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[54] **COMPRESSED GAS CIRCUIT BREAKER**

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[52] **U.S. Cl.** ..... **200/148 A**

[51] **Int. Cl.** **H01h 33/70**

[58] **Field of Search** ..... 200/148 A, 148 R

[56] **References Cited**

UNITED STATES PATENTS

3,551,624 12/1970 Fischer ..... 200/148 A

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Attorney, Agent, or Firm—Kenyon & Kenyon Reilly Carr & Chapin

[57] **ABSTRACT**

An electric compressed gas circuit breaker has cooperating stationary and movable contacts and an arc blasting assembly including a stationary blast piston and cooperating therewith, a blast cylinder made of electrically insulating material and having a bottom to which the movable contact is mounted. During circuit breaking, the cylinder's bottom is moved to separate the contacts, the cylinder having an end provided with a nozzle which, due to the cylinder's simultaneous movement relative to the stationary piston, further compresses the gas in which the assembly operates, so that an arc extinguishing blast is ejected through this nozzle. The cylinder is made from electrically insulating material and the bottom removably connects with the cylinder's end remote from its nozzle, by the cylinder's inside having a keyway and its bottom having a key cooperating with this keyway in a removable manner. This keyway is an annular keyway extending circumferentially around the inner surface of the cylinder and this key is a segmented annular key having a circumferential portion inserted in this keyway and a circumferential portion in axial abutting relationship with the bottom in the direction the bottom transmits the moving force to the cylinder during the circuit breaking operation. Means are provided for removably fastening this annular key in the described relationship with the bottom. It follows that the mechanical stress resulting from the transmission of force between the bottom and the cylinder is distributed uniformly throughout the cylinder.

7 Claims, 3 Drawing Figures

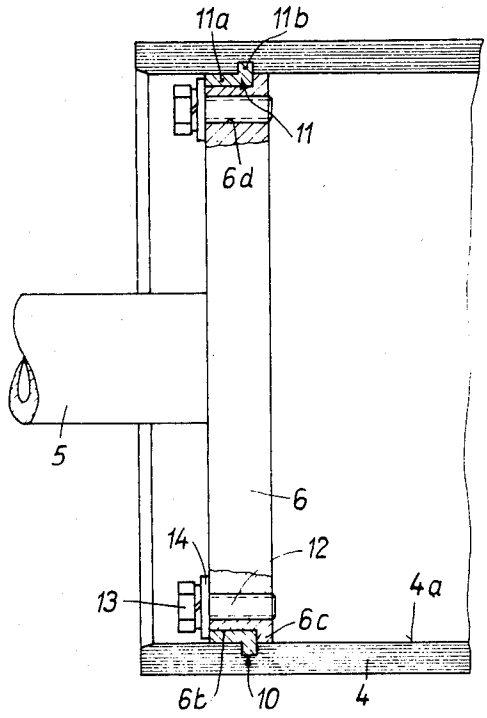


Fig. 1

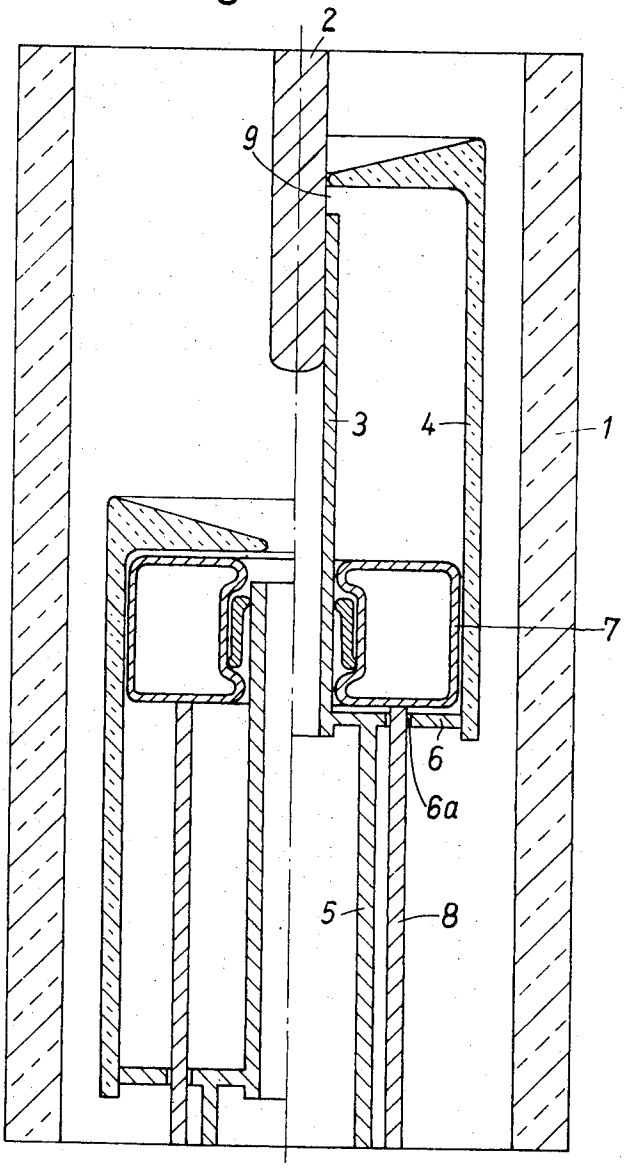


Fig. 2

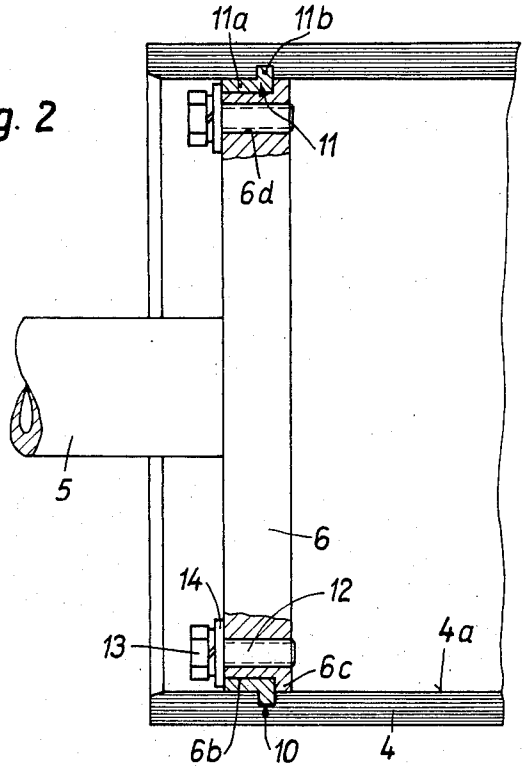
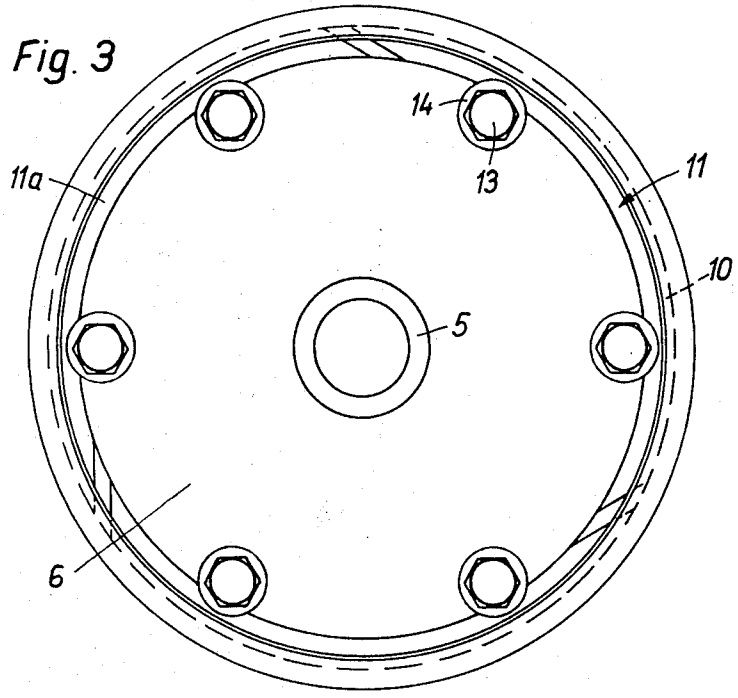


Fig. 3



COMPRESSED GAS CIRCUIT BREAKER

BACKGROUND OF THE INVENTION

An electric compressed gas circuit breaker has its elements operating in an electrically insulating housing confining compressed gas surrounding these elements. These elements include cooperating stationary and movable contacts, the movable contact being operated by a mechanism responsinve to electrical overloading or other conditions to quickly move the movable contact from the stationary contact to break the electric circuit protected or controlled by the circuit breaker. When the electrical potential and power involved is enough to result in an arc being drawn between the separating contacts, an arc blasting assembly may be used, which further compresses the compressed gas and ejects the gas through a nozzle directed to blast out the arc.

DESCRIPTION OF THE PRIOR ART

German Pat. No. 1,069,740 discloses the concept of such a circuit breaker having a blast cylinder connected to move with the movable contact so that the two are moved together during the circuit breaking action, the blast cylinder containing a stationary piston and further compressing the compressed gas by the relative movement between it and the cylinder, and the latter having a gas jet nozzle which ejects this further compressed gas into the arc.

In the above patented construction the blast cylinder is reciprocatively mounted and guided by a plurality of cooperating guide rods interassociated by rollers, and the cylinder has external laterally projecting arms for connection with actuators which pull the movable contact and the cylinder during the circuit breaking and arc blasting action. This construction is bulky and requires an undesirably large diameter housing for confining the compressed gas. The construction is also undesirably complicated and, therefore, expensive. When servicing is necessary, the disassembly and reassembly of all of the parts involved is excessively time consuming.

In the above referred to circuit breaker, the end of the blast cylinder, which moves towards the piston and which may be referred to as the top end, mounts both the movable electric contact and the blast nozzle; and the cylinder, through its external laterally projecting arms, receives the actuating force during circuit breaking. Therefore, the cylinder is subject to high stresses and is made of metal.

In another form, shown by German published patent application No. 1,913,969, the blast cylinder does not require the space-occupying external laterally projecting arms because the movable contact is connected with the blast cylinder's bottom, by which is meant the blast cylinder's end opposite its end having the gas blast nozzle. Therefore, the blast cylinder can be pulled or actuated, to open the circuit and create the blast, by means other than the external laterally projecting arms or the like.

SUMMARY OF THE INVENTION

One object of the present invention is to provide an electric compressed gas circuit breaker with an arc blasting assembly of the type described, with the blast cylinder made of electrically insulating material and with the movable contact mechanically connected with this cylinder's bottom, and with the latter connecting with this cylinder in a removable manner to permit simplified initial assembly of the parts and subsequent easy servicing, and in such a manner that the mechanical stresses involved during circuit breaking and blast creating are distributed circumferentially uniformly and widely throughout the cylinder's wall as is desirable when the latter is made from insulating material.

According to the invention, this object is attained by making the blast cylinder's bottom separate from the blast cylinder and inserted in the lower end of the latter, the bottom's periphery axially slidably engaging the cylinder's inner surface, the latter being formed with a radially extending keyway means and the bottom having key means extending therefrom radially into this keyway means, the key means having means for releasably fastening them to this bottom to fasten the latter and the cylinder together.

The above radially extending keyway means is formed by an annular keyway extending circumferentially around this surface. The keyway is in the form of a continuous circumferentially uninterrupted groove extending partially through the thickness of the wall. The cylinder's bottom is partially undercut in an axial direction circumferentially from its outside surface inwardly while leaving a flange having its periphery slidably inserted in the cylinder. The key means comprises a segmented annular key having a cylindrical portion removably fitting the undercut portion of the bottom and a flange extending radially into the annular keyway. In this way the annular key is in abutting relationship with the bottom in the direction receiving the force during the circuit breaking operation. The key's cylindrical portion substantially fits the cylinder's inner surface. The removable fastening means holds this annular key with its inner end butted axially against the bottom's flange; or in other words, in the abutting relationship. The fastening means may comprise screw fastenings having threaded shanks screwed into threaded holes formed in the bottom and head elements on the outside of the bottom and engaging the key and holding its segments in abutting relationship. These fastenings are stressed only during closing or resetting of the circuit breaker. The screw fastenings are accessible from the outside of the bottom.

It follows that with this arc blasting assembly, the cylinder may be made of insulating material which, of course, is of less mechanical strength than metal; the need for external radially projecting arms is eliminated, thereby permitting a smaller overall circuit breaker housing, and initial assembly and subsequent servicing is simplified.

DESCRIPTION OF THE DRAWINGS

Having reference to the accompanying drawings:

FIG. 1, in longitudinal section, schematically shows a high voltage power circuit breaker with a blasting assembly, the parts being shown on the right-hand side of the broken line in the circuit closing position and on the left-hand side of this line being shown in circuit breaking position;

FIG. 2, in longitudinal section, shows the blast cylinder bottom construction of the present invention; and

FIG. 3 shows a bottom end view of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIG. 1, it is to be understood that this is drawn in an extremely schematic and simplified manner for the purpose of showing the general construction and operation of a compressed gas circuit breaker adapted for use with high voltage electric power currents.

In this figure only a portion of the fully enclosing housing 1 of the circuit breaker is shown. This housing may be cylindrical and made of insulating material and confines the compressed gas. The gas may be SF_6. A stationary electric contact 2 is positioned in the upper end of the housing 1 and supported by the latter by means which are not shown. The movable contact 3 is connected with the blast cylinder 4 made of insulating material, this contact 3 and cylinder 4 being actuated together by an actuator or drive rod 5 connected with a suitable mechanism (not shown) which, when tripped for any reason, pulls the rod 5 downwardly, this rod connecting with the blast cylinder's bottom 6 to which both the contact 3 and cylinder 4 are connected. A stationary annular piston 7 is positioned inside of the cylinder 4 by a plurality of supporting members 8 which pass through holes 6a in the cylinder's bottom 6. The upper end of the blast cylinder 4 is closed excepting for the blast jet orifice 9.

When the contact 3 and cylinder 4 are in the circuit-open position, as represented on the leftside of the broken line in FIG. 1, and are then moved to the circuit-closed position shown on the right side of this line, the blast cylinder 4 becomes filled with the compressed gas in the housing 1. When the circuit breaker mechanism is tripped by an electrical overload or for other reasons, the tubular drive rod 5 is pulled downwardly very rapidly, the stationary piston 7 on which the blast cylinder slides ejecting the compressed gas in the form of a blast through the blast orifice 9, and blasting out any arc that may form.

It can be seen that the actuating force exerted by the drive rod 5 is applied to the blast cylinder's bottom 6 which mounts both the movable contact 3 and the cylinder 4, and that enough force must be involved to mechanically separate the contacts and to further compress the compressed gas to produce the arc extinguishing blast. This force must be transmitted to the lower end of the blast cylinder 4 through its bottom 6.

In FIGS. 2 and 3 only the parts required to illustrate the principles of the present invention are shown. Thus, the holes 6a of FIG. 1 are not shown and the movable contact 3 is also eliminated. The present invention is concerned with the connection of the cylinder 4 with its bottom 6.

As shown by FIG. 2, the bottom 6 is separate from the cylinder 4, the latter being made of a laminated molded plastic. The inner surface 4*a* of the cylinder 4 is formed with an annular groove 10 extending circumferentially and without interruption around this surface to form the keyway. This groove 10 is rectangular in cross-section and it extends only partially through the wall of the cylinder 4. The cylinder's bottom 6 is partially undercut in an axial direction, as at 6*b*, leaving a flange 6*c* slidably inserted in the cylinder and peripherally fitting the latter's inner surface 4*a*.

The segmented annular key 11 is in the form of at least three segments, as indicated by FIG. 3, the segmenting cuts in the ring being angular with respect to the radius of the ring so that the segments can be fitted in the annular keyway. The annular key 11 has a cylindrical portion 11a removably fitting the undercut portion 6*b* in the periphery of the bottom 6, and a flange 11*b* extending radially into the keyway 10. The bottom 6 is formed with an annular series of threaded holes 6*d* into which a corresponding number of cap screws 12 are screwed. The heads 13 of these screws bear against washers 14 having a diameter large enough to abut against the outer end of the cylindrical portion 11a of the annular key 11 to hold the latter in position and take the force of closing the circuit breaker.

It is to be understood that the drive rod 5, the bottom 6, the segmented annular key 11, and the fastening elements 13 and 14, are all made of metal and are, therefore, easily designed to have adequate structural strength to handle the load imposed by the rapid movement involved by the circuit breaking operation. Because the cylinder 4 is made of electrically insulating material, and therefore, non-metallic material, and because its wall should not be made unnecessarily thick to perform its blast forming function, its ability to handle the mechanical force involved requires attention. It can be seen that with the annular key and keyway the mechanical stress is distributed uniformly from the periphery of the bottom 6 to the cylinder 4. The fastenings, such as the cap screws illustrated, should be uniformly interspaced and used in sufficient number to provide the necessary mechanical strength required during closing or resetting of the circuit breaker.

Because the heads 13 of the cap screws are on the outside or bottom side of the bottom 6, they are easily accessible both for initial installation and subsequent removal of the bottom for servicing. The segmented annular key should be made in at least three segments. During installation the bottom 6 is inserted far enough in the cylinder to provide clearance from the annular keyway 10. The key segments are placed in this keyway one after the other, and the bottom then retracted into the abutting relationship previously described. Thereupon the cap screws 12, having the washers 14 under thier heads 13, may be screwed snugly into position so that the abutting relationship is maintained during resetting of the circuit breaker.

With this new construction, an electric compressed gas circuit breaker may be made more compactly, particularly in its transverse or lateral direction. Externally, the cylinder may be entirely free from any projections or extensions. The described features provide simplified initial assembly of the parts and subsequent easy servicing and in such a manner that the mechanical stresses involved during circuit breaking and blast creating are distributed circumferentially uniformly throughout the cylindrical wall, as is desirable when the latter is made from insulating material.

It is to be noted that the cap screws 12 are required only during reclosing or resetting of the circuit breaker, which action does not ordinarily involve either substantial force or speed. During circuit breaking, when the cylinder must be pulled down rapidly, the cap screws are not required at all. The annular key 11 is held in the annular keyway by the radially abutting relationship it has with the undercut 6*b* of the bottom. The radial flange 6*c* of the bottom is in continuous peripheral or circumferential contact with the annular key 11 where the two respective parts butt together. The mechanical

stress distribution is substantially completely uniform with respect to the peripheral connection between the bottom and the cylinder.

What is claimed is:

1. An electric compressed gas circuit breaker having cooperating stationary and movable contacts and an arc blasting assembly including a stationary blast piston and cooperating therewith a blasting cylinder made of electrically insulating material and having a bottom to which said movable contact is mounted; wherein the improvement comprises said bottom being separate from said cylinder and inserted therein with the bottom's periphery axially slidably engaging the cylinder's inner surface, the latter being formed with an annular keyway extending circumferentially therearound, a segmented annular key having a circumferential portion inserted in said keyway, and a circumferential portion in axial abutting relationship with said bottom, and means for removably fastening said annular key in said relationship with said bottom.

2. The circuit breaker of claim 1 in which said annular key has at least three segments, and all of its segments are of substantially equal circumferential lengths.

3. The circuit breaker of claim 1 in which said bottom is partially undercut in an axial direction circumferentially from its outside inwardly while leaving a flange slidably inserted in said cylinder, said key having a cylindrical portion removably fitting said undercut portion of said bottom and a flange extending radially into said keyway, and said removable fastening means holding said key with its inner end butted axially against said bottom's flange, said key's cylindrical portion substantially fitting said cylinder's inner surface.

4. The circuit breaker of claim 3 in which said fastening means is accessible from the outside of said bottom and removable therefrom.

5. The circuit breaker of claim 4 in which said segmental key is made of at least three segments and all of its segments are of substantially equal circumferential lengths.

6. The circuit breaker of claim 5 in which said fastening means comprise screw fastenings having threaded shanks screwed into threaded holes formed in said bottom and head elements on the outside of said bottom and engaging said key and holding its segments in said butted manner.

7. The circuit breaker of claim 6 in which said screw fastenings are symmetrically located circumferentially with respect to said segments.

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