(No Model.)

T. A. EDISON.

SYSTEM OF ELECTRIC LIGHTING.

No. 328,573. Patented Oct. 20, 1885.

Fig 1.

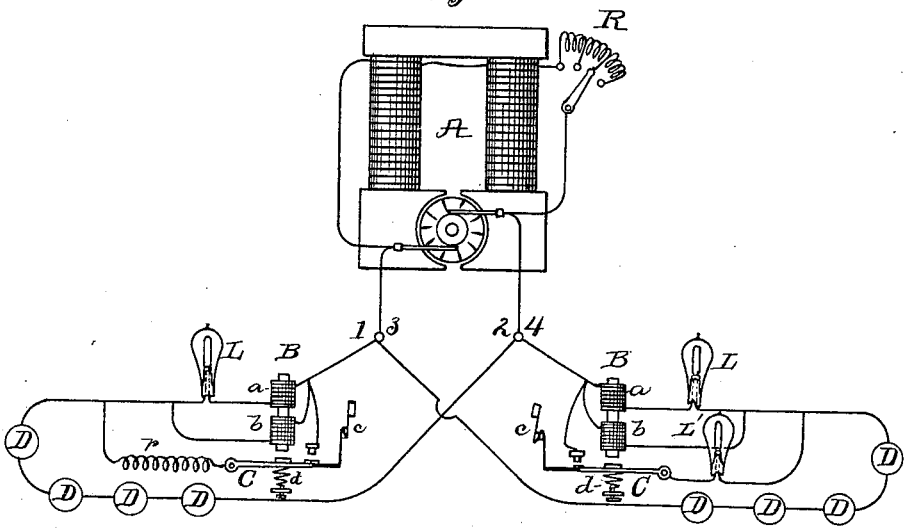


Fig 2.

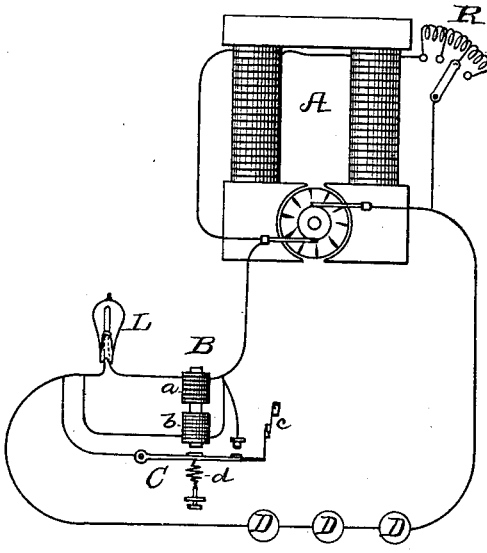


Fig 4.

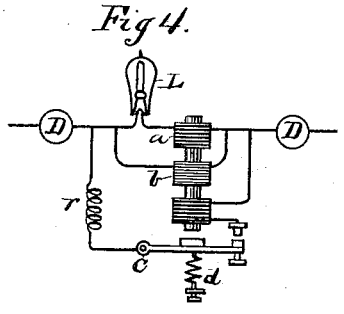
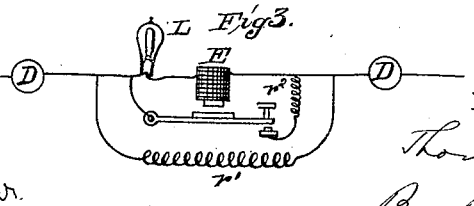


Fig 3.



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THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY.

SYSTEM OF ELECTRIC LIGHTING.

SPECIFICATION forming part of Letters Patent No. 328,573, dated October 20, 1885.

Application filed October 2, 1884. Serial No. 144,544. (No model.)

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a certain new and useful Improvement in Systems of Electric Lighting, (Case No. 630,) of which the following is a specification.

The object I have in view is to utilize incandescing electric lamps upon high-tension circuits for street-lighting, or for other purposes where great economy in conductors is desirable and a high-tension current is not objectionable.

My invention relates, first, to the arrangement of the incandescing electric lamps in series in a high-tension circuit, with peculiar automatic cut-out mechanisms for the lamps, which maintain the continuity of the circuit when the carbon conductor of a lamp breaks; and, second, to the arrangement for a system of several circuits, all the circuits being taken from a common source of supply, and means being provided for maintaining constant the relative resistances of the several circuits.

With regard to the first part of my invention, I employ at each lamp of the series in the circuit an electro-magnetic cut-out with a localizing shunt-circuit around the lamp, which is constantly closed to prevent the action of all the cut-outs when one acts. I may use a differential cut-out, the localizing shunt forming the high-resistance coils of the magnet. The differential cut-out is a differentially-wound electro-magnet or solenoid, one set of coils being directly in the line in series with the lamps and the other set of coils being in a constantly-closed shunt (the localizing circuit) around the particular lamp the mechanism is designed to cut out. This magnet or solenoid acts upon an armature or core, closing, when the lamp-carbon breaks, a shunt around the broken lamp. The shunt is maintained in any of the known ways by a mechanical lock—such as a spring-catch or trigger—or by an electrical lock, throwing into circuit coarse-wire coils, which maintain the magnetism and hold the shunt closed. In these general respects the differential automatic cut-out for an incandescing electric lamp does not differ, except in its application, from similar mechanisms used in connection with arc-lamps; but an automatic cut-out for incandescing electric lamps depending for its proper operation upon other conditions than the similar mechanism for arc-lamps, the construction and adjustment of the devices are necessarily different. In an arc-light cut-out the cut-out may operate when the arc becomes abnormally long, and while there is still current in both sets of coils of the differential magnet or solenoid; but in my cut-out for incandescing electric lamps the operation is designed to take place only when the lamp-carbon is broken and there is a total cessation of current in one set of the differential coils. The incandescing carbon conductor of the lamp changes its resistance rapidly under changes in temperature, the lowering of the temperature producing an increase in its resistance. This may occur at any time by the flickering of the lamps from any cause—such as the cutting out of a lamp—or the temperature of each lamp may be decreased and the resistance increased when the load is too great for the dynamo or dynamos supplying the current. It is evident, also, that this peculiar property of the incandescing carbon conductors might cause all the cut-outs to act when the dynamo is first started up. To overcome these difficulties I make the retracting-spring of sufficient strength and strain it to the proper point, so that the armature or core will not be moved, except upon a complete cessation of the current through that set of coils of the differential magnet or solenoid which is in the line. The shunt-circuit which is closed by this cut-out mechanism may include another lamp, or a resistance in other form equal to the broken lamp, or where the current is regulated at the source of supply this shunt will have practically no resistance at all.

The localizing shunt-circuit, which is constantly closed around each lamp, instead of including one set of coils of the differential magnet, may be a simple resistance. The cut-out will then be a magnet whose armature-lever closes the cut-out shunt at its back point. The parts will be constructed and adjusted so that the magnet will attract the armature and keep the shunt open when there is any current in the magnet, and will not permit the shunt to close or remain closed except upon a total cessation of current in the magnet-coils.

In carrying out the second part of my in-

vention I provide a source of electrical supply composed of one or more dynamo-electric machines, the machines (if more than one) being connected to common or omnibus conductors in the station. The machine (or each machine, if more than one is employed) is provided with means, either manual or automatic, for varying the current generated by it. This is preferably an adjustable resistance in the field-magnet circuit of the machine, which is a derived circuit taken from the armature of the machine. From this common source of supply is run two or more lighting-circuits, each containing a number of incandescing electric lamps having cut-out mechanisms. In a system of this character it is essential that the relative resistances of the several circuits taken from the common source of supply should be maintained, so that the current will be properly distributed between the two or more circuits, and each will receive the right number of ampères of current to maintain the lamps at normal incandescence. This may be done in several ways, all of which come within the scope of the broad invention hereinafter claimed. The cut-out for each lamp may be arranged to throw in an equivalent resistance, whether another lamp or not; or the regulation can be performed by throwing resistances into the circuits at the central station. The last way is covered specifically by an application for patent of even date herewith, Serial No. 144,545, and hence is not claimed herein, except as it comes within the scope of the broad invention hereinafter claimed.

The circuits, instead of being simple circuits, may be compensating circuits—a construction which is also covered specifically by an application of even date herewith, Serial No. 144,546.

In the accompanying drawings, forming a part hereof, Figure 1 is a view, principally in diagram and partially developed, illustrating a system embodying my invention; Fig. 2, a similar view of a dynamo-electric machine and a single circuit supplied thereby; Fig. 3, a view of a modified form of cut-out, and Fig. 4 a view of the cut-out showing electrical lock.

A is a dynamo-electric machine, having its field-circuit derived from its armature and including an adjustable resistance, R. This machine supplies incandescing electric lamps L D, arranged in series.

B is a differentially-wound electro-magnet, forming the operating element of the cut-out at each lamp. This magnet has one set of coils, *a*, located in the line in series with all the lamps, while its other set of coils, *b*, is in a shunt constantly closed around the lamp and forming a localizing circuit for the cut-out.

The armature-lever C closes a shunt-circuit around the lamp, and this circuit is held closed by a spring-lock, *c*, Figs. 1 and 2, or by an electrical lock formed by magnet-coils *c'* in the shunt-circuit, Fig. 4. The retracting-spring *d* of the armature-lever is adjusted to produce the effect described. The shunt closed by lever C may have practically no resistance, as in Fig. 2, or it may include a resistance, *r*, equal to a lamp or an extra lamp, L', Fig. 1.

The circles D are intended to represent lamps and cut-outs, one being developed for each circuit.

In Fig. 3 the cut-out is composed of a magnet, E, in series with all the lamps, and a constantly-closed shunt-circuit around the lamp and magnet containing a resistance, *r'*. The magnet E keeps the cut-out shunt open while L is burning, no change in resistance of L, due to changes in temperature, serving to weaken E enough to close the cut-out shunt.

In starting up the plant the cut-out shunts will be opened, provided the resistance *r* or lamp L' of Fig. 1 is used, otherwise a small resistance, r^2, in the cut-out shunt is employed to give magnet E sufficient force to open said cut-out shunt.

In Fig. 1 two circuits, 1 2 and 3 4, are taken from the same machine, and the relative resistances of the circuits are maintained by the operation which takes place at the cut-outs, resistances equal to the lamps cut out or other lamps being thrown into circuit as the lamps break.

What I claim is—

1. The combination, with incandescing electric lamps arranged in series, of automatic cut-out mechanisms for the several separate lamps, (including a localizing constantly-closed shunt around each lamp,) maintaining the continuity of the circuit as the incandescing conductors of the lamps break, substantially as set forth.

2. The combination, with incandescing electric lamps arranged in series, of differentially-wound magnets or solenoids closing shunt-circuits around the lamps as they are broken, one set of coils of each differential magnet or solenoid being in the main circuit and the other set of coils being in a constantly-closed shunt around the lamp, and mechanical or electrical locks for holding the shunts closed, substantially as set forth.

3. The combination, with an incandescing electric lamp, of a magnet in series therewith controlling a cut-out shunt, and constructed and adjusted, substantially as described, to permit the same to be closed only after a total cessation of current in the coils of said magnet, and not being affected by changes in resistance of the incandescing conductor, and a constantly-closed shunt-circuit around said lamp, and magnet for localizing the cut-out, substantially as set forth.

4. The combination, with an incandescing electric lamp, of a differentially-wound magnet or solenoid having one set of coils in series therewith and the other set in a constantly-closed shunt around said lamp and the first set, an armature or core and retractor acting to close a shunt around the lamp, said parts being constructed and adjusted to act only upon a complete cessation of current in the set of coils in series with the lamp, and not to be

affected by changes in resistance of the incandescing conductor, substantially as set forth.

5. The combination, with an incandescing electric lamp, of a differentially-wound magnet or solenoid having one set of coils in series therewith and the other set in a constantly-closed shunt around said lamp and the first set, an armature or core and retractor acting to close a shunt around the lamp, and a mechanical or electrical lock for keeping said shunt closed, the parts being constructed and adjusted to act only upon a complete cessation of current in the set of coils in series with the lamp, and not to be affected by changes in resistance of the incandescing conductor, substantially as set forth.

This specification signed and witnessed this 12th day of September, 1884.

THOS. A. EDISON.

Witnesses:

WM. H. MEADOWCROFT,

PAUL D. DYER.