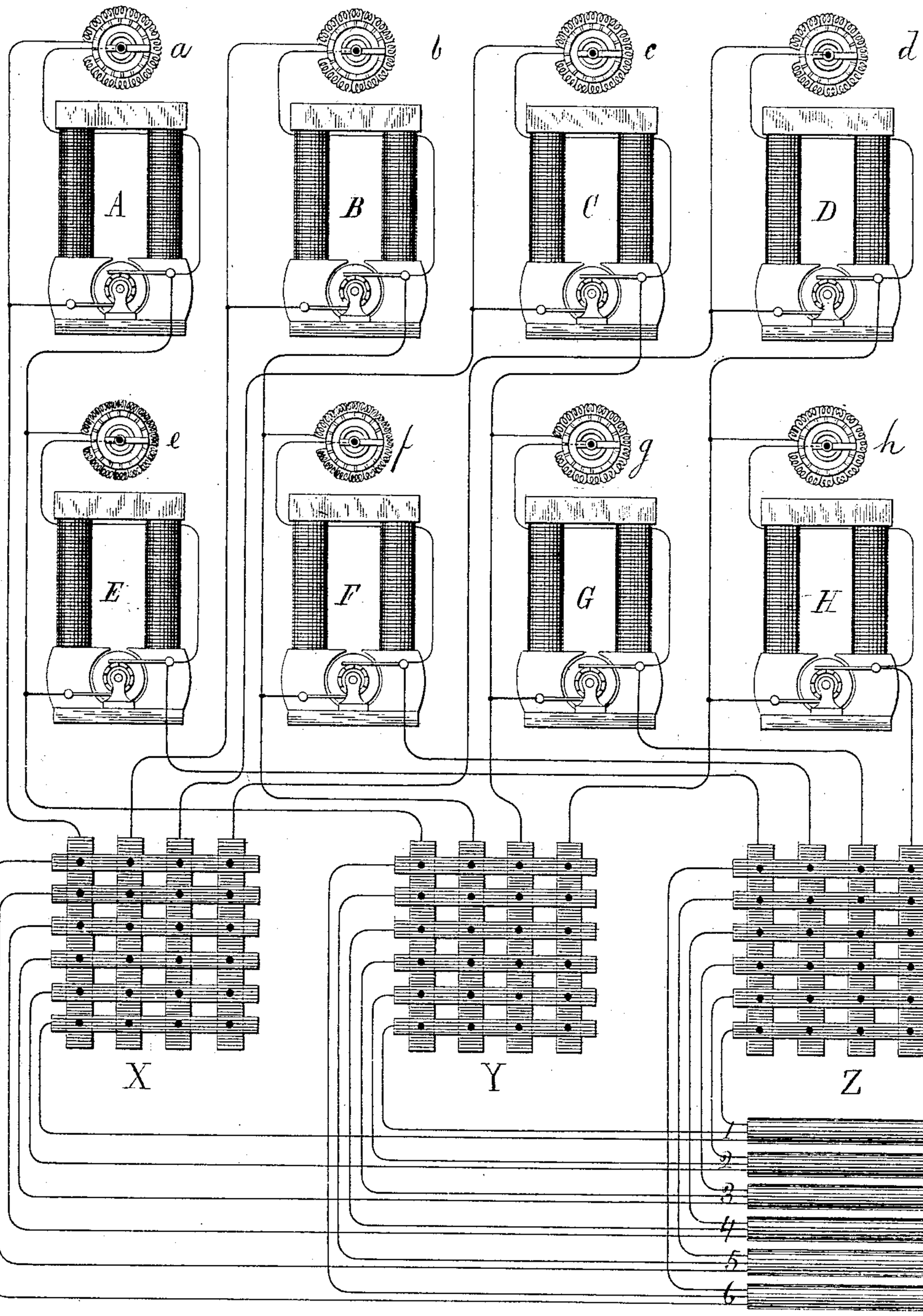
(No Model.)

C. S. BRADLEY.

SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 291,141. Patented Jan. 1, 1884.



WITNESSES

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CHARLES S. BRADLEY, OF NEW YORK, N. Y.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 291,141, dated January 1, 1884.

Application filed August 18, 1883. (No model.)

To all whom it may concern:

Be it known that I, CHARLES S. BRADLEY, of the city, county, and State of New York, have invented a new and useful Improvement in Systems of Electrical Distribution, of which the following is a specification.

In a system of electric lighting in which the current-conveying conductors are arranged on the multiple-arc or derived-circuit plan it is of the utmost importance that the electrical pressure or difference of potential between the conductors be maintained perfectly constant and uniform in all parts of the system. To this end the system of conductors is generally made to consist of a cross-connected network of conductors called "mains," from which the lamps or other converting devices are directly supplied with current in multiple arc, and another set of conductors called "feeders," which connect a central station or source of electric energy with points uniformly distributed over the system of mains, and which are employed solely to convey the current to the mains without directly supplying any lamps or other converting devices.

Heretofore it has been the practice to connect all the feeders supplying the system of mains with a common source of electric energy, so that the currents supplied to all the feeders have the same pressure; but it frequently happens that the total load is distributed over the system in such a way with respect to the points where the feeders join the mains, and with respect to other conditions, that the pressure necessary to be maintained in one feeder in order properly to supply the lamps in one part of the system is too great properly to feed the lamps at another part of the system supplied by another feeder, and therefore the pressure has to be maintained either excessively high at some of the lamps or excessively low at others. As long as the load—that is, the number of lamps or other converting devices—upon the system is small, it is comparatively immaterial how they are distributed, because then the lamps themselves, being of very high resistance compared with the resistance of the conductors, form almost the whole resistance in the circuit, and the system is practically a perfect multiple-arc system—that is, lamps may be turned on or off without materially affecting the brilliancy of those already in operation, while the electro-motive force of the source is kept constant; but when the load is large the joint resistance of the lamps is so small that the resistance of the mains and feeders becomes a very important factor in the total resistance in circuit, and turning on more lamps has but little effect in reducing the resistance of the circuit compared with the extra current they require to feed them, so that unless the electrical pressure is raised as the load increases the supply of current becomes inadequate and the candle-power of the lamps falls below the standard. Consequently, if there are more lamps at one point of the system than at another the pressure in the conductors which supply that part of the system should be correspondingly higher, in order that the lamps may have the same candle-power. If, for example, we have a light load on the system of mains near the junction of one feeder and a heavy load near the junction of a second feeder, the heavy load will, since the resistance of its feeder is a larger percentage of the total resistance in circuit, require to have a higher pressure maintained in its feeder than will the light load, in order to cause the two sets of lamps to burn with equal brilliancy. The resistance of the mains also affects the pressure at any point, depending upon the distribution of the load between the points where the feeders join the mains. Therefore, if both feeders are supplied from the same source of current, and if the pressure employed be sufficiently high to bring the second set of lamps to the standard of brilliancy, the current supplied to the other feeder will be of too high pressure for the first set. Under these circumstances it has been found necessary to disconnect the feeder requiring the lower pressure from the source of current, and let the first set of lamps be supplied from the other side of the main by the feeder requiring the higher pressure; but this plan is very objectionable, for the reason that those lamps which are no longer supplied by their

nearest feeder have to obtain their current by way of the feeder already supplying the other lamps, and since they are farther along the main the pressure of the current which reaches them, as already explained, is often very considerably reduced, the consequence being that either they are burned too low or the other lamps are burned too high. There is also another very important objection to this method of securing uniformity in the pressure, which is that the total current has to be conveyed to the mains through only a few of the feeders, and the joint resistance of the feeders is thereby very materially increased. To overcome this important difficulty I have devised the method herein described and specifically claimed, whereby I am enabled to maintain the pressure much more uniform over the entire system, under all conditions of load, and at the same time to utilize the conductivity of all the feeders combined to supply the current to the system of mains.

In the accompanying drawings, which represent a central generating-station, my invention is illustrated as applied in the case of a multiple-arc system arranged on the triple-conductor plan, such as that described in Letters Patent to Edison, granted March 20, 1883, and numbered 274,290; but my invention is equally applicable to any other arrangement of current-supplying conductors. In the triple-conductor plan the current is supplied to the lamps or other converting devices by three sets of conductors, instead of by two, two of the sets respectively forming the positive and negative conductors, between which is maintained an electro-motive force of double that required to feed one lamp, and the third forming an intermediate or "compensating" conductor, between which and each of the others is maintained an electro-motive force sufficient to feed one lamp, or half that between the positive and negative conductors. Each feeder, therefore, which connects the central station with the triple system of mains consists of three conductors, separately connected with the three corresponding conductors of the mains.

The dynamo-electric machines A B C D E F G H, &c., or other sources, as many as required, which generate the electric current, are connected in sets of two each, according to the plan described in the patent to Edison before referred to, the two dynamos of each set being connected in series, as shown, and having a combined electro-motive force equal to that to be maintained between the positive and negative conductors. I provide three switch-boards, X, Y, and Z, as shown, or similar switching contrivances, and I connect the corresponding vertical bars of these, respectively, with the three points of each of the sets of dynamos from which the currents are taken—that is, I connect the first bar of the first switch-board with one terminal of one set of dynamos, the first bar of the third switch-board with the other terminal, and the first bar of the intermediate switch-board with the intermediate connection made between the two dynamos, as shown. In the same manner the second, third, and other sets of dynamos are respectively connected with the second, third, and other vertical bars of the switch-boards, as clearly shown, so that the vertical bars form separate terminals of all the sets of dynamos for operating the system on the triple-conductor plan. Each of the feeders 1 2 3 4 5 6, &c., as many as are employed to convey the current to different points of the system of mains, has its three conductors, respectively, connected with the corresponding horizontal bars of the switch-boards X Y Z—*i. e.*, the two terminal or positive and negative conductors are respectively connected with the switch-boards, forming the positive and negative terminals of the dynamos, and the intermediate conductors are connected with the intermediate switch-board, as shown. These switch-boards are arranged in the well-known manner, so that any of the vertical bars may be connected with any of the horizontal bars by plugs, or in any other suitable way.

I provide each dynamo with an independent regulating apparatus *a b c d e f g h*, &c., for regulating its electro-motive force by throwing more or less resistance in or out of a shunt-circuit on which the field is supplied in the well-known manner, as shown in the drawings, or by any other suitable means, so that each set of dynamos may be adjusted to supply a current of any desired electro-motive force independently of that supplied by each of the others. Whenever the distribution of the load over the system causes the pressure at any point or points to be too high or too low, I increase or diminish the pressure of the current supplied to certain feeders independently, by means of the regulators, until the pressure on each feeder is adapted to the conditions of load it has to supply, and, if necessary, I connect or disconnect dynamos from some of the mains, and disconnect or connect them to others by means of the switch-boards X Y Z. In this way I am enabled not only to maintain different pressures in the various feeders, according to the distribution of the load, and thereby to secure a uniform pressure, as nearly as possible, throughout the system, but also to avail myself of the joint conductivity of all the feeders to convey the current to the system of mains, instead of passing the entire current through only those feeders that require to be supplied with currents of higher pressure—an advantage of great importance when the load is large.

Another advantage of my invention is that it permits the feeders employed to be of different resistances, since the differences in resistance may be compensated for by difference in the pressure maintained therein, and in this way the shorter feeders may be allowed to be of less resistance than the larger ones.

It is evident that my invention is also applicable to similar multiple-arc systems of elec-

trical distribution for the production of power, heat, &c., as well as light.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The method of regulating the electrical pressure or potential in an electrical-supply system, which consists in feeding different points of the system from two or more independent sources of supply of electrical energy, and in separately regulating the electro-motive forces of these sources, according to the conditions of the load.

2. The method of regulating the electro-motive force or pressure in a multiple-arc system of current-supplying conductors or mains, consisting in conveying the current to different points of the mains by means of feeders supplying the feeders with electric currents by independent sources of electrical energy, and separately regulating their electro-motive forces, so as to maintain different pressures in the various feeders, according to the conditions of the load, substantially as described.

3. The method of regulating the electrical pressure or potential in a multiple-arc system of current-supplying conductors or mains from which the lamps or other converting devices are directly supplied, consisting in conveying the current from a generating-station to different points of the mains, by means of independent feeding-conductors, supplying these feeders with electric currents by independent dynamo-machines, and separately regulating their electro-motive forces according to the conditions of the load, substantially as described.

4. The combination, with a multiple-arc system of conductors or mains, and two or more conductors or feeders connecting it at different points with a central station, of two or more independent dynamo-machines, each of which is provided with an independent regulating apparatus and a set of switching contrivances, whereby any of the dynamo-machines may be separately connected to any of the feeders, substantially as and for the purpose described.

Signed this 17th day of August, 1883.

CHAS. S. BRADLEY.

Witnesses:
CHARLES G. CURTIS,
JOSEPH M. WILLIAMS.

Corrections in Letters Patent No. 291,141.

It is hereby certified that in Letters Patent No. 291,141, granted January 1, 1884, upon the application of Charles S. Bradley, of New York, New York, for an improvement in "Systems of Electrical Distribution", errors appear on the third page of the printed specification requiring correction, as follows:

In lines 13 and 14, the words "Electro-motive force or" should read *Electrical.*

In line 14, the words *or potential* should be read after the word "pressure."

In line 17, a *comma* should be read after the word "feeders;" and

In line 43, a *comma* should be read after the word "apparatus."

And that the specification should be read with these corrections therein to make the Letters Patent conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 29th day of January, A. D. 1884.

[SEAL.]

M. L. JOSLYN,
Acting Secretary of the Interior.

Countersigned:

BENJ. BUTTERWORTH,
Commissioner of Patents.