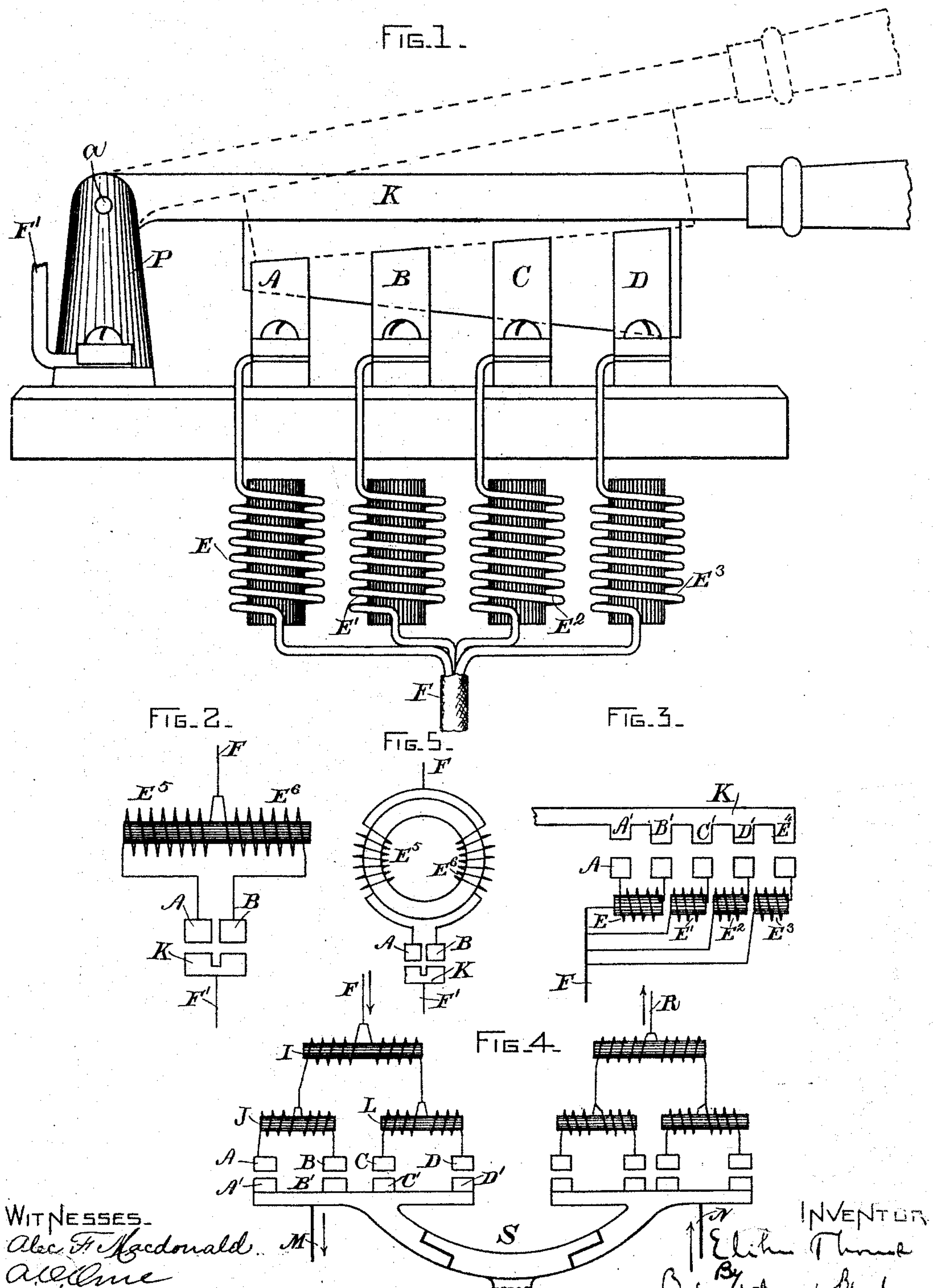
(No Model.)

E. THOMSON.

ELECTRIC CIRCUIT BREAKER.

No. 490,178. Patented Jan. 17, 1893.



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ELECTRIC-CIRCUIT BREAKER.

SPECIFICATION forming part of Letters Patent No. 490,178, dated January 17, 1893.

Application filed October 28, 1892. Serial No. 450,223. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at Swampscott, county of Essex, and State of Massachusetts, have invented a certain new and useful Improvement in Electric-Circuit Breakers, of which the following is a specification.

The present invention relates to switches or other circuit controlling apparatus by means of which electric currents of great strength can be safely controlled. It is well known that difficulty is experienced in switching currents of large volume, particularly when the potential is considerable. In such cases it is desirable that such circuit breaking apparatus be employed having contacts arranged to form multiple paths through which the current is divided, but if on opening such a circuit the time of make and break at the respective contacts is not absolutely simultaneous the last one which is opened receives the full discharge of the heavy current and is apt to be injured. In this way switches for heavy currents are very frequently damaged if the total volume of current is free to shift from one contact to another and so concentrate the entire current energy upon the one last opened. It is to obviate this difficulty that my invention is designed, and it may be applied to switches and all forms of circuit breakers or controllers in which shifting connections are to be made.

The accompanying drawings illustrate diagrammatically the invention applied in a number of its simplest forms, but it will be understood that I do not intend to restrict the invention to the particular form of apparatus shown, or indeed to any particular form of circuit controller.

The principle on which the invention is founded is that currents will not instantly leave circuits of considerable self-induction to seek other paths, and in applying this principle to the purpose in hand I place in circuit with each of the multiple contacts a self-inductive coil or other device such that under normal conditions practically no impedence is offered to the flow of current, but which when the switch is opened maintains the proper distribution of the current through the respective paths so that only the proper fraction of the current is broken at each of the contacts, for example, if each contact carries one hundred ampères and there are in all ten contacts at which the circuit is opened as nearly simultaneously as possible, then the amount of current ruptured by each contact will remain practically one hundred ampères instead of one thousand ampères at the last of the contacts opened, as would be the case in the ordinary multiple switch, for, as will be readily understood, the increased current tending to rush through the last contact gives rise to an electro-motive force momentarily reducing the flow of increased current and preventing its passage during the short interval during which the last contact remains closed after the others have been opened.

In the drawings I have shown an ordinary self-inductive coil as the best means for impeding the sudden shunting of the current from one contact to another. In certain cases other devices accomplishing the same function may be used.

In Figure 1 a knife switch is shown in which the moving member or blade K is pivoted at *a* to a post P connected to one side of the circuit F′. The blade K engages when closed a number of stationary contacts A, B, C, and D which are connected in multiple to the other side of the circuit F, and are so arranged that when the blade is lifted the circuit would be simultaneously broken at the different contacts were it not for unavoidable errors of construction which make an absolutely simultaneous break difficult of attainment and not to be relied upon. The contacts A, B, C and D are connected together into a common line F by coils E, E′, E^2, E^3, which are wound upon iron cores and have a certain self-induction depending upon the current which is to be opposed. Now assuming the switch closed, a fraction of the entire line current will pass through each of the contacts, and the different self-inductive coils. If the switch be suddenly opened and the circuit at one or more contacts be broken later than at the others, the self-inductive effect of the coils E, E′, E^2, E^3, will nevertheless preserve substantially that value of current through each of the contacts which was previously flowing through it, and thereby sudden concentra-

tion of the energy at one or another of the contacts is avoided.

In Fig. 2 a modification of the invention is shown in which a pair of contacts A, B are connected respectively to line F through coils E^5, E^6 wound reversely on the same core or around the same axis so as to normally exert a counter magnetizing effect upon one another and thereby not impede the normal flow of current when the circuit is closed through the other contact K connected to line F'. Should, however, in opening the switch contact A or B leave K slightly before the other, an inductive effect due to an attempted shifting of the current to the contact remaining closed and through the corresponding reactive coil will maintain the proper distribution of current as already described. There will be no magnetism developed by the coils E^5, E^6 when there is an equal division of current through them, but the moment a shifting tends to take place such that the coil E^6, for example, receives the heavier flow it magnetizes the core which acts independently to produce an electro-motive force in the adjacent coil tending to force the current to continue its original direction and allowing opening of the switch without either contact carrying an undue fraction of the current. The coils E^5 and E^6 may be wound upon a magnetic core of the open or closed magnetic circuit type, Fig. 5 differing from Fig. 2 in showing a ring core.

In Fig. 3 a slightly different form of switch apparatus is illustrated in which the contacts are designed to be opened and closed successively rather than simultaneously, and the reactive effect in each of the multiple paths is graduated correspondingly. The switch arm K carries contacts A', B', C', D' and E^4 adapted to engage the other line contacts shown, and there is a clear connection between the contacts A, A' without any intermediate coils, which contacts are the first opened and the last to be closed. The remaining contacts are also opened and closed in succession, one after another, and in circuit with them respectively are reactive coils E, E', E^2, E^3 constructed to give a graduated self-inductive effect, the coil E being of greater length and of greater self-induction than E' and the others arranged in like progression. In this way an increasing self-induction will be interposed in the paths remaining closed longest, and the circuit will be broken gradually at each of the contacts without any undue rush of current to any one as is the case with the other devices previously described.

Fig. 4 is a diagram of a double-pole switch making use of the invention. As indicated by the arrows the current enters at F and divides between the two coils shown reversely wound on core I. Each of these divisions is again redivided through similar coils wound on the cores J and L and lead eventually to a row of multiple contacts A, B, C and D. The other member of the switch is shown at S and carries corresponding contacts A', B', C' and D' connected to the other side of the circuit M. The return circuit entering at N and leaving the switch at R is a counterpart of that described. In this last extension of the invention each pair of contacts as A—B or C—D are connected together through two reversely wound coils, and the pairs themselves are similarly connected through the coils on the core I. The inductions in the various coils will, when the switch is thrown with moderate quickness insure a fairly uniform division of current at the various contacts so that the proper amount only is ruptured at each.

What I claim as new and desire to secure by Letters Patent is.

1. The combination of a multiple contact circuit breaker with self-inductive coils as described, arranged to preserve a proper distribution of the current between the different paths provided for it.

2. The combination of a multiple contact circuit breaker with means for impeding or retarding the sudden rush of increased volume of current through the contact or contacts which may be opened last.

3. The combination of a multiple circuit breaker with generators of electro-motive force acting upon a sudden increase of current through any one path to retard such increased flow and maintain the normal distribution of current, as described.

4. The combination of a circuit breaker having multiple contacts, with conducting paths of considerable self-induction leading to such contacts respectively and acting to preserve the proper distribution of current flowing therethrough when the circuit is opened.

5. The combination of a circuit breaker affording multiple paths for the current, with counter magnetizing or reversely wound self-induction coils in the respective paths so that the self-inductive effect is developed only when the normal distribution of current between the different paths is disturbed, as set forth.

6. The combination of a circuit breaker affording multiple paths for the current, which paths are divided into pairs, counter magnetizing or reversely wound reactive coils normally balancing the self-inductive effect in each such path, and similar reactive coils through which different pairs are connected together, having a like normal counter magnetizing effect, as set forth.

7. An electric switch having multiple contacts connected together through self-inductive coils or devices impeding the instantaneous shifting of the current from one to another of such contacts.

In testimony whereof I have hereto set my hand this 25th day of October, 1892.

ELIHU THOMSON.

Witnesses:
JOHN W. GIBBONEY,
BENJAMIN B. HULL.