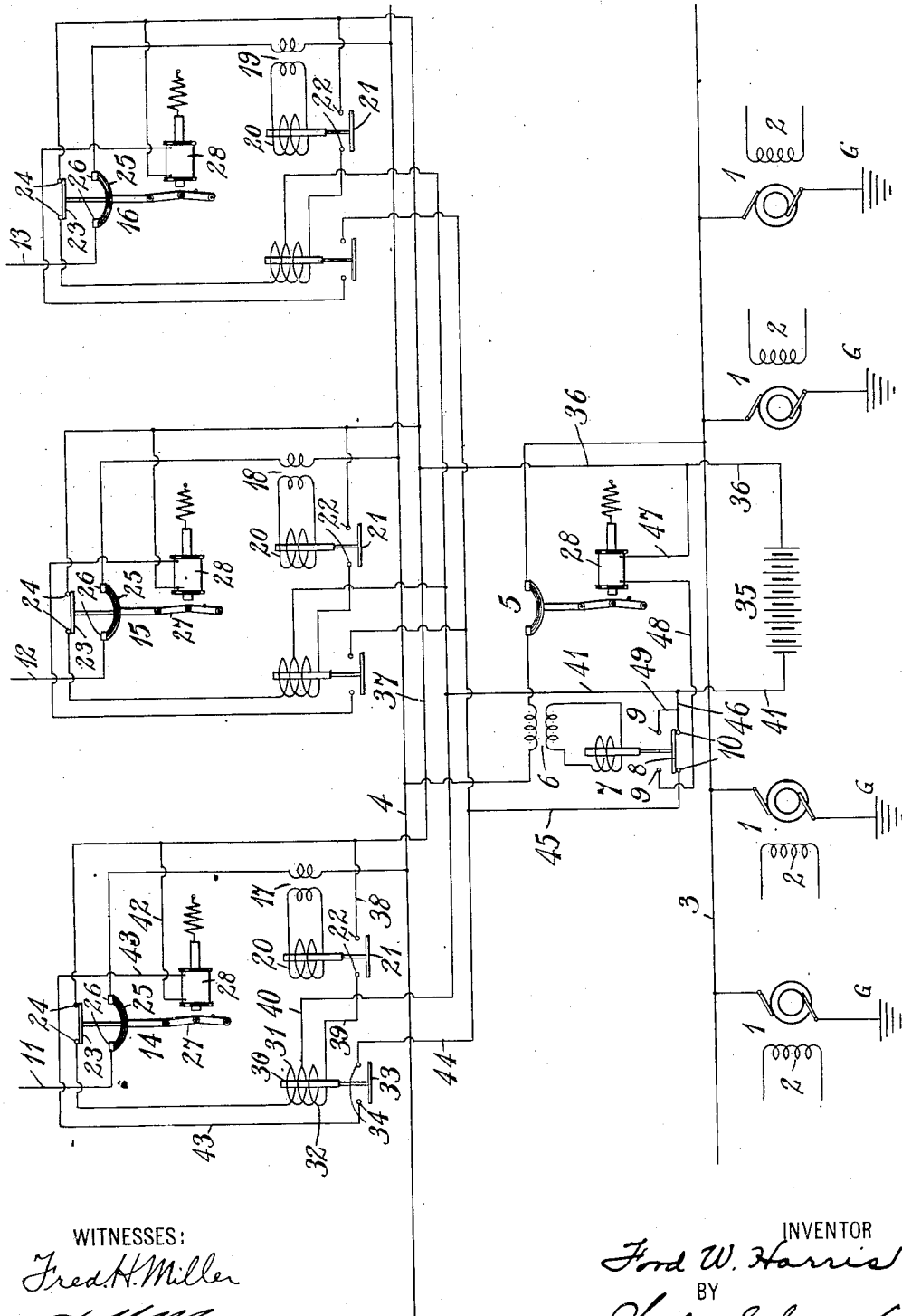


F. W. HARRIS.
SYSTEM OF DISTRIBUTION.
APPLICATION FILED MAR. 13, 1911.

1,173,569.

Patented Feb. 29, 1916.



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SYSTEM OF DISTRIBUTION.

1,173,569.

Specification of Letters Patent.

Patented Feb. 29, 1916.

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To all whom it may concern:

Be it known that I, FORD W. HARRIS, a citizen of the United States, and a resident of Wilksburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Systems of Distribution, of which the following is a specification.

My invention relates to systems of electrical distribution, and particularly to such systems as are adapted to supply energy from a common distributing bus-bar to a plurality of feeder circuits.

The object of my invention is to provide a system of the above-indicated character that shall be simple in arrangement and operation, and shall embody a circuit interrupter in each feeder circuit, an auxiliary circuit interrupter of relatively large capacity connected in series between the distributing bus-bar and the source of energy, and automatic means for selectively opening said feeder interrupter or auxiliary interrupters in accordance with predetermined overload conditions.

In power stations of large capacity, it is the usual practice to provide each feeder circuit with an individual interrupter which is required to handle all overloads, irrespective of the degree thereof. Hence, the feeder interrupters which are designed and constructed to operate on moderate overloads are required to interrupt the circuits under particularly excessive demands and short circuits. It follows that such interrupters are subjected to very severe operating conditions and are frequently badly damaged or completely destroyed when opening abnormal amounts of power for which they are not designed. The cost of the repair and maintenance of such apparatus is great and it is to reduce such expense that my invention is intended.

According to my present invention, I provide each feeder circuit with an individual circuit interrupter of such capacity as to successfully handle moderate overloads, while I employ an auxiliary circuit interrupter of relatively large capacity which I connect in series between the distributing bus-bar and the source of energy, said interrupter being adapted to interrupt the circuit under conditions of particularly excessive overloads or short circuits.

In order to relieve the feeder circuit

breakers from handling overloads in excess of their capacity, I provide suitable series transformers, relays and switching devices whereby I selectively open the feeder interrupters or the auxiliary interrupter in accordance with the degree of overload.

The single figure of the accompanying drawing is a diagrammatic view of a system of distribution which embodies my invention.

Referring to the drawing in detail, a plurality of generators 1, having ground connections at G, and field magnet windings 2, are connected to a common generator bus-bar 3 from which energy is delivered to a distributing bus-bar 4, through an auxiliary interrupter 5 and the primary winding of a series transformer 6, the secondary winding of which is adapted to energize a relay 7 in accordance with predetermined circuit conditions. The relay 7 is provided with a switch member 8 and upper and lower contact terminals 9 and 10, respectively.

The distributing bus-bar 4 is connected to a plurality of feeder circuits 11, 12 and 13, through interrupters 14, 15 and 16 and through the primary windings of series transformers 17, 18 and 19. The secondary winding of each of the series transformers 17, 18 and 19 is adapted to energize a primary relay 20 which carries a switch member 21 to engage contact terminals 22.

The circuit interrupters 5, 14, 15 and 16 are of like construction, except that the interrupters 14, 15 and 16 are of much lighter construction and are severally provided with auxiliary switch members 23 and cooperating contact terminals 24. Each interrupter comprises a bridging contact member 25, cooperating stationary contact members 26, an operating mechanism 27 and a trip coil 28, and may be adjusted to open automatically under any desired overload for which it is designed. The ultimate breaking capacity of the auxiliary interrupter 5 is sufficient to permit the interrupter to successfully open the most severe short circuits upon the system, while the capacity of the feeder interrupters is only sufficient to accommodate moderate overloads. The feeder interrupters are intended to be adjusted to handle the usual overloads while the auxiliary interrupter 5 is adjusted to open under all demands which exceed the amount for which the feeder interrupters

are set. It should be understood that these interrupters form no part of my invention, except as they perform a necessary function in the operation of the system, and, hence, any other suitable devices for accomplishing the same purpose may be employed.

Coöperating with each primary relay 20, is a secondary relay 30 which is provided with a holding winding 31, a closing winding 32, a switch member 33 and coöperating contact terminals 34. Each holding winding 31 is so connected in circuit that it is energized whenever the feeder circuit interrupter with which it is associated is closed, although not sufficiently energized to raise the core 30, while the closing coil 32 is dependent for energization upon the action of the primary relay 20, and when so energized, is adapted to actuate the core 30.

The circuit connections and mode of operation of the system is as follows: Assuming the circuit connections, switching devices, etc., to occupy the positions shown in the drawing and that a moderate overload exists upon the feeder circuit 11, energy is immediately supplied from the distributing bus-bar 4, through the primary winding of the series transformer 17, to the feeder circuit. It is evident that, if the current traversing the secondary winding of the series transformer 17 exceeds the predetermined amount for which the relay is adjusted, said relay is energized and causes the switch member 21 to engage its coöperating contact terminals 22, thereby completing a circuit from the positive side of a battery 35, or other suitable source of energy, through a conductor 36, conductor 37, conductor 38, switch members 21 and 22, conductor 39, closing coil 32, conductor 40, and conductor 41 to the negative side of the battery. Thus, the closing coil 32 of the secondary relay 30 is sufficiently energized to raise the switch member 33 into engagement with the contact terminals 34 in which position it is held by the holding coil 31. A circuit is then completed from the positive side of the battery 35, through conductor 36, conductor 37, conductor 42, trip coil 28, conductor 43, switch members 33 and 34, conductor 44, conductor 45, switch members 8 and 10, conductor 46, and conductor 41 to the negative side of the battery 35. Upon the completion of the circuit just traced, energy is supplied to the trip coil 28 of the circuit interrupter 14 and said interrupter is opened in the usual manner, thereby disconnecting the feeder circuit 11 from the rest of the system. As soon as the interrupter 14 is opened, the current in series transformer 17 falls to zero and the switch member 21 associated with the primary relay 20 is dropped into its open position, thereby opening the circuit through the closing coil 32 of the secondary

relay 30. At the same time, the switch member 23 is dropped out of engagement with its contact terminals 24, and the circuit through the holding coil 31 of the secondary relay 30 is interrupted, thus allowing the switch member 33 to fall to its initial open position.

It is seen from the foregoing description that each of the feeder circuits may be selectively disconnected from the system by means of its associated feeder circuit interrupter under conditions of ordinary overload for which it is adjusted.

Assuming that an excessive overload or severe short-circuit exists upon the feeder circuit 11, said overload being in excess of the value for which the auxiliary circuit interrupter 5 is adjusted, the operation of the system is as follows: Upon the first rush of current through the series transformers 6 and 17, the relays 7 and 20, respectively, are energized simultaneously. The switch member 8 is drawn away from its lower contact terminals 10 and into contact with its upper contact terminals 9, to complete a circuit from the positive side of the battery 35, through conductor 36, conductor 47, trip coil 28 of the auxiliary interrupter 5, conductor 48, switch members 8 and 9 and conductors 49, 46 and 41 to the negative side of the battery. Energy is thereby supplied to the trip coil 28 and the auxiliary circuit interrupter 5 is caused to open and thus interrupt the abnormal overload.

It has already been pointed out that the primary relay 20 is energized concurrently with the relay 7. Its switch member 21 is thereby raised into contact with contact terminals 22 to establish a circuit through the closing coil 32 of the secondary relay 30, in the manner hereinbefore described. When the closing coil 32 is energized, switch member 33 is caused to engage its contact terminals 34, as already set forth and is held in engagement by holding coil 31 as long as the interrupter 14 is closed. However, inasmuch as the time consumed in operating the two relays 20 and 30 is in excess of that required to effect the operation of the single relay 7, it is evident that the switch member 8 of the relay 7 is disengaged from its lower contact terminals 10 at the time when the switch member 33 of the secondary relay 30 makes contact with its contact terminals 34. Hence, no circuit is established through the trip coil 28 of the feeder interrupter 14 and the interrupter 14 is not opened until the cessation of the current through the series transformer 6, by reason of the opening of the auxiliary interrupter 5, allows the relay 7 to drop its associated switch member 8 into contact with the lower contact terminals 10. As soon as this coöperative engagement is effected, energy is supplied to the trip coil 28 of the feeder

interrupter 14, through the circuit hereinbefore traced. The interrupter 14 is thereby opened to disconnect the feeder circuit 11 from the system subsequently to the initial interruption of the main circuit through the agency of the auxiliary circuit interrupter 5. It is evident then, that the feeder interrupter 14 is protected from opening an overload in excess of that for which it is adjusted and designed.

When the interrupter 14 is opened, energy is cut off from the holding coil 31 of the secondary relay 30 by reason of the disengagement of the switch member 23 from its cooperating contact terminals 24. The secondary relay 30 is thereby deenergized, it being understood that the closing coil 32 thereof was deenergized through the agency of the primary relay 20 when the current was cut off from the series transformer 7 by reason of the opening of the interrupter 5. Hence, the switch member 33 is disengaged from its contact terminals 34 and the supply of energy to the trip coil 28 of the interrupter 14 is discontinued. The auxiliary interrupter 5 may then be closed and the normal operation of the system resumed, except on the feeder 11 which sustained the overload and which remains segregated from the distributing bus-bar 4 by reason of the open position of the feeder interrupter 14. Thus, the defective feeder is indicated by the position of its own feeder interrupter.

Although I have described the operation of the system in connection with an overload upon a single and a particular feeder circuit, it is evident, since all of the feeder trip coil circuits are interlocked with the lower contact terminals 10 of the relay 7, that the system will operate in a similar manner if a plurality of feeder circuits are overloaded or if any other particular feeder circuit is similarly affected.

In certain classes of power systems, it may be found expedient to so modify and rearrange the system hereinbefore set forth in detail that each feeder circuit shall be provided with a plurality of series-connected interrupters of different capacities which may be selectively operated in a manner similar to that described, such modifications in the arrangement of circuits and auxiliary devices being within the province of those skilled in the art. I have shown and described the system in connection with single-phase or direct-current distribution, but it will be readily understood that poly-phase systems may be conveniently arranged to embody my invention without exceeding the spirit and scope thereof.

I claim as my invention:

1. The combination with a source of energy, a plurality of feeder circuits, a circuit interrupter in each feeder circuit, and a circuit interrupter of relatively large ca-

capacity between said source and said feeder interrupters, of means for opening said large capacity interrupter under excessive overloads and subsequently selectively opening the overloaded feeder circuit interrupters and for opening the overloaded feeder circuit interrupters under relatively small overloads.

2. The combination with a source of energy, a distributing bus-bar, a plurality of feeder circuits connected thereto, a circuit breaker for each feeder circuit, and a relatively large-capacity circuit breaker in the circuit between said source and said bus-bar, of relays associated with the respective feeder circuits and with said circuit between said source and said bus-bar for opening said large-capacity breaker under total overloads in excess of a predetermined amount and for subsequently opening the circuit breakers associated with the overloaded feeders, and for selectively opening the breakers associated with the overloaded feeders when the total overload is less than a predetermined amount.

3. The combination with a source of energy, a plurality of feeder circuits, a circuit breaker for each feeder circuit, and a relatively large-capacity circuit breaker connected in series between said source and said feeder breakers, of electro-responsive means for opening said large capacity breaker under predetermined overload conditions and for subsequently selectively opening the overloaded feeder breakers.

4. A distributing system comprising a source of energy, and a plurality of feeder circuits, a plurality of feeder circuit breakers, an auxiliary circuit breaker in series between said source and said feeder breakers, a main relay dependent upon the current through said auxiliary breaker for tripping said breaker, a primary relay associated with each feeder circuit and dependent upon the current therein, and a secondary relay for each feeder circuit and dependent upon the operation of said main relay and said associated primary relay for tripping said feeder breaker.

5. A distributing system comprising a source of energy, a plurality of feeders, a circuit breaker for each feeder, an auxiliary circuit breaker in series between said circuit breaker and said source, two cooperating relays associated with each feeder breaker for tripping said feeder breaker, a holding coil and a closing coil for one of said relays, said holding coil being normally energized, and a single relay associated with said auxiliary circuit breaker for tripping said breaker under predetermined load conditions, said relay being interlocked with the trip coil of each feeder circuit breaker.

6. A distributing system comprising a source of energy, a plurality of feeder cir-

cuits, a plurality of feeder circuit breakers,
an auxiliary circuit breaker connected be-
tween said source and said feeder breakers,
electro-responsive means for opening said
5 feeder breakers under predetermined load
conditions, electro-responsive means for
opening said auxiliary breaker independent
of said feeder breakers under other prede-
termined load conditions, and means for
10 precluding the prior operation of said

feeder breakers under said last predeter-
mined load conditions.

In testimony whereof, I have hereunto
subscribed my name this 7th day of March,
1911.

FORD W. HARRIS.

Witnesses:

J. L. EDWARDS,

B. B. HINES.