A. D. RICCIA.

AUTO TRANSFORMER.

APPLICATION FILED DEC. 2, 1921.

1,426,775.

Patented Aug. 22, 1922.

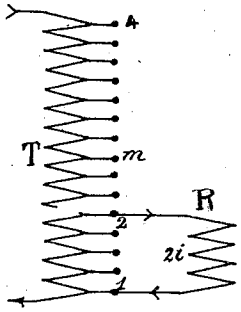


Fig. 1

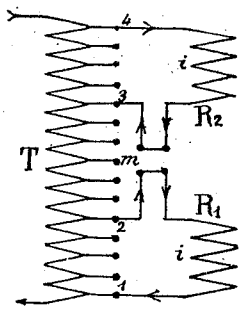


Fig. 2

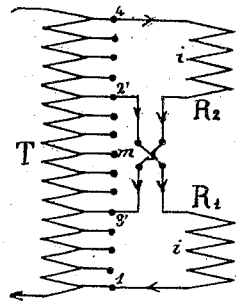


Fig. 2'

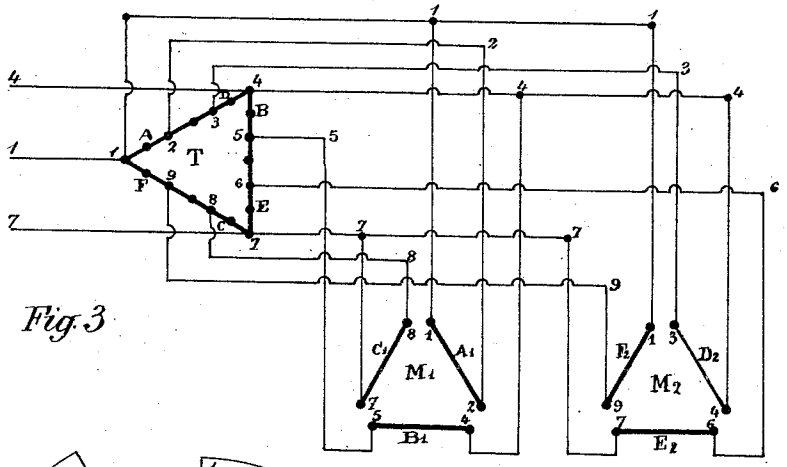


Fig. 3

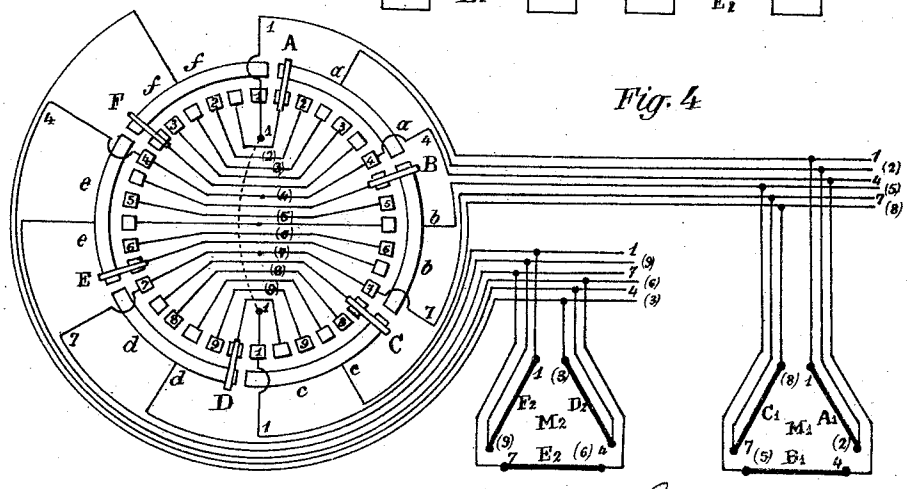


Fig. 4

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AUTOTRANSFORMER.

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To all whom it may concern:

Be it known that I, ANGELO DELLA RICCIA, residing at Brussels, Belgium, 253 Chaussée d'Alsemberg, have invented certain new and useful Improvements in Autotransformers, of which the following is a specification.

In various applications of single-phase and polyphase currents, auto-transformers are employed for regulating between 0 and the working tension, the voltage used upon motors or like apparatus. Fig. 1 of the accompanying drawings shows a diagram of the known arrangement of an auto-transformer of this kind, wherein T is the auto-transformer, R the motor or like device supplied and 2 the movable contact member cooperating with the contact pieces from 1 to 4.

The invention is applicable in the case in which the motors or like devices to be supplied are disposed in pairs, and relates to a particular arrangement wherein the technical effect consists in affording a much higher efficiency than is obtained with known arrangements. In fact, in transformers with distinct primary and secondary windings, the transfer of energy from primary to secondary is carried out exclusively by induction. In the auto-transformers with a single winding, a portion of the energy is transferred from one circuit to the other by simple conduction and only the remainder by induction, the winding operating partly as a continuous current shunt and as secondary, and partly as a primary circuit.

I hereby propose to increase to the maximum the portions of the winding which are intended for use as shunt and secondary and to reduce to a minimum the portions of the winding to be used as primary, thereby reducing the mean value of all the currents employed, with a consequent increase in efficiency.

In the accompanying drawings, Fig. 1 shows the known arrangement of an auto-transformer. Fig. 2 and the following figures set forth diagrams of dispositions according to this invention. Figs. 2 and 2′ show for two positions of the movable contact an arrangement for single-phase current with two groups of apparatus to be supplied. Fig. 3 shows the arrangement for three-phase current. Fig. 4 shows a control device for regulating while in operation, using the arrangements as shown in Fig. 3.

In Figs. 2 and 2′, T is the auto-transformer, R_1 R_2 are the two apparatus or groups of apparatus on the supply circuit, 1 and 4 are the end contact pieces of the auto-transformer, 2 and 3 are the contact members movable upon the contact pieces from 1 to 4. Supposing that the contact members 2 and 3 are symmetrically disposed with reference to the middle contact piece m and are obliged to move through equal distances in the contrary sense, the auto-transformer will be symmetrically loaded. When the contact members 2 and 3 coincide with the middle contact piece m, R_1 and R_2 will be connected in series, and the transformer will operate without load. When the contact member 2 is upon the contact piece 4 and the contact member 3 is upon the contact piece 1, R_1 and R_2 will be connected in parallel and will receive the full voltage, and the auto-transformer will also operate without load.

If e is the standard voltage of the working circuit, i the power current taken by each group of apparatus R_1 R_2, r the total resistance of the winding of the atuo-transformer, if it be supposed that all wattless current is neglected and if the voltage supplied to the two groups R_1 R_2 is varied in a uniform manner, the mean power furnished by the auto-transformer is:

$\frac{2}{3}\ ei$ in the case of Fig. 1.

$\frac{1}{3}\ ei$ in the case of Figs. 2 and 2′.

and the loss in heat is:

$\frac{2}{3}\ ri^2$ in the case of Fig. 1

$\frac{1}{6}\ ri^2$ in the case of Figs. 2 and 2′.

A like arrangement may be used for polyphase currents.

Fig. 3 shows by way of example an arrangement for three-phase current with the auto-transformer T mounted in delta connection and supplying two three-phase motors M_1 M_2 also in delta connection. A_1 B_1 C_1 and D_2 E_2 F_2 are respectively the three windings of each of the motors which are respectively supplied by the six corresponding sections A B C D E F of the auto-transformer. If the movable contact members 2 and 3, 5 and 6, 8 and 9 are caused to move at each side of the triangle by equal amounts and in the contrary sense, the arrangement will provide in the case of each phase, the same operating conditions and advantages as above set forth for the single-phase circuit in Figs. 2 and 2′. It must be observed that the two motors M_1 M_2 should possess three phases which are en-

tirely separate in arrangement. For the apparatus with star connection, the three-phases should not possess a common fixed neutral point.

To obtain the above-described displacement of the movable contacts for each phase, the apparatus may be provided with a device such as the controller shown by way of example in Fig. 4. The said controller consists of a double set of contact pieces disposed in contrary sense and connected in pairs with the corresponding points of the auto-transformer windings, and six sectors *aa*, *bb*, *cc*, *dd*, *ee*, *ff*, each of which is respectively connected with one end of the six corresponding windings of the motors, the other ends of the said windings being respectively connected with one of the contact pieces corresponding to the main terminals of the auto-transformer (1, 4, 7, 1, 7, 4). The apparatus employs six slides A B C D E F spaced at 60° and mechanically connected together, in order to make contact successively between the various contact pieces and the sectors. The width of the slides A B C D E F cooperating with the said contact pieces should be made smaller than the space between the contact pieces to prevent short-circuiting of the sections of the auto-transformer.

It is obvious that the contact pieces, sectors and slides corresponding to the six windings in the supply circuit, may, instead of being disposed upon a single disc (or cylinder) as shown diagrammatically in Fig. 4, be divided into two, three or six superposed rows and placed in an oil bath. Known devices may be added thereto for obtaining a quick break of the circuit and the stoppage of the slides at determined points.

The operation of a control device may, if desired, be effected by a servomotor, and the latter can be regulated by one or more relays if necessary.

Claims:

1.—An auto-transformer for the supply of two symmetrically disposed secondary circuits, comprising for each secondary circuit a stationary terminal connected in the circuit at the corresponding end of the transformer winding and a terminal movable along the said winding, the two movable terminals being symmetrically disposed, and means for moving the same by equal amounts and in contrary sense upon the whole length of the winding.

2.—An auto-transformer for the supply of two symmetrically disposed secondary circuits for each phase, comprising for each secondary circuit a stationary terminal connected in the circuit at one end of the transformer winding corresponding to the phase of the said circuit and a terminal which is movable along the said winding, the two movable terminals of the two secondary circuits of a given phase being symmetrically disposed on the corresponding winding of the transformer, and means for moving the same by equal amounts and in contrary sense upon the whole length of the said winding, this being effected simultaneously and in like manner for each of the phases.

3.—In combination with an auto-transformer for the supply of two symmetrically disposed secondary circuits for each phase and employing for each secondary circuit a stationary terminal connected in the circuit at one end of the corresponding transformer winding and a terminal movable along the said winding, a controller for displacing the movable terminals comprising two sets of contact pieces disposed in contrary sense and connected in pairs to the different points of the corresponding windings of the transformer, sectors corresponding to the secondary windings to be supplied, and contact slides movable upon the said contact pieces and sectors, for connecting two separate secondary circuits simultaneously to two separate portions of a given secondary winding, this being carried out for each phase.

In testimony whereof I affix my signature.

ANGELO DELLA RICCIA.