Dec. 4, 1934. C. G. KOPPITZ 1,982,875

ALTERNATING CURRENT TRANSMISSION SYSTEM

Filed Aug. 9, 1933

Fig. 1.

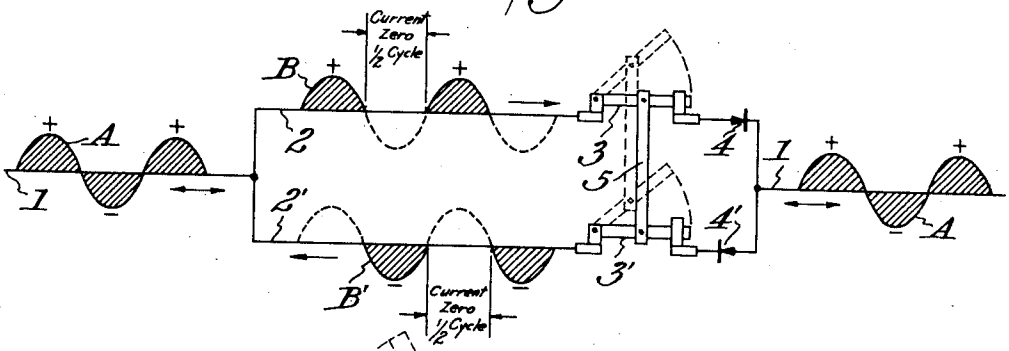
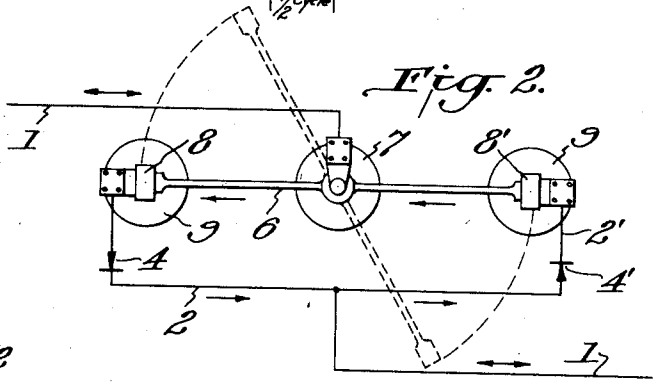


Fig. 2.



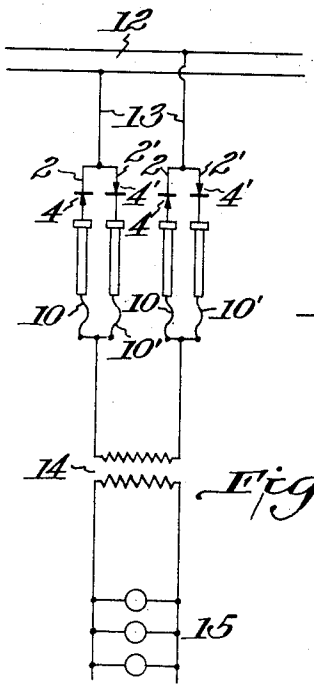
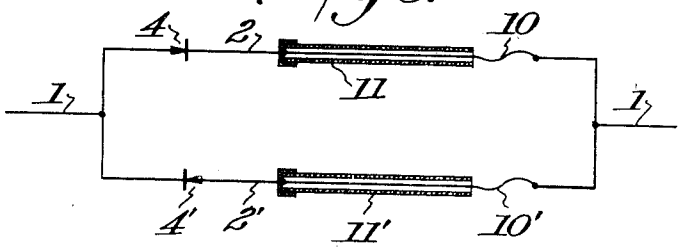


Fig. 4.

Fig. 3.



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ALTERNATING CURRENT TRANSMISSION SYSTEM

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5 Claims. (Cl. 175—294)

This invention relates to alternating current transmission systems and particularly to methods of and apparatus for the interruption of current flow in such systems or circuits.

Although current flow in an alternating current circuit falls to zero twice in each cycle and thereby creates a condition favorable for circuit interruption, the exceedingly short period of approximately zero current flow is insufficient to effect such cooling of the arc stream as will destroy this path of low break-down value and the reversed voltage will normally build up at such a rate that current flow will be established for several succeeding half cycles, particularly in the case of heavy currents at elevated voltages. Mechanisms have been designed for cooling the arc path and for accelerating the separation of switch or fuse sections, but such mechanisms are, in general, comparatively expensive.

Objects of the invention are to provide novel methods and relatively simple arrangements for facilitating the interruption of current flow in alternating current circuits. An object is to provide a method of facilitating the interruption of current flow in an alternating current circuit by increasing the period of approximately zero current flow in the portions of the line at which the circuit is opened. More particularly, objects of the invention are to provide methods of and apparatus for interrupting current flow in alternating current circuits, which methods and apparatus are characterized by the use of two parallel paths for unidirectional current in a section of the circuit, the circuit being opened in one or preferably both of said paths.

These and other objects and advantages of the invention will be apparent from the following specification when taken with the accompanying drawing, in which:

Fig. 1 is a schematic view illustrative of the method contemplated and of apparatus appropriate for a carrying out of the invention;

Fig. 2 is a somewhat diagrammatic plan view of an air break switch embodying the invention; and

Figs. 3 and 4 are diagrammatic views of fuse systems embodying the invention.

As shown schematically in Fig. 1, a single line conductor 1 is divided, at the section where current flow is to be interrupted, into two parallel paths 2, 2' which include an interrupter 3, 3' and rectifier 4, 4', respectively. The rectifiers are of any convenient or desired type and, as indicated diagrammatically, are oppositely arranged in the parallel paths 2, 2' to restrict current flow in the separate paths to alternate half cycles. As indicated by the current curves A which are superposed upon the main line sections 1, the normal alternating current flow takes place in the main circuit but, as indicated by the broken curves B, B', only a pulsating unidirectional current flows in each branch 2, 2', respectively, of the current interruption system. The interrupters 3 will be, in the case of switch elements, connected for simultaneous operation by a switch member 5.

When the switches 3 are opened, one will immediately draw an arc which has a maximum duration of one half cycle. If the rate of separation of the contacts is great enough, the other switch will have opened so far during that first half cycle that the reversed voltage which builds up across the other switch gap during the succeeding half cycle will not be sufficient to establish conduction across the cold gap of that switch; and current flow will therefore be interrupted in not more than one half cycle. Conduction cannot be established across the heated path along which the arc was drawn since the rectifier prevents a voltage rise across that gap during the succeeding half cycle. If the speed of contact separation is slow with respect to the rate of voltage rise following the instant of zero current flow in the main line, arcing will be established in the other path during the succeeding half cycle but the ionized path of the first parallel circuit is cooled down for a full half cycle before a voltage again tends to build up across that path. This cooling of the ionized path after each half cycle of arcing speedily results in a rupture of current flow in one path, and consequently in the main circuit.

Another advantage in the case of arcing which persists over a plurality of half cycles is the reduction of arc energy in each of the two arcs to one half of the usual amount, which materially facilitates de-ionization of the arc streams.

As shown in Fig. 2, a known type of double blade switch may be employed in an air break switch embodying the invention. The switch includes a blade 6 mounted on a rotary insulator 7 for cooperation with contacts 8, 8' on stationary insulator columns 9. One side of the alternating current line 1 is connected to the switch blade, and the opposite side is connected to the contacts 8, 8' through the parallel leads 2, 2' and the oppositely arranged rectifiers 4, 4', respectively.

As shown in Fig. 3, the current interrupters may be fuses 10, 10' in the respective paths 2, 2' which include rectifiers 4, 4'. The fuses may be of any desired or appropriate type and are shown, for

purposes of illustration, as including expulsion tubes 11, 11' in which the links 10, 10' are mounted. Fuses of this type are satisfactory in a low cost removal of fault system where delay in refusing is permissible but it is to be understood that automatic refusing systems may be employed.

A conventional arrangement of a load circuit is shown in Fig. 4, the main lines 12 being connected by leads 13 to the primary of a step-down transformer 14 which has a secondary across which the load circuit 15 is connected. Each lead 13 is split into the parallel branches 2, 2' which include rectifiers 4, 4' and fuse links 10, 10', respectively.

When fuses are employed to interrupt current flow, an overload will result in a blowing of a fuse in one of the paths in which current is flowing at that instant and, in the next half cycle the other set of fuses is called upon to carry the heavy current flow, thus resulting in a blowing of one or both of the fuses which carry current during that half cycle. The relatively long interval of one half cycle after a particular fuse blows facilitates the prompt interruption of current flow.

It will be understood that the invention is not restricted to any particular type of circuit interrupter but may be applied with equal facility to the interruption of normal or abnormal flow of alternating current power in order to perform normal switching operations or to relieve the system by disconnecting faulty sections, to fusing systems and to lightning arresters or surge protectors.

I claim:

1. An alternating current circuit including a series section comprising two parallel paths, oppositely arranged rectifier systems in said paths for restricting the current flow in said paths to half cycles of opposite polarity, and means in each of said paths for interrupting current flow therein.

2. An alternating current circuit as claimed in claim 1, wherein said means comprises a switch in each path, and means for simultaneously actuating said switches.

3. An alternating current circuit as claimed in claim 1, wherein said means comprises a fuse in each path.

4. An alternating current circuit comprising a pair of conducting lines between a current source and a load circuit, a pair of paths in each of said lines and including oppositely arranged rectifier systems, whereby current flow in each of said paths is restricted to pulsating unidirectional current, and switch means for opening each of said paths.

5. An alternating current circuit as claimed in claim 4, wherein a fuse is included as a series element in each of said paths.

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