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(54) **STATIC INDUCTION ELECTRIC APPARTUS**

ELEKTRISCHE VORRICHTUNG ZUR STATISCHEN INDUKTION

APPAREIL ÉLECTRIQUE À INDUCTION STATIQUE

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JP-U- S63 124 725

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Description

Technical Field

[0001] The present invention relates to a stationary induction electric apparatus including a tertiary winding for use in aluminum refining and the like.

Background Art

[0002] As this kind of an autotransformer, for example, there has been proposed a single-phase autotransformer including a single-phase three-legged iron core consisting of a main leg and two side legs, in which divided common windings and series windings are arranged on the main leg and on one of the side legs, a tap winding is connected in series to the series windings or the common windings, and a tertiary winding is arranged between the main leg and one of the common windings (for example, see PTL 1).

[0003] In this autotransformer, it is necessary to increase impedance between the tertiary winding and another winding in order to reduce breaking capacity of a cut-off portion of the tertiary winding and suppress an electromagnetic mechanical force due to short-circuit current. Thus, to increase the impedance between the tertiary winding and another winding, impedance of the tertiary winding is made high.

[0004] JP S62 257711 A discloses a transformer with a first ternary winding, a primary winding, a second ternary winding, a tap winding and secondary winding.

[0005] JP S61 46116 A discloses a transformer with a relay device for a transformer.

Citation List

Patent Literature

[0006] PTL 1: JP H05-159948 A

Summary of Invention

Technical Problem

[0007] However, although the conventional technology disclosed in PTL 1 described above is adapted to increase the impedance of the tertiary winding relatively by reducing primary-to-secondary impedance, it cannot meet a request to conversely reduce the impedance of the tertiary winding.

[0008] Accordingly, the present invention has been made in view of the problem of the conventional technology, and it is an object of the present invention to provide a stationary induction electric apparatus capable of reducing inductance of a tertiary winding to near zero.

Solution to Problem

[0009] To achieve the above object, one aspect of a stationary induction electric apparatus according to the present invention is a stationary induction electric apparatus according to claim 1, including a common winding, a series winding, and a tertiary winding arranged on a main leg iron core, in which the tertiary winding is divided, and one of divided tertiary windings is arranged between the common winding and the series winding. Additionally, a three-phase three-legged autotransformer according to the present invention includes the stationary induction electric apparatus including the above structure.

Advantageous Effects of Invention

[0010] In the one aspect of the stationary induction electric apparatus according to the present invention, the tertiary winding is divided, and one of divided tertiary windings is arranged between the common winding and the series winding, whereby separation impedance of the tertiary winding can be reduced to near zero.

[0011] Additionally, in the one aspect of the three-phase three-legged autotransformer according to the present invention, the separation impedance of the three-phase tertiary winding can be reduced.

Brief Description of Drawings

[0012]

FIG. 1 is a structural diagram of a stationary induction electric apparatus according to the present invention;
FIG. 2 is a connection diagram of a U-phase winding in FIG. 1;
FIG. 3 is a connection diagram illustrating one phase of a separate winding transformer which is an illustrative example that does not form part of the present invention;
FIGS. 4A and 4B are diagrams illustrating magnetic flux distributions of FIG. 2 and FIG. 3;
FIGS. 5A and 5B are graphs illustrating impedance characteristics of FIG. 3, in which FIG. 5A is a graph illustrating characteristics of primary-to-secondary impedance, secondary-to-tertiary impedance, and tertiary-to-primary impedance, and FIG. 5B is a graph illustrating characteristics of primary separation impedance, secondary separation impedance, and tertiary separation impedance;
FIGS. 6A and 6B are graphs illustrating impedance characteristics of FIG. 2, in which FIG. 6A is a graph illustrating characteristics of primary-to-secondary impedance, secondary-to-tertiary impedance, and tertiary-to-primary impedance, and FIG. 6B is a graph illustrating characteristics of primary separation impedance, secondary separation impedance, and tertiary separation impedance;
FIG. 7 is a connection diagram illustrating a first modification of the stationary induction electric apparatus according to the present invention; and
FIG. 8 is a connection diagram illustrating a second modification of the stationary induction electric apparatus according to the present invention.

Description of Embodiments

[0013] Next, embodiments of the present invention will be described with reference to the drawings. In the following description of the drawings, the same or similar parts are denoted by the same or similar reference signs.
[0014] In addition, embodiments given below exemplify devices and methods for embodying the technological idea of the present invention, and the technological idea of the invention does not limit the materials, shapes, structures, arrangements, and the like of components to those below. The present invention is only limited by the claims.
[0015] Hereinafter, a description will be given of a stationary induction electric apparatus according to a first embodiment of the present invention with reference to the drawings.
[0016] In the present embodiment, the stationary induction electric apparatus is formed by a three-phase three-legged autotransformer.
[0017] As illustrated in FIG. 1, in a three-phase three-legged autotransformer 10, a three-legged iron core 11, a U-phase winding 12U, a V-phase winding 12V, and a W-phase winding 12W, respectively, are wound on a U-phase main leg iron core 11U, a V-phase main leg iron core 11V, and a W-phase main leg iron core 11W of the three-legged iron core 11.
[0018] The U-phase winding 12U, the V-phase winding 12V, and the W-phase winding 12W have the same structure, and thus, as a representative thereof, the U-phase winding 12U will be described below.
[0019] Specifically, as illustrated in FIG. 2, the U-phase winding 12U includes one divided tertiary winding LTb of a tertiary winding LT divided into two, a common winding LC, a tap winding Ltap, an other divided tertiary winding LTa of the tertiary winding LT, and a series winding LS that are coaxially arranged in this order outwardly on the main leg iron core 11U.
[0020] As illustrated in FIG. 2, connections of the respective windings are made such that a three-phase AC U-phase primary side terminal U is connected to one end of the series winding LS, the other end of the series winding LS is connected to one end of the common winding LC, and the other end of the common winding LC is connected to a middle point O of a star connection via the tap winding Ltap. Then, the tap winding Ltap is provided with an unillustrated tap selector, and a tap selected by the tap selector is connected to a U-phase secondary side terminal u.
[0021] Additionally, one end of the divided tertiary winding LTa of the tertiary winding LT is connected to a terminal a, and the other end of the divided tertiary winding LTa is connected to one end of the divided tertiary winding LTb of the tertiary winding LT, and the other end of the divided tertiary winding LTb is connected to a terminal b. In other words, the divided tertiary windings Lta and LTb are connected in series between the terminals a and b.
[0022] Similarly to the U-phase, also in V-phase and W-phase, the divided tertiary winding LTa, the common winding LC, the tap winding Ltap, the divided tertiary winding LTb, and the series winding LS are arranged on the main leg iron core in this order.
[0023] However, in the V-phase, the divided tertiary windings LTa and LTb are connected in series between terminals b and c, and in the W-phase, the divided tertiary windings LTa and LTb are connected in series between the terminals c and a. Accordingly, the tertiary windings LT of the U-phase, the V-phase, and the W-phase are delta-connected.

[0024] In the present embodiment, the autotransformer is structured such that the two divided tertiary windings LTa and divided tertiary windings LTb formed by dividing the tertiary winding LT into two are connected in series, in which the one divided tertiary winding LTa is arranged between the common winding LC and the series winding LS, and the other divided tertiary winding LTb is arranged between the common winding LC and the main leg iron core 11. By doing this, separation impedance (%Zt) of the entire tertiary winding LT can be set to substantially zero.

[0025] In this case, the separation impedance (%Zt) of the tertiary winding LT can be set to substantially zero by setting the number of turns of each of the divided tertiary windings LTa and LTb to be, for example, 50% when the number of turns of the entire tertiary winding LT is 100%.

[0026] A description will be given of the reason why, in the autotransformer, the separation impedance (% Zt) of the tertiary winding LT can be set to substantially zero, as described above, with reference to a separate winding transformer 20 illustrated in FIG. 3.

[0027] In the separate winding transformer 20, a primary winding L1, a tertiary winding L3, a secondary winding L2, and a tap winding Ltap are coaxially arranged in this order on a main leg iron core 21, as illustrated in FIG. 3. Herein, the primary winding L1 is separated from the primary winding L2. In the separate winding transformer 20, the separation impedance (%Z) of the tertiary winding L3 can be set to substantially zero by arranging the tertiary winding L3 in the intermediate position between the primary winding L1 and the secondary winding L2.

[0028] In other words, the separation impedance (% Z) of each winding is represented by $\%Z \propto n^2 \times L$, where n represents the number of turns, and L represents inter-winding distance, that is, the separation impedance (%Z) is proportional to the product of the square of the number n of turns and the inter-winding distance L.

[0029] Thus, the numbers n of turns of the primary winding L1, the secondary winding L2, and the tertiary winding L3 are set equal, and also an inter-winding distance L13 between the primary winding L1 and the tertiary winding L3 and an inter-winding distance L32 between the tertiary winding L3 and the secondary winding L2 are set equal. Then, when a primary winding-to-tertiary winding impedance is %Z13, a tertiary winding-to-secondary winding impedance is %Z32, and a secondary winding-to-primary winding impedance is %Z21, and if %Z13 = %Z32 = 10%, %Z21 = 20%.

[0030] The total impedance %ZT of all the impedances in this case is as follows:

$$\%ZT = (\%Z13 + \%Z32 + \%Z21) / 2 = (10 + 10 + 20) / 2 = 20\%.$$

[0031] Accordingly, since the value of a tertiary separation impedance %Z3 is obtained by subtracting the secondary winding-to-primary winding impedance %Z21 from the total impedance %ZT, %Z3 = %ZT - %Z21 = 20 - 20 =0.

[0032] As illustrated in FIG. 4A, the leakage magnetic flux distribution of the separate winding transformer 20 has a trapezoidal shape with a long top side between the primary winding L1 and the secondary winding L2, and has a trapezoidal shape with a short top side between the primary winding L1 and the tertiary winding L3 and between the tertiary winding L3 and the secondary winding L2.

[0033] Thus, in the separate winding transformer 20, the impedance %Z3 of the tertiary winding L3 can be made substantially zero by merely arranging the tertiary winding L3 between the primary winding L1 and the secondary winding L2.

[0034] As illustrated in FIG. 5A, the relationship between inter-winding impedance and tap position in this case is such that while the primary winding-to-secondary winding impedance and the secondary winding-to-tertiary winding impedance are both reduced as the tap number decreases from the maximum tap number, the tertiary winding-to-secondary winding impedance has substantially a constant value regardless of the tap number.

[0035] When the impedances of the primary winding L1, the secondary winding L2, and the tertiary winding L3 are separated from the inter-winding impedance characteristics of FIG. 5A, the separation impedance of the primary winding L1 is about 12%, which is constant, and the separation impedance of the secondary winding L2 is irregularly reduced from 12% as the tap number decreases from the maximum tap number. On the other hand, the separation impedance of the tertiary winding L3 is maintained constant at about 2%, which is near zero, regardless of the tap number.

[0036] However, in the autotransformer, the primary winding is formed by a part of the series winding LS and a part of the common winding LC, and the common winding LC forms the secondary winding. In other words, the primary winding is formed by a part of the series winding LS and a part of the common winding LC, and the secondary winding is formed by the common winding LC.

[0037] Due to this, it is impossible to set the separation impedance %Z3 of the tertiary winding LT to substantially zero by only arranging the tertiary winding LT between the common winding LC and the series winding LS, as in the separate winding transformer 20.

[0038] Accordingly, in the present embodiment, the tertiary winding LT is divided into two to form the divided tertiary windings LTa and LTb. The one divided tertiary winding LTa is arranged between the common winding LC and the series winding LS, and the other divided tertiary winding LTb is arranged between the common winding LC and the main leg iron core 11, whereby the impedance %Z3 of the tertiary winding LT can be set to substantially zero.

[0039] As illustrated in FIG. 4B, while the leakage magnetic flux distribution of this autotransformer has a trapezoidal shape with a wide top side between the common winding LC and the series winding LS corresponding to between the primary winding and secondary winding of the separate winding transformer, the magnetic flux distribution thereof corresponding to between the primary winding and the tertiary winding becomes negative in the divided tertiary winding LTb, and has a fluctuation waveform whose peaks are appearing in positions of the tap winding Ltap and the series winding LS between the common winding LC and the series winding LS. The leakage magnetic flux distribution thereof corresponding to between the secondary winding and the tertiary winding becomes negative in the divided tertiary winding LTb, has a positive peak in the position of the common winding LC, and then is reduced to become negative again in the divided tertiary winding LTa, resulting in a fluctuation waveform. In any case, the leakage magnetic flux distribution exhibits irregularity.

[0040] In accordance with this, in the impedance distribution of the U-phase winding 12U, inter-winding impedances respectively corresponding to impedance between the primary winding and the secondary winding and impedance between the secondary winding and the tertiary winding gently increase in sawtooth waveforms as the tap number decreases, whereas impedance between the tertiary winding and the primary winding is constant at about 15%, as illustrated in FIG. 6A.

[0041] As illustrated in FIG. 6B, in an impedance distribution obtained by separating a separation impedance (%Z1) corresponding to the primary winding, a separation impedance (%Z2) corresponding to the secondary winding, and the tertiary separation impedance (%Z3) corresponding to the tertiary winding from the impedance distribution of FIG. 6A, the separation impedance (%Z1) corresponding to the primary winding L1 gently increases as the tap number decreases, whereas the separation impedance (%Z2) corresponding to the secondary winding L2 increases while fluctuating in a sawtooth waveform. On the other hand, the separation impedance (%Zt) of the tertiary winding LT corresponding to the tertiary winding L3 gently decreases as the tap number decreases from 2.5% at the maximum tap number, and can be substantially zero when the tap number becomes half or less.

[0042] The separation impedance %Zt of the tertiary winding LT can be adjusted in accordance with the number of turns of the entire tertiary winding LT and the individual numbers of turns of the divided tertiary windings LTa and LTb.

[0043] Herein, in the case of setting the separation impedance (%Zt) of the tertiary winding LT to substantially zero, numbers na and nb of turns of the divided tertiary windings LTa and LTb are set to 50% each so that na = nb, whereby the separation impedance (%Zt) can be set to substantially zero, which is a minimum value. The reason for this is that by equalizing the numbers of turns of the divided tertiary windings LTa and LTb, outer diameters of the divided tertiary windings LTa and LTb become equal, distances between the divided tertiary winding LTa, the tap winding Ltap, and the series winding LS become equal, and also, a distance between the divided tertiary winding LTb and the common winding LC become equal.

[0044] However, when the numbers of turns of the divided tertiary windings LTa and LTb are made different, the distances between the divided tertiary windings LTa and LTb and the windings adjacent thereto become different, whereby the separation impedance of the tertiary winding LT has a larger value than the minimum value.

[0045] However, the tertiary separation impedance (%Zt) of the tertiary winding LT can be finely adjusted by making the numbers of turns of the divided tertiary windings LTa and LTb different. In this case, an extreme difference between the numbers of turns of the divided tertiary windings LTa and LTb causes a loss of balance, which affects the reduction of the tertiary separation impedance (%Zt). Thus, the maximum range of difference between the numbers of turns of the divided tertiary windings LTa and LTb is preferably about 60% to 40%.

[0046] In this case, when finely adjusting each impedance without changing the number of turns of each winding, the number of turns of any one of the divided tertiary winding LTa and LTb is increased.

[0047] Additionally, setting of the tertiary separation impedance (%Zt) of the tertiary winding LT to substantially zero is not limited to being determined by only the numbers of turns of the divided tertiary windings LTa and LTb. The tertiary separation impedance (%Zt) may be controlled by setting the numbers of turns so that the tertiary separation impedance of the tertiary winding LT becomes negative and connecting a current limiting reactor to the tertiary winding LT.

[0048] As described above, in the autotransformer of the first embodiment, one of the divided tertiary windings LTa and LTb obtained by dividing the tertiary winding LT into two is arranged between the common winding LC and the series winding LS, and the other one thereof is arranged between the common winding LC and the main leg iron core 11, whereby the tertiary impedance of the entire tertiary winding LT can be set to substantially zero.

[0049] In this case, by connecting the divided tertiary windings LTa and LTb in series, the tertiary separation impedance can be adjusted not only in the case of setting the ratio between the numbers of turns of the divided tertiary windings LTa and LTb to 50%, which is equal to each other, but also in the case of setting the numbers of turns thereof different, so that great flexibly in setting the tertiary separation impedance can be provided.

[0050] In addition, by arranging the common winding LC on the inner side and the series winding LS on the outer side, it is necessary to increase an insulation distance in the series winding LS to which a primary side high voltage is applied. However, only the insulation distance on the inner side needs to be considered, so that the outer diameter of the autotransformer can be reduced.

[0051] Incidentally, in an illustrative example that does not form part of the present invention, the series winding LS can be arranged on the inner side, and the common winding LC can be arranged on the outer side. In this case, it is necessary to increase inner and outer insulation distances between the series winding LS and the divided tertiary windings LTa and LTb, which increases the outer dimeter of the autotransformer.

[0052] Note that while the above embodiment has described the case where the divided tertiary windings LTa and LTb are connected in series, the invention is not limited thereto, and the divided tertiary windings LTa and LTb can be connected in parallel. In this case, it is necessary to equalize the numbers of turns of the divided tertiary windings LTa and LTb. Additionally, since the tertiary currents are in parallel, currents flowing through the divided tertiary windings LTa and LTb may be set to half of a value in the case of series connection, and the numbers of turns thereof may be set to a value twice that in the case of series connection. However, when connecting the divided tertiary windings LTa and LTb in parallel, it is necessary to be careful not to cause current imbalance.

[0053] In addition, the above embodiment has described the case where, in FIG. 2, the other end of the divided tertiary winding LTa is wired to the divided tertiary winding LTb by passing around the series winding LS and passing over the divided tertiary winding LTa, the tap winding Ltap, and the common winding LC. However, the present invention is not limited to the above structure. As illustrated by a dotted line in FIG. 2, reversing the winding direction of the divided tertiary winding LTb allows for wiring from the divided tertiary winding LTa to the divided tertiary winding LTb by passing under the tap winding Ltap and the common winding LC.

[0054] Additionally, while the above embodiment has described the case where the tap winding Ltap is arranged between the common winding LC and the divided tertiary winging LTa, the present invention is not limited thereto. As illustrated in FIG. 7, the tap winding Ltap may be arranged between the common winding LC and the divided tertiary LTb. Alternatively, as illustrated in FIG. 8, the tap winding Ltap may be divided into two and arranged inside and outside the common winding LC. In this case, the divided tap windings Ltap may be connected either in series or in parallel. However, in the case of parallel connection, it is necessary to be careful not to cause current imbalance.

[0055] Furthermore, in a single-phase three-legged autotransformer, a side leg iron core may be provided in addition to a main leg iron core, and a tap winding together with an excitation winding may be arranged on the side leg iron core. In this case, the tap winding may be one or may be divided.

[0056] Additionally, while the above embodiment has described the case where the present invention is applied to the three-phase three-legged autotransformer, the invention is not limited thereto. The present invention is also applicable to a three-phase five-legged autotransformer and a single-phase three-legged autotransformer. Reference Signs List

[0057]

10:	Three-phase three-legged autotransformer
11:	Three-phase three-legged iron core
11U:	U-phase main leg iron core
11V:	V-phase main leg iron core
11W:	W-phase main leg iron core
12U:	U-phase winding
12V:	V-phase winding
12W:	W-phase winding
LC:	Common winding
LS:	Series winding
LT:	Tertiary winding
LTa, LTb:	Divided tertiary winding
Ltap:	Tap winding

Claims

1. A stationary induction electric apparatus, wherein the stationary induction electric apparatus is an autotransformer, the apparatus comprising a common winding (LC), a series winding (LS), and a tertiary winding (LT) arranged on a main leg iron core (11U), and a first divided tertiary winding (LTa) of the tertiary winding (LT) is arranged between the common winding (LC) and the series winding (LS),
wherein the stationary induction electric apparatus is **characterized in that** a second
divided tertiary winding (LTb) of the tertiary winding (LT), the common winding (LC), the first divided tertiary winding (LTa) of the tertiary winding (LT), and the series winding (LS) are coaxially arranged in this order outwardly on the main leg iron core (11U).

2. The stationary induction electric apparatus according to claim 1, wherein the tertiary winding (LT) is divided into two.

3. The stationary induction electric apparatus according to claim 1 or 2, wherein the divided tertiary windings (LTa, LTb) are connected in series.

4. The stationary induction electric apparatus according to claim 1 or 2, wherein the divided tertiary windings (LTa, LTb) are connected in parallel.

5. The stationary induction electric apparatus according to any one of claims 1 to 4, wherein a number of turns of each of the divided tertiary windings (LTa, LTb) is arranged such that a short-circuit impedance of the tertiary winding (LT) is set to zero.

6. The stationary induction electric apparatus according to any one of claims 1 to 5, wherein a tap winding (Ltap) is arranged between the common winding (LC) and one of the divided tertiary windings (LTa, LTb).

Patentansprüche

1. Stationäre elektrische Induktionsvorrichtung, wobei die stationäre elektrische Induktionsvorrichtung ein Spartransformator ist und die Vorrichtung eine Parallelwicklung (LC), eine Reihenwicklung (LS) und eine Tertiärwicklung (LT) umfasst, die auf einem Hauptschenkeleisenkern (11U) angeordnet sind,
wobei die Tertiärwicklung (LT) geteilt ist, und eine erste geteilte Tertiärwicklung (LTa) der Tertiärwicklung (LT) zwischen der Parallelwicklung (LC) und der Reihenwicklung (LS) angeordnet ist,
wobei die stationäre elektrische Induktionsvorrichtung **dadurch gekennzeichnet ist, dass** eine zweite geteilte Tertiärwicklung (LTb) der Tertiärwicklung (LT), die Parallelwicklung (LC), die erste geteilte Tertiärwicklung (LTa) der Tertiärwicklung (LT) und die Reihenwicklung (LS) in dieser Reihenfolge koaxial nach außen auf dem Hauptschenkeleisenkern (11U) angeordnet sind.

2. Stationäre elektrische Induktionsvorrichtung nach Anspruch 1, wobei die Tertiärwicklung (LT) zweigeteilt ist.

3. Stationäre elektrische Induktionsvorrichtung nach Anspruch 1 oder 2, wobei die geteilten Tertiärwicklungen (LTa, LTb) in Reihe verbunden sind.

4. Stationäre elektrische Induktionsvorrichtung nach Anspruch 1 oder 2, wobei die geteilten Tertiärwicklungen (LTa, LTb) parallel verbunden sind.

5. Stationäre elektrische Induktionsvorrichtung nach einem der Ansprüche 1 bis 4, wobei eine Anzahl an Windungen von jeder der geteilten Tertiärwicklungen (LTa, LTb) derart ausgeführt ist, dass eine Kurzschlussimpedanz der Tertiärwicklung (LT) auf Null gestellt ist.

6. Stationäre elektrische Induktionsvorrichtung nach einem der Ansprüche 1 bis 5, wobei zwischen der Parallelwicklung (LC) und einer der geteilten Tertiärwicklungen (LTa, LTb) eine Anzapfwicklung (Ltap) angeordnet ist.

Revendications

1. Appareil électrique à induction stationnaire, dans lequel l'appareil électrique à induction stationnaire, dans lequel l'appareil électrique à induction stationnaire est un autotransformateur, l'appareil comprenant un enroulement commun (LC), un enroulement en série (LS), et un enroulement tertiaire (LT) agencés sur un noyau de fer de patte principale (11U),
dans lequel l'enroulement tertiaire (LT) est divisé, et un premier enroulement tertiaire divisé (LTa) de l'enroulement tertiaire (LT) est agencé entre l'enroulement commun (LC) et l'enroulement en série (LS),
dans lequel l'appareil électrique à induction stationnaire est **caractérisé en ce qu'**un second enroulement tertiaire divisé (LTb) de l'enroulement tertiaire (LT), l'enroulement commun (LC), le premier enroulement tertiaire divisé (LTa) de l'enroulement tertiaire (LT) et l'enroulement en série (LS) sont agencés de manière coaxiale dans cet ordre vers l'extérieur sur le noyau de fer de patte principale (11U).

2. Appareil électrique à induction stationnaire selon la revendication 1, dans lequel l'enroulement tertiaire (LT) est divisé en deux.

3. Appareil électrique à induction stationnaire selon la revendication 1 ou 2, dans lequel les enroulements tertiaires divisés (LTa, LTb) sont connectés en série.

4. Appareil électrique à induction stationnaire selon la revendication 1 ou 2, dans lequel les enroulements tertiaires divisés (LTa, LTb) sont connectés en parallèle.

5. Appareil électrique à induction stationnaire selon l'une quelconque des revendications 1 à 4, dans lequel un nombre de spires de chacun des enroulements tertiaires divisés (LTa, LTb) est agencé de telle sorte qu'une impédance en court-circuit de l'enroulement tertiaire (LT) est définie à zéro.

6. Appareil électrique à induction stationnaire selon l'une quelconque des revendications 1 à 5, dans lequel un enroulement de prise (Ltap) est agencé entre l'enroulement commun (LC) et l'un des enroulements tertiaires divisés (LTa, LTb).

FIG. 1

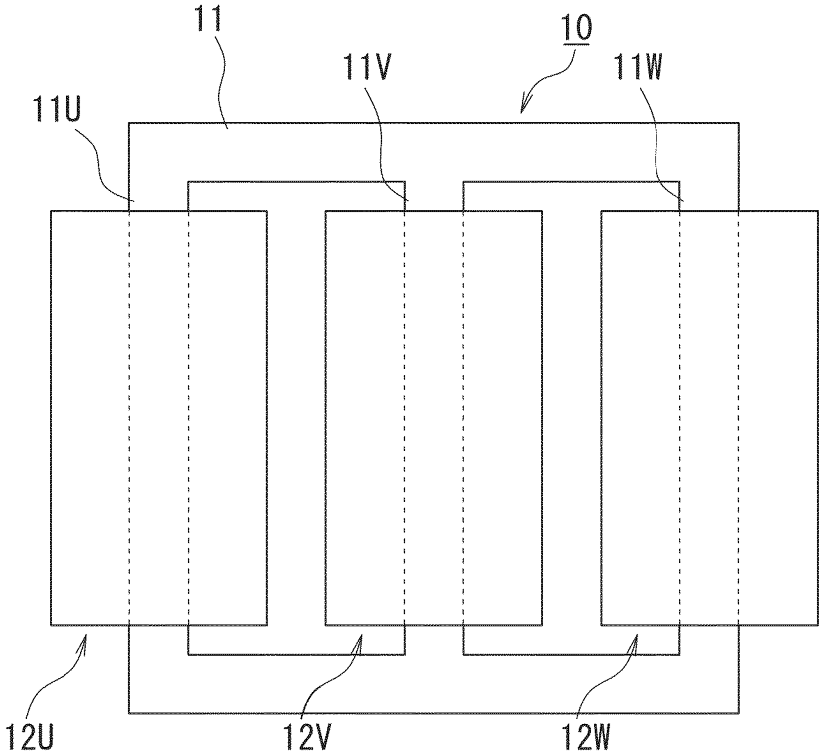

11
10
11V
11W
11U
12U
12V
12W

FIG. 2

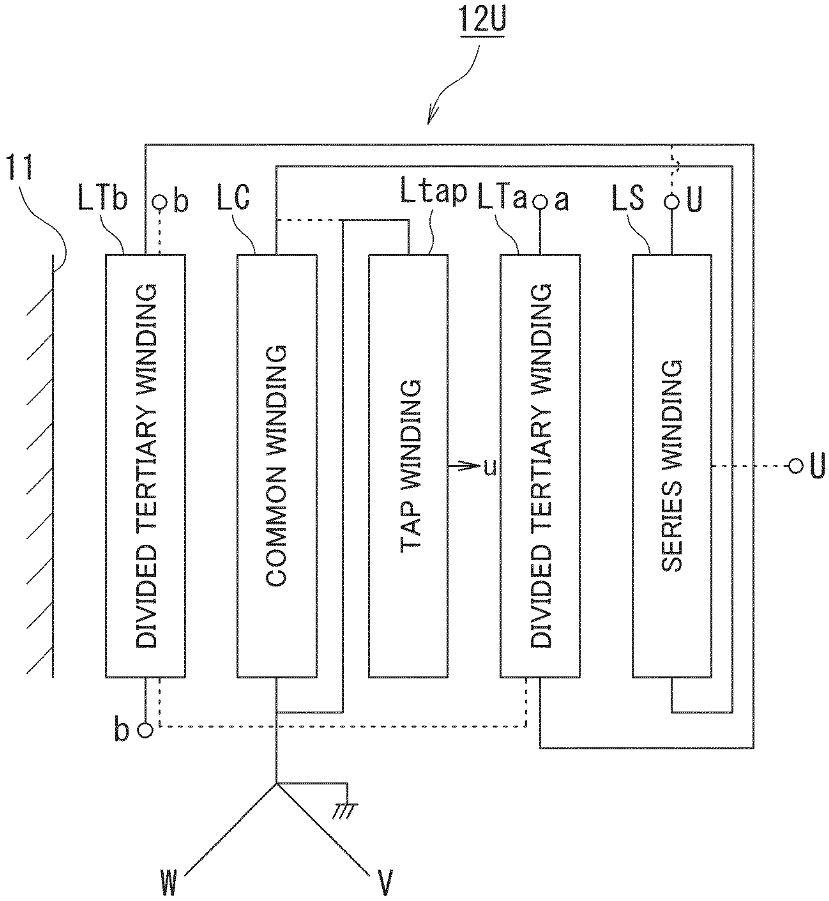

12U
11
LTb
b
LC
Ltap
LTa
a
LS
U
DIVIDED TERTIARY WINDING
COMMON WINDING
TAP WINDING
u
DIVIDED TERTIARY WINDING
SERIES WINDING
U
b
W
V

FIG. 3

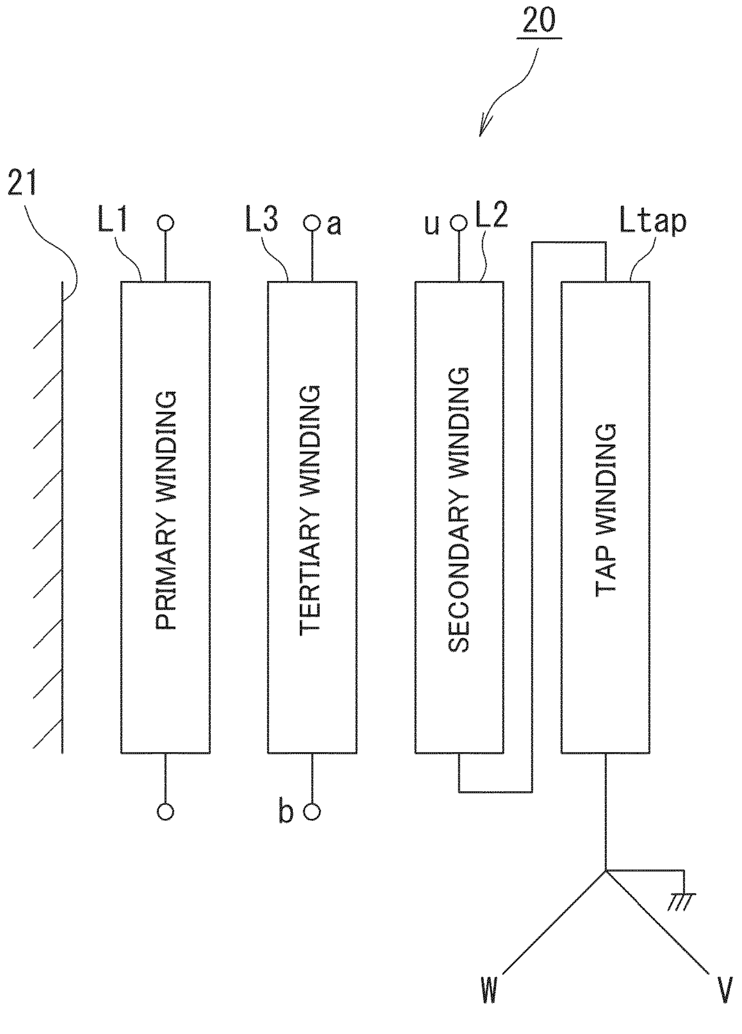

20
21
L1
L3
a
u
L2
Ltap
PRIMARY WINDING
TERTIARY WINDING
SECONDARY WINDING
TAP WINDING
b
W
V

FIG. 4A

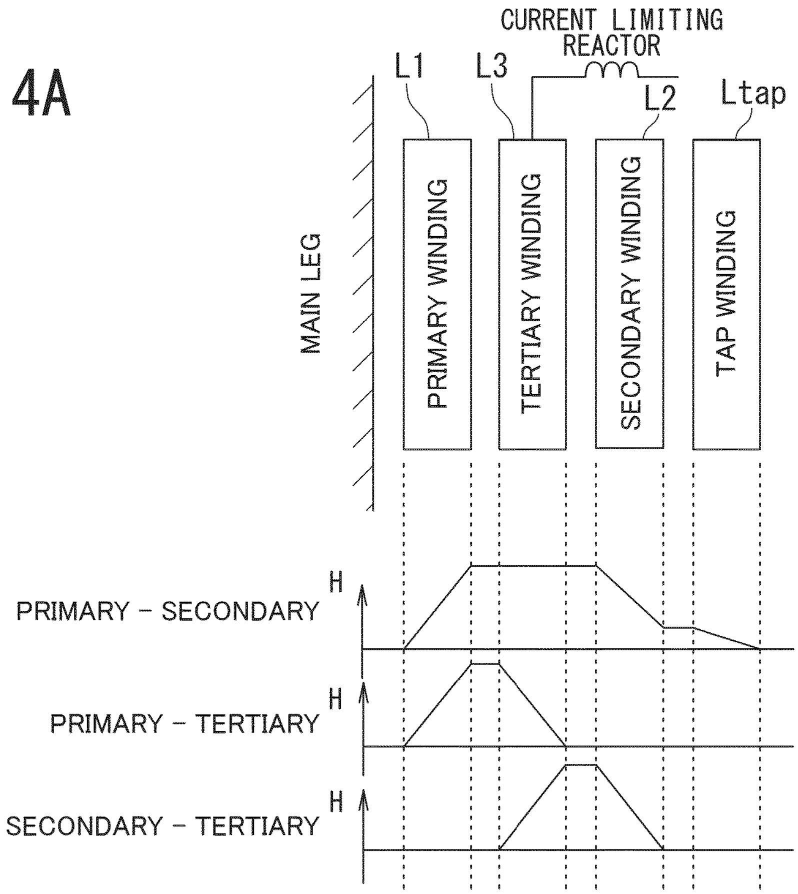

CURRENT LIMITING
REACTOR
L1
L3
L2
Ltap
MAIN LEG
PRIMARY WINDING
TERTIARY WINDING
SECONDARY WINDING
TAP WINDING
H
PRIMARY - SECONDARY
H
PRIMARY - TERTIARY
H
SECONDARY - TERTIARY

FIG. 4B

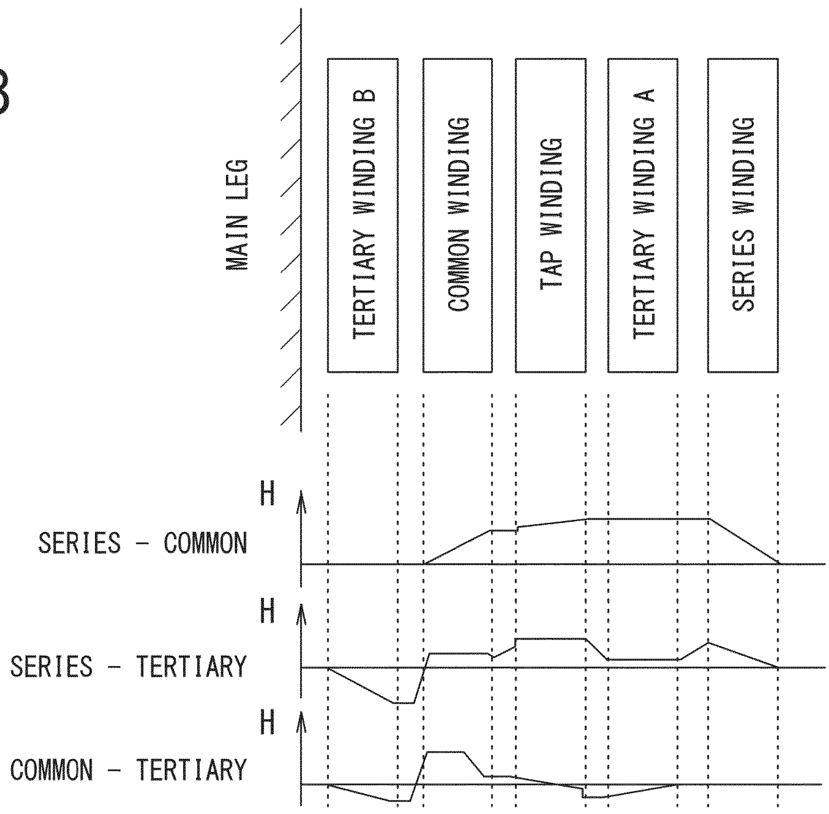

MAIN LEG
TERTIARY WINDING B
COMMON WINDING
TAP WINDING
TERTIARY WINDING A
SERIES WINDING
H
SERIES - COMMON
H
SERIES - TERTIARY
H
COMMON - TERTIARY

FIG. 5A

FIG. 5B

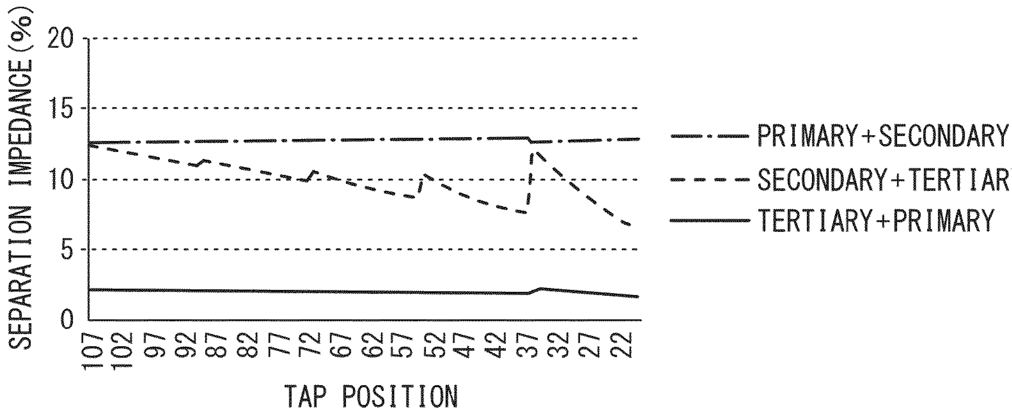


FIG. 6A

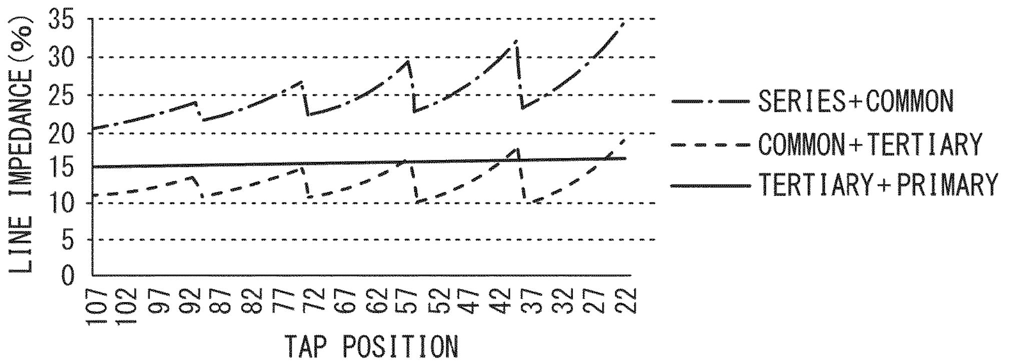


FIG. 6B

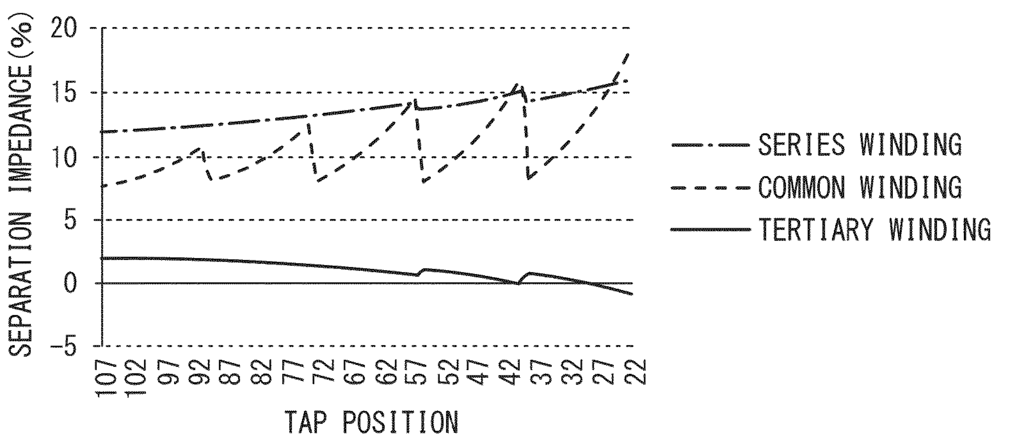


FIG. 7

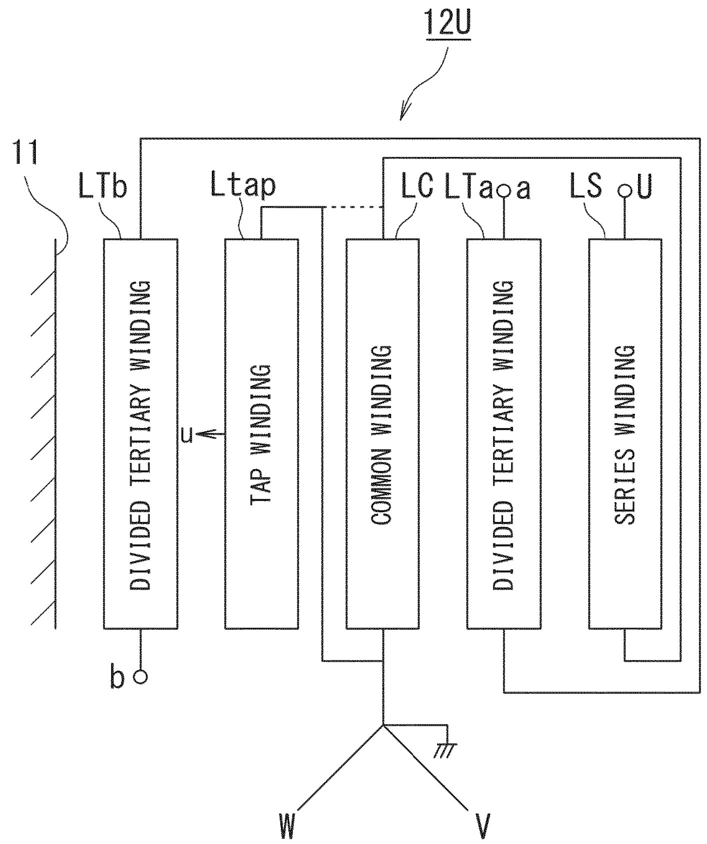
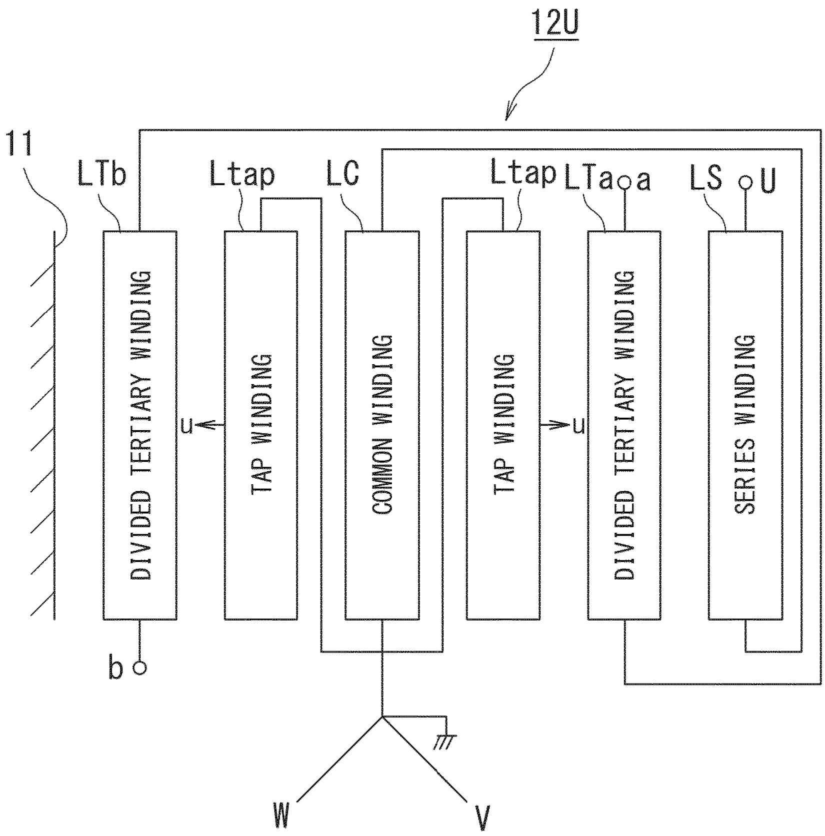

12U
11
LTb
Ltap
LC
LTa
a
LS
U
DIVIDED TERTIARY WINDING
u
TAP WINDING
COMMON WINDING
DIVIDED TERTIARY WINDING
SERIES WINDING
b
W
V

FIG. 8


12U
11
LTb
Ltap
LC
Ltap
LTa
a
LS
U
DIVIDED TERTIARY WINDING
u
TAP WINDING
COMMON WINDING
TAP WINDING
u
DIVIDED TERTIARY WINDING
SERIES WINDING
b
W
V

REFERENCES CITED IN THE DESCRIPTION

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