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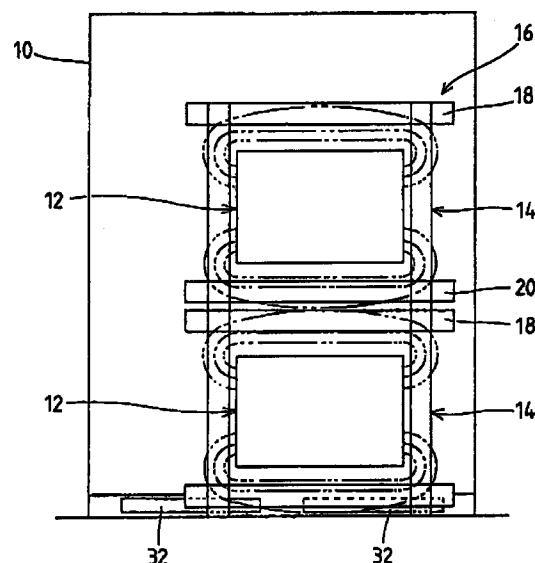
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(54) **Transformer structure and equipment therefor**

(57) The aim of the invention is to reduce an installation area occupied by transformers inside a cubicle and to prevent the generation of vibrational noise and heat. The transformer structure (12) is constructed so that a molded transformer, in which a single-phase transformer is molded by a molding material, and current and instrument transformers, which are connected to the primary sides of the single-phase transformers, are molded integrally by a molding material. This transformer structure (12) is positioned and fastened in place inside a rectangular frame (14). Two of these frames (14) are stacked in the vertical direction and connected to each other. A transformer apparatus (16) which contains two of such frames (14) are stacked and connected in the vertical direction is installed inside a cubicle (10). The molded transformers are installed inside the frames (14) so that the central axes of the windings of the transformers are placed horizontally.

FIG.1



Description

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates to a transformer structure and equipment therefor wherein the installation area required for power distribution transformers installed inside a cubicle can be reduced.

Description of Related Technology

Inside cubicles which are installed at substations, etc., current transformers used for the measurement of electric current, instrument transformers used for the measurement of voltage, and relays, etc. are installed in a prescribed layout around transformers used for power distribution, and these respective components are connected by cables. In regard to the transformers, oil-containing transformers, in which a steel box is filled with an insulating oil and a transformer main body is immersed in such an oil, are generally known.

Here, in cases where the transformation of a 3-phase AC current is accomplished using three single-phase transformers, the respective transformers are lined up in the lateral direction and connected by wires. As a result, the installation area occupied by the transformers inside each of the cubicles is increased, so that the size of the cubicles themselves is also increased. The reason for this is that when the oil-containing transformers are used as described above, the transformers are not stacked vertically because of the danger that a fire might be ignited if the transformers should fall over during a disaster such as an earthquake, etc. Furthermore, it has also been pointed out that the vertical stacking of transformers makes maintenance and inspection of the individual transformers extremely difficult. In such cases, furthermore, the work of connecting current transformers, instrument transformers and relays, etc. to the respective power transformers is difficult and time-consuming, and the level of danger is increased as a result of high-voltage parts which are exposed inside the cubicles.

Figure 9 is a circuit diagram of a transformer system which has generally been used in the past for three-phase/single-phase transformation, and a plurality of relays VCB and switches PCS are required therein. In the case of this system, furthermore, there is an extremely high danger of burning damage to the transformers when the load on the secondary side increases.

One proposal for dealing with the various problems described above has been submitted by the present applicant as an invention titled "TRANSFORMER STRUCTURE AND EQUIPMENT THEREOF" (Japanese Patent Application No. 6-60264). As shown in Figure 7, the transformer structure of this application is constructed so that molded transformers 2, which are formed by molding transformers by a molding material 1

consisting of an insulating material such as a synthetic resin or synthetic rubber, etc., are positioned and fastened in place inside frames 3, and a plurality of such frames are stacked in a vertical direction. In this structure, there is absolutely no danger of any fire occurring due to oil leakage as a result of transformers falling over as in the case of conventional oil-containing transformers. Accordingly, this system is extremely safe. In addition, since a plurality of transformers are stacked in the vertical direction, the installation area can be greatly reduced.

In the transformer structure described above, the molded transformers 2 are installed inside the frames 3 so that the central axes P of the windings of each transformer Tr are positioned vertically as shown in Figure 8. Accordingly, when a plurality of frames 3 are stacked, the lines of magnetic force (indicated by two-dot chain lines) from the molded transformers 2, 2 installed above and below interfere with each other as shown in Figure 7, thus causing the frames 3 to vibrate which leads to problems such as the generation of noise and the generation of heat.

SUMMARY OF THE INVENTION

The present invention is devised in light of the drawbacks encountered in the prior art described above and is proposed for the purpose of solving these problems in a suitable manner. The object of the present invention is to provide a transformer structure and equipment thereof which make it possible to accomplish a smaller size by reducing the installation area to be occupied by the transformers inside a cubicle and which also make it possible to prevent the generation of vibrational noise and heat.

In order to achieve the object, the transformer structure of the invention of the present application is characterized in that:

transformers used for power distribution are molded by an insulating material such as a synthetic resin, synthetic rubber, etc.,

the thus molded transformers are positioned and fastened in place inside frames so that the central axes of the windings of such molded transformers are placed horizontally, and

a plurality of such frames that contain such molded transformers are stacked in the vertical direction, and the respective transformers are connected to each other by wires.

Furthermore, in order to achieve the object, the transformer structure of another invention of the present application is characterized in that:

single-phase transformers used for power distribution are molded by an insulating material such as a synthetic resin, synthetic rubber, etc.,

the thus molded transformers are positioned and fastened in place inside frames so that the central axes of the windings of such molded transformers are placed horizontally, and

a plurality of such frames that contain such

molded transformers are stacked in the vertical direction, and the respective single-phase transformers are connected to each other by V-V wiring.

In addition, in order to achieve the object, the equipment for the transformer structure of still another invention of the present application is characterized in that:

molded transformers, each of which is formed by molding a power distribution transformer by an insulating material such as a synthetic resin, synthetic rubber, etc. and current and instrument transformers, which are connected to such a molded transformer, are molded into integral units by an insulating material such as a synthetic resin, synthetic rubber, etc. so as to obtain transformer structures,

the thus obtained transformer structures are respectively installed inside frames so that the central axes of the windings of such transformers are placed horizontally, and

a transformer apparatus, which is obtained by stacking a plurality of such frames in the vertical direction and by connecting the transformers of the transformer structures which are installed inside such frames to each other by means of wires, is installed inside a cubicle.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a front view of the schematic layout of an equipment for transformer structures constituting an embodiment of one invention of the present application.

Figure 2 is an explanatory diagram which illustrates the schematic structure of a transformer apparatus constituting an embodiment of one invention of the present application.

Figure 3 is an explanatory diagram which illustrates the internal structure of a molded transformer used in an embodiment of one invention of the present application.

Figure 4 is a wiring diagram of a transformer used in an embodiment of one invention of the present application.

Figure 5 is a circuit diagram of a transformer apparatus constituting an embodiment of the invention of the present application.

Figure 6 is a front view of the schematic layout of transformer equipment that uses a transformer structure, constituting another embodiment of the invention of the present application.

Figure 7 in a front view of the schematic layout of transformer equipment that uses a transformer structure proposed in a previous application filed by the present applicant.

Figure 8 is an explanatory diagram which illustrates the internal structure of the molded transformer shown in Figure 7.

Figure 9 is a circuit diagram of a transformer system constituting prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Next, the transformer structure and equipment therefor of the invention of the present application will be described in terms of preferred embodiments with reference to the accompanying drawings.

Figure 1 shows the schematic layout of the transformer equipment for a transformer structure according to the embodiment, and a transformer apparatus 16, which is formed by stacking and connecting two frames 14, 14, each containing a transformer structure 12, in the vertical direction, is installed inside a cubicle 10. As shown in Figure 1, each of the frames 14 is formed as a rectangular frame including an upper frame member 18 and a lower frame member 20, and a transformer structure 12 is positioned and fastened in between. The upper frame 14 and the lower frame 14 are connected by fastening the lower frame member 20 of the upper frame 14 to the upper frame member 18 of the lower frame 14 by means of bolts in a multiple number of locations.

Each of the transformer structures 12 consists of a single-phase transformer Tr used for power distribution, a current transformer CT and an instrument transformer PT; and these respective transformers are connected to each other. More specifically, as shown in Figure 2, the single-phase transformer Tr is molded by a molding material 26, which is an insulating material, so as to obtain a molded transformer 23, and the current transformer CT and the instrument transformer PT are connected to the primary side of the single-phase transformer Tr which is inside the molded transformer 23. Furthermore, the molded transformer 23, current transformer CT and instrument transformer PT are all molded into an integral unit by a molding material 28, which consists of an insulating material such as a synthetic resin, synthetic rubber, etc., so that no high-voltage parts are exposed to the outside. As a result, the transformer structures 12 which are molded by the molding material 28 are extremely safe structures, since there is absolutely no danger of fire due to the leakage of oil which is caused by transformers falling over as in conventional oil-containing transformers. Meanwhile, the molding materials 26 and 28 may be a synthetic resin such as an epoxy, polyester resin, etc. or a synthetic rubber such as a butyl rubber, ethylene-propylene rubber, etc.

The molded transformers 23 are installed inside the corresponding frames 14 so that as shown in Figure 3 the central axes P of the windings 30 of the transformer Tr are oriented horizontally. As a result, when the transformer structures 12, 12 are stacked as shown in Figure 1, the lines of magnetic force (indicated by two-dot chain lines) generated by the molded transformers 23, 23 positioned above and below are prevented from interfering with each other. Thus, vibrational noise and heat caused by the interference of lines of magnetic force can be prevented.

An ammeter A which is connected to the current transformer CT and a voltmeter V which is connected to

the instrument transformer PT are disposed outside the molding material 28. These ammeter A and voltmeter V are digital instruments which can perform measurements using a small current. The heat dissipating effect can be improved by forming through-holes in the molding material 28 in positions corresponding to the current transformer CT and instrument transformer PT.

The single-phase transformer Tr in the molded transformer 23 of the upper transformer structure 12 and the single-phase transformer Tr in the molded transformer 23 of the lower transformer structure 12 are as shown in Figure 4 connected by V-V wiring; and three-phase AC transformation is performed by U, V, W-u, v, w, and a single-phase alternating current is extracted from o. In this embodiment, the wiring is different-capacity V-V wiring wherein, for example, a 200 KVA single-phase transformer Tr is installed on the upper side and a 300 KVA single-phase transformer Tr is installed on the lower side.

In the transformer structure 12 on the upper side, as shown in Figure 2, a relay VCB is connected to the current transformer CT and to the instrument transformer PT which are connected to the primary side of the single-phase transformer Tr in the molded transformer 23. In this embodiment, the relay VCB is separated from the transformer structure 12; however, it would be possible to mold the relay VCB integrally with the transformer structure 12. As seen from the circuit diagram shown in Figure 5, this embodiment of the transformer apparatus 16 is extremely simple and is able to withstand the load applied to the secondary side of the transformers so that burning damage to the transformers Tr can be prevented. The reference numeral 32 in Figure 1 indicates blowers such as silocco fans, etc., which are installed in the cubicle 10. In this case, a cooling effect can be obtained by using the blowers 32 so as to introduce outside air into the cubicle 10. An air exhaust port (not shown) is formed in the side of the cubicle 10. In addition, it would also be possible to install the blowers 32 on the frames 14 which contain the transformer structures 12 so that air is blown directly onto the transformer structures 12 by such blowers 32. Furthermore, it would also be possible to increase the cooling efficiency by installing pairs of blowers 32 on opposite sides of each of the transformer structures 12 (left and right, top and bottom, and front and back) so that one of each pair of blowers 32 blows air onto the corresponding transformer structure 12, while the other blower 32 of such a pair sucks air from the transformer structure 12.

In the transformer equipment as described above, each individual transformer structure 12 is constructed by using the molding material 28 so as to mold the molded transformer 23, current transformer CT and instrument transformer PT into an integral unit. As a result, there is absolutely no danger of fire due to overturned transformer structures. Accordingly, a plurality of such transformer structures 12 can be stacked in the vertical direction, and the installation area occupied by the transformers inside the cubicle 10 can be reduced. The cubicle 10 can be installed either outdoors or indoors,

and the space in the installation location can be effectively utilized as a result of the reduction in the installation area. Furthermore, since three-phase/single-phase transformation can be handled using two single-phase transformers, the electrical wiring system can be supplied as a system for a single transformer structure 12. Moreover, by installing the transformer structures in a stacked fashion, the lines of magnetic force generated by the molded transformers 23, 23 positioned above and below are prevented from interfering with each other; accordingly, vibrational noise and heat generated by such interference of lines of magnetic force can be prevented.

Since a plurality of transformer structures 12, 12 can be connected merely by fastening the frames 14, 14 to each other, the transformer apparatus 16 in which, for example, a 200 KVA transformer Tr is installed above and a 300 KVA transformer Tr is installed below can be quickly and simply converted into a transformer apparatus 16 in which, for example, a 300 KVA transformer Tr is installed above and a 500 KVA transformer Tr is installed below. Thus, working time can be shortened and costs can be reduced. Furthermore, since the current transformers CT and instrument transformers PT are also molded, it is possible to increase the useful life of these transformers. As a result, there is almost no need for maintenance or inspection; and the working characteristics of the system do not suffer despite the fact that the transformer structures can be stacked in the vertical direction. Accordingly, there is virtually no need for replacement parts, etc., and the running costs can be reduced. Furthermore, since no high-voltage parts are exposed inside the cubicle, workers can work safely inside the cubicle 10 during cleaning, maintenance or inspection of the respective components of the transformer apparatus 16. Moreover, installation of the transformer structures 12, 12 is easy; accordingly, the capacity of the transformer apparatus as a whole can easily be changed by replacing the transformer structures 12 that contain single-phase transformers Tr of different capacities. Furthermore, since the transformers Tr, current transformers CT and instrument transformers PT are enclosed, the internal space available is effectively utilized. In addition, since all high-voltage parts are molded in the molding material 28, it can be possible to install only the transformer structures 12, omitting the cubicle 10.

In the embodiments, two transformer structures which are equipped with single-phase transformers are stacked; however, as shown in Figure 6, it would be possible to stack, for example, three transformer structures 12 that contain single-phase transformers. In addition, it would also be possible to stack four or more transformer structures. Moreover, it would also be possible to stack transformer structures equipped with three-phase transformers or to stack a combination of transformer structures equipped with single-phase transformers and transformer structures equipped with three-phase transformers. In addition, it would also be possible to integrally

mold AVR's (automatic voltage regulators), LRD's, WW's, etc. inside the transformer structures.

Claims

1. A transformer structure characterized in that:
 - transformers (Tr) for power distribution are molded by an insulating material (26) such as a synthetic resin, synthetic rubber, etc.,
 - transformers (23) thus molded are positioned and fastened in place inside frames (14) so that central axes (P) of windings (30) of said molded transformers (Tr) are placed horizontally, and
 - a plurality of said frames (14) that contain molded transformers (23) are stacked in a vertical direction with said transformers (Tr) connected to each other by wires.
2. A transformer structure characterized in that:
 - single-phase transformers (Tr) used for power distribution are molded by an insulating material (26) such as a synthetic resin, synthetic rubber, etc.,
 - transformers (23) thus molded are positioned and fastened in place inside frames (14) so that central axes (P) of windings (30) of said molded transformers (Tr) are placed horizontally, and
 - a plurality of said frames (14) that contain said molded transformers (23) are stacked in a vertical direction with said single-phase transformers (Tr) connected to each other by V-V wiring.
3. A transformer equipment characterized in that:
 - molded transformers (23), which are obtained by molding power direction transformers (Tr) via an insulating material (26) such as a synthetic resin, synthetic rubber, etc. , and current and instrument transformers (CT, PT), which are connected to said transformers (Tr), are molded integrally by an insulating material (28) such as a synthetic resin, synthetic rubber, etc. so as to form transformer structures (12),
 - a plurality of said frames (14) are stacked in a vertical direction and said transformers (Tr) of said transformer structures (12) installed inside said frames (14) are connected to each other by means of wires, thus obtaining a transformer apparatus (16) which is installed inside a cubicle (10).
4. A transformer equipment according to Claim 3, wherein a relays (VCB) is connected to said transformers (Tr) in said transformer structures (12).

FIG.1

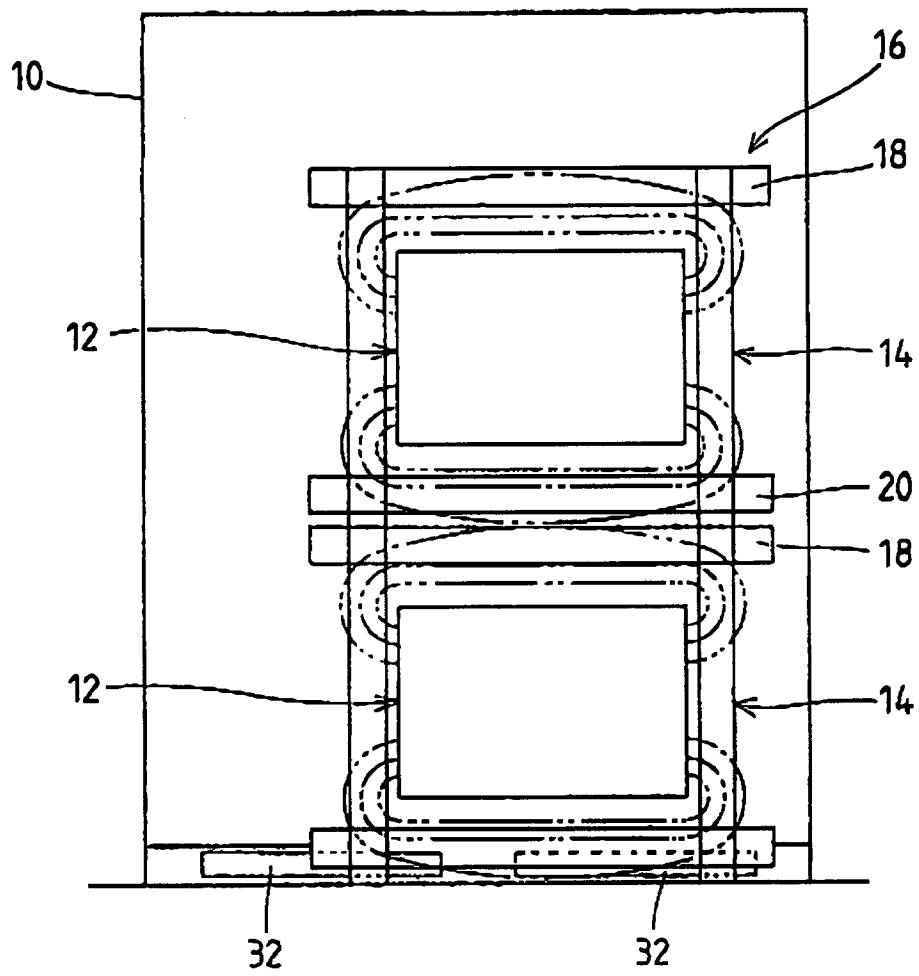


FIG. 2

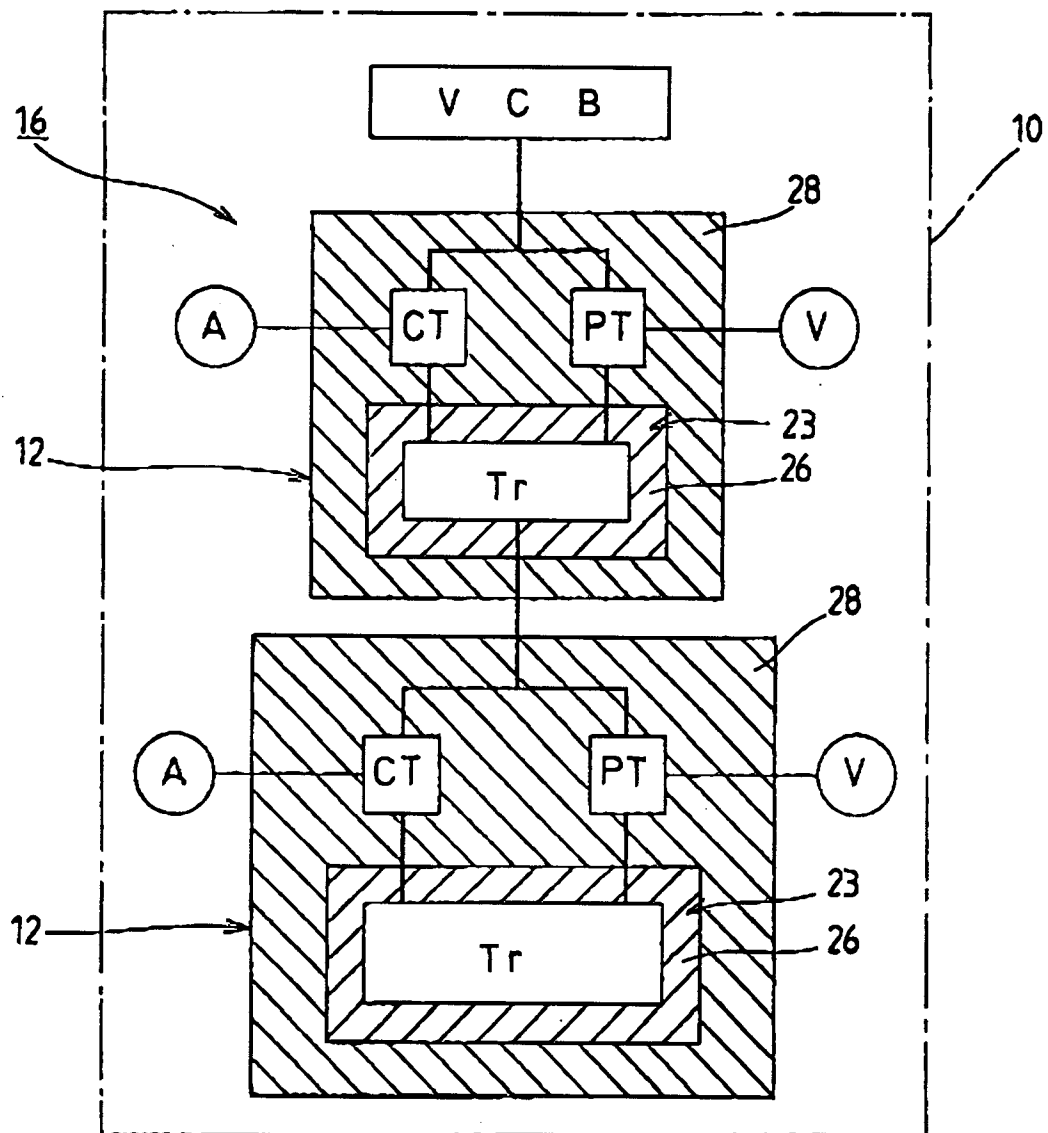


FIG. 3

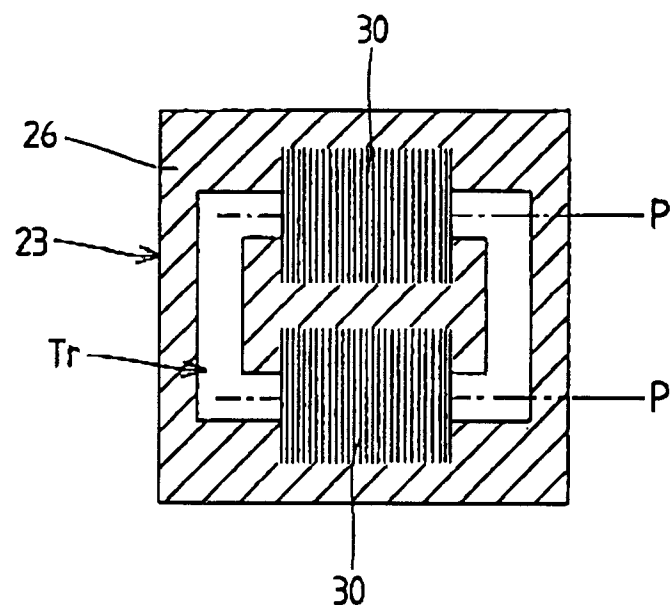


FIG. 8

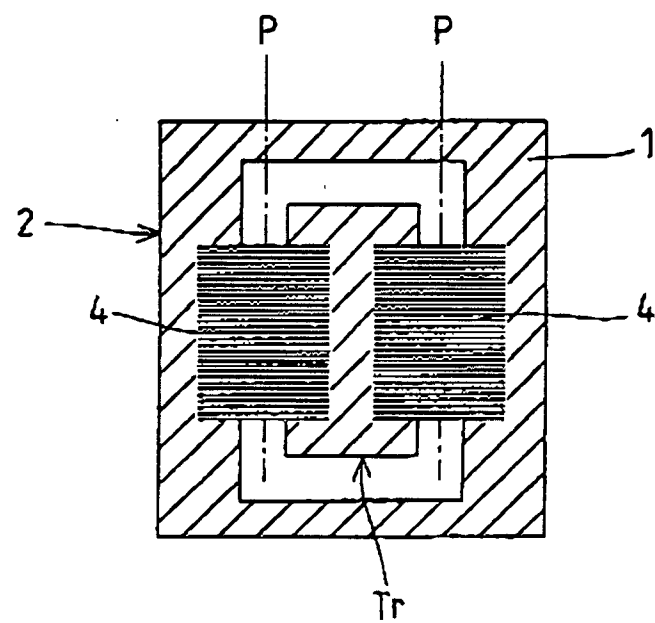


FIG.4

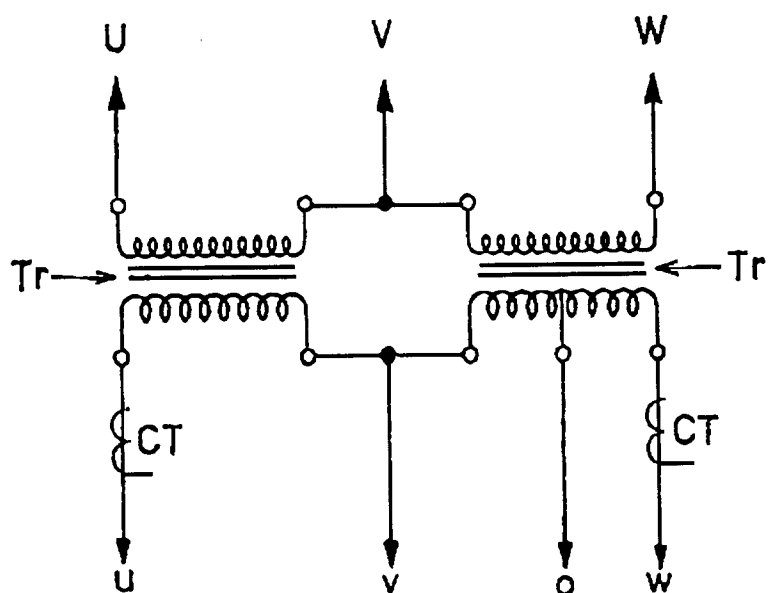


FIG. 5

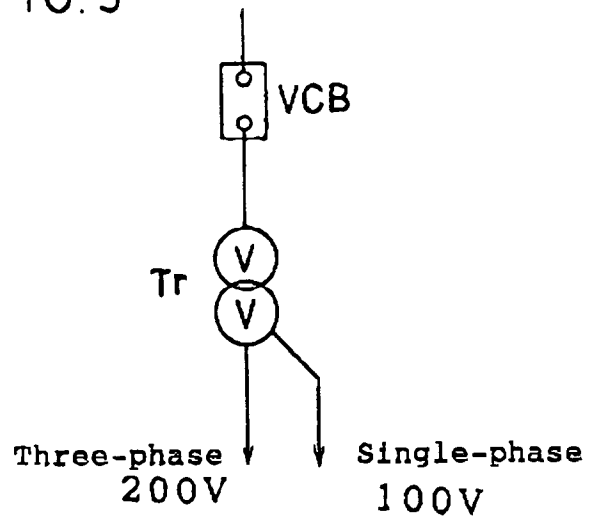


FIG. 9

PRIOR ART

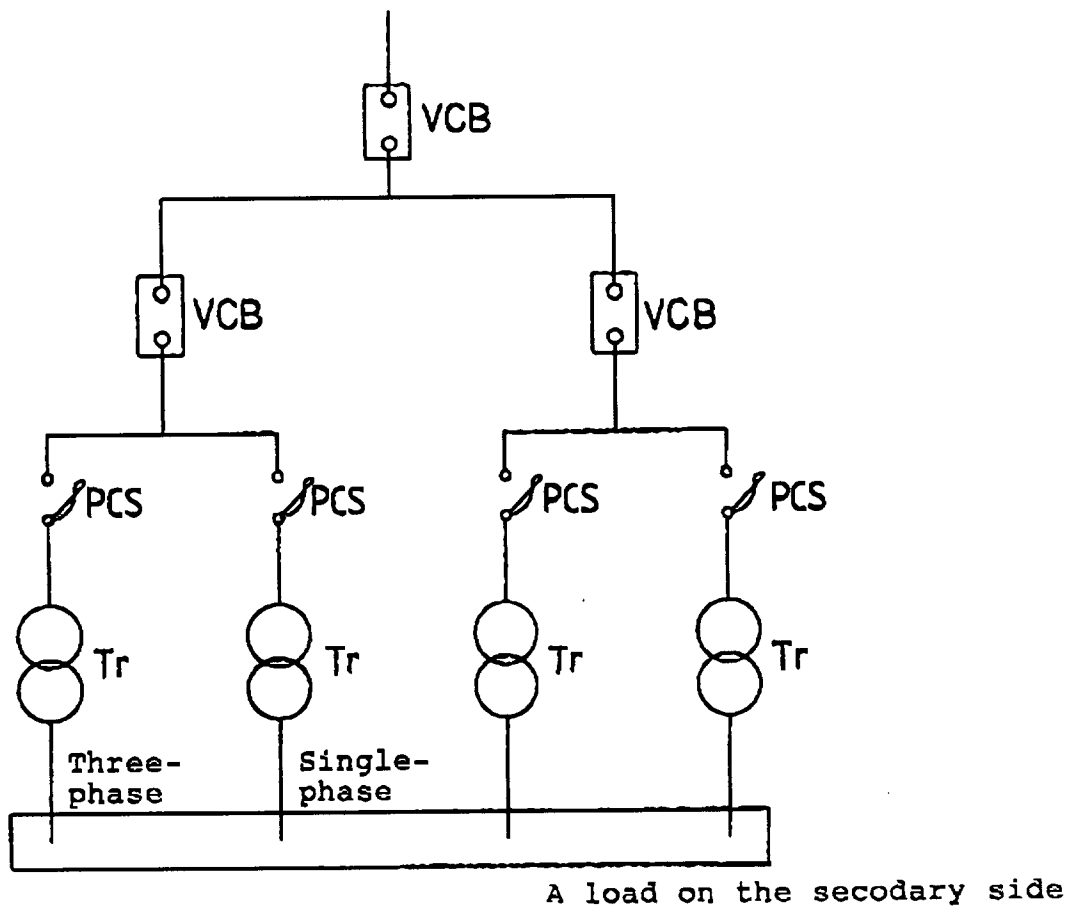


FIG. 6

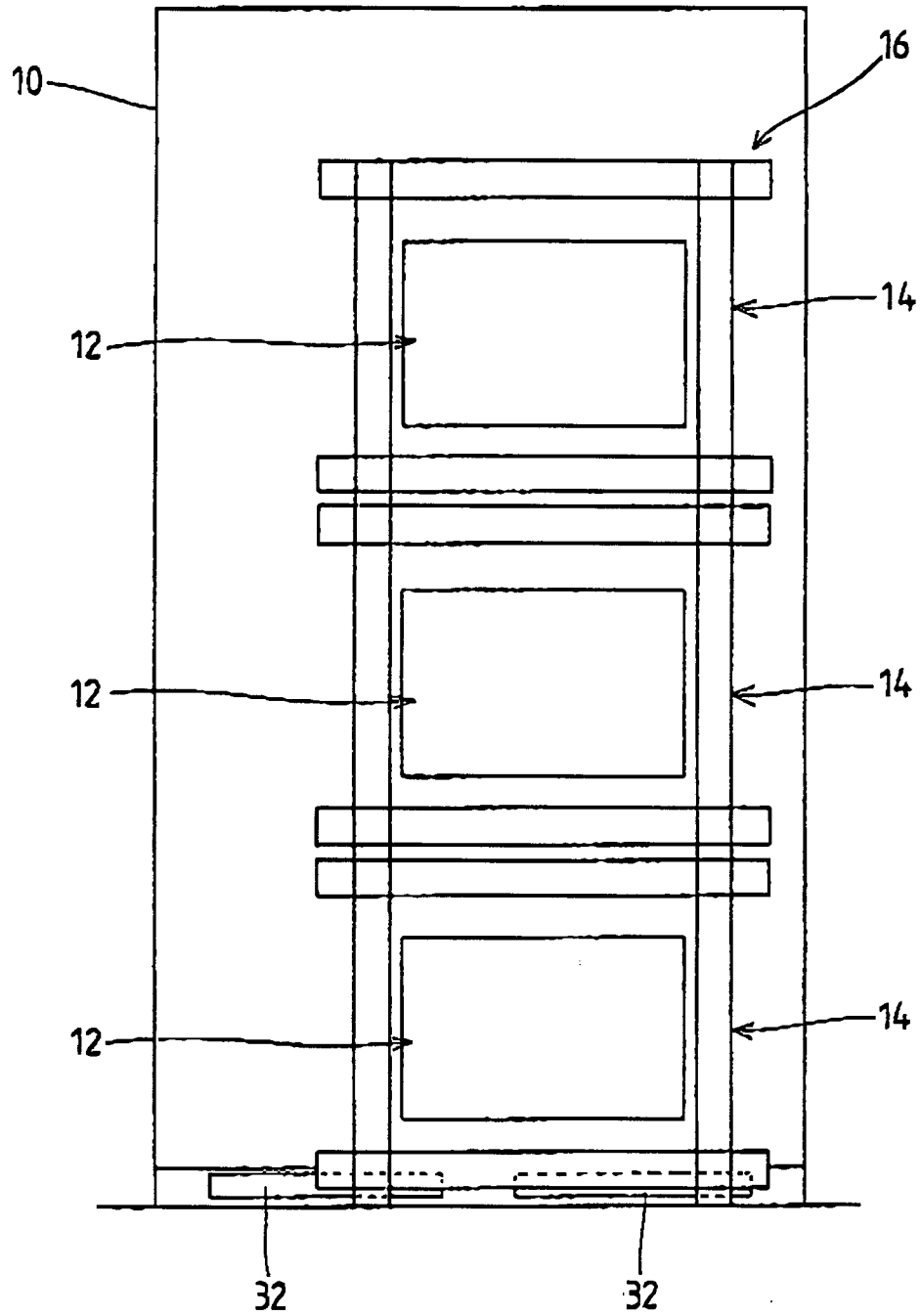


FIG. 7

