. 720,561 filed January 7, 1947, now Patent No. 2,601,417. Compartments 18, 19, and 20 house smaller circuit breakers.

Compartments 23 and 24 may contain other apparatus necessary in a switchboard as, for instance, a transformer or a switchgear.

Each of the circuit breakers in compartments 18, 19, 20, and 21 is provided with a pipe 25 which is preferably flexible and which is connected from the circuit breaker to the coupling 26 mounted in the front door of each of the respective compartments.

The function of the preferably flexible pipe 25 will be hereinafter more specifically described. It should, however, be understood that this pipe is connected to lead compressed air to a portion of the operating mechanism of the circuit breaker to operate the same.

The pipe should be flexible since it will be necessary at times to open the doors of the various compartments while the circuit breaker is in the compartment or to rack the truck mounted circuit breaker between the test and the operative condition in the compartment while the door remains closed.

The hose 11 from the compressed air source 10

is provided with the matching coupling member 28 to interengage with coupling 26 of hose 25.

Assuming that each of the circuit breakers is operated to closed position by a solenoid closing coil and assuming that one of the solenoid closing coils is inoperative for any reason with the circuit breaker open, then the portable compressed air supply 10 may be utilized to reclose the circuit breaker without requiring that the operator approach the circuit breaker closing.

The operator moves the tank 10 to a position where the hose coupling 28 of hose 11 may be connected to coupling 26 of pipe 25. After making this connection, he then returns to the tank 10 which may be located at a remote point as determined by the length of hose 11 and turns the valve operator 12 to lead compressed air from the tank 10 through pipes 11 and 25 to the circuit breaker operating the circuit breaker to closed position.

Should the circuit breaker close on a short circuit, then the operator being at a remote point operating the valve 12 will be in a much safer position than if he had attempted to close the circuit breaker manually.

The degree of safety will, of course, be determined by the length of the flexible hose 11 which may be made long enough to provide absolute safety under all conditions.

As hereinafter pointed out, the utilization of the movable tank 10 and hose 11 requires only minor modification of existing circuit breaker structure; that is, it would only be necessary to lengthen the guide tube for the solenoid plunger to make sure that the solenoid plunger is a piston-like fit in the guide tube, seal the bottom of the guide tube leaving an opening to which the hose 25 may be connected and to connect the hose 25 to the coupling 26 which may be connected to the door of the compartment.

This change in existing solenoid operated circuit breakers requires a minimum of material and but an hour or two of time. Consequently, the installation of the auxiliary compressed air operating system for utilization in connection with many circuit breakers and even many switchboards requires only the single portable tank 10 and its hose 11 and the slight change in each of the circuit breakers above mentioned and hereinafter described.

While my invention, of course, lends itself to permanent installations, the utilization of a portable tank and flexible hose 11 or at least the utilization of the detachable and attachable construction of hose 11 in connection with each of the hoses 25 is much simpler and far more economical than a plurality of parallel permanent compressed air pipe lines.

In Figure 2 I have shown the modification that may readily be made in a circuit breaker in order to enable my novel auxiliary compressed air system to operate.

The circuit breaker is of the type disclosed in application Serial No. 720,561, filed January 7, 1947, now Patent No. 2,601,417, and is of the type described therein as a blow-open, blow-closed circuit breaker; that is, the closing movement and just as the contacts engage, but before they have fully engaged, the current loop through the elements provides a blow-closed effect. When the circuit breaker is tripped, the elements are so arranged that the current loop provides a blow-open effect.

The circuit breaker 110 is supported in any suitable manner on a panel 111, carrying additional supporting brackets, not shown, to support the various pivot pins hereinafter described.

The back panel 111 carries an upper back connection stud 115 and a lower back connection stud 116, mounted in any suitable insulators 215 and 216. The upper back connection stud 115 carries at the end thereof a stationary contact structure 117. Movable contact arm 125 carrying movable contact 126 and arc horn 127 is pivotally mounted on the pin 128 which passes through the arcuate horizontally extending slot 129 in extension 131 of the lower back connection stud 116.

Highly conductive inserts 134 on either side of the extension 131 ensure good current conducting engagement between contact arm 125 and the extension 131.

Arm 125 is a double arm, the elements of which are mounted on opposite sides of extension 131 and pressed by spring washers against conductive inserts 134.

The current path established when the contacts are closed is thus from the upper back connection stud 115 to the stationary contact structure 117, then through movable contact 126 and movable contact arm 125 to the extension 131 of the lower back connection stud 116 and then to the lower back connection stud 116.

It will thus be seen that when the contacts are closed, a U-shaped current loop is established with the contact elements 117—126 at one of the bends or corners of the loop.

The movable contact 125 is held closed during the operation of the circuit breaker by the toggle 152, one link 153 of which is connected to the pin 150 on contact arm 125, the opposite end of the link 153 being connected to the knee pin 155 of the toggle 152.

The other link 154 of the toggle 152 is connected at one end to the knee pin 155 and is pivoted at the other end on the stationary pin 157. Link 154 has a downward extension 162 which with link 154 forms a bell crank lever 154—162. Roller 163 secured at the end of link 162 is engaged in detent 164 of latch 165.

When the overload trip coil 171 is energized, the armature 172 is raised against extension 167 of latch 165 causing the latch 165 to pivot counterclockwise about the stationary pin 166 so that the detent 164 thereof disengages roller 163 and the toggle 152 may break downwardly to open the circuit breaker as shown in Figure 2.

During the closing operation the possible movement of the toggle upwardly through center is prevented by the cross-bar or stop 170 above the knee pin 155. When the toggle 152 has broken downwardly, thus permitting the contact 125 to be forced open by the blow-open effect, the knee pin 155 drops and roller 163 rises. Roller 163 is connected to the link 175. Link 175 is provided at its outer left-hand end with a slot 176 in which rides the pin 177. Pin 177 is connected to the upper end of the bell crank lever latch 178 which is pivoted on the pin 179.

Latch 178 has a detent 180 which engages roller 181 on the closing arm 182. Arm 182 is pivotally mounted on the pin 183 and is biased toward the right into clockwise movement by the compression spring 184.

When now the roller 163 rises up toward the left, on opening of the contacts, the link 175 is driven to the left rapidly and when the end 176a of the slot 176 strikes pin 177, latch 178 is given a hammer blow in a counterclockwise direction to disengage the detent 180 from roller 181.

is pushed up, the compression spring 44 aids in maintaining the valve 41 against its seat on the valve opening 40.

As the upper limit of travel of member 30 is reached, the collar 45 on valve rod 42 strikes against the abutment 46 at the bottom of member 30 and the valve rod 42 and valve 41 are pulled upwardly opening the exhaust opening 40.

By this time, the toggle 190 has been extended to close the circuit breaker or other closing apparatus has been operated to the full closed position of the circuit breaker, and no further rise of the solenoid armature-piston is needed and, of course, no further build-up of pressure in chamber 34 is desired. Further building up of pressure is, however, avoided by the automatic opening of the valve 41.

By this means, therefore, a simple modification of existing circuit breaker construction makes possible the utilization of auxiliary remote control air operating means for closing a circuit breaker without interfering with the electrical operation thereof.

If, for any reason, the solenoid mechanism should go out of order, the operator need not take the risk of manually closing the circuit breaker on a possible short circuit but need merely wheel the tank 10 to a position where the hose 11 may be attached to hose 25 and then standing far enough from the circuit breaker to be safe he need merely operate valve 12 to close the breaker.

If a short circuit does exist resulting in immediate reopening of the circuit breaker with the attendant possibly dangerous arc, the operator is sufficiently remote from the circuit breaker and its compartment to be safe.

Where a single unit is to be available to operate many circuit breakers, it may even be desirable to fix the air tank and especially the valve operator 12 at some position sufficiently remote from all circuit breakers so that the operator turning the valve 12 at that position will be absolutely safe, and then a hose 11 of sufficient length may be provided so that it may be connected to any of the circuit breakers which are to be operated by the auxiliary air system.

Such a stationary system for use in a large installation requires, however, its own air compressor and other auxiliary means for ensuring a continuous supply of air at full pressure. In a small sub-station, the added cost of an air compressor may not be warranted, especially since the occasions when a solenoid coil will fail to operate will be very rare.

Accordingly, the installation should be so arranged that it will not be expensive. For this reason, a simple drum may be used for the tank 10 and it may be mounted in simple fashion on wheels or even a dolly to be readily portable.

In a very small unit, the tank may even be filled by a hand pump or the tank may from time to time be taken down to a conveniently located power pump to be refilled.

In Figure 3 I have shown a modification of my invention so that it may be utilized as the primary means for closing a circuit breaker rather than as an auxiliary means.

In this case, the solenoid coil 199 is dispensed with, and the guide tube 31 is the closing cylinder. Otherwise, all of the elements operate as previously described in connection with Figure 2, but there is no solenoid operated closing mechanism.

When it is desired to close the circuit breaker, hose 11 is connected to hose 25 and air is admitted to chamber 34a below the piston 30a to operate the piston upwardly in the manner previously described. All other elements of the air system as well as of the circuit breaker may be identical.

While in the circuit breaker here disclosed I have not shown manual closing means, it will be obvious that a handle attached to link 197 of toggle 190 may be utilized to close the circuit breaker manually for test purposes but since the possibility that short circuit may exist still remains when the circuit breaker is in the operative position, the auxiliary air system here disclosed may be utilized with absolute safety by the operator to close the circuit breaker even on a short circuit.

In Figure 4 I have shown in perspective a standard circuit breaker 22 of the type shown in Figure 1 and well-known in the art, the circuit breaker being provided with the solenoid housing 50 shown in greater detail in Figures 5 and 6. The solenoid mechanism in housing 50 acts as the operating means for closing the circuit breaker.

Solenoid core 54 acts as a piston, travelling from the dotted line position 55 to the solid line position 56 to drive the plunger 52 upwardly to close the circuit breaker. The solenoid coil normally drives the core 54 upwardly. When it is desired to utilize fluid pressure to drive core 54 upwardly to close the circuit breaker, pipe 25 is attached to the tapped opening 53 in solenoid housing cover 59 to admit fluid under pressure below the core 54. The operation for closing the circuit breaker is then identical with that described in connection with Figures 1 to 3.

While in the foregoing I have disclosed a specific type of circuit breaker in which a toggle is extended to close the contacts, it will be obvious that this system is applicable as well to all other types of circuit breakers.

The system of Figure 2 may be utilized in connection with any solenoid operated circuit breaker, and the system of Figure 3 may be utilized in connection with any type of circuit breaker whether manually or solenoid operated.

The circuit breakers in connection with which my invention is used may have manual closing means, solenoid closing means or even special air operated closing means. My auxiliary air operating system may be utilized in connection with any of these closing means or a substitute therefor where closing the circuit breaker manually is dangerous, where the closing solenoid is out of order for any reason, or where the normal air operated closing system is out of order for any reason.

In the foregoing I have described my invention solely in connection with specific illustrative embodiments thereof. Since many variations and modifications of my invention will now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein contained but only by the appended claims.

I claim:

1. In a circuit breaker having a pair of cooperable contacts, an electromagnet having an armature, mechanism controlled by said armature for operating said contacts into engagement, a chamber for said armature, said armature forming a piston in said chamber, and a source of fluid pressure connectable to said chamber for operating said contacts into engagement.

2. In a switchboard, a plurality of circuit breakers, a compartment individual to each of said circuit breakers, each of said circuit break-

The compression spring 184 is now in a position to drive the arm 182 clockwise around the pivot 183. This results in the movement of the parts to the condition wherein the closing toggle 190 has collapsed and in which the adjustable stop member 191 at the upper end of the arm 182 strikes the extension 162 of the link 154 rotating link 154—162 in a counterclockwise direction to reextend the toggle 152 once more and to re-engage the roller 163 in detent 164 of latch 165.

The re-setting or extending of the toggle 152 does not at this time, however, result in closing of the circuit breaker, since pin 185 on arm 182 which is connected to arm 162 moves the arm 161 to the right, thus moving the pin 160 at the lower end of contact arm 125 to the right. This moves the pin 126 of the contact arm 125 to the right-hand side of the slot 129 but at the same time pushes the pin 160 over sufficiently so that the contact arm continues to rotate outwardly toward the left around pin 129 which is held by the right-hand end of slot 129. Thus, even though the latch 165 is re-set, the circuit breaker remains open.

The closing toggle 190 is prevented from breaking upwardly by the stop 195. Toggle 190 comprises a link 193 connected by pin 194 to the closing arm 182 and connected at the other end to the knee pin 196. Link 197 is connected at one end to knee pin 196 and at the other end to the stationary pin 198. Closing solenoid 199 is provided with the armature 200.

Now when the circuit breaker is in the open position with the latches all re-set, the contacts may be closed by energization of the solenoid coil 199. On such energization the armature 200 is raised to extend the toggle 190. When the toggle 190 is thus extended, closing arm 182 is rotated counterclockwise to the left about pin 183. This compresses the spring 184 and moves the arm 182 over to the left until latch 178 engages roller 181 on the arm 182. At the same time the movement of arm 182 to the left pulls the arm 161 to the left, thus pulling on pin 160 and causing the contact arm 125 to rotate in a counterclockwise direction around the pivot pin 155.

Spring 184 is provided only to re-set, the toggle 152 and consequently is a relatively light spring so that it does not interfere with the closing of contacts as would be the case where opening springs are used. Thus, the mechanical force needed to close the contact is only necessary to overcome the inertia of the parts and the relattively slight force of the re-setting spring 184.

The contacts are driven home once they are initially engaged by the blow-closed effect above described. In fact, the closing coil and armature, as hereinafter pointed out, are aided by the arrangement of the parts which produce a net blow-closed effect during closing.

Also, the travel which is given to the closing coil and plunger 200 need merely be sufficient to complete the closing operation and no over-travel need be provided to provide any hammer blow or kinetic effect to slam the contacts home. The parts may thus be made lighter and at the same time, owing to the utilization of the electromagnetic forces to close the contacts rather than sheer mechanical force or kinetic energy, the parts are more durable.

Thus far, one type of circuit breaker in connection with which my invention may operate has been described. This circuit breaker has been described specifically so that a complete operative system may be shown.

It will be obvious, however, from the following that any circuit breaker with a solenoid closing coil may readily be adapted to utilize the principles of my invention and, in fact, any circuit breaker may be operated whether or not it has a solenoid closing coil in accordance with the principles of my invention.

Referring again to Figure 2, the closing plunger 200 is, as was previously pointed out, operated by the armature 30 of the solenoid coil 199. The armature 30 operates in the guide tube 31.

In accordance with my invention, the guide tube 31 which is normally only slightly longer than the coil 199 is extended downwardly to form a cylinder. The bottom of the guide tube is sealed by wall 32. The pipe or flexible hose 25 is connected to opening 33 in the bottom wall 32 so that air may be admitted to the chamber 34 of the guide tube 31 below the armature 30 which is a piston-like fit in the guide tube 31.

When air is thus admitted, as previously described, from tank 10 through hose 11, couplings 28 and 26, pipe 25, and opening 33 to chamber 34, compressed air forces the armature 30 which now acts as a piston to force the plunger 200 up, extending the toggle 190 and closing the circuit breaker.

This is the only modification that is essential in order to adapt the circuit breaker to the utilization of my novel auxiliary system.

After the circuit breaker is closed, however, the various latches above-described hold it closed and it is no longer necessary to support the armature-piston 30 by air or other means.

It may in certain circumstances be desirable, in fact, to lead off the air in chamber 34 to prevent excess pressure in the guide tube 31. That is, in order to utilize the tank for many operations without the necessity for recharging it frequently, it may be desirable to charge the tank 10 to a pressure much higher than that which is necessary actually to close a particular circuit breaker.

When the valve 12 is opened, the pressure builds up quickly in chamber 34 of the guide tube to force the piston-armature 30 up as the pressure increases. After the armature 30 has been forced up to close the circuit breaker, no further build-up of pressure is needed or even desired.

Hence, it is desirable to provide an exhaust valve in the guide tube 31 so that pressure will not build up too high therein. The operator who turns the valve can thus watch the appropriate indicator on the switchboard and when it has shifted from "open" to "closed," then he need merely close the valve 12.

Where an exhaust valve is provided in the guide tube, then lower pressures must be used in the tank 10 in order to avoid accidental rupture or distortion of the guide tube 31 or a stronger guide tube is needed, or the operator must be very skillful and quick in operating the valve 12 to close the same the moment the circuit breaker indicator reads "closed."

In order to obviate this necessity for extreme care or skill, I provide the exhaust vent 40 in the bottom wall 32 which is normally closed by the valve 41 at the end or rod 42 spring biased by compression spring 43 downwardly against the valve seat or opening 40.

The compression spring 43 and the rod 42 ride in a vertical opening 44 in the solenoid armature-piston 30. When the armature-piston 30 is in the down position, the valve 41 seats against the valve opening 40. As the armature-piston 30

ers having a pair of cooperable contacts, an electromagnet having an armature, mechanism controlled by said armature for operating said contacts into engagement by either electrical or hydraulic influence, a chamber for said armature, said armature forming a piston in said chamber.

3. In a switchboard, a plurality of circuit breakers, a compartment individual to each of said circuit breakers, each of said circuit breakers having a pair of cooperable contacts, an electromagnet having an armature, mechanism controlled by said armature for operating said contacts into engagement, a chamber for said armature, said armature forming a piston in said chamber, a portable source of fluid pressure connectable to said chamber for operating said contacts into engagement, and means for selectively making said connection from said source to any one of said circuit breaker mechanisms.

4. In a circuit breaker having a pair of cooperable contacts, an electromagnet having an armature, mechanism controlled by said armature for operating said contacts into engagement, a chamber for said armature, said armature forming a piston in said chamber, a source of fluid pressure connectable to said chamber for operating said contacts into engagement, a normally closed exhaust vent, and means operated as said contacts are operated into engagement for opening said vent to drop the pressure in said chamber.

JOSEPH D. WOOD.

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