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E. M. HEWLETT.

ELECTRIC TRANSMISSION OF POWER.

(Application filed Nov. 23, 1901.)

(No Model.)

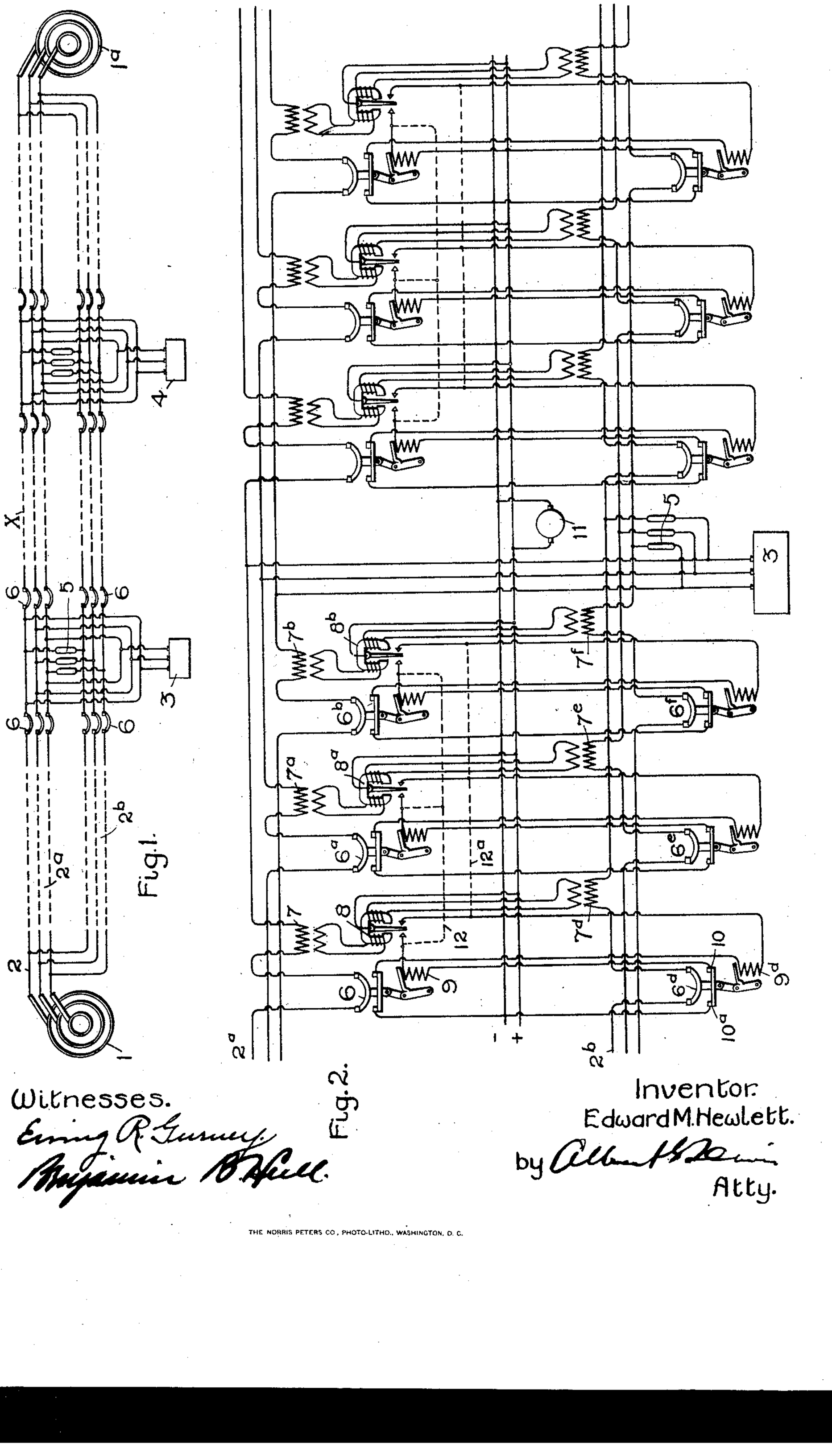

Fig. 1.

Fig. 2.

Witnesses.
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UNITED STATES PATENT OFFICE.

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ELECTRIC TRANSMISSION OF POWER.

SPECIFICATION forming part of Letters Patent No. 706,559, dated August 12, 1902.

Application filed November 23, 1901. Serial No. 83,410. (No model.)

To all whom it may concern:

Be it known that I, EDWARD M. HEWLETT, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Electrical Transmission of Power, (Case No. 2,309,) of which the following is a specification.

In transmitting power over long distances general public annoyance is often occasioned by accidents to the transmitting-lines at points between the source of power and point or points of consumption, and which by reason of the outlying position require considerable time for repairs, during which time of course the light or power supplied the consumers is cut off. In long-distance-transmission systems where high potentials are employed accidents of this character are especially liable to happen, as the insulation is more difficult to maintain and the stretch of line between stations is much longer and more difficult to carefully inspect. Besides the public annoyance by failure of service a danger arises in such systems often from grounded circuits and liability of people or animals coming in contact with the dangerously-charged wires.

It is the object of my invention to remove or at least ameliorate these difficulties, to which end I provide in the region over which energy is distributed duplicate transmission-lines carried to the several subdistributing-points or stations over independent routes as far apart as possible, so that the same disturbing conditions may not exist in both routes at the same time. I provide also at the subdistributing-points means for electrically connecting or tying together the two transmission-lines and automatic apparatus for disconnecting either side of either line with respect to the substation in case of a short circuit, ground, or other serious condition which would interfere with effective service over that line. Thus the several supplied stations are connected together and to the source or sources by lines approaching the stations over different geographical paths connected in multiple, and in case of damage to any part of either route that part is automatically cut out and rendered dead without interruption of service.

My invention embodies various features of novelty relating to such a system, which will be hereinafter more fully indicated.

In the accompanying drawings, Figure 1 is a diagram of a general transmission system embodying my improvements; and Fig. 2 is a similar diagram of part of the system, showing in detail the controlling apparatus at the several distributing-points or substations.

Referring first to Fig. 1, 1 may represent a source of electrical energy located, for example, at a point adjacent to a waterfall or other source of cheap power, and communicating through the usual forms of apparatus with a transmission or distribution circuit 2. This circuit may of course be of any desired character. I have shown by way of example a triphase alternating system. Obviously, however, the character or form of the transmitted energy and the number of wires employed has no significance from an inventive standpoint. I have shown the system as supplying two subpoints of distribution, commonly called "substations," as 3 and 4, and these stations are connected with the source and with one another through duplicate sets of transmission-mains, as indicated at 2^a 2^b. These mains are carried over different routes as far apart as practicable with a view to reasonable economy of installation, and at the several distributing-stations they are cross-connected by switches 5, on either side of which is an automatic switch 6, so controlled that in case of an uneven balance of the distributing-mains that carrying the heavier load will be automatically cut out. Switches of this character are provided on each side of each substation in the system, so that a defective line is opened in the section at which the defect occurs and the remaining part of the system is unaffected. Thus in case a short circuit occurred at the point X between stations 3 and 4 the section of the line 2^a between such stations would be automatically isolated without great increase in the resistance of the transmission system, since all of the parts of the system still have the full carrying capacity of the conductors except the section X. A system of this kind is sufficiently flexible to admit of the use of generators at different points in the system. For example, another generator

1ª might be attached to the other end of the transmission-line or at some intermediate point, if desired, without interfering with the generator 1.

In Fig. 2 I have shown in detail a mode of cutting out any section of the transmission-line which may become disordered. I have shown only one substation 3. Since the arrangements will be precisely alike for all, this will be sufficient. On each side of the station connected in the line I interpose switches, a break for each phase of the triphase system shown being employed, as indicated at 6 6ª 6ᵇ, and I control the operation of these switches or circuit-breakers by means of a relay jointly responsive to the action of both lines. Two of these relays should be used in a triphase system, so as to permit the line-section to be cut out in case of a short circuit or damage to any phase. I connect a series transformer 7 7ª 7ᵇ in each of the phases, the secondary of which connects with a coil on a differential relay 8 8ª 8ᵇ, under the joint influence of a transformer in the line 2ª and one in the line 2ᵇ. Thus so long as both sides of the system are doing their calculated duty the armature of the relay is unaffected; but in case of one side carrying more current than the other, indicating a local interference at some point, the coil on one side of the relay prevails and the armature is drawn toward that coil and closes a contact, including a trip-coil for the circuit-breaker in the overloaded phase and insuring the opening of the disturbed side of the system. A similar outfit is provided for the line 2ᵇ, transformers 7ᵈ, 7ᵉ, and 7ᶠ being connected in the phases of that line. An exactly similar arrangement is provided on the other side of station 3. Let us suppose that a short circuit exists between two of the wires to the left of station 3. The extra load imposed on the transformer 7 or 7ª increases the attractive force of the relay-coil controlled by said transformer and shifts the relay-tongue to the left—say that of 8—thus energizing trip-coil 9 of the circuit-breaker 6 on the disturbed line, opening the circuit, and cutting out the section disturbed. A similar action occurs with any other line on either side of the station.

When a circuit-breaker is tripped and opens one of the phases, the relay having one side killed would immediately reverse and open the corresponding phase on the other side of the system. In order to prevent this, I provide a contact in the trip-circuit governed by the circuit-breaker or relay on the opposite side of the system. For example, trip-coil 9 connects through contacts 10 10ª on the circuit-breaker 6ᵈ of the corresponding phase to 6 on the opposite side of the system, and, conversely, trip-coil 9ᵈ connects through contacts controlled by circuit-breaker 6. If desired, all the phases may be opened when any one is overloaded, in which case all trip-coils on one side may be actuated when any phase is out of balance a determinate amount. Such an arrangement is shown in dotted lines. If any relay-armature is shifted to the left by preponderance of pull of a phase in the upper side of the system, all the breakers 6 6ª 6ᵇ open. If, on the other hand, it shifts to the right by preponderance of pull of a phase in the lower side of the system, the breakers 6ᵈ 6ᵉ 6ᶠ will open, the common connections being effected in the one case by dotted wire 12 and in the other by wire 12ª, as will be evident on inspection of the drawings.

In case the disturbance occurs between stations the circuit is opened at each station and the section cut out and rendered dead. The service is not interrupted or materially disturbed, since the switches 5, which are normally closed, keep both sets of mains in service on each side of the damaged section, whereas one line of the damaged section is in good condition and may remain so until the damaged section is repaired.

I have shown diagrammatically at each station a local source for operating the trip-coils. This may be of any desired character, that shown being a direct current, of one hundred and ten volts, say, furnished by a small direct-current generator 11.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A system for transmitting electric energy, comprising duplicate transmission-mains connected in parallel at the substation or local distributing-point, and differential means responsive to both mains for automatically opening the damaged main in case the two sides become unbalanced.

2. An electrical transmission system comprising a generating-station, a distant distributing-station, multiple transmitting-mains, conductive ties between the multiple mains at one or more points, and a differential device at such points controlled by the mains jointly for opening a main which becomes disproportionately loaded.

3. An electrical transmission system containing multiple transmitting-mains traversing different geographical routes, conductive ties between the different mains at a protected point or points, and means responsive to an unbalancing of the mains for opening the defective main in the region of the disturbance.

4. An electrical transmission system comprising a source of energy and a distributing system containing duplicate transmitting-mains, a differential relay at or near a protected point controlled by the joint effect of the two mains, and a circuit-breaker in each main actuated by the relay when the main in which the circuit-breaker is connected carries a disproportionate load with respect to its companion main.

5. An electrical transmission system comprising a source of energy, duplicate transmitting-mains, one or more substations, conductive ties between the mains at the substa-

tions, relays controlled by the joint effect of the duplicate mains, circuit-breakers at each side of the conductive tie, and connections with the relays for opening the circuit of the disturbed main at that side of the tie in which the disturbance occurs.

6. An electrical transmission system comprising a polyphase alternating-current generator, duplicate distributing-mains traversing different geographical routes, conductive ties at different points between the termini of the system, circuit-breakers for the different phases on each side of a tie, and differential relays controlled by the joint effect of the duplicate mains at each side of a tie for opening the circuit of a disturbed section of the transmitting-main.

7. An electrical transmission system comprising a polyphase alternating-current generator, duplicate distributing-mains cross-connected by conductive ties at points between the termini of the system, current-transformers in different phases at or near such ties, and circuit-breakers in each main governed by the joint effect of coöperating transformers in the duplicate mains to open the main which becomes disproportionately loaded.

8. A polyphase transmission system comprising a generator, duplicate transmission-mains cross-connected by metallic ties at points between termini, series transformers in different phases of each main at or near a tie, differential relays controlled by the joint effect of the duplicate mains, and circuit-breakers in each main opened by the relay when the main in which the circuit-breaker is connected is disproportionately loaded.

9. An electrical transmission system comprising a source of energy, and a distributing system containing duplicate transmitting-mains, a differential relay at or near a protected point controlled by the joint effect of two corresponding mains, a circuit-breaker in each main tripped by the relay, and means for disabling the circuit-breaker in the duplicate line when its companion operates.

10. An electrical transmission system comprising a source of energy, and a distributing system containing duplicate transmitting-mains, a differential relay at or near a protected point controlled by the joint effect of two corresponding mains, a circuit-breaker in each main tripped by the relay, and a contact in each trip-circuit opened when the companion circuit-breaker operates.

In witness whereof I have hereunto set my hand this 22d day of November, 1901.

EDWARD M. HEWLETT.

Witnesses:

BENJAMIN B. HULL,

MARGARET E. WOOLLEY.