

No. 771,317.

PATENTED OCT. 4, 1904.

W. S. MOODY.
ALTERNATING CURRENT TRANSFORMER.

APPLICATION FILED JAN. 31, 1903.

NO MODEL.

Fig. 1.

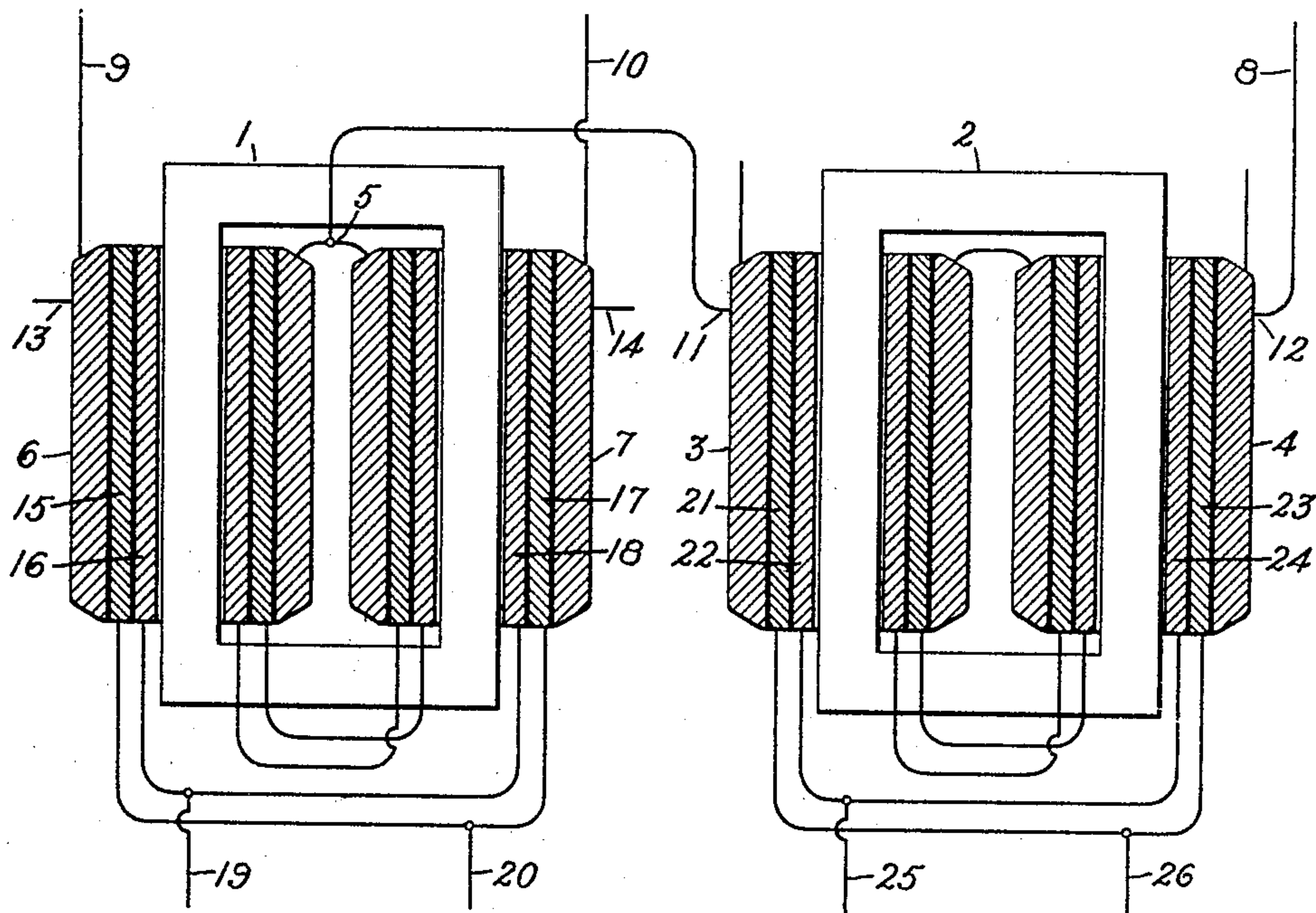
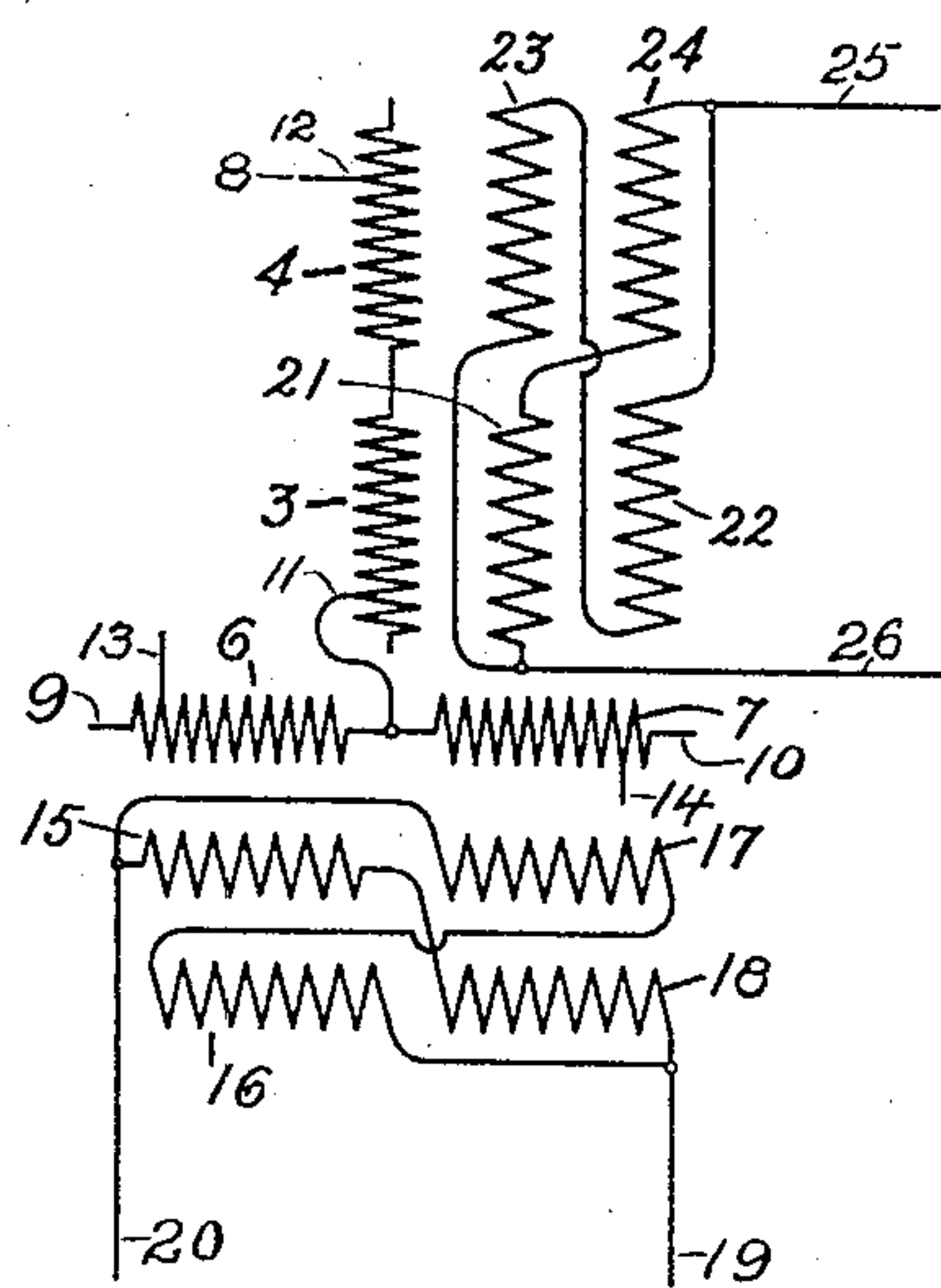


Fig. 2.



Witnesses.

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UNITED STATES PATENT OFFICE.

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ALTERNATING-CURRENT TRANSFORMER.

SPECIFICATION forming part of Letters Patent No. 771,317, dated October 4, 1904.

Application filed January 31, 1903. Serial No. 141,241. (No model.)

To all whom it may concern:

Be it known that I, WALTER S. MOODY, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Alternating-Current Transformers, of which the following is a specification.

My invention relates more especially to alternating-current transformers of the core type, and comprises certain improvements in the arrangement of windings and their inter-connection.

In cases where current flows into or out of the middle or other intermediate point of a winding it is necessary that the current flowing in one portion of the winding toward or from the middle point should neutralize in its magnetic effects the current flowing to or from the middle point in the other half or portion of the winding. This neutralization is ordinarily sufficiently complete in the case of the shell-type transformer if the point at which the current enters is central in the winding-space. In the core-type transformer, however, one half of the winding is placed on one leg of the core and the other half on the other leg. This means that the reactance between the two halves of the winding is very high and that the magnetic effect of the currents in the two halves of the winding would to no great extent be neutralized when the currents in the two halves differ appreciably in value. I have found that the desired result may be secured by making use of multiply-connected windings coöperating with the first-mentioned windings, these multiply-connected windings consisting of two coils on each leg of a transformer, the coils on one leg connected, respectively, in series with the coils on the other leg. The two pairs of sets of coils are then connected in multiple with each other, due to which arrangement any inequality of current between the two halves or portions of the first-mentioned winding has its magnetic effect distributed equally to each of the legs of the transformer-core through the close inductive relation of the multiply-con-

nected coils, which may act as either secondaries or primaries with respect to said winding.

The features of novelty which appertain to my invention I have pointed out with particularity in the appended claims, while the invention itself I have endeavored to make clear in the following specification, which is to be taken in connection with the accompanying drawings, in which—

Figure 1 is intended as an illustration of one of the various embodiments of which it is capable, while Fig. 2 is a simplified diagram of circuits.

In the drawings I have represented my invention as applied to a system of phase transformation in which three-phase current is converted into quarter-phase current, or vice versa. For convenience in speaking of the windings of the transformers used for this transformation I shall refer to some of the windings as "primaries" and the other windings as "secondaries;" but it will readily be understood by one skilled in the art that the flow of energy may be reversed, the coils previously acting as primaries then serving as secondaries, and vice versa.

In the particular system of phase transformation shown in the drawings a primary, or it may be a secondary, of one transformer has one of its terminals connected into the middle point of a corresponding primary or secondary on another transformer. The three remaining terminals are connected to leads, which form a vehicle for three-phase currents. The remaining windings on the two transformers carry quarter-phase currents. The transformer which has one of its windings connected into the middle point of a winding on the other transformer has received the name of "teaser," the other transformer being called the "main" transformer. For purposes of interchangeability these transformers are made identical in construction; but each is provided with taps in its windings, so that it may serve in a manner well understood in the art either as a teaser or as a main transformer.

In Fig. 1 in the drawings the main trans-

former has its core indicated at 1, and the teaser has its core indicated at 2. The teaser-winding consists of two coils 3 4 on the respective legs of the core 2, these coils being
 5 connected in series with each other, with one terminal leading to the junction 5 between two coils 6 and 7, similarly arranged on the core 1 of the main transformer, and the other terminal to one of the three-phase mains or
 10 leads 8. The remaining three-phase leads 9 10 are connected to or constitute continuations of the terminals of the windings 6 7, as indicated. The teaser-winding 3 4 requires to be of less voltage than the voltage of the
 15 winding 6 7 of the main transformer, for which reason the terminals of the coils 3 4 when the latter are used together as a teaser-winding are brought out from the winding at short distances from the ends thereof, as indicated
 20 at 11 12. The windings of the main transformer are provided with similar taps, as at 13 14, so that less than the whole winding may be utilized in case the transformer is used as a teaser.

25 On each leg of the core 1 of the main transformer are provided two secondary windings 15 16 and 17 18. The inside coil 16 on the one leg is connected in series with the outside coil 17 on the other leg of the core, the
 30 remaining coils 15 and 18, which are respectively outside and inside coils, being also connected in series with each other. The two sets of coils thus cross-connected are joined in multiple with each other across two of the
 35 quarter-phase mains 19 20. The four secondary coils 21 to 24, inclusive, on the core 2 of the teaser-transformer are similarly connected to the remaining two-phase mains 25 26.

40 The relations of the windings, which are shown in cross-section in Fig. 1, may perhaps be rendered a little clearer by reference to Fig. 2, in which the teaser and main windings are represented at 3 4 and 6 7, respectively. The corresponding secondary windings on the main transformer are indicated at
 45 15 to 18, inclusive, while the secondary windings on the teaser-transformer are similarly indicated at 21 to 24, inclusive.

By reference to Fig. 2 it will be evident
 50 that idle current flowing in the main winding 6 7 on either side of the junction 5 must operate inductively upon the adjacent secondary windings, thereby giving rise to a corresponding flow of idle current in these windings.
 55 The idle current thus generated in the windings on one leg of the transformer necessarily flows in the corresponding secondary windings upon the other leg of the core, the secondary windings on one core-leg being respectively in series with the corresponding windings on the other leg of the core. The equalization of the magnetizing effects of the primary windings 6 and 7 thus prevents the flow of lagging current in the windings 6 and 7
 65 from raising the voltage in one winding and

lowering it in the other, as would otherwise take place without the use of the means which I have indicated for neutralizing the effects of the currents of the two windings 6 and 7. The connections between the windings 21 to 24 of
 70 the teaser-transformer are not necessary when the transformer is used as a teaser, the coils, however, being connected up, as shown, for sake of simplicity, so that, if desired, the transformer may at any time be used as a main
 75 transformer.

My invention is valuable when used in phase-changing transformers, as above described; but it is capable of useful application in other relations as well, so that I do not
 80 wish to be limited to any greater degree than rendered necessary by the scope of my claims.

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

1. In a transformer of the core type, the
 85 combination of two windings or coils on each leg of the transformer-core connected each in series with a winding or coil on the other leg of the core, connections joining in multiple the two sets of series-connected coils, and a
 90 pair of series-connected coils inductively related to the first-mentioned coils and conveying current through connections made with the terminals of the two coils and with the junction between them.

2. In a core-type transformer, the combination of two series-connected coils or windings, one on each leg of the core of the transformer, a conductor extending from the junction between said coils and adapted to convey
 100 current, a plurality of coils on each leg of the transformer-core, connections for joining in series each of the said plurality of coils on one leg of the core with a coil on the other leg of the core, and connections joining in multiple
 105 the pairs of series-connected coils.

3. In a core-type transformer, the combination of a plurality of coils or windings concentrically arranged on each leg of the core of the transformer, means for connecting a
 110 winding on one leg in series with a winding on the other leg, a conductor extending from the junction between said series-connected windings and adapted to convey current, connections between the remaining windings such
 115 that two windings lying one within the other on one leg of the core are joined to corresponding windings on the other leg of the core, so that the inner winding on each core-leg is in series with an outer winding on the
 120 other, and connections joining in multiple the pairs of windings thus cross-connected.

4. In a core-type transformer, the combination of a primary winding consisting of two coils in series with each other, one on each leg
 125 of the transformer-core, and a secondary winding consisting of two pairs of coils, one pair on each leg of the transformer-core, connections joining in series each secondary coil on one leg with a secondary coil on the other leg
 130

of the transformer-core, and connections joining in multiple the two sets of series-connected secondary coils.

5 In a system of phase transformation, the combination of two transformers having teaser and main windings respectively, and coils on the two legs of the core of each transformer connected in parallel circuit.

10 6. The combination of two transformers of the core type, windings on said transformers

having a terminal of one connected with an intermediate point in the length of the other, and multiply-connected coils on the two legs of the core of each transformer.

In witness whereof I have hereunto set my hand this 28th day of January, 1903.

WALTER S. MOODY.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.