Jan. 7, 1969 W. PUCHER 3,420,972

HIGH VOLTAGE GAS BLAST CIRCUIT BREAKER

Filed June 1, 1966

Fig. 1

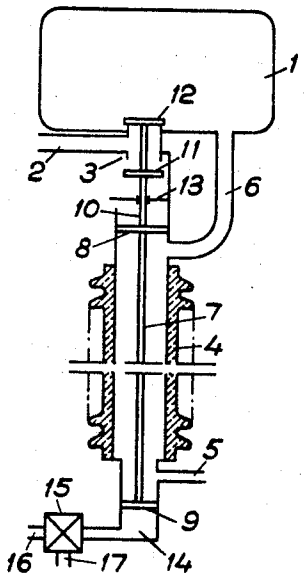


Fig. 2

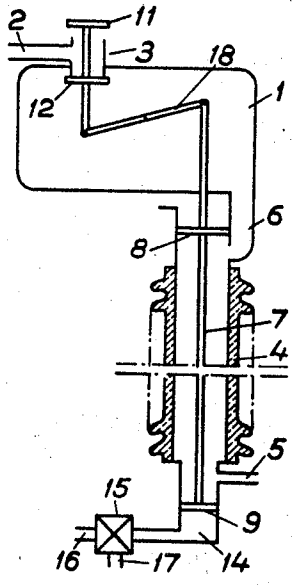


Fig. 3

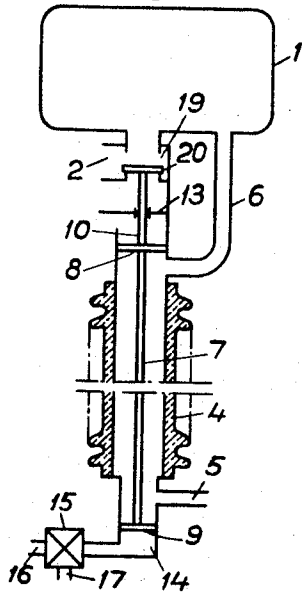


Fig. 4

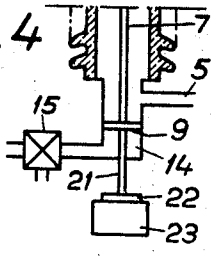
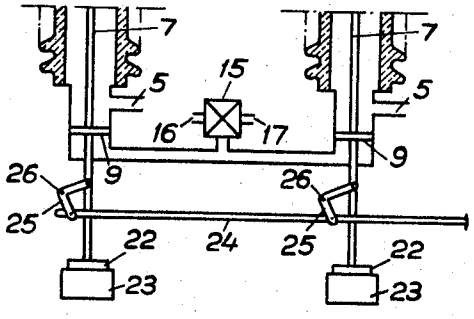


Fig. 5



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HIGH VOLTAGE GAS BLAST CIRCUIT BREAKER

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U.S. Cl. 200—148 9 Claims
Int. Cl. H01h 33/82

The present invention relates to gas blast circuit breakers for high voltage and in particular refers to a device with which such a breaker can be released very quickly when, for example, a short circuit occurs.

Due to the continually increasing short circuit power in most of the larger transmission networks for electrical energy, it is particularly desirable that the breakers intended for breaking short circuit currents have a short breaking time. By breaking time is meant the time from the moment the breaker receives the opening impulse to the moment of current interruption. In order to achieve shorter breaking times the blast valves of the power breaks and possibly the intermediate valves for the opening and closing of the breaker are usually arranged in the immediate vicinity of the power breaks at high potential. These valves must however be controlled by means of operating devices placed at earth potential and it has thus been proved to be difficult to effect a simple and sufficiently quick transmission of necessary operating pulses from earth to high potential. This problem has been particular insolvable for breakers for the highest service voltages, since these breakers can have a total height of around 10 metres and the impulses must thus be transferred over a relatively long path. Among other things this has meant that for these breakers the previously used pneumatic transfer system has proved to be too slow. The operating times can however be considerably reduced if the impulses are transferred mechanically by means of an operating rod. In order that this rod can be quickly accelerated, its mass must be small so that the rod will be long and thin. To prevent bending of this long, thin rod during the transfer of the necessary operating force, the rod has been arranged so that it is normally prestressed by a tensile force. When a rod is subjected to a tensile force, the rod is extended and with the rod lengths which are relevant here these increases in length are appreciable. The unfavourable influence this has on the operating time can be avoided by subjecting the rod to a tensile force before the breaker receives the opening impulse. The force can be effected by means of springs but in gas blast circuit breakers it has proved to be more suitable to also use the compressed gas for this purpose. In a known device which operates according to the last mentioned principle the valve member operated by the operating rod is opened in the direction of the flow of the compressed gas. This means that the sealing area of the valve member is the determining factor for the tensile force on the operating rod and for the acceleration force on the rod at the opening of the valve. From a design standpoint it is, however, a disadvantage not to be able to choose these forces regardless of said area. With another known device where compressed gas in a supporting insulator is used for effecting prestressing of the rod, the sealing means for the compressed air at both ends of the rod are relatively complicated.

The present invention provides a gas blast circuit breaker with a device for quick release which is not impaired by the above mentioned disadvantages. The gas blast circuit breaker according to the invention comprises at least one power break which is pneumatically operable

by means of a compressed gas valve placed at high potential. The movable valve member of the valve is connected to an operating device placed at earth potential by means of an insulating operating rod arranged inside a supporting insulator filled with compressed gas, which operating rod is prestressed by a tensile force when the power break is in the closed position. The device is characterised in that said prestressing is effected by means of two axially displaceable pistons connected to the rod and fitting tightly against cylinder-like surfaces at the upper and lower ends of the rod. When opening the power break the operating rod is arranged to drive the movable valve member in the direction against the flow of the compressed gas which causes the opening of the power break. With such an arrangement a particularly simple construction is obtained, since the acceleration force can be chosen without regard to the sealing area of the compressed gas valve and at the same time the tensile force on the operating rod can be kept low. Since it is the tensile force which determines, for a given maximum permissible tensile stress, the dimension and weight of the rod, the releasing time for the breaker can be made short.

According to a further development of the invention the effective pre-stressing area of the valve member is less than the area of the piston arranged at the upper end of the operating rod and further the sum of the effective pre-stressing area of the movable valve member and the area of the lower piston is greater than the area of the upper piston. In addition, the areas of the pistons intended for prestressing the rod are chosen in relation to the effective area of the movable valve member so that during the opening a great acceleration of the valve member is produced, and also the necessary prestressing pressure and distinct return of the valve member during closing are obtained.

In a specially suitable embodiment the lower end of the rod is fixed to the armature of a holding magnet which in the closed position of the power break holds the armature and thereby the rod against the influence of a vertically directed force emanating for example from the compressed gas. Through, for example, a demagnetising current impulse in the holding magnet the armature can be made to separate from the magnet poles so that a particularly short releasing time can be achieved.

High voltage gas blast circuit breakers usually have a plurality of series connected power breaks per pole and it is particularly important that all the power breaks open at the same time. With a breaker which according to the present invention is operated by means of substantially vertical operating rods this can be achieved in a particularly simple way by connecting all the operating rods together mechanically, for example, by means of a horizontal rod arranged at earth potential.

Accordingly, a primary object of this invention is to provide a novel high speed operating mechanism for gas blast circuit breakers.

Another object of this invention is to provide a novel prestressing arrangement for the mechanical operating link of a high voltage circuit breaker.

Yet a further object of this invention is to provide an improved operating mechanism for gas blast circuit breakers which uses compressed gas for prestressing the mechanical rod extending from a grounded operating mechanism to a remotely positioned interrupter at line potential.

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

FIGS. 1 and 2 schematically show in partial cross-section first and second embodiments of operating devices intended for air blast circuit breakers which open when

a conduit is put under pressure and close when the same conduit is connected to the free air.

FIG. 3 is a diagram similar to FIGS. 1 and 2 showing a modified construction for breakers which open when a conduit is connected to the free air and close when the conduit is put under pressure.

FIG. 4 is a diagram similar to FIGS. 1–3, showing an operating device placed at earth potential.

FIG. 5 is a further schematic diagram showing how a plurality of operating rods can be mechanically connected together in the embodiments of FIGS. 1–4.

In FIG. 1 a container **1** placed at high potential and permanently filled with compressed air is shown. This container can for example enclose a power break, the fixed contact **1***a* of which is supported by a bushing insulator **1***b* and the movable contact **1***c* of which is supported by a pneumatically operated mechanism **1***d*, arranged in the wall of the container. This mechanism **1***d* is intended for operating the movable contact and for opening and closing the channels for the compressed air by means of a so-called blast valve. Arrangements of this type are well known, and no detailed description is needed by one skilled in the art. Through a conduit **2** and an intermediate valve **3** the operating mechanism can be connected either to the compressed air container **1** or to the free air. The container **1** is supported by a hollow supporting insulator **4** which besides supporting the container **1** at high potential also serves as a pneumatic connection between container **1** and the mechanism **1***d* and the lower part of the breaker. The lower end of supporting insulator **4** is connected to a compressed air source **5***a*, through a conduit **5**, while its upper end is connected with the container **1** through the conduit **6**. Inside the supporting insulator **4** an operating rod **7** of insulating material is arranged, which at its upper end is provided with a piston **8** and at its lower end with a piston **9** having a smaller diameter than piston **8**. The pistons **8** and **9** are axially displaceable within the cylinder-like space at the upper and lower ends of the supporting insulator. Suitable seals (not shown) are arranged between the pistons and the cylinder surfaces. The top of the operating rod **7** is connected to valve discs **11** and **12** of the intermediate valve **3** by means of a valve rod **10**. A screen **13** is arranged between the valve disc **11** and the piston **8** for preventing this piston **8** from being influenced by the compressed air which during the operation of the system flows out past the valve disc **11**. A cylinder space **14** below the piston **9** which is at earth potential can, by means of an operating valve **15**, be connected either to a compressed air conduit **16** or to the free air through the opening **17**.

With the intermediate valve **3** in the position shown in FIG. 1 the conduit **2** is connected to the free air and the power break is closed. The container **1** and the supporting insulator **4** are filled with compressed air, while the space **14** is connected to the free air through the operating valve **15** and the opening **17**. The operating rod **7** is biased downward by the pressure on the piston **9** and the valve disc **12** and by the force of gravity a counterforce in an upward direction is also applied by the pressure on the lower side of the piston **8**. Since the sum of the effective areas of the valve disc **12** and the piston **9** is greater than the corresponding area of the piston **8**, the valve disc **12** will be pressed against its valve seat with a certain net downward force. Further, the operating rod **7** will be subjected to a tensile force the magnitude of which depends on the overpressure of the enclosed air and the area of the piston **9**. The valve rod **10** will on the other hand be prestressed by a compressive force, but this is no disadvantage since this rod is relatively short and besides does not need to be made of insulating material. If now the power break is to be opened, for example during a short circuit, the operating valve **15** will receive an opening impulse so that the space **14** below the piston **9** is connected to the conduit **16** and is thereby filled with compressed air, for example of the same pressure as in the supporting insulator **4**. Since the area of the piston **8** is greater than the effective area of the valve disc **12**, the valve disc **12** will open the connection between the container **1** and the conduit **2**, while the valve disc **11** closes the connection to the free air. The conduit **2** is then filled with compressed air, so that the power break opens and remains open as long as the space below the piston **9** is kept filled with compressed air. When the power break is to be closed, the space below the piston **9** is emptied of compressed air through the valve **15** and the opening **17**, so that the valve discs **11** and **12** return to the position shown in FIG. 1. The compressed air in the conduit **2** and in the operating mechanism **2***d*, then flows past the valve disc **11** and out into the free air, so that the power break is closed.

In the device according to FIG. 2 (in which similar numerals represent similar parts): the positioning of the intermediate valve **3** is changed from that of FIG. 1 and the valve is connected to the operating rod **7** by means of a lever **18** pivoted on pivot **18***a*. With this arrangement the stroke length of the operating rod **7** can be chosen without regard to the stroke length of the valve discs **11** and **12** and besides the effective area of the valve plate **12** does not need to be less than the area of the piston **8** as with the device according to FIG. 1. In all other respects the two devices shown are the same.

The device according to FIG. 3 is intended for breakers with such an operating mechanism that the power break is closed as long as the conduit **2** is subjected to pressure, but is opened when this conduit is connected to the free air. Due to this different method of operation of the breaker instead of the intermediate valve **3** shown in FIGS. 1 and 2, another intermediate valve **19** with a valve disc **20** which is displaceable between a lower and an upper valve seat can be used. The operation of the device according to FIG. 3 is otherwise similar to that described in connection with FIG. 1.

In FIG. 4 another modification of the portion of the operating device arranged at earth potential is shown. The lower end of the operating rod **7** has a rod **21** permanently fixed thereto which carries the armature **22** of a magnet **23**, which holds the operating rod in the position which corresponds to closed power break. The space **14** below the piston **9** is filled with compressed air, so that the rod **21** is permanently prestressed by a vertically directed force of magnet **23** counteracting the holding force. The magnet **23** can for example be of the type which comprises a permanent magnet which generates a magnetic flux through armature **22**. By providing a current impulse through a suitable release coil arranged in the magnet **23** (not shown) or by mechanically shunting the flux through the armature **22** the armature **22** can be made to separate from the magnet **23** at a desired time so that the valve arranged at high potential changes position and the power break is opened. The closing can, for example, be effected by emptying the space **14** with the valve **15**, whereby the rod **7** moves up and the breaking gap is closed. The cylinder space **14** is filled immediately afterwards with compressed air again so that the breaker is ready to carry out a new opening.

FIG. 5 shows how a plurality of vertical operating rods **7** can be connected together mechanically in order to achieve simultaneous opening of several electrically power breaks connected in a predetermined arrangement. The vertical rods are connected with each other by a horizontal connecting rod **24** which is connected to the vertical operating rods by means of links **25**. Links **25** are supported in bearings **26** which are suitably guided to be laterally, but not vertically, movable, whereby the operating rods are not subjected to bending. If one of the magnets **23** now receives a releasing impulse, the corresponding operating rod will be forced upwards, so that the connection rod **24** is moved to the right, which means that also the other operating rods are forced upwards. Such a me-

chanical connection ensures that on a single impulse all the power breaks open, even if there should be a fault in one of the magnets **23**, for example interruption in a magnet coil. Closing of the power break and resetting of the operating rods can also be effected by means of a pneumatically actuated piston connected to the connection rod **24** (not shown). With the last mentioned embodiment the pistons **9** and the connections through the valve **15** to the cylinder spaces **14** could be eliminated and the valve **15** used instead for operating the piston connected to the operating rod **24**.

Other embodiments of the invention than those shown are also feasible. The operating rod **7** thus does not need for example to prestress said blast valve, not shown, of the power break indirectly through an intermediate valve, but can instead be directly mechanically connected to the blast valve. Although this invention has been described with respect to its preferred embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of the invention be limited not by the specific disclosure herein, but only by the appended claims.

I claim:

1. An operating device for a high voltage gas blast circuit breaker; said high voltage gas blast circuit breaker including a support; a conductive chamber supported from said support; a passage for control of the circuit breaker; valve means for selectively connecting said passage to the interior of the conductive chamber and to free air; an operating device connected to said valve means; said operating device including an insulation rod extending downwardly from said conductive chamber; first and second pistons connected to upper and lower portions, respectively of said rod; cylinder means receiving said first and second pistons; and high pressure gas supply means connected to said cylinder means intermediate said first and second pistons and to said conductive chamber; said insulation rod between said first and second pistons being prestressed by the pressure of said gas supply means acting against said first and second pistons; said valve means including a movable valve member exposed to the pressure within said conductive chamber, and operating means connected to the bottom of said rod for moving said rod upwardly to move said valve member in a direction which causes opening of the circuit breaker.

2. The operating device as claimed in claim **1**, in which said upward movement connects said passage to the conductive chamber.

3. The operating device as claimed in claim **1**, in which said upward movement connects said passage to free air.

4. The operating device as set forth in claim **1**, wherein the effective area of the top of said movable valve member is less than the effective area of said first piston.

5. The device as set forth in claim **4**, wherein the sum of the effective areas of said movable valve member and said lower piston is greater than the effective area of said upper piston.

6. The device as set forth in claim **1**, wherein said operating means includes valve means for selectively connecting the bottom of said second piston to a source of high pressure or to atmospheric pressure.

7. The operating device as set forth in claim **3**, wherein the effective area of the top of said movable valve member is less than the effective area of said movable valve member and said lower piston being greater than the effective area of said upper piston.

8. The device as set forth in claim **6**, which includes a magnet armature connected to the bottom of said insulation rod, and a fixed magnet receiving said armature in the lowest position of travel of said insulation rod; said rod moving upwardly when said armature is released by said magnet under the force of the pressure acting on said first piston.

9. The device as set forth in claim **8**, which includes a plurality of identical circuit breakers and operating devices therefor; and means for interconnecting each of the insulation rods associated with each of said operating devices for simultaneous movement.

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