C. LE G. FORTESCUE.

SYSTEM OF ELECTRIC CURRENT DISTRIBUTION.

APPLICATION FILED NOV. 16, 1911.

1,073,598. Patented Sept. 23, 1913.

Fig. 1.

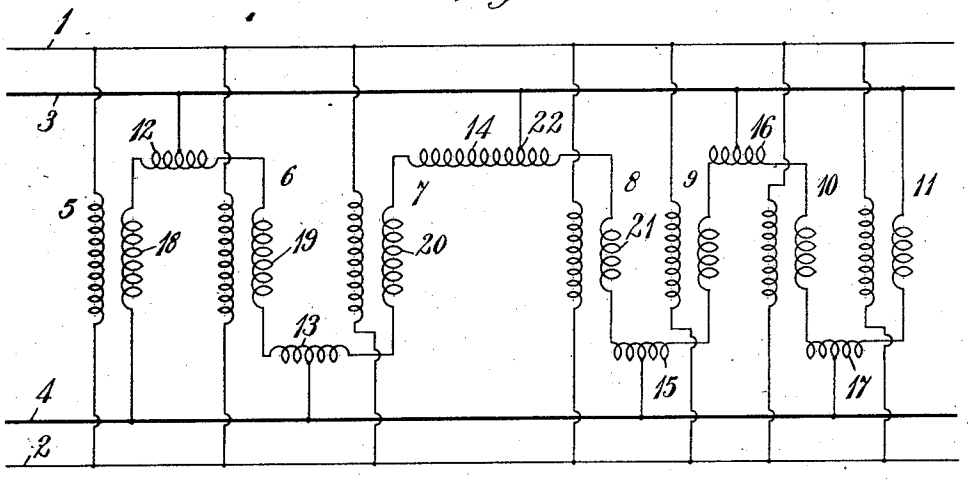


Fig. 2.

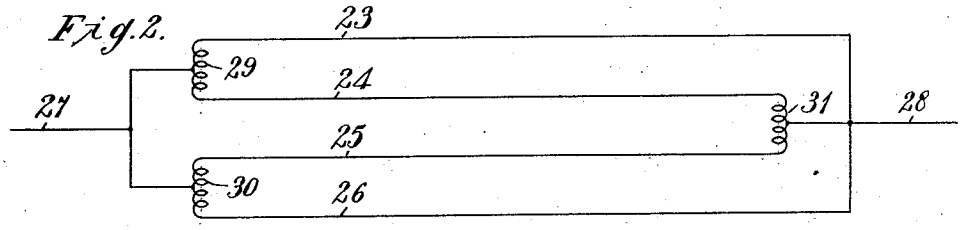
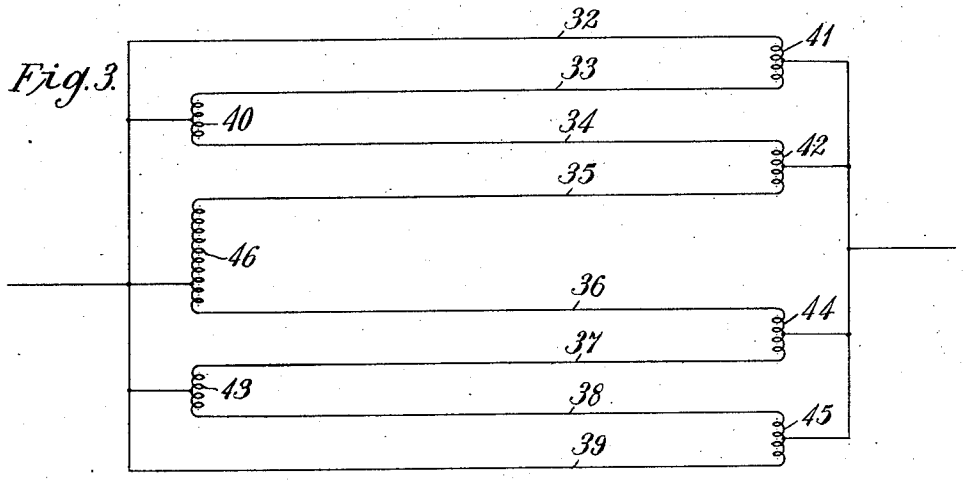


Fig. 3.



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SYSTEM OF ELECTRIC-CURRENT DISTRIBUTION.

1,073,598. Specification of Letters Patent. Patented Sept. 23, 1913.

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To all whom it may concern:

Be it known that I, CHARLES LE G. FORTESCUE, a subject of the King of Great Britain, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Systems of Electric-Current Distribution, of which the following is a specification.

My invention relates to electric current distributing systems which embody a plurality of groups of conductors, transformers, or other electric devices which are connected in multiple-circuit relation.

The object of my invention is to provide simple and relatively inexpensive means for insuring a distribution of current through the several conductors, transformers or other devices arranged in the manner above indicated, according to their several capacities.

In alternating current distributing systems, a plurality of transformers are frequently arranged in multiple circuit relation, and, while they are in some cases all similar to each other, if the number is large, it more often happens that they may be divided into several unlike groups of similar transformers. For example, the transformers may have been purchased in different lots at different times and from different manufacturers of electrical apparatus, so that, even if they are intended to correspond, they seldom do in all particulars. A slight difference in transformer losses or in other particulars may produce a material unbalancing of the currents traversing the transformers.

According to my present invention, I not only provide means for equalizing the currents in each group of similar transformers, but also provide means for properly apportioning the currents traversing the several groups according to their capacities.

My invention is not restricted to transformer systems and may, for example, be used in connection with a plurality of alternating current bus bars or other conductors. As is well known, when a group of alternating current conductors are connected in multiple circuit, the current is not equally distributed among the conductors even if they are similar in every particular, a greater current being carried by the outer conductors of the group. By means of my invention a suitable distribution of current may be maintained.

Figure 1 of the accompanying drawings is a diagrammatic view of the distributing system embodying my invention as applied to transformers. Fig. 2 illustrates my invention applied to a group of similar conductors. Fig. 3 illustrates my invention applied to unlike groups of similar conductors.

Referring to Fig. 1 of the drawings, alternating current energy from any suitable source (not shown) may be supplied at relatively high voltages to line conductors 1 and 2, and be distributed through low-voltage conductors 3 and 4, a plurality of transformers 5, 6, 7, 8, 9, 10 and 11 being interposed for the purpose of effecting the desired change in voltage. Assuming that transformers 5, 6 and 7 are similar to each other and that transformers 8, 9, 10 and 11 are also similar to each other, while the transformers of one of the groups differ somewhat from the transformers of the other group; the transformers of one group will, under usual conditions, be found to take more than their share of the load, and, consequently, I have provided relatively small auxiliary transformers 12, 13, 14, 15, 16 and 17 which may be of the single-winding type as hereinafter pointed out. The transformer 12 is interposed between the terminals of windings 18 and 19 of transformers 5 and 6, transformer 13 is similarly connected between the terminals of windings 19 and 20 of transformers 6 and 7. The transformers 15, 16 and 17 are correspondingly connected relative to the transformers 8, 9, 10 and 11, the middle points of the auxiliary transformers being connected, in each case, to one of the line conductors 3 and 4. The free terminal of the winding 18 is connected to conductor 4 and the free terminal of the corresponding winding of transformer 11 is connected to conductor 3. The free terminal of the winding 20 of transformer 7 is connected to the corresponding terminal of winding 21 of transformer 8, through auxiliary transformer 14, and an intermediate tap 22 in the winding of transformer 14 is connected to line conductor 3. The location of the tap 22 in the winding of transformer 14 depends upon the relative characteristics

of the transformer in the respective groups and, when properly located, insures, in conjunction with the auxiliary transformers 12, 13, 15, 16 and 17 which equalize between the transformers in each group, a proper division of current between the groups.

It may be found desirable to provide several intermediate taps in the winding of the transformer 14, and some suitable means for easily adjusting the connection between the conductor 3 and the transformer taps, in order that it may be possible to obtain the most advantageous distribution of current. The auxiliary transformers may interconnect either the primary windings or the secondary windings of the transformers, and the windings not so interconnected are connected across the line conductors in multiple-circuit relation in the usual manner.

Referring to Fig. 2 of the drawings, a group of similar conductors 23, 24, 25 and 26 are introduced between sections 27 and 28 of a line conductor. In order to insure that each conductor carries its share of the electric current transmitted, auxiliary transformers 29, 30 and 31 are utilized as follows: Transformer 29 is connected across one pair of terminals of the conductors 23 and 24. Transformer 30 is similarly connected across one set of terminals of conductors 25 and 26. Transformer 31 is connected across the free terminals of the conductors 24 and 25. The middle points in transformers 29 and 30 are joined to section 27 of the line conductor, and the middle point of transformer 31, together with the free terminals of conductors 23 and 26, are connected to section 28 of the line conductor.

In Fig. 3 of the drawings, conductors 32, 33, 34 and 35 are similar to each other and constitute one group, while conductors 36, 37, 38 and 39 are also similar to each other and constitute another group. The equalization of current between the conductors of the several groups is respectively effected by auxiliary transformers 40, 41 and 42, and 43, 44 and 45, while a suitable division of current between groups is maintained by auxiliary transformer 46. The transformer 46 corresponds to the transformer 14 of Fig. 1, and its intermediate tap is so connected as to effect the desired division.

The circuit connections of the system illustrated may be varied within the spirit and scope of my invention, and other electrical apparatus may be substituted for the transformers of Fig. 1 and the conductors of the other figures. Consequently, I desire that only such limitations shall be imposed as are indicated in the appended claims.

I claim as my invention:

1. A distributing system comprising unlike groups of electrical devices in multiple circuit relation, current-equalizing means interconnecting the devices of each group and current-apportioning means interposed between the groups.

2. A distributing system comprising groups of transformers, current-equalizing means interconnecting the transformers of each group and current-apportioning means between the groups, the transformers of each group being similar to each other.

3. A distributing system comprising unlike groups of similar transformers, inductive means interconnecting terminals of the transformers of each group in pairs, and an inductive current-apportioning means between groups, the middle points of the inductive means and an intermediate point, other than the middle point, of the apportioning means constituting the terminals of the system.

4. A distributing system comprising groups of similar transformers, inductive means connecting the terminals of the transformers of each group in pairs and a single-winding, auxiliary transformer connected between groups, the middle points of the inductive means and an intermediate point, other than the middle point, of the auxiliary transformer constituting the terminals of the system.

In testimony whereof, I have hereunto subscribed my name this 11th day of Nov., 1911.

CHARLES LE G. FORTESCUE.

Witnesses:
WALTER M. DANN,
B. B. HINES.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents. Washington, D. C."