Dec. 25, 1956 W. C. GEIGER, JR 2,775,670

COMBINED AIR PUFFER AIR BUFFER FOR CIRCUIT BREAKERS

Filed Sept. 4, 1953 3 Sheets-Sheet 1

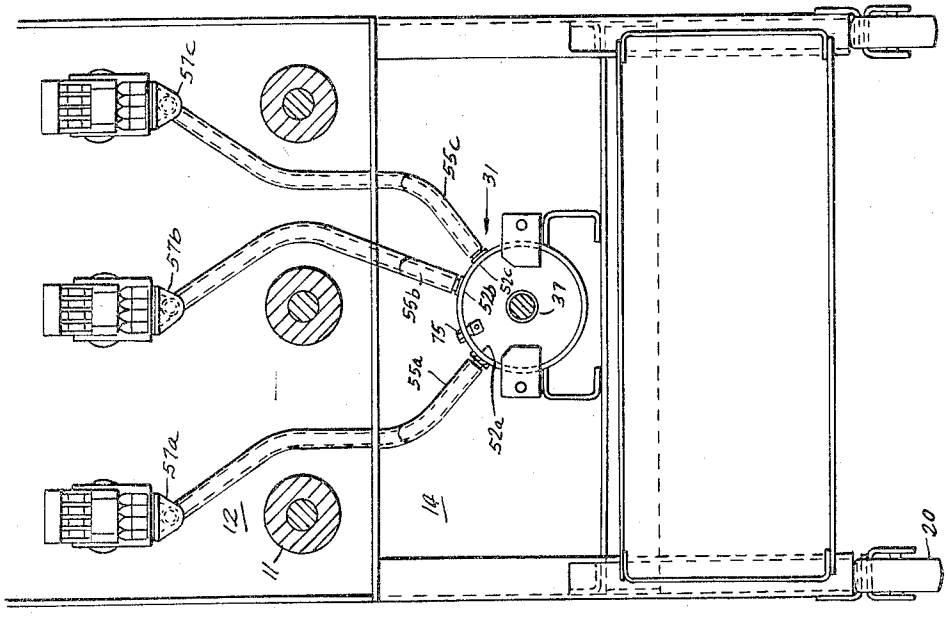


FIG. 2

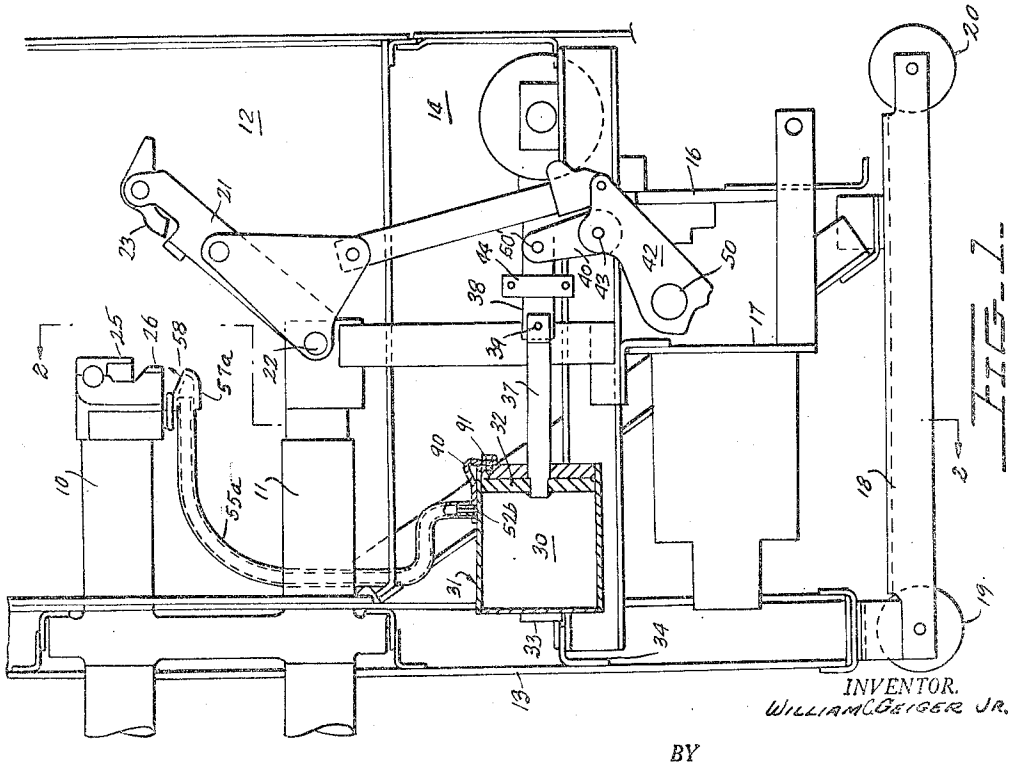


FIG. 1

INVENTOR.
WILLIAM C. GEIGER JR.

BY

Ostrolenk & Dabes

ATTORNEYS

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FIG. 4.

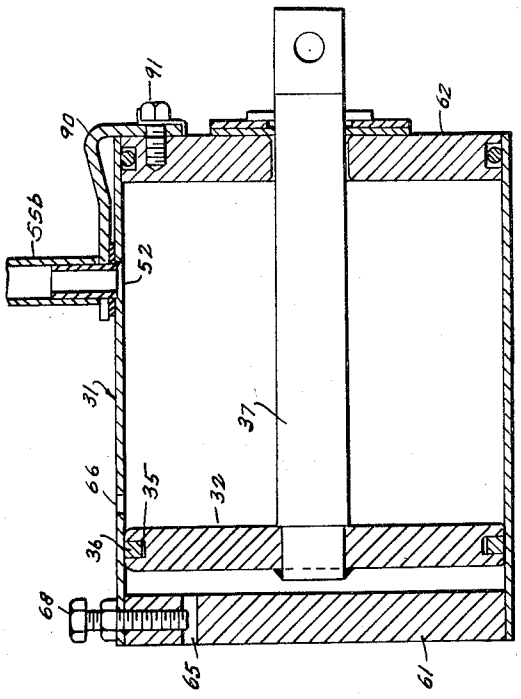
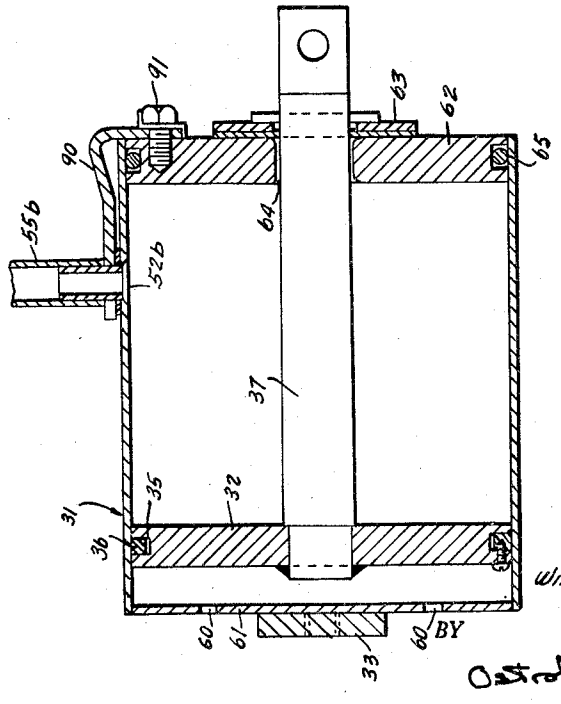


FIG. 7.



INVENTOR.
WILLIAM C. GEIGER JR.

BY

ATTORNEYS

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COMBINED AIR PUFFER AIR BUFFER FOR CIRCUIT BREAKERS

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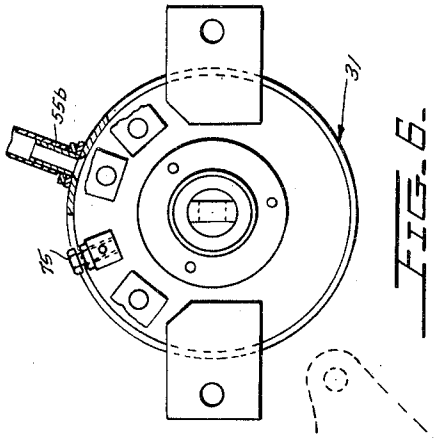


FIG. 6.

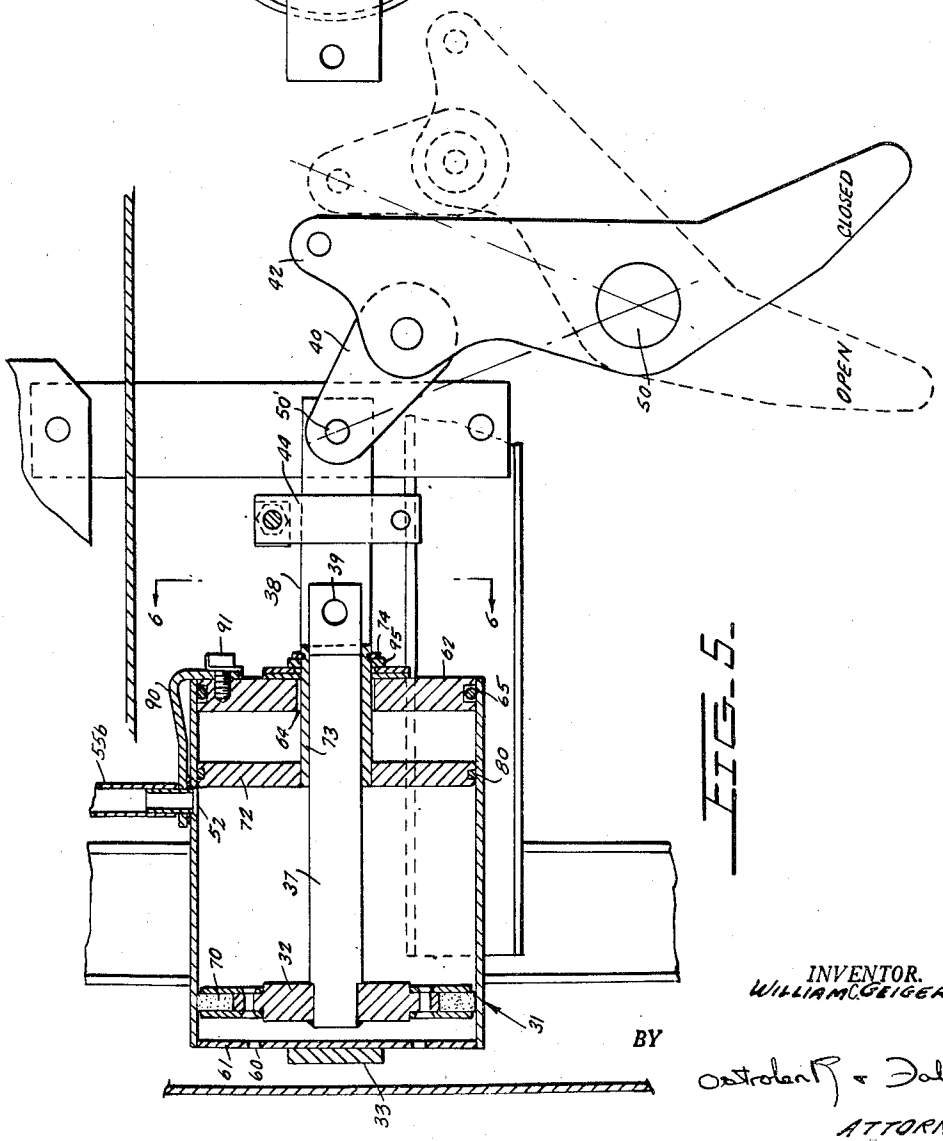


FIG. 5.

INVENTOR.
WILLIAM C. GEIGER JR.

BY

Ostrolenk & Faber

ATTORNEYS.

United States Patent Office 2,775,670 Patented Dec. 25, 1956

2,775,670

COMBINED AIR PUFFER AIR BUFFER FOR CIRCUIT BREAKERS

William C. Geiger, Jr., Philadelphia, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa.

Application September 4, 1953, Serial No. 378,613

8 Claims. (Cl. 200—148)

My invention relates to a puffer buffer device for circuit breakers and is more particularly directed to a piston cylinder arrangement which performs the dual function of an air puffer and an air buffer.

In the operation of automatic interrupting equipment, it is frequently desirable to provide an air puffer in order to transfer the arc from the arcing contacts and aid in the extinguishment of the arc. This is particularly desirable for a circuit breaker which relies on a magnetic blow out in order to lift the arc into the arc chute. That is, in the event the circuit breaker is required to interrupt a low magnitude fault current, the magnetic force created by the ampere turns of the blow out coil may not create a sufficient force to pull the arc into the arc chute. Hence, on magnetic blow out circuit breakers, it is particularly desirable to provide them with an air puffer device which operates independently of the magnitude of the fault current being interrupted to thereby force the arc off the arcing contacts in the event of an interruption of a relatively low magnitude fault current.

In addition to the desirability of providing circuit interrupting equipment with an air puffer, it is also desirable to provide such equipment with a buffer which will be effective during the opening operation of the circuit breaker.

When the circuit breaker is automatically opened to interrupt an arc, the cooperating contacts usually must separate within a period of time less than one half cycle. Thus, in view of the fact that the speed of opening is rapid, a rebound frequently occurs.

In the event the arc is extinguished while the cooperating contacts are being moved apart, it is possible that the bridge or movable contact arm may rebound after reaching its maximum distance from the stationary contact and thereby possibly cause restriking of the arc.

In circuit breakers which are designed for a predetermined amount of rebound, it is necessary to make the distance between the bridge and the stationary contact, when the bridge is in the fault position, a sufficient distance to prevent restriking. Thus, this means that the circuit breaker must be able to charge in order to provide for the extra rebound distance.

With a buffer arrangement, the rebound of the circuit breaker moving arm can be eliminated thereby enabling a design in which restriking is prevented although utilizing a minimum amount of space between the bridge and the stationary contact when the circuit breaker is in the open position. In addition to this feature, a buffer device on the circuit breaker will also absorb shock and thereby provide a quiet opening of the interrupting apparatus.

With the novel device of my invention, I have provided a piston cylinder arrangement which combines the above mentioned desirable air puffer and air buffer in a single unit. This device is constructed so that the initial movement of the piston will result in the creation of extreme high velocity air into the vicinity of the cooperating contact to serve as an air puffer to transfer the arc. Continued movement of the same piston comprises additional air at one end of the cylinder to thereby serve as an air buffer during the opening portion of the circuit breaker irrespective of the breaker.

The combined air puffer and air buffer device of my invention will function to transfer the arc and provide shock absorbing means irrespective of the magnitude of the fault current being interrupted. That is, whenever the cooperating contacts and the circuit breaker are separated, the combined air puffer air buffer will operate regardless of the reason for the separation thereof.

In the construction of my novel device, the bridge or movable contact arm of the circuit breaker is only retarded at the final portion of the opening stroke. That is, due to the compressibility of the air as is well known by the gas laws, the high retarding pressure will only be built up near the end of the closing stroke and there will be no retarding motion during the major portion of the opening operation.

Accordingly, a primary object of my invention is to provide a novel device which during the initial opening operation functions as an air puffer and during the latter portion of the opening operation serves as an air buffer.

Another object of my invention is to provide an attachment for a circuit interrupting equipment in which a piston cylinder arrangement will direct an air stream in the area of the cooperating contacts during the initial opening operation and thereafter sufficiently compress air to provide a buffing action to prevent rebound of the bridge and the circuit breaker.

Another object of my invention is to provide a combined air puffer air buffer which utilizes straight-line motion wherein a single piston will serve the dual function of providing a high velocity stream of air for transferring the arc and thereafter provide a cushioning effect for the opening components.

Still another object of my invention is to provide a single cylinder and single piston arrangement which will serve as a combined air puffer air buffer for the three pole circuit breaker.

Another object of my invention is to provide a piston cylinder arrangement to serve as a combined air puffer air buffer for the three pole circuit breaker which requires no auxiliary source of energy or auxiliary stored pressure air.

A still further object of my invention is to provide an air puffer air buffer which derives its energy solely from the opening operation of the circuit breaker.

As heretofore noted, it is desirable to provide a buffer arrangement for an automatic circuit breaker in order to prevent the rebound of the bridge when the circuit breaker is moved from the engaged to the disengaged position.

In addition to providing buffing action at the end of the opening stroke, it is also desirable to prevent the rebound of the cooperating contacts when they are moved from the disengaged position to the engaged position. That is, when the circuit breaker is either automatically or manually closed, it is desirable to have the cooperating contacts meet and stay in high pressure engagement without bouncing or separating from each other.

Many devices and apparatuses of the prior art have been provided to serve this function. However, these devices usually operate either on the so-called "billiard ball" principle or by interposing a stop means at the end of the closing stroke.

In the second embodiment of my invention, I provide a single cylinder piston arrangement which not only serves the heretofore mentioned function of an air puffer during the initial part of the opening operation and an air buffer during the final portion of the opening operation but also functions as an air buffer during the

final portion of the closing operation. Thus, the single apparatus of my invention utilizing only one piston and one cylinder serves a triple function and operates during both the opening and closing operation. Thus, in the event an automatic interrupting device has to be adapted with an air puffer, it is desirable to use the novel apparatus of my invention since the single unit which is utilized as an air puffer also functions as an air buffer during both the opening and closing operation of the circuit breaker. With this device, the air bleeds and air openings are so positioned that there will be no drag during the major portion of either the opening or closing stroke and only during the last portion of the opening or closing stroke will the air buffer be effective as a shock absorber.

Accordingly, another object of my invention is to provide a combination air puffer air buffer which will not only transfer the arc from the cooperating contacts during the initial portion of the opening operation but will also serve as a buffer during the last portion of both the opening and closing stroke.

Another object of my invention is to provide a piston cylinder arrangement which will serve the triple function for a three pole circuit breaker of providing a stream of air when it is needed and acting as a buffer to prevent rebound at the end of the opening and closing stroke.

A still further object of my invention is to provide a single auxiliary unit for a three pole interrupting device which functions during both the opening and closing operation.

In a third embodiment of my invention, I provide a combined air puffer air buffer with a single cylinder in which two pistons are housed, one of which is controlled from the bridge and the second of which is mounted concentric on the control shaft of the first.

The air puffing operation of the device is performed by the first cylinder during the first portion of the opening operation. After the piston has been moved a major portion of the distance through the cylinder, it will subsequently engage the second piston which is mounted concentric on the control shaft. Hence, the force will be transmitted through the control shaft through the first piston to the second piston which, in turn, will function as a buffer drive closing operation. The second piston is positioned near the orifice or air stream outlet of the system. Hence, movement of the first piston toward the second piston will permit a maximum rate of flow of the air since the second system cuts off a portion of the cylinder which does not provide a stream of air for the puffing operation. Hence, with the third embodiment whereby two coordinated pistons are used in a single cylinder, maximum efficiency of the device is obtained with a maximum rate of air flow.

Accordingly, a further object of my invention is to provide a combined air puffer air buffer in which a first and second piston are mounted in a single cylinder whereby the first piston performs the puffing operation and the second piston performs the buffing operation.

Still another object of my invention is to provide an auxiliary device for a multi-pole circuit breaker in which a first piston is operatively mounted within a cylinder and has a second piston mounted concentric therewith to perform buffing operation during the opening operation of the circuit breaker.

A still further object of my invention is to provide a dual piston straight-line device for a circuit interrupter which performs the function of a puffer and a buffer.

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

Figure 1 is a side view of the first embodiment of my novel combination air puffer air buffer and illustrates its placement and connection to a circuit breaker.

This figure illustrates the position of the various parts when the bridge is in the open position.

Figure 2 is a view taken in the direction of the arrows **2—2** of Figure 1 and illustrates the manner in which a single combined air puffer air buffer serves three poles of a multi-pole circuit breaker.

Figure 3 is an enlarged cross-sectional view of the combined air puffer air buffer of the first embodiment illustrated in Figure 1. This figure illustrates the position of the piston with respect to the cylinder when the circuit breaker is in the closed or engaged position.

Figure 4 illustrates a second embodiment of my invention. This figure shows a cross-sectional view of a combined air puffer air buffer which performs the triple function of a puffer during the initial portion of the opening operation, a buffer during the last portion of the opening operation and a buffer during the last portion of the closing operation. This figure illustrates the positions of the parts when the bridge is in the closed or engaged position.

Figure 5 illustrates a third embodiment of my invention in which the combined air puffer air buffer utilizes a first and second piston wherein the second piston is mounted concentrically on the operating shaft of the first piston. This figure illustrates the position of the parts when the circuit breaker is in the closed position.

Figure 6 is an end view taken in the direction of the arrows **6—6** of Figure 5 and illustrates the pressure relief valve which may be used with my novel device.

In Figures 1 and 2, I have shown a typical circuit breaker to which my novel combined air puffer air buffer can be adapted. The circuit breaker may be of the type described in copending application Serial No. 374,864 filed August 18, 1953, in which the upper and lower main studs **10** and **11** of the circuit breaker **12** are mounted on the back wall **13**. The operating mechanism **14** is, in turn, supported on the brackets **16** and **17**. The entire circuit breaker **12** is mounted on the base **18**, which, in turn, is mounted on the walls **19** and **20**.

The bridge **21** is pivotally mounted at **22** on the lower stud **11** and contains arcing contacts **23** and **24** which cooperate with the stationary arcing and main contacts **25** and **26** mounted on the upper stud **10**.

The combined air puffer air buffer of my invention is illustrated generally by the numeral **30** and is comprised of the cylinder **31** and piston **32**. The cylinder **31** can be mounted to the circuit breaker in any desirable manner as for example by means of the brackets **33—34**. In the arrangement shown, the cylinder **31** is stationary and the piston **32** moves with respect thereto. The piston **32** is provided with a groove **35** which forms a seat for a piston ring **36**.

The operating arm **37** is connected at one end to the piston **32** and at the opposite end is connected to the link **38** by means of the pin **39**. The link **38** is attached to the link **40** by means of the pin **50** and the link **40**, in turn, is an integral welded part of main operating arm **42**.

Member **44** applies clamping pressure to link **38** to hold pivot pin **50** and **39** in place.

The puffer buffer cylinder **31** is provided with three outlets **52***a*, **52***b* and **52***c* which are preferably on one circumference thereof. The outlets **52***a*, **52***b* and **52***c* are respectively connected to the outlet tubes **55***a*, **55***b* and **55***c* to supply a puff of air for each pole of the circuit breaker, as best seen in Figure 3. These puffer outlet tubes **55** may be secured and held in place by means of the brackets **90** which are in turn secured to one end of the cylinder by means of bolts **91**.

In the cross-sectional view of Figure 1, the placement of a nozzle **57***b* at the end of one tube **55***b* below the upper stud **10** is illustrated.

The arrow **58** indicates the direction of air flow when the circuit breaker opens.

As best seen in Figures 1 and 3, the outlets similar to

52*b* are positioned on the cylinder at a point intermediate its extreme ends. As will hereinafter be more apparent, the position of these outlets intermediate the ends enable the single device to operate as a combined air puffer air buffer.

When the circuit breaker opens, the main operating arm **42** will be rocked in a clockwise direction about the pivot **50** thereby moving the piston operating arm **37** and the piston **32** from the left to the right.

During the initial opening operation of the circuit breaker when the piston is moved from the position seen in Figure 3 to the right toward the outlet **52***b*, the air within the chamber **31** will be forced through the tubes **55***a*, **55***b*, **55***c* out to the nozzles **57***a*, **57***b* and **57***c*.

Thus, during the initial opening operation when the cooperating contacts **23—25** and **24—26** are initially separated, an air stream will be forced through the nozzles **57***a*, **57***b* and **57***c* toward the cooperating contacts to thereby transfer or lift the arc therefrom.

As above noted, this condition exists while the piston **32** is being moved from the position of Figure 3 toward the openings **52***a*, **52***b* and **52***c*. However, after the piston **32** passes the openings **52***a*, **52***b* and **52***c*, air will no longer be forced through the tubes **55***a*, **55***b* and **55***c*.

Since the operation of the puffer element is required only during the opening operation, this does not represent a disadvantage of the device. That is, since it is only necessary to lift or transfer the arc off the cooperating contacts into the arc chute, it is not necessary to continuously provide an air stream on the contacts after the bridge **21** has completed a major portion of its opening operation.

After the piston **32** has passed openings **52***a*, **52***b*, and **52***c*, it will commence to compress air in the extreme right hand end of the cylinder **31**. During the final portion of the opening stroke, this compressed air will act as a cushion for the opening mechanism of the circuit breaker to thereby insure that the opening will be quiet and to prevent rebound thereof.

Due to the compressibility of the air, the high retarding pressure will only be built up near the very end of the closing stroke and hence, there will be no retarding motion during the major portion of the opening operation.

In the arrangements of Figures 1, 2 and 3, an auxiliary means may be provided for proper adjustment of the combined air puffer air buffer. Thus, for example, as seen in Figure 3, I have shown a plurality of ports **60** in the left end wall of the cylinder **31**. By providing these air intakes, the speed with which the piston **31** moves from the position of Figure 3 to a position close to the openings **52***a*, **52***b* and **52***c* will not be retarded. That is, by providing a plurality of ports **60**, no vacuum will build up behind the piston **32**.

The opposite wall **62** may serve as one guide or support for the piston operating arm **37**. The tolerance or distance between the opening and the end **32** and the piston operating arm **37** may serve as an air bleed clearance or an orifice for the escape of air. Means **63** may be provided for adjustment of this air bleed clearance. The clearance **64**, although permitting a build up of compressed air within the chamber once the piston **32** has passed to the right of the openings **52***a*, **52***b* and **52***c*, will permit gradual escape or release of the compressed air.

Accordingly, with the device of Figures 1, 2 and 3, I have shown a novel apparatus wherein during the initial opening operation, it functions as an air puffer and during the latter portion of the opening operation will serve as an air buffer.

In Figure 4, I have shown a second embodiment of my invention which serves the same functions as the combined opening air puffer air buffer described in connection with Figures 1, 2 and 3 and in addition thereto, serves as an air buffer during the closing operation of the circuit breaker **12**.

Basically, the construction of the combined air puffer air buffer of the second embodiment illustrated in Figure 4 is similar to that heretofore described in connection with Figures 1, 2 and 3. However, in this arrangement, I have provided a relatively small air bleed **65** at the left hand end of the cylinder **31**. The opening of air bleed **65** may be adjusted in cross-sectional area by means of the adjustment screw **68**. Thus, during the opening operation, the piston **32** will be moved to the right by the piston operating arm **37** in a manner heretofore described.

During the initial opening operation, a stream of air will be pushed through the tubes **57***a*, **57***b* and **57***c* in a manner heretofore described and in the latter portion of the opening operation, there will be air compressed in the extreme right hand end of the cylinder **31** which will thereby provide a buffing action.

In the arrangement noted in connection with Figures 1, 2 and 3, I provide relatively large ports **60** in the left hand wall **61** of the cylinder unit **31**. Hence, during the closing operation of the circuit breaker, the piston **32** cannot compress air within the cylinder **31** due to the relatively large opening **60**. However, in the second embodiment of Figure 4, I have provided a relatively large opening **66** at a point somewhere intermediate the end **61** and the opening **52**. Thus, with this arrangement, during the closing operation when the piston **32** is moved from the extreme right hand position toward the relatively large opening **66**, there will be no drag on the closing operation and no air will be compressed due to the relatively large opening. However, since the piston **32** moves past the opening **66** toward the left, air will now be compressed in the extreme left hand portion of the chamber **31**. Thus, since the air bleed **65** is relatively small, the air can be compressed in this area in substantially the same manner as heretofore described in connection with the end of the opening operation. Thus, when the cooperating contacts are brought into engagement, the piston **32**, by compressing the air within the chamber **31**, will provide a cushioning or buffing means to absorb energy and prevent the rebound of the cooperating contacts.

A screw **68** may be provided to adjust the opening of the air bleed **65** so that the proper degree of cushioning or buffing for the circuit breaker can be obtained.

In Figures 5 and 6, I have shown a third embodiment of my invention in which an auxiliary piston is used in cooperation with the main system.

The device has a main cylinder **31** and a main piston **32** which may be provided with a soft felt packing **70** around its outer circumference. The piston **32** is connected to and operated by the piston operating rod **37** which is connected to the main operating member **42** in a manner heretofore described in connection with Figure 1.

However, in the third embodiment of Figure 5, I have provided an auxiliary piston **72** which is mounted on the sleeve **73**, which sleeve, in turn, is concentrically mounted on the piston operating shaft **37**. The auxiliary piston **72** may be provided with a metal ring **80** around its outer circumference.

During the initial opening operation of the circuit breaker, the air puffer operates in substantially the same manner as described in connection with Figure 1. However, it will be noted that the chamber on the right of the piston **32**, as seen in the third embodiment of Figure 5, is smaller than the same area as seen in either the first embodiment of Figure 1 or the second embodiment of Figure 2. That is, the auxiliary piston **72** is positioned to the right of the opening **52**.

Since the auxiliary piston **72** is positioned near the orifice **52**, the movement of the main piston **32** toward the auxiliary piston **72** will permit a maximum rate of flow of the air. After the initial opening operation of the circuit breaker is completed, the main piston **32** will be moved past the orifice **52** and brought into en-

gagement with the auxiliary piston 72. Thus, the continued movement to the right of the piston 32 will thereby drive the auxiliary piston 72 to the right thereby compressing the air in the extreme right hand end of the chamber 31.

The compressing of the air in the extreme right hand end of the cylinder 31 will function to provide a buffing action for the final opening operation of the circuit breaker in substantially the same manner as heretofore described in connection with the first and second embodiments of my invention.

The member 38 which is secured to the piston control shaft 37 by means of the pin 39 may be provided with a ring protruding member 74. Thus, when the circuit breaker is moved to the closed position, the force of the main operating arm 42 will be transmitted through the link 38—37 to the piston 32 to thereby drive this member to the extreme left hand position, as seen in Figure 5. Since the auxiliary piston 72 had previously been moved to the extreme right hand position during the opening operation of the circuit breaker, the engagement of the ring 74 with the collar 73 will thereby move the auxiliary piston 72 to its extreme left hand position during the closing operation of the circuit breaker, as seen in Figure 5. It will be noted that the sleeve or collar 73 may also be provided with a protruding pin or ring 95 which engages the wall 62 of the cylinder 31 to thereby limit its extreme left-ward movement.

It will be noted that in the third embodiment of Figure 5, I have shown an adjustable air bleed clearance 64 which operates in the manner heretofore described in connection with Figure 3. In view of Figure 5, the right end wall of the cylinder 31 may be provided with a felt packing, or a similar material, 65, in order to seal this end of the buffer in such a manner that only the clearance 75 will provide an escape for the compressed air. In addition to the air bleed clearance 64, the release valve 75 permits a relatively rapid release of the compressed air in the right hand end of the chamber 31 which is created near the end of the opening operation.

It will be noted that in the various embodiments, the air reliefs may comprise multiple clearance relief holes such as 75 located on the periphery of the cylinder end wall which may be either fixed or adjustable.

With a plurality of openings in the front, it is possible to minimize air turbulence effects in the cylinder to thereby produce a faster air bleed at the instant the air pressure reaches a maximum to eliminate the possibility of trapped air causing any rebound.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of my invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein but only by the appended claims.

I claim:

1. A combined air puffer air buffer device for a multipole circuit breaker comprising a cylinder and a piston; said cylinder being rigidly mounted on said circuit breaker; said piston operatively connected to the opening mechanism of said circuit breaker; a plurality of orifices in said cylinder along a circumference which is intermediate the ends thereof; tube means connected to each of said orifices and terminated respectively at each pole of said circuit breaker; said piston moved toward said orifice during the initial opening operation to provide an air puffing operation; said piston moved away from said orirfice during the final opening operation of said circuit breaker to provide an air buffer action; said piston being moved in only first direction during both the initial and final opening operation of said circuit breaker.

2. A combined air puffer air buffer device for a multipole circuit breaker comprising a cylinder and a piston; said cylinder being rigidly mounted on said circuit breaker; said piston operatively connected to the opening mechanism of said circuit breaker; a plurality of orifices in said cylinder along a circumference which is intermediate the ends thereof; tube means connected to each of said orifices and terminated respectively at each pole of said circuit breaker; said piston moved in a first direction during the opening operation of said circuit breaker; said piston moved toward said orifices during the initial opening operation of said circuit breaker; said piston moved away from said orifices during the final opening operation of said circuit breaker; said piston being moved in only first direction during both the initial and final opening operation of said circuit breaker; means to prevent drag of said piston during the initial opening operation.

3. A combined air puffer air buffer device for a circuit breaker comprising a cylinder and a piston; said cylinder rigidly mounted on said circuit breaker; said piston operatively connected to the opening mechanism of said circuit breaker; a plurality of orifices in said cylinder along a circumference which is intermediate the ends thereof; tube means connected to each of said orifices and terminated respectively at each pole of said circuit breaker; said piston moved in a first direction during the opening operation of said circuit breaker; said piston moved toward said orifices during the opening operation of said circuit breaker; said piston moved away from said orifices during the final opening operation of said circuit breaker; means to prevent the rapid motion of said piston during the final closing operation of said circuit breaker to thereby provide an air buffing operation.

4. A combined air puffer air buffer device for a circuit breaker comprising a cylinder and a piston; said cylinder rigidly mounted on said circuit breaker; said piston operatively connected to the opening mechanism of said circuit breaker; a plurality of orifices in said cylinder along a circumference which is intermediate the ends thereof; tube means connected to each of said orifices and terminated respectively at each pole of said circuit breaker; said piston moved in a first direction during the opening operation of said circuit breaker; said piston moved toward said orifices during the opening operation of said circuit breaker; said piston moved away from said orifices during the final opening operation of said circuit breaker; an opening in said cylinder intermediate one end and said plurality of orifices; said piston moved in a second direction during the closing operation of said circuit breaker; said piston moved toward said opening during the initial closing operation; said piston moved away from said opening during the final closing operation.

5. A combined air puffer air buffer device for a circuit breaker comprising a cylinder and a piston; said cylinder rigidly mounted on said circuit breaker; said piston operatively connected to the opening mechanism of said circuit breaker; a plurality of orifices in said cylinder along a circumference which is intermediate the ends thereof; tube means connected to each of said orifices and terminated respectively at each pole of said circuit breaker; said piston moved in a first direction during the opening operation of said circuit breaker; said piston moved toward said orifices during the opening operation of said circuit breaker; said piston moved away from said orifices during the final opening operation of said circuit breaker; an opening in said cylinder intermediate one end and said plurality of orifices; said piston moved in a second direction during the closing operation of said circuit breaker; said piston moved toward said opening during the initial closing operation; said piston moved away from said opening during the final closing operation; said final movement of said piston during said closing operation performing an air buffer operation.

6. A combined air puffer air buffer having a cylinder, a first piston and an auxiliary piston; said cylinder having an orifice intermediate its ends; said auxiliary piston normally positioned adjacent said orifice; said main pis-

ton operated by the opening movement of a circuit breaker; said main piston having relative movement with respect to said auxiliary piston during the initial opening operation of said circuit breaker; said first piston moving said auxiliary piston during the final opening operation of said circuit breaker.

7. A combined air puffer air buffer having a cylinder, a first piston and an auxiliary piston; said cylinder having an orifice intermediate its ends; said auxiliary piston normally positioned adjacent said orifice; said main piston operated by the opening movement of a circuit breaker; said main piston having relative movement with respect to said auxiliary piston when said main piston is moved in a first direction toward said orifice; said auxiliary piston moved by said main piston when said first piston is moved in said first direction away from said orifice.

8. A combined air puffer air buffer having a cylinder, a first piston and an auxiliary piston; said cylinder having an orifice intermediate its ends; said auxiliary piston normally positioned adjacent said orifice; said main piston

operated by the opening movement of a circuit breaker; said main piston having relative movement with respect to said auxiliary piston when said main piston is moved in a first direction toward said orifice; said auxiliary piston moved by said main piston when said first piston is moved in said first direction away from said orifice; said combined air puffer air buffer performing an air puffing operation during the initial opening stroke and an air buffer operation during the final portion of the opening operation.

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