

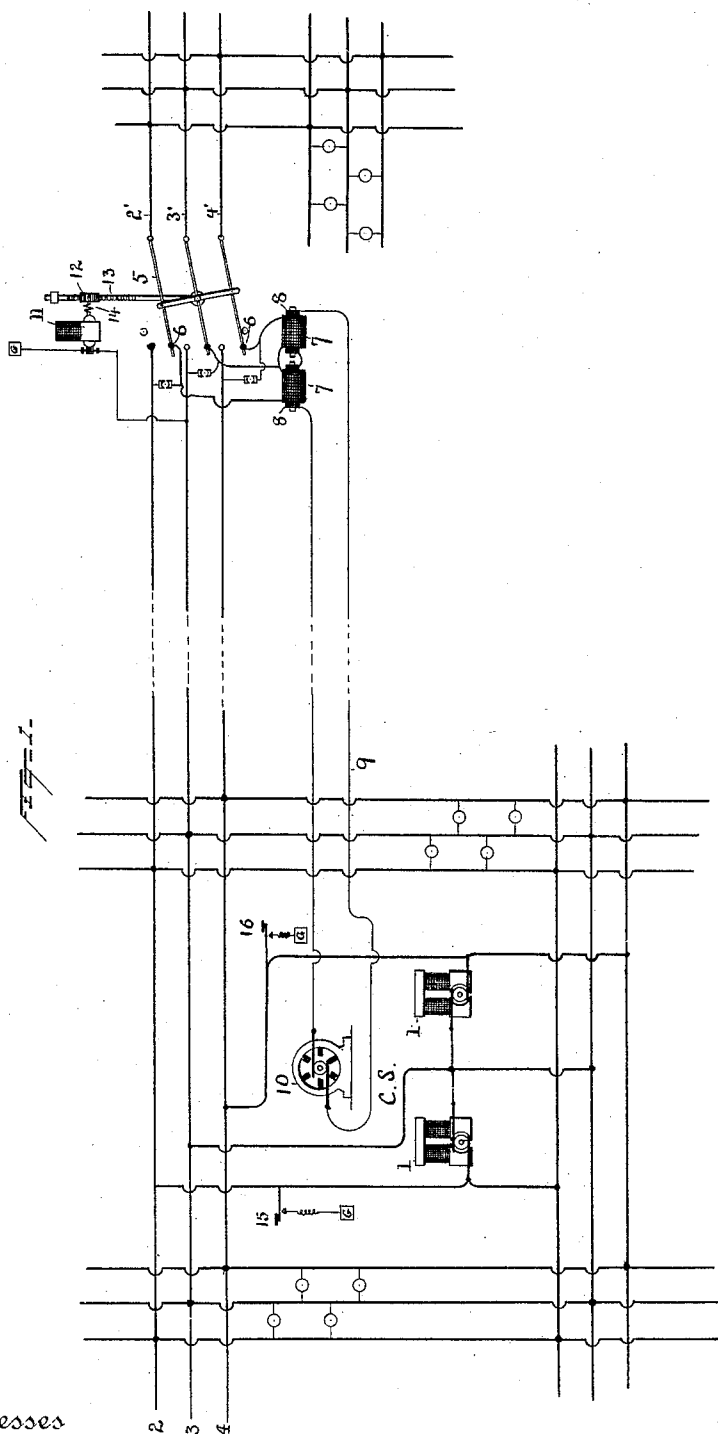
(No Model.)

2 Sheets—Sheet 1.

H. W. LEONARD.
SYSTEM OF ELECTRICAL DISTRIBUTION.

No. 468,099.

Patented Feb. 2, 1892.



Witnesses
Norris A. Clark.
A. F. Charles

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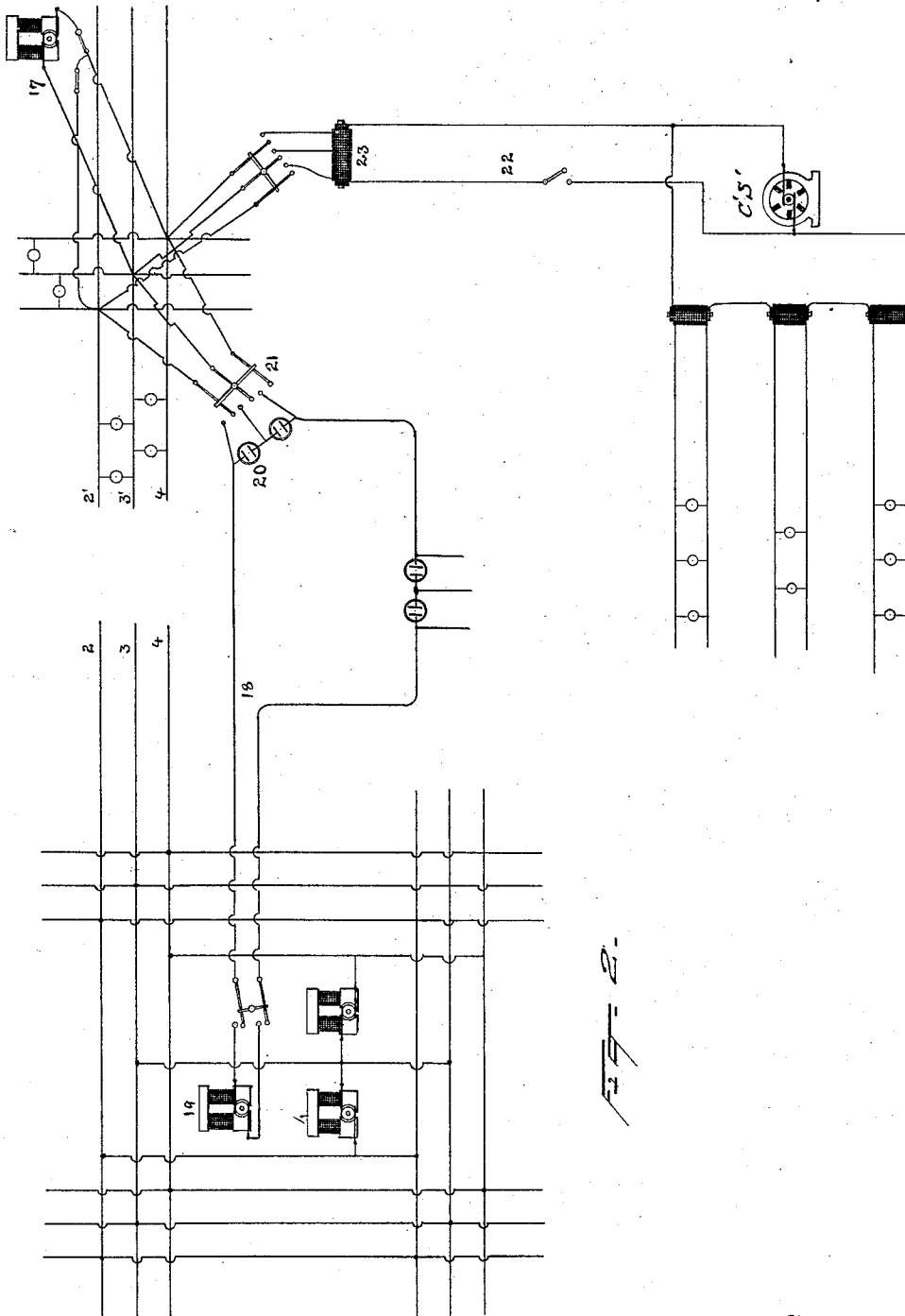
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UNITED STATES PATENT OFFICE.

HARRY WARD LEONARD, OF NEW YORK, N. Y.

SYSTEM OF ELECTRICAL DISTRIBUTION.

SPECIFICATION forming part of Letters Patent No. 468,099, dated February 2, 1892.

Application filed May 12, 1891. Serial No. 392,472. (No model.)

To all whom it may concern:

Be it known that I, HARRY WARD LEONARD, a citizen of the United States, residing at New York city, county and State of New York, have invented a certain new and useful Improvement in Systems of Electrical Distribution, of which the following is a specification.

The present invention relates to systems for distributing electricity for electric lighting, &c., the system being especially adapted to localities where the demand for current is spread over a large area, the demand, however, not being sufficient in outlying districts to warrant the construction of a central or supply station in the neighborhood, and where there is a large variation in the demand for current at different times of the day.

The object of the invention is to provide a simple and economical system of the character indicated, as hereinafter set forth.

In lighting systems now used the capital necessary to furnish feeders of sufficient capacity to supply the current required when all or the maximum number of the lamps are in circuit in a distant section of the system is very large. The three-wire system can furnish the ordinary day supply with comparatively small outlay for conductors; but to furnish the feeders for the maximum demand would increase the cost of the system nearly ten times, and this is in many cases prohibitive. By the present improvement this large outlay is avoided or put off until the use of current is sufficient to justify it.

In the accompanying drawings, Figures 1 and 2 are diagrams illustrating my invention as applied to a three-wire system.

In Fig. 1, C S is a central station in the center of a thickly-populated district. At this station are continuous low-tension current-generators 1 1—that is, generators adapted to directly furnish the translating devices used with current of suitable voltage—connected to the wires 2 3 4 of a three-wire or compensating incandescent electric-lighting system, the arrangement of these conductors being the same as in the well-known Edison system. The conductors 2 3 4 extend to a distant section of the town in which the system is located (indicated at the right of the figure) where a comparatively small number of lamps

or other translating devices are used. 5 is a three-lever switch (or a switch of any suitable form) adapted, when in one position, to connect wires 2, 3, and 4 with the corresponding wires 2', 3', and 4' of the distant section. These latter wires may be house-wires, put in as usual in the three-wire system. The switch 5 when in its second position bears on three contacts 6, which are connected by wires to the secondaries 7 of inductoriums or converters. The primaries 8 of said converters are connected by a simple or two-wire circuit 9 to a generator adapted to produce high-tension, alternating, pulsatory, or intermittent current, such as ordinarily employed with converters. The circuit 9 being of small wire is quite inexpensive. This generator is preferably, though not necessarily, placed at the same central station as the generators 1.

In putting in a plant I wire the town with permanent conductors arranged according to the system to be employed, which may be a two-wire or a three-wire system, and connect with said conductors the permanent generators 1. At the same time I provide a temporary generator 10 and the temporary circuit 9 and converters. I may control the switch 5 from the central station by means of suitable circuit connections and a motor or magnet.

11 is a small motor with a permanent or separately-excited field. The armature-shaft drives a gear 12, which engages a rack 13, said rack being connected to the switch. The connection between the armature and the gear-wheel is preferably through a yielding spring 14. One terminal of the motor is connected to ground at G and the other terminal is connected to the neutral wire 3. At the central station keys or circuit-closers 15 and 16 are provided for grounding the positive main 2 or the negative main 4 through a suitable resistance.

During the day-time, when comparatively few lamps or other translating devices are in use, the switch 5 is on the upper series of contacts and the conductors 2', 3', and 4' are connected directly to the main part of the system. The generator 10 is stopped and out of use. There being few lamps in use, as above stated, they can be supplied satisfactorily and economically from the main con-

tinuous-current system. It is desirable, also, that during the day the system should be in this condition, since it is during the day that the current is used most largely for running 5 motors for electroplating and other purposes requiring continuous current. At night, however, when a larger number of lamps are thrown into circuit, it is not economical to supply them from the main system. At this 10 time, therefore, the switch is moved to the position shown in the drawings, connecting 2', 3, and 4' with these secondaries of the converters, generator 10 being at this time put in operation. If for any reason it should be de- 15 sired to supply the entire system with alternating current, the switch 5 would be moved to its upper position and the wires leading from the secondaries of the transformers would be connected to the mains 2 3 4, gen- 20 erators 1 being thrown out of use. To move the switch, key 15 is closed for a moment, sending a current through motor 11 in the direction to turn its armature to move the rack-bar down. The first effect will be to coil 25 the spring. Then when the tension reaches a certain point the switch will be thrown over suddenly. It is evident that other means and other circuits for controlling the distant switch may be employed.

30 As above set forth, it would not be economical to supply all of the lamps in the distant section directly from the main part of the system. On the other hand, it would not be economical to supply the comparatively 35 small number of lamps in said distant section in use during the day by means of the converters and the generator 10, because of the expense of running the additional generator and also because the converters are most effi- 40 cient when the entire number of lamps or translating devices for which the converter is constructed are in circuit and are more and more inefficient as the number of lamps is reduced. It will be seen, therefore, that by the simple 45 system described the most efficient and economical arrangement is obtained both for the day and for the night services. As the demand for current increases at the outer portion of the central section of the system addi- 50 tional feeders are laid and the switches and transformers are moved farther from the station. If the demand for current largely increase in the distant section, all that is necessary to do is to construct a central station 55 in that district and to connect the continuous-current generators of the new station directly to the mains 2', 3', and 4' without changing them in any manner. The generator 10, circuit 9, and the converters may be then dispensed with or may be transferred to another 60 outlying district. It is evident that any number of converters may be connected to the system at points where they are required.

In Fig. 2 a central station and three-wire 65 system are shown, the latter extending toward a distant isolated plant or toward a distant section of the city to be lighted. (Shown at

the right in said figure.) The wires are arranged according to the three-wire plan; but the terminals of the generator 17, which nor- 70 mally supplies current to said isolated plant or distant section, are or may be connected to the central wire and to the two outer wires, respectively, as shown. It is desirable that means should be provided for supplying cur- 75 rent to the plant in case accidents should happen to the generator 17 and at times when it is not desirable to run said generator. It is evident that the generator may be a battery, either primary or secondary, as well as 80 a dynamo. I provide a circuit 18, leading from a generator 19 to converters in the form of storage-batteries 20, and from these batteries suitable wires, including switches, are extended to the mains of the distant system. 85 When the switch adjacent to the generator is closed, the batteries are being charged. This is preferably done when generator 17 is in operation, the switch 21 being at this time open. At C' S' is a second central station. This is 90 the station of an alternating-current system, and from an alternating-current generator a circuit 22 extends to a transformer 23, which is so wound that the current in the secondary has practically the same voltage as the con- 95 tinuous current of the three-wire system. This system is used as follows: If current from an external source is desired during the day, when a small number of lamps only are in circuit and while the demand is not sub- 100 ject to great fluctuations, the switches 21 will be closed and the current will be supplied from the storage-batteries, which have previously been charged; but if the current from an external source be desired at night, when the 105 maximum number of lamps is in use, the circuit 22 will be closed and the plant will be supplied with an alternating current of the same voltage by means of the alternating-current transformers, the storage-batteries being 110 charged during such time. It is evident that the generator 1 and the generator shown at C' S' may be operated from the same station, if desirable. From this it will be seen that I supply the same systems at different times of 115 the day with both continuous and alternating current, according to the demand for current at the time when such supply is called for. This can be done because the translating devices employed in the system—viz., incan- 120 descent lights—can be operated equally well and will produce the same results with either continuous or alternating current. Generator 17 may in some cases be dispensed with and the storage-batteries and the alternating- 125 current transformers be relied on entirely. Storage-batteries distribution over large areas has heretofore proved unsuccessful, because the maximum load is about ten times the average load and both the large investment 130 and the great depreciation incidental to the large current required for the maximum load renders their use unprofitable. For about eighteen hours of every day the load is only

about one-third of the average load, and only about one-fourth of the entire daily output is made during these eighteen hours, the other three-fourths being made during the six hours of principal lighting.

Suppose now we put in continuous-current dynamos able to operate the average load of the system directly and storage-batteries capable of standing their full charging-current, so that in six hours they could be completely charged. During the eighteen hours of the light load the necessary current will be one-third of the average—that is, one-third of the charging-current—so that with this plant we need only run the continuous-current dynamo about six hours per day and yet get the highest economy. During the six hours the alternating-current source supplies the system through the transformers, these conditions being such as to produce the highest economy, and the storage-batteries are being charged. During the other eighteen hours of the day both the continuous-current and alternating-current dynamos are at rest, and the storage-batteries supply the current under conditions of the highest economy. In case of emergency the batteries and the continuous-current apparatus could be made to carry the full load without resorting to the alternating-current apparatus.

If at any time it is desired to connect the isolated plant with the main three-wire system, the wires 2', 3', and 4' may be connected to wires 2, 3, and 4. It will be evident that many of the features of my improvement may be applied to a two-wire as well as a three-wire system.

Having thus described the invention, what I claim is—

1. The combination of a three-wire distri-

bution system extending over a large area and having continuous-current generators at a central station, means for disconnecting a section of the system from or connecting it to the rest of the system, converters adjacent to said section, means for connecting the secondaries thereof to the mains of the disconnected section of the three-wire system, a circuit through said converters to the central station, and a suitable generator connected to said circuit, substantially as described.

2. The combination of a three-wire system of electrical distribution, continuous-current generators at a central station connected to said system, a high-tension generator at said station, a circuit from the latter generator to distant converters, a switch interposed in the conductors of the three-wire system and adapted to make and break the same, and terminals co-operating with the same switch and connected to the secondaries of said converters, substantially as described.

3. The combination, in a three-wire distribution system, of continuous-current generators connected to the mains of said system, means for disconnecting a section of the system from or connecting it to the rest of the system, converters for said section, means for connecting the secondaries thereof to the mains of the disconnected section of the three-wire system, a circuit through said converters, and an alternating-current generator connected to said circuit, substantially as described.

This specification signed and witnessed this 27th day of April, 1891.

HARRY WARD LEONARD.

Witnesses:

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