(No Model.)

O. B. SHALLENBERGER.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 390,990. Patented Oct. 9, 1888.

Fig. 1,

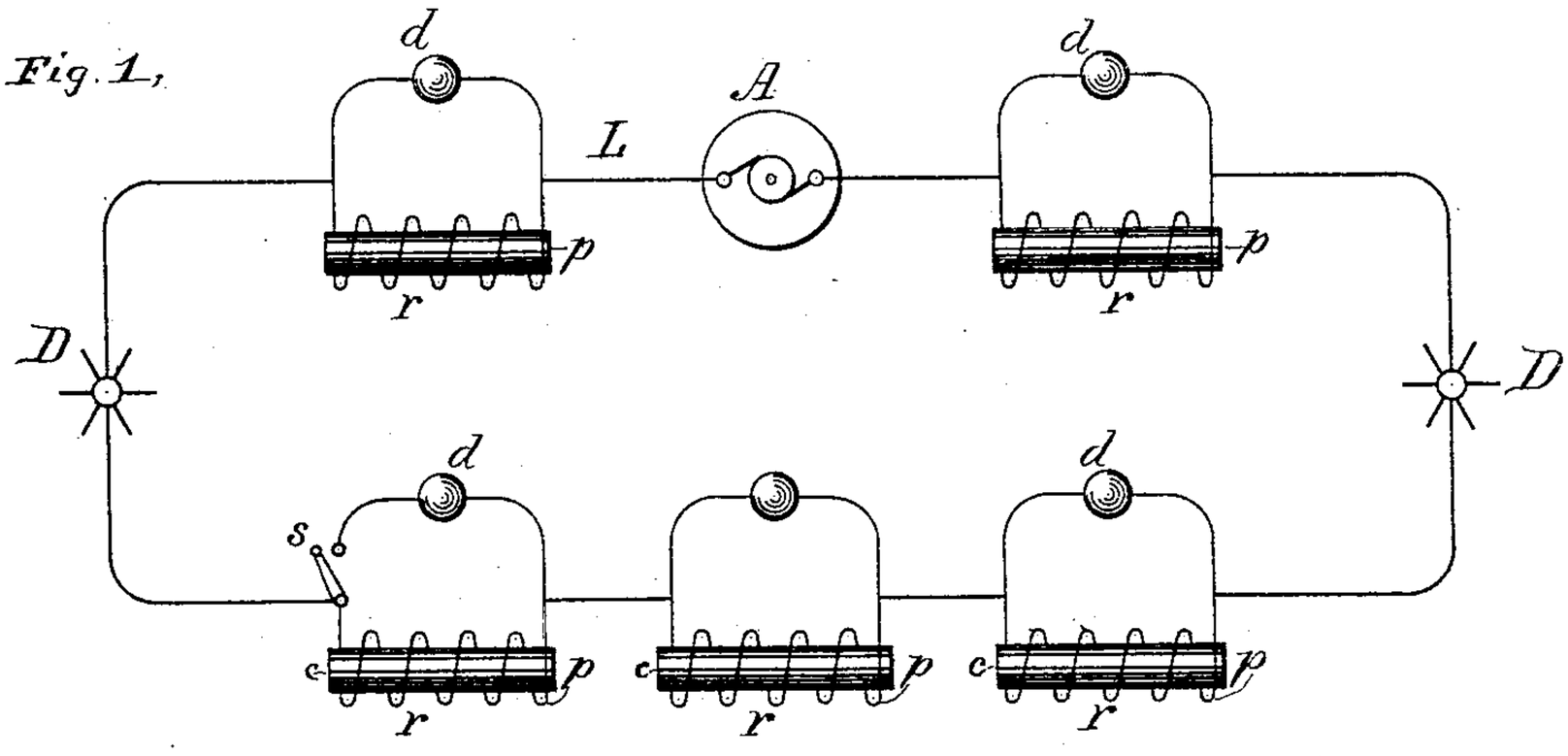
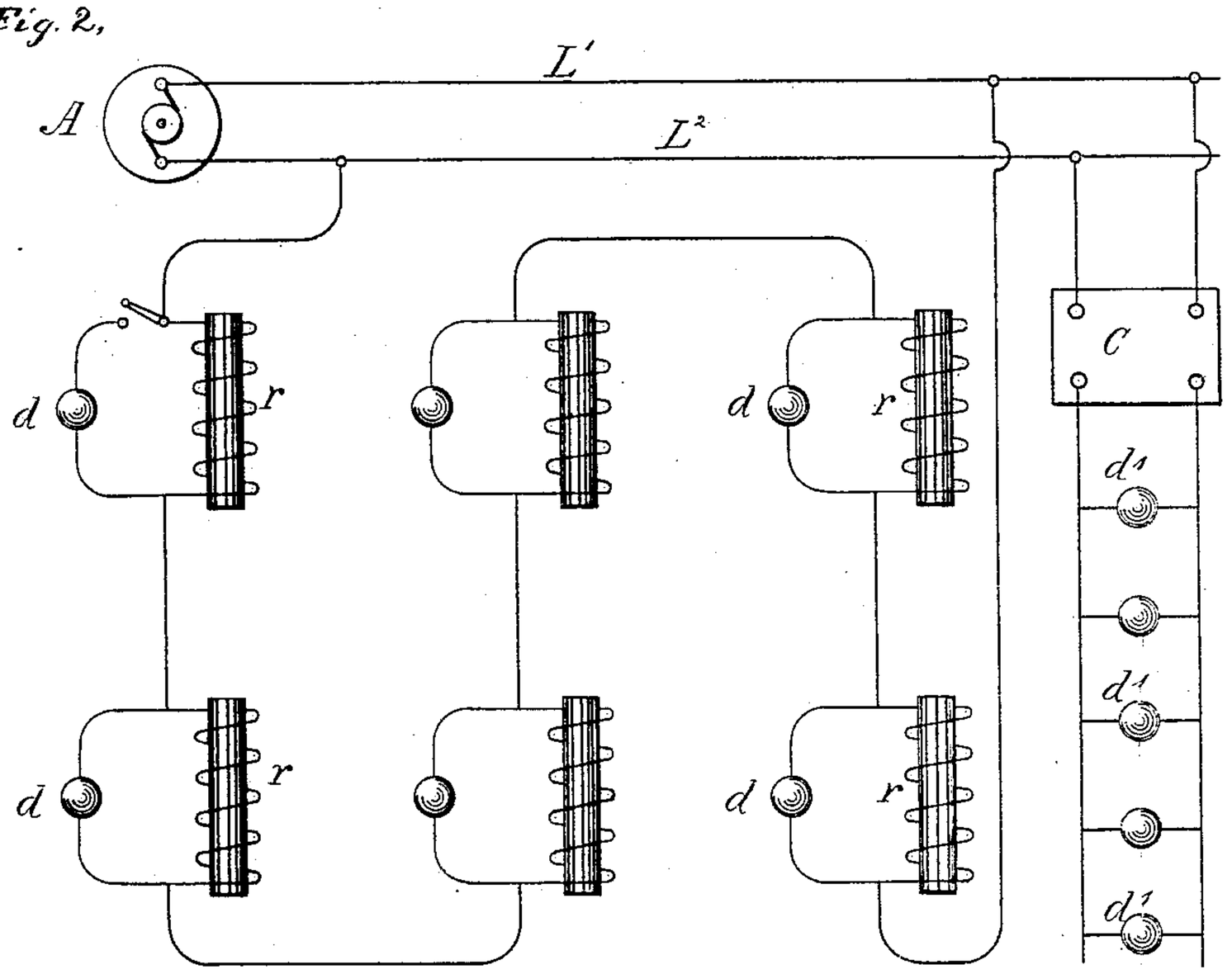


Fig. 2,



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SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 390,990, dated October 9, 1888.

Application filed October 1, 1887. Serial No. 251,197. (No model.) Patented in England May 29, 1888, No. 7,850; in France May 29, 1888, No. 190,872; in Belgium May 29, 1888, No. 81,965, and in Italy May 29, 1888, XXII, 23,537, and XLVI, 258.

To all whom it may concern:

Be it known that I, OLIVER B. SHALLENBERGER, a citizen of the United States, residing in Rochester, in the county of Beaver, in the State of Pennsylvania, have invented certain new and useful Improvements in the System of Electrical Distribution for Street Lighting, of which the following is a specification.

The invention described and claimed in the above-named application has been patented since the date of execution of the application as follows: in Great Britain, No. 7,850, May 29, 1888; in France, No. 190,872, May 29, 1888; in Belgium, No. 81,965, May 29, 1888, and in Italy No. XXII, 23,537, and No. XLVI, 258, May 29, 1888.

The invention relates to the organization of circuits and apparatus for distributing electric currents.

The object of the invention is especially to provide convenient and economical means for operating isolated incandescent electric lamps or other translating devices requiring electric currents of moderate potential, and at the same time to secure the advantages pertaining to the systems of electrical distribution and conversion known as "alternate-current" or "secondary" systems. In operating translating devices by these systems it is customary to transmit currents of very high potential to points within the immediate vicinity of translating devices, and at or near such devices to reduce the potential of the currents as may be required. When, however, but a single translating device is required at any given point, it involves a considerable expense to supply a converter or potential-reducing device for each such translating device; but either such an organization must be adopted or else secondary conductors must be employed for each converter of sufficient length to include several different and more or less distantly-located translating devices. Such conductors are necessarily of greater size than the primary conductors or those conveying the currents of high potential, and therefore a greater expense is involved.

In general terms the invention may be said to consist in connecting a number of translating devices in series with each other, and in connecting in shunt-circuit around each device a suitably-constructed reactive coil, and in thus dispensing with the converters or potential-reducing devices as usually organized. This reactive coil must, however, be of peculiar and special construction in order to serve the purposes of the invention. Its winding and core must be so related to each other and to the translating device that, when the translating device is operating under a normal difference of potential, a counter electro-motive force will be developed which is the equivalent in one aspect of a resistance much greater than that of the translating device—say from fifteen to thirty times as great in the case of an incandescent electric lamp. The relations, however, must still further be such that under any considerable increase in the difference of potential, as may be occasioned, for instance, by the breaking of a lamp-filament, the core attains a point of high magnetic saturation, and a normal amount of current will be allowed to pass through the reactive coil, so that the remainder of the translating devices will receive a full amount of current. The reactive coil must further be so proportioned that it will permit the passage of the increased current without introducing any greater effective resistance into the circuit than that represented by itself and the lamp under normal conditions. This would evidently be impossible if a simple resistance-coil were used, or even a reactive coil of ordinary proportions, for the reason that the lamp-resistance when connected in parallel with the coil is relatively very low, and hence its removal would make the resistance of the portion of the circuit in which it is placed many times greater than the joint resistance of the lamp and coil. The effect of this would be that under a constant electro-motive force applied to the series circuit a large portion of the total difference of potential would be included between the terminals of the reactive coil upon the breaking of the the corresponding lamp, and this would necessarily reduce the light given by the other lamps in circuit. At the same time it would consume a large amount of energy uselessly. In order to overcome this difficulty, it is necessary to so proportion the reactive coil that when

the entire current passes through it, the lamp being out of circuit, such a degree of supersaturation will be attained that the phases of the counter electro-motive force are produced at a time considerably later than the corresponding current-impulses. This results in the restoration to the circuit of a sufficient amount of energy by the coil to maintain the current normal even though a difference of potential apparently greater than the normal exists between the terminals of the coil, and therefore an apparently greater total difference of potential than really exists would be indicated by the addition of the differences of potential found at the terminals of the individual devices. The point of saturation is approached as the ratio of current to the difference of potential begins to increase, or high saturation is the point at which the rise in the effective counter electro-motive force is very small in proportion to that of the applied electro motive force, owing to the lag of the reactive coil.

In the accompanying drawings, Figure 1 is a diagram illustrating the system as applied to a circuit of constant current, and Fig. 2 is a diagram illustrating the application to a circuit of constant electro-motive force.

Referring to Fig. 1, A represents a suitable source of alternating, intermittent, or pulsatory electric currents, and L its circuit. In the circuit there are included in series any convenient and required number of translating devices *d d*—such, for instance, as incandescent electric lamps. Around each lamp there is connected a reactive coil, *r*. This may consist of coils of wire *p*, surrounding cores *c*, of soft iron, the coils and core being disposed in any convenient manner. One of the devices *d* is represented as having its circuit interrupted, as at *s*.

In the circuit L there are also represented devices D D, which may be electric-arc lamps, or other devices requiring constant currents. These, however, are not necessary to the system, but are shown as being applicable. The purpose of the invention, it will be understood, is to provide means for operating a number of translating devices in series and to insure that the interruption or failure of one or more of the devices shall not interfere with the operation of the others. It will be evident that if several devices may be thus connected in series currents of high potential, and consequently wires of small cross-section, may be employed.

It has heretofore been proposed to connect translating devices in series and provide each with a circuit-controller, switch, or fusible connection, which, upon the failure of the translating device, will operate to automatically complete the circuit through another conductor.

It has been proposed to place a group of translating devices in a shunt upon an adjustable reactive coil which serves at all times as a resistance, forcing the primary current to traverse such devices. Such coil was to be adjusted mechanically to compensate for any change in the number of translating devices, and it did not contemplate the cutting of the devices out of circuit without also removing a corresponding amount of the reactive coil, for otherwise the self-induction of the latter would prevent the passage of the normal current.

The invention herein described dispenses with the necessity of all such mechanical controlling devices and provides a constantly-closed path for the current around each translating device, depending for its adjustment upon purely electrical reactions.

It is evident that a simple resistance so placed would prevent the actual interruption of the circuit, but would be impracticable, owing to the fact that if its resistance were high enough to prevent undue waste when the translating device is in operation a large amount of energy would be consumed, when, by the failure of the translating device, the current to supply the remaining devices would be compelled to pass through it alone. In this system a coil having a suitable self-induction is employed instead of a passive resistance, and it therefore requires for its operation an alternating, pulsatory, or periodically-interrupted current.

In carrying out the invention it is necessary to determine suitable proportions for a coil, which, when kept in permanent shunt-circuit with the lamp, shall derive only a small fraction of the current by reason of its high self-induction or counter electro-motive force. The actual resistance of the conductor itself need not be great as compared to that of the translating device—as, for example, for an incandescent lamp of fifty ohms resistance a suitable resistance for the coil is one ohm. Suppose, now, that the circuit of the lamp or other translating device be interrupted while the current is being supplied to other translating devices connected in series. The effect of the passage of the whole current through the coil is primarily to increase the difference of potential at its terminals, and thereby increase the magnetic saturation of the iron core. By suitably proportioning the amount of iron in the core the counter electro-motive force may be prevented from rising in a proportionate degree to the applied electro-motive force and the departure is greater as the difference of potential increases.

It would appear on first consideration that such an increase in potential between the terminals of one of the translating devices would necessitate an increase in the electro-motive force applied to the entire circuit in order to maintain the current constant. Such, however, is not necessarily the case. With a properly-proportioned coil the current is maintained at practically the normal amount without either increasing or decreasing the electro-motive force of the circuit.

In Fig. 2 the invention is illustrated in connection with a constant-potential circuit. The generator A has connected in its circuit L′ L²

an electric converter, C, designed to be operated by currents of constant potential. Translating devices *d' d'* are connected in the secondary circuit of this converter. The translating devices *d d* are connected in series, as before, and they are provided with inductive resistances *r r*, connected in shunt-circuit, as before.

I claim as my invention—

1. The combination, with a circuit supplied by alternating electric currents, of two or more incandescent electric lamps or other translating devices connected in series therein, and reactive coils connected across their respective terminals, the winding of each reactive coil being so related to the mass of iron in its core that upon the interruption of the current through any lamp a normal current is allowed to pass to the other lamps by reason of the consequent high magnetic saturation of the core of the corresponding reactive coil.

2. The combination, with an electric circuit supplied by alternating electric currents, of two or more incandescent lamps or other translating devices connected in series therewith and reactive coils connected across their respective terminals, each lamp or translating device having less resistance than the effective resistance of its reactive coil, and said coil having a core the maguetic qualities or capacity of which is such with reference to the coil that when its lamp is removed from the circuit it will develop under the normal current required for the lamp and yield to the circuit a counter electro-motive force approximately equivalent to the applied electro-motive force which it absorbs and the phases of which are subsequent to those of the applied electro-motive force, whereby the remaining lamps may be maintained at normal candle-power.

In testimony whereof I have hereunto subscribed my name this 1st day of September, A. D. 1887.

OLIVER B. SHALLENBERGER.

Witnesses:

DANL. W. EDGECOMB,

CHARLES A. TERRY.