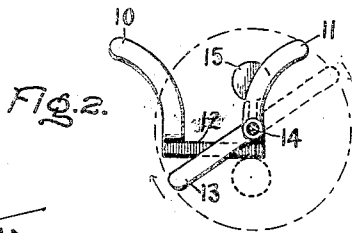


933,826.

3 SHEETS—SHEET 1.



Irving E. Stearns
J. Ellis Glen

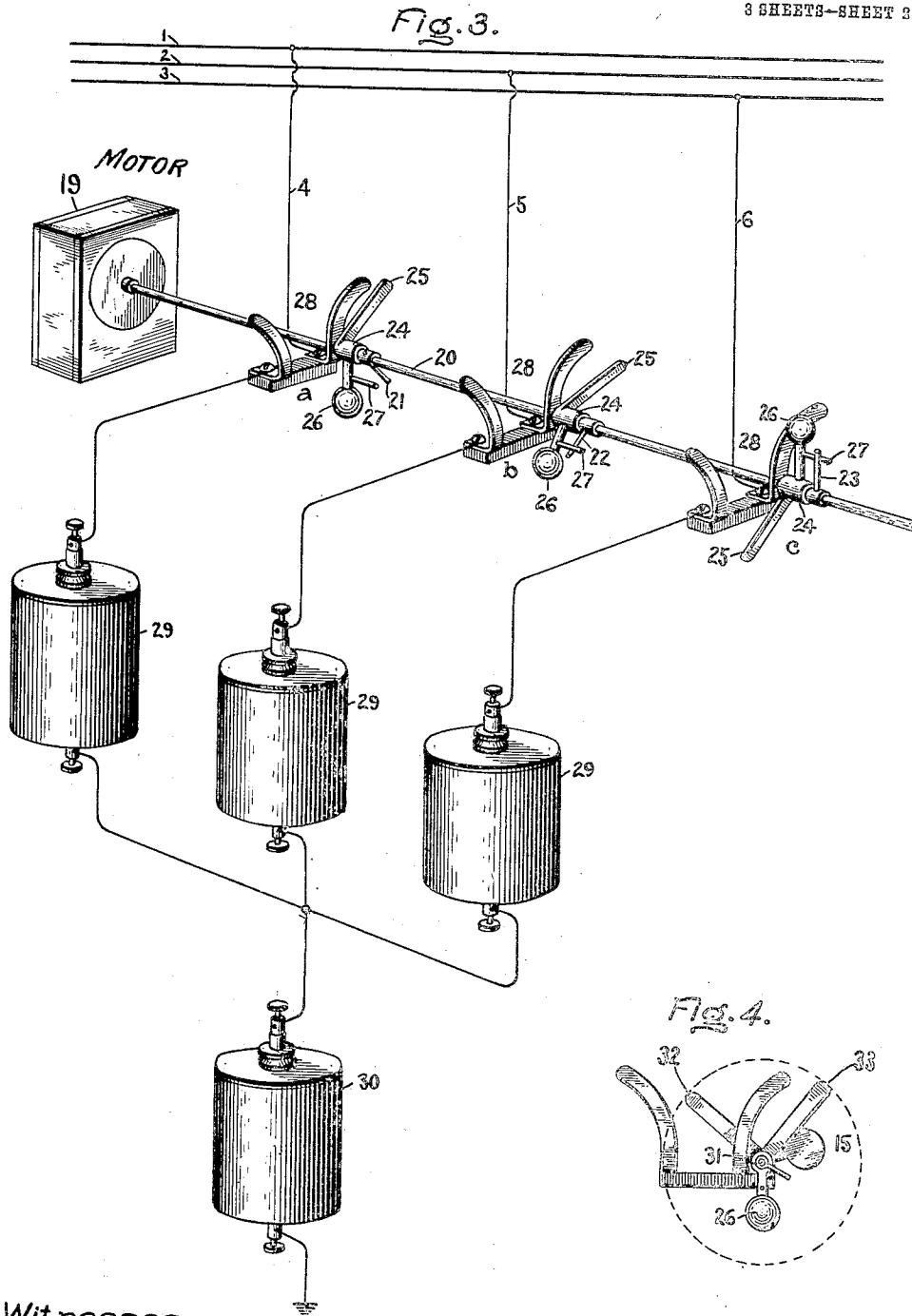
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E. E. F. CREIGHTON.
 INTERMITTENT LINE SWITCH.
 APPLICATION FILED OCT. 31, 1907.

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Patented Sept. 14, 1909.

3 SHEETS—SHEET 2.



Witnesses:
 Irving E. Steers
 J. Ellis Allen.

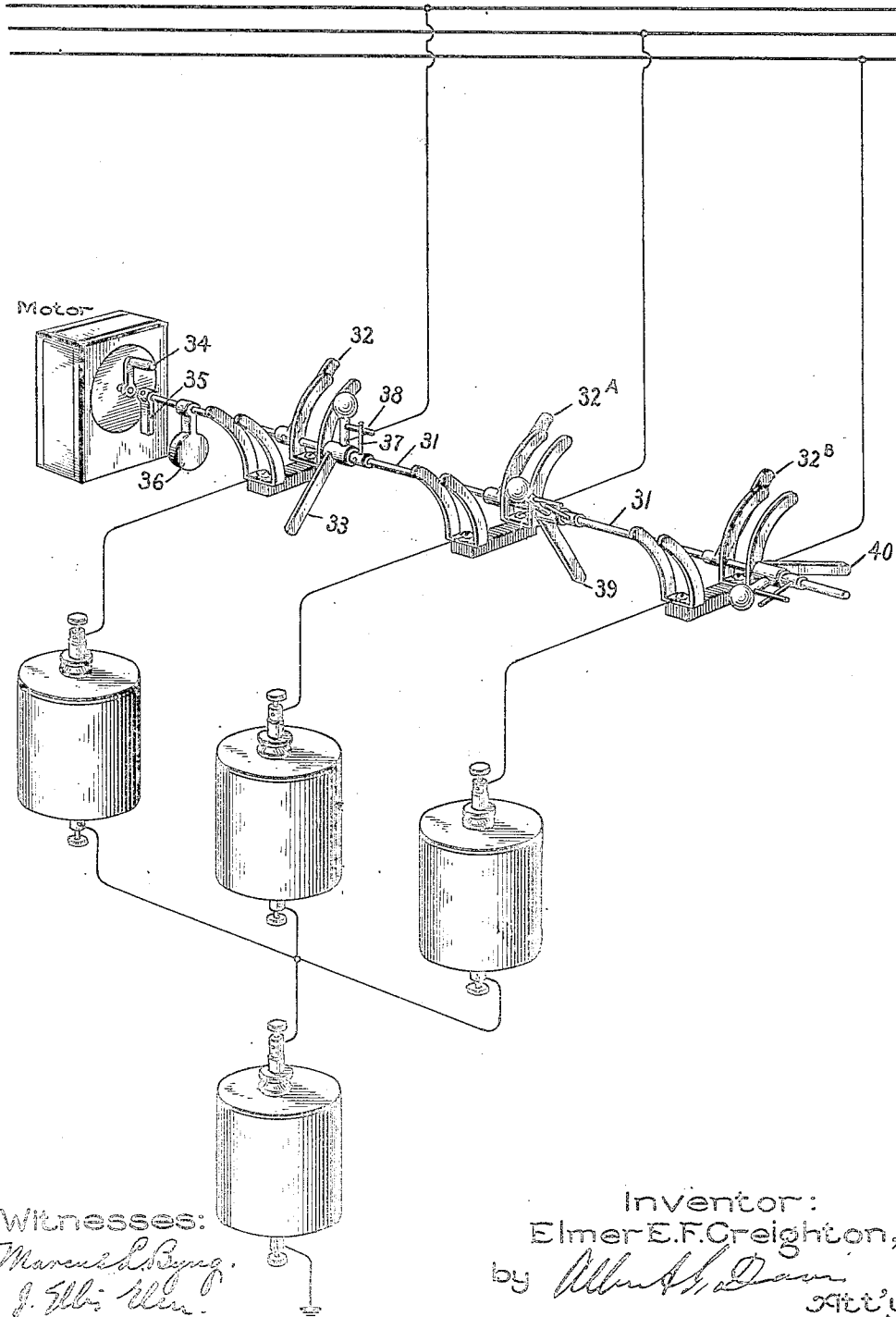
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Fig. 5.



UNITED STATES PATENT OFFICE.

ELMER E. F. CREIGHTON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

INTERMITTENT LINE-SWITCH.

933,826.

Specification of Letters Patent. Patented Sept. 14, 1909.

Application filed October 31, 1907. Serial No. 339,999.

To all whom it may concern:

Be it known that I, ELMER E. F. CREIGHTON, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Intermittent Line-Switches, of which the following is a specification.

This invention relates to lightning arresters, by which is now meant all devices which protect a transmission line from the effect of direct strokes of lightning, static charges, abnormal frequencies or potential due to surge effects or resonance, and the like.

A type of lightning arrester which I have developed is disclosed in a prior application of mine and consists of plates of aluminum immersed in a suitable electrolyte. When an electric current passes through a cell of this kind it forms on the electrodes a thin film of aluminum oxid which offers a high resistance to the current, so long as the circuit is closed. I have discovered that if the circuit remains open for any length of time, the film deteriorates so that it does not immediately resist current flow when the circuit is again closed, but requires a measurable time in which to re-form. I find that the deterioration takes place very slowly, extending over a number of hours, while the re-formation can be effected in a fraction of a second,—a half-cycle of alternating current, in fact if the film has not deteriorated too far. These aluminum cell arresters are usually installed with a spark-gap in series therewith, to prevent undue leakage of current. This means that the film is liable to deterioration under normal conditions of service.

The object of the present invention is to insure the closing of the circuit and the consequent re-forming of the resistant film at predetermined intervals of time. I accomplish this by means of a switch which closes momentarily, intermittently and automatically without requiring special attention from the station attendant. The switch is preferably an arm or blade arranged adjacent to the spark-gap and actuated at regular intervals by a clock-work or other motor, so as to bridge said gap momentarily. Where a plurality of aluminum cell arresters is in use, connected between the conductors of a multi-phase transmission line, the several switches may be grouped for ac-

tuation by one motor. In case the motor fails to work, the switch can be operated by hand. In fact, the motor may be discarded and the switch installed as a hand-switch, if desired.

In the accompanying drawing, Figure 1 is a diagrammatic perspective view of an installation embodying my invention; Fig. 2 is a detail showing its mode of operation; Fig. 3 illustrates a modification; and Figs. 4 and 5 show the two systems combined.

The transmission line selected for illustration is a three-phase line, whose conductors 1, 2, 3 are severally connected by legs 4, 5, 6 with the three aluminum cell lightning arresters 7, 8, 9, the latter being shown in section. Interposed in each leg is a spark-gap, consisting preferably of horns 10, 11 mounted on a block 12 of insulation. Pivoted adjacent to each gap, and preferably on one of the horns, is a switch-blade 13 adapted to be turned into contact with the other horn and thus bridge the gap. In order to operate all the switches simultaneously, the blades are all mounted at the same angle on a common shaft 14, of wood or other insulating material, whereby a rotation of the shaft will close or open all the gaps at once. In order to hold the switches normally open, I secure to the shaft a counterweight 15, which hangs normally in the position shown in Fig. 1 and keeps the switch-blades away from the gaps. The switches may be operated by hand, if desired, by simply turning the counterweight clockwise to the position shown in Fig. 2, and then letting it drop through the remainder of the revolution. When the weight is uppermost, the switch-blades will have nearly closed the gaps. Upon letting the weight drop, it causes the blades to sweep up over the opposite horns, thus momentarily closing the gaps, and permitting a rush of current through the cells for a fraction of a second: long enough to insure a re-forming of the resistant films in said cells.

If it is desired to make the switch operate automatically and intermittently, a motor 16, is located adjacent to one end of the shaft, with a rotating arbor in line with said shaft. Said arbor rotates clockwise once in a given number of hours, say twelve. The arbor and the shaft carry cooperating abutments, such as a dog 17 on the arbor

and a rock-arm 18 on the shaft. The rock-arm normally hangs downward and the dog comes in contact with it at the lowest point in its revolution, from which point the dog carries up the rock-arm and the counterweight until they are at the highest point, as shown in Fig. 2. When the weight becomes overbalanced and drops, it carries the rock-arm away from the dog, and the switch-blades again assume the position shown in Fig. 1 until another half revolution of the dog causes it to overtake the rock-arm.

The motor may be an ordinary spring clock-movement, or an electric motor; or a combination of both, the clock being used to close periodically the circuit of an electric motor which rotates the arbor carrying the dog. Or an electrically-wound self-winding clock may be used, which would require almost no attention from the station attendant: the whole object of the automatic feature being to insure a periodic closing of the spark-gaps for a brief instant of time.

Fig. 1 shows the arrangement for a circuit in which each conductor of the line is connected directly to ground through its own lightning arrester. In this system, if one of the conductors becomes grounded, the full line potential is thrown on the arrester in one ground leg. Either this arrester must be designed with enough plates to operate under this abnormal condition, or else a fourth leg must be introduced between the lower end of each leg shown in Fig. 1 and the ground. This method of connection is advisable from the standpoint of economy. Fig. 3 shows such an arrangement. It will be seen, however, that if the switches on the horn gaps are all closed simultaneously, as provided for in Fig. 1, the ground leg will not be thrown into operation, because it is connected in at the neutral point, which remains at zero potential. But if, on the other hand, the horn gap switches are closed only one at a time, the line connected with the switch that is closed will discharge through its phase leg to the ground leg and in so doing will reestablish the film on the ground leg-arrester. If the capacity current of the system is at least equal to the leakage current through the arrester, then this closing of one switch after another will be sufficient to reestablish the film in all four legs of the arrester up to that corresponding to the impressed voltage between line and ground.

Fig. 3 shows a switch for closing the horn gaps in succession. The driving mechanism 19 rotates the shaft 20 continuously. Said shaft is of insulating material and carries three dogs 21, 22, 23 set at angular intervals of 120 degrees. Adjacent to each dog is a sleeve 24 loosely mounted on the shaft, and carrying a light switch-blade 25, and a counterweight 26 set to hold said blade normally in an open position, as shown at *a*. An arm

27 on the counterweight or blade extends into the path of the dog so that the latter will strike said arm and rotate said sleeve during one-half of a revolution, as shown at *b*. When the dog arrives at the upper position, as shown at *c*, the counterweight will fall over, and sweep the blade quickly across the horn gap 28, thus closing the circuit for a fraction of a second only, but long enough to reestablish the film on the arrester 29 in circuit with said gap; and, if the capacity current is large enough, the film on the ground leg arrester 30 will also be reestablished.

It is evident that the two switches shown in Figs. 1 and 3 can both be used in the same circuit, if desired; as indicated in Fig. 4: the two shafts being combined in a single shaft 31 on which are mounted fixed blades, as blade 32, corresponding to those of Fig. 1, and also loosely mounted blades, as blade 33, corresponding to those of Fig. 3.

Fig. 5 illustrates in perspective the systems shown in Fig. 1 and that shown in Fig. 3 combined into one system. The revolution of the motor shaft causes the dog 34 to pick up the rock arm 35, which is rigidly attached to the shaft 31, and carries the arm upward, causing the shaft 31 to revolve. Its revolution causes the dog 37 to engage with its corresponding arm 38, and thus trip the blade 33, which sweeps across the gap. A further revolution of the shaft in like manner actuates the blades 39 and 40 in succession. When then these three blades have consecutively bridged their corresponding gaps, the weight 36 has moved through an angle of 180° when it falls downward through the rest of the circle by its own weight quickly sweeping the blades 32, 32^A, 32^B across their corresponding gaps simultaneously, and, thereby establishing momentarily a circuit through the cells from line to line.

If the capacity current of one leg to ground is not equal to the leakage current of the arrester, each cell, including the ground leg cell, will have its film only partly reestablished during the consecutive bridging of the spark gaps; but when the blades 32, 32^A, 32^B bridge all the gaps simultaneously, the cells in the phase legs will have their films fully reestablished, as at that instant dynamic current flows through the cells, thus building up the film. The complete reestablishment of the film on these phase-leg cells will be sufficient for all practical purposes, even if the ground-leg cell has its film only partially reestablished.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The combination with an electrolytic lightning arrester, of a spark-gap in series therewith, and a switch for closing said spark-gap at will.

2. The combination with a plurality of

aluminum cell lightning arresters, of spark-gaps in series therewith, and means for bridging said gaps at will.

3. The combination with a plurality of aluminum cell lightning arresters, of horn spark-gaps in series therewith, switch-blades adapted to close said gaps, and a common means for periodically actuating all of said blades.
4. The combination with a plurality of aluminum cell lightning arresters, of horn spark-gaps in series therewith, switch-blades adapted to close said gaps, a common means for actuating all of said blades, and means for giving said blades a quick momentary closure.
5. The combination with a plurality of aluminum cell lightning arresters, of horn spark-gaps in series therewith, switch-blades adapted to close said gaps, a shaft for operating all of said blades, and one or more counterweights mounted on said shaft.
6. The combination with a plurality of aluminum cell lightning arresters, of spark-gaps in series therewith, and means for automatically and periodically closing said gaps.
7. The combination with a plurality of aluminum cell lightning arresters, of spark-gaps in series therewith, switch-blades adapted to close said gaps, and means for simultaneously and periodically actuating said blades.
8. The combination with a plurality of aluminum cell lightning arresters, of spark-gaps in series therewith, switch-blades adapted to close said gaps, a shaft common to said blades, and means for periodically actuating said shaft.
9. The combination with a plurality of aluminum cell lightning arresters, of spark-gaps in series therewith, switch-blades adapted to close said gaps, a shaft common

to said blades, one or more counterweights adapted to give said blades a sudden impulse to cause a momentary closing thereof, and a motor arranged to rotate said shaft to a point where the weight can act.

10. The combination with a plurality of aluminum cell lightning arresters, of spark-gaps in series therewith, switch-blades adapted to close said gaps, a shaft common to all of said blades, a rock-arm on said shaft, a motor having an arbor carrying a dog adapted to engage with said rock-arm, and a counterweight to give a quick actuation of said shaft to close and open the switches momentarily.

11. The combination of an electrolytic lightning arrester and means for reestablishing periodically the insulating film upon the electrodes of said arrester.

12. The combination of an electrolytic lightning arrester, and means for automatically reestablishing the insulating film upon the electrodes of said arrester.

13. The combination of an electrolytic lightning arrester connected to a line in series with a spark gap and means for periodically sending a momentary current through said arrester.

14. The combination with the line conductors of a transmission system of electrolytic condensers connected respectively in series with a spark gap to said conductors and to a common neutral, a ground connection from said neutral including an electrolytic condenser, and means for closing said gaps first consecutively and then simultaneously.

In witness whereof, I have hereunto set my hand this 30th day of October, 1907.

ELMER E. F. CREIGHTON.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.