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Kashima

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[54] **STATIONARY INDUCTION APPARATUS**

[75] Inventor: **Yoshitake Kashima,** Hitachi, Japan

[73] Assignee: **Hitachi, Ltd.,** Tokyo, Japan

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[30] **Foreign Application Priority Data**

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June 14, 1972 Japan.....47/58578

[52] **U.S. Cl.**..... **336/84,** 336/94, 336/172, 336/184

[51] **Int. Cl.**..... **H01f 15/04,** H01f 27/28

[58] **Field of Search** 336/5, 12, 84, 172, 336/180, 186, 184, 192, 170, 94

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Primary Examiner—Thomas J. Kozma
Attorney—Paul M. Craig, Jr. et al.

[57] **ABSTRACT**

When three single-phase transformers are connected to form a 3-phase bank serving as a super-high-voltage power transformer, each of the windings of each single-phase transformer is divided into at least two winding sections wound separately around different core legs, and a lead-out conductor from the high-voltage end of one of the two winding sections is extended along the periphery of the other winding section and combined at a predetermined point on the periphery with another lead-out conductor from the high-voltage end of the other winding section so that both the lead-out conductor may be connected together with an external terminal.

14 Claims, 9 Drawing Figures

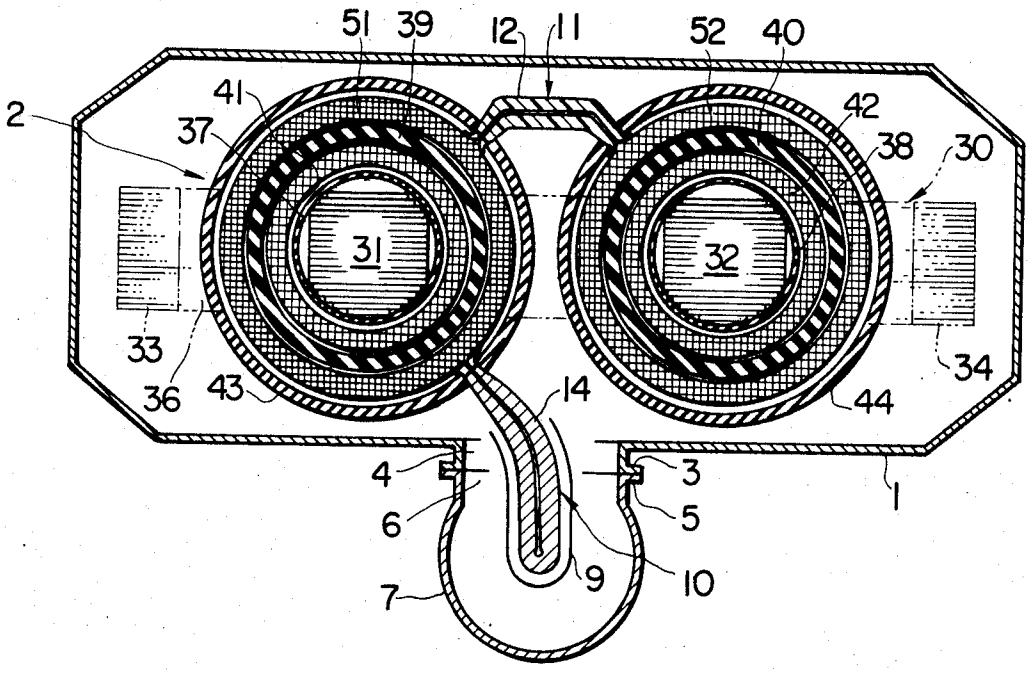
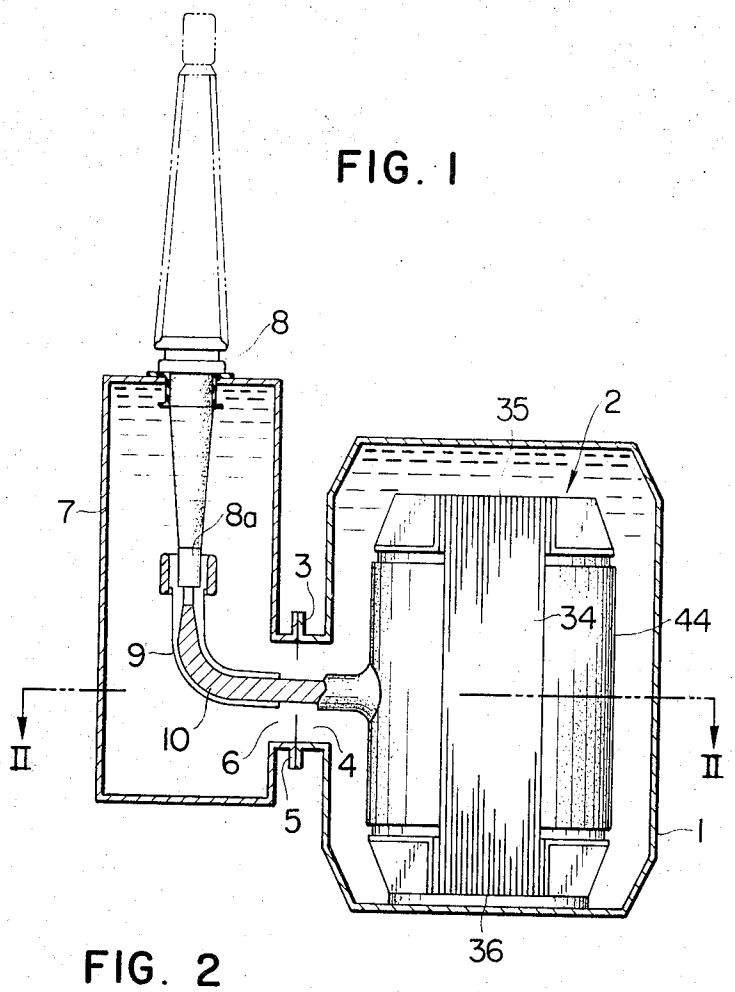


FIG. 1


8
35
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7
8a
3
34
44
9
10
6
4
II
II
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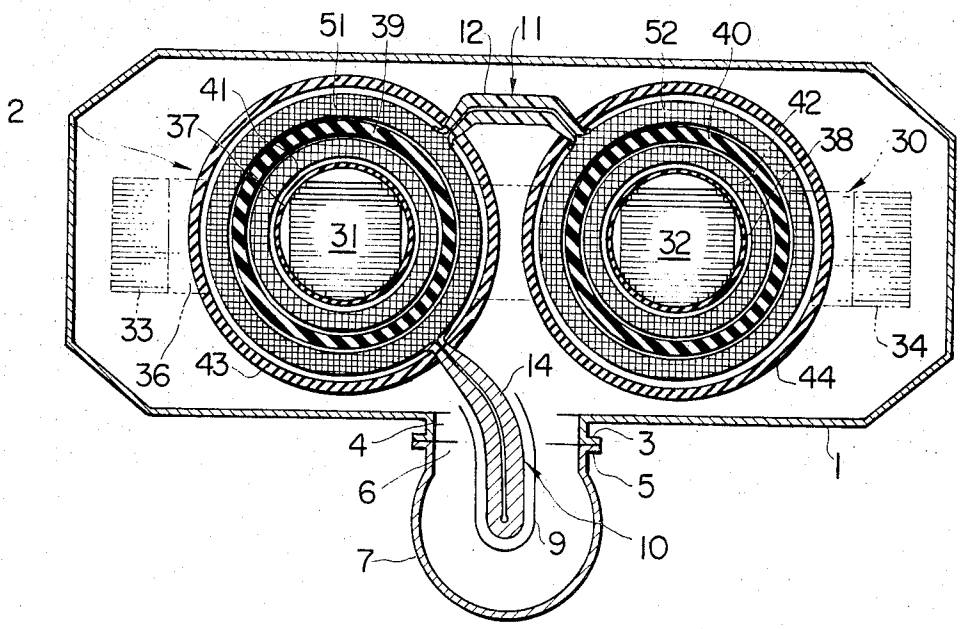
1
36

FIG. 2


51
39
12
11
52
40
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42
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31
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1

FIG. 3

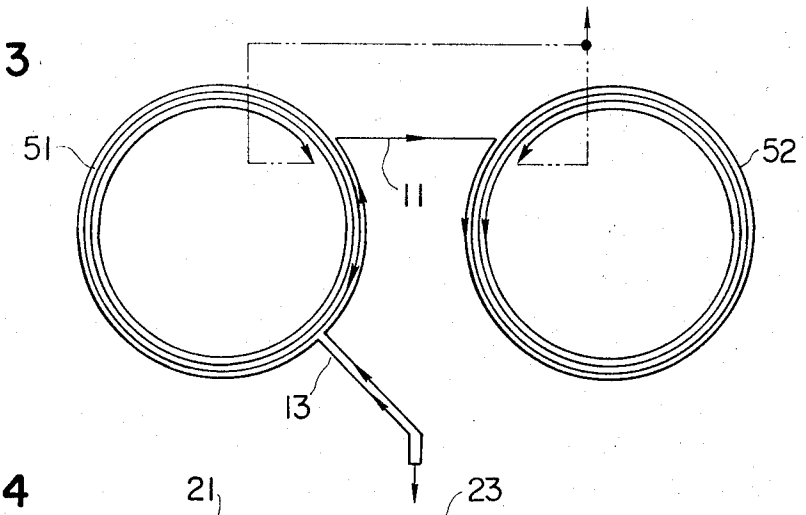
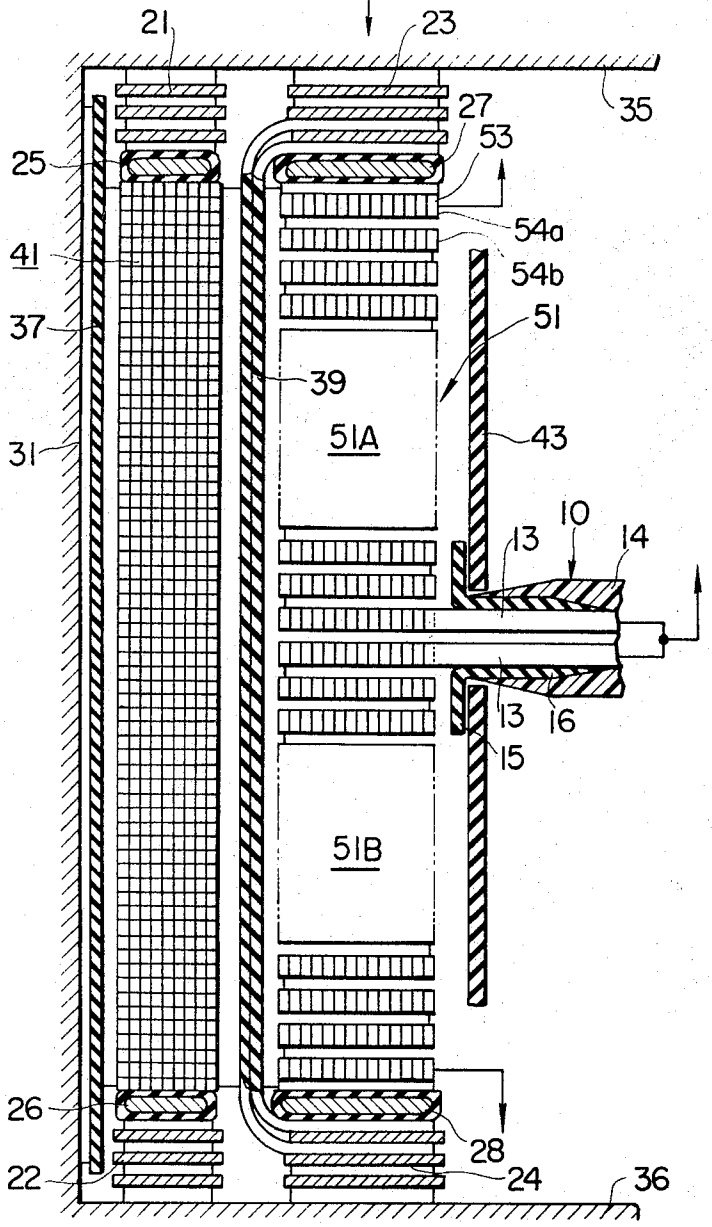

51
11
52
13

FIG. 4


21
23
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54a
54b
41
51
37
39
51A
43
31
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51B
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24
36

FIG. 5

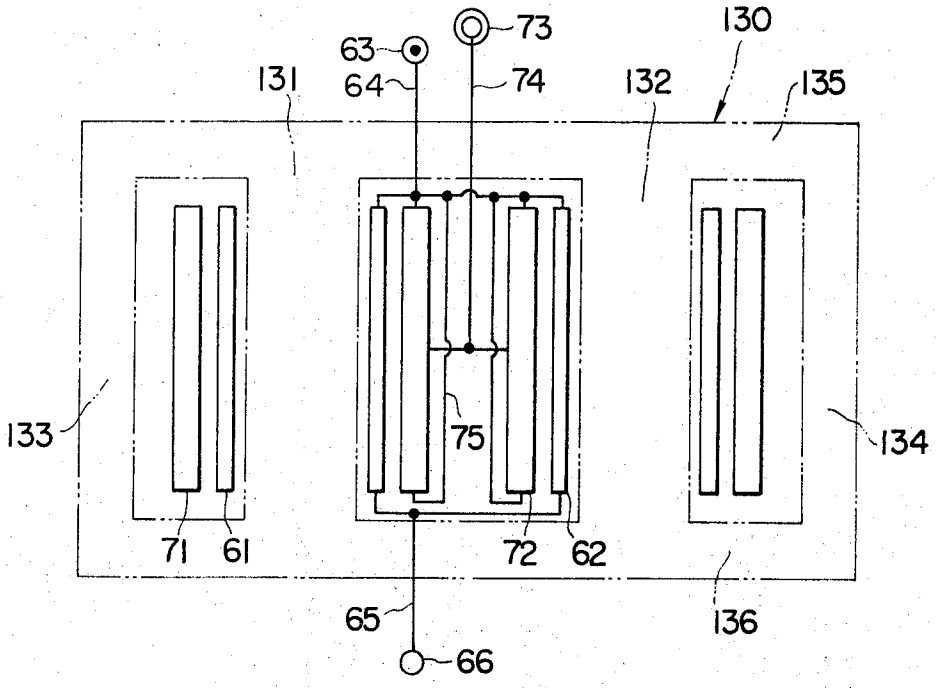
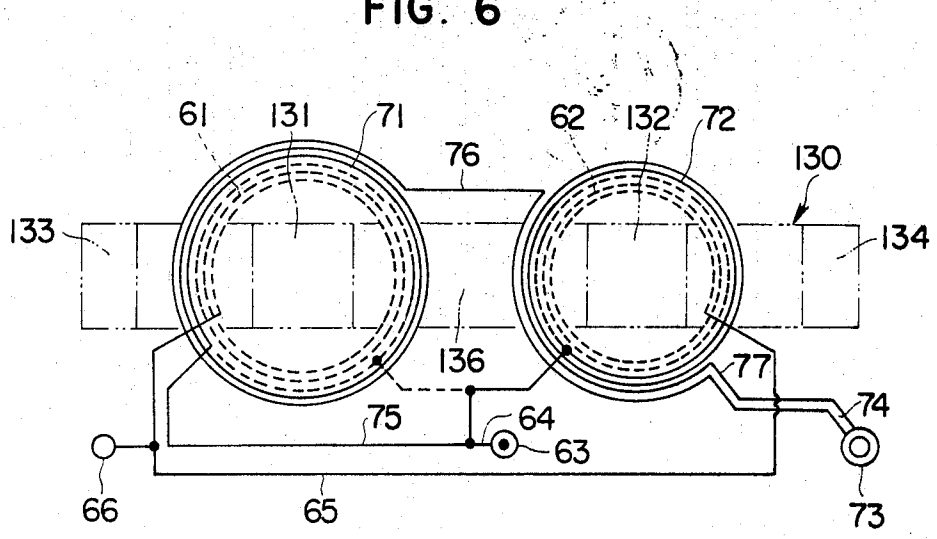

63
73
130
131
64
74
132
135
133
75
134
71
61
72
62
65
136
66

FIG. 6


61
131
71
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132
72
76
130
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136
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FIG. 7

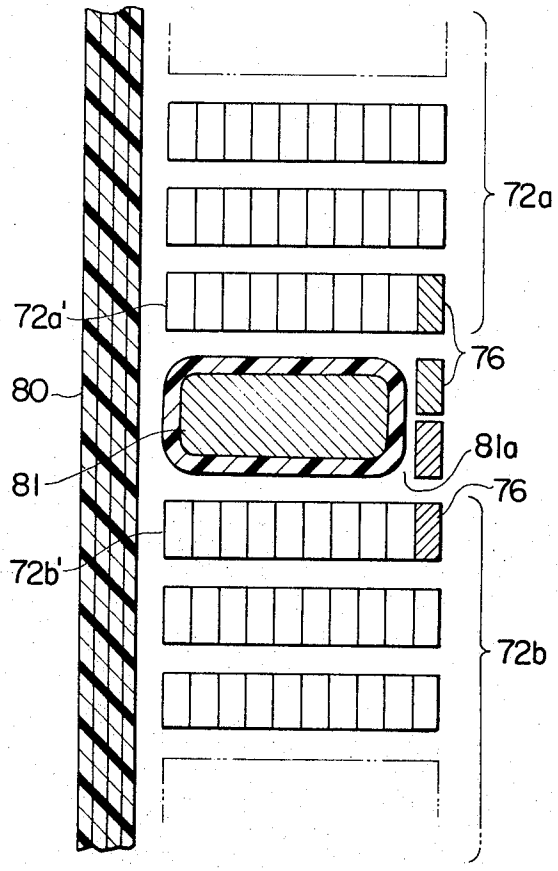


FIG. 8

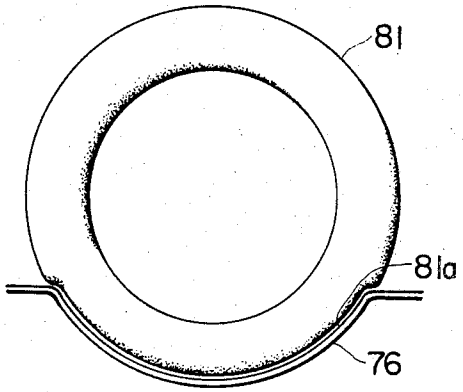
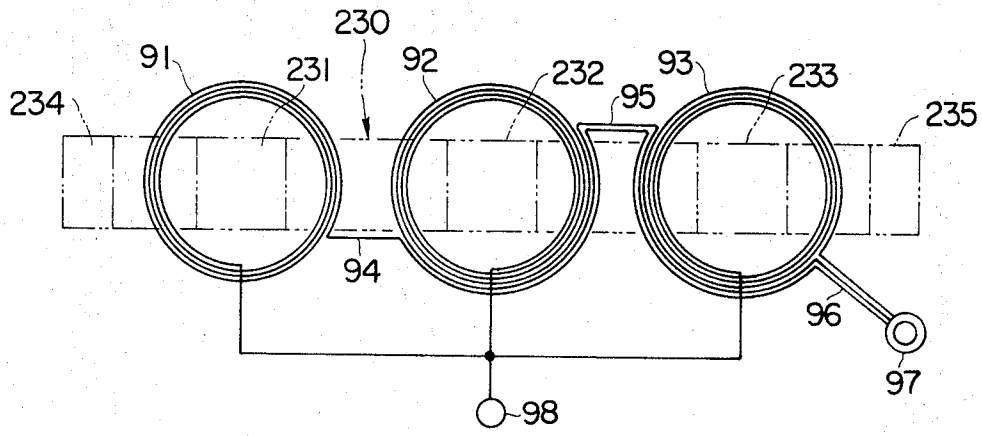


FIG. 9



STATIONARY INDUCTION APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an improvement in an electrical stationary induction apparatus, and more particularly to a large capacity transformer or reactor used in a superhigh-voltage power system dealing with a line voltage higher than about 500 KV.

2. Description of the Prior Art

With increasing demand for electric power a superhigh-voltage power transmission system with a line-to-line voltage of 500 KV or 1,000 KV has been put into practice. Accordingly, a 3-phase transformer to be used in such a system must have a large power capacity, e.g., from 1,000 MVA to 3,000 MVA. The 3-phase transformer having such a large capacity requires a big physical size and therefore is very heavy so that the fabrication thereof becomes very difficult. Also, in such a transformer used in giant power transmission system, even a small amount of moisture or dust penetrating into the transformer will often cause deterioration in the insulation and in some extreme cases result in the breadkdowns of the insulators used. For this reason, such a transformer will often cause is assembled in a factory and transported to the place of installation such as a power plant or substation. At the place of installation, the minimum of work should be done, such as connection between the windings and bushings and associated insulation in order that the internal parts of the transformer may not be exposed to the atmosphere. In order to eliminate the inconvenience memtioned above and others encounted by the transformer having such a large capacity, it is proposed to combine a plurality of single-phase transformers having less capacity together to form a three-phase bank having a necessary capacity. With this arrangement, the overall weight and size can indeed be reduced to a certain extent. However, if each winding of the single-phase transformer is formed of a single conductor, the radial size of the completed bank is not appreciably reduced in comparison with the three-phase transformer. It is, therefore, necessary to consitute each winding of the single-phase transformer of at least two winding sections wound around different core legs of the transformer and connected in parallel with each other. This division of the winding into several sections makes possible the allotment of capacity to the respective winding sections and therefore enables the diametrical size of the transformer and therefore the overall diametrical size of the completed bank to be considerably reduced. Lead wires are drawn from the high-voltage ends of the winding sections and from the low-voltage ends of the winding sections, combined together in each group, i.e., grouped into high-voltage leads and low-voltage leads, and connected with bushings serving as external terminals. In general, such combined groups of lead wires are shaped into Y or T and clothed in an insulating sheeth. Since in this case the high-voltage conductors from the high-voltage ends of the winding sections form intricate circuits, high intensity fields are complicately distributed in the transformer so that secure insulation becomes very difficult. Especially, the insulation of the grouped lead wires must be carefully provided since most of the insulation breakdowns take place in such parts. Namely, if is rather easy to provide insulation on an linear conductor by insulating tape, but it is very difficult to establish a complete insulation near the branch of bundled conductors. With the transformer transported to the place of installation in assembled condition it is usual to furnish the transformer with bushings at the spot, to connect the lead wires from the winding sections with the bushings, and then to provide insulation such as described above. It takes much time to perform the insulation of the grouped lead wires so that there is more chance that the insulators of the transformer absorbs moisture with the result that the property of the insulator deteriorates. Moreover, the high-voltage leads of the high-voltage winding sections in the transformer have the same potential as the superhigh-voltage transmission line so that the insulating layers on the high-voltage leads must be made thick enough to withstand not only the line-to-line and the line-to-ground voltages of the transmission lines but the voltage for inpulse test. Therefore, the size and weight of the insulating layers are increased and the supporting means therefor must necessarily be stronger so that there is caused an increase in the overall size and weight of the transformer.

SUMMARY OF THE INVENTION

One object of the present invention is to provide an electrical stationary induction apparatus having excellent stability in the electrical insulation thereof.

Another object of the present invention is to provide an electrical stationary induction apparatus wherein the insulation of the high-voltage lead wires from the high-voltage windings is simplified so that the work of providing insulation on the high-voltage lead wires at the spot of installation may be completed in a short time.

An additional object of the present invention is to provide an electrical stationary induction apparatus wherein the size of the oil tank is reduced to have the minimum insulation gap between the tank and the winding so that the overall size and weight of the apparatus may be reduced.

A further object of the present invention is to provide an electrical stationary induction apparatus wherein the lead-out conductors from the plural winding sections can be guided out in such a manner that any of the lead-out conductors may not lie without the diameter of the winding section.

The present invention, which has been made to attain the above-mentioned objects, is characterized by an electrical stationary induction apparatus comprising a magnetic core including at least two main legs and yokes to magnetically couple said main legs, a high-voltage winding including at least two winding sections wound around said main legs, wherein the outer end portion of the conductor of one winding section of the high-voltage winding serving as a first lead conductor is passed to the periphery of the other winding section of the high-voltage winding, curved along the periphery and leaves at a predetermined position the periphery together with the outer end portion of the conductor of the other winding section serving as a second lead conductor so that the first and second lead conductors may be connected with an external terminal, and wherein the portions of the first and second lead conductors separated from the winding sections are provided with insulating sheathes. With this structure of the lead-out conductors, the combined part of the lead conductors is wound about the periphery of the winding section

where almost no gradient of potential is created so that the insulation of the part can be easily performed since only the parts of the lead conductors between the winding sections and between the winding section and the external terminal have to be clothed in insulating layers. In addition to this the property of insulation itself can be much improved due to the reduction of working time required for insulation.

In this specification, "winding section" is used as a general term for windings wound around the main core legs. Further, in the case of a two-winding transformer, the "high-voltage winding sections" are those parts of the high-voltage winding which are wound around different core legs and the "low-voltage winding sections" are those parts of the low-voltage winding which are wound around different core legs. In a like manner, "tertiary winding sections" are defined for the three-winding transformers in addition to the "high-voltage winding sections" and the "low voltage winding sections." Also, in the case of an auto-transformer, the "series winding sections" and the "shunt winding sections" are similarly defined.

In the case of a reactor, only one winding is wound around each core leg so that the turns of conductor wound around each core leg can be termed simply as a winding section or a high-voltage winding section. Moreover, each winding section of the high-voltage winding, i.e., high-voltage winding section, which is connected between the superhigh-voltage transmission lines is divided into two "unit coils" disposed in a stack and connected in parallel with each other, and the lead-out conductors to be connected with the transmission lines are taken out from between the unit coils disposed in a stack. Furthermore, when a winding is composed of a plurality of pancake coils, each of the pancake coils is called a "coil segment."

In an electric apparatus having a large capacity, the cross sectional area of the winding conductor must be large since heavy current is drawn through the windings. Accordingly, the winding conductor may preferably be constitued of a plurality of insulated conductor elements bundled together for the purpose of reducing eddy current loss due to the magnetic flux linking the conductors. The "lead conductor" or "lead wire" in this specification designates not only a separate lead conductor connected with the end of the winding but also the end portion of the winding conductor when used for connection with other conductors or terminals.

According to the present invention, a shielding ring may be provided between the unit coils disposed in a stack so as to relax the electric field near the high-voltage lead conductors taken out from between the unit coils. In the preferred embodiment of the present invention, the shielding ring has a smaller diameter partially or entirely along its periphery than the diameter of each of the similar unit coils so as to leave a space for receiving the lead-out conductors from the adjacent winding sections. Alternatively, a part of winding conductor serving as the outermost turn or a few outermost turns of the innermost coil segment of each unit coil is removed to form a space in which the lead-out conductors from the adjacent winding sections are received. By passing the lead-out conductors through the spaces provided in the manners described above, the lead-out conductors can be confined within the diameter of each winding section so that the insulation gap between the oil tank and the high-voltage parts of the apparatus can be reduced. In addition, the lead-out conductors from the adjacent winding sections have almost the same potential as the shielding ring or the outermost turns of the innermost coil segment so that no specific insulation has to be provided between them. Because of the absence of specific insulation the thickness of the lead-out conductors received in the space can be small and therefore the volume of the space need not be increased. Usually, each of the windings is constituted of the two winding sections which are wound around the two main core legs of the four-legged magnetic core. Accordingly, the winding sections are so wound around the main core legs that the ampere-turns of the winding sections wound around different core legs may be opposite to each other so as not to cancel one magnetic flux created by the winding sections around one core leg with another created by the winding sections around the other core leg. When a three-legged core is used which comprises a pair of parallel disposed main core legs and an additional yoke disposed parallel to and between the main core legs, the ampere-turns of the winding sections are all of the same polarity.

In order to further reduce the diameter of each winding as in an electrical stationary induction apparatus which has an extremely large capacity and the diameter of the windings of which cannot be effectively reduced by the division of each winding into two winding sections wound around separate core legs, the individual winding should be divided into three winding sections. In such a case, a five-legged core may be used which comprises three main core legs and two side yokes and the three winding sections are wound around the separate three main legs.

The preferred embodiments of the present invention will now be described in detail by reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross sectional view of an electrical stationary induction apparatus as an embodiment of the present invention.

FIG. 2 is a horizontal cross section of the apparatus shown in FIG. 1, taken along line II—II.

FIG. 3 schematically shows the state of the winding conductor of an individual coil of the apparatus being arranged in a characteristic way.

FIG. 4 is a vertical cross section of one of the magnetic core legs of a transformer embodying the present invention.

FIG. 5 schematically shows the arrangement of the winding conductor of a single-winding transformer.

FIG. 6 schematically shows how the terminal or the tap leads are taken out of the individual coils of the single-winding transformer shown in FIG. 5 and connected with one another.

FIG. 7 shows a part of the high-voltage windings of an electrical stationary induction apparatus embodying the present invention, in which individual coils are assembled in a vertical stack.

FIG. 8 is a view illustrating a shielding ring and associated lead-out conductor.

FIG. 9 is a plan view of an stationary induction apparatus embodying the present invention, consisting of three coils.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 and 2 show a structure of a high-voltage transformer according to the present invention, in which the main part of a transformer 2 is immersed in an insulating oil contained in an oil tank 1. The main part 2 comprises a magnetic core 30 made of silicon-steel laminations, windings disposed around the core 30, and insulating material for insulation either between the core 30 and the windings or among the windings.

The magnetic core 30 is constituted of a pair of parallel disposed main legs 31 and 32, side yokes 33 and 34 arranged on both sides of the main legs 31 and 32, an upper yoke 35 and a lower yoke 36 provided for serving as magnetic circuits between the main legs and the side yokes, and well known clamping means to rigidly maintain the above said members in an assembled position. The main legs are inserted in a hollow cylinders 37 and 38 of insulating material and low-voltage winding sections 41 and 42 parallel connected are separately mounted on the insulating cylinders 37 and 38. The ends of the low-voltage winding sections are connected with common lead-out conductors to form a parallel connection and the lead-out conductors are connected with low-voltage bushings mounted on the oil tank 1 so as to provide external terminals, as is the usual case. Such lead-out conductors and bushings are, however, not shown in these figures.

Insulating hollow cylinders 39 and 40 surround the low-voltage winding sections 41 and 42 to provide an interwinding insulation and high-voltage winding sections 51 and 52 are separately disposed around the insulating cylinders, respectively. The high-voltage winding sections 51 and 52 are inserted in insulating cylinders 43 and 44 so as to increase the withstand voltage between the winding sections and the oil tank 1. Each of the high-voltage winding sections is usually subdivided into two units; e.g., the high-voltage winding section 51 into units 51A and 51B as shown in FIG. 4, and the adjacent ends of the unit coils 51A and 51B are connected together with a high-voltage lead-out conductor 10 while the other ends of the unit coils 51A and 51B are commonly connected with the neutral conductor. Each of the high-voltage winding section units 51A and 51B comprises an assembly in alternate stack of coil segments 54*a* and 54*b*; the former having insulated conductor wire 53 wound from the outer to inner direction and the latter from the inner to outer direction. The low-voltage and the high-voltage winding sections 41, 42 and 51, 52 are fixed to the upper and the lower yokes 35 and 36 of the magnetic core 30 by means of insulating rings 21, 22 and 23, 24 and clamping rings 25, 26 and 27, 28, respectively. As seen in FIG. 1, the oil tank 1 is provided with an opening 4 having a flange 3 and to the oil tank 1 is added a bushing pocket 7 provided with an opening 6 having a flange 5 to be mated with the flange 3 of the tank 1. The bushing pocket 7 is provided with an high-voltage bushing 8 and filled with insulating oil. The above said high-voltage lead-out conductor 10 is connected via the openings 4 and 6 with the lower terminal 8*a* of the bushing 8 immersed in the insulating oil. The lead-out conductor 10 is clothed in a shielding coating 9 of conductor to even the intensity of the surface field of the conductor 10.

Now, the details of such a high-voltage lead or bridge conductor will be explained. Reference may be had to FIG. 2 which shows the horizontal cross section of the apparatus shown in FIG. 1, taken along the line II—II in FIG. 1. A lead conductor 11 which is an extension of the high-voltage end of the high-voltage winding section 52, is passed through the insulating cylinders 44 and 43 and extended along the periphery of the high-voltage winding section 51. An insulating tape is wound around the passage portion of the conductor 11 to form an insulating layer 12 having a desired withstand voltage. The lead conductor 11 covers about a quarter turn around the winding section 51 and is then taken out through the insulating cylinder 43 to form the lead-out conductor 10 with an insulating sheath 14 coated thereon. The high-voltage end 13 of the high-voltage winding section 51 is also connected with the lead conductor 11 at the quarter-turn position thereof, as seen in FIG. 3. Cylindrical insulators 16 having flanges 15 are provided covering the edges of the perforations of the insulating cylinders through which the high-voltage lead-out conductors 10 and 11 are passed so as to increase the insulation near the perforations, as seen in FIG. 4. The structure of the high-voltage lead-out conductor 10 is more clearly shown in FIG. 3. As shown in FIG. 3, the winding sections 51 and 52 are opposite in the direction of turn from each other so as to assume opposite ampere-turns. Therefore, the magnetic flux through the main leg 31 of the core 30 and that through the legs 32 are in the additive direction.

Accordingly, the effect of the quarter turn of the conductor 11 around the winding section 51 is set off by that of the counterpart of the winding conductor of the winding section 52. Thus, there is no unbalanced condition in ampere-turns due to the quarter turn conductor 11 between the high-voltage winding sections 51 and 52. Moreover, if the other ends of the windings 51 and 52 are located near the openings of the insulating cylinders 43 and 44 through which the conductor 11 is passed, then the thickness of the layer of each winding 51 or 52 can be made uniform so that the thickness of the layer of the winding need not be specifically made large due to the provision of the lead conductor 11. Where each winding section comprises separate, parallel connected unit coils, e.g., 51A and 51B, as shown in FIG. 4, the lead-out ends of the unit coils 51A, 51B and 52A, 52B (of the winding section 52 but not shown) are confined within the high-voltage lead-out conductor 10. Usually, the extension of the gathered lead-out ends of the unit coils 51A, 51B, 52A and 52B is connected with the terminal 8*a* of the bushing 8. However, the extended portion may be replaced by a single conductor.

In the above described embodiment, a two-winding transformer having a primary winding and a secondary winding consisting of two winding sections, has been mentioned. The present invention can also be applied to a three-winding transformer having a tertiary winding wound between the low-voltage winding and the main core legs. In a reactor, only a winding section is wound around each core leg.

An auto-transformer is preferably used to convect different high-voltage transmission lines of, for example, a 275 KV system and a 500 KV system. The application of the present invention to such an auto-transformer will now be described with FIGS. 5 and 6.

Referring to FIG. 5, a magnetic core 130 has a four-leg configuration consisting of two main legs 131 and 132, side yokes 133 and 134, and upper and lower yokes 135 and 136. The main legs 131 and 132 have shunt winding sections 61 and 62 and series winding sections 71 and 72 wound around them. In addition the main legs may, if necessary, be provided with a tertiary winding (not shown). Each of the series winding sections 71 and 72 comprises two unit coils, i.e., upper and lower units as in the embodiment shown in FIG. 4, parallel connected with each other and a lead-out conductor 74 to be connected with a high-voltage terminal 73 is taken out from the intermediate point between the winding sections 71 and 72. The lead-out conductors from the tops and bottoms of the series winding sections 71 and 72 are parallel connected by means of a lead wire 75, the point of the parallel connection is connected in series with the shunt winding sections 61 and 62 connected parallel with each other and the point is also connected through a lead wire 64 with an intermediate-voltage terminal 63. The remaining ends of the winding sections 61 and 62 are both connected through a lead wire 65 with a low-voltage terminal, e.g., the neutral terminal 66.

FIG. 6 schematically shows how the leads are taken out from the series winding sections 71 and 72 and connected with the high-voltage terminal 73, the intermediate terminal 63 and the neutral terminal 66. The outer end portion of the conductor of winding section 71 serving as a lead conductor 76 is passed to the right, curved along the periphery of the series winding section 72, and connected with the high-voltage terminal 73 while the outer end portion of the conductor of the winding section 72 also serving as a lead conductor 77 runs parallel to the lead conductor 76 and is connected with the terminal 73. The portions of the lead conductors 76 and 77 between the winding section 72 and the terminal 73 form a composite lead-out conductor 74.

In the structure of the winding shown in FIG. 6, the lead conductor 76 wound along the winding 72 renders the distribution of the winding conductor in the winding 72 non-uniform. Such a non-uniforming in conductor distribution can be avoided according to the following artifices. Namely, a part of the periphery of a shielding ring 81 provided between the unit coils 72*a* and 72*b* of the series winding section 72 wound around an insulating cylinder 80 for main insulation, is cut away to form a recess 81*a* to receive the lead conductor 76 therein, as seen in FIGS. 7 and 8. Alternatively, a part of the conductor constituting the outermost turn of each coil segment 72*a'* or 72*b'* of each unit coil 72*a* or 72*b* is removed to leave a space for the lead conductor 76, as seen in FIG. 7.

FIG. 9 schematically shows in horizontal cross section a five-leg core transformer having a magnetic core 230 consisting mainly of three parallel disposed main legs 231, 232 and 233 and a couple of side yokes 234 and 235 disposed on both outer sides of and parallel to the main legs, and having an electrical circuit consisting of windings, each winding being divided into three sections 91, 92 and 93 and the sections 91, 92 and 93 being wound respectively around the main legs 231, 232 and 233 and electrically connected parallel with one another. The electrical wiring of these winding sections and the arrangement of the lead conductors 94, 95 and 96 are as shown in FIG. 9. Numerals 97 and 98 disignate a high-voltage and a low-voltage terminals. The detail of this embodiment is not explained since the individual parts bear no difference from those of the foregoing embodiments and it will be easy for those skilled in the art to enlarge upon such details.

I claim:

1. An electrical stationary induction apparatus comprising a magnetic core consisting of at least two main legs and yokes to magnetically couple said main legs, a high-voltage winding consisting of at least two winding sections wound separately around said main legs, wherein the outer end portion of the conductor of one winding section of said high-voltage winding serving as a first lead conductor is passed to the periphery of the other winding section of said high-voltage winding, curved along said periphery and leaves at a predetermined position said periphery together with the outer end portion of the conductor of said other winding section serving as a second lead conductor so that said first and second lead conductors may be connected together with an external terminal.

2. An electrical stationary induction apparatus as claimed in claim 1, wherein said magnetic core comprises a pair of parallel disposed main legs, a pair of side yokes disposed opposite and parallel to said main legs, and an upper and a lower yokes, to magnetically couple said main legs and said side yokes, and said high-voltage winding is separately distributed around said main legs.

3. An electrical stationary induction apparatus as claimed in claim 1, wherein said magnetic core comprises three main legs, a pair of side yokes disposed opposite and parallel to said main legs, and an upper and a lower yokes to magnetically couple said main legs and said side yokes, and said high-voltage winding is separately distributed around said three main legs.

4. An electrical stationary induction apparatus as claimed in claim 1, wherein said high-voltage winding sections wound separately around said main legs are all parrallel connected by means of said lead-conductors.

5. An electrical stationary induction apparatus as claimed in claim 1, wherein each of said high-voltage winding section wound around each of said main legs comprises a pair of unit coils arranged in a stack and parallel connected with each other, and said lead conductors are taken out from between the opposing ends of said unit coils.

6. An electrical stationary induction apparatus as claimed in claim 2, wherein said first lead conductor is wound along a portion of the periphery of said other winding section which is facing to the periphery of said one winding section and led out from said periphery of said other winding section toward the outside of an air gap between the peripheries of said two winding sections together with said second lead conductor in parallel relation with each other.

7. An electrical stationary induction apparatus as claimed in claim 4, wherein said lead conductors parallel connecting said winding sections are extended parallel, clothed in a common insulating sheath and convected with a high-voltage terminal, and said insulating sheath is covered by a shielding conductor.

8. An electrical stationary induction apparatus as claimed in claim 5, wherein between said unit coils wound around each main leg is provided a shielding ring which is partially cut away in such a manner that the outer diameter of said ring may be partially smaller

than that of said unit coils to form a space for receiving said lead conductors therein.

9. An electrical stationary induction apparatus as claimed in claim **5**, wherein each of said unit coils consists of a plurality of pancake-shaped coil segments of two kinds alternately disposed in a stack, one of said two kinds of said coil segments having its conductor wound radially from outer to inner positions and the other kind of coil segment having its conductor wound radially from inner to outer positions with the direction of winding in said two kinds of coil segments being the same, and wherein the outermost turn of the innermost coil segment of said unit coil is removed to define a space to receive said lead conductors therein.

10. As electrical stationary induction apparatus comprising a magnetic core consisting of at least two main legs, at least a pair of side yokes disposed opposite and parallel to said main legs, and upper and lower yokes to magnetically couple said main legs and said side yokes, a high-voltage winding consisting of at least two winding sections wound separately around said main legs, and a low-voltage winding consisting of winding sections wound around said main legs under said high-voltage winding sections, wherein the outer end portion of the conductor of one winding section of said high-voltage winding serving as a first lead conductor is passed to the periphery of the other winding section of said high-voltage winding, curved along said periphery and leaves at a predetermined position said periphery together with the outer end portion of the conductor of said other winding section of said high-voltage winding serving as a second lead conductor so that said first and second lead conductors may be connected together with an external terminal.

11. An electrical stationary induction apparatus as claimed in claim **10**, wherein there is additionally provided a tertiary winding consisting of winding sections wound around said main legs under said winding sections of said low-voltage winding.

12. An electrical stationary induction apparatus comprising a magnetic core consisting of at least two main legs, at least a pair of side yokes disposed opposite and parallel to said main legs, and an upper and a lower yokes to magnetically couple said main legs and said side yokes, a shunt winding consisting of at least two winding sections separately wound around said main legs and parallel connected with each other, and a series winding consisting of at least two winding sections wound around said shunt winding, first ends of which winding sections are connected in series with the parallel connection of said respective winding sections of said shunt winding and second ends of which are parallel connected with each other, wherein the outer end portion of the conductor of one winding section of said series winding serving as a first series connection lead is passed to the periphery of the other winding section of said series winding, curved along said periphery and leaves at a predetermined position said periphery together with the outer end portion of the conductor of said other winding section serving as a second series connection lead so that said first and second series connection leads may be connected together with an external high-voltage terminal.

13. An electrical stationary induction apparatus as claimed in claim **12**, wherein there is additionally provided a tertiary winding consisting of at least two winding sections wound around said main legs under said winding sections of said shunt winding.

14. An electrical stationary induction apparatus as claimed in claim **12**, wherein each of said winding section of said series winding consists of two unit coils disposed in a stack and parallel connected with each other, said first and second series connection leads connected with said high-voltage terminal are taken out from between said unit coils disposed in a stack, and each of said winding section of said shunt winding is connected near the top and bottom thereof in parallel with the corresponding one of winding sections of said series winding.

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