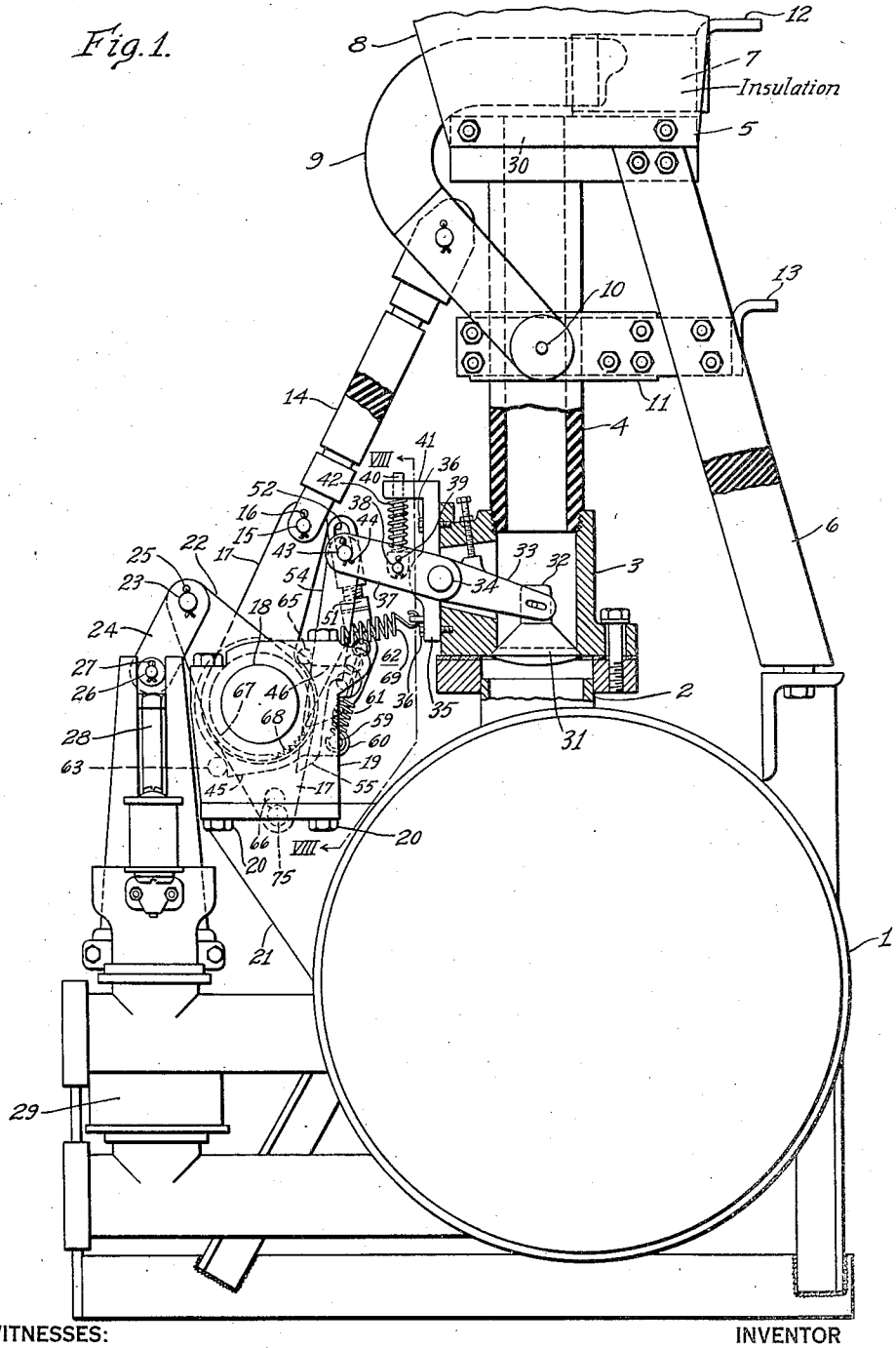
Jan. 21, 1947. E. H. HALL 2,414,522

GAS BLAST CIRCUIT INTERRUPTER

Filed May 25, 1943 5 Sheets-Sheet 1

Fig. 1.



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GAS BLAST CIRCUIT INTERRUPTER

Filed May 25, 1943 5 Sheets-Sheet 2

Fig. 2.

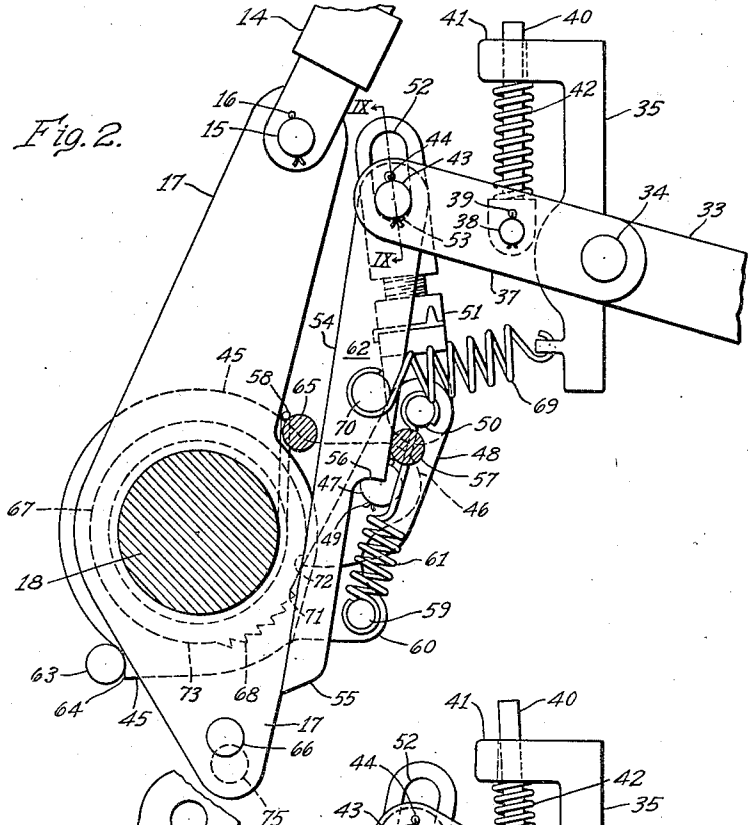
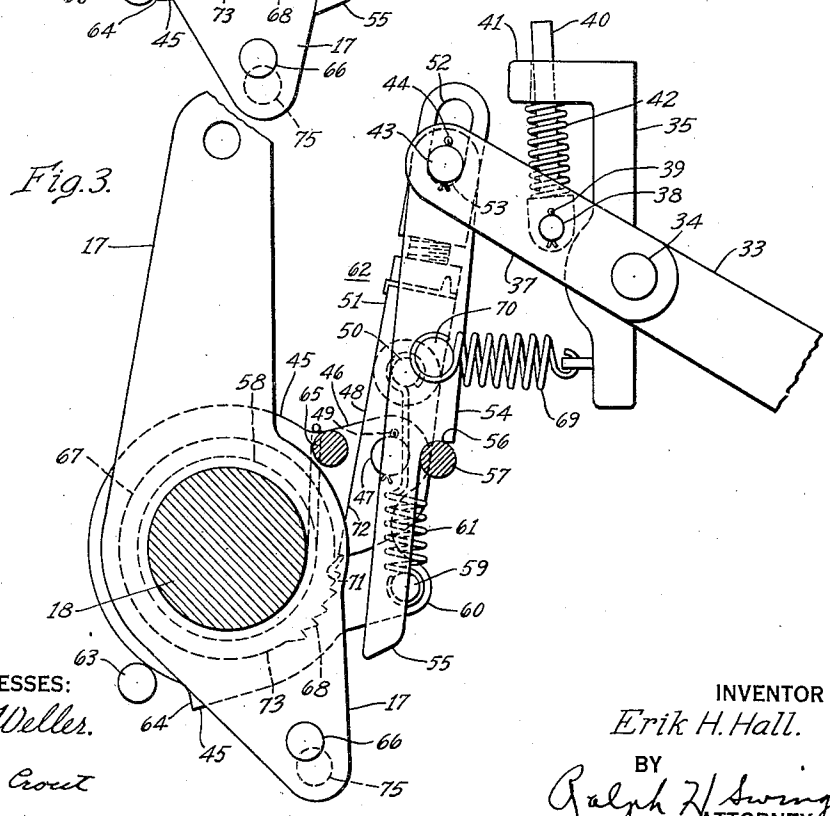


Fig. 3.



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GAS BLAST CIRCUIT INTERRUPTER

Filed May 25, 1943 5 Sheets-Sheet 3

Fig. 4.

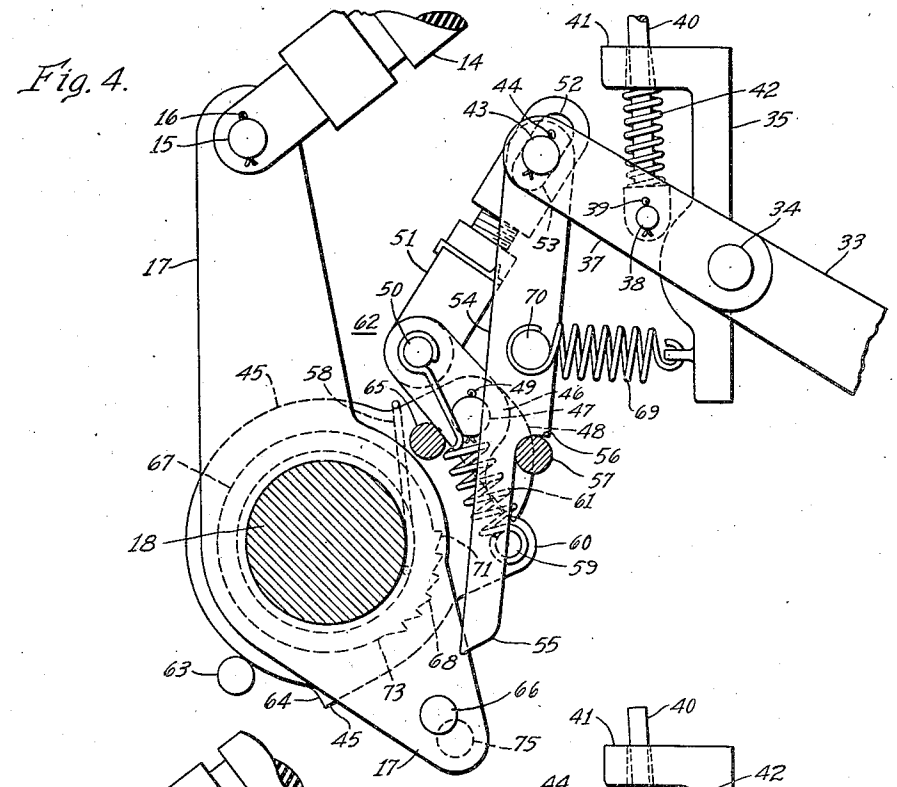
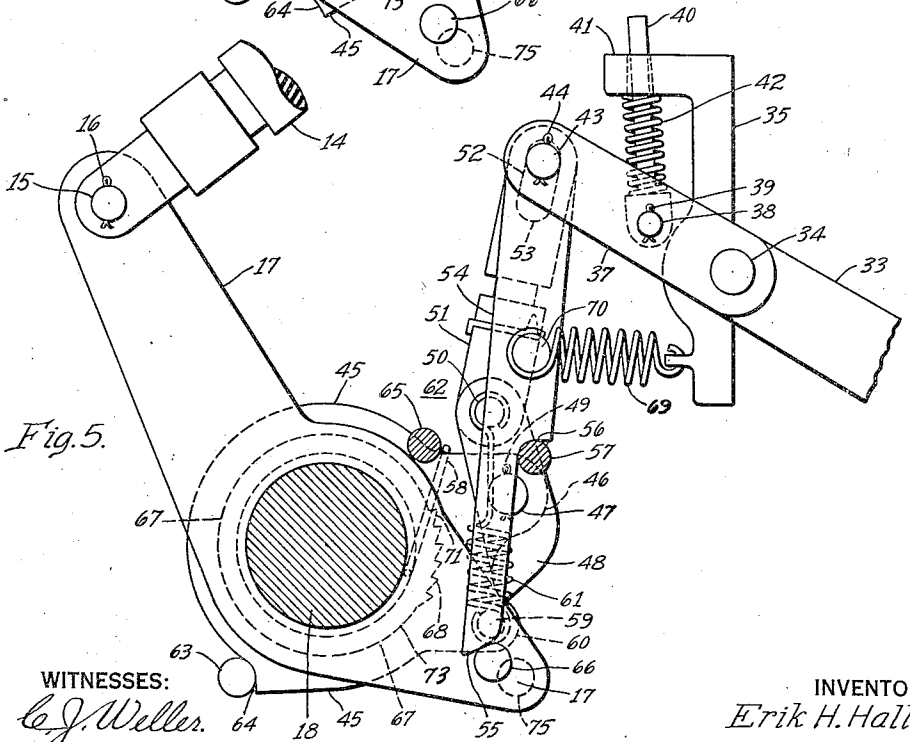


Fig. 5.



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GAS BLAST CIRCUIT INTERRUPTER

Filed May 25, 1943 5 Sheets-Sheet 4

Fig. 6.

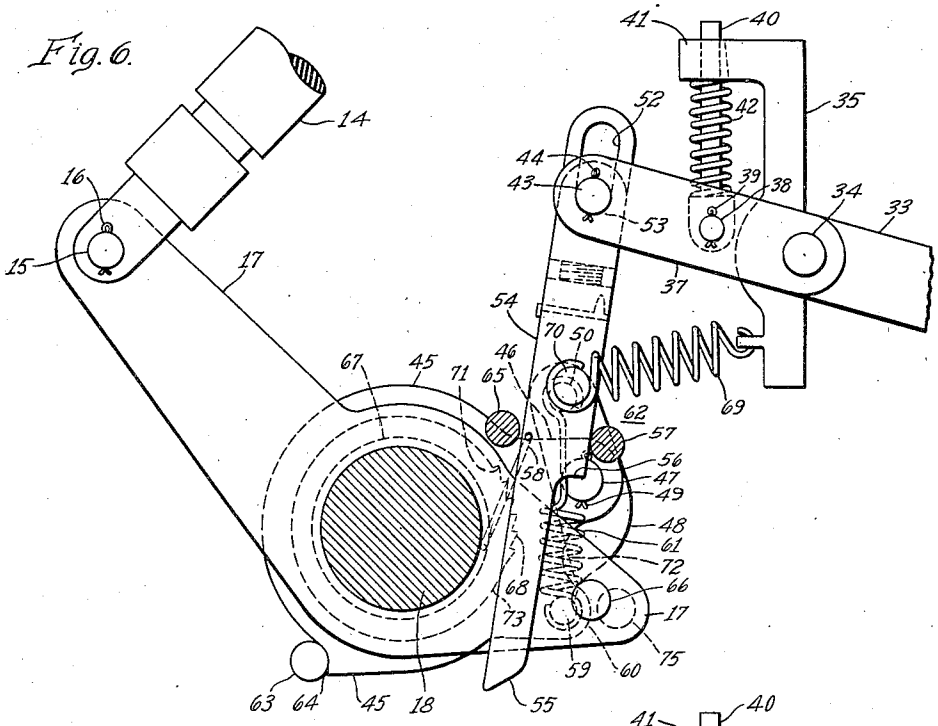
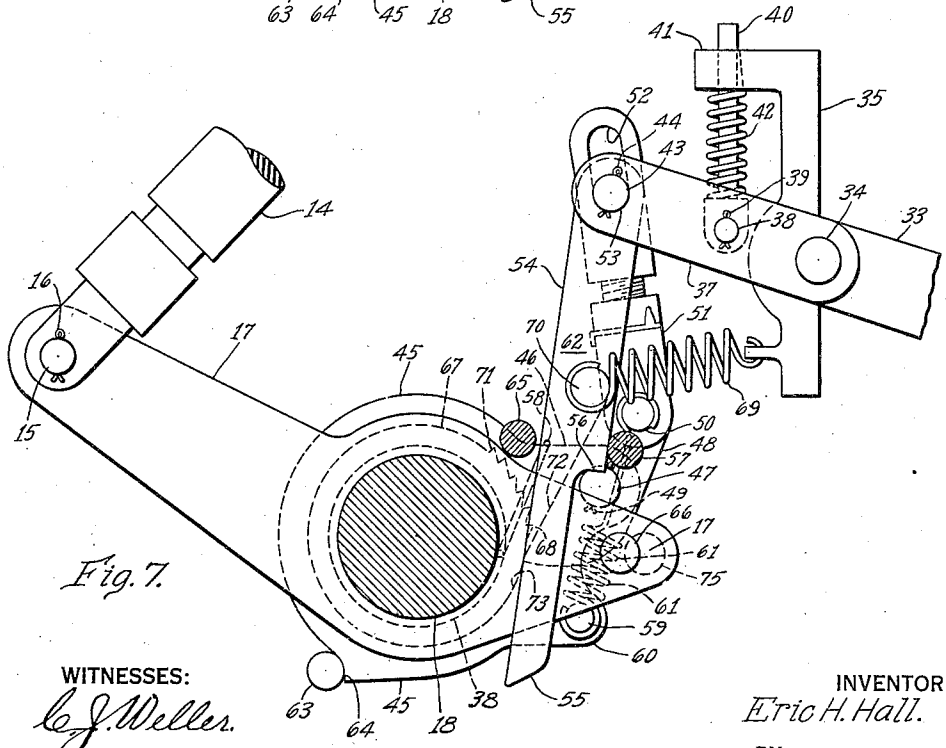


Fig. 7.



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GAS BLAST CIRCUIT INTERRUPTER

Filed May 25, 1943 5 Sheets-Sheet 5

Fig.8.

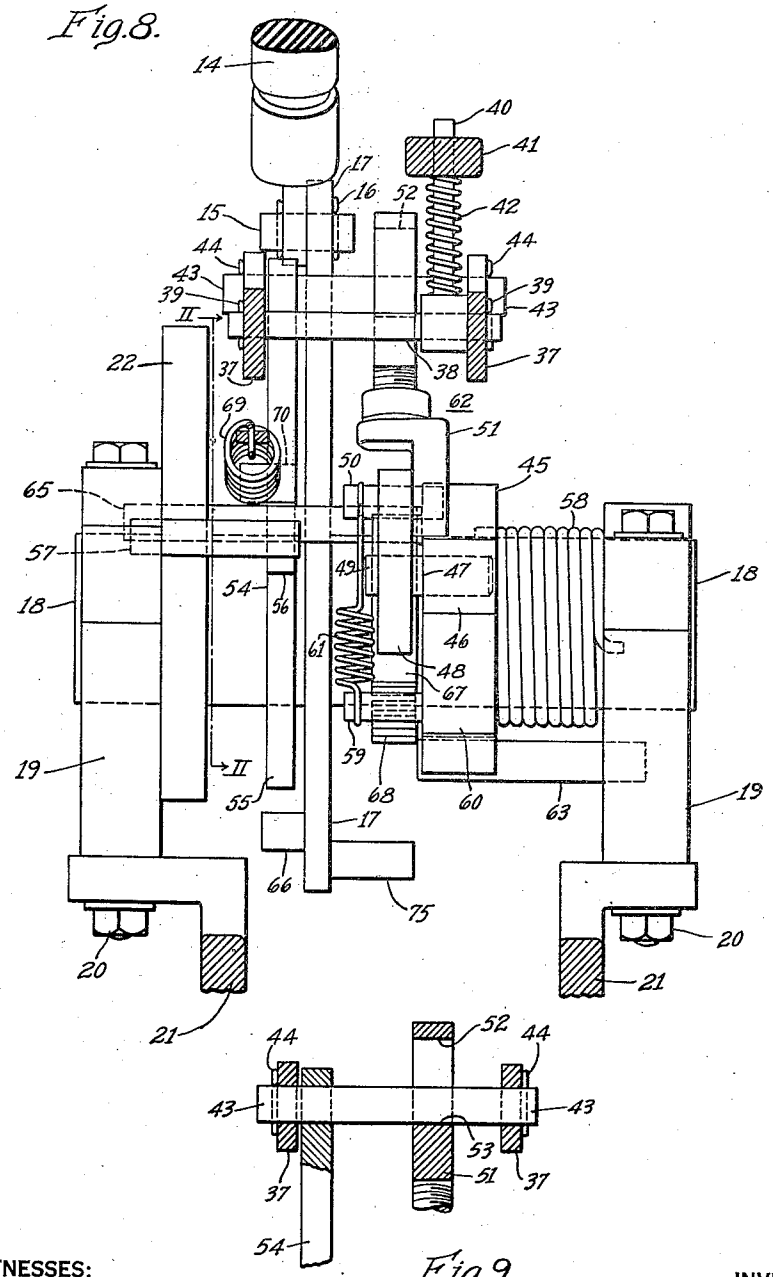


Fig.9.

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Patented Jan. 21, 1947

2,414,522

UNITED STATES PATENT OFFICE

2,414,522

GAS BLAST CIRCUIT INTERRUPTER

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Application May 25, 1943, Serial No. 488,337

12 Claims. (Cl. 200—148)

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This invention relates to circuit interrupters in general, and, in particular, to gas blast type circuit interrupters.

More specifically it is an object of my invention to provide an improved operating mechanism for actuating the gas blast valve of a gas blast type of circuit interrupter.

Another object is to provide an improved valve mechanism which opens the blast valve only during a portion of the opening operation, and which maintains the blast valve closed during a closing operation to conserve the supply of gas.

Another object is to provide an improved valve mechanism which also functions to open the valve immediately upon a reversal of contact motion during a closing operation. Such a reversal of contact motion will occur when the interrupter is attempted to be closed during the existence of overload conditions in the electrical circuit controlled by the interrupter. The arc, carrying the overload current, will then jump between the contacts even before they touch each other, and this arc will trip the breaker mechanism to cause the reversal of contact motion during such a closing operation.

Another object is to provide an improved blast valve mechanism which utilizes improved ratchet means to relate the contact motion with the valve motion.

In my copending patent application, Serial No. 473,823, filed January 28, 1943, now U. S. Patent 2,381,353, issued August 7, 1945, and assigned to the assignee of this application, there is shown and described a gas blast valve operating mechanism of the ratchet type which functions to open the blast valve during the opening operation of the interrupter and which keeps the blast valve closed during the closing operation of the interrupter to conserve the supply of compressed gas. In my aforesaid application ratchet means are provided to open the blast valve during a closing operation of the interrupter when a reversal of contact mechanism takes place because of an attempt to close the interrupter during the existence of overload conditions in the circuit controlled by the interrupter.

A further object is to provide an improved blast valve operating mechanism which utilizes pawl means which are engageable with the ratchet means during a portion of the opening operation of the interrupter.

A more specific object is to provide an improved valve mechanism in which a ratchet ring rotates with the operating shaft and to provide improved pawl means which engage with the ratchet ring

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during the initial portion of the opening operation of the interrupter.

Another object is to provide an improved blast valve mechanism in which improved toggle means are employed to relate the opening movement of the contacts with the opening of the blast valve.

Further objects and advantages will readily become apparent upon a reading of the following specification, taken in conjunction with the drawings, in which:

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

Fig. 2 is an enlarged sectional view of the blast valve operating mechanism shown in Fig. 1, taken on the line II—II of Fig. 8, the parts being shown in the closed circuit position of the interrupter.

Fig. 3 is a view similar to Fig. 2 but showing the disposition of the parts during the initial portion of the opening operation when the blast valve is fully open;

Fig. 4 is a view similar to Fig. 2 but showing the disposition of the parts at a subsequent time when the valve actuating toggle is broken by the toggle breaking pin;

Fig. 5 is a view similar to Fig. 2 but showing the disposition of the parts at a subsequent time when the support collar has been returned to its original position by the retrieving spring;

Fig. 6 is a view similar to Fig. 2 but showing the disposition of the parts at a later time when the valve latch has been tripped to close the valve;

Fig. 7 is a view similar to Fig. 2 but showing the disposition of the parts in the fully open circuit position of the interrupter with the blast valve closed;

Fig. 8 is a view, partly in section, taken along the line VIII—VIII of Fig. 1, and

Fig. 9 is a fragmentary elevational view taken along the line IX—IX of Fig. 2.

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 2 which, in turn, carries a valve casing 3. Secured to the upper end of the valve casing 3 is a tubular insulator 4, which has secured to its upper end an insulating support 5. The insulating support 5 may be given additional support by an insulating member 6. The support 5 carries a stationary contact assembly 7 which, in this instance, is included within an arc extinguishing structure 8, only a portion of which is shown. The arc ex-

tinguishing structure 8 may be of conventional form and does not concern the present invention.

Coacting with the stationary contact assembly 7 is a movable contact 9, which is preferably of blade-like construction and generally C-shaped, and mounted for swinging movement about a pivot 10 carried by a conducting bracket 11.

External circuit connections to the interrupter are made through a pair of terminal members 12 and 13, the first of which is secured to the stationary contact assembly 7, and the second one of which is connected to the conducting bracket 11. Therefore, when the interrupter is in the closed circuit position as shown in Fig. 1, an electrical circuit is established between the terminals 12 and 13 through the stationary contact assembly 7, the movable contact 9 and the conducting bracket 11.

The movable contact 9 is actuated to open and closed circuit positions by an insulating operating rod 14 connected by a pin 15 with cotter pins 16 to a crank plate member 17, in this instance formed as an integral part of the shaft 18. The shaft 18 is journaled in suitable brackets 19 secured by bolts 20 to two support plates 21 as more clearly shown in Figs. 1 and 8. The shaft 18 is actuated by a crank arm 22, which in this instance is formed as an integral part of the shaft 18. The crank arm 22 is connected by a pin 23 and cotter pins 25 to a link 24, the other end of which is connected by the pin 26 and cotter pins 27 to the connecting rod 28 of an air actuated piston operated within the cylinder 29. The connecting rod 28 may be moved up and down to effect respective closing and opening movements of the movable contact 9 by the admission of compressed gas from the storage tank 1 to the operating cylinder 29 by suitable valves well known in the art.

The tubular insulator 4, 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 7 and 9. This gas blast passage proceeds through the short conduit 2, through the valve casing 3, through the tubular insulator 4 and opening 30 provided through the insulating support 5 which is preferably coextensive with the passage within the tubular insulator 4. In the event the movable contact 9 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 30 and will be subjected to a blast of arc extinguishing gas caused to flow through the tubular insulator 4, whereby the arc will be extinguished. Control of the blast of gas to the arc in this instance may be obtained by a valve 31 disposed in the lower end of the valve casing 3. The valve 31 has a stem 32 operatively coupled to one end of an actuating member 33. In this instance the actuating member 33 is rigidly secured to a rock shaft 34 journaled in the side of the valve casing 3. A bearing bracket 35 secured by bolts 36 to the valve casing 3 cooperates with the valve casing 3 to provide a bearing for the rock shaft 34. The rock shaft 34 extends exteriorly of the valve casing 3, and has a pair of rocker arms 37 secured to the opposite ends thereof.

The rocker arms 37 support a pin 38 held in place by cotter pins 39 as more clearly shown in Figs. 2 and 8. A spring guide rod 40 is pivotally mounted on the pin 38 and has its upper end slidably guided in a fixed guide bracket 41, in this instance formed as an integral part of the bearing bracket 35 as more clearly shown in Figs. 1 and 8. A compression spring 42 encircles the spring guide rod 40 and is interposed between the fixed guide bracket 41 and the lower end of the spring guide rod 40. It will, therefore, be apparent that the compression spring 42 biases the rocker arms 37 in a counterclockwise direction about the rock shaft 34 as viewed in Fig. 1 to hence bias the valve 31 toward its closed position. The rocker arms 37 also support a pin 43, secured in place by cotter pins 44, as more clearly shown in Fig. 9, the purpose for which will appear more clearly hereinafter.

Slidable on the shaft 18 is a support collar 45 having a bracket portion 46 integrally formed therewith. A support pin 47 is rigidly secured to the bracket portion 46 of the support collar 45 as more clearly shown in Fig. 8. Pivotally mounted on the support pin 47 is a pawl latch 48. A cotter pin 49 passing through the support pin 47 maintains the pawl latch 48 on the support pin 47 as more clearly shown in Fig. 2.

A knee pin 50 rigidly secured to an adjustable link member 51 slidably passes through the upper end of the pawl latch 48 as more clearly shown in Fig. 8. Formed in the upper end of the adjustable link member 51 is an elongated slot 52 more clearly shown in Fig. 9. As shown in Fig. 9 the pin 43 passes through the elongated slot 52. In the closed circuit position of the interrupter as shown in Figs. 1, 2, 8 and 9, the pin 43 abuts against the lower end 53 of the elongated slot 52 as clearly shown in Fig. 9.

Pivotally mounted on the pin 43 (see Fig. 9) is a valve latch 54 having a tripping portion 55 and a latching portion 56 as more clearly shown in Fig. 4. A tension spring 69 secured at its righthand end, as viewed in Fig. 4, to the bearing bracket 35 and secured at its lefthand end to a pin 70, which is rigidly secured to the valve latch 54 (see Fig. 8), biases the valve latch 54 in a counterclockwise direction about the pin 43 as viewed in Fig. 4, the purpose for which will appear more clearly hereinafter. Rigidly secured to the lefthand bracket 19 as viewed in Fig. 8, is a latch pin 57 the purpose for which will also appear more clearly hereinafter.

Encircling the shaft 18 is a retrieving spring 58. The righthand end of the retrieving spring 58, as viewed in Fig. 8, is rigidly secured to the righthand bracket 19. The lefthand end of retrieving spring 58 is rigidly secured to the support collar 45. Consequently it will be apparent that the retrieving spring 58 biases the support collar 45 in a clockwise direction about the shaft 18, as viewed in Figs. 1 and 2. A spring pin 59 is rigidly secured to a bracket portion 60 of the support collar 45 as more clearly shown in Figs. 1 and 2. A tension spring 61 is interposed between the spring pin 59 and the knee pin 50 as more clearly shown in Figs. 2 and 8.

It will be observed that the pawl latch 48, the knee pin 50 and the adjustable link member 51 constitutes a valve actuating toggle generally designated by the reference numeral 62.

A stop pin 63, rigidly secured to the righthand bracket 19 as viewed in Fig. 8, limits the clockwise rotation of the support collar 45 about the shaft 18 as more clearly shown in Fig. 2. A stop portion 64 of the support collar 45 engages the stop pin 63 in the closed circuit position of the interrupter as shown more clearly in Fig. 2. Rigidly secured to the lefthand end bracket 19, as viewed in Fig. 8, is a toggle breaking pin 65 more clearly shown in Figs. 1, 2 and 8. Rigidly secured

to the crank plate member 17 is a valve latch tripping pin 66 and a pawl latch straightening pin 75 as more clearly shown in Figs. 2 and 8.

A ratchet ring 67 is formed in this instance as an integral part of the shaft 18, and has formed thereon a plurality, in this instance six, ratchet teeth 68 as more clearly shown in Fig. 2.

The operation of my improved blast valve mechanism will now be explained. In the closed circuit position of the interrupter as shown in Figs. 1, 2, 8 and 9, the stop portion 64 of support collar 45 engages stop pin 63, and the pawl latch 48 is maintained against the smooth portion 72 of the ratchet ring 67 by tension spring 61 as more clearly shown in Fig. 2. The valve latch 54 is in its lower position not engaging the latch pin 57, and the compression spring 42 maintains the valve 31 in its closed position, the pin 43 resting against the lower end 53 of the elongated slot 52 (see Fig. 9). In this position of the interrupter the electrical circuit therethrough is completed through the terminal members 12 and 13. The valve 31 is closed and consequently on compressed air passes through the tubular insulator 4.

When it is desired to break the electrical circuit through the interrupter or in response to overload conditions existing in the electrical circuit controlled by the interrupter, suitable mechanism (not shown) actuates valves to operate the piston within the cylinder 29 and hence to drive the connecting rod 28 downwardly. The downward movement of the connecting rod 28 through the linkage 24 rotates the crank arm 22 and hence the shaft 18 in a counterclockwise direction as viewed in Figs. 1 and 2. This counterclockwise movement of the shaft 18 also rotates in a counterclockwise direction, as viewed in Fig. 1, the crank plate member 17. The counterclockwise rotation of the crank member 17, as viewed in Fig. 1, acts through the insulating operating rod 14 to move the movable contact 9 away from the stationary contact 7. Meanwhile the ratchet ring 67, integrally formed with the shaft 18, rotates therewith, the pawl latch 48 sliding over the smooth surface 72 of the ratchet ring 67. Further opening movement brings the first tooth 71 of the ratchet ring 67 into engagement with the pawl 48.

There is usually a certain "wipe" or overlap between the movable contact 9 and the stationary contact 7. Consequently a certain opening movement of the movable contact 9 results before the movable contact 9 separates from the stationary contact 7 to draw an arc. It is also desirable not to open the blast valve 31 until an arc is actually drawn to conserve the compressed air supply. It will therefore be apparent that during the time that the movable contact 9 is moving away from the stationary contact 7, and before any arc is drawn therebetween, the pawl latch 48 is sliding over the smooth surface 72 of the ratchet ring 67. When the movable contact 9 finally moves away from the stationary contact 7 to draw an arc therebetween, the rotative movement of the ratchet ring 67 causes the first tooth 71 to pick up the pawl latch 48 and to thus cause the support collar 45 to move with the ratchet ring 67 and the shaft 18. The counterclockwise rotative movement of the support collar 45, as viewed in Fig. 2, causes the valve actuating toggle 62 to rise and to straighten, thus forcing pin 43 to raise (see Fig. 9) and to cause the rocker arms 37 to rotate in a clockwise direction about the rock shaft 34 as viewed in Fig. 1. This causes opening of the blast valve 31. The opening of the blast valve 31 permits an upward blast of compressed air to pass upwardly through the tubular insulator 4, through the opening 30 and between the separating contacts 7, 9. Thus, because of the provision of the smooth portion 72 on ratchet ring 67 a certain amount of opening movement of the movable contact 9 is permitted before the blast valve 31 opens. Consequently, the opening of the blast valve 31 is delayed until the movable contact 9 actually separates from the stationary contact 7 to draw an arc.

Continued counterclockwise rotation of the shaft 18, ratchet ring 67 and support collar 45 causes the valve actuating toggle 62 to straighten as clearly shown in Fig. 3. This causes the valve latch 54, which is pivotally supported on the pin 43, to also rise upward until the latching portion 56 of the valve latch 54 latches over the latch pin 57, the tension spring 69 meanwhile biasing the valve latch 54 in a counterclockwise direction about the pin 43. The disposition of the several parts at this time in the opening operation of the interrupter is clearly shown in Fig. 3. Fig. 3, therefore, represents the disposition of the parts when the contacts 7, 9 have separated to draw an arc, when the blast valve 31 is latched to its open position by the valve latch 54 and when the valve actuating toggle 62 is in its straightened position.

It will be observed that the tension spring 61, having its direction of force to the right of the support pin 47, creates a torque acting on the pawl latch 48 to bias the pawl latch in a clockwise direction about the support pin 47 as viewed in Fig. 3. Therefore the tension spring 61 serves during this portion of the opening operation of the interrupter to bias the pawl latch 48 against the first tooth 71 of the ratchet ring 67. If the tension spring 61 were not used there might be a tendency for the pawl latch 48 to disengage from the first tooth 71 before the valve latch 54 had latched over the latch pin 57, such a set of circumstances leading to a closing of the blast valve 31 during a time when an arc was drawn between the contacts 7, 9 and when a blast of arc extinguishing gas was needed.

Further counterclockwise rotative movement of the shaft 18 and ratchet ring 67 causes the pawl latch 48 to engage the toggle breaking pin 65 as shown in Fig. 4. It will be apparent therefore that the toggle breaking pin 65 causes the valve actuating toggle 62 to break at the knee pin 50 as shown in Fig. 4. Thus, the pin 65 constitutes a disengaging means which operates to effect the disengagement of the pawl 48 from the ratchet ring 67. However, the valve 31 remains in its open position because of the valve latch 54, which had previously latched over the latch pin 57. Fig. 4, therefore, shows the disposition of the several parts when the valve actuating toggle 62 has been broken by the toggle breaking pin 65 and when the valve 31 is maintained in its open position by the valve latch 54 latching over the latch pin 57.

It will be observed that when the pawl latch 48 engages the toggle breaking pin 65, the direction of force of the tension spring 61 is to the left of the support pin 47 as viewed in Fig. 4. Therefore, the tension spring 61 maintains the valve actuating toggle 62 in its broken position, as shown in Fig. 4, to prevent the pawl latch 48 from reengaging any of the ratchet teeth. It will consequently be observed that the tension spring 61 performs two functions, first of maintaining the pawl latch 48 into engagement with the ratchet tooth 71 until the pawl latch 48 is forced against the toggle breaking pin 65 to break the valve ac-

tuating toggle 62. When this occurs the second function of the tension spring 61 comes into play to maintain the toggle 62 in its broken position as shown in Fig. 4 and also to maintain the pawl latch 48 out of engagement with the ratchet teeth 68.

However, after the valve actuating toggle 62 has been broken by the toggle breaking pin 65 as shown in Fig. 4, the retrieving spring 58 returns the support collar 45 and the valve actuating toggle 62 to its original position with the stop portion 64 of support collar 45 engaging the stop pin 63. The tension spring 61 meanwhile maintains the toggle 62 in its broken position, and the pin 43 raises to the top of the elongated slot 52 as shown in Fig. 5.

Meanwhile the shaft 18 has continued its counterclockwise rotation to further lengthen the arc drawn between the contacts 7, 9. The arc extinguishing blast of gas which passes around the valve 31 and upward through the tubular insulator 4 serves to extinguish the lengthened arc, and it is therefore desirable to close the blast valve 31 after the arc has been extinguished. The valve latch tripping pin 66, rigidly secured to the crank plate member 17, performs this function by engaging the trip portion 55 of the valve latch 54, as shown in Fig. 5, to thus cause a slight clockwise movement of the valve latch 54 about the pin 43 to result in the valve latch 54 being disengaged from the latch pin 57 to result in the closing of the blast valve 31.

Fig. 5 shows the disposition of the several parts when the support collar 45 has been returned to its initial position with the toggle 62 broken, and when the valve latch tripping pin 66 is just beginning to force the valve latch 54 out of engagement with the latch pin 57. Thus the blast valve 31 is almost ready to be closed in Fig. 5 and the movable contact 9 is being separated a considerable distance from the stationary contact 7 to produce a sufficient isolating gap between the contacts 7, 9.

Continued counterclockwise rotation of the shaft 18 causes the pawl latch straightening pin 75 to near the lower portion of the pawl latch 48 as shown in Fig. 6. It was stated previously that the tension spring 61 maintained the toggle 62 in its broken position so that the pawl latch 48 would not reengage with the ratchet teeth 68 during the opening operation and the support collar 45 could return to its initial position. It is now desirable to straighten the toggle 62 and the pin 75 performs this function.

Fig. 7 shows the disposition of the several parts in the fully open circuit position of the interrupter. In Fig. 7 there is a considerable isolating gap between the contacts 7, 9. The tension spring 61 maintains the pawl latch 48 against the smooth portion 73 of the ratchet ring 67. Fig. 7 therefore, shows the parts with the blast valve 31 closed, the arc having been extinguished, and with a considerable gap between the contacts. The pawl latch 48 engages the smooth portion 73 of the ratchet ring 67 so that during the subsequent closing operation of the interrupter, the pawl latch 48 will ratchet over the ratchet teeth 68.

During the closing operation of the interrupter the crank plate member 17 will rotate with the shaft 18 in a clockwise direction. The contacts 7, 9 will move toward each other, and the pawl latch 48 will ratchet over the ratchet teeth 68. The blast valve 31 remains closed. This closing movement will continue until the interrupter is in the fully closed circuit position as shown in Figs. 1, 2, 8 and 9. During a subsequent opening operation the movement of the several parts will be as heretofore explained; consequently a further description thereof is not necessary.

Occasionally, it may occur that overload conditions exist in the electrical circuit controlled by the interrupter when the interrupter is in the open circuit position. In this event when it is attempted to close the interrupter an arc will jump across the contacts 7, 9 because of the high voltage even before the movable contact 9 engages the stationary contact 7. The arc which jumps between the contacts 7, 9 before they have actually contacted will carry an overload current which will trip the breaker mechanism and will cause an immediate opening operation of the interrupter even before the interrupter has been completely closed. Consequently, the net result is a reversal of contact movement during a closing operation before the contacts 7, 9 have actually engaged.

It will be observed that in the blast valve mechanism which I have provided, should reversal of contact movement take place during a closing operation due to the aforesaid state of conditions, the reversal of movement of the ratchet ring 67 will immediately serve to pick up the pawl latch 48 at the particular tooth which at this time is adjacent the pawl latch 48. This reversal of the ratchet ring 67 will cause the valve actuating toggle 62 to be raised and straightened to result in the pin 43 being forced upward by the adjustable link member 51 to result in an opening of the blast valve 31. Consequently, it will be observed that the reversal of contact movement during a closing operation will serve to immediately open the blast valve 31 in the same manner as the blast valve 31 would be opened during a normal opening operation. I use the term "normal" opening operation to indicate an opening operation from the completely closed circuit position of the interrupter.

It will, therefore, be apparent that the valve mechanism which I have provided serves to immediately open the blast valve 31 due to a reversal of contact movement during a closing operation at any intermediate position during the closing operation. In this instance I employ six teeth on the ratchet ring 67, but a greater number may be employed. Consequently there will be, in the construction illustrated, five intermediate positions, corresponding to the first five teeth, at which the pawl latch 48 may be picked up upon a reversal of contact movement during a closing operation of the interrupter. The opening of the blast valve 31, will of course, serve to deliver an arc extinguishing blast of gas upward through the tubular insulator 4 between the contacts 7, 9 to extinguish the arc thus drawn when it was attempted to close the interrupter during the existence of overload conditions in the electrical circuit controlled by the interrupter.

From the above description it will be apparent that I have provided a novel blast valve mechanism for use in circuit interrupters which functions to open the blast valve 31 during a predetermined portion of the opening operation, and which also functions to maintain the valve 31 closed during the closing operation to conserve the supply of compressed gas. It will be apparent that the position of the valve latch tripping pin 66 determines when the valve latch 54 will be tripped to close the blast valve 31. It will be observed that when the contacts 7, 9 actually be-

gin to separate to draw an arc the blast valve 31 will immediately be opened.

It will also be apparent that I have provided a blast valve operating mechanism which functions to immediately open the blast valve 31 upon a reversal of contact motion at intermediate positions during a closing operation caused by a closing of the interrupter during the existence of overload conditions in the electrical circuit controlled by the interrupter.

Although I have shown and described a specific embodiment of my invention, it is to be clearly understood that the same was merely for the purpose of illustration and that changes and modifications may readily be made by those skilled in the art without departing from the spirit and the scope of the invention.

I claim as my invention:

1. In a circuit interrupter of the gas blast type, contact means for establishing an arc, a shaft rotatable in accordance with contact movement, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a ratchet ring fixed to and rotatable with the shaft, a collar slidable on the shaft, a pawl operatively connected to the valve and resting upon the face of the ratchet ring in the closed circuit position of the interrupter, the pawl being pivotally mounted on the collar and engageable with the ratchet ring during a portion of the opening operation of the interrupter to cause opening of the valve, and disengaging means for effecting the disengagement of the pawl from the ratchet ring after a predetermined opening travel of the interrupter, the shaft and ratchet ring continuing their opening rotative movement after operation of the disengaging means.

2. In a circuit interrupter of the gas blast type, contact means for establishing an arc, ratchet means movable in accordance with contact movement, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, collar means, pawl means pivotally mounted on the collar means and engageable with the ratchet means during a portion of the opening operation of the interrupter to cause opening of the valve, valve latching means for maintaining the valve open after the pawl means has disengaged from the ratchet means, and tripping means movable in accordance with movement of the contact means for tripping the valve latching means to close the valve near the end of the opening operation of the interrupter.

3. In a circuit interrupter of the gas blast type, contact means for establishing an arc, a shaft rotatable in accordance with contact movement, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a ratchet ring fixed to and rotatable with the shaft, a collar slidable on the shaft, a pawl pivotally mounted on the collar and engageable with the ratchet ring during a portion of the opening operation of the interrupter to cause opening of the valve, disengaging means for effecting the disengagement of the pawl from the ratchet ring, the ratchet ring continuing its rotative motion after operation of the disengaging means, and valve latching means for latching the valve open after the pawl has disengaged from the ratchet ring by operation of the disengaging means.

4. In a circuit interrupter of the gas blast type, contact means for establishing an arc, a shaft rotatable in accordance with contact movement, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, ratchet means

rotatable with the shaft, a collar slidable on the shaft, toggle means relating opening movement of the valve with rotative movement of the collar, one member of the toggle means comprising a pawl engageable with the ratchet means during a portion of the opening movement of the interrupter to cause straightening of the toggle means to open the valve, and biasing means urging the pawl into engagement with the ratchet means.

5. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, a first means movable in accordance with contact motion, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a second means movable with respect to the first means, toggle means pivotally supported at one end to the second means and operatively connected with the valve, and a third means for moving the second means in response to the initial opening movement of the first means from the closed circuit position of the interrupter.

6. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, ratchet means movable in accordance with contact motion, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a first means movable with respect to the ratchet means, toggle means pivotally supported at one end to the first means and operatively connected with the valve, and pawl means for moving the first means in response to the initial opening movement of the ratchet means from the closed circuit position of the interrupter.

7. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, ratchet means movable in accordance with contact motion, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, collar means movable with respect to the ratchet means, toggle means pivotally supported at one end to the collar means and operatively connected with the valve, and pawl means engaging the ratchet means for moving the collar means in response to the initial opening movement of the ratchet means from the closed circuit position of the interrupter.

8. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, ratchet means movable in accordance with contact motion, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a first means movable with respect to the ratchet means, a valve actuating toggle, the toggle comprising a pawl at one end pivotally mounted to the first means, the other end of the toggle being operatively connected to the valve, the pawl being engaged by the ratchet means to straighten the toggle to open the valve during the initial portion of the opening operation of the interrupter.

9. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, ratchet means movable in accordance with contact motion, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a first means movable with respect to the ratchet means, a valve actuating toggle, the toggle comprising a pawl at one end pivotally mounted to the first means, the other end of the toggle being operatively connected to the valve, the pawl being engaged by the ratchet means to straighten the toggle to open the valve during the initial portion of the opening operation of the interrupter, and relatively fixed means to break the toggle at

a predetermined point in the opening operation of the interrupter.

10. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, ratchet means movable in accordance with contact motion, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a first means movable with respect to the ratchet means, a valve actuating toggle, the toggle comprising a pawl at one end pivotally mounted to the first means, the other end of the toggle being operatively connected to the valve, the pawl being engaged by the ratchet means to straighten the toggle to open the valve during the initial portion of the opening operation of the interrupter, relatively fixed means to break the toggle at a predetermined point in the opening operation of the interrupter, and valve latching means to maintain the valve open after the toggle has been broken.

11. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, ratchet means movable in accordance with contact motion, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a first means movable with respect to the ratchet means, a valve actuating toggle, the toggle comprising a knee pin and a pawl pivotally mounted on the first means, the knee pin passing through one end of the pawl, the pawl engaging the ratchet means during the initial portion of the opening operation of the interrupter, and spring means connected at one end to the knee pin to bias the pawl into engagement with the ratchet means or away from the ratchet means depending on which direction the toggle is broken.

12. In a circuit interrupter of the gas blast type, separable contacts for establishing an arc, ratchet means movable in accordance with contact motion, a valve operable to cause an arc extinguishing blast of gas to extinguish the arc, a first means movable with respect to the ratchet means, a valve actuating toggle, the toggle comprising a knee pin and a pawl pivotally mounted on the first means, the knee pin passing through one end of the pawl, the pawl engaging the ratchet means during the initial portion of the opening operation of the interrupter, relatively stationary means for breaking the toggle, and spring means connected at one end to the knee pin to bias the pawl into engagement with the ratchet means or away from the ratchet means depending on which direction the toggle is broken.

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