

[54] **CONTACT OPENING MEANS FOR A CIRCUIT BREAKER**

[75] Inventors: **Melbourne G. Jawelak; Richard R. Boni**, both of McMurray, Pa.

[73] Assignee: **McGraw-Edison Company**, Elgin, Ill.

[22] Filed: **July 26, 1972**

[21] Appl. No.: **275,332**

[52] U.S. Cl. **200/150 R, 200/146 R**

[51] Int. Cl. **H01h 33/68**

[58] Field of Search..... **200/150 G, 148 A, 146 R**

[56] **References Cited**

UNITED STATES PATENTS

2,749,412 6/1956 McBride et al. 200/150 G

FOREIGN PATENTS OR APPLICATIONS

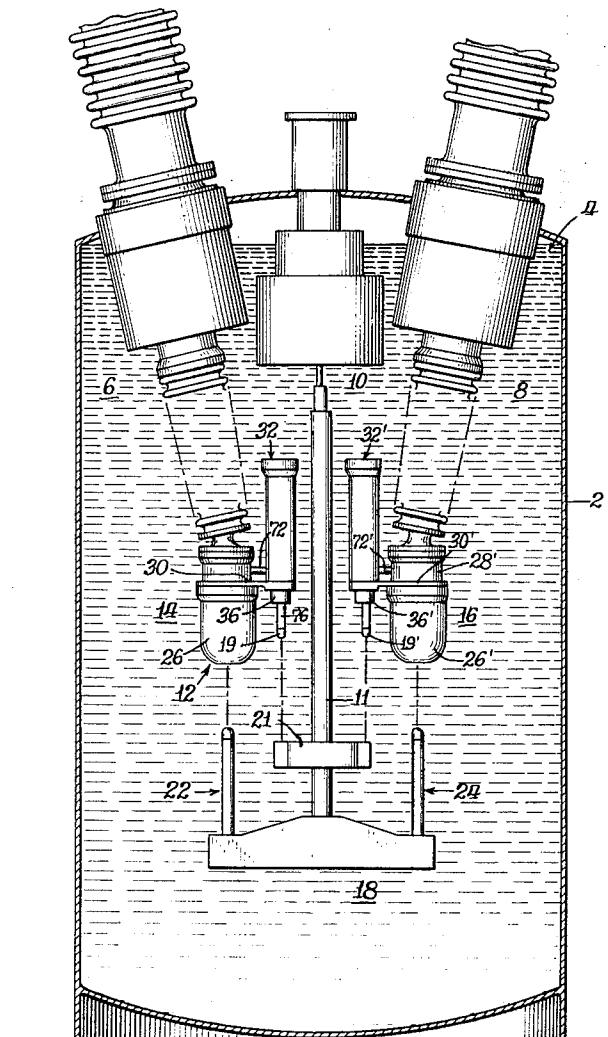
106,334 1/1939 Australia..... 200/148 A

[57]

ABSTRACT

An auxiliary kickoff contact opening means is provided which supplements the main contact opening means during the initial opening movement of the circuit breaker contacts. The initial kickoff force is provided by a spring and control means is included which comprises a piston engaging the spring and a fluid connection to the interior of a main contact structure and an interrupting chamber. During initial opening movement of a main movable contact, gas pressure generated by an arc between the main contacts is applied via the fluid connection against the piston to thereby apply force to the spring in a direction opposite to its opening force. If sufficient gas pressure is generated, the opening force of the spring will be retarded. If the gas pressure is excessive, the piston and spring will be moved in a direction opposite to the opening movement and the initial opening force of the spring will be completely nullified.

2 Claims, 5 Drawing Figures



Primary Examiner—Robert S. Macon
Attorney, Agent, or Firm—Jon Carl Gealow

Fig. 1.

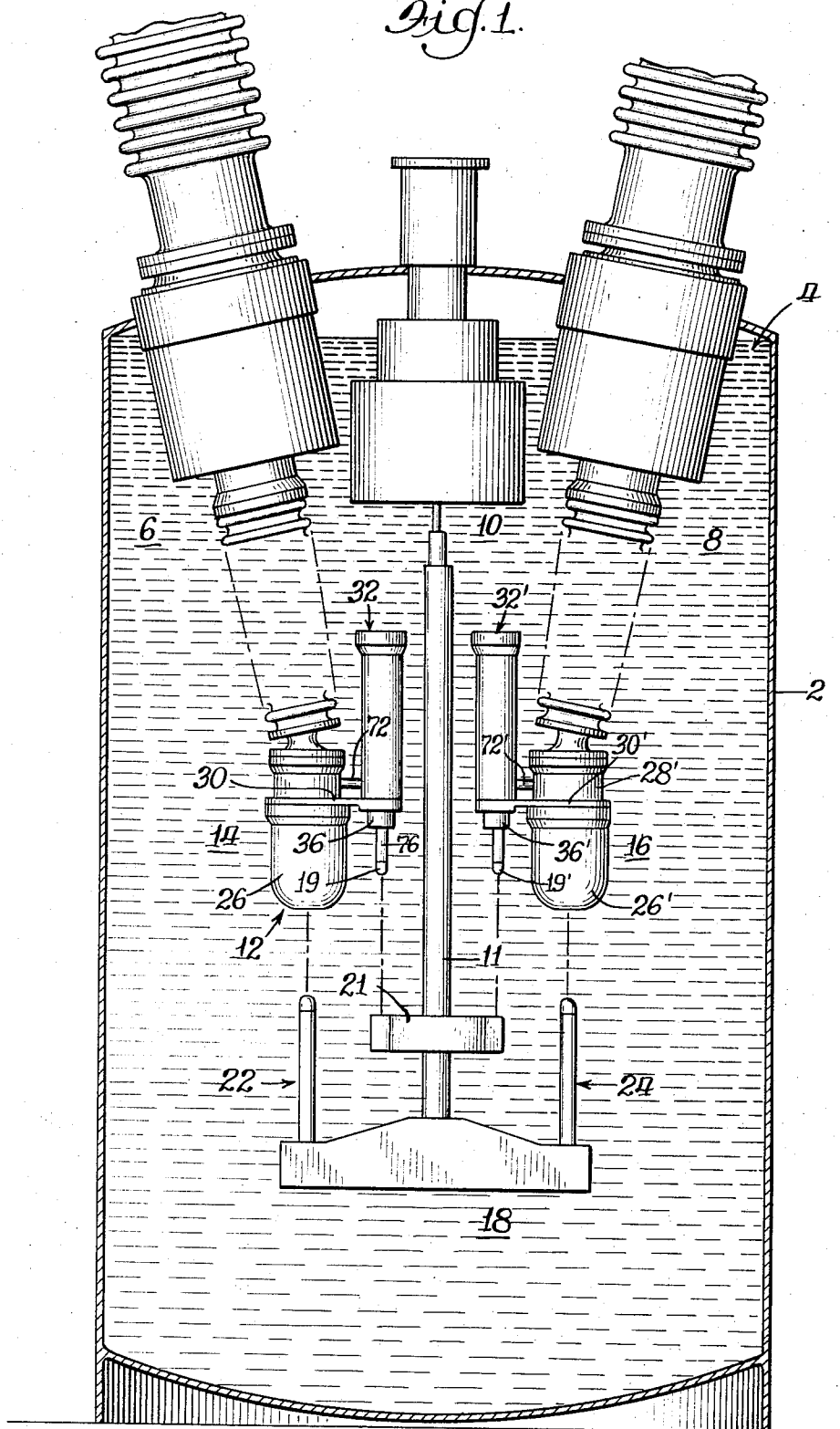


Fig. 2.

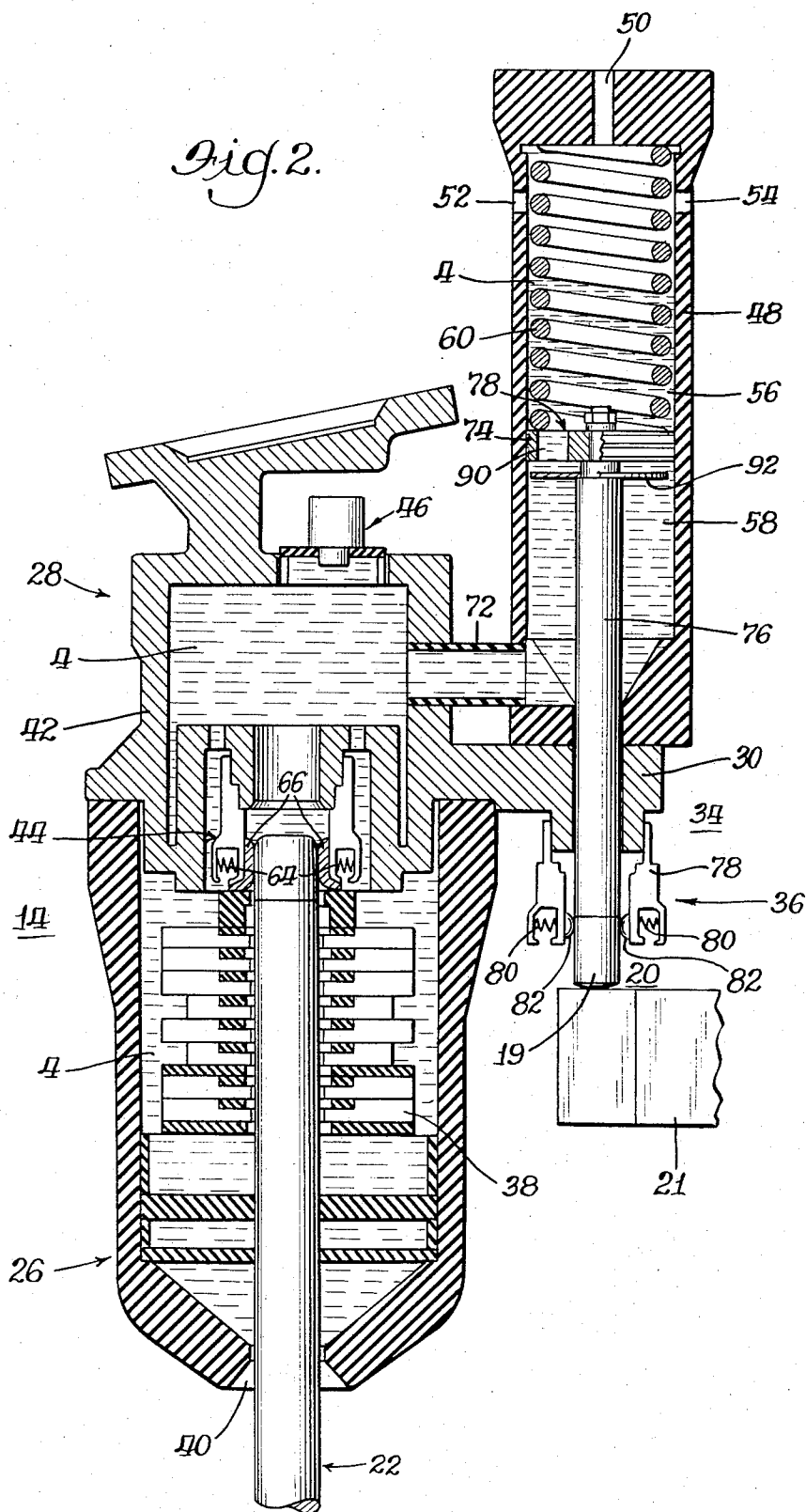
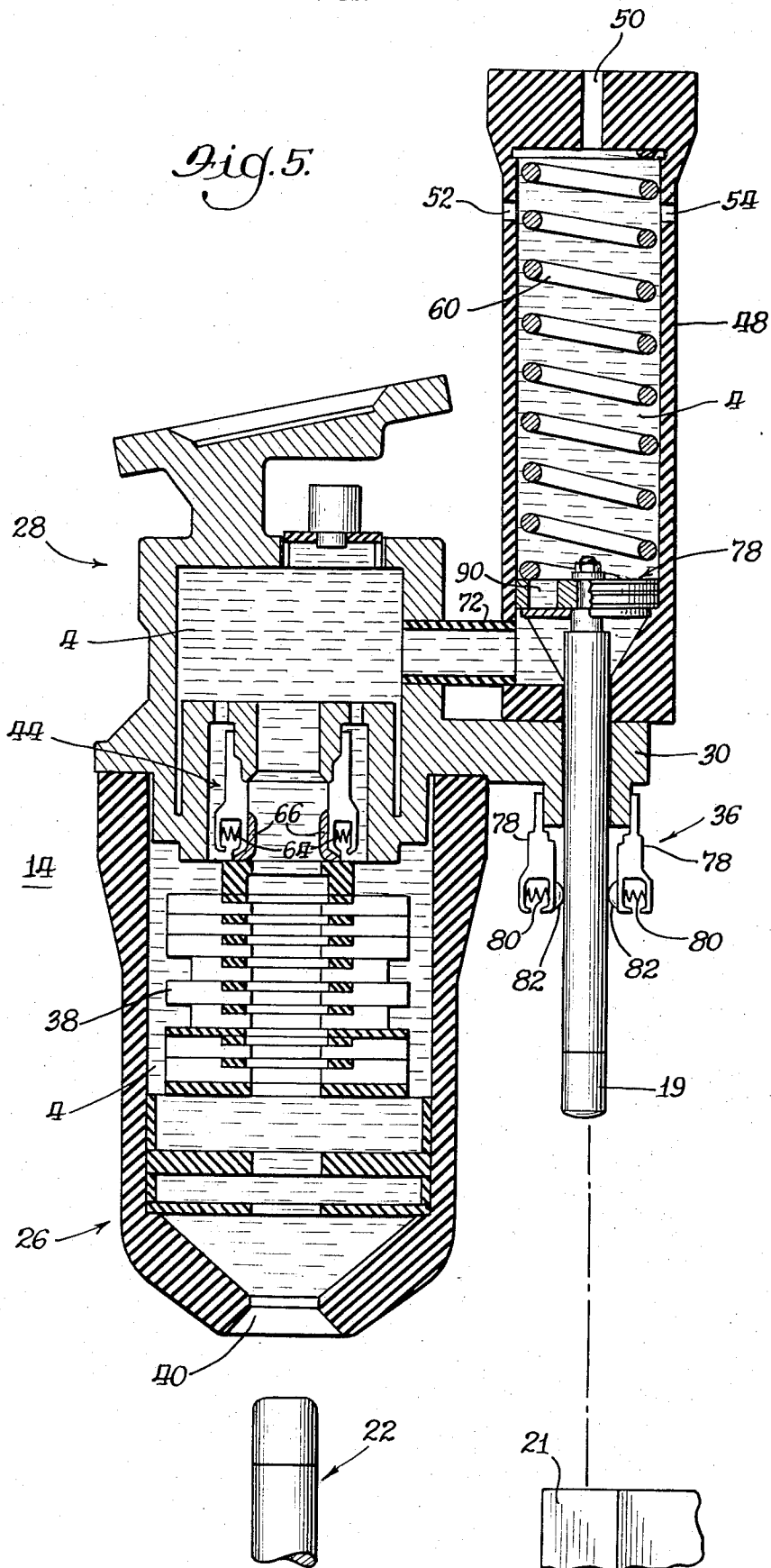


Fig. 5.



CONTACT OPENING MEANS FOR A CIRCUIT BREAKER

BACKGROUND OF THE INVENTION

Opening mechanisms for large circuit breakers are generally designed to give a high speed opening operation in order to minimize the time during which arcing occurs and interrupt fault current as quickly as possible. Because of the size of the circuit breakers and the use of the same opening mechanism to open three single phase circuit breakers in a three phase system, the opening mechanisms have a considerable amount of inertia which must be overcome during the initial opening movement. Accordingly, the initial opening movement is usually not of the high speed desired. To overcome this problem, auxiliary kickoff opening mechanisms typically utilizing a spring have been connected to supplement the main opening mechanism and provide the initial high speed movement. However, in the case of severe arcing and very excessive gas pressure which may occur during initial interruption of current, particularly where fault current is being interrupted, it is preferred that the kickoff opening force be retarded or even nullified because of additional opening force due to high gas pressure and magnetic force caused by high current interruption which will mechanically damage the circuit breaker if the opening speed becomes too great.

It is accordingly an object of the invention to provide an auxiliary contact opening means which will provide initial high speed opening movement and at the same time be controllable in response to heavy arcing by the main contacts of the circuit breaker such that the initial opening force is retarded or entirely nullified.

SUMMARY OF THE INVENTION

The objects of the invention are accomplished by providing a contact opening means which becomes operative when the main contact opening means is actuated and provides substantially all of the opening force during the initial opening movement of the main contacts. The movement of the auxiliary contact opening means may be slowed or reversed in response to arcing and to gas pressure caused by the arcing at the main contacts. In the event that the current arcing is of a very high level such that excessive magnetic opening force is applied to the main movable contact, the gas pressure will oppose the auxiliary contact movement. Thus, the auxiliary contact opening means will not provide any initial opening force.

The continuous current carrying capabilities of the circuit breaker is increased over the current carrying capabilities of the main contacts by the additional current carrying capability of the auxiliary contacts. However, wherein the main contacts carry the total current at both the main and auxiliary contacts only for a short interval of time at opening and closing, it is not necessary to design the main contacts to carry the higher continuous or normal current load.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a circuit breaker, partially in cross-section, illustrating an auxiliary contact opening means according to the instant invention;

FIG. 2 illustrates the main and auxiliary contacts of the circuit breaker in a closed condition and the auxil-

ary contact opening means according to the instant invention;

FIG. 3 is a view similar to that of FIG. 2 during an opening or closing operation of the circuit breaker in which the auxiliary contacts are open, the main contacts of the circuit breaker are still closed and the auxiliary contact opening means is operating to provide initial opening force;

FIG. 4 is a view similar to that of FIGS. 2 and 3 in which the auxiliary contacts are open, the main contacts have just opened and are arcing, and the auxiliary contact means continues to provide initial opening force; and

FIG. 5 is a view similar to FIGS. 2-4 in which both the auxiliary contacts and main contacts of the circuit breaker are in full open position and the auxiliary contact means has completed its opening force movement.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to FIG. 1, a circuit breaker is shown as having a metal tank 2 filled with a dielectric fluid 4. Insulator means 6 and 8 are mounted on the tank 2 and extend into the dielectric fluid 4. Main circuit breaker opening and closing means 10 having an insulating rod 11 is mounted on the tank 2 and extends into the dielectric fluid 4 within the tank 2. A circuit interrupter 12 includes stationary interrupter means 14 mounted on the lower end of the insulator means 6 a movable main contact structure 18 connected to the insulating rod 11, and auxiliary contact structure 20 includes a cross member 21 and a conductive end 19 of piston rod 76 (see FIGS. 2-5). The movable main contact structure 18 includes movable contacts 22 and 24 which are movable into and out of engagement with the stationary interrupter means 14 and 16, as will be later described in detail with respect to FIGS. 2-5. It may be noted that the stationary interrupter means 14, movable contact 22, auxiliary stationary contact means 34 and a portion of the movable auxiliary contact structure 20 comprise a half pole assembly. The stationary interrupter means 16, movable main contact 24, auxiliary stationary contact means 34 and another portion of movable auxiliary contact structure 20 comprise another half pole assembly. The two half pole assemblies are electrically connected in series and together comprise a full pole assembly. The insulator means 6 and 8 each enclose an electrical conductor (not shown) connected to an electrical system and to one of the half pole assemblies so that the full pole assembly interrupts the current carried by the electrical conductors.

The stationary interrupter means 14 comprises an interrupter housing 26, a main stationary contact structure 28, and auxiliary contact opening means 32 mounted on a member 30 projecting from the contact structure 28, and including a piston 74 and insulative piston rod 76. Auxiliary stationary contact means 34 comprises a spring cluster 36 and the projecting member 30. The elements of the stationary interrupter means 16 are substantially identical with the elements of the stationary interrupter means 14 and are identified by the same numerals with the addition of a prime mark. Because the elements of stationary interrupter means 16 are substantially identical to and operate in the same manner as the elements of stationary interrupter means 14, they will not be further described in

detail. Also, the auxiliary contact means is described in detail in copending application Ser. No. 275,333, filed July 26, 1972, now U.S. Pat. No. 3,819,893 issued June 25, 1974, and assigned to the assignee of this application. Accordingly, the auxiliary contact means is described only to the extent that it cooperates with the subject matter of the instant invention.

Referring to FIGS. 2-5, the interrupter housing 26 is mounted on the main stationary contact structure 28 and includes an interrupter chamber 38 and a movable contact entrance opening 40. The interrupter chamber 38 is of a type well known in the art and will not be further described in detail. As shown in FIG. 1, the main stationary contact structure 28 and the interrupter housing 26 are both below the level of the dielectric fluid 4 and both contain dielectric fluid 4. The main stationary contact structure 28 is mounted on an end of the insulator means 6 and is electrically connected to the previously mentioned electrical conductor within the insulator means 6. The main stationary contact structure 28 includes an electrically conductive housing 42 from which the electrically conductive projecting member 30 extends and a main contact spring cluster 44. A pressure relief valve 46 is mounted on the electrically conductive housing 42 for releasing excess gas pressure within the housing 42. The spring cluster 44 includes a plurality of contact units each comprising a spring finger 62, a spring 64 and a contact button 66.

The auxiliary contact opening means 32 includes a cylinder 48 of an insulating material mounted on the projecting member 30. The auxiliary contact opening means 32 includes openings 50, 52 and 54 for admitting or exhausting oil into the cylinder 48 and chambers 56 and 58 each of which may contain dielectric fluid 4. The auxiliary contact opening means 32 also includes a spring 60 positioned in chamber 56 for providing most of the contact opening force during initial opening movement of the movable main and auxiliary contact structures 18 and 20.

Control means 70 includes a fluid connection pipe 72 connecting the interior of the main stationary contact structure 28 and the chamber 58 in cylinder 48, and a piston 74 slidably movable within cylinder 48. The piston rod 76 is affixed to the piston 74 and projects out of the cylinder 48 and through the projecting member 30. As can be seen in FIGS. 2-4, when the movable main and auxiliary contact structures 18 and 20 are not in their full open position, the piston rod 76 extends into engagement with the movable auxiliary contact cross member 21. The cross member 21 and the movable main contact structure 18 are affixed to the main circuit breaker opening and closing means 10. Note, however, that the piston rod 76 is not affixed to the cross member 21. A plate check valve 78 is carried on the piston 74 and includes disc 92. When the piston 74 slides in a relatively downward direction, the disc 92 is closed so that dielectric fluid 4 in the chamber 58 is pumped into the main stationary contact structure 28 and the interrupter chamber 38. When the piston 74 moves in a relatively upward direction, the valve disc 92 will move away from the valve opening 90 due to oil pressure in the chamber 56 so that oil in the chamber 56 moves through the valve opening 90 into the chamber 58.

As previously stated, the auxiliary stationary contact means 34 includes the electrically conductive projecting member 30 and a spring cluster 36. The spring clus-

ter 36 includes a plurality of contact units each comprising a spring finger 78, a spring 80 and a contact button 82.

As shown in FIG. 2, the movable contact 22 has a closed, engaged position with the stationary main spring contact cluster 44 and the auxiliary stationary contact means 34 has a closed, engaged position with the movable auxiliary contact structure 20 in which the spring contact cluster 36 engages the conductive end 19 of piston rod 76 which in turn is in engagement with the cross member 21. In this position of the main and auxiliary contacts, the circuits of the main and auxiliary contacts are in parallel and the main contacts carry the major portion of the current in the system to which the circuit breaker is connected. For example, in a particular size circuit breaker, the main contacts carry 3,000 amperes and the auxiliary contacts carry 1,000 amperes. In FIG. 5, the main movable contact 22 is shown in a fully open, disengaged position relative to the main stationary contact structure 28. The movable auxiliary contact structure and the auxiliary stationary contact means 34 are also shown in their fully disengaged, open position in FIG. 5 with the cross member 21 disengaged from the conductive end 19 of piston rod 76 and the conductive end 19 spaced from the auxiliary spring contact cluster 36. FIGS. 3 and 4 show the main stationary contact structure 28 and main movable contact 22, and auxiliary stationary contact means 34 and movable auxiliary contact structure 20 during opening and closing movement intermediate their fully closed and fully open positions respectively shown in FIGS. 2 and 5. During an opening operation, the movable auxiliary contact structure 20 disengages from the auxiliary contact means 34 prior to disengagement of the main movable contact 22 from the main contact spring cluster 44, as shown in FIG. 3. Consequently, during an opening operation, when the auxiliary contacts separate, the current formerly carried by them is diverted and flows through the main contacts. The auxiliary contacts thus need not be of interrupting duty and no arc interruption structure is required for the auxiliary contacts. Also, during closing movement, the main movable contact 22 engages the main spring contact cluster 44 prior to engagement of the movable auxiliary contact structure 20 with the auxiliary stationary contact means 34. Thus, no arcing occurs at the auxiliary contacts on closing and the auxiliary contacts do not carry current until after the main contacts are closed.

In FIG. 4, the main and auxiliary contacts are shown at a later time during opening movement at which the movable auxiliary contact structure 20 has moved further away from the auxiliary stationary contact means 34 and the main movable contact 22 is just disengaging from the main spring contact cluster 44. In this position of the contacts, an arc 68 is occurring between the main movable contact 22 and the main contact spring cluster 44. At this time, dielectric fluid 4 is being pumped by the spring 60 and piston means 74 through the fluid connection 72 into the arc 68 and through the interrupting chamber 38 as the main movable contact 22 continues in its opening movement out of the interrupting chamber 38.

A contact opening operation may be initiated by actuation of the main circuit breaker opening and closing means 10 which is typically of the spring operated type and is well known in the art. Such opening and closing

mechanisms generally have considerable inertia and have low spring rates so that the first part of the opening operation is relatively slow. The spring rate of the spring 60 is relatively high so that upon release of the cross member 21, a spring 60 will rapidly move from its charged position as shown in FIG. 2 toward its discharged condition as shown in FIG. 5. The size and proportion of the circuit breaker components is such that the spring 60 is completely or substantially completely discharged during the initial portion of the contact opening movement before the main circuit breaker opening and closing means 10 attains a high rate of movement. Thus, the spring 60 acts as a booster or kickoff contact opening force for both the movable main and auxiliary contacts 22 and 21. As previously mentioned, the spring 60 and piston means 74 also pump dielectric fluid 4 into the arc 68 formed between the main spring contact cluster 44 and the main movable contact 22 to aid in extinguishing the arc.

The arcing which occurs during opening of the circuit breaker main contact decomposes the dielectric fluid 4 and generates gas 84 (indicated by arrows in FIG. 4) causing the pressure within the main stationary contact structure 28. In the event that the arcing is sufficiently severe to cause relatively high gas pressure in the main stationary contact structure 28, the gas will flow through the fluid connection 72 and into the chamber 58 against the piston 74. This gas pressure will cause retarding of the action of the spring 60 so that the piston 74, the piston rod 76 and the fluid connection 72, all of which comprise part of the control means 70, control the degree of opening force provided by the auxiliary contact opening means 32.

The construction and arrangement of the main contact structure 28 and the main movable contact 22 is such that current flowing in the arc from main spring contact cluster 44 to the movable contact 22 will cause a magnetic force on the movable contact 22 in the direction of its opening movement. This force is particularly high during the initial opening movement of the movable contact 22 when an exceptionally high level of current is being interrupted. In this situation, a very high level of gas pressure will also result and the pressure of the gas will not only retard the action of the auxiliary contact opening means 22, but it will force the piston 74, piston rod 76 and spring 60 in an upward direction opposite to that of the opening movement direction of these elements so that the piston rod 76 moves entirely out of contact with the cross member 21. Thus, the initial additional opening force of the auxiliary contact opening means is completely removed from its effect on the main movable contact 22 and the movable auxiliary contacts structure 20. In summary, when the magnetic opening force on the main movable contact 22 is very high, the additional initial opening force of the auxiliary contact opening means 32 is completely nullified. If the gas pressure within the main stationary contact structure 28 and the chamber 58 exceeds a predetermined level, the pressure release valve 46 will open to permit the excess gas to escape.

It can thus be seen that an auxiliary contact opening means providing a kickoff opening force has been provided which is controllable as to the amount of initial opening force it provides in response to the degree of main contact arcing and resulting gas pressure created during the opening operation. Also, due to the relationship between the arcing and the magnetic force applied

to the main movable contacts, the auxiliary contact opening means is controllable to provide a lesser degree of opening force when the magnetic opening force increases.

While only a single specific embodiment of the invention has been shown herein, it will be realized that many modifications thereof are feasible without departing from the spirit and scope of the invention. It is accordingly intended that the scope of the invention is not to be limited to the specific embodiment disclosed.

We claim:

1. In a circuit breaker including main stationary and movable contact structures, the main movable contact being movable to open and closed positions relative to the main stationary contact structure, said contact structures carrying current when in said closed position and interrupting current while moving from the closed to the open position, a first housing containing dielectric fluid and enclosing said stationary and movable contacts when the contacts are in their closed position, the movement of the movable contact to the open position causing arcing of said current resulting in decomposition of the fluid and creating of gas within the first housing, a main contact opening means for moving the main contact out of engagement with the stationary contact, the combination comprising:

an auxiliary spring for providing additional main contact opening force during the initial opening movement of the main movable contact;

a second housing having a first chamber and a second chamber containing fluid and having an enclosed fluid connection with the first housing;

a piston slidable in the directions of the main movable contact and being positioned within the second housing, said piston having a piston rod extending from the second housing into engagement with the main movable contact structure;

The first chamber of the second housing being positioned on one side of the piston and the second chamber of the second housing being positioned on the other side of the piston, said auxiliary spring being positioned within the first chamber and biasing the piston and piston rod in the direction of opening movement of the main movable contact and the piston rod against the auxiliary movable contacts; and

said gas and fluid within the first housing flowing through said fluid connection into said second chamber, said piston and piston rod moving in the direction of the first chamber against the bias force of the auxiliary spring and the piston rod moving out of engagement with the main movable contact structure in response to flow of the gas and fluid from the first housing into the second chamber whereby the opening force of the auxiliary spring provided to the main movable contact is retarded.

2. The combination according to claim 1 wherein:

said current flows from the main stationary to the main movable contact in a direction such that a magnetic force biases the main movable contact toward its open position during opening movement of the main movable contact, said magnetic force being at a maximum during interruption of a high current level by the main contacts; and

said gas creates a maximum pressure during initial opening movement of the main movable contact while a high current level is being interrupted whereby the opening force of the auxiliary spring is nullified.

* * * * *