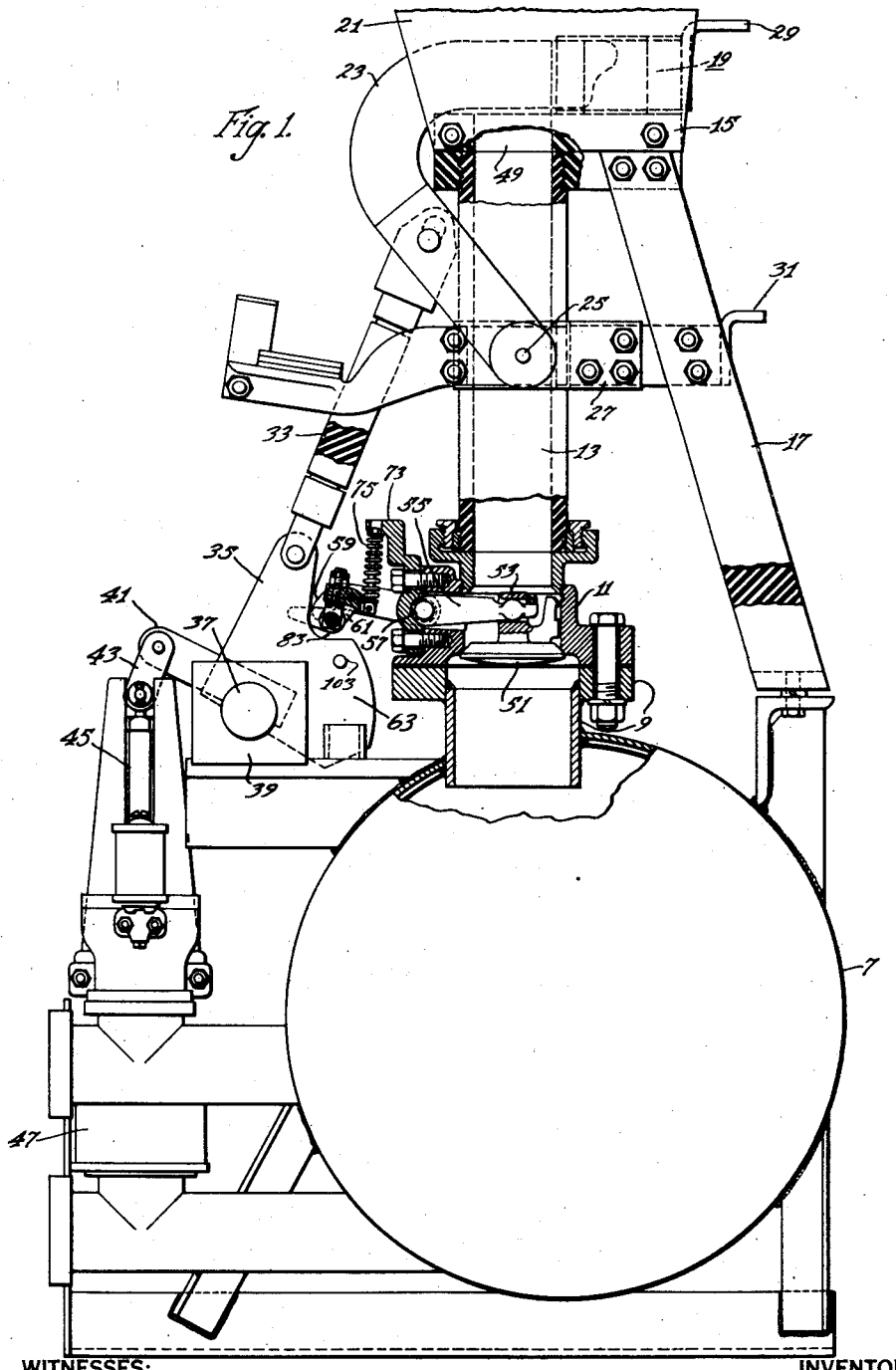
Sept. 1, 1942. B. P. BAKER ET AL 2,294,824

CIRCUIT INTERRUPTER

Filed Sept. 21, 1940 3 Sheets-Sheet 1

Fig. 1.



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CIRCUIT INTERRUPTER

Filed Sept. 21, 1940 3 Sheets-Sheet 2

Fig. 2

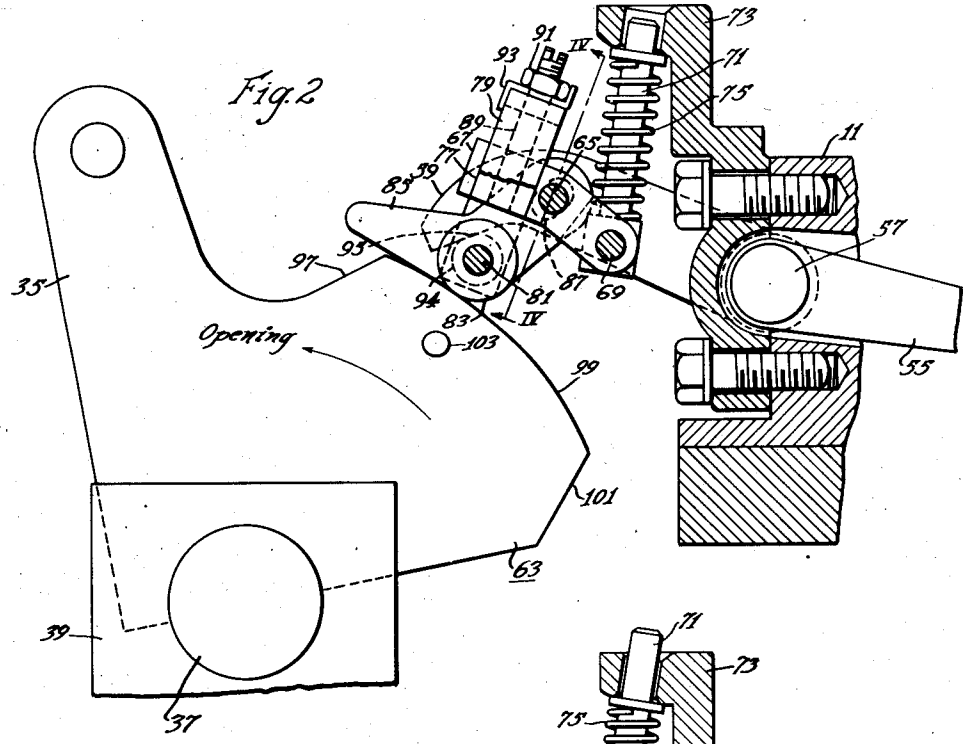
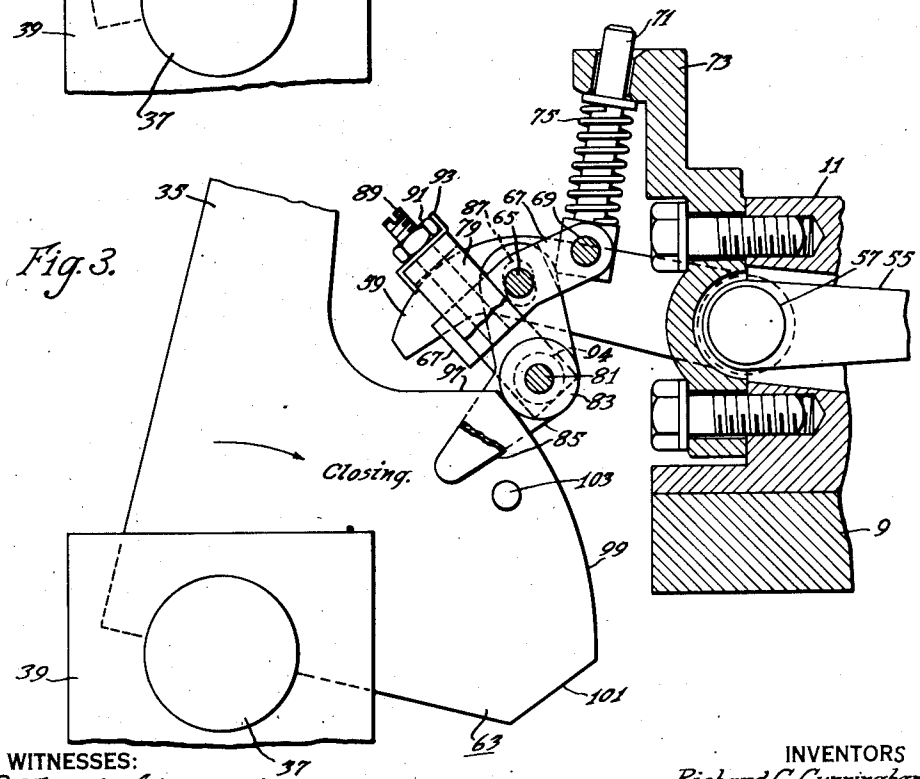


Fig. 3.



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CIRCUIT INTERRUPTER

Filed Sept. 21, 1940 3 Sheets-Sheet 3

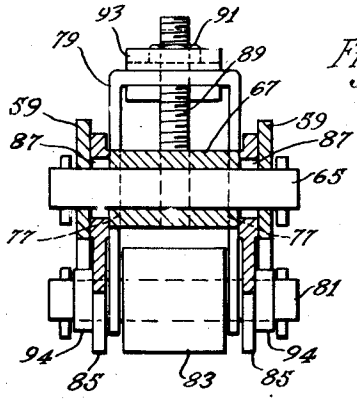

Fig. 4.

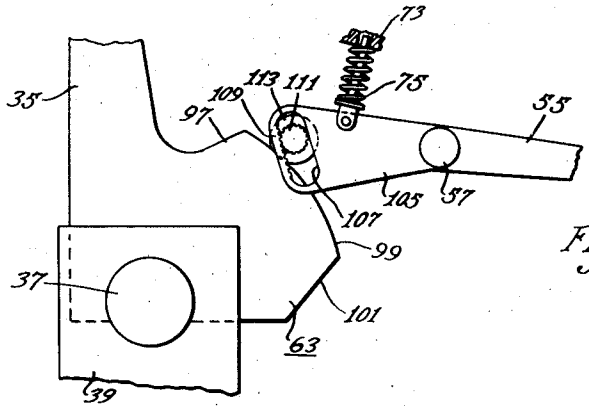

Fig. 5.

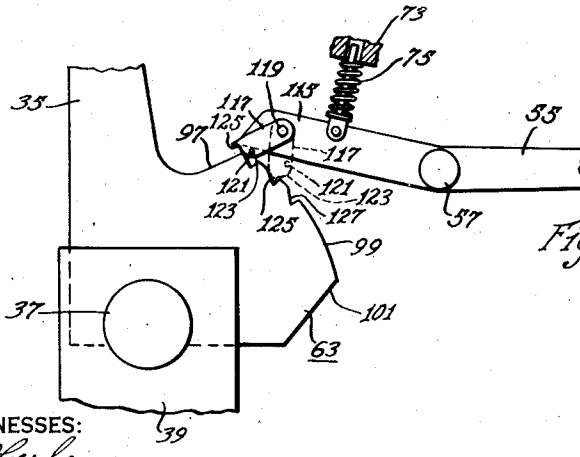

Fig. 6.

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UNITED STATES PATENT OFFICE

2,294,824

CIRCUIT INTERRUPTER

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Application September 21, 1940, Serial No. 357,686

8 Claims. (Cl. 200—148)

This invention relates to improvements in circuit interrupters, and, more particularly, to operating mechanisms for actuating the gas blast valve of circuit interrupters of the gas blast type.

In the application of A. H. Bakken, Serial No. 313,745, filed January 13, 1940, and assigned to the assignee of the instant application, is shown and described a gas blast circuit interrupter in which the gas blast valve is mechanically controlled in accordance with the contact movement. The aforesaid application also broadly contemplates an arrangement for mechanically opening the gas blast valve only during the opening operation of the interrupter so as to conserve arc extinguishing gas. This result has been achieved by the use of a single action cam mechanism of the collapsible type driven by the contact operating mechanism for actuating the blast valve. The structural arrangement is such that during the opening movement of the contacts the cam is maintained in an extended or operative position, whereas during the closing movement of the contacts the cam is collapsed to an inoperative position. This mechanism, however, requires that the contacts must reach their fully closed position before the cam mechanism is restored to operative position for opening the gas blast valve during a subsequent circuit interrupting operation.

If an interrupter of this type is closed against a short circuit, there is a hazard that the contact structure may be reversed before the valve operating mechanism has opportunity to restore itself to operative position due to the application of a tripping impulse to the interrupter before the contacts are fully closed. Under this condition the interrupter would open without the aid of an arc extinguishing blast of gas which may cause considerable damage to the interrupting structure.

The main object of the instant invention is to improve the operation of circuit interrupters of the aforesaid type by the provision of operating mechanism for the gas blast valve which insures reliable operation of the valve under all operating conditions.

A further and more specific object resides in the provision of an improved gas blast valve operating mechanism for circuit interrupters of the gas blast type which insures positive valve action during the opening operation of the interrupter and conserves arc extinguishing gas during the closing operation.

Other objects and advantages will become apparent in the following description when considered in connection with the accompanying drawings, in which:

Figure 1 is a side elevation view partly in section of a circuit interrupter illustrating our invention;

Fig. 2 is an enlarged view of the blast valve operating mechanism of the interrupter shown in Fig. 1;

Fig. 3 is an enlarged view of the mechanism shown in Fig. 2 illustrating the several parts thereof in relatively different positions;

Fig. 4 is a sectional view of a portion of the blast valve operating mechanism taken along the line IV—IV of Fig. 2;

Fig. 5 is a fragmentary and partially schematic illustration of a modified form of blast valve operating mechanism; and

Fig. 6 illustrates another arrangement of gas blast valve operating mechanism also in fragmentary and partially schematic form.

Referring to the drawings, the reference numeral 7 designates a tank for storing gas, such as air, under pressure. Extending from the upper end of the tank 7 is a relatively short flanged conduit 9 which, in turn, carries a valve casing 11. Secured to the upper end of the valve casing 11 is a tubular insulator 13 which has secured to its upper end an insulating support 15. The insulating support 15 may be given additional support by an insulating member 17. The support 15 carries a stationary contact assembly 19 which, in this instance, is enclosed within an arc extinguishing structure 21, only a portion of which is shown. The arc extinguishing structure 21 may be of conventional form and does not constitute a specific embodiment of the instant invention.

Coacting with the stationary contact assembly 19 is a movable contact 23 which is preferably of blade-like construction and generally C-shaped, and mounted for swinging movement about a pivot 25 carried by a conducting bracket 27. External circuit connections to the interrupter are made through a pair of terminal members 29 and 31, the first of which is secured to the stationary contact assembly 19, and the second one of which is connected to the conducting bracket 27. Thus, when the interrupter is in the closed circuit position as shown in Fig. 1, an electrical circuit is established between the terminals 29 and 31 through the stationary contact 19, the movable contact 23 and the conducting bracket 27.

The movable contact 23 is actuated to open

and closed circuit positions, by an insulating operating rod 33 actuated by a crank arm 35 carried by a shaft 37, in turn journaled in a suitable bracket 39. The shaft 37 is actuated by a crank arm 41 coupled by suitable linkage 43 to the connecting rod 45 of an air actuated piston operated within the cylinder 47. The connecting rod 45 may be moved up and down to effect closing and opening movement of the movable contact 23 by the admission of compressed gas from the tank 7 to the operating cylinder 47 by suitable valves well known in the art.

The tubular insulator 13, in addition to serving as a support, also provides a passage for conducting an arc extinguishing blast of gas from the storage tank 7 to the space between the contacts 19 and 23. This gas blast passage proceeds through the short conduit 9 to the valve casing 11, through the tubular insulator 13, and opening 49 through the insulating support 15 which is preferably coextensive with the passage within the tubular insulator 13.

In the event the moving contact 23 is moved to the open circuit position while the circuit interrupter is carrying load, an arc will be drawn across the upper end of the passage 49 and will be subjected to a blast of arc extinguishing gas caused to flow through the tubular insulator 13, whereby the arc will be extinguished. Control of the blast of gas to the arc in this instance may be obtained by a valve 51 disposed in the lower end of the valve casing 11. The valve 51 has a stem 53 operatively coupled to one end of an actuating member 55. In this instance the actuating member 55 is rigidly secured to a rock shaft 57 journaled in the side of the valve casing 11. The shaft 57 extends exteriorly of the casing 11, and has a pair of actuating arms 59 secured to the opposite ends thereof. The actuating arms 59 carry a roller assembly generally indicated at 61 in Fig. 1, which is adapted to be actuated by a cam 63 in this instance forming an integral part of the crank arm 35.

A more complete illustration of the arrangement of the roller assembly 61 in connection with the actuating arms 59 will be found in Figs. 2 and 4.

The two actuating arms 59 are joined by a pin 65. Journaled about the pin 65 and disposed between the arms 59 is a rocker arm 67. The rocker arm 67, as shown in Fig. 2, is pivoted at 69 to a spring guide rod 71, the upper end of which is slidably operative in a bracket 73 which forms an extension of the valve casing 11. A compression spring 75 encircling the guide rod 71 biases the rocker arm 67 in a clockwise direction, as viewed in Fig. 2. The rocker arm 67 is channeled on opposed sides as shown at 77, in Fig. 4 for slidably receiving the parallel legs of a U-shaped yoke member 79. The lower end of the yoke member 79 has a pin 81 journaled therein which, in turn, rotatably carries the roller 83. The pin 81 also carries a pair of bell crank shaped arms 85 disposed on the outer sides of the yoke 79. The right-hand end of the arms 85 are provided with an elongated slot 87 through which the pin 65 also extends.

From the foregoing description, it will be apparent that the yoke 79 carrying the pin 81 and the roller 83 thereon will be movable in the slots 77 an amount determined by the relative motion as afforded by the elongated slots 87, between the pin 65 and the arms 85. Thus, the position of the roller 83 is movable with respect to the actuating arms 59. In order to fix the position of the roller 83 with respect to the arms 59, an adjustment is provided which includes the bolt 89 secured at its lower end to the rocker arm 67 and extending upwardly through the yoke 79. A nut 91 adjustable on the upper end of the bolt 89 determines the upper limiting position which the yoke 79 may assume with respect to the rocker arm 67. An S-shape locking member 93, as more clearly shown in Fig. 2, maintains the nut 91 against rotation once the proper adjustment of the roller 83 has been made. From the foregoing description, it will appear that the rocker arm 67, the yoke 79, roller 83, and the arms 85 are so united as to be rotatable as a unit about the pin 65. The spring 75, therefore, biases the entire roller assembly in a clockwise direction about the pin 65, as viewed in Fig. 2.

The roller assembly is normally maintained in a fixed or set position with respect to the actuating arms 59, the outer ends of which serve as stops for two short sleeves 94 surrounding the ends of the pin 81 which engage the lower sides of the arms 59 at 95, as shown in Fig. 2. Also as long as the roller assembly is held in a set position with respect to the actuating arms 59, the spring 75 serves the further function of biasing the arms 55 and 59 for rotation in a counterclockwise direction about the axis 57 so as to maintain the valve 51 in the closed position.

As shown more particularly in Fig. 1, the valve operating mechanism is so arranged that when the valve 51 is closed, the roller 83 is disposed in the path of movement of the cam 63. It will be noted that the cam 63 has a leading edge 97 which rises steeply and a relatively large top surface 99 and a trailing edge 101 also of slope similar to the leading edge 97. When the movable contact 23 is in the closed circuit position, the roller 83 assumes a position adjacent the leading edge 97 of the cam 63, as shown in Fig. 1. Upon movement of the contact 23 to the open circuit position, the leading edge 97 of the cam 63 engages the roller 83, causing the actuating arms 59 and the actuating member 55 to be rotated clockwise against the bias of spring 75 so as to open the valve 51 permitting a blast of gas to flow from the tank 7 to the tubular insulator 13 to extinguish the arc.

It will, of course, be apparent that during the time the roller 83 travels over the top surface 99 of the cam 63, as more clearly shown in Fig. 2, the valve 51 will be held in the open position. Just prior to the time the contact 23 reaches its full open circuit position, cam 63 will have moved a distance sufficient with respect to the roller 83 so that the roller will descend along the sloping trailing surface 101 of the cam, thereby permitting the valve 51 to close.

During the closing operation of the interrupter, crank arm 35 and the cam 63 are rotated in a clockwise direction. At the beginning of the closing movement the sloping edge 101 of the cam 63 engages the roller 83 and rotates the entire roller assembly comprising the rocker arm 67, yoke 79 and arms 85 about the pin 65 in a counterclockwise direction as viewed in Fig. 3. This counterclockwise rotation of the roller assembly continues until the roller again rides on the top surface 99 of the cam 63. The pivotal axis 65 of the roller assembly 61 and the pin 69, as well as the various lever arms tending to rotate the assembly and also the angular displacement between the various lever linkages, is such that rotation of the roller assembly will take place in the counterclockwise direction,

thereby compressing the spring 75 but without imparting movement to the actuating arms 59 and the valve 51. Thus during the closing stroke of the interrupter, the valve 51 is permitted to remain closed so as to conserve arc extinguishing gas during an opening-closing operation.

In the event the interrupter is being closed under conditions of overload on the connected circuit, the circuit may be completed as a result of sparkover between the contacts prior to the actual engagement or movement of the contacts to the fully closed circuit position. While closing the interrupter against an overload, the interrupter will immediately receive a tripping impulse so as to cause the contacts to be reversed before being moved to the fully closed position. This requires the opening of the gas blast valve 51 to admit an arc extinguishing blast of gas to interrupt the arc.

However, the roller assembly 61 during the greater portion of the closing movement of the contacts is in the inoperative position and ineffective to cause an opening of the blast valve 51. Fig. 3 more clearly illustrates the position of the roller assembly 61 during the closing stroke just prior to engagement of the interrupter contacts. It will be noted that the roller 83 is still on the top surface 99 of the cam 63 and maintains the assembly in the inoperative position. The roller assembly 61 would normally reset to the operative position as the roller 83 is permitted to move over the leading edge 97 in the event the actuating arm 35 is moved to the fully closed circuit position. However, if opening movement of the interrupter is initiated under conditions of overload, where an arc has been established during the closing movement of the interrupter and the operating mechanism has a position as illustrated in Fig. 3, the roller assembly 61 would be ineffective to open the gas blast valve 51. In order to avoid possible failure of the gas blast operation during operating conditions of the kind above enumerated, the cam 63 is provided with a transversely extending pin 103 which extends laterally from the sides of the cam 63 so as to engage the free ends of the arms 85 when the cam 63 is moved toward the closed circuit position.

During this closing movement the pin 103 will first engage the upper edges of the arms 85 and rotate the entire roller assembly 61 about the pin 65 in a counterclockwise direction, as viewed in Fig. 3, momentarily raising the roller 83 from the upper surface 99 of the cam 63 until the pin 103 passes beyond the arms 85 to the lower side thereof.

It will thus be apparent that if the operating arm 35 is reversed from a position shown in Fig. 3, the pin 103 will engage the lower edges of the arms 85 to cause the entire roller assembly 61 to be rotated in a clockwise direction until the sleeves 94 on pin 81 again rest against the surfaces 95 of the actuating arms 59, in which position the roller assembly 61 is operative to effectively actuate the actuating arms 59 and cause the valve 51 to be opened. Therefore, even though the interrupter is caused to be opened before the contacts have reached their fully closed circuit position, the blast valve will be positively actuated to provide the necessary arc extinguishing blast for interrupting the circuit.

In Figs. 5 and 6, different arrangements for controlling the actuating member 55 of the blast valve operating mechanism are shown. In these figures like parts will be given the corresponding numbers of reference as used in the previous figures. With particular reference to Fig. 5, the actuating arms 59 formerly illustrated are replaced by an arm 105 having an elongated slot 107 adjacent the left-hand end. The slot 107 is provided with teeth at its left-hand side so as to provide a rack 109, as shown. The rack 109 is adapted to coact with a pinion 111 translatable in the slot 107. The pinion 111 is preferably coaxially secured to a cam roller 113 adapted to operate over the surface of the cam 63. Thus, if the crank arm 35 is rotated in a counterclockwise direction to effect an opening movement of the interrupter, cam 63 will engage the roller 113 to rotate the same in a clockwise direction. This clockwise rotation of roller 113 will also impart a similar rotation to the pinion 111. Since the pinion 111 is in engagement with the rack 109, the rack 109 will be raised by the pinion to cause the pinion to assume a position at the lower end of the slot 107. Raising of the rack 109 obviously raises the actuating arm 105, causing it to rotate in a clockwise direction about the axis 57 so as to open the gas blast valve. As the roller 113 travels beyond the trailing edge 101 of the cam 63, the spring 75 causes the actuating arm 105 to again close the air blast valve. During the closing operation of the interrupter, the crank arm 35 and cam 63 are rotated in a clockwise direction so that the cam 63 in its engagement with the roller 113 causes the roller to be rotated in a counterclockwise direction. Consequently, the pinion 111 will also be rotated in a counterclockwise direction and will be caused to travel upwardly along the rack 109 without imparting motion to the actuating arm 105. The gas blast valve is thereby not actuated during the closing operation.

If for any reason during the closing operation of the interrupter the contacts are caused to be reversed as, for example, when closing the interrupter against a short circuit, the reversal of contact movement will also be accompanied by reversal of the movement of the cam 63 which will again cause rotation of the roller 113 in a clockwise direction actuating the pinion 111 in the same direction so as to raise the actuating arm 105 and open the gas blast valve. If the angle between longitudinal axis through the slot 107 and the tangent to the upper surface 99 of the cam 63 is maintained small, as illustrated in Fig. 5, less friction is required between the roller 113 and the surface 99 of the cam 63 to cause the roller to actuate the arm 105. If more rapid valve action is desired, greater gripping action is required between the cam surface 99 and the roller 113 which may be obtained by roughening these respective surfaces.

Another arrangement for obtaining the objects of our invention is shown in Fig. 6. In this arrangement an actuating arm 115 replaces the arms 59 of Figs. 1 to 4 or the arm 105 of Fig. 5. The arm 115 carries a cam follower 117 hingedly secured at its upper end by a pin 119. The lower end of the follower 117 has a rounded bearing surface 121 normally adapted to bear against the surface of cam 63 when the cam is rotated in a counter-clockwise direction during the opening movement of the interrupter. The follower 117 is maintained in this position by a stop pin 123 which is caused to bear against the lower edge of the actuating arm 115. Thus, if the bearing surface 121 is caused to ride over the top surface 99 of the cam 63, the actuating arm 115 will be moved upwardly, rotating the

actuating member 55 in a clockwise direction about the axis 57 to open the gas blast valve. Obviously, as the bearing surface 121 moves beyond the top surface 99 of the cam 63, the gas blast valve is again permitted to close. During the closing movement of the interrupter, as the crank arm 35 and cam 63 are moved clockwise, the edge 101 of cam 63 engages the cam follower 117, rotating it about its pivotal support 119 which permits the follower to ride over the top surface 99 of the cam without imparting motion to the actuating arm 115, thereby allowing the gas blast valve to remain closed during the closing operation of the interrupter.

When the crank arm 35 is in the fully closed position, the cam follower 117 will again assume a reset position adjacent the leading edge 97 of the cam 63. In order to render the cam follower 117 operative at or near the end of the closing stroke in the event of reversal of contact movement initiated by a tripping impulse as a result of closing the interrupter against a short circuit, the lower end of the cam follower 117 is provided with a pawl 125, and the top cam surface 99 has a plurality of notches 127 therein to provide a ratchet to engage the pawl 125. Thus, if the crank arm 35 and cam 63 are rotated in a counterclockwise direction from the position shown in Fig. 6, the pawl 125, as illustrated in the dotted line position of the follower 117, will engage one of several of the notches 127 positively rotating the cam follower in a clockwise direction about its pivotal axis 119 to the set or operative position, thereby again causing the bearing surface 121 to ride over the top surface 99 of the cam 63 to actuate the gas blast valve to the open circuit position.

Thus, the arrangement shown in Fig. 6, as the structures previously described, provides for a positive actuation of the gas blast valve during the opening movement of the contact structure irrespective of the circuit conditions and at the same time provides for the conservation of arc extinguishing gas during the closing operation of the interrupter.

Although we have shown and described specific structures, it is to be understood that the same is for the purpose of illustration and that changes and modifications may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

We claim as our invention:

1. In a circuit interrupter of the gas-blast type, separable contacts for establishing an arc, operating means for actuating said contacts to open and closed positions, a source of gas under pressure, a valve for releasing a blast of gas from said source to extinguish said arc, an operating member for actuating said valve to open and closed positions, said contact operating means including a cam movable in accordance with the opening and closing movements of said contacts, and a cam follower operative on the surface of said cam during the opening movement of said contacts to actuate said operating member to cause said valve to open, said cam having an inclined surface portion to cause said follower to open the valve during the initial portion of the opening movement of the contacts from the fully closed position of said contacts, said cam follower being arranged to be inoperative to cause a valve operation during the closing movement of said contacts, and means in advance of said inclined surface during closing movement of the contacts operable to cause said follower to open said valve when opening movement of said contacts occurs prior to the time the contacts reach the fully closed position.

2. In a circuit interrupter of the gas-blast type, separable contacts for establishing an arc, operating means for actuating said contacts to open and closed positions, a valve arranged to be supplied with gas under pressure, an actuating member for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam movable in accordance with the opening and closing movements of said contacts, a cam follower coacting with said cam and arranged to have a set position with respect to said valve actuating member for causing said member to be operated during the opening movement of said contacts, said cam having an inclined surface portion for causing said follower to open the valve during the initial portion of the opening movement of said contacts from the fully closed position of said contacts, said cam follower being movable from said set position to an inoperative position during movement of said contacts to the closed position without imparting motion to the valve actuating member, and means other than said inclined surface portion and rendered operative during the closing movement of said contacts a predetermined time prior to complete closing of said contacts to cause said cam follower to be moved to set position in the event of reversal of contact movement from closing to opening movement prior to the time the contacts reach fully closed position.

3. In a circuit interrupter of the gas-blast type, separable contacts for establishing an arc, operating means for actuating said contacts to open and closed positions, a valve arranged to be supplied with gas under pressure, an actuating member for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam movable in accordance with the opening and closing movements of said contacts, a coacting cam roller hingedly secured to said valve actuating member, means biasing said cam roller to a set position with respect to said valve actuating member to cause said cam to operate said valve actuating member during the opening movement of said contacts, said cam having an inclined surface portion for causing said cam roller to open said valve during the initial portion of the opening movement of said contacts from the fully closed position of said contacts, said cam roller being movable by said cam relative to said valve actuating member without imparting motion to said member during the closing movement of said contacts, and means other than said inclined surface portion operative in accordance with movement of said contacts for restoring said cam roller to its set position in the event of contact reversal from closing to opening prior to the time the contacts reach the fully closed position.

4. In a circuit interrupter of the gas-blast type, separable contacts for establishing an arc, operating means for actuating said contacts to open and closed positions, a valve arranged to be supplied with gas under pressure, an actuating member for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam movable in accordance with the opening and closing movements of said contacts, an arm hinged to said valve actuating member, a roller carried by said arm adapted to coact with said cam, means biasing said arm to a set position with respect to said valve actuat-

ing member to cause said cam to operate said valve actuating member during the opening movement of said contacts, said cam having an inclined surface portion for causing said arm to open said valve during the initial portion of the opening movement of said contacts from the fully closed position of said contacts, said arm being moved relative to said valve actuating member by said cam without imparting motion to said valve actuating member during the closing movement of said contacts, and means on said cam for engaging said arm to restore it to its set position in the event of reversal of contact movement from closing to opening prior to the time the contacts reach fully closed position and prior to the time said roller engages said inclined surface.

5. In a circuit interrupter of the gas-blast type, separable contacts for establishing an arc, operating means for actuating said contacts to open and closed positions, a valve arranged to be supplied with gas under pressure, means biasing said valve to the closed position, an actuating member for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam movable in accordance with the opening and closing movements of said contacts, a coacting cam follower hingedly secured to said valve actuating member and biased by said valve biasing means to a set position with respect to said valve actuating member to cause said cam to operate said valve actuating member during the opening movement of said contacts, said cam having an inclined surface portion for causing said cam follower to open said valve during the initial portion of the opening movement of the contacts from the fully closed position of said contacts, said cam follower being movable by said cam relative to said valve actuating member without imparting motion to said member during the closing movement of said contacts, and means independent of said inclined surface portion operative to move said follower to set position to open said valve in the event of contact reversal from closing to opening prior to the time the contacts reach fully closed position.

6. In a circuit interrupter of the gas-blast type, separable contacts for establishing an arc, operating means for actuating said contacts to open and closed positions, a valve arranged to be supplied with gas under pressure, an actuating member for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam movable in accordance with the opening and closing movements of said contacts, a coacting cam follower hinged to said valve actuating member, said cam follower being arranged to assume a set position with respect to said valve actuating member during the opening movement of said contacts to cause said cam to operate said valve actuating member to open said valve, said cam having an inclined surface portion for causing said follower to open said valve during the initial portion of the opening movement of said contacts from the fully closed position of said contacts and having another surface portion for causing said follower to maintain said valve in substantially full open position for a predetermined distance of the opening movement of said contacts, said cam follower being moved by said cam with respect to said valve actuating member to an inoperative position during the closing movement of said contacts, and means including a pawl and ratchet arrangement between said cam and said cam follower operative to move said cam follower to said set position upon reversal of contact movement from closing to opening movement prior to the time said contacts reach the fully closed position.

7. In a circuit interrupter of the gas-blast type, separable contacts for establishing an arc, operating means for actuating said contacts to open and closed positions, a valve arranged to be supplied with gas under pressure, an actuating member for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam movable in accordance with the opening and closing movements of said contacts, a coacting cam roller movably mounted on said valve actuating member, said cam roller being arranged to be rotated by said cam during both the opening and closing movements of said contacts, a pinion rotatable with said cam roller, and a rack operatively associated with said pinion and carried by said valve actuating member, said rack and pinion being so arranged that rotation of said cam roller imparts motion to said valve actuating member only during the opening movement of said contacts.

8. In a gas-blast circuit interrupter, separable contacts for establishing an arc, a source of gas under pressure, a valve for releasing gas under pressure from said source to extinguish said arc, operating means for said valve operative during opening movement of said contacts from the closed position to open said valve and to maintain the valve in its fully open position during a substantial portion of the opening movement of the contacts sufficient to completely interrupt the arc and prevent restriking thereof, said valve operating means being inoperative to open said valve during the closing movement of said contacts, and means for restoring said valve operating means to operative condition to cause opening of the valve upon contact reversal from closing to opening occurring during the time when the contacts are within a predetermined distance of the fully closed position.

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