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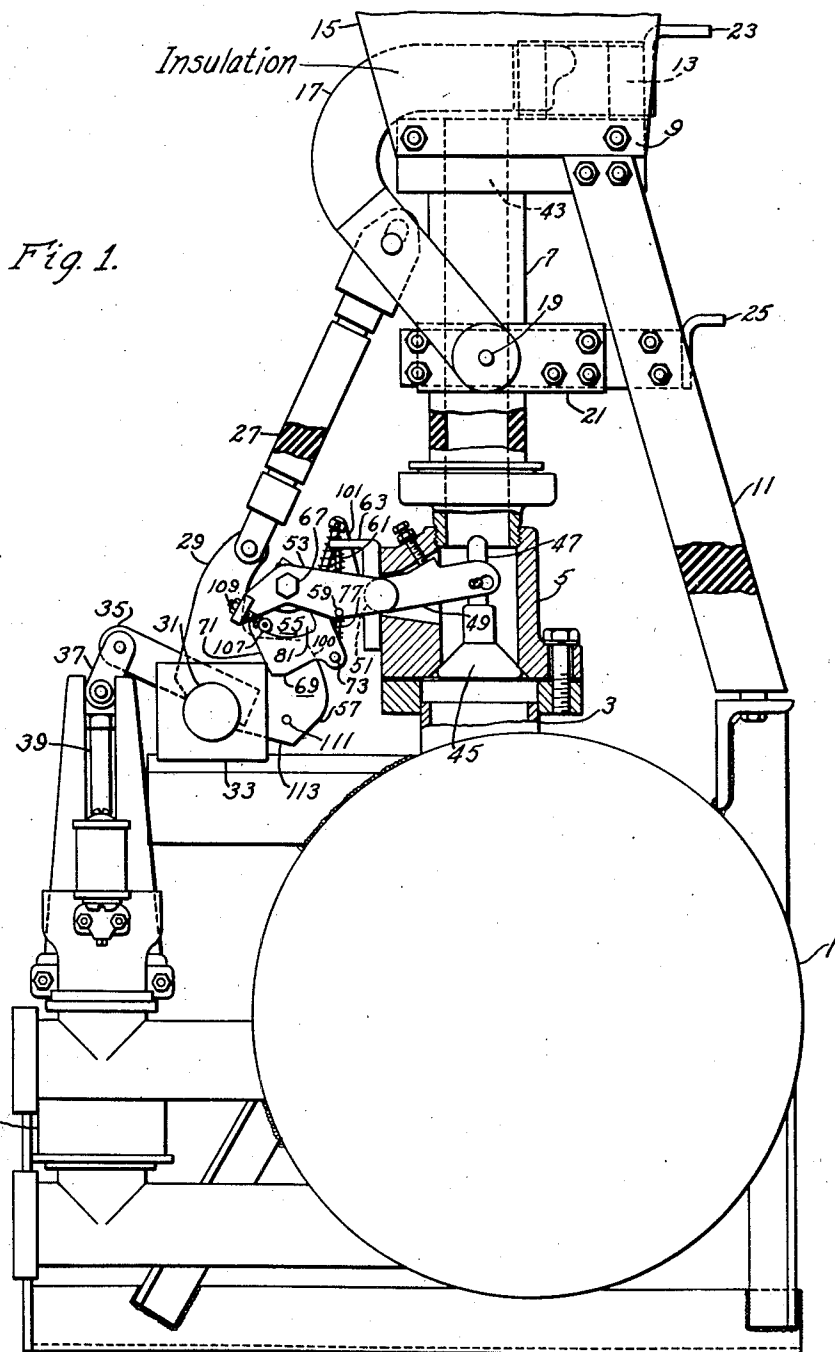
E. H. HALL ET AL

2,310,779

CIRCUIT INTERRUPTER

Filed Oct. 24, 1941

3 Sheets-Sheet 1



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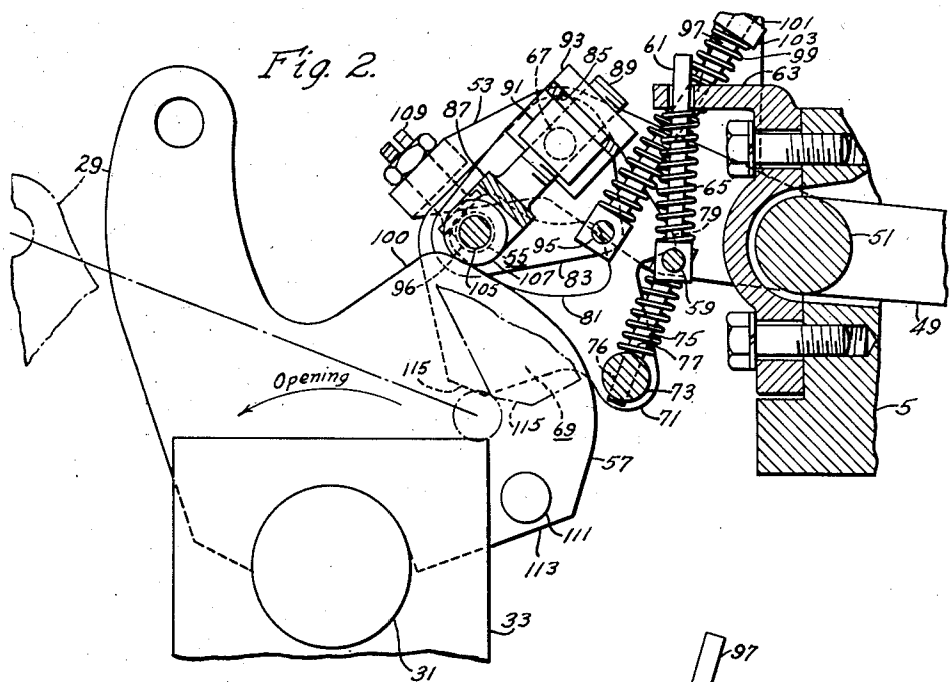
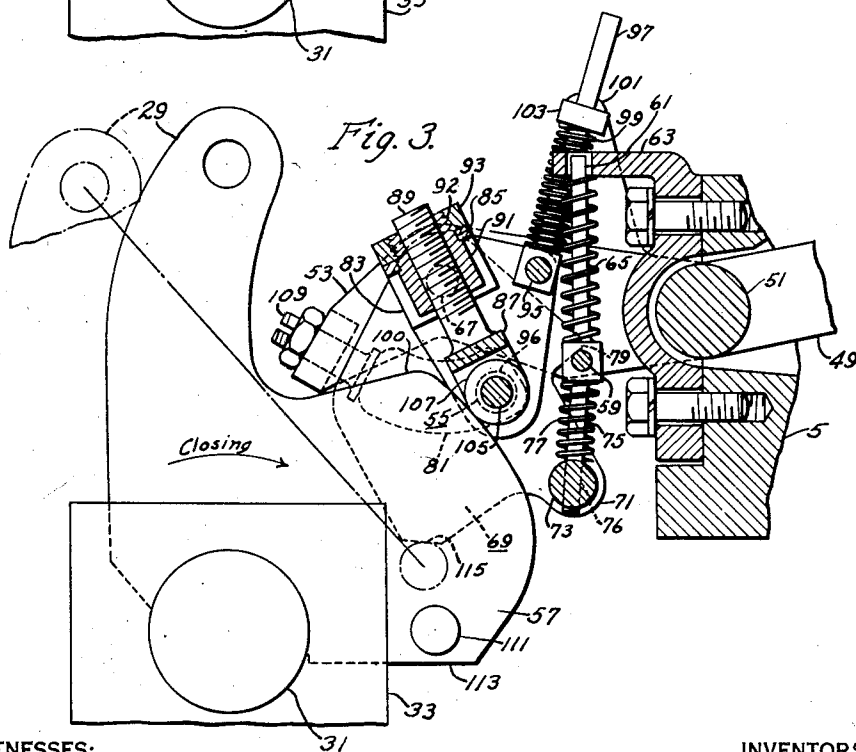
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2,310,779

CIRCUIT INTERRUPTER

Filed Oct. 24, 1941

3 Sheets-Sheet 2



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2,310,779

CIRCUIT INTERRUPTER

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Application October 24, 1941, Serial No. 416,360

15 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 patent application of R. C. Cunningham and B. P. Baker, Serial No. 357,696, filed September 21, 1940, and assigned to the assignee of the instant application there is shown and described a gas blast valve operating mechanism which functions to open the blast valve during the opening operation of the breaker, and which keeps the blast valve closed during the closing operation of the breaker to conserve the supply of compressed gas. In the valve operating mechanism of the aforesaid application there is provided means to open the gas blast valve when the breaker is closed on an overloaded circuit.

In the aforesaid application the operating mechanism consisted of a rotatable roller assembly which was operated during the opening operation of the breaker by a cam attached to the main operating shaft of the breaker. During the closing operation of the breaker the roller assembly was rotated to an inoperative position. When the breaker in the aforesaid application was closed during the existence of overload conditions in the circuit connected to the breaker, or when there was a reversal of the contact mechanism before the contacts were fully closed, a pin was provided on the cam to rotate the roller assembly to an operative position. However, the rotation of the roller assembly by the pin when the breaker was closed on an overloaded circuit required a certain amount of time, and there was consequently a delay before the gas blast valve was operated to extinguish the arc drawn.

The present invention, although operating in a generally similar manner, is an improvement in the gas blast valve operating mechanism described in the aforesaid application. It is an improvement in at least three respects. In the present invention, by the utilization of a plurality of compression springs instead of one compression spring which was used in the aforesaid application, there results a greater flexibility in the gas blast valve operating mechanism. The design of suitable compression springs is consequently greatly facilitated.

Also in the present invention there is provided a greater flexibility of adjustment of the rotatable roller assembly, whereas in the aforesaid application adjustment in only one direction was permitted. One of the most important improvements of the present invention over the mechanism described in the aforesaid application is the

fact that in the present invention when the breaker is attempted to be closed during the existence of overload conditions in the external circuit connected to the interrupter the gas blast valve is immediately (without any delay) operated to extinguish the arc drawn during such an opening operation.

The main object of the present invention is to provide a gas blast valve operating mechanism which is reliable under all operating conditions and which conserves arc extinguishing gas during the closing of the breaker.

Another object of the present invention is to provide a gas blast valve operating mechanism which will open the blast valve immediately upon a reversal of the contact operating mechanism when the breaker is closed on an overloaded circuit.

It is another object of the present invention to provide an improved gas blast valve operating mechanism which has a great flexibility of adjustment, and the parts of which may easily be designed for long life and reliable operation.

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

Figure 1 is a side elevational view, partly in section, of a gas blast type of circuit interrupter illustrating our invention and shown in the closed circuit position;

Fig. 2 is an enlarged side elevational view of the blast valve operating mechanism of the interrupter shown in Fig. 1, and showing the disposition of the parts during a normal opening operation of the interrupter;

Fig. 3 is a view similar to Fig. 2, but illustrating the positions of the several parts during a closing operation of the interrupter;

Fig. 4 is an enlarged fragmentary front elevational view of the interrupter shown in Fig. 1 to indicate the need for flexibility of adjustment, some of the parts being shown in cross-section; and,

Fig. 5 is an enlarged side elevational fragmentary view, partly in section, of a modified gas blast valve operating mechanism, and showing the disposition of the parts thereof during an opening operation from an intermediate closing position.

Referring to the drawings, and in particular to Fig. 1, the reference numeral 1 designates a storage tank for storing gas, such as air, under pressure. Extending from the upper end of the storage tank 1 is a relatively short flanged conduit 3 which, in turn, carries a valve casing 5. Secured

to the upper end of the valve casing 5 is a tubular insulator 7 which has secured to its upper end an insulating support 9. The insulating support 9 may be given additional support by an insulating member 11. The support 9 carries a stationary contact assembly 13 which, in this instance, is enclosed within an arc extinguishing structure 15, only a portion of which is shown. The arc extinguishing structure 15 may be of conventional form and does not concern the present invention.

Coacting with the stationary contact assembly 13 is a movable contact 17 which is preferably of blade-like construction and generally C-shaped, and mounted for swinging movement about a pivot 19 carried by a conducting bracket 21. External circuit connections to the interrupter are made through a pair of terminal members 23 and 25, the first of which is secured to the stationary contact assembly 13, and the second one of which is connected to the conducting bracket 21. Thus, when the interrupter is in the closed circuit position as shown in Fig. 1, an electrical circuit is established between the terminals 23 and 25 through the stationary contact 13, the movable contact 17 and the conducting bracket 21.

The movable contact 17 is actuated to open and closed circuit positions by an insulating operating rod 27 actuated by the crank arm 29 carried by a shaft 31, in turn journaled in a suitable bracket 33. The shaft 31 is actuated by a crank arm 35 coupled by suitable linkage 37 to the connecting rod 39 of an air actuated piston operated within the cylinder 41. The connecting rod 39 may be moved up and down to effect respective closing and opening movements of the movable contact 17 by the admission of compressed gas from the storage tank 1 to the operating cylinder 41 by suitable valves well known in the art.

The tubular insulator 7, in addition to serving as a support, also provides a passage for conducting an arc extinguishing blast of gas from the storage tank 1 to the space between the contacts 13 and 17. This gas blast passage proceeds through the short conduit 3, through valve casing 5, through the tubular insulator 7, and opening 43 provided through the insulating support 9 which is preferably coextensive with the passage within the tubular insulator 7.

In the event the moving contact 17 is moved to the open circuit position while the circuit interrupter is carrying load, an arc will be drawn across the upper end of passage 43 and will be subjected to a blast of arc extinguishing gas caused to flow through the tubular insulator 7, whereby the arc will be extinguished. Control of the blast of gas to the arc in this instance may be obtained by a valve 45 disposed in the lower end of the valve casing 5. The valve 45 has a stem 47 operatively coupled to one end of an actuating member 49. In this instance the actuating member 49 is rigidly secured to a rock shaft 51 journaled in the side of the valve casing 5. The shaft 51 extends exteriorly of the casing 5, and has a pair of rocker arms 53 secured to the opposite ends thereof. The rocker arms 53 carry a rotatable roller assembly generally indicated at 55 in Fig. 1, which is adapted to be actuated by a cam 57 in this instance forming an integral part of the crank arm 29.

A more complete illustration of the arrangement of the roller assembly 55 in connection with the other operative parts of the gas blast valve operating mechanism will be found in Figs. 2 to 4, inclusive.

The two rocker arms 53 are joined by a pin 59. A spring guide rod 61 is pivotally mounted on the pin 59 and has its upper end slidably operative in a bracket 63 which is an integral extension of the valve casing 5. A compression spring 65 encircling the spring guide rod 61 biases the rocker arms 53 in a counter-clockwise direction about the rock shaft 51.

Two pivot screws 67, as clearly shown in Fig. 4, threadably secured to the rocker arms 53 pivotally support a lever latch, generally indicated by the reference numeral 69. The lever latch 69 comprises two metallic plates 71, the upper ends of which are pivotally mounted on the pivot screw 67 and the lower ends of which are joined together by a pin 73. A spring guide rod 75 is pivotally supported on the pin 59 and has its lower end slidably operative in a hole 76 drilled through the pin 73. A compression spring 77 encircling the spring guide rod 75 biases the lever latch 69 in a clockwise direction about the pivot screws 67 looking at Figs. 2, 3 or 5.

Each plate 71 has a projection 79 which is biased against the pin 59 by compression spring 77 and serves as a stop for the clockwise rotation of the lever latch 69 about pivot screws 67. Also each metallic plate 71 has a slot 81 formed therein, the purpose for which will appear hereinafter. Pivotally mounted on the pivot screws 67 and disposed between the two metallic plates 71 is a U-shaped yoke member 83. In the bight of the U-shaped yoke member 83 is drilled a hole 85, through which is adjustably inserted the stem 89 of a U-shaped roller yoke 87. The U-shaped roller yoke 87 is adjustably secured to the U-shaped yoke member 83 by two nuts 91 and 93, nut 91 having an upper extension 92 which projects through the hole 85 and is threadably engaged by the nut 93 as most clearly shown in Fig. 3. A pin 95 passes through the parallel legs of the U-shaped yoke member 83 and pivotally supports a spring guide rod 97, the other end of which is slidably operative in an eyelet 103 which is rotatably supported on a bracket 101, the bracket 101 being an integral extension of the rocker arm 53. A compression spring 99 encircling the spring guide rod 97 biases the U-shaped yoke member 83 in a clockwise direction about the pivot screws 67 in Figs. 1, 2, 3 and 5.

A pin 105 carrying a roller 107 passes through holes provided in the parallel legs of the U-shaped roller yoke 87. It also passes very loosely through the parallel legs of the U-shaped yoke member 83 as shown at 94 in Fig. 4 and through the slots 81 in the two plates 71. The ends of the pin 105 are surrounded by sleeves 96 which normally rest against adjustable stop screws 109 which are threadably secured to the ends of the rocker arms 53. A pin 111 rigidly secured to the cam 57 and disposed perpendicularly with respect to the plane thereof is provided for a purpose which will appear hereinafter.

The operation of the gas blast valve operating mechanism will now be explained. When the circuit interrupter, which is shown in the closed circuit position in Fig. 1, is actuated to the open circuit position, the crank arm 29 is rotated in a counter-clockwise direction about the shaft 31. The movable contact 17, which is attached through the insulating operating rod 27 to the crank arm 29, is rotated in a counter-clockwise direction about its pivot 19 to result in opening the electrical circuit through the breaker and in drawing an arc between the movable contact 17

and the stationary contact 13. At the same time that the crank arm 29 is rotating in a counter-clockwise direction about the shaft 31, the leading edge 100 of the cam 57, which is an integral part of the crank arm 29, engages the roller 107 and forces the rocker arms 53 in a clockwise direction about the rock shaft 51 against the bias of compression spring 65. Depending on the shape of the cam surface, the blast valve 45 is correspondingly held open during the opening operation of the circuit interrupter.

It is thus apparent that during the opening operation of the circuit interrupter when an arc is being drawn between the movable contact 17 and the stationary contact 13, an arc extinguishing blast of gas from the storage tank 1 is admitted through the tubular insulator 7 to result in an extinguishment of the arc. The disposition of the parts during a normal opening operation is shown by the full lines in Fig. 2.

When the electrical circuit is desired to be completed through the interrupter, the crank arm 29 is rotated by the shaft 31 in a clockwise direction. The cam 57 also rotates in a clockwise direction about the shaft 31. During the closing operation of the interrupter the lower leading cam edge 113 strikes against the roller 107, and the entire roller assembly, consisting of the U-shaped roller yoke 87 and the U-shaped yoke member 83, is rotated in a counter-clockwise direction about the pivot screws 67 to result in the roller 107 being forced to an inoperative position and sliding over the top surface of the cam 57 in a manner as shown by the full lines in Fig. 3. It is thus apparent that during the closing of the circuit interrupter the roller 107 is pushed to an inoperative position and consequently the valve 45 remains closed during the entire closing operation of the interrupter. This conserves the gas stored in the storage tank 1 and renders the performance of the interrupter more economical. During the closing operation the pin 111 strikes the plates 71 forcing them slightly in a counterclockwise direction about the pivot screws 67 against the bias of compression springs 77 until the pin 111 snaps past the plates 71, the latter then returning to their original position.

Occasionally it may occur that the external circuit conditions are such that an overload condition exists during the time when it is desired to close the breaker. Consequently the trip mechanism may be operated before the contacts 17 and 13 fully engage. The trip mechanism (not shown) may be actuated therefore before the breaker is fully closed and before the roller 107 has returned to its operative position. It is desirable to provide means during the closing operation for instantaneously opening the blast valve 45 upon a reversal of the contact operating mechanism even though the roller 107 is not in an operative position.

The pin 111, which is in a position adjacent to the surfaces 115 of the plates 71 at this time, engages the faces 115 of the metallic plates 71 and serves to open the gas blast valve 45 immediately upon a reversal of the contact operating mechanism during a closing operation before the contacts of the breaker are fully closed. It is apparent that the force exerted by the pin 111 on the faces 115 of the metallic plates 71 is in a direction to the left of the pivot screws 67 as shown by the dotted lines in Fig. 3, and consequently the lever latch 69 will be raised and will result in a clockwise movement of the rocker arms 53 about the rocker shaft 51 to effect an opening of the

blast valve 45. The pin 111 will remain in engagement with the surfaces 115 of plates 71 to hold the blast valve 45 open the desired length of time during such an abnormal opening operation. The dotted lines in Fig. 2 show the moment of separation of the pin 111 from the surface 115 of the plates 71, at which time the valve 45 will again close.

It is thus apparent that we have provided a gas blast valve operating mechanism which functions to open the blast valve during the opening operation of the breaker, the blast valve remaining closed during the closing operation of the breaker. We have also provided means for instantaneously opening the gas blast valve upon a reversal of the contact operating mechanism during the closing operation caused by the actuation of the trip mechanism before the contacts are fully closed.

It will be readily apparent that by the provision of three compression springs 65, 77, and 99 we have eliminated the difficulty of overworking a single compression spring. It will furthermore be apparent that the position of the pin 111 immediately adjacent to the lower surfaces 115 of the plates 71 is such that there will occur an immediate (not a delayed) opening of the valve 45 upon a reversal of the contact operating mechanism during the closing operation caused by an actuation of the trip mechanism before the contacts 13 and 17 are fully closed. Thus the reversal of the contact operating mechanism during a closing operation, which draws an arc between the contacts 13 and 17, will actuate the pin 111 against the faces 115 of the metallic plates 71 and force the lever latch 69 upwards to result in an immediate opening of the blast valve 45 to extinguish the arc drawn between the contacts 13 and 17.

For each pole of the interrupter there is provided an identical gas blast valve operating mechanism. It is desirable to have flexibility in the adjustment of the rollers 107 so that all of the blast valves 45 of the several poles of the interrupter will be opened at the same time and will remain open for the same length of time. For this purpose we have provided an adjustment of the roller 107 in two perpendicular directions. The adjustable roller stop screws 109 provided at the end of each rocker arm 53 provide an adjustment in one direction, and the two nuts 91 and 93 provide an adjustment of the roller stem 89 in a direction at right angles thereto. We have consequently provided great flexibility in the adjustment of the position of the roller 107. It is possible to adjust the roller 107 associated with the gas blast valve operating mechanism associated with each pole of the breaker so that the valves 45 of all of the poles may be operated simultaneously and for the same length of time. It may be desired, however, to have the valve 45 of one pole of the breaker operate prior to the operation of one or more of the other valves 45 associated with the other poles of the breaker, and in this event the adjustment is also easily made.

Fig. 4, showing a fragmentary front elevational view of the interrupter shown in Fig. 1, clearly indicates the ease of adjustment of the position of the several rollers 107 to have simultaneous operation of all the blast valves 45 of the breaker. Only two poles are shown, but it is obvious that there may be more.

The embodiment of our invention shown in Fig. 5 is the same as that shown in the other figures,

but the plates 71 of the lever latch 69 are notched along one side as shown by the reference numeral 117. The pin 111 may be made smaller than in the previous figures so as to easily snap sequentially past the notches 117 during a closing operation of the breaker as previously described. By the provision of a multiplicity of notches 117 on the plates 71 we have provided for a greater number of immediate opening positions of the valve 45 when the contact operating mechanism is reversed during a closing operation prior to full closure of the contacts 13 and 17. During normal closing of the breaker, the pin 111 will simply snap past each notch 117. However, if at any intermediate position of the pin 111 the contact operating mechanism is reversed during a closing operation as a result of the actuation of the trip mechanism prior to full closure of the contacts 13 and 17, then the pin 111 will catch on the notch 117 where it is then positioned; the lever latch 69 will be raised, and the valve 45 will immediately be opened. Consequently, for various intermediate closing positions of the pin 111 there will be an immediate opening of the valve 45 upon a reversal of the contact operating mechanism during a closing operation prior to full closure of the contacts 13 and 17, and prior, of course, to a resetting of the roller yoke 87 to an operative position. By a suitable configuration of the notches 117 and of the plates 71, the valve 45 may be held open for a desired period of time during such an abnormal opening operation.

From the foregoing it is apparent that we have provided a novel valve operating mechanism associated with a gas blast type of circuit breaker which provides flexibility of adjustment, a multiplicity of compression springs to facilitate their design, and the provision of novel means for the immediate actuation of the gas blast valve during a reversal of the contact operating mechanism during a closing operation prior to the full closure of the contacts.

Although we have shown and described specific structures, it is to be understood that the same are for the purposes of illustration and that changes and modifications may be made therein 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 to 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 member movable in accordance with the opening and closing movements of said contacts, said member having a cam surface, an additional actuating portion carried by said member, a coacting cam roller hingedly secured to said valve actuating member, means biasing said cam roller to an operative position with respect to said valve actuating member to cause said cam surface to engage said cam roller and thus to operate said valve actuating member during the normal opening movement of said contacts, said cam roller being movable to an inoperative position relative to said valve actuating member without imparting motion to said valve actuating member during the closing movement of said contacts, and means comprising a rotatable member pivotally supported by said valve actuating member and rotat-

able with respect thereto to engage said additional actuating portion so as to operate said valve actuating member to open said valve in the event of reversal of said contact operating means prior to closure of said contacts during a closing operation of said interrupter and while said cam roller is in inoperative 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 member movable in accordance with the opening and closing movements of said contacts, said member having a cam surface, an off-standing member rigidly secured to said member, a coacting cam roller pivotally secured to said valve actuating member, means biasing said cam roller to an operative position with respect to said valve actuating member to cause said cam surface to engage said cam roller to operate said valve actuating member during the normal opening movement of said contacts, said cam roller being movable to an inoperative position during the closing movement of said contacts, and means comprising a member rotatable with respect to said valve actuating member, said last mentioned member cooperating with said off-standing member to actuate said valve actuating member to open said valve in the event of reversal of contact movement during a closing operation of the interrupter prior to full closure of said contacts and also during the time when said cam roller is in an inoperative 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 to 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 member movable in accordance with the opening and closing movements of said contacts, said member having a cam surface, a transverse pin rigidly secured to said member, a coacting cam roller hingedly secured to said valve actuating member, means biasing said cam roller to an operative position with respect to said valve actuating member to cause said cam surface to operate said valve actuating member during the normal opening movement of said contacts, said cam roller being movable to an inoperative position during the closing operation of said interrupter, and means comprising a member pivotally supported by said valve actuating member and operative by said pin to open said valve during a reversal of contact movement during a closing operation of the interrupter prior to full closure of said contacts and at a time when said cam roller is in an inoperative 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 member rotatable in accordance with contact movement, said rotatable member having a cam surface, a coacting cam roller hingedly secured to said valve actuating member and biased to an operative position with respect

thereto, said cam surface engaging said cam roller during the normal opening operation of said interrupter to cause said valve actuating member to open said valve, said cam roller being forced by said cam to an inoperative position during at least a part of the closing operation of said interrupter, an off-standing pin secured to said cam, and means comprising a member pivotally supported by said valve actuating member and having notches cut therein to cooperate with said off-standing pin to cause said valve to be opened substantially instantaneously upon a reversal of contact movement during a closing operation of said interrupter and prior to full closure of said contacts at a time when said cam roller is in an inoperative position.

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, an actuating member for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam rotatable in accordance with contact movement, a coacting cam roller pivotally secured to said valve actuating member and biased to an operative position with respect thereto, said cam engaging said cam roller during the normal opening operation of said interrupter to cause said valve actuating member to open said valve, said cam roller being moved by said cam to an inoperative position during part of the closing movement of said contacts, an off-standing pin secured to said cam and substantially perpendicular to the plane thereof and movable therewith, means comprising one or more plate members pivotally secured to said valve actuating member and having a plurality of notches formed along one side thereof, said notches cooperating with said pin to force an instantaneous opening of said valve upon a reversal of contact movement during a closing operation of said interrupter prior to full closure of said contacts and while said cam roller is in an inoperative 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 rotatable in accordance with contact movement, an off-standing pin rigidly secured to said cam, a U-shaped roller yoke, a coacting cam roller pivotally supported by said U-shaped roller yoke, one or more pivot screws, said U-shaped roller yoke being pivotally supported by said one or more pivot screws to said valve actuating member, said cam engaging said cam roller during the normal opening operation of said interrupter to cause said valve actuating member to open said valve, said cam roller being moved by said cam during the closing operation of said interrupter to an inoperative position, one or more plate members pivotally supported by said pivot screws to said valve actuating member, said one or more plate members being engaged by said off-standing pin to cause an opening of said valve upon a reversal of contact movement during a closing operation of the interrupter prior to full closure of said contacts, and during the time when said cam roller is in an inoperative 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, one or more actuating members for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam rotatable with the movement of said contacts, an off-standing pin secured to said cam, a U-shaped roller yoke, a coacting cam roller pivotally supported in said U-shaped roller yoke, one or more pivot screws, said U-shaped roller yoke being pivotally supported by said one or more pivot screws to said valve actuating members, said cam engaging said cam roller during the normal opening operation of said interrupter to cause said valve actuating member to open said valve, said cam roller being moved by said cam to an inoperative position during the closing operation of said interrupter, one or more plate members pivotally supported on said valve actuating members by said pivot screws, notches provided along one side of said plate members to cooperate with said off-standing pin to cause a substantially immediate opening of said valve upon a reversal of contact movement during a closing operation of said interrupter prior to full closure of said contacts and while said roller is in an inoperative position.

8. 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, two actuating members for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam rotatable in accordance with contact movement, an off-standing pin secured to said cam, a U-shaped roller yoke with a threaded stem, a coacting cam roller pivotally supported in said U-shaped roller yoke, a U-shaped member, said stem of said U-shaped roller yoke being adjustably secured by nuts on said U-shaped member, two pivot screws threadedly secured to the opposed outer faces of said two actuating valve members, said U-shaped yoke member being pivotally supported by said two pivot screws to said two valve actuating members, said cam engaging said roller during the normal opening operation of said interrupter to cause said valve actuating members to open said valve, said cam roller being moved by said cam during the closing operation of said interrupter to an inoperative position, one or more plate members pivotally supported by said pivot screws to said valve actuating members, said one or more plate members being engaged by said off-standing pin to cause an opening of said valve upon a reversal of contact movement during a closing operation of the interrupter prior to full closure of said contacts and during the time when said cam roller is in an inoperative position.

9. 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, two actuating members for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam rotatable in accordance with contact movement, an off-standing pin secured to said cam, a U-shaped roller yoke with a threaded stem, a coacting cam roller pivotally supported in said U-shaped roller yoke, a U-shaped member, said stem of said U-

shaped roller yoke being adjustably secured by nuts on said U-shaped member, two pivot screws threadedly secured to the opposed outer faces of said two actuating valve members, said U-shaped yoke member being pivotally supported by said two pivot screws to said two valve actuating members, said cam engaging said roller during the normal opening operation of said interrupter to cause said valve actuating members to open said valve, said cam roller being moved by said cam during the closing operation of said interrupter to an inoperative position, one or more plate members pivotally supported by said pivot screws to said two-valve actuating members and having a plurality of notches along one side thereof, said notches on said plate members engaging with said off-standing pin to cause an immediate opening of said valve upon a reversal of contact movement during a closing operation of the interrupter prior to full closure of said contacts and during the time when said cam roller is in an inoperative position.

10. 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, two actuating members for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam rotatable in accordance with contact movement, an off-standing pin secured to said cam, a U-shaped roller yoke with a threaded stem, a coacting cam roller pivotally supported on said U-shaped roller yoke, a U-shaped member, said stem of said U-shaped roller yoke being secured by adjustable screws to said U-shaped member, two pivot screws threadedly secured to the opposed outer faces of said two actuating valve members, said U-shaped yoke member being pivotally supported by said two pivot screws to said two valve actuating members, said cam engaging said roller during the normal opening operation of said interrupter to cause said valve actuating members to open said valve, said cam roller being moved by said cam during the closing operation of said interrupter to an inoperative position, one or more plate members pivotally supported by said pivot screws to said two valve actuating members, said plate members being so positioned that at a predetermined time prior to full closure of said contacts said off-standing pin is adjacent one edge of said plate members to engage said plate members upon a reversal of contact movement to force said two valve actuating members to open said valve.

11. 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, two actuating members for operating said valve to establish an arc extinguishing blast of gas, said contact operating means including a cam rotatable in accordance with contact movement, an off-standing pin secured to and rotatable with said cam, a U-shaped roller yoke with a threaded stem, a coacting cam roller pivotally supported on said U-shaped roller-yoke, a U-shaped member, said stem of said U-shaped roller yoke being secured by adjustable screws to said U-shaped member, two pivot screws threadedly secured to the opposed outer faces of said two actuating valve members, said U-shaped yoke member being pivotally supported by said two pivot screws

to said two valve actuating members, said cam engaging said roller during the normal opening operation of said interrupter to cause said valve actuating members to open said valve, said cam roller being moved by said cam during the closing operation of said interrupter to an inoperative position, one or more plate members pivotally supported by said pivot screws to said two valve actuating members and having a plurality of notches along one side thereof, said plate members being so positioned that said off-standing pin engages sequentially said notches during the intermediate portion of the closing operation of said interrupter so that upon a reversal of contact movement prior to full closure of said contacts and during the time when said roller is in an inoperative position said pin will cooperate with the notch which it then engages to cause opening of said valve.

12. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, operating means for actuating said contacts to open and to closed circuit 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 member movable in accordance with the opening and closing movements of said contacts, cam means interengaging said member with said actuating member to open said valve during a normal opening operation of said interrupter, means rendering said cam means inoperative during at least a portion of the closing operation of said interrupter, and means mounted on said actuating member for movement independently of said cam means and operative to interengage said member with said actuating member to open said valve only when there is a reversal of contact movement during a closing operation and while said cam means is rendered inoperative.

13. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, movable means for moving said contacts to open and to closed circuit positions, a valve arranged to be supplied with gas under pressure, said movable means including a first operating part and a second operating part, a first valve actuating member engaging said first operating part during a normal opening operation of said interrupter to actuate said first valve actuating member to open said valve, means rendering said first valve actuating member inoperative to open said valve during at least a portion of the closing operation of said interrupter, a second valve actuating member movable with respect to said first valve actuating member, said second valve actuating member engaging said second operating part to open said valve only during a circuit opening operation while said first valve actuating member is in its inoperative position and when there is a reversal of contact movement during a closing operation.

14. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, movable means for moving said contacts to open and to closed circuit positions, a valve arranged to be supplied with gas under pressure, said movable means including a first operating part and a second operating part, a first valve actuating member, means biasing said first valve actuating member to a position where it is operative to open said valve upon movement of said first operating part during a normal opening operation of said interrupter, means rendering said

first valve actuating member inoperative to open said valve during at least a portion of the closing operation of said interrupter, a second valve actuating member movable with respect to said first valve actuating member, a second biasing means biasing said second valve actuating member to an operative position, said second valve actuating member engaging said second operating part to open said valve only during a circuit opening operation while said first valve actuating member is in an inoperative position and when there is a reversal of contact movement during a closing operation.

15. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, movable means for moving said contacts to open and to closed circuit positions, a valve arranged to be supplied with gas under pressure, said movable means including a first operating part and

5 a second operating part, a first valve actuating member, means for adjusting the position of said first valve actuating member in at least two directions, said first valve actuating member engaging said first operating part during a normal opening operation of said interrupter to open said valve, means rendering said first valve actuating member inoperative during at least a portion of the closing operation of said interrupter, a second valve actuating member movable with respect to said first valve actuating member, said second actuating member engaging said second operating part to open said valve only during a circuit opening operation while said first actuating member is in an inoperative position and when there is a reversal of contact movement during a closing operation.

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