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L. WILSON.

PARALLEL FEEDER PROTECTION.

APPLICATION FILED JULY 16, 1903.

NO MODEL.

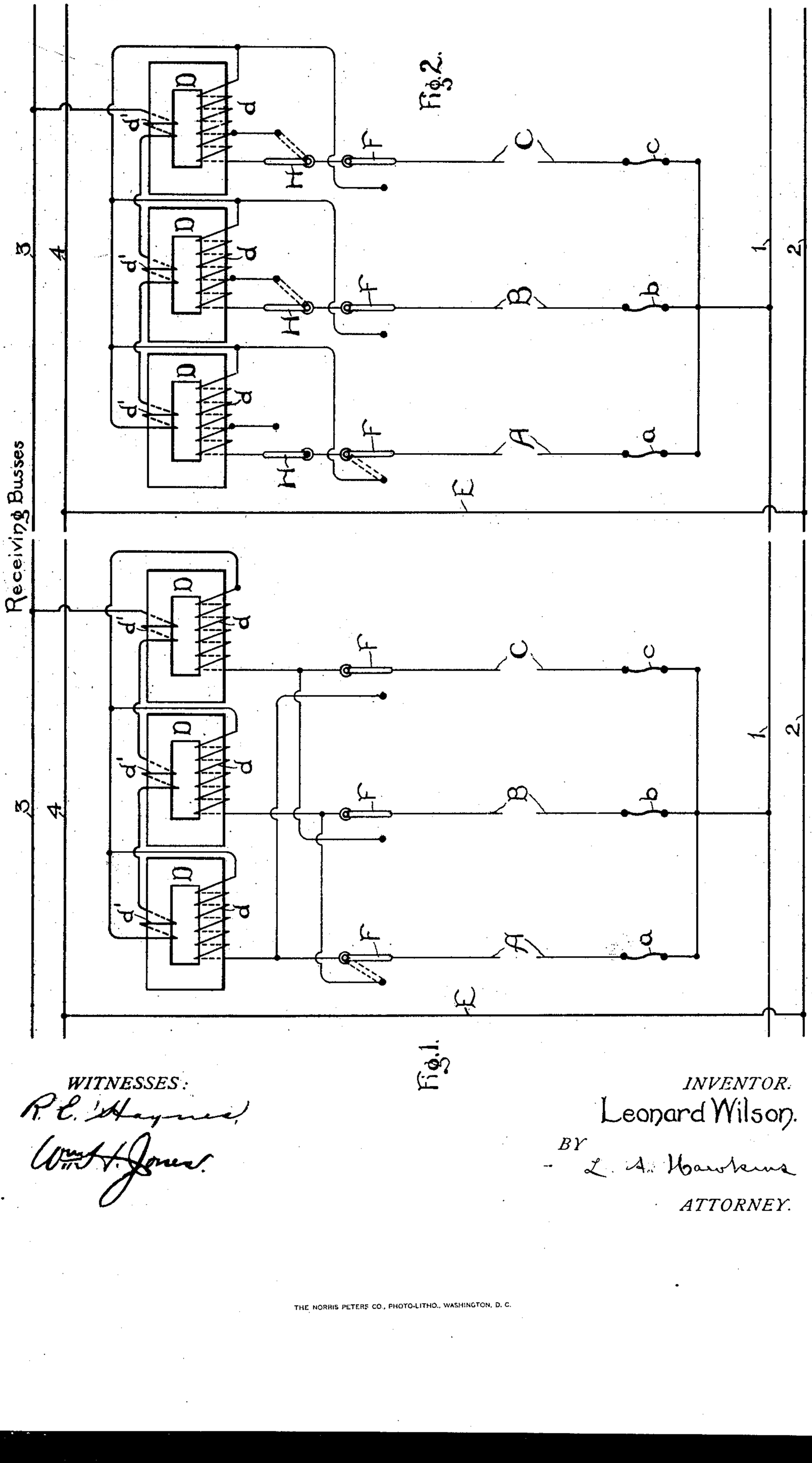

Fig. 1.

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UNITED STATES PATENT OFFICE.

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PARALLEL-FEEDER PROTECTION.

SPECIFICATION forming part of Letters Patent No. 751,595, dated February 9, 1904.

Application filed July 16, 1903. Serial No. 165,848. (No model.)

To all whom it may concern:

Be it known that I, LEONARD WILSON, a subject of the King of England, and a resident of Pittsfield, Massachusetts, have invented certain new and useful Improvements in Parallel-Feeder Protection, of which the following is a specification.

My invention relates to protective devices for systems of distribution, and especially for such systems as employ feeders, connected in parallel both at the generating and distributing end. In such systems it is important that if one feeder becomes short-circuited a rush of current from the healthy feeders to the faulty feeder should be prevented in order that the fuses or other protective devices may not open the circuit of all the feeders, and thus produce a shut-down of the system. In United States Patent No. 726,837, issued to Leonard Andrews under date of May 5, 1903, the use of discriminating choke-coils is explained for the purpose of preventing excessive current. The arrangement described in this patent, though very simple in its application to two feeders and though applicable with modifications to any number of feeders, nevertheless in the latter case introduces certain complications because of the necessary difference in size in the various choke-coils used.

The object of my invention is to provide means of equal simplicity for any number of feeders for preventing the rush of current in such a system.

In the accompanying drawings, Figure 1 shows an arrangement embodying my invention, and Fig. 2 shows a modification of the same.

Referring to the drawings, 1 2 represent the bus-bars at the generating-station, and 3 4 the bus-bars at the receiving-station. Feeders A B C are connected through fuses *a b c* or other protective devices in parallel to bus-bar 1. The other ends of feeders A B C are connected through the discriminating or differential choke-coils D to bus-bar 3.

E represents the main of opposite polarity, the parallel feeders and the protective devices for this main being omitted for the sake of simplicity. Each of the choke-coils D has two windings, one winding, *d*, being in series with its feeder. The other winding, *d'*, is in series with all three feeders and has only one-third as many turns as winding *d*. Thus the ampere-turns of the two windings are equal and are so arranged that under normal circumstances they neutralize each other, and consequently the choke-coils D offer no impedance to the flow of current from the feeders A B C to bus-bar 3. If, however, one of the feeders, as A, becomes short-circuited, the fuse *a* will blow, disconnecting the feeder from generator bus-bar 1. When current flows from the healthy feeders B C back through feeder A to the short circuit, the current in winding *d* of the choke-coil of feeder A will be reversed relatively to the currents in windings *d* of the other choke-coils, and the current will be equal in magnitude to the sum of the other two currents. The electromotive force induced in coil *d'* by coil *d* of feeder A will be opposed in direction to and twice as great in magnitude as the electromotive forces induced in the other coils *d'*. The effect on windings *d'* in series in the three choke-coils will therefore be neutralized and for the present may be left out of consideration. The full impedance of winding *d* of the choke-coil of the feeder A will be placed in series with the impedance of the windings *d* of feeders B C in parallel, thus offering a check to the rush of current and preventing the blowing of fuses *b* and *c*. The drop in voltage across the choke-coil of feeder A will be twice that across the choke-coils of feeders B and C in parallel. If the choke-coils are of sufficient capacity so that the current flowing back through feeder A to the short circuit is limited to the full-load current of the feeder, then the drop on bus-bars 3 and 4 will be equal to one-third of the original voltage. The reason for this is that since the choke-coils prevent an abnormal flow of current only the drop in the choke-coils themselves need be considered, and this

drop is approximately equal to the full-line voltage. Since two-thirds of this voltage drop is across the choke-coil *d* of feeder A and since the bus-bars 3 and 4 are placed by the short circuit of feeder A, in shunt to the choke-coil *d* of feeder A the voltage on the bus-bars is approximately two-thirds of normal. Thus the drop at the bus-bars due to the short circuit is about one-third of the original voltage. It is evident that as the number of feeders is increased this drop will become smaller, in every case being equal to one divided by the number of parallel feeders. With a large number of feeders in parallel this drop will consequently be negligible and will in no way interfere with the operation of the system. With a comparatively small number of feeders, however, as shown in the drawings, this drop can be eliminated by restoring the balance of the choke-coils, and thus destroying their impedance. In order to accomplish this result, switch F in the circuit of feeder A is thrown over, as shown in the dotted lines, to the auxiliary contact connected with feeder B. This places two choke-coils in parallel with feeder B. Feeder B will then take two-thirds of the current and feeder C the remaining one-third. The choke-coils will then be balanced, and the system will continue to operate as before. The switches F in the circuit of the feeders may be operated by hand or by any automatic device, such as those described in Patent No. 726,837, before mentioned.

Where a considerable number of feeders are operated in parallel, any automatic device is entirely unnecessary, since the drop on the receiving bus-bars is so small that it will not interfere with the operation of the system.

Another arrangement of switches for restoring the balance of the choke-coils is shown in Fig. 2. In this arrangement the auxiliary contact of switch F is arranged to short-circuit the winding *d* of the choke-coil, and at the same time by means of switches H one-third of the number of turns of windings *d* in the other two choke-coils are cut out, as shown by the switches in dotted lines. By this means the balance of the choke-coils will be restored and the voltage drop on the receiving bus-bars eliminated. This latter arrangement of switches is preferable as regards CR drop in the feeders, but requires slightly greater complication of switches. Other methods of balancing the choke-coils after the cutting out of the faulty feeder will be obvious to those skilled in the art and require no further illustration.

I do not desire to limit myself to the particular construction and arrangement of parts here shown, since changes therein which do not depart from the spirit of my invention and which are within the scope of the appended claims will be obvious to those skilled in the art.

Having thus fully described my invention, I claim as new and desire to protect by Letters Patent—

1. In combination, parallel feeders, and a choke-coil for each feeder having a number of turns in series with the feeder and a number of turns in series with all the feeders.

2. In combination, parallel feeders, and a choke-coil for each feeder having one winding in series with the feeder and a second winding in series with all the feeders, the ratio of turns of said windings being equal to the number of parallel feeders.

3. In combination, parallel feeders and a choke-coil for each feeder having two opposing windings of normally equal ampere-turns, one of said windings being energized by the current in one feeder and the other by the sum of the currents in all the feeders.

4. In combination, parallel feeders, a choke-coil for each feeder having two opposing windings of equal ampere-turns, one of said windings being energized by the current in one feeder and the other by the current in all the feeders, and means for restoring the balance of the remaining choke-coils when one feeder is cut out.

5. In combination, parallel feeders, and a choke-coil for each feeder having one winding connected between its feeder and a point common to all the choke-coils and a second winding connected in series with the like windings of the other choke-coils to the common point.

6. In combination, a plurality of parallel feeders, and a choke-coil for each feeder having one winding energized by the current in its feeder and a second winding opposing the first and energized by the sum of the currents in all the feeders.

7. In combination, a plurality of parallel feeders, a choke-coil for each feeder having one winding energized by the current in its feeder and a second winding of normally equal ampere-turns opposing the first winding and energized by the sum of the currents in all the feeders, and means for restoring the balance of the windings when one feeder is cut out.

8. In combination, parallel feeders, a choke-coil for each feeder having one winding in series with its feeder and a second winding in series with all the feeders, and means for varying the relative number of turns of said windings.

Signed at Pittsfield, Massachusetts, this 10th day of July, 1903.

LEONARD WILSON.

Witnesses:
L. A. HAWKINS,
R. E. HAYNES.