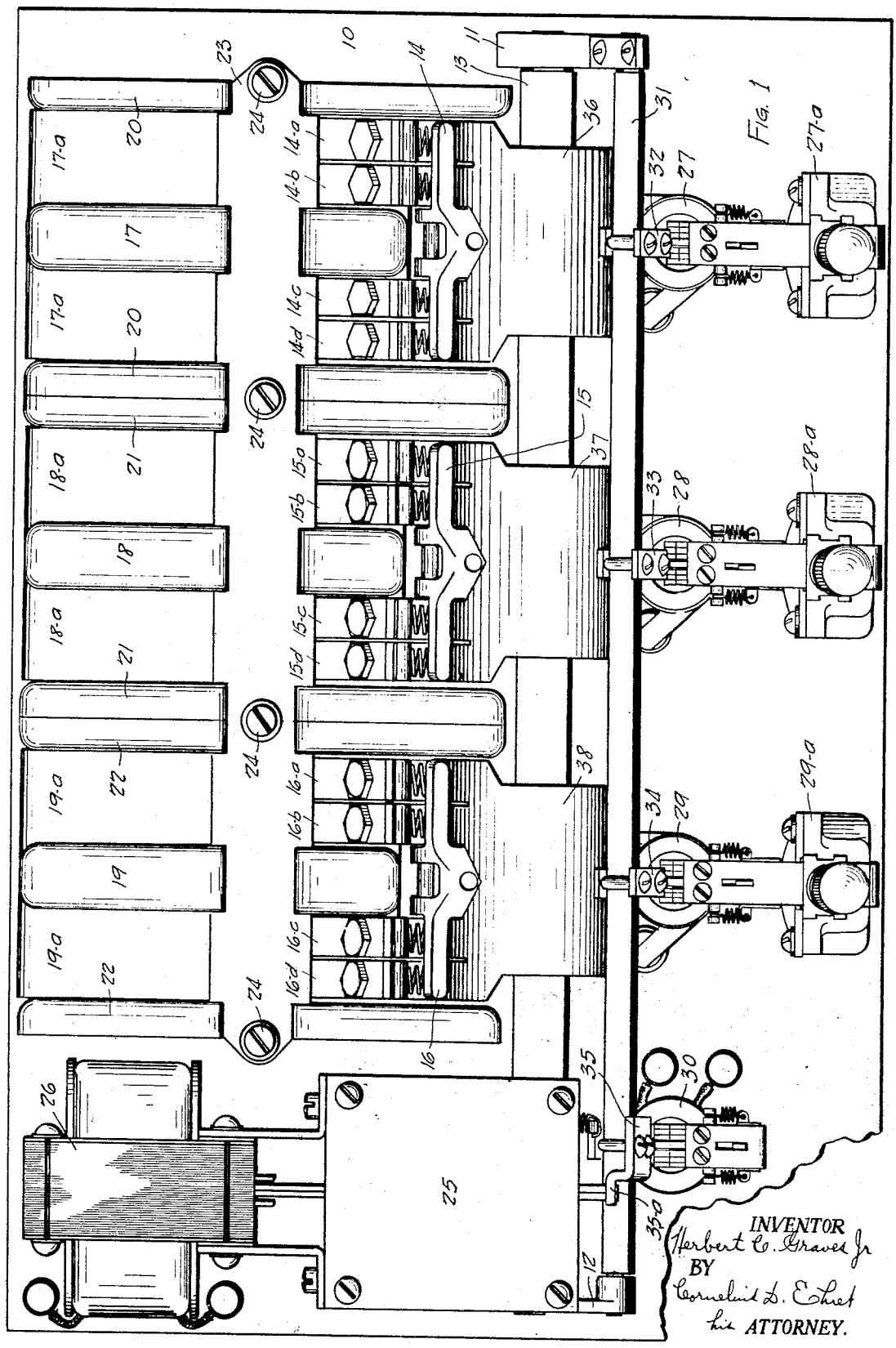
Dec. 24, 1935. H. C. GRAVES, JR 2,025,386

ELECTRIC CIRCUIT BREAKER

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Dec. 24, 1935. H. C. GRAVES, JR 2,025,386

ELECTRIC CIRCUIT BREAKER

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FIG. 2

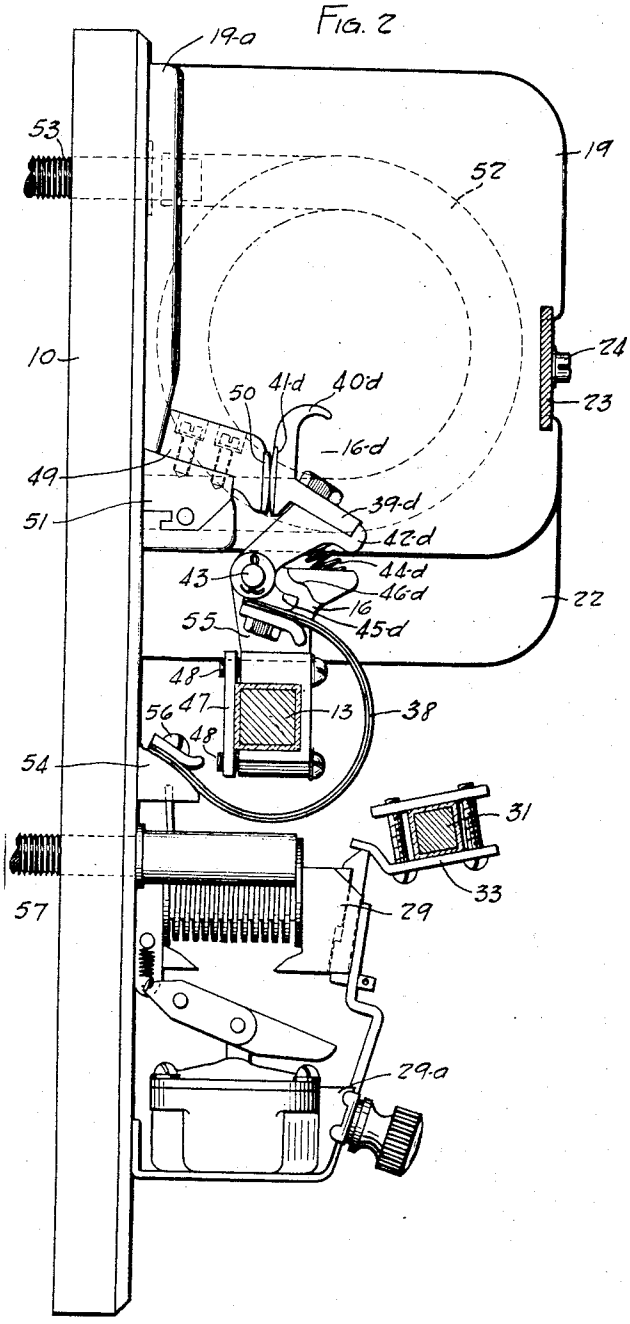
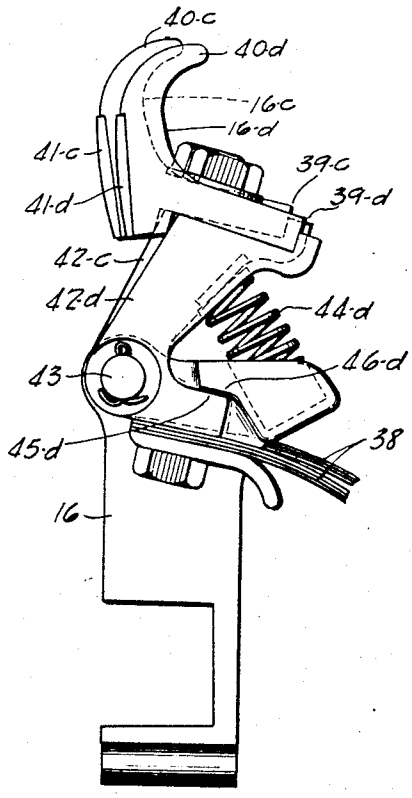


FIG. 3



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ELECTRIC CIRCUIT BREAKER

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FIG. 4

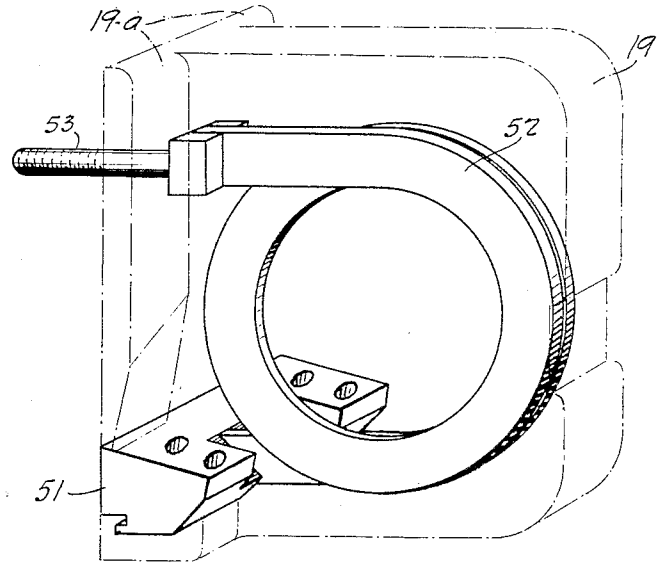
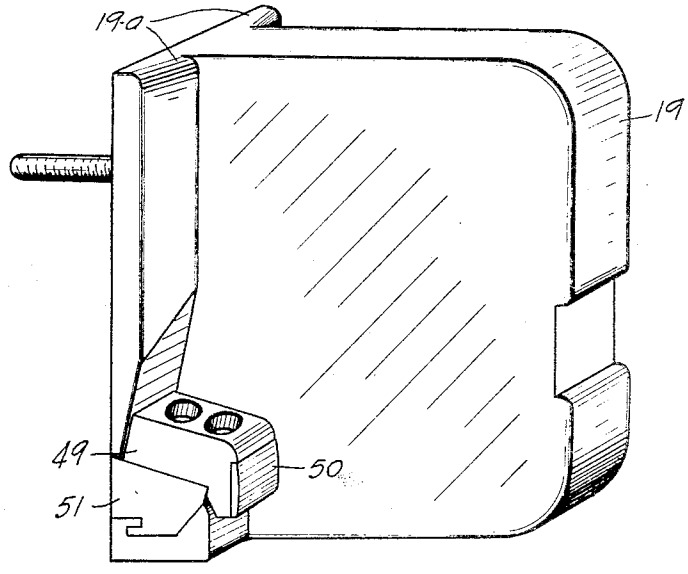


FIG. 5



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ELECTRIC CIRCUIT BREAKER

Filed Feb. 15, 1934 5 Sheets-Sheet 4

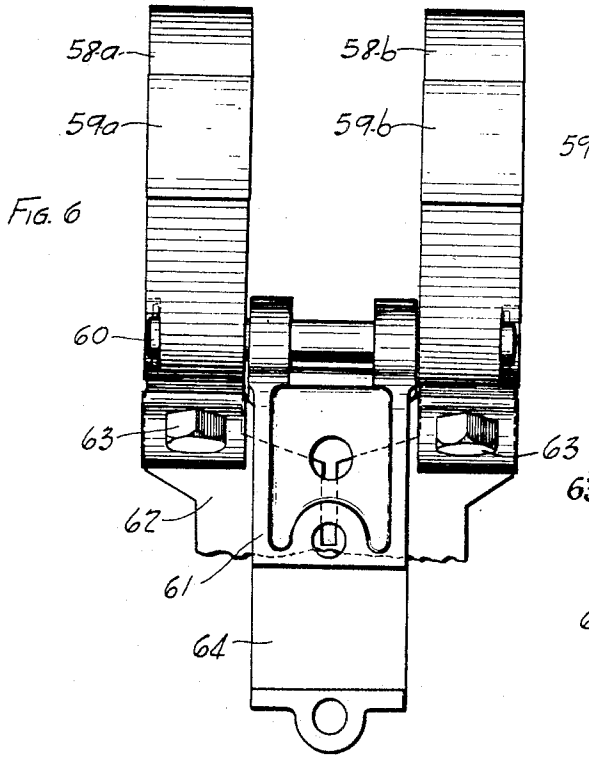


FIG. 6

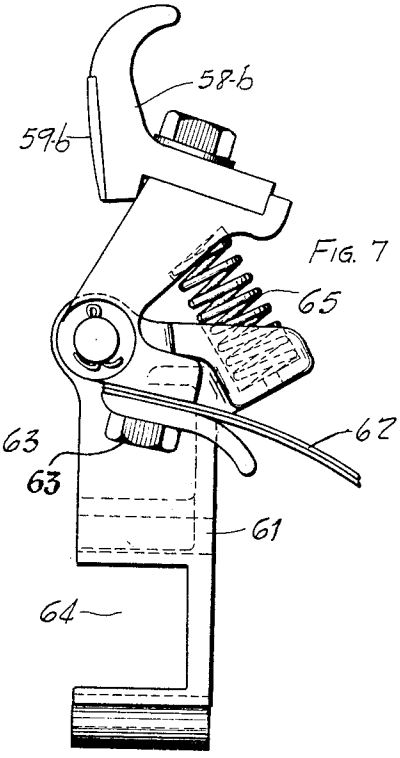


FIG. 7

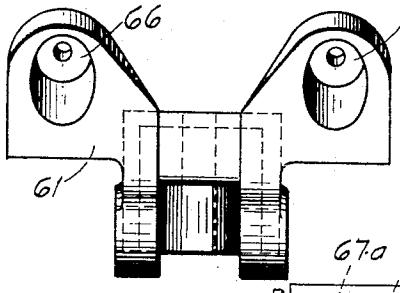


FIG. 8

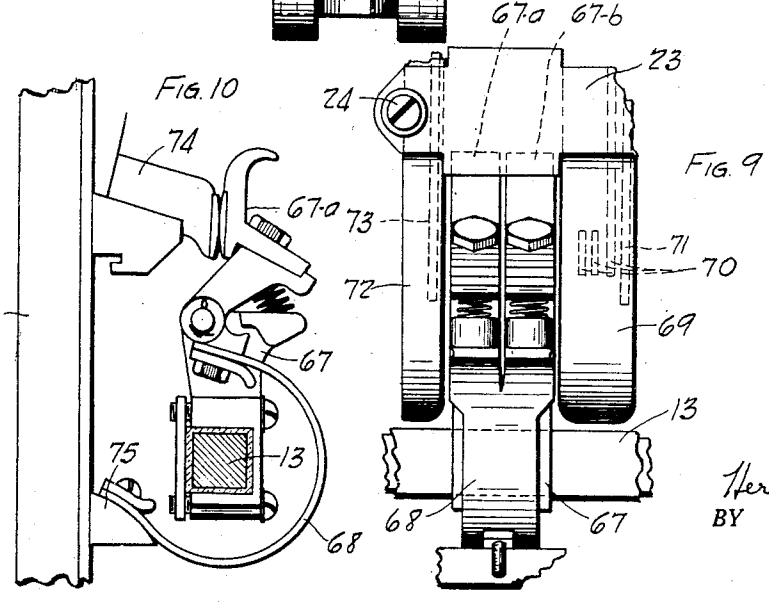


FIG. 10

FIG. 9

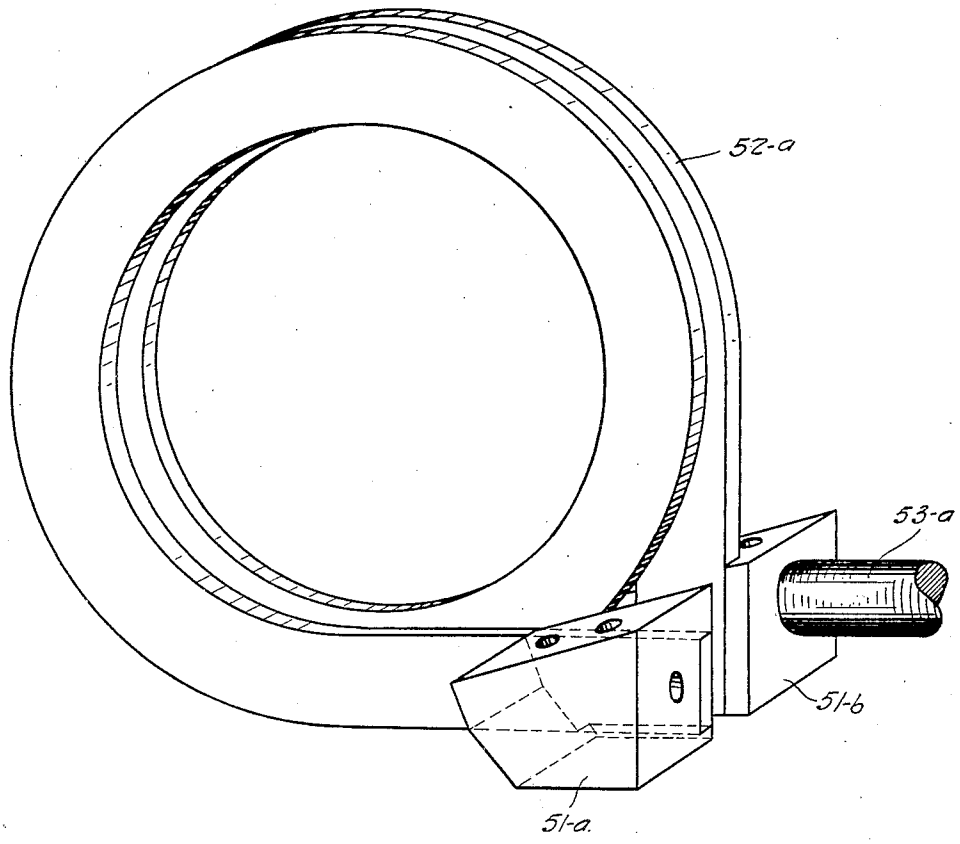
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ELECTRIC CIRCUIT BREAKER

Filed Feb. 15, 1934 5 Sheets-Sheet 5

FIG. 11



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UNITED STATES PATENT OFFICE

2,025,386

ELECTRIC CIRCUIT BREAKER

Herbert C. Graves, Jr., East Bradford Township, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of New Jersey

Application February 15, 1934, Serial No. 711,331

23 Claims. (Cl. 200—147)

My invention relates to an electric circuit breaker or interrupter and more particularly to new and improved contact structures, and new and improved arrangements for blowing out the arc formed between the contacts upon opening of the breaker.

There have been proposed heretofore numerous arrangements for blowing out the arc formed between separable contacts of an electric circuit breaker. These arrangements have usually comprised a flat magnetic blowout coil consisting of a few turns connected in series with the electrical circuit of the contacts. This blowout coil is generally arranged in a plane parallel to the plane of movement of the movable contact and immediately adjacent the cooperating stationary and movable contacts. With this type of magnetic blowout coil, in the absence of any magnetic materials adjacent thereto, the magnetic field is parallel to the axis of the coil only in the plane of the coil, and becomes increasingly more inclined at distances away from the plane of the coil, the magnetic field being generally in the form of a toroid. On the other hand, it is desirable to have the field of the magnetic blowout coil substantially perpendicular to the plane of movement of the movable contact in the plane of movement so that the arc, which moves at all times at right angles to the field, will be extended and attenuated in the plane of movement of the movable contact. The foregoing problem arises particularly in the case of circuit breakers or interrupters of very high current-carrying capacities in which it may be desirable to employ a plurality of movable contact elements electrically connected in parallel. With this arrangement, if the particular contact element, or elements, which finally breaks contact with the stationary contact element, is not immediately adjacent the magnetic blowout coil, the field at this point may be so weak and have such a direction as to be ineffective to secure the desired blowing of the arc. In extreme cases, the field may actually have such a direction as to blow in or concentrate the arc rather than to blow it out and attenuate it.

Another disadvantage of many of the circuit breakers of the prior art is the fact that the arrangement of the elements of the circuit, including the separable contacts is such that the flow of current in this circuit produces electro-dynamic forces tending to separate the contacts. The effect of these forces is to decrease the contact pressure and, in some cases, actually to produce separation of the contacts with consequent heating or burning of the contact surfaces.

It is an object of my invention, therefore, to provide a new and improved electric circuit breaker or interrupter which will overcome the above-mentioned disadvantages of the arrangements of the prior art and which will be simple, reliable and rugged in operation and economical to manufacture.

It is another object of my invention to provide an improved contact structure for an electric circuit breaker or interrupter provided with a magnetic blowout coil in which the breaking of the circuit at a contact element immediately adjacent the blowout coil is insured.

It is a further object of my invention to provide a new and improved contact structure of high current-carrying capacity for an electric circuit breaker or interrupter comprising a plurality of movable contact elements, electrically connected in parallel, in which the circuit is finally broken at that contact element, or elements, immediately adjacent the magnetic blowout coil.

It is a further object of my invention to provide a new and improved blowout arrangement for the contacts of an electric circuit breaker or interrupter in which the normal field of the blowout coil is modified to secure more satisfactory blowing of the arc.

It is a further object of my invention to provide a new and improved blowout arrangement for the contacts of a multiple pole electric circuit breaker or interrupter in which the influence of the magnetic field of the blowout coil of one pole upon the contacts of the adjacent pole is substantially eliminated.

It is a still further object of my invention to provide new and improved contact structure for an electric circuit breaker or interrupter in which the electro-dynamic forces, set up by current flowing in the circuit including the separable contacts, are effective to increase contact pressure at the contact surfaces.

In accordance with one embodiment of my invention, an electric circuit breaker or interrupter comprises a stationary contact structure, a stationary terminal structure and a movable contact structure consisting of an oscillating shaft upon which is supported a contact arm and two groups of contact elements pivotally mounted in the end of the contact arm and electrically connected in parallel. There is provided a suitable operating mechanism, either manual or automatic, for actuating the oscillating shaft to move the movable contact elements into and out of engagement

with the stationary contact structure. A magnetic blowout coil is interposed between the two groups of contact elements. Each of the contact elements is provided with a biasing or wiping spring and a stop surface cooperating with a complementary stop surface on the contact arm to limit the movement of the contact element in response to the biasing spring. The stop members of those contact elements immediately adjacent the magnetic blowout coil permit a greater movement than those of the other movable contacts, with the result that the electrical circuit is always finally broken at that contact, or contacts, immediately adjacent the magnetic blowout coil.

The magnetic blowout coil is preferably formed as an interchangeable unit with a mass of arc-resistant insulating material molded completely to surround and encase the blowout coil and thus protect it from any arcs formed upon the opening of the breaker. In certain instances, it may be desirable also to provide an additional arc-resistant barrier on the side of the cooperating contacts opposite that of the blowout coil. If desired, this last-named barrier may include a plate of magnetic material which acts as a core or part of the magnetic circuit of the blowout coil, and modifies its magnetic field so that this field is substantially normal to the plane of motion of the movable contacts throughout the operating range of the blowout coil.

My invention comprises also improved electric circuit breakers or interrupters embodying one or more of the above-described features. In the case of a multiple circuit or multiple pole circuit interrupter utilizing contacts on only one side of the magnetic blowout coil, the blowout coil unit may include also a magnetic plate or shield molded and encased in the arc-resistant material which is effective to support them in their proper relative positions.

In accordance with another feature of my invention, the connection between the movable contact elements and a stationary terminal, with which they are electrically connected, comprises one or more flexible or resilient conductors formed into a loop and so disposed that the electro-dynamic forces set up in the loop by the current flowing therein is effective to urge the movable contact elements about their respective pivots into engagement with the stationary contact structure, and thus to increase the contact pressures of the breaker.

For a better understanding of my invention, together with other and further features and objects thereof, reference is had to the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

Referring more particularly to the drawings, Fig. 1 illustrates a front elevation of a 3-pole solenoid-operated circuit breaker or interrupter embodying my invention;

Fig. 2 is a side elevation of one pole of the breaker shown in Fig. 1;

Fig. 3 is a detailed side elevation of the movable contact structure of Fig. 2;

Fig. 4 is a phantom view of my improved blowout coil unit, while Fig. 5 is a perspective of the same unit;

Figs. 6 and 7 are, respectively, a front elevation and side elevation of a modified form of the moving contact structure;

Fig. 8 is a plan view of the contact arm of Fig. 6;

Fig. 9 is a fragmentary front elevation of a further modified contact structure and associated blowout coil, while Fig. 10 is a side elevation of the contact structure of Fig. 9;

Fig. 11 is a perspective of a modified form of blowout coil suitable for use with a contact structure as shown in side elevation in Fig. 3 and in front elevation in Fig. 6.

Referring now more particularly to Fig. 1 of the drawings, there is illustrated in front elevation an improved electric circuit breaker or interrupter embodying my invention and comprising a base or panel member 10 upon which is supported a pair of brackets 11 and 12. Journalled in these brackets is an oscillating operating or actuating shaft 13 to which are secured the contact arms 14, 15 and 16 insulated therefrom by suitable insulation. Mounted on the contact arms 14, 15 and 16 are a plurality of groups of independent contact elements 14*a–d*, 15*a–d* and 16*a–d*, respectively. The independently mounted contact elements associated with each of the contact arms 14, 15 and 16 are divided into two groups by the barriers 17, 18 and 19, respectively. These barriers are preferably of molded arc-resistant insulating material in which are encased suitable magnetic blowout coils, as described more fully hereinafter. On the opposite sides of the movable contact elements from the barriers 17, 18 and 19 are auxiliary barriers 20, 21 and 22, respectively, also of molded arc-resistant insulating material. The barriers 17 to 22, inclusive, are provided with notches into which fit a retaining strip 23, also of arc-resistant insulating material, and provided with notches cooperating with those of the barriers in retaining the barriers in predetermined fixed relationship. The strip 23 may be secured to the panel 10 in any suitable manner as by means of screws or bolts 24. In addition, the barriers 17, 18 and 19 are provided with integrally molded flanges 17*a*, 18*a* and 19*a*, respectively, which are effective to maintain the desired spacing therebetween.

The operating shaft 13 may be actuated by any suitable mechanism, such as a mechanism enclosed in a housing 25 and operated either manually or by an electromagnet or solenoid 26, as illustrated. Associated with the circuits of the contact arms 14, 15 and 16 are overload tripping relays 27, 28 and 29 which may be of any suitable type well-known in the art, and which comprise no part of my present invention. In addition, there may be provided an auxiliary tripping relay 30 energized in response to any predetermined condition, or manually, at the will of the operator. If desired, time-delay mechanisms 27*a*, 28*a* and 29*a* may be associated with the tripping relays 27, 28 and 29, respectively. Also journalled in the brackets 11 and 12 is a tripping shaft 31 upon which are mounted the tripping arms 32, 33, 34 and 35, arranged to be tripped by the relays 27, 28, 29 and 30, respectively. The tripping arm 35 is provided with a projecting arm 35*a* which cooperates with any suitable latching member of the operating mechanism 25. The above-described operating and tripping mechanism may be of any of the several types well-known in the art, although I prefer to use that mechanism illustrated and described in a copending application of H. C. Graves, Serial No. 711,332, filed February 15, 1934, and assigned to the same assignee as the present application.

Associated with the movable contact elements, mounted on the contact arms 14, 15 and 16, are

flexible or resilient conducting strips, or groups of strips, 36, 37 and 38 which serve to interconnect the movable contact elements with stationary terminals of the panel 10, as described more fully hereinafter.

The arrangement of the several cooperating parts of a single pair of stationary and movable contact elements is shown more clearly in Fig. 2 which is a side elevation of one pole of the circuit interrupter of Fig. 1, for example, the pole including the contact arm 16 and independently movable contact elements 16*a–d*. From this figure, it is apparent that the movable contact element 16*d* comprises a contact member 39*d* formed with an arcing horn 40*d* and provided with an insert 41*d* of arc-resistant, conductive material. The contact member 39*d* is secured to the auxiliary contact arm 42*d* pivoted at 43 on the main contact arm 16 and provided with a wiping or biasing spring 44*d*. The auxiliary contact arm 42*d* and the main contact arm 16 are provided with cooperating stop surfaces 45*d* and 46*d*, respectively, to limit the movement of the auxiliary arm 42*d* in response to the biasing spring 44*d*. The contact arm 16 is provided with a recess which engages the operating shaft 13 and is clamped thereon by a suitable plate 47 secured to the arm 16 by screws 48.

Cooperating with the movable contact element 16*d* is a stationary contact block 49 also provided with an insert of arc-resistant conductive material 50 and secured to a terminal block 51, as illustrated. The terminal block 51 cooperates not only with the movable contact element 16*d*, but also with the contact elements 16*a*, 16*b*, and 16*c*, together with associated contact blocks, forming part of the same pole of the circuit breaker. Encased within the arc-resistant barrier 19 is a suitable magnetic blow-out coil 52, preferably comprising a pan-cake coil of relatively few turns, connected at one end to the terminal 51 and at the other end to a terminal stud 53 projecting from the rear of the panel 10. The movable contact element 16*d* is interconnected with a stationary terminal 54 by means of the resilient conducting strip or element 38 which is secured at one end to the auxiliary contact arm 42*d* by a cap screw 55 and to the terminal block 54 by screw 56. The resilient conductor 38 may be individual to the contact element 16*d*, with similar conductors interconnecting the elements 16*a–c* and the terminal 54, or it may be common to the movable elements 16*a–d*, as shown in Fig. 1.

The stationary terminal 54 may be connected to a suitable terminal stud 57 through the coil of the overload trip relay 29. From the above, it can be seen that all of the cooperating stationary contact elements 49 and movable contact elements 14*a*—16*d* may be readily removed for repair or replacement without interference from the other parts of the apparatus.

The general principles of operation of the above-described circuit breaker or interrupter will be well understood by those skilled in the art. In brief, the energization of the electromagnet 26 is effective to actuate the operating shaft 13 through the mechanism 25 and to move the movable contact elements 14*a–d*, 15*a–d* and 16*a–d* into engagement with their corresponding stationary contact structures.

The relative positions of the parts of one pole of the breaker, when in circuit-closing position, are as shown in Fig. 2. Under these conditions, the biasing spring 44*d* is effective to urge the movable contact element 16*d* about its pivot 43 into engagement with the stationary contact block 49. As current flows in the circuit including the circuit interrupter, and thus through the flexible or resilient conductor 38, the electro-dynamic forces set up in the conductor 38, due to the current flowing therein, tend to expand the loop into which the conductor 38 is formed, exerting a pull on the contact element 16*d* about the pivot 43 and increasing the contact pressure between the stationary and movable contact elements. This is in contradistinction to the arrangements of the prior art in which an increase in the current in the circuit in which the contacts are connected, has been effective mutually to repel the stationary and movable contact elements, thus decreasing the contact pressure.

Upon occurrence of a short-circuit or other abnormal electrical condition in the circuits of any of the stationary and movable contacts, one of the tripping relays 27, 28 or 29 is actuated to engage its associated tripping arm on the tripping shaft 31 and to unlatch the operating mechanism 25, which contains a biasing spring effective to actuate the shaft 13 and connected contacts to open-circuit position. Under such abnormal conditions the electro-dynamic stresses set up in the resilient conductor 38 are effective still further to increase the contact pressures and, as the contact arm 16 moves in a clockwise direction, as referred to, the stresses of the resilient conductor 38 and the wiping springs 44 are effective to rotate the auxiliary contact arm 42*d* in a counter-clockwise direction, producing a sliding or wiping movement between the contact surfaces 41*d* and 50*d*, and effecting a final breaking of the circuit at the arcing horn 40*d*.

As stated above, the characteristics of the magnetic field of the blowout coil 52 are such that it decreases in intensity at distances away from the plane of the coil and also becomes inclined with respect to the axis of the coil, so that it is desirable that the circuit shou'd be finally broken as close to the blowout coil as possible. The cooperating stop surfaces 45*d* and 46*d* of the element 16*d* are so related to the corresponding stop surfaces of the contact element 16*c* that the wiping spring of the contact element 16*c* is effective to rotate it about its pivot through an angle greater than that through which the element 16*d* is able to move. This relationship is snown clearly in Fig. 3. As a consequence, the contact between the element 16*c* and the stationary contact element 49 is always broken subsequently to that between the contact element 16*d* and the stationary contact element. In other words, the circuit is finally broken between the stationary contact element and that movable contact element immediately adjacent the magnetic blowout coil. The same relationships obtain between the contact elements 16*a* and 16*b* and, similarly, between the other independent contact elements 15*a–d* and 14*a–d*. When this latter arrangement is employed, it may be desirable to use inserts 41*d*, 50*d* of low resistance contact material, but to form the inserts 41*c*, 50*c*, of the contact elements at which the circuit is finally broken, of arc-resistant conductive material.

The magnetic blowout coil 52 and its associated arc-resistant barrier 19 is preferably formed into an interchangeable magnetic blowout coil unit. A phantom view of such a unit is shown in Fig. 4, while Fig. 5 illustrates a perspective of the complete unit. As there illustrated, the magnetic blowout coil 52, with its terminal stud 53 and terminal block 51, is encased in a mass of arc-

resistant insulating material molded completely to surround and support the magnetic blowout coil. The molded unit is preferably provided with flanges 19a which, as shown clearly in Fig. 1 of the drawings, aid in the proper spacing of the blowout coil units on the panel or base 10 of the interrupter.

A modified form of a movable contact assembly embodying my invention is shown in front elevation in Fig. 6, and in side elevation in Fig. 7. In this form only two independently movable contact elements 58a and 58b are utilized. These elements are pivotally mounted on a contact arm 61 at the pivot 60 and are spaced apart and disposed to be movable on opposite sides of an arc-resistant barrier including a magnetic blowout coil. In other words, these elements correspond to the single movable contact elements of Fig. 1 immediately adjacent opposite sides of the blowout coils. These movable elements are interconnected with a stationary terminal on the breaker panel by a flexible or resilient conductor 62 secured to the elements 58a, 58b by suitable screws 63 and divided, as shown, or comprising independent strips, to maintain separate contact pressures on the two movable contact elements due to currents flowing in the flexible conductor or conductors. The arm 61 is provided with a recess 64 to engage the operating shaft 13, as in the previous modifications, and each movable contact element has its independent biasing or wiping spring 65. A top plan view of the contact arm alone is shown in Fig. 8, clearly showing the recesses 66 for the wiping springs 65.

A still further modification of my invention is shown in Figs. 9 and 10 in which Fig. 9 is a fragmentary front elevation of one pole of a circuit interrupter, while Fig. 10 is a side elevation of the contact structure thereof.

Referring more particularly to Fig. 9, a contact arm 67 is provided with a pair of independently movable contact elements 67a and 67b immediately adjacent each other, and connected through a flexible or resilient conductor 68 to a suitable stationary terminal element 75, as in previous modifications. In this case, both of the movable contact elements are disposed to be mounted on one side of an arc-resistant barrier 69, including a magnetic blowout coil 70. On the opposite side of the movable contacts 67a, 67b is a second arc-resistant barrier 72. The barriers 69 and 72 may be suitably secured to the base 10 by means of the retaining strip 23 and screws 24, as in Fig. 1.

In case the embodiment of Fig. 9 is utilized in a multiple pole interrupter, as in Fig. 1, it may be desirable to shield the adjacent cooperating stationary and movable contacts from the magnetic field of the blowout coil 70. This may be done by incorporating within the barrier 69 a plate or shield 71 of magnetic material, which is effective substantially to isolate the field of the blowout coil 70 from the cooperating contacts of the adjacent pole. In this arrangement, also, a plate or vane 73 of magnetic material is molded into the barrier 72 and acts as an armature or core for the magnetic blowout coil 70, intensifying and modifying the magnetic field thereof so that it is substantially horizontal or parallel to the axis of the coil throughout its operating range; that is, throughout the space between the barriers 69 and 72, where the magnetic field of the blowout coil is effective to extend and attenuate the arc. In certain instances it may be satisfactory to use magnetic vanes 71 and 73 smaller than those illustrated and extending only in the immediate elevation of the contacts where the arc is initiated. If desired, the movable contact elements 67a, 67b may be designed to separate from their cooperating stationary contact element 74 successively, the movable contact element 67b immediately adjacent the blowout coil 70 being effective to open the circuit including the separable contacts. In this case, the movable contact elements 67a, 67b correspond to one of the pairs of movable contact elements 14a—14b, 14c—14d, etc., of Fig. 1.

In Fig. 11 is illustrated a modified form of blowout coil unit suitable for use in connection with a contact structure represented in side elevation in Fig. 3 and in front elevation in Fig. 6. In this modified form of my improved blowout coil, the terminal block 51 of Fig. 4 is divided into a pair of terminal blocks 51a and 51b, electrically and mechanically separated. Suitable contact elements (not shown) may be attached to one of the terminal blocks, for example, block 51b, rather than to an independent terminal, as in the unit of Fig. 4. When employing this unit with a contact structure, as shown in Figs. 3 and 6, it is apparent that the movable contact elements 16c, 16d cooperate with contact blocks 51a and 51b, straddling the blowout coil 52a, which is preferably encased in an arc-resistant barrier as in the units of Figs. 4 and 5.

As described above, the movable contact element 16d disengages its cooperating stationary contact element before the movable element 16c. This latter movable contact element, together with its associated stationary contact element, is preferably provided with a contact surface of arc-resistant material, since the circuit is always broken by these contacts. The contact element 16d and its associated stationary contact element, however, are preferably of low resistance contact materials, such as copper, silver, etc., to provide a path of high conductivity for the flow of current under normal conditions.

With such an arrangement, it is seen that, in the circuit-closing position of the interrupter, the circuit is completed through the flexible conductor 38, the high conductivity movable contact element 16d, and its associated stationary contact element mounted on the contact block 51b. In parallel to this main path is the auxiliary path, including the movable contact element 16c, its associated stationary contact element, and the blowout coil 52a. Although this latter circuit includes the contact elements having arc-resistant contact surfaces, which are of relatively higher resistance than the other contact surfaces, an appreciable current will flow in this parallel circuit. Upon operation of the interrupter to circuit-opening position, the main circuit is initially broken at the contact element 16d and the entire load current is transferred to the contact element 16c flowing through the blowout coil 52a. The result of this arrangement is that there is provided a high conductivity path for the normal flow of current through the contact element 16d while the circuit is finally broken at the contact element 16c, which, with its associated blowout coil 52a, carries the full load current during the short interval required for circuit interruption.

While I have described what I at present consider the preferred embodiments of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from the spirit of my invention, and I therefore, aim in the appended claims,

to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What I claim is:

1. An electric circuit interrupter comprising a stationary contact structure, a stationary terminal structure, a movable contact structure comprising a movable contact arm and a pair of groups of contact elements pivotally supported on said arm and all electrically connected in parallel, means for operating said contact arm for moving said movable contact elements into and out of engagement with said stationary contact structure, a magnetic blowout coil interposed between said groups of contact elements, and means effective, upon the movement of said movable contact structure, to circuit-opening position, to retard the disengagement of said stationary contact structure and that contact element of each group nearest said blowout coil until after the disengagement of the remaining contact elements therefrom.

2. An electric circuit interrupter comprising a stationary contact structure, a stationary terminal structure, a movable contact structure comprising a movable contact arm and a pair of similar contact elements similiarly and pivotally supported on said arm and electrically connected in parallel, means for operating said contact arm for moving said movable contact elements into and out of engagement with said stationary contact structure, and a magnetic blowout coil interposed between said contact elements.

3. An electric circuit interrupter comprising a stationary contact structure, a stationary, terminal structure, a movable contact structure comprising a movable contact arm and a plurality of independent contact elements pivotally supported on said arm and electrically connected in parallel, means for operating said contact arm for moving said movable contact elements into and out of engagement with said stationary contact structure, a magnetic blowout coil unit adjacent one side of said movable contact structure and comprising a blowout coil, a magnetic shield adjacent the side of said coil away from said movable contact structure, and a mass of arc-resistant insulating material molded to surround and completely enclose said coil and said shield and to support them in proper relative position, and means effective, upon movement of said movable contact structure to circuit-opening position, to retard the disengagement of said stationary contact and that contact element nearest said blowout coil until after the disengagement of the remaining contact elements therefrom.

4. In an electric circuit interrupter, a stationary contact structure, a movable contact structure cooperating therewith and comprising a pair of groups of contact elements all electrically connected in parallel, a magnetic blowout coil interposed between said groups of contact elements, and means effective, upon the movement of said movable contact structure to circuit-opening position, to retard the disengagement of said stationary contact structure and that contact element of each group nearest said blowout coil until after the disengagement of the remaining contact elements therefrom.

5. In an electric circuit interrupter, a stationary contact structure comprising a pair of groups of contact elements electrically connected in parallel, an arc-resistant barrier separating said groups of contact elements, a magnetic blowout coil encased in said barrier, a movable contact structure comprising two groups of independent contact elements cooperating with said stationary groups and straddling said barrier, said movable contact elements being similarly pivoted in said contact structure and electrically connected in parallel, an independent wiping spring for each of said contact elements tending to urge it into engagement with said stationary contact structure, each of said contact elements being provided with a stop surface and said movable contact structure being provided with a plurality of complementary stop surfaces to limit the motion of said contact elements by their respective wiping springs, the cooperating stop surfaces of that movable contact element of each group nearest said blowout coil being advanced relative to the other cooperating stop surfaces, whereby said contact elements nearest said blowout coil are the last to disengage their respective stationary contact elements upon the movement of said movable contact structure to circuit-opening position.

6. In an electric circuit interrupter, a stationary contact structure having mutually interconnected contact surfaces, a movable contact structure cooperating therewith and comprising a plurality of indeepndent contact elements for individually engaging said contact surfaces and mutually interconnected to provide for division of the total current flowing between said stationary contact structure and said movable contact structure, and a magnetic blowout coil in circuit with said contact structures and interposed between said independent contact elements.

7. In an electric circuit interrupter, a stationary contact structure, a movable contact structure cooperating therewith and comprising a plurality of independent contact elements electrically connected in parallel, and a magnetic blowout coil interposed between said independent contact elements with its axis substantially normal to the plane of motion of said movable contact structure.

8. In an electric circuit interrupter, a stationary contact structure, a movable contact structure cooperating therewith and comprising a pair of independent contact elements electrically connected in parallel, a magnetic blowout coil encased in a block of arc-resistant insulating material and interposed between said contact elements, and an arc resistant barrier on the outer side of each of said contact elements.

9. In an electric circuit interrupter, a unitary stationary contact structure comprising a pair of contact elements at the same potential, an arc-resistant barrier separating said contact elements, a magnetic blowout coil encased in said barrier, and a unitary movable contact structure comprising a pair of independent contact elements at the same potential and supporting arms, said movable contact structure straddling said barrier to provide paths, each carrying part of the total current between said contact structures, on opposite sides of the barrier.

10. In an electric circuit interrupter, a stationary contact structure, a cooperating movable contact structure comprising a plurality of independent contact elements electrically connected in parallel, a magnetic blowout coil adjacent one side of said movable contact structure, and means effective, upon the movement of said movable contact structure to circuit-opening position, to retard the disengagement of said stationary contact structure and that contact element nearest

said blowout coil until after the disengagement of the remaining contact elements therefrom.

11. In an electric circuit interrupter, a stationary contact structure, a cooperating movable contact structure comprising a plurality of independent contact elements similarly pivoted in said contact structure and electrically connected in parallel, biasing means for urging said contact elements into engagement with said stationary structure, a magnetic blowout coil adjacent one side of said movable contact structure, and means for limiting the movement of all of said contact elements in response to said biasing means and for limiting to a lesser extent the movement of that contact element nearest said blowout coil.

12. In an electric circuit interrupter, a stationary contact structure, a cooperating movable contact structure comprising a plurality of independent contact elements similarly pivoted in said contact structure and electrically connected in parallel, an independent wiping spring for each of said contact elements tending to urge it into engagement with said stationary contact structure, and a magnetic blowout coil adjacent one side of said movable contact structure, each of said contact elements being provided with a stop surface and said movable contact structure being provided with a plurality of complementary stop surfaces to limit the motion of said contact elements by their respective wiping springs, the cooperating stop surfaces of that contact element nearest said magnetic blowout coil being advanced relative to the other cooperating stop surfaces, whereby said last-mentioned contact element is the last to disengage said stationary contact structure upon the movement of said movable contact structure to circuit-opening position.

13. In a multiple circuit electric circuit interrupter, a stationary contact structure for each of the multiple circuits, a cooperating movable contact structure for each of said stationary contact structures, a magnetic blowout coil adjacent one side only of each of said movable contact structures and connected in their respective circuit, and a magnetic shield adjacent that side of each blowout coil away from its associated movable contact structure effective substantially to eliminate the influence of the magnetic field of a blowout coil associated with one circuit upon an arc between the contact structures connected in another circuit.

14. In a multiple circuit electric circuit interrupter, a stationary contact structure for each of the multiple circuits, a cooperating movable contact structure for each of said stationary contact structures comprising a plurality of independent contact elements electrically connected in parallel, a magnetic blowout coil adjacent one side of each of said movable contact structures and connected in their respective circuit, a magnetic shield adjacent that side of each blowout coil away from its associated movable contact structure, and means effective, upon the movement of said movable contact structures to circuit-opening position, to retard the disengagement of said stationary contact structures and those contact elements nearest the unshielded sides of said blowout coils until after the disengagement of the remaining contact elements therefrom.

15. In a multiple circuit electric circuit interrupter, a stationary contact structure for each of the multiple circuits, a cooperating movable contact structure for each of said stationary contact structures, a magnetic blowout coil adjacent one side only of each of said movable contact structures and connected in their respective circuit, said blowout coil being encased in a body of arc-resistant insulating material, an arc-resistant barrier on the other side of each of said movable contact structures, and a magnetic shield adjacent that side of each blowout coil away from its associated movable contact structure, effective substantially to eliminate the influence of the magnetic field of a blowout coil associated with one circuit upon an arc between the contact structures connected in another circuit.

16. In an electric circuit interrupter, a stationary contact structure, a cooperating movable contact structure, a magnetic blowout coil adjacent one side only of a said cooperating contact structures, and a magnetic armature for said blowout coil mounted substantially parallel to said blowout coil and on the opposite side of said cooperating contact structures.

17. In an electric circuit interrupter, a stationary contact structure, a cooperating movable contact structure, an arc-resistant barrier mounted on one side only of said cooperating contact structures and provided with a magnetic blowout coil encased therein, an arc-resistant barrier mounted substantially parallel to said first-named barrier and on the opposite side of said cooperating contact structures, and a magnetic armature for said blowout coil encased on said second-named barrier.

18. In an electric circuit interrupter, a unitary blowout coil structure comprising an air core pan-cake blowout coil and a magnetic shield mounted adjacent only one side thereof and substantially coextensive with said coil.

19. In an electric circuit interrupter, a unitary blowout coil structure comprising an air core pan-cake blowout coil, a magnetic shield adjacent one side of said coil and substantially coextensive therewith, and a mass of arc-resistant insulating material molded to surround and completely enclose said coil and said shield and to support them in proper relative positions.

20. In a multiple electric circuit interrupter, a blowout coil unit comprising an air core pan-cake blowout coil, a pair of projecting terminals connected to the end thereof, a mass of arc-resistant insulating material molded to surround and completely enclose said coil except for said projecting terminals, and formed with a flange along one edge thereof suitable for mounting on a base of said interrupter and proportioned to space the unit with respect to other similar blowout units of the interrupter.

21. In an electric circuit interrupter, a pair of stationary contact elements, a movable contact structure cooperating therewith and comprising a pair of similar independent contact elements similarly mounted adjacent each other and electrically connected in parallel, a terminal connected to a first of said stationary contact elements, a magnetic blowout coil connected between said stationary contact elements and disposed between said movable contact elements, and means effective, upon the movement of said movable contact structure to circuit-opening position, to retard the disengagement of the second of said stationary contact elements and its cooperating movable contact element until after the disengagement of the other contact elements.

22. In an electric circuit interrupter, main cooperating stationary and movable contact elements, a terminal connected to said stationary contact element, auxiliary cooperating stationary

and movable contact elements similar to said main contacts and similarly mounted adjacent thereto, a magnetic blowout coil connected in series with said auxiliary contact elements and disposed between said main and auxiliary contact elements, said blowout coil and auxiliary contact elements being connected in parallel to said main contact elements, means for moving said movable contact elements into and out of engagement with said stationary contact elements and for effecting the disengagement of said main contact elements before that of said auxiliary contact elements.

23. In an electric circuit interrupter, main cooperating stationary and movable contact elements, a terminal connected to said stationary contact element, auxiliary cooperating stationary and movable contact elements similar to said main contact elements and similarly mounted adjacent thereto and including arc-resistant contact surfaces, a magnetic blowout coil connected in series with said auxiliary contact elements and disposed between said main and auxiliary contact elements, said blowout coil and auxiliary contact elements being connected in parallel to said main contact elements, a movable contact arm in which said movable contact elements are mounted, contact springs individual to said movable contact elements, said contact arm and movable contact elements being provided with cooperating stop surfaces to limit the motion of the contact elements in response to the forces of said contact springs, and the cooperating stop surfaces of said auxiliary movable contact being advanced with respect to the other, whereby said auxiliary contact elements are the last to disengage upon the operation of said circuit interrupter to circuit-opening position.

HERBERT C. GRAVES, JR.

CERTIFICATE OF CORRECTION.

Patent No. 2,025,386. December 24, 1935.

HERBERT C. GRAVES, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 35, claim 3, strike out the comma after the word "stationary" second occurrence; and second column, line 27, claim 6, for "indeepndent" read independent; page 6, second column, line 16, claim 16, strike out "a" before "said"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of August, A. D. 1936.

(Seal)

Leslie Frazer
Acting Commissioner of Patents.

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(Seal) Acting Commissioner of Patents.