

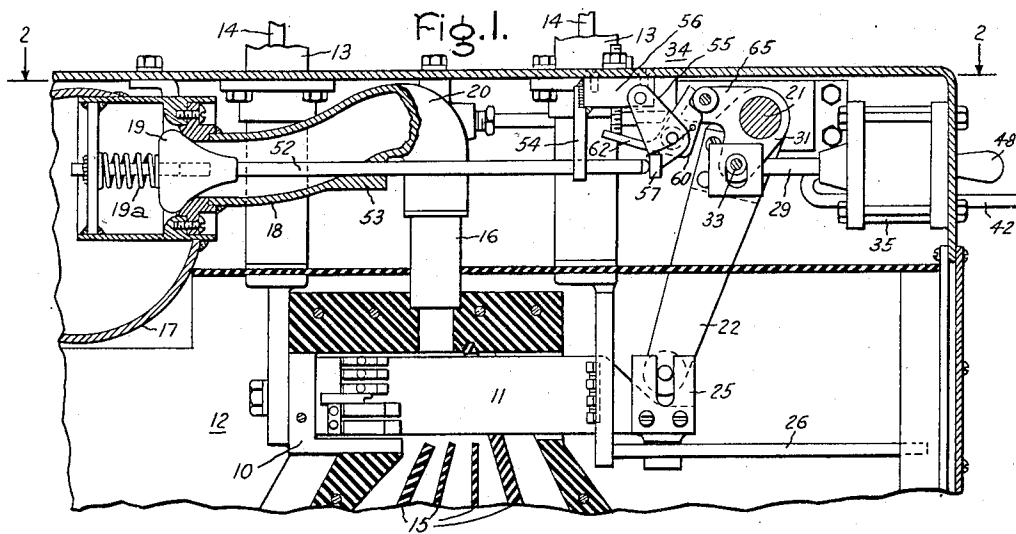
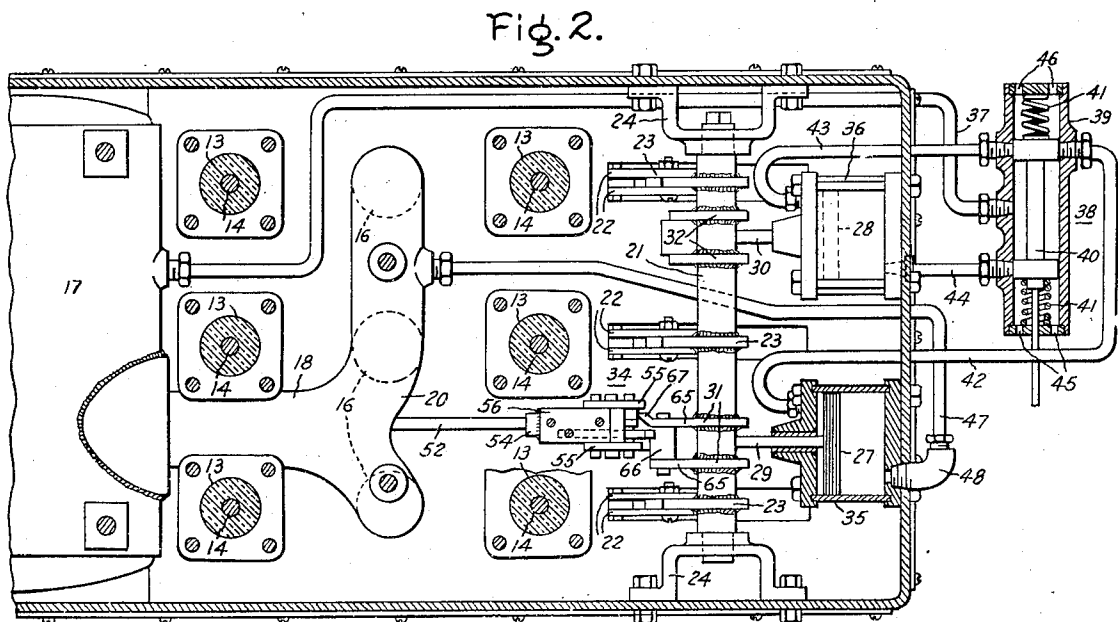
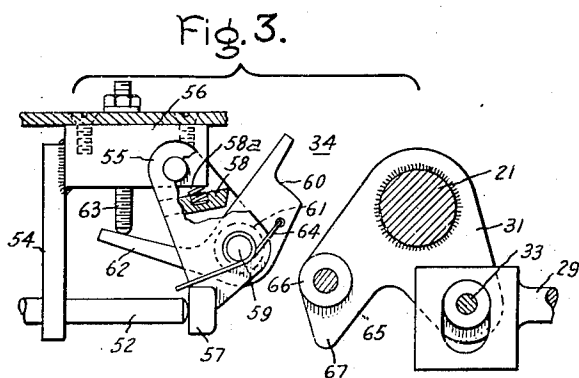
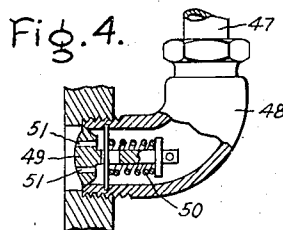
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L. J. LINDE ET AL

2,213,797

ELECTRIC CIRCUIT BREAKER

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## UNITED STATES PATENT OFFICE

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## ELECTRIC CIRCUIT BREAKER

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17 Claims. (Cl. 200-148)

Our invention relates to electric circuit breakers and more particularly to improvements in electric circuit breakers of the gas blast type.

It is an object of our invention to provide an improved circuit breaker of the above type which has a high interrupting capacity and at the same time is compact, durable and reliable in operation.

It is another object of our invention to provide an improved pneumatic operating mechanism for controlling the movement of the relatively movable contacts of the breaker.

It is a further object of our invention to provide an improved means, coordinated with the contact actuating means, for controlling the admission of a gas blast to the arc gap formed upon separation of the contacts.

It is still another object of our invention to provide a circuit breaker of the fluid blast type including improved means for controlling the admission of the fluid blast to the arc chamber during both contact opening and contact closing operations.

Further objects and advantages of our invention will become apparent as the following description proceeds, reference being had to the accompanying drawing in which Fig. 1 is a partial elevational view in section of an electric circuit breaker embodying our invention; Fig. 2 is a plan view taken along the line 2-2 of Fig. 1; Fig. 3 is an enlarged elevational view of the arrangement shown in Fig. 1 for operating the blast valve; and Fig. 4 is an enlarged elevational view, partially in section, of a detail of the pneumatic operating system.

In the drawing we have shown our invention as embodied in a three-phase circuit breaker in which the parts of the breaker are mounted in an enclosed metal framework to form a unit of the type that may readily be installed in a cubicle of metal-clad switch gear of the type now in extensive use. A fixed contact 10 and a movable contact 11 are provided for each phase of the breaker and are arranged to separate within an interrupting unit comprising an insulating structure illustrated generally by the numeral 12. The fixed and movable contacts 10 and 11 are supported in insulated relation by insulating bushings 13 and the conductors 14 associated therewith. The insulating structure 12 defines an arc chamber in which the arc is drawn when the contacts are separated and also includes a plurality of barriers 15 which extend divergently from the arc chamber and form a plurality of passages into which the arc is driven and interrupted

under the action of a gas blast from conduit 16. An electric circuit breaker embodying interrupting units of this type is more fully described and claimed in the copending application of Prince et al., Serial No. 303,126, filed November 6, 1939, and assigned to the same assignee as the present application.

A tank 17 mounted at one end of the breaker structure provides a source of compressed air which is supplied to the interrupting units 12 of each of the phases through a conduit 18 under the control of a blast valve 19 which is normally biased to closed position by a spring 15a. The conduit 18 is connected to the individual supply conduits 16 by a manifold 20.

In accordance with the present invention an improved pneumatic operating mechanism is provided for moving the contact 11 into and out of engagement with fixed contact 10, which is capable of maintaining the desired speed of contact separation and which also provides suitable cushioning at the end of the opening stroke so as to prevent destructive stresses from occurring in the movable parts of the breaker. As illustrated in Figs. 1 and 2, the movable contact 11 of each phase is connected to a crankshaft 21 by means of insulating arms 22 which are secured to a flange 23 welded to the crankshaft. The crankshaft is rotatably supported from the breaker framework by suitable brackets 24. The connection between the lower end of the insulating arm and the movable contact is accomplished through a pin and slot connection with a cross-head 25 secured to the movable contact and slidably mounted on guide rods 26. It is apparent that oscillation of the crankshaft will be effective to reciprocate the movable contact 11 and move it into and out of engagement with fixed contact 10. As illustrated in the drawing, oscillation of the crankshaft is accomplished by means of a pair of operating pistons 27 and 28 which are connected to the crankshaft by means of piston rods 29 and 30. Two pairs of spaced flanges 31 and 32 secured to the crankshaft 21 form cranks to which the piston rods 29 and 30 are operatively connected by means of crank pins 33. The spaced flanges 31 are specially constructed to cooperate with a pivoted latch assembly illustrated generally by numeral 34 to control the operation of the blast valve 19 in accordance with the position of the crankshaft 21. This feature of the invention will be described more in detail at a later point in the specification.

The pneumatic operating system for pistons 27 and 28 which are mounted in cylinders 35 and 55

36, respectively, will now be described. The pistons are operated by means of compressed air supplied to the cylinders 35 and 36 through a conduit 37 under the control of a diverter valve illustrated generally by numeral 38. The valve may be of any desired construction and in the particular embodiment illustrated comprises a cylindrical casing 39 in which a double-ended piston member 40 is slidably mounted. The piston is biased to central position by suitable springs 41. Conduit 37 communicates at one end with the tank 17 and at the other end with the central portion of the valve casing 39. Conduits 42 and 43 communicate at one end with the opening end of cylinders 35 and 36, respectively, and at the other end with the interior of the casing 39 at a point spaced axially of casing 39 from conduit 37. A conduit 44 communicates with the opposite end of cylinder 36 and with the interior of the casing at a point on the opposite side of conduit 37 from the conduits 42 and 43. The piston member 40 of the valve may be shifted from one extreme position to the other by any suitable means such as a solenoid (not shown). When the piston member 40, as shown in Fig. 2, is moved to its uppermost position the conduit 37 is placed in communication with the conduits 42 and 43 so that air is admitted to the opening end of the cylinders 35 and 36 to move the pistons 27 and 28 to the right resulting in the separation of the contacts of the breaker. With the valve piston 40 in this position the conduit 44 is placed in communication with the atmosphere through the openings 45 in the lower end of the valve casing 39. Similar openings 46 are provided at the upper end of valve casing 39. The area of these openings 45 and 46 is sufficient to allow the free escape of air from the cylinders.

In accordance with one feature of the present invention, the opening movement of the circuit breaker is retarded by introducing air on the closing side of the piston 27 in cylinder 35 through a conduit 47 communicating at one end with the blast manifold 20, and at the other end with the closing end of the cylinder 35. The pressure in the manifold 19 is considerably less than the pressure in the tank 17 and therefore provides a desirable source of lower pressure air for retarding the opening movement of the contacts. As clearly shown in Fig. 4, conduit 47 is connected to the closing end of cylinder 35 by an elbow 48 in which a check valve 49 is provided. The check valve is normally biased to closed position by a spring 50 and is provided with a plurality of small openings 51 to provide for the gradual escape of air from the closing side of the piston as the breaker completes the opening movement of the contacts. If cushioning of the moving parts during contact closing is desired similar apertured check valves may be provided in conduits 42 and 43 to permit free flow of actuating fluid to the pistons 27 and 28 for opening and gradual escape of fluid during closing.

The arrangement just described has proved very satisfactory for pneumatically operating the movable contacts of the breaker. The working surface of both pistons is available for moving the contacts to open circuit position and insures adequate separation of the movable contacts. The blast manifold has been found to be a very satisfactory source of air at a lower pressure for retarding the opening movement of the contacts. The use of one side of one of the pistons only for moving the contacts to closed position has

been found to be entirely adequate. The double piston operating mechanism makes it possible to provide for fast speed of separation and cushioning of the movable parts with a very compact mechanism.

In accordance with an important feature of the present invention the blast valve 19 is operated in accordance with the position of the crankshaft 21 to admit a blast of air to the interrupting unit 12 during both opening and closing of the contacts. The valve 19 is provided with a horizontally extending valve stem 52 which is supported in a suitable bearing 53 formed in the conduit 18, and by a depending guide arm 54. As previously stated, the blast valve is operated in accordance with the position of the crankshaft 21 by a pivoted assembly 34. The assembly 34 includes a pair of arms 55 which are pivotally mounted on opposite sides of a supporting block 56. A pad 57 between the two arms 55 forms a bearing surface which engages the free end of the valve rod 52. A reinforcing member 58 extends between the spaced arms 55 and is provided with a recess for the reception of a coiled spring 58a which engages the lower surface of the supporting block 56 and biases the pivoted assembly against the end of the valve stem 52. A pin 59 extending between the spaced arms 55 supports a pivoted latching arm 60 and a roller 61. The latching arm 60 is provided with an extension 62 which engages an adjustable stop 63. A spring 64 biases the latching member 60 against the stop.

The spaced flanges 31, between which the piston rod 29 of piston 27 is connected, are also provided with arm portions 65 between which a roller 66 is mounted. As shown in Figs. 1 and 2 the roller 66 forms a stop or thrust member and engages the end of the latching arm 60 in the closed circuit position of the breaker. One of the arms 65 is provided with an offset cam portion 67 which cooperates with the roller 61 on the pivoted assembly 34 to open the blast valve during closing movement of the contacts.

The features and advantages characterizing the circuit breaker construction just described will become more apparent from a consideration of the operation thereof which will now be described. If, with the parts of the circuit breaker in the position shown in Figs. 1 and 2, piston 40 of control valve is moved to its uppermost position either by manual operation or in response to an abnormal circuit condition, compressed air will be admitted to the opening side of pistons 27 and 28 through conduit 37, valve casing 39 and conduits 42 and 43. As pistons 27 and 28 move to the right the crankshaft 21 will be rotated in counterclockwise direction as viewed in Fig. 1 and the movable contacts 11 will move to the right away from fixed contacts 10. As best shown in Fig. 1, the pivoted assembly 34 is latched to the crankshaft 21 by means of latch arm 60 and the roller 66 when the breaker is in closed position. As the crankshaft 21 rotates to separate contacts 10 and 11, the pivoted assembly moves in a clockwise direction and results in an opening of the blast valve 19. Air flows from the tank 17 through conduit 18, manifold 20 and conduits 16 to the individual interrupting units 12 until at a certain point in the separating movement of the contacts the roller 66 slips from the latching arm 60 and allows the pivoted assembly to swing in a counterclockwise direction under the action of the biasing spring 19a of the valve 19. It is apparent that the portion of the separating movement of the contacts during which air is

admitted to the interrupting units may be controlled by properly proportioning the parts of the pivoted assembly 34 and cooperating roller 66 and its supporting arms 65.

5 As soon as air is admitted to the blast manifold 19 air under pressure is conducted therefrom to the closing side of piston 27 through conduit 47 to retard the opening movement of the contact and reduce the shock to the moving parts of the  
10 breaker as they reach the end of the opening stroke. Since the air from the manifold acts upon only one piston and is initially at a lower pressure than air on the opening side of the pistons 27 and 28, it is readily possible to get the  
15 desired cushioning effect without retarding the speed of separation of the contacts to an undesirable extent, particularly at the beginning of the opening stroke. The relative positions of the parts of the pivoted assembly 34 and the cooperating parts carried by the crankshaft 21 when the  
20 breaker is in open circuit position are illustrated in Fig. 3.

The breaker is closed by moving the control valve member 40 to its lowermost position from that indicated in Fig. 2. This movement of the  
25 valve member 40 places the closing side of piston 28 in communication with the tank 17 through conduits 37 and 44. Piston 27 is not utilized for closing the contacts of the breaker. The offset cam portion 67 on one of the supporting arms 65  
30 carried by the crankshaft is arranged to engage the roller 61 of the pivoted assembly to open the blast valve 19 for a brief interval just prior to the closing of the contacts. The length of time that the blast valve is open during closing of the  
35 breaker contact varies with the type of service to which the breaker is applied. The air blast during the closing movement of the contacts protects them from the action of the arc established upon circuit closing and also clears the  
40 interior of the interrupting unit of gases which may linger there from the prior circuit interrupting operation. If the breaker is apt to be subjected to repeated closures within short intervals it may be desirable to lengthen the blast  
45 during closing to cool the contacts and more effectively clear the interrupting unit of hot gases. It is apparent that the duration of the blast of air during closing movement of the contacts may  
50 be readily varied by changing the length of cam portion 67. It is also seen that with the present construction the length of time during which the blast valve is open during contact separation is independent of the period during which the valve  
55 is open during the contact closing operation. This feature of the arrangement disclosed by applicants is very desirable inasmuch as it makes possible the most efficient use of the compressed air. The broad idea of admitting a blast of fluid  
60 to the arc chamber during circuit interrupting operation of the breaker for a period of time which is independent of the period during which the blast of fluid is admitted to the arc chamber during circuit closing operation, is not our  
65 invention and is embodied in a circuit breaker control system disclosed and claimed in the copending application of Thumin et al., Serial No. 317,564, filed February 6, 1940, and assigned to the same assignee as the present invention.

70 From the foregoing description it is seen that applicants have devised an improved pneumatic operating mechanism for electric circuit breakers which is coordinated with an improved arrangement for operating the blast valve during both  
75 circuit opening and closing movements of the

breaker. The structure disclosed by applicants incorporates many desirable features for air blast circuit breaker operation and at the same time is so compact that the entire breaker structure and operating mechanism is readily incorporated  
5 in a unit which may be placed in a metal-clad cubicle designed for oil breakers of similar rating.

While we have shown and described a particular embodiment of our invention, it will be apparent to those skilled in the art that many  
10 modifications thereof may be made without departing from our invention, and we intend in the appended claims to cover all modifications falling within the true scope and spirit of our invention.

What we claim as new and desire to secure by  
15 Letters Patent of the United States, is:

1. An electric circuit breaker of the fluid blast type comprising relatively movable contacts, an operating mechanism for moving said contacts to open and closed circuit positions, and means including a plurality of pistons for controlling said  
20 operating mechanism, means for supplying fluid under pressure to one side of each of said pistons for moving said contacts to open circuit position, means for supplying fluid under pressure to the opposite side of one of said pistons during opening  
25 movement thereof to reduce the speed of separation of said contacts, and means for supplying fluid to the opposite side of the other of said pistons for moving said contacts to closed  
30 circuit position.

2. An electric circuit breaker of the fluid blast type comprising relatively movable contacts, an operating mechanism for moving said contacts to open and closed circuit positions, and means including a plurality of pistons for controlling said  
35 operating mechanism, means for supplying fluid under pressure to one side of each of said pistons for moving said contacts to open circuit position, means responsive to movement of said operating  
40 mechanism for admitting fluid at a lower pressure to the opposite side of one of said pistons to reduce the speed of separation of said contacts, and means for supplying fluid to the opposite side of the other of said pistons for moving said con-  
45 tacts to closed circuit position.

3. An electric circuit breaker of the fluid blast type comprising relatively movable contacts, an operating mechanism for moving said contacts to open and closed circuit positions, and means including a plurality of pistons for controlling said  
50 operating mechanism, means for supplying fluid under pressure to one side of each of said pistons for moving said contacts to open position, means for supplying fluid under pressure to the opposite side of one of said pistons during opening  
55 movement of said contacts, and valve means constructed and arranged to allow fluid to flow freely to said other side of said piston to precharge the cylinder associated therewith for dashpot action during the remainder of the opening stroke of  
60 said piston and to permit the gradual escape of fluid from said opposite side of said one piston during the remainder of the opening stroke of said piston to provide the desired cushioning of the moving parts of said breaker.  
65

4. An electric circuit breaker of the gas blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of gas  
70 under pressure, and an operating mechanism for moving said contacts to open and closed circuit positions comprising an operating member, a plurality of driving pistons for moving said operating member, means for supplying gas under  
75

pressure to one side of each of said pistons for moving said operating member in one direction to separate said relatively movable contacts, valve means for controlling the flow of arc extinguishing gas from said source to said arc chamber and operable in response to movement of said operating member in said one direction, and means connected with the low pressure side of said valve means for supplying gas under pressure to the opposite side of one of said pistons to retard the opening movement of said contacts.

5. An electric circuit breaker of the fluid blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of fluid under pressure for supplying arc extinguishing fluid to said arc chamber, an operating mechanism for said relatively movable contacts comprising an operating member, a fluid actuated piston for controlling the operation of said member, means for supplying fluid under pressure to one side of said piston for moving said operating member in a direction to separate said contacts, valve means operable during circuit interrupting operation of said breaker for admitting an arc extinguishing blast of fluid to said arc chamber, and means connected to the low pressure side of said valve means for supplying fluid under pressure to the opposite side of said driving piston to decrease the speed of separation of said contacts.

6. An electric circuit breaker of the gas blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, means for supplying a gas blast to said chamber, a valve for controlling the flow of gas to said chamber, an operating mechanism for moving said contacts including an operating member, a plurality of pistons for operating said member, means for supplying fluid under pressure to one side of each of said pistons for moving said contacts to open circuit position, means for supplying fluid to the closing side of one of said pistons from the low pressure side of said blast valve during opening movement of said contacts to retard the separation of said contacts, and a pivoted assembly interposed between said blast valve and said operating member and latched thereto for a portion of the opening movement of said contacts to retain said blast valve in open position for a predetermined period during the opening movement of said contacts.

7. An electric circuit breaker of the fluid blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of fluid under pressure for supplying arc extinguishing fluid to said arc chamber, an operating member for moving said relatively movable contacts comprising an operating member, a plurality of pistons for controlling the operation of said member, means for supplying fluid under pressure to one side of said pistons for moving said member in a direction to separate said contacts, valve means operable in response to movement of said operating member in said one direction to admit an arc extinguishing blast of fluid to said arc chamber, means connected to the low pressure side of said blast valve for supplying fluid under pressure to the opposite side of one of said driving pistons to decrease the speed of separation of said contacts, and means for opening said blast valve during closing movement of said movable contacts to admit a gas blast to said arc chamber for a period of time during the closing movement of

said contacts which is independent of the time during which the blast valve is open during the separating movement of said contacts.

8. An electric circuit breaker of the gas blast type comprising relatively movable contacts separable to draw an arc, means for operating said contacts to open and closed position, valve means for controlling the supply of arc extinguishing gas to said contacts, and means including a pivoted assembly interposed between said operating means and said valve means for causing operation of said valve means to open position for periods of independent length during both opening and closing of said contacts.

9. An electric circuit breaker of the gas blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of gas under pressure for supplying a gas blast to said arc chamber, a valve for controlling the flow of fluid from said source to said arc chamber, operating means for operating said contacts to open and closed circuit positions, and means responsive to the operation of said operating means for operating said valve to admit a blast of gas to said arc chamber during at least a portion of both opening and closing movement of said contacts, said last mentioned means being effective to maintain said valve open for a period of time and a portion of the contact travel during opening movement of said contacts which is independent of the period of time and the portion of contact travel during which said valve is open during closing movement of said contacts.

10. An electric circuit breaker of the gas blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of gas under pressure for supplying a gas blast to said arc chamber, valve means for controlling the flow of gas from said source to said arc chamber, means for operating said contacts to open and closed circuit positions, and means for operating said valve means in accordance with the position of said relatively movable contacts to admit a blast of gas to said arc chamber during both opening and closing movements of said contacts, said last mentioned means being constructed and arranged to open said blast valve for a period of time during the opening movement of said contacts which is independent of the period of time that said blast valve is open during closing movement of said contacts.

11. An electric circuit breaker of the fluid blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of fluid under pressure connected with said arc chamber, a valve for controlling the flow of fluid from said source to said arc chamber, operating means for moving said contacts to open and closed circuit positions, and means including a pivoted assembly for moving said valve to open position, said means including a pivoted latch arm and a roller, said latch arm being latched to said operating means for a predetermined portion of the movement of said operating means in the direction to separate said contacts, and means carried by said operating means for engaging said roller for a predetermined portion of the movement of said operating means in a direction to close said contacts.

12. An electric circuit breaker of the fluid blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an

arc in said chamber, a source of fluid under pressure connected with said arc chamber, a valve for controlling the flow of fluid from said source to said arc chamber, operating means for moving said contacts to open and closed circuit positions, and means including a pivoted member for moving said valve to open position, said pivoted member being latched to said operating means and movable therewith for a predetermined portion of the opening movement of said contacts, and means carried by said operating means for engaging said pivoted member when said operating means is moved in a direction to close said contacts to open said blast valve for a predetermined time during the closing movement of said contacts.

13. An electric circuit breaker of the gas blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of fluid under pressure for supplying a gas blast to said chamber, a rotatable operating member for moving said contacts to open and closed circuit positions, valve means for controlling the flow of gas to said arc chamber, said last mentioned means being latched to said rotatable operating member and movable thereby to open said valve means for a predetermined portion of the movement of said operating member in a direction to separate said contacts.

14. An electric circuit breaker of the gas blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of gas under pressure for supplying a gas blast to said chamber, a rotatable operating member for moving said contacts to open and closed circuit positions, valve means for controlling the flow of gas from said source to said arc chamber in accordance with the position of said contacts, said last mentioned means comprising an assembly pivoted to a fixed support and including a pair of spaced pivotally mounted arms between which a pivoted latching arm and a roller are mounted, a stop member carried by said rotatable operating member for engaging said latch arm during a predetermined portion of the movement of said operating member in a direction to separate said contacts to admit a gas blast to said arc chamber, and means carried by said operating member for engaging the roller of said pivoted assembly during a portion of the movement of said operating member in a direction to close said contacts to admit a gas blast to said arc chamber during closing movement of said contacts.

15. An electric circuit breaker of the gas blast

type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of gas under pressure connected with said arc chamber, a rotatable operating member for moving said contacts to open and closed circuit positions, a blast valve for controlling the flow of gas from said source to said arc chamber in response to movement of said operating member, means controlling the operation of said blast valve comprising a member pivoted to a fixed support and engaging a portion of said blast valve, a latch arm pivoted on said first pivoted member and having a portion engaging a stop on said rotatable operating member and effective to open said blast valve for a predetermined portion of the movement of said rotatable member in a direction to separate said relatively movable contacts, and means for limiting the pivotal movement of said latch to cause said latch to become disengaged from said stop at a predetermined point in the opening operation of said breaker.

16. An electric circuit breaker of the gas blast type comprising relatively movable contacts separable to draw an arc, means for effecting operation of said contacts to open and closed positions, valve means for controlling the supply of arc extinguishing gas to said contacts, and means including a pivoted assembly operable in response to operation of said first mentioned means for operating said valve means to open position during circuit interrupting and circuit closing operations of said breaker, the period of time during which said valve means is open during circuit interrupting operation of said breaker being independent of the period of time during which said valve means is open during circuit closing operation of said breaker.

17. An electric circuit breaker of the gas blast type comprising means defining an arc chamber, relatively movable contacts separable to draw an arc in said chamber, a source of gas under pressure for supplying a gas blast to said chamber, operating means for moving said contacts to open and closed circuit positions, valve means for controlling the flow of gas to said arc chamber, latching means and means associated with said operating means cooperating with said latching means to positively drive said valve means for a predetermined portion of the movement of said operating means in a direction to separate said contacts to open said valve means for a predetermined portion of the movement of said operating means.

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