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[54] **CIRCUIT BREAKER OPERATING DEVICE**

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[51] **Int. Cl.** **F15b 11/08**

[58] **Field of Search** 60/407, 412, 413, 477, 60/478, DIG.10, 464, 432; 91/43, 459, 461

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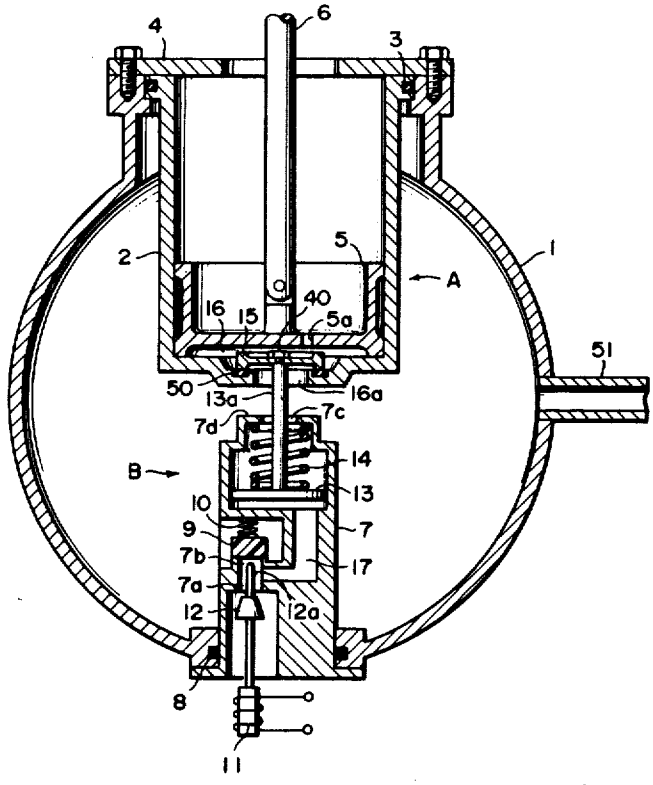
[57] **ABSTRACT**

A circuit breaker operating device in which means including a cylinder having a piston connected to the movable contact in the breaking mechanism, a fluid introducing valve for supplying an operating fluid into a main introducing space beneath the piston, and elements for controlling the movement of the fluid introducing valve are disposed within a storage tank containing the operating fluid to eliminate the need for provision of any fluid supply pipe and reduce the pressure loss to a minimum so that the pressure of the operating fluid can be fully effectively utilized for breaking the circuit at a high speed.

21 Claims, 4 Drawing Figures



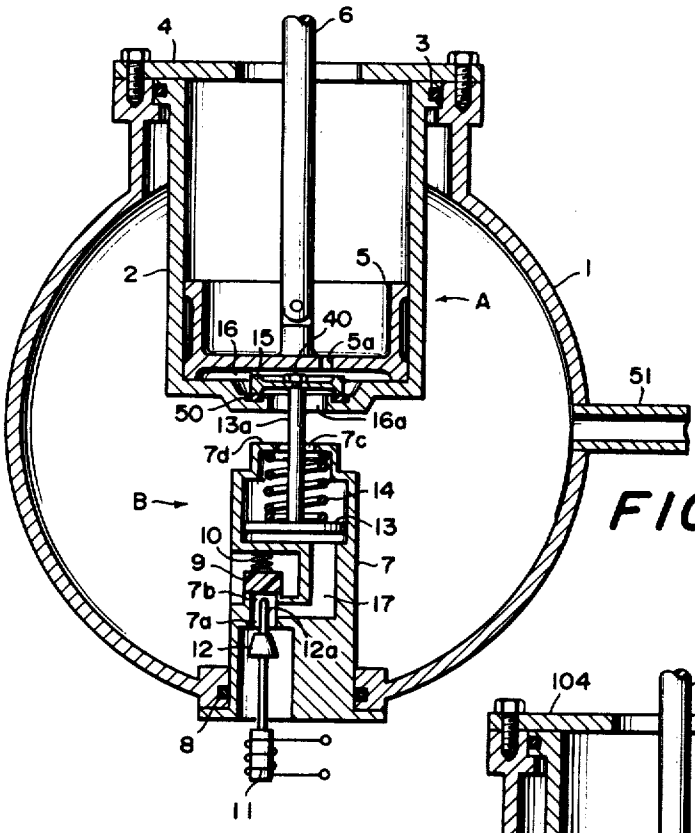


FIG. 1

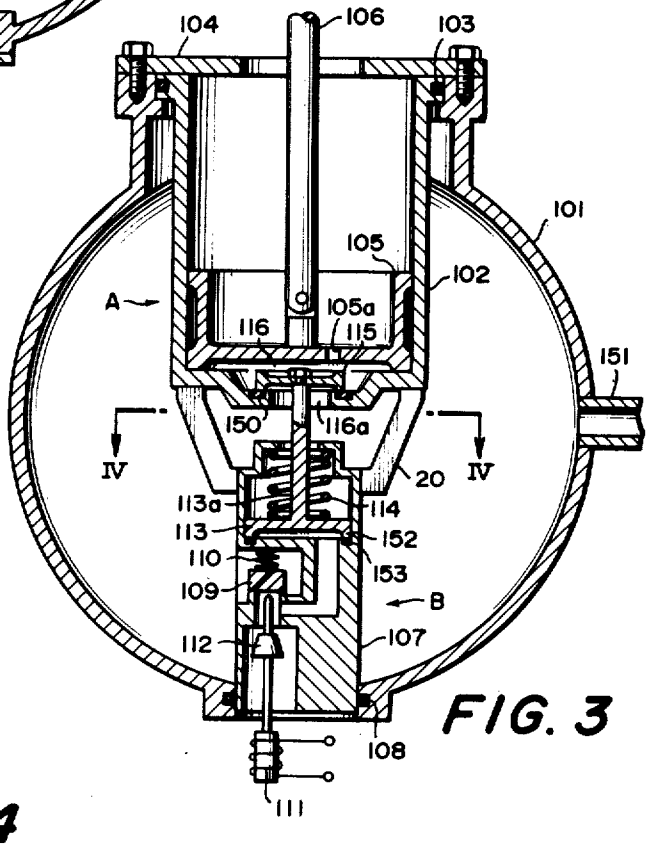


FIG. 3

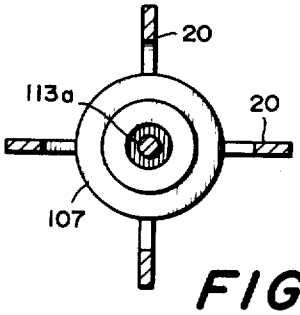


FIG. 4

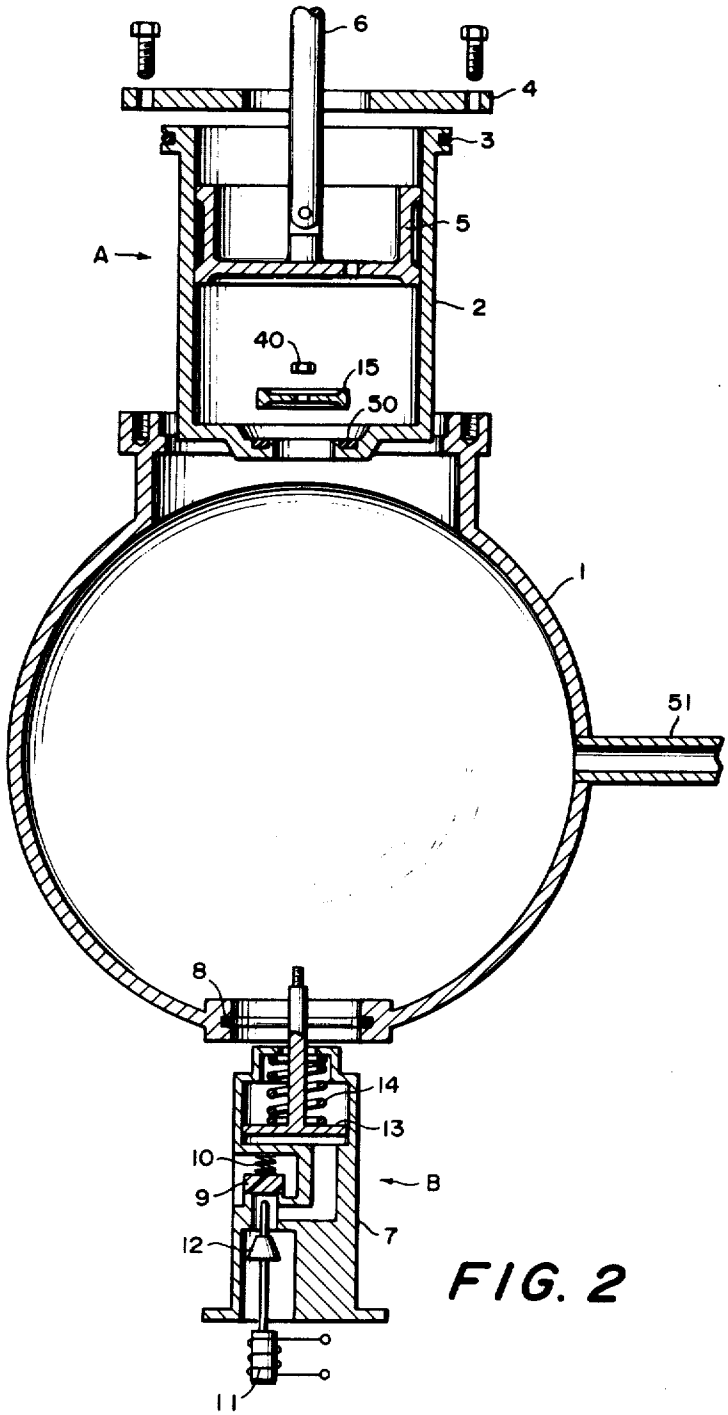


FIG. 2

CIRCUIT BREAKER OPERATING DEVICE

BACKGROUND OF THE INVENTION

This invention relates to circuit breaker operating devices, and more particularly to improvements in an operating device of the kind above described in which a fluid is used as a means for imparting an actuating force for operating a circuit breaker.

The employment of ultra high voltage and the increase in the capacity of a high power transmission network in recent years has necessitated the use of circuit breakers having a high voltage rating and a high breaking capacity. Such a circuit breaker must cut off a current of very large value. It is thus necessary to part the circuit breaker contacts at a high speed in order to improve the transient stability during breaking the circuit.

Air blast circuit breakers, double pressure type SF6 gas circuit breakers and puffer type circuit breakers are commonly known. In anyone of these known circuit breakers, the operating time of the operating device for moving the movable contact away from the stationary contact in the circuit breaker occupies a relatively great proportion of the length of time required for breaking the circuit. It is therefore desirable that the operating device can operate at a highest possible speed in order to obtain a satisfactory breaking characteristic.

A conventional circuit breaker operating device has such a structure that a piston is disposed movably within a stationary cylinder, and this piston is operatively connected to the movable contact in the circuit breaker. In breaking the circuit, a pressurized fluid such as air under pressure is supplied to the piston to cause sliding movement of the piston in the cylinder. This movement of the piston is transmitted to the movable contact to urge the movable contact away from the stationary contact thereby attaining the circuit breaking operation.

Such conventional operating device is provided with a control valve device consisting of a fluid introducing valve for controlling the flow of the pressurized fluid toward the piston and valve actuating means for actuating this valve by the fluid and a storage tank for the pressurized fluid which provides the force required for causing sliding movement of the piston and driving the valve actuating means. Fluid supply pipes are connected between the piston and the control valve device and between the control valve device and the storage tank so that the pressurized fluid in the storage tank can be supplied to the piston through the control valve device and fluid supply pipes.

Such conventional operating device has had a serious defect. In response to the application of a breaking instruction signal to the circuit breaker, the fluid introducing valve is opened by the valve actuating means to supply the pressurized fluid to the piston. In the conventional operating device, a considerably long time has been required until the piston starts to move in the circuit breaking direction due to the fact that a dead space exists within the fluid supply pipes and gives rise to a considerable pressure loss. This delay in the operating time has been one of the principal causes giving rise to an undesirable decline of the operating characteristic of the circuit breaker.

In a known structure proposed in an effort to obviate such a defect, the fluid supply pipe between the piston and the control valve device is eliminated. In this improved operating device, the fluid introducing valve is disposed adjacent to one of the openings of the cylinder to normally hermetically close this opening. According to this structure, the pressurized fluid passing through the fluid introducing valve in the open position could immediately impart the actuating force to the piston without delay, and thus, the length of time required for the piston to start to move after the opening of the fluid introducing valve could be reduced. However, in this improved operating device too, the storage tank has been disposed independently of the control valve device, and the fluid supply pipe between the storage tank and the control valve device has been still left as the communication means therebetween. As a result, the delay in the operating time due to the pressure loss in this fluid supply pipe has remained still and this has been the neck which obstructs the desired reduction of the length of time required for breaking the circuit.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a circuit breaker operating device in which an operating fluid contained in a storage tank can be directly supplied to a piston without any substantial pressure loss so that the device can operate at a high speed.

Another object of the present invention is to provide a circuit breaker operating device in which the space within the storage tank containing the operating fluid is connectably partitioned by a fluid introducing valve from a main introducing space defined beneath the piston for supplying the operating fluid to the piston.

Still another object of the present invention is to provide a circuit breaker operating device in which the fluid introducing valve connectably partitioning the space within the storage tank from the main introducing space is urged to the open position by an actuating piston which is actuated in response to the application of a breaking instruction signal.

Yet another object of the present invention is to provide a circuit breaker operating device in which circuit breaking mechanism actuating means including the piston and the cylinder and valve actuating means including the actuating piston are disposed and fixed within the storage tank in axially parallel relation with each other.

A further object of the present invention is to provide a circuit breaker operating device in which the valve actuating means is rigidly fixed to the circuit breaking mechanism actuating means and is slidable relative to the storage tank.

In accordance with one aspect of the present invention, there is provided a circuit breaker operating device comprising a storage tank filled with an operating fluid under pressure; circuit breaking mechanism actuating means including a cylinder fixed to said storage tank and having an inlet port disposed within said storage tank, and a first piston disposed slidably within said cylinder and operatively connected to the movable contact in the circuit breaking mechanism; a fluid introducing valve disposed to openably close said inlet port of said cylinder so as to permit flow of the operating fluid under pressure contained in said storage tank into a main introducing space defined between said first piston and said cylinder in the position in which it opens said inlet port and to shut off the flow of the operating fluid into said main introducing space in the position in which it closes hermetically said inlet port; and

valve actuating means including a second piston for controlling the movement of said fluid introducing valve in response to the application of a breaking instruction signal.

The operating device of the present invention having a structure as above described in advantageous in that the operating fluid contained in the storage tank can be directly supplied to the piston with low pressure loss without using any fluid supply pipe thereby eliminating the pressure loss in the pipe in the prior art device of this kind, so that the pressure of the operating fluid can be fully effectively utilized to shorten the operating time of the operating device. The present invention is further advantageous in that the overall size of the device can be reduced due to the fact that the actuating means can be disposed within the storage tank.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal sectional view of a first embodiment of the circuit breaker operating device according to the present invention in the circuit making position of the circuit breaker.

FIG. 2 is a view similar to FIG. 1 but showing the parts in exploded fashion for illustrating the manner of assembling of the device shown in FIG. 1.

FIG. 3 is a longitudinal sectional view of a second embodiment of the present invention.

FIG. 4 is a section taken on line IV—IV in FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be described with reference to the accompanying drawing. FIG. 1 is a longitudinal sectional view of a first embodiment of the circuit breaker operating device of the present invention in an operating state corresponding to the circuit making position of the circuit breaker (not shown). Referring to FIG. 1, a storage tank 1 contains therein an operating fluid such as air under high pressure and is disposed in electrically insulated relation from the circuit breaking mechanism (not shown) of the circuit breaker. A compressor (not shown) is connected to the storage tank 1 through a conduit 51 so as to maintain the pressure of the high-pressure operating fluid in the storage tank 1 above a predetermined setting. The high-pressure operating fluid may be SF6 gas, oil or any other suitable fluid in lieu of the air under high pressure. A cylinder 2 is rigidly fixed at the upper end thereof to a supporting plate 4 bolted to an upper opening of the storage tank 1 and is supported to extend downward in FIG. 1 from the upper opening of the storage tank 1 being maintained fluid-tight by a gasket 3. A piston 5 is disposed within the cylinder 2 to be slidable along the inner wall surface of the cylinder 2 and is provided with a perforation of small diameter 5*a*. The operating device of the present invention can operate at a high speed for the reason that the cylinder 2 is disposed bodily within the storage tank 1 as shown and the operating fluid under high pressure contained in the storage tank 1 can be directly supplied to the piston 5 without passing through any fluid supply pipes.

An operating rod 6 is mechanically connected to the piston 5 for transmitting a contact parting force to the movable contact in the circuit breaking mechanism (not shown). This operating rod 6 is normally urged downward in FIG. 1 by a contact making means such as a reset spring (not shown). The cylinder 2 and piston 5 constitute an actuating unit A for actuating the circuit breaking mechanism.

A valve casing 7 is rigidly fixed at the lower end thereof in a lower opening formed in the operating fluid storage tank 1. This valve casing 7 is disposed opposite to the cylinder 2 and is supported to extend upward from the lower opening of the storage tank 1 by being maintained fluid-tight by a gasket 8. The valve casing 7 is formed thereinside with a space 17 having an opening 7*a* communicating with the atmosphere and openings 7*b* and 7*c* communicating with the internal space of the storage tank 1. A pilot valve 9 is urged downward in FIG. 1 by a compression spring 10 to be pressed against the opening 7*b* to normally hermetically close the opening 7*b*. A breaking instruction signal is applied to an energizing coil 11. In response to the application of the breaking instruction signal to the energizing coil 11, a trigger valve 12 is urged upward in FIG. 1 to hermetically close the opening 7*a*, and at the same time, the upper end 12*a* of the trigger valve 12 acts to urge the pilot valve 9 upward in FIG. 1 against the force of the compression spring 10 to open the opening 7*b*.

An actuating piston 13 is slidably disposed within the upper space portion of the valve casing 7 and is normally urged downward in FIG. 1 by a compression spring 14. A fluid introducing valve 15 is rigidly fixed by a nut 40 to the upper end of a piston rod 13*a* which is fixed integrally to the actuating piston 13. The compression spring 14 is interposed between the actuating piston 13 and a spring bearing portion 7*d* of the valve casing 7 so as to normally urge the actuating piston 13 and fluid introducing valve 15 downward in FIG. 1. The fluid introducing valve 15 can make fluid-tight engagement with a valve seat 50 formed at one end of the cylinder 2 so as to prevent flow of the operating fluid under high pressure in the storage tank 1 into a main introducing space 16 beneath the piston 5 through the inlet port 16*a* of the cylinder 2.

The outer diameter of the fluid introducing valve 15 is selected to be smaller than that of the actuating piston 13 so that, during the circuit breaking operation, the fluid introducing valve 15 can be easily urged to the open position by the pressure of the operating fluid in the storage tank 1 thereby permitting flow of the operating fluid under high pressure into the main introducing space 16. It will be seen that the piston rod 13*a* having the fluid introducing valve 15 fixed thereto is disposed in axially parallel relation with the axis of of the cylinder 2 and that the direction in which the fluid introducing valve 15 is urged to the open position is the same as the moving direction of the piston 5 during the circuit breaking operation of the operating device. By virtue of the above arrangement, the operating device of the present invention can operate at a high speed.

The valve casing 7 and various elements disposed within this valve casing 7 constitute a valve actuating unit B.

In the circuit making position shown in FIG. 1, the upper end 12*a* of the trigger valve 12 is spaced apart from the pilot valve 9. In this state, the pilot valve 9 is urged by the compression spring 10 to hermetically close the opening 7*b*, the opening 7*a* is not closed by the trigger valve 12, and the portion of the space 17 lying between these two openings 7*a*, 7*b* and the actuating piston 13 communicates with the atmosphere. The main introducing space 16 communicates also with the atmosphere through the perforation 5*a* of the piston 5.

Thus, the piston **5** is held in the lowermost position within the cylinder **2** by the force of the reset spring, and the volume of the main introducing space **16** in such a state is very small. Although the pressure of the operating fluid in the storage tank **1** acts to force the fluid introducing valve **15** toward the main introducing space **16**, the downward force imparted by the operating fluid to the actuating piston **13** fixed to the fluid introducing valve **15** cooperates with the force of the compression spring **14** to press the fluid introducing valve **15** against the valve seat **50** thereby hermetically closing the inlet port **16***a* against the force of the operating fluid acting upon the fluid introducing valve **15**.

In response to the application of the breaking instruction signal to the energizing coil **11** in such a state, the trigger valve **12** is urged upward in FIG. **1** to hermetically close the opening **7***a*, and at the same time, the upper end **12***a* of the trigger valve **12** urges upward the pilot valve **9** to open the opening **7***b*. Therefore, the operating fluid in the storage tank **1** is filled immediately in the space **17** through the opening **7***b*. As a result, the relation between the forces acting upon the fluid introducing valve **15** and actuating piston **13** is reversed. That is, the downward force acting upon the actuating piston **13** is cancelled by the upward force imparted thereto by the operating fluid supplied through the opening **7***b* and space **17**, and the fluid introducing valve **15** is urged upward in FIG. **1** by the pressure of the operating fluid to open the inlet port **16***a* due to the fact that the fluid introducing valve **15** has a pressure receiving area which provides a greater force than the force of the compression spring **14**.

As soon as the inlet port **16***a* is opened, the operating fluid in the storage tank **1** is filled in the main introducing space **16** to urge the piston **5** upward in FIG. **1**, hence to impart the contact parting force to the movable contact of the circuit breaker. Due to the fact that the operating fluid is not filled in the main introducing space **16** by way of a pipe used in the conventional device but it is directly filled in the main introducing space **16** through the inlet port **16***a* disposed within the storage tank **1**, an undesirable pressure loss due to such pipe can be completely eliminated and the pressure of the operating fluid can be fully effectively utilized for driving the piston **5**.

In the circuit making position shown in FIG. **1**, the upper surface of the fluid introducing valve **15** is very slightly spaced from the lower surface of the piston **5**. Thus, in the initial stage of the movement of the fluid introducing valve **15** in the valve opening direction, the fluid introducing valve **15** abuts the piston **5** to cease the movement thereof temporarily. Therefore, the gap initially formed between the fluid introducing valve **15** and the valve seat **50** is not so large. However, due to the fact that the initial volume of the main introducing space **16** is very small, the gap initially formed between the fluid introducing valve **15** and the valve seat **50** is large enough to ensure instantaneous filling of the operation fluid in the main introducing space **16**. When the piston **5** starts to move upward in FIG. **1** by the pressure of the operating fluid filled in this space **16**, the fluid introducing valve **15** can also move upward in FIG. **1**, with the result that the gap formed between the fluid introducing valve **15** and the valve seat **50** increases gradually. Thus, the operating fluid can be filled in the main introducing space **16** with a low pressure loss to impart a desirable driving force to the piston **5**.

After impartation of sufficient inertia to the piston **5** by the pressure of the operating fluid, the breaking instruction signal applied to the energizing coil **11** disappears and the trigger valve **12** is restored to the position shown in FIG. **1** by a resetting means (not shown) to cause discharge of the operating fluid in the space **17** to the atmosphere through the opening **7***a*. Therefore, the sum of the downward force acting upon the actuating piston **13** and the force of the compression spring **14** overcomes the upward force acting upon the fluid introducing valve **15** again, and the fluid introducing valve **15** is urged downward in FIG. **1** to hermetically close the inlet port **16***a* again. The valve actuating unit B is restored to the circuit making position shown in FIG. **1**.

Although the supply of the operating fluid from the storage tank **1** is ceased in the above state, the piston **5** moves further upward by inertia to reach the circuit breaking position for parting the movable contact and is mechanically locked in such position by a locking means (not shown). This completes the circuit breaking operation of the circuit breaker. The operating fluid filled in the main introducing space **16** is relatively gradually discharged to the atmosphere through the perforation **5***a* bored in the piston **5** so as to eliminate an undesirable reaction force which may be imparted to the circuit making means during subsequent circuit making operation by the piston **5**.

In making the circuit again, the locking means is released and the action of, for example, the reset spring in which the force is accumulated during the circuit breaking operation is utilized to bring the movable contact into contact with the stationary contact. At the same time, the piston **5** is urged downward in FIG. **1** to be restored to the position shown in FIG. **1**. The piston **5** can move smoothly in the above direction due to the fact that the operating fluid filled in the main introducing space **16** has been discharged through the perforation **5***a* of the piston **5** and the pressure in this space **16** is substantially equal to the atmospheric pressure. The perforation **5***a* of the piston **5** acts also to alleviate the pressure rise occurring in the main introducing space **16** during the movement of the piston **5** toward the original position shown in FIG. **1**. This pressure rise is negligible for the reason that the movement of the piston **5** in the circuit making operation is generally slower than that in the circuit breaking operation. The perforation **5***a* of the piston **5** may be eliminated to maintain the piston **5** in the circuit breaking position by the operating fluid in the storage tank **1**, and a valve means acting to discharge the operating fluid in the main introducing space **16** in response to the application of a making instruction signal to the reset spring may be provided so as to eliminate an undesirable reaction force which may be imparted to the piston **5** as soon as the circuit making operation is started.

The operating fluid is in no way limited to air under high pressure and any other suitable fluid may be used in lieu of air. In this latter case, it is necessary to provide a collecting vessel for collecting the operating fluid discharged from the opening **7***a* and the perforation **5***a*.

In the first embodiment above described, the pressure of the operating fluid filled in the space **17** is utilized to drive the fluid introducing valve **15**. However,

the structure may be such that the force driving the fluid introducing valve **15** can be obtained by discharging a portion of the operating fluid to the atmosphere in response to the application of the circuit breaking instruction to the energizing coil **11.** It will be understood that the present invention is featured by the fact that the inlet port **16***a* for filling the operating fluid in the main introducing space **16** for driving the piston **5** is disposed within the operating fluid storage tank **1.** In other words, the present invention is featured by the fact that the main introducing space **16** is partitioned directly by the fluid introducing valve **15** from the space within the storage tank **1** containing the operating fluid which drives the piston **5.** Thus, the circuit breaker operating device according to the present invention can operate at a high speed without any substantial pressure loss in contrast to a large pressure loss which has been encountered with prior art devices using fluid supply pipes. Further, due to the fact that the fluid introducing valve **15** in the first embodiment above described is adapted to move in the same direction as the moving direction of the piston **5,** the initial volume of the main introducing space **16** in the circuit making position shown in FIG. 1 can be made very small so that the dead space owing to this space **16** can be reduced and the length of time required for circuit breaking operation can be shortened. More precisely, if the fluid introducing valve **15** were arranged to move in a direction perpendicular to the direction of movement of the piston **5,** the main introducing space **16** would have a maximum volume corresponding to the stroke required for the fluid introducing valve **15** to move until the circuit breaking operation is completed, and this would result in the defect that a large dead space is formed. The present invention obviates such a defect and the volume of the main introducing space **16** can be reduced to a minimum.

The circuit breaker operating device shown in FIG. 1 can be assembled in a manner as shown in FIG. **2.**

At first, the valve actuating unit B is inserted in the lower opening of the storage tank **1** and fixed in the predetermined position. Then, the cylinder **2** is inserted in the upper opening of the storage tank **1** in axially parallel relation with the valve actuating unit B, and the fluid introducing valve **15** is connected to the actuating piston **13** by the nut **40** within the cylinder **2.** Subsequently, the piston **5** is disposed slidably within the cylinder **2,** and the supporting plate **4** is fixed to the storage tank **1** to support the cylinder **2** in the predetermined position.

It will be seen that the cylinder **2** has an open internal space which communicates with the atmosphere surrounding the storage tank **1,** and the piston **5** is disposed in this internal space of the cylinder **2.** By virtue of such structure, the operating device can be very easily assembled in spite of the fact that the storage tank **1** has a narrow internal space.

FIGS. **3** and **4** show a second embodiment of the circuit breaker operating device according to the present invention. This second embodiment is generally similar in construction to the first embodiment. Thus, like parts are designated by adding **100** to the corresponding ones of the first embodiment and any detailed description as to such parts will not be given herein.

In the second embodiment, an actuating piston **113** to which a fluid introducing valve **115** is fixed has a valve portion **152** so that this actuating piston **113** can act also as a fluid shut-off valve. In the circuit making position in which the fluid introducing valve **115** is in fluid-tight engagement with a valve seat **150** formed in a cylinder **102,** the valve portion **152** of the actuating piston **113** is also in fluid-tight engagement with a valve seat **153** fixed to a valve casing **107.** Relatively loose fluid-tightness is allowable between the actuating piston **113** and the inner wall of the valve casing **107** in the circuit making position of the operating device due to the fact that the actuating piston **113** itself acts as the fluid shut-off valve. In spite of this advantage, however, such difficulty arises that, in the circuit making position of the operating device, satisfactory fluid-tight engagement must be always maintained between the fluid introducing valve **115** and the valve seat **150** and between the actuating piston **113** and the valve seat **153.** This defect becomes marked when thermal expansion occurs in the individual parts.

More precisely, if an actuating unit A for actuating the circuit breaking mechanism and an actuating unit B for actuating the fluid introducing valve **115** were fixed in a storage tank **101** in a manner as shown in the first embodiment, the fluid introducing valve **115** hermetically closing the inlet port **116***a* of the cylinder **102** would not make satisfactory fluid-tight engagement with the valve seat **150** and mal-operation of the circuit breaker would result due to the fact that the units A and B and the storage tank **101** may make thermal expansion of different degrees depending on the materials and ambient conditions.

A suitable means is provided in the second embodiment of the present invention in order to obviate such a defect. This means comprises a plurality of connecting members **20** as shown in FIGS. **3** and **4** which connect rigidly the upper end of the valve casing **107** in the valve actuating unit B to the cylinder **102** in the circuit breaking mechanism actuating unit A. The number and thickness of these connecting members **20** are selected so as not to obstruct the flow of the operating fluid into a main introducing space **116.**

The circuit breaking mechanism actuating unit A and the valve actuating unit B are disposed opposite to each other in axially parallel relation, and the valve actuating unit B is disposed so as to be slidable in the axial direction thereof relative to the storage tank **101** while being maintained in fluid-tight relation with the storage tank **101** by means of a gasket **108.** Thus, the difference between the coefficients of thermal expansion of the units A, B and the storage tank **101** can be absorbed by the sliding movement of the valve actuating unit B, and mal-operation of the circuit breaker due to incomplete fluid-tight engagement between the fluid introducing valve **115** and the valve seat **150** can be prevented.

The term "axially parallel relation" is used to denote such a relationship that the axis of the valve actuating unit B registers with or is suitably parallelly displaced from the axis of the cylinder **102** which is the stationary part of the circuit breaking mechanism actuating unit A. In other words, the cylinder **102** and the valve actuating unit B are mechanically connected to each other by the connecting members **20** in such a relationship that the valve actuating unit B is movable in the same axial direction as that of the cylinder **102** when thermal expansion occurs. Therefore, the force tending to move the fluid introducing valve **115** away from the valve seat **150** due to the different coefficients of thermal ex-

pansion of the units A, B and storage tank **101** is absorbed to cause corresponding downward movement of the valve actuating unit B.

It will be understood from the foregoing detailed description that, in the present invention, the inlet port **16a** for the operating fluid is disposed within the operating fluid storage tank **1**, and the fluid introducing valve **15** is disposed to partition directly the space within the storage tank **1** containing the operating fluid from the main introducing space **16** into which the operating fluid is filled during the circuit breaking operation for imparting the contact parting force to the movable contact of the circuit breaker. Thus, the operating fluid can be filled in the main introducing space **16** as soon as the fluid introducing valve **15** is actuated by the valve actuating unit B. Further, due to the fact that no fluid supply pipes exist in this portion, no pressure loss occurs and the operating fluid in the storage tank **1** can be fully effectively utilized so as to shorten the length of time required for actuating the piston **5**.

Further, in the present invention, the main introducing space **16** is defined between the cylinder **2** and the piston **5** imparting the contact parting force to the movable contact of the circuit breaker, and the inlet port **16***a* of the cylinder **2** having the main introducing space **16** therein is openably closed by the fluid introducing valve **15**. The cylinder **2** in the circuit breaking mechanism actuating unit A is disposed opposite to and mechanically connected with the valve actuating unit B in axially parallel relation, and the valve actuating unit B is arranged to be slidable in the axial direction thereof relative to the storage tank **1** while being maintained in fluid-tight relation with the storage tank **1**. Thus, even when the circuit breaking mechanism actuating unit A, valve actuating unit B and storage tank **1** have different coefficients of thermal expansion, the force tending to move the fluid introducing valve **15** away from the associated valve seat can be absorbed by the slidable connection to prevent mal-operation of the circuit breaker due to incomplete fluid-tight engagement of the fluid introducing valve **15** with the valve seat. Furthermore, the overall size of the circuit breaker can be reduced due to the fact that the entirety or portions of the operating device can be disposed within the storage tank **1**.

I claim:

1. A circuit breaker operating device comprising a storage tank filled with an operating fluid under pressure; circuit breaking mechanism actuating means including a cylinder fixed to said storage tank and having an inlet port disposed within said storage tank, and a first piston disposed slidably within said cylinder and operatively connected to the movable contact in the circuit breaking mechanism; a fluid introducing valve disposed to openably close said inlet port of said cylinder so as to permit flow of the operating fluid under pressure contained in said storage tank into a main introducing space defined between said first piston and said cylinder in the position in which it opens said inlet port and to shut off the flow of the operating fluid into said main introducing space in the position in which it closes hermetically said inlet port; and valve actuating means including a second piston for controlling the movement of said fluid introducing valve in response to the application of a breaking instruction signal.

2. A circuit breaker operating device comprising a storage tank connected to a compressor by a conduit and containing an operating fluid of predetermined pressure therein; circuit breaking mechanism actuating means including a cylinder fixed to said storage tank and having an inlet port disposed within said storage tank, and a first piston disposed slidably within said cylinder and operatively connected to the movable contact in the circuit breaking mechanism; a fluid introducing valve disposed to openably close said inlet port of said cylinder so as to permit flow of the operating fluid under pressure contained in said storage tank into a main introducing space defined between said first piston and said cylinder in the position in which it opens said inlet port and to shut off the flow of the operating fluid into said main introducing space in the position in which it closes hermitically said inlet port; and valve actuating means rigidly fixed to said storage tank in fluid-tight relation, said valve actuating means including a second piston for controlling the movement of said fluid introducing valve in response to the application of a breaking instruction signal.

3. A circuit breaker operating device as claimed in claim **2**, wherein said first piston and said fluid introducing valve are moved in the same direction during the circuit breaking operation, and said first piston is very slightly spaced from said fluid introducing valve in the circuit making position so that said main introducing space has a small initial volume in such position.

4. A circuit breaker operating device as claimed in claim **3**, wherein said first piston is provided with a perforation of small diameter so that the operating fluid within said main introducing space can be discharged through said perforation after the circuit breaking operation.

5. A circuit breaker operating device as claimed in claim **3**, wherein said valve actuating means includes a valve casing slidably receiving said second piston therein, and said second piston is fixed to said fluid introducing valve.

6. A circuit breaker operating device as claimed in claim **5**, wherein said second piston is normally urged by a compression spring in a closing direction of said fluid introducing valve, the direction of movement of said second piston for urging said fluid introducing valve to the open position is the same as the direction of movement of said first piston during the circuit breaking operation by being actuated by the operating fluid supplied from said storage tank through said fluid introducing valve, and said fluid introducing valve abuts said first piston in the initial stage of movement thereof in the opening direction to define a limited gap between it and the valve seat, said fluid introducing valve being then moved to its full open position with the subsequent movement of said first piston.

7. A circuit breaker operating device as claimed in claim **6**, wherein the movement of said second piston is controlled by the operating fluid contained in said storage tank.

8. A circuit breaker operating device as claimed in claim **7**, wherein said valve casing is formed with a space having an opening communicating with the atmosphere and another opening communicating with the space within said storage tank, and said openings are opened and closed by a pilot valve and a trigger valve respectively so that the operating fluid in said storage tank can actuate said second piston.

9. A circuit breaker operating device as claimed in claim **8**, wherein said opening communicating with the space within said storage tank is opened and closed by

said pilot valve normally urged in a closing direction by a compression spring, said opening communicating with the atmosphere is opened and closed by said trigger valve having an energizing coil actuated in response to the application of the breaking instruction signal, and one end portion of said trigger valve acts to urge said pilot valve to the open position against the force of said compression spring.

10. A circuit breaker operating device as claimed in claim **7,** wherein the outer diameter of said fluid introducing valve is selected to be smaller than that of said second piston.

11. A circuit breaker operating device as claimed in claim **10,** wherein said second piston is provided with a valve portion which can be brought into fluid-tight engagement with a valve seat fixed to said valve casing.

12. A circuit breaker operating device comprising a storage tank connected to a compressor by a conduit and containing an operating fluid of predetermined pressure therein; circuit breaking mechanism actuating means including a cylinder fixed to said storage tank and having an inlet port disposed within said storage tank, and a first piston disposed slidably within said cylinder and operatively connected to the movable contact in the circuit breaking mechanism; a fluid introducing valve disposed to openably close said inlet port of said cylinder so as to permit flow of the operating fluid under pressure contained in said storage tank into a main introducing space defined between said first piston and said cylinder in the position in which it opens said inlet port and to shut off the flow of the operating fluid into said main introducing space in the position in which it closes hermetically said inlet port; and valve actuating means including a valve casing, and a second piston disposed slidably within said valve casing and fixed integrally to said fluid introducing valve for controlling the movement of said fluid introducing valve in response to the application of a breaking instruction signal.

13. A circuit breaker operating device as claimed in claim **12,** wherein said valve casing in said valve actuating means is disposed slidable relative to said storage tank and is rigidly connected by connecting members to said cylinder in said breaking mechanism actuating means.

14. A circuit breaker operating device as claimed in claim **13,** wherein a gasket is provided between said valve casing and said storage tank to maintain fluid-tight engagement therebetween.

15. A circuit breaker operating device as claimed in claim **13,** wherein said first piston is provided with a perforation of small diameter so that the operating fluid within said main introducing space can be discharged through said perforation after the circuit breaking operation.

16. A circuit breaker operating device as claimed in claim **13,** wherein said second piston is normally urged by a compression spring in a closing direction of said fluid introducing valve, the direction of movement of said second piston for urging said fluid introducing valve to the open position is the same as the direction of movement of said first piston during the circuit breaking operation by being actuated by the operating fluid supplied from said storage tank through said fluid introducing valve, and said fluid introducing valve abuts said first piston in the initial stage of movement thereof in the opening direction to define a limited gap between it and the valve seat, said fluid introducing valve being then moved to its full open position with the subsequent movement of said first piston.

17. A circuit breaker operating device as claimed in claim **16,** wherein the movement of said second piston is controlled by the operating fluid contained in said storage tank.

18. A circuit breaker operating device as claimed in claim **17,** wherein said valve casing is formed with a space having an opening communicating with the atmosphere and another space communicating with the space within said storage tank, and said openings are opened and closed by a pilot valve and a trigger valve respectively so that the operating fluid in said storage tank can actuate said second piston.

19. A circuit breaker operating device as claimed in claim **18,** wherein said opening communicating with the space within said storage tank is opened and closed by said pilot valve normally urged in a closing direction by a compression spring, said opening communicating with the atmosphere is opened and closed by said trigger valve having an energizing coil actuated in response to the application of the breaking instruction signal, and one end portion of said trigger valve acts to urge said pilot valve to the open position against the force of said compression spring.

20. A circuit breaker operating device as claimed in claim **17,** wherein the outer diameter of said fluid introducing valve is selected to be smaller than that of said second piston.

21. A circuit breaker operating device as claimed in claim **20,** wherein said second piston is provided with a valve portion which can be brought into fluid-tight engagement with a valve seat fixed to said valve casing.

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