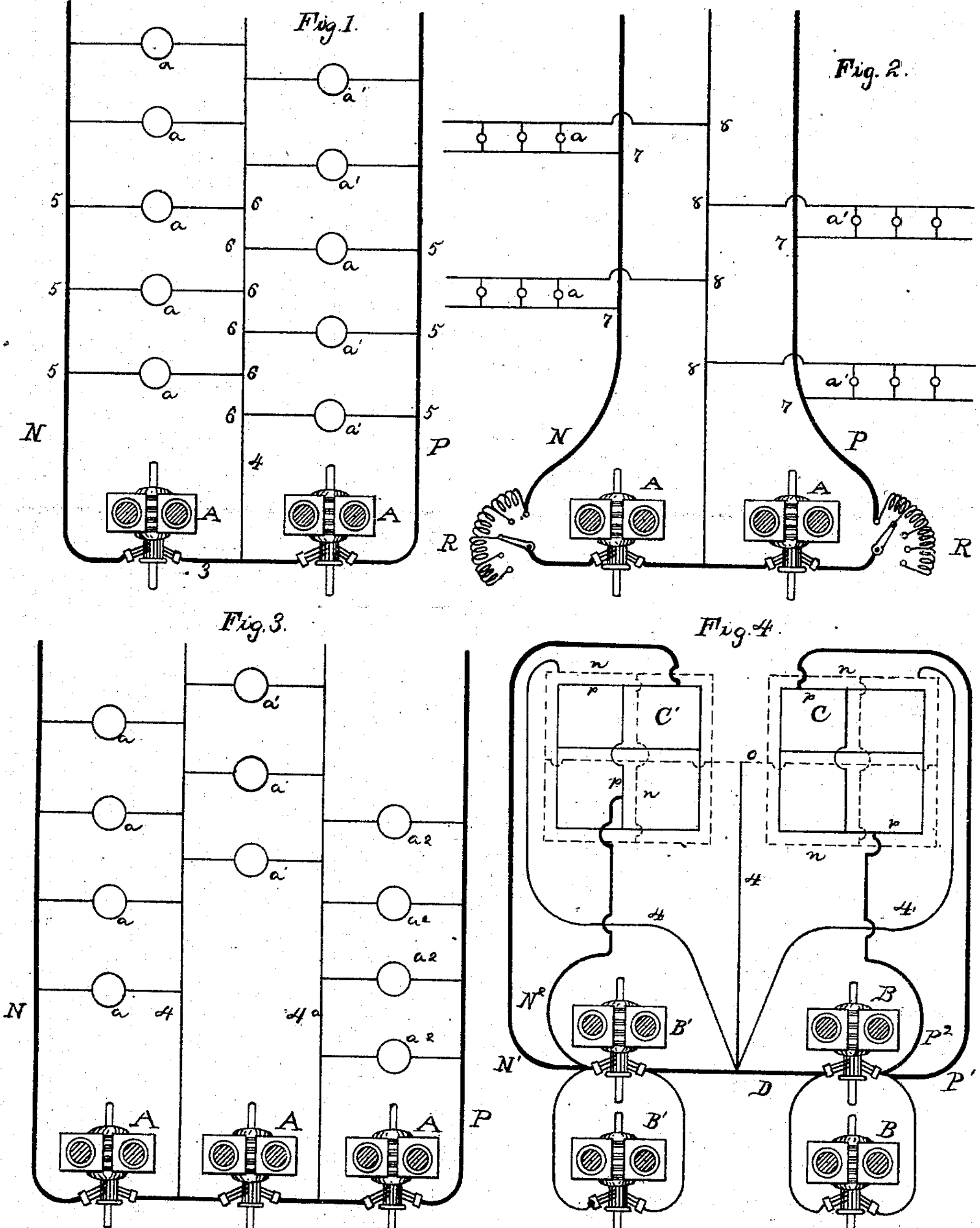
(No Model.) 3 Sheets—Sheet 1.

T. A. EDISON.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 274,290. Patented Mar. 20, 1883.



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(No Model.)

3 Sheets—Sheet 2.

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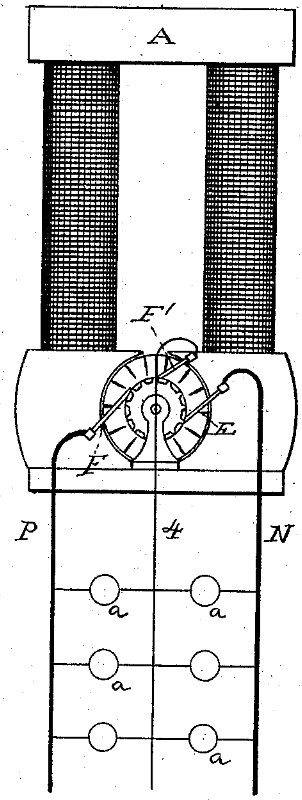

Fig 5.

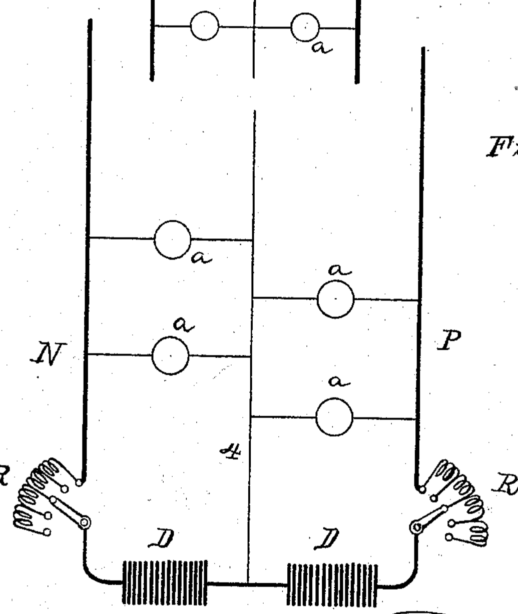

Fig. 6.

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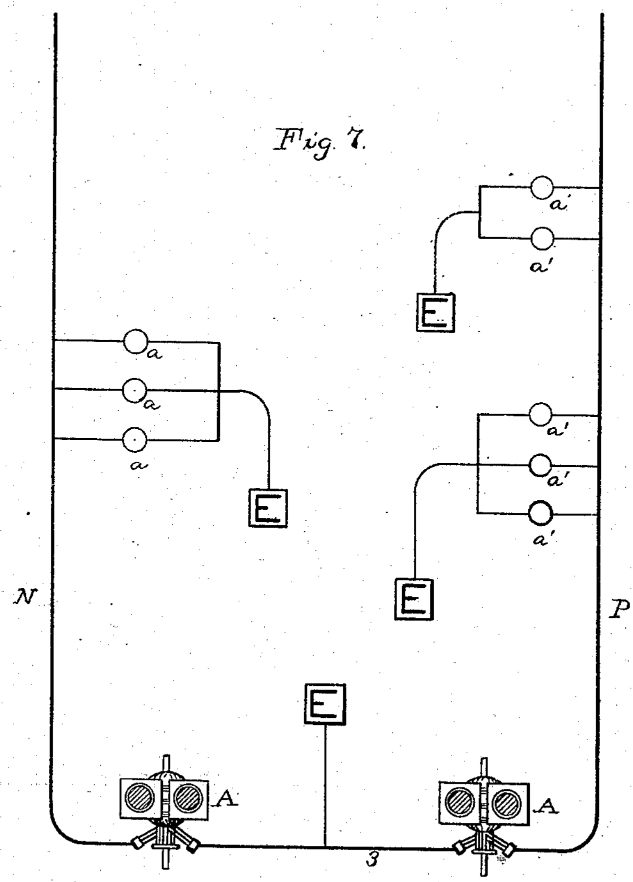

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UNITED STATES PATENT OFFICE.

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

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 274,290, dated March 20, 1883.

Application filed November 27, 1882. (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 new and useful Improvement in Systems of Electrical Distribution, (Case No. 520,) of which the following is a specification.

In multiple-arc systems of lighting by electrical incandescence in which complete or round metallic circuits are used it may sometimes be desired to employ electric currents of unusually high electro-motive force, so that the size of the conductors which convey said current may be diminished, thus economizing in metal, and allowing the conductors to be placed overhead instead of laid under ground in places where the former arrangement is more convenient. It is also generally desirable in such systems that the incandescing electric lamps or other translating devices should be independent of each other—that is, that such devices shall be independently controllable, so that each lamp can be lighted and extinguished separately and without affecting any others.

To provide a system in which currents of high tension can be used, while at the same time each lamp is entirely independent of all the others, the lamps being also each of the standard or usual resistance, is the object of my invention; and I accomplish this by employing a source of energy of high electro-motive force, arranging the translating devices in multiple series, dividing said source into as many parts as there are translating devices in series in any circuit, and correspondingly dividing each series of lamps, such division being made by means of a central compensating conductor or conductors connected between the divisions of the source of energy, and also between the translating devices, so that when all the devices in any multiple-arc circuit are in use current will pass through all such devices, the current passing across from the positive to the negative main conductor; but if one or more translating devices are removed from any series circuit the excess of current which would otherwise affect the other lamps in the circuit is taken by the compensating central conductor, so that the other lamps remain unchanged. The compensating-conductor is preferably a metallic wire, though the earth might be used for the purpose, if it is so desired.

In carrying out my invention the central station or source of electrical supply for the system may contain one, two, or any desired number of generators, according to the number of translating devices to be supplied with current, such generators developing a high electro-motive force. Such generators are preferably dynamo or magneto electric machines; but secondary batteries may be employed, if desired, and the generators may be connected in any desired manner. If two generators, placed in series, are employed, the compensating-conductor is connected between the two to the wire connecting their armatures, such compensating-conductor extending out between the two main conductors leading from the generators. The multiple-arc circuits which contain the lamps or other translating devices extend across from each main conductor to the compensating-conductor. When equal numbers of lamps are in circuit on opposite sides of the compensating-conductor, no current will traverse such compensating-conductor, the whole amount generated passing out through the positive main conductor across both sets of multiple-arc circuits containing lamps, and back by the negative main conductor, as will be more fully hereinafter explained. Thus the same effect is produced as though two lamps were in series in each multiple-arc circuit, as the current must pass through two lamps to get from the positive to the negative conductor. At the same time, however, such two lamps are independently controllable.

In case lamps are removed from one side of the compensating-conductor, so that the numbers on opposite sides become unequal, a portion of current varying in amount according to the degree of inequality will pass through the compensating-conductor, the direction of such current varying according to whether the positive or the negative side contains the greater number of devices. The system should be so arranged by properly locating the lamps and conductors that at no time can there be a very great inequality between the two sets of lamps. Thus very little current will ever traverse the compensating-conductor, almost the whole passing out through the positive and returning by means of the negative main conductor. The compensating-conductor can therefore be of very small mass, it never being required to convey much current. An adjustable resistance is preferably placed in each main conductor, so that in case the drop in electro-motive force is greater on one main conductor than on the other the resistance may be adjusted to compensate for such inequality. In systems of general distribution such resistances would be placed in the conductors of the feeding-circuits.

It is evident that two or more generators may be placed on each side of the central conductor in series or in multiple arc, if desired.

If currents are to be employed of such high tension that three or more lamps must be placed in each cross-circuit between the positive and negative sides of the main circuit, three or more generators or series of generators may be placed in series, with two or more compensating-conductors extending between the main conductors, such compensating-conductors being connected between the generators or series of generators, the source of energy being thus divided into as many parts as there are lamps in series.

By the use of my invention lamps in different districts connected with separate central stations may be connected in series with each other, the generators of the two stations being connected by a conductor, and compensating-conductors running from convenient parts of the district.

If desired, one generator only might be placed at the central station, having its commutator provided with an extra brush or brushes, placed between the main brushes, from which the compensating conductor or conductors run, such conductors being connected with the multiple-arc circuits between the lamps.

My invention is illustrated in the annexed drawings, in which Figure 1 is a diagram showing an arrangement of two generators in series. Fig. 2 represents a similar arrangement of generators, but a different one of the translating devices. Fig. 3 shows the arrangement of three generators in series. Fig. 4 shows an arrangement whereby lamps in different districts, supplied from separate stations, may be placed in series. Fig. 5 shows the arrangement where one generator is used. Fig. 6 illustrates the use of secondary batteries, and Fig. 7 shows the use of the earth as a compensating-conductor.

In Fig. 1, A A represent dynamo or magneto electric machines connected in series by conductor 3, and having positive and negative main conductors P N extending from them. Midway between the generators the compensating-conductor 4 is attached to conductor 3. Multiple-arc circuits 5 6 extend from the compensating-conductor to each of the main conductors, and each of such multiple-arc circuits contains a lamp or other translating device, those on one side of the compensating-conductor being designated by a, and those on the other by a'. When, as shown, the number of lamps a is equal to that of lamps a', any current which may tend to return through conductor 4 will be neutralized by the current which will meet it from wire 3, so that no current will pass in either direction in said conductor 4; but if a lamp, a', is removed from circuit, so that less current will pass from conductor P to conductor 4, the tendency from wire 3 to wire 4 will be correspondingly greater than the return tendency, and current due to the inequality will flow in wire 4, which will pass through the lamps a and return through conductor N, while if a lamp or lamps, a, be removed, so that less current will pass from 4 to N, the difference of current will return through conductor 4. Thus the conductor 4 compensates for differences in either side; and while the lamps are independently controllable and any lamp can be removed from circuit without varying the current flowing to the lamps on the opposite side, yet it is evident that currents may be employed of as high tension as though the lamps were arranged in multiple series in the ordinary way.

The arrangement shown in Fig. 2 is similar to that just described, except that here the lamps a and a' are placed across multiple-arc circuits 7 8, derived from the main conductor P N. The same effect is of course produced as just described. The adjustable resistances R R are shown in this figure, which are used to compensate for differences in the drop in electro-motive force of the two conductors.

In Fig. 3 three generators, A A A, are shown in series, there being two compensating-conductors, 4 and 4^a, and three sets of lamps, a a' a^2, the main portion of the current passing entirely across from conductor P to conductor N, and an amount due to differences in the number of translating devices will return through the central conductors. The number of lamps a^2 being greater than a', a portion of current due to the difference will return through conductor 4^a, the remainder passing through lamps a' to conductor 4. The number of lamps a being greater than a', current will flow from the generators through conductor 4 to supply lamps a, which current will return through main conductor N.

In Fig. 4, C and C' each represent a district to be supplied with electric energy, a central station or source of supply being provided for each district. At one central station generators B B are placed in multiple arc, and at the other generators B' B' are similarly arranged. It is desired to connect lamps in district C in series with lamps in district C'. To accomplish this a conductor, D, is run from one station to the other, connecting one pole of each battery of generators together. From the other poles run the feeding-circuits P' N' and P^2 N^2, such feeding-circuits being connected with the main conductors of the system. Compensating-conductors 4 are connected at convenient points to said main conductors, all such compensating-conductors being connected at the same point to the wire D between the stations, so that a divided source of electric energy is formed, as in the previous cases. Current flows through feeding-conductors P' P^2 to main conductors *p p*, thence through cross-circuits containing translating devices to main conductors *n n*, by a conductor, *o*, to district C', through translating devices to main conductors *p*, and back to the generators by feeders N' N^2. It is evident that each translating device in district C is in series with one in district C', though all such devices are independently controllable, the conductors 4 acting to compensate for the removal of any device on either side. It is evident that any desired number of districts might be connected in this manner by proportionately dividing the source of energy, so that currents of very high electro-motive force may be employed. Fig. 5 illustrates the application of my invention to a single generator, A, of high electro-motive force.

The main current is taken from the machine by the commutator-brushes F F, to which are connected the main conductors P N, and an extra brush, F', is provided between the main brushes, from which runs the compensating-conductor 4. Lamps *a* are arranged as in Fig. 1. The current taken by the extra brush neutralizes the tendency for current to return on the compensating-wire, so that no current traverses that wire so long as the number of translating devices remains the same on each side of the same, while as the numbers vary, current traverses such conductors in one or the other direction, as previously explained.

It is evident that the generator may be still further divided by the use of a greater number of extra brushes and compensating-conductors.

In Fig. 6, D D are secondary batteries, P N being the main conductors, and 4 the central conductor. R R are the adjustable resistances, for the purpose before described. It is evident that with either of the forms described the adjustable resistances R R may or may not be used, as found necessary.

Fig. 7 illustrates the use of the earth as a compensating-conductor, which arrangement may be convenient in some cases, though I usually prefer to use a metallic conductor. The generators A A are connected by wire 3 in series, and conductors P N extend from them. Translating devices *a'* are connected with conductor P, and also to earth E, and translating devices *a*, connected to conductor N, are also connected to earth. Between the generators A A wire 3 is connected to earth, as shown. It will readily be seen that current will pass through the earth from P to N, and thus through both sets of translating devices in multiple series. An amount of current due to the inequality between the devices *a* and *a'* will, it is evident, pass between wire 3 and the translating devices through the earth in the same manner as explained with reference to the metallic conductor 4 of Fig. 1.

What I claim is—

1. In a system of electrical distribution having translating devices arranged in multiple series, the compensating conductor or conductors connecting the translation-circuits with the source of energy, substantially as and for the purpose set forth.

2. A system of electrical distribution having in combination the following elements, viz: a divided source of electrical energy, main conductors extending therefrom, translating devices arranged in multiple series, and a compensating conductor or conductors connecting the translation-circuits with the source of energy at the points of division, substantially as and for the purpose set forth.

3. In a system of electrical distribution, the combination, with translating devices arranged in series across main conductors, of a source of electric energy divided into as many parts as there are lamps in series, and a compensating conductor or conductors connected between the divisions of the source of energy and between the lamps in series, substantially as set forth.

4. The combination, with a source of electrical energy, of main conductors leading therefrom, translating devices in circuit from said main conductors, a compensating-conductor, and an adjustable resistance in each of said main conductors, substantially as set forth.

This specification signed and witnessed this 20th day of November, 1882.

THOS. A. EDISON.

Witnesses:
H. W. SEELY,
EDWARD H. PYATT.