(No Model.)

2 Sheets—Sheet 1.

E. E. RIES.

ELECTRIC HEATING SYSTEM.

No. 381,817. Patented Apr. 24, 1888.

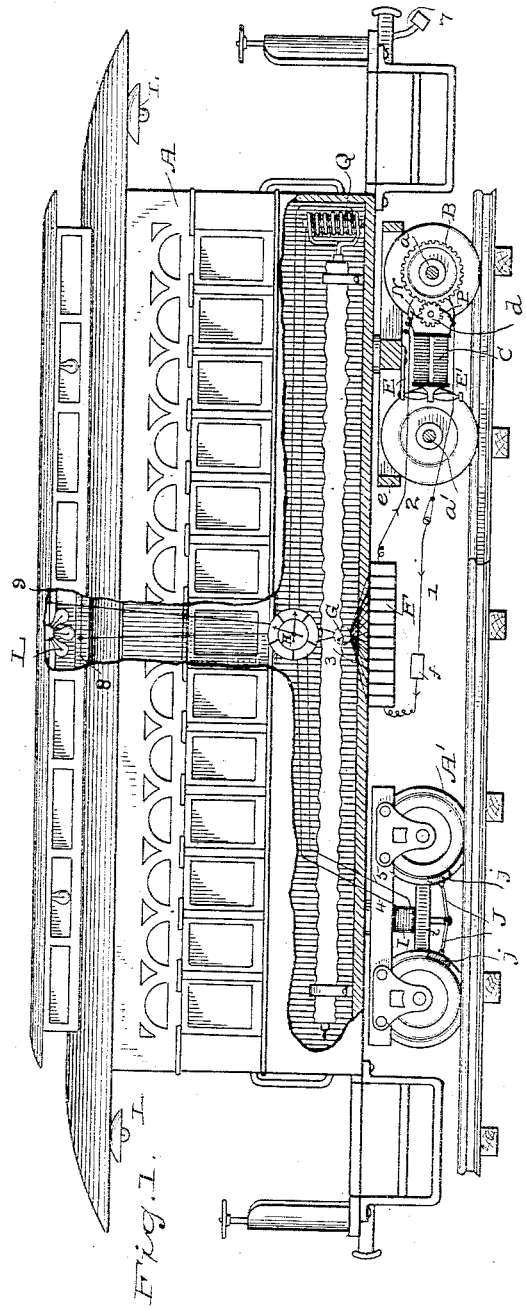

Fig. 1.

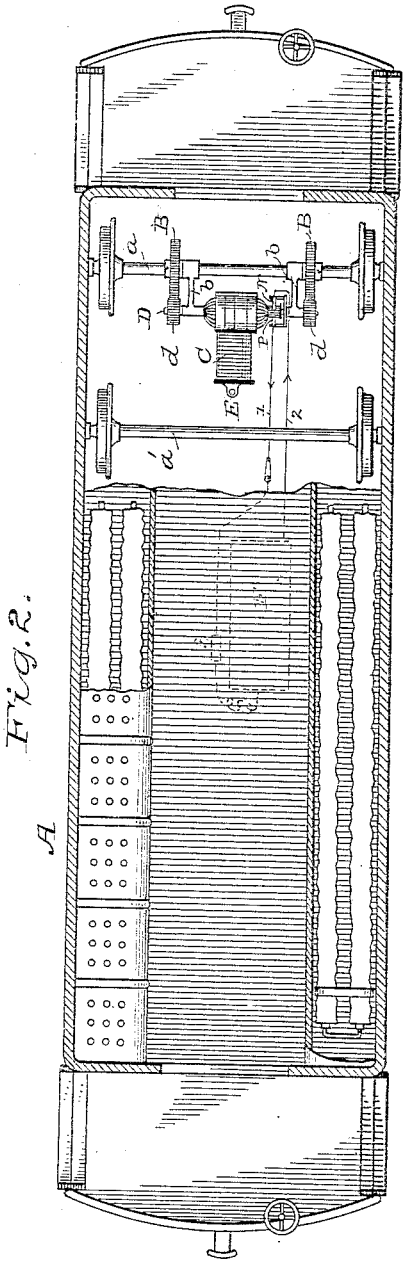

Fig. 2.

Witnesses.

H. A. Lamb.

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By his Attorney

Frankland James.

(No Model.) 2 Sheets—Sheet 2.

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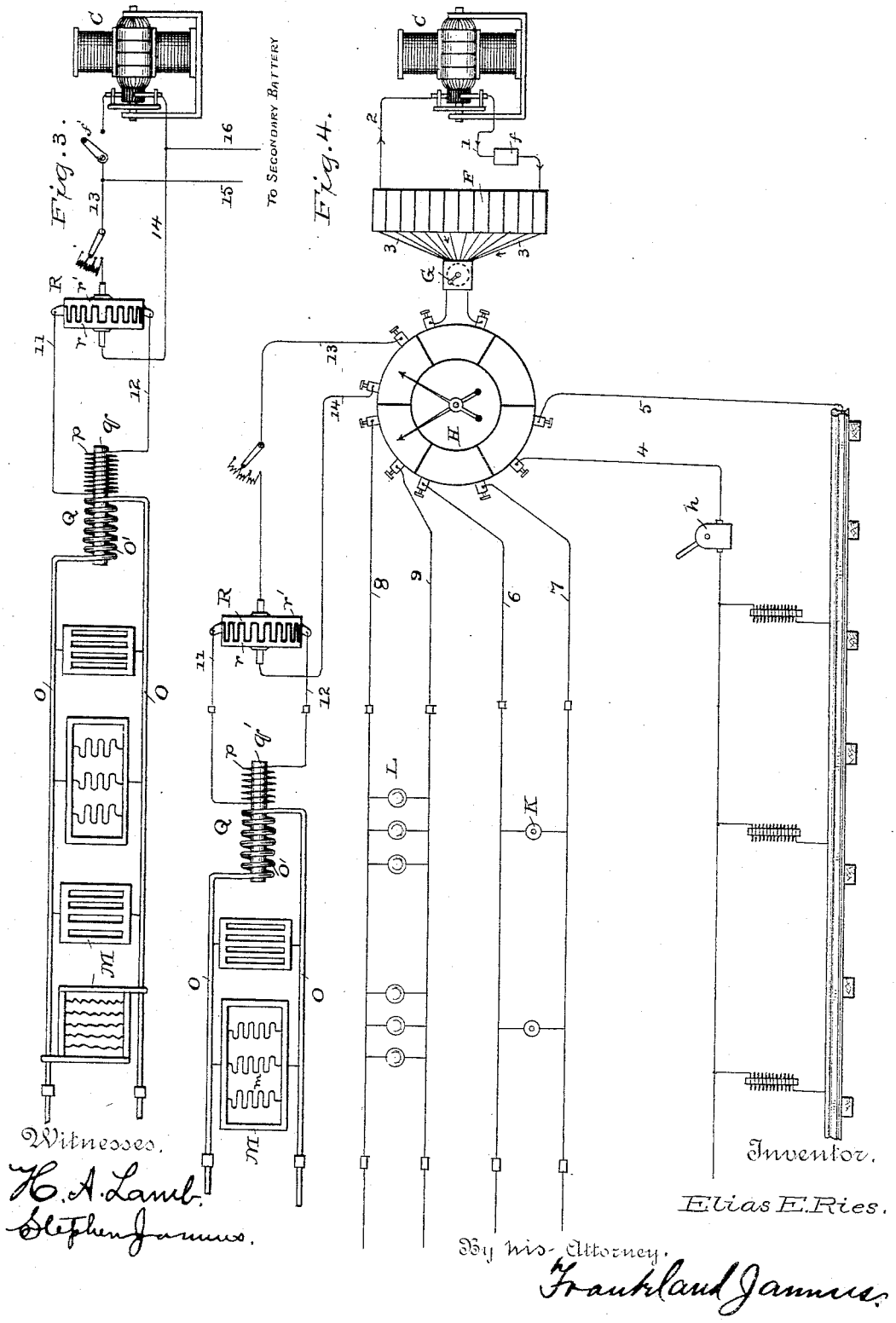

Witnesses.
H. A. Lamb.
Stephen Jamus.

Inventor.
Elias E. Ries.

By his Attorney.
Frankland Jamus.

UNITED STATES PATENT OFFICE.

ELIAS E. RIES, OF BALTIMORE, MARYLAND, ASSIGNOR OF ONE-HALF TO ALBERT H. HENDERSON, OF SAME PLACE.

ELECTRIC-HEATING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 381,817, dated April 24, 1888.

Application filed June 27, 1887. Serial No. 242,630. (No model.)

To all whom it may concern:

Be it known that I, ELIAS E. RIES, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Electric-Heating Systems, of which the following is a description.

My improvement relates to a new and useful method of heating by electricity; and it consists in such an arrangement and organization of instrumentalities as enable me to supply currents for heating, lighting, and charging storage-batteries, the operating of motors, and all the various uses to which the electric current can be put, from a single generating-station.

One of the objects of my invention is to produce currents of extremely low electro-motive force, but of great intensity, for the purpose of heating buildings, cars, &c., from currents of opposite quality—that is, of comparatively high electro-motive force and small intensity. For this purpose I utilize the capabilities of the inductional transformer in connection with a generator of high-tension currents, the high-tension currents being produced at the lowest comparative cost and conveyed to the point of consumption by the smallest and least costly conductors, the large surface conductors which are necessary to develop the ultimate effects of the transformed currents being located only at the points where the mechanical effects are to be reproduced, which place will be the consumers' stations, whether the same be separate railway-cars, dwellings, or halls.

In two other applications, Serial Nos. 227,044 and 227,045, filed February 9, 1887, pending herewith, I have fully described a system of producing currents of electricity suitable for heating purposes by the aid of inductional transformers operated by alternating currents of high tension, said systems necessarily limiting the application of the currents to devices operative with alternating currents. In the present instance, however, the main generator and the main-line wires carry continuous currents, so that by the addition of a pole-changer or current-alternator in branch circuits to be operated by alternating currents all species of electrical apparatus can be operated from the main generator, as was originally described and explained in said previous applications. For the sake of illustration, however, I have shown my generating and consuming stations all in one and upon a railway-car, the object being to show how completely the system meets every requirement of lighting, heating, braking, and signaling on a thoroughly-equipped railway. The same arrangements will, however, be placed at central stations, from which service-wires will extend to separate consumers, the only difference being that, instead of being driven by the momentum of the train, the generator will be driven by an independent steam-engine. The system also includes various details of arrangement and construction, as will be fully hereinafter set forth.

Having shown my generator as mechanically connected with the axle of the car, it will necessarily, unless otherwise provided, operate during the entire time that the car is in motion. While it is desirable to have this connection so arranged that the generator will be at all times ready to produce current, still under some conditions—as, for example, when the train is traveling on an upgrade—it would be manifestly a waste of energy to add to the load already upon the locomotive. Therefore I provide a manual switch by means of which the generator-circuit can be controlled and the generator caused to become operative at the desired times only.

In the drawings, Figure 1 is an elevation, partly in section, showing a railway-car equipped according to my invention. Fig. 2 is a plan view of the car shown in Fig. 1, a portion thereof being broken away. Fig. 3 is a diagram showing the simplest form of my apparatus as applied to heating only, the current passing direct from the generator to the interrupter. Fig. 4 is a diagram showing the generator, a storage-battery, a central switch-board connected with the storage-battery, and different varieties of consumption-circuits leading from said switch-board.

Similar letters denote like parts throughout.

A represents a car. *a a'* are the axles of one of the trucks thereof. The axle *a* is provided with gear-wheels B.

C is a dynamo-electric generator of the con-

tinuous type, the extremities of the armature-shaft D of which are provided with gear-pinions *d* in mesh with the gear-wheels B, and said armature-shaft D is supported in operative relation with the said axle *a* by means of link-bearings *b*. The generator is additionally supported at its opposite extremity by connections E E', extending to and secured to suitable portions of the frame of the truck *e*. A storage-battery, F, of suitable capacity is located at any convenient point upon the car and connected by circuit-wires 1 and 2 with the generator C. Any convenient form of regulator *f* is included in the battery-circuit conductor 1, and I usually prefer to charge the battery in series, as indicated by the connections extending thereinto, although under some conditions it is desirable to charge in parallel. Separate connections 3 from each cell or battery, or from groups containing any desired number of cells, extend to a commutator-switch, G, by which any desired portion of the battery from a single cell or group to the entire number can be connected to discharge in parallel the current passing from said commutator-switch G to the switch-board H, from which extend the various circuits to be supplied, which, as shown, are the braking-circuit 4 5, which circuit is provided with a regulator or circuit-closing device, *h*, substantially similar to that described in Letters Patent No. 356,963, granted to me February 1, 1887, one of the braking devices being shown in position, the solenoid I operating upon a plunger, *i*, said plunger being connected by links J to brake-shoes *j*, acting against the tires of the wheels A'.

It will be obvious that when applied to central-station work the brake-solenoids can be replaced by motors for performing any desired species of work. A signaling-circuit, 6 7, also extends from the switch-board H through the car or train when a number of cars are connected, and is provided with suitable push-buttons or other circuit-closing devices, K. The lighting-circuit 8 9 also extends from said switch-board, and is provided with incandescent lamps L wherever desired.

For developing the large amounts of heat necessary to properly warm dwellings, cars, &c., I use heat-radiating devices M, in which a large amount of surface of a good conductor—preferably strips of thin sheet-copper, *m*—is used, the same being placed in parallel between conductors O of very large cross section, said conductors leading from the secondary coils O' of an inductional transformer, Q, which is shown theoretically in Figs. 3 and 4, O' being the secondary coils, *q* the core, and *p* being the primary coils, these latter being connected by circuit-conductors 11 12 with a pole-changer, R, by which the continuous current received from the switch-board H through conductors 13 14 is interrupted and delivered to the primary coils as of alternating polarity.

The ordinary resistance of the translating devices is, as pointed out, extremely low, and the heating-current so large in volume as compared with its electro-motive force that the increased resistance of the radiators due to a rise of temperature beyond a predetermined point will operate to automatically reduce the current flowing after the desired flow of current and the desired temperature has been reached, so that when arranged in parallel, as described, each radiator will, when properly proportioned, itself constitute an automatic regulator.

I find that by making the normal electrical resistance of the heat-developing conductors very low—say from one tenth to one ohm—these exposed conductors being placed in parallel order between supply or main conductors of practically negligible resistance, and by employing as the heat-reducing agency a converted electric current of very large volume or heating capacity, but of extremely low electro-motive force—say from one-half to one volt—the increase in resistance of said heat-developing conductors due to a rise in temperature is proportionately so large as compared with their low normal or cold resistance, and so much greater than it would be in the case of translating devices of higher resistance, as to operate very effectively in maintaining a practically constant working temperature by automatically regulating and controlling the amount of current passing through each. In other words, the current will equalize or distribute itself among the heaters or radiating devices in proportion to their temperature, preventing overheating of such as have nearly reached the desired or predetermined limit of temperature by being diverted through such as may have a lower temperature. For example, where the heaters are arranged in different rooms or compartments, the heat radiated from one may pass off so rapidly as to prevent its temperature rising above a predetermined point, while another similar heater in a place where the heat is retained and the surrounding temperature continuously raised will soon reach the predetermined limit of temperature, at which point the resistance will have increased to such an extent as to divert a large portion of the current that would otherwise pass therethrough, said current finding an easier path through other and less-heated conductors. In addition to the automatic regulation referred to, it will be in some cases found desirable to provide thermostatic cut-outs, substantially as referred to in another application, No. 227,045, filed February 9, 1887.

The pole-changer R is composed of two metallic toothed wheels, *r r'*, respectively, the teeth of the wheels being arranged to intermesh, as shown, and every part of each wheel being thoroughly insulated from the other. The working-conductors 13 14, leading from the source of continuous current, are connected, respectively, to the portions *r r'* of the pole-changer, and the terminals of the primary coils *p* are each provided with brushes

bearing on opposite sides of the periphery thereof. The device as a whole, being continuously rotated in any convenient manner—as, for instance, by means of a separate electric motor or a clock-train—serves to break up and rapidly change the polarity of the previously continuous current as supplied to the primary coils of the transformer.

The foregoing is the arrangement shown in Fig. 1, and also in the diagram Fig. 4. In Fig. 3, however, a slight modification is illustrated, in which the circuit of the pole-changer is by wires 13 14 direct from the generator instead of direct from the switch-board H, which latter is entirely dispensed with. Working-circuit conductors 15 16 are shown in Fig. 3 as leading from the circuit-wires 13 14, and these conductors may lead to a storage-battery or to a lighting-circuit, or, in fact, to any other desired form of apparatus. The generator is in this case operated intermittently only—that is, by the momentum of the train when running without steam from the engine. In case the circuit 15 16 is connected to a storage-battery it will be charged, or partially charged, whenever the generator is in operation, and as soon as the generator ceases to deliver current will proceed to discharge through the pole-changer R, and from there to the primary coils of the inductional transformer Q.

When a storage-battery is placed in the circuit 15 16, a manual or other desired form of switch, *f'*, is included in the main circuit 13 14 between the generator and the said branch 15 16. When the generator ceases to deliver current, the said switch is employed to open the said circuit between the branch and the generator, and the storage-battery is allowed to discharge, its current passing to the pole-changer R, instead of through the armature of the generator, as might otherwise be the case. When, however, the armature of the generator is running at a speed sufficient to produce current of higher electro-motive force than the discharge of the battery, the switch *f'* is employed to close the generator-circuit and the supply of the current to the pole-changer will be direct from the generator. By adjustment of the resistance-switch in the circuit of the pole-changer any desired portion of the main current may be caused to pass through and charge the storage-battery.

The circuits 13 14 of the pole-changers are provided with resistance-switches, by means of which the quantity of said current passing to the interrupter may be limited as desired or stopped entirely.

It will be understood from the foregoing that the system herein described includes the use of a continuous-current generator in combination with translating devices, utilizing both continuous and alternating currents, the object being to enable the various effects described to be produced from the current supplied by one generator, whether the same be a simple dynamo-electric machine mechanically connected to the axle of one of the wheels of a car or of a locomotive, or a large stationary dynamo driven by a separate steam-engine at a central distributing-station, the method and manner of distributing being substantially the same in all the examples referred to.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. The herein-described method of utilizing a continuous current of electricity of relatively high potential and small volume, which consists in transmitting said continuous current from a generating-station over relatively small conductors to one or more points of consumption, converting a portion of said continuous current at the point or points of consumption into one of intermittent or alternating polarity and increasing the volume or quantity of the said current, then passing the converted current through heat-developing conductors in the secondary circuit of the transformer, and in passing the remainder of the continuous current into one or more continuous-current consumption-circuits, as set forth.

2. The herein described method of producing heat from electricity, which consists in generating continuous currents of relatively high electro-motive force and small volume, transmitting said continuous currents over relatively small conductors to a storage battery or batteries located at or near the point or points of consumption, interrupting the current from the storage-battery at the points of consumption, sending said interrupted currents to inductional transformers, and utilizing the secondary currents for the production of heat, substantially as described.

3. In a system of heating cars by electricity, the combination, with a car or cars, of one or more generators arranged to be driven by the momentum of said cars, an inductional transformer or transformers having suitable car-heating devices in the secondary circuits thereof, and a pole-changer in the generator-circuit, whereby the current sent to the primary coils of the transformer is of alternating polarity.

4. The combination, with a source of continuous currents, of a secondary battery located in the external circuit thereof, connections from each of the cells of said battery to a commutator-switch, a distributing-circuit and two or more working-circuits leading therefrom, one of which includes a pole-changer, and an inductional transformer and heating devices in the secondary circuit thereof, and connections between the distributing and commutator switches, whereby any desired portion of the battery may be put in circuit therewith and with either of the consumption-circuits leading therefrom, substantially as described.

5. The combination, with suitable source of continuous currents of electricity, of a secondary battery in circuit therewith, a distributing-switch and connections between the switch and battery, a branch circuit, includ-

ing electric lamps or other translating devices arranged in multiple arc, extending from said switch and another branch extending therefrom and including a pole-changer, an inductional transformer operated by the interrupted current, and heating devices included in a circuit of low resistance extending from the secondary coils of the inductional transformer, substantially as described.

6. The combination, with a suitable source of continuous currents, of a secondary battery connected to said source and arranged to be charged in series, a commutator-switch and separate connections extending from the cells of said battery to said switch, a distributing-switch to which said commutator-switch is connected, whereby any desired portion of the secondary battery may be connected therewith in multiple arc, and consumption-circuits extending from said distributing-switch, one of said circuits including a pole changer, an inductional transformer, and heating devices included in the secondary circuit of the transformer, substantially as set forth.

7. The combination, with a source of continuous currents, of a secondary battery in circuit with said source and arranged to be charged thereby in series, a commutator-switch having terminals connected with each separate cell or group of cells in the battery, a distributing-switch to which the battery-switch is connected, and whereby any desired portion of the cells of the battery may be connected in multiple arc, and a heating-circuit of very low resistance, an inductional transformer, the secondary coils of which are connected with the heating-circuit, the primary coils whereof extend to a pole-changer, and connections between the separate portions of the interrupter and the distributing-switch for supplying the current thereto, substantially as described.

8. The herein-described method of utilizing a continuous current of electricity of relatively high electro motive force and small volume, which consists in transmitting said continuous current over relatively small conductors to a storage battery or batteries located at or near the point or points of consumption, interrupting a portion of the current from the storage-battery, passing the interrupted current through an inductional transformer, whereby they are converted into secondary currents of larger volume and lower electromotive force, and supplying the remaining energy of the storage-battery direct to translating devices utilizing continuous currents, substantially as described.

9. The combination, with a source of continuous current of high tension, of two or more consumption-circuits supplied therefrom and containing translating devices requiring currents of different character or quality, and means, substantially as shown, for interrupting or alternating the currents in one of said circuits without interfering with the continuous flow of current in the remaining circuit or circuits, substantially as described.

10. The combination, with a source of continuous current of high tension, of two or more consumption-circuits supplied therefrom and containing translating devices requiring currents of different character or quality, means, substantially as shown, for interrupting or alternating the currents in one of said circuits without interfering with the continuous flow of current in the remaining circuit or circuits, and an inductional transformer for reducing the electro-motive force of said interrupted or reversed current, substantially as described.

11. In a system of heating by electricity, the combination, with suitable low-resistance supply-conductors, of a plurality of low-resistance heat-developing metallic conductors arranged in multiple arc between said supply-conductors, and adapted to automatically regulate the heat developed in each of said conductors by variation in the flow of current therethrough caused by the change in their respective resistances due to the heat developed, substantially as described.

In testimony whereof I hereto affix my signature in presence of two witnesses.

ELIAS E. RIES.

Witnesses:

CHARLES W. HANDY,

D. C. DIGGES.