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ELECTRIC CONTROLLING APPARATUS

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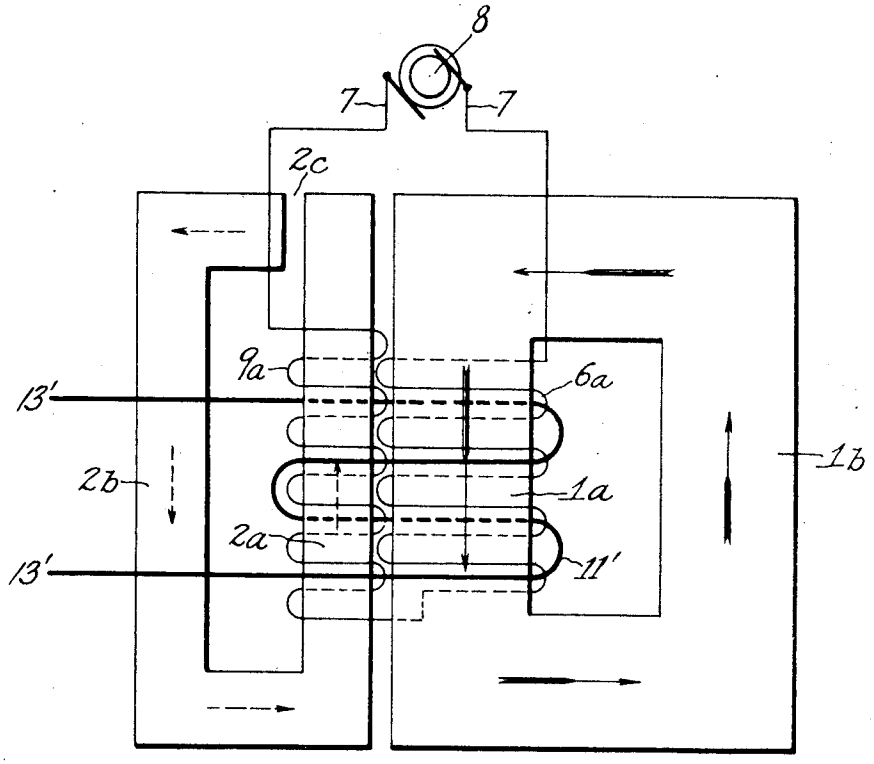

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ELECTRIC CONTROLLING APPARATUS

Original application filed September 15, 1928, Serial No. 306,259. Divided and this application filed June 14, 1930. Serial No. 461,253.

This invention relates to improved controlling apparatus and method of control for regulating the voltage, where energy is derived from an alternating current source subject to variations in the voltage supplied, or in the frequency, or both, and wherein the derived voltage is maintained substantially constant irrespective of the variations in the supply. The invention also relates to obtaining any desired control of the output voltage where the supply voltage varies. For example, with an increase in supply voltage, the output voltage may be caused to decrease in a predetermined amount; or with an increase in supply voltage, the output voltage may be caused to increase in a predetermined amount; or with an increase in supply voltage, a predetermined successive increase and decrease, or vice versa, may be caused to occur, or any desired results may be secured by relative proportioning of the parts.

This application is a division of my pending application Serial Number 306,259, filed September 15, 1928.

The main object is to provide an improved method of control and form of apparatus which may be simple in character and low in cost of construction, and adapted to be introduced in the alternating current circuit as a unit for securing automatic control of the voltage delivered and adapted for general use. The improved apparatus is adapted to be interpolated in an alternating current circuit between the source and the translating device, or translating devices, and maintain the required voltage substantially constant and avoids the use of auxiliary controlling means. It is not only adapted for use where the required voltage is the same in general as that of the supply voltage, but is particularly well adapted for instances where the required derived voltage is materially different from that of the supply lines, such for example, as for supplying required substantially constant alternating current voltage to the power unit of a radio receiving set where the voltage is stepped down from that of the supply voltage, which latter may ordinarily be about 110 volts. This invention not only serves to maintain the derived alternating current voltage substantially constant, but also serves as a transformer and avoids the use of an additional transformer where the required voltage is to be transformed from that of the available supply. The invention thus combines in one unit the functions of a transformer and voltage regulator with resulting simplicity and reduced cost of apparatus, as well as attaining high efficiency in operation.

This invention also permits the use of a simple form of core structure and windings adapted to be conveniently made and assembled at low cost. Other objects and advantages will be apparent to those skilled in the art from the following description and accompanying drawing; likewise, it will be appreciated that the invention is applicable to various uses and capable of modification in design and construction to meet particular requirements.

The accompanying drawing is a diagram illustrating one embodiment of this invention.

The core of the controller, or transformer, is laminated in the usual manner, and in the accompanying drawing, is indicated as having all its laminæ in parallel planes and is shown having its core made up of two cooperating parts magnetically separated from each other. The main primary exciting winding 6*a* is wound about one leg 1*a* forming part of a core whose magnetic circuit is completed by another leg 1*b* and upper and lower connecting portions. Adjoining the leg 1*a* is shown another leg 2*a* having a winding 9*a* connected in series with the winding 6*a* across the alternating current supply lines 7 supplied by the alternating source 8. The magnetic circuit of the leg 2*a* is continued by a lower connecting portion and another leg 2*b* which extends by an upper portion towards the upper end of the leg 2*a*, an air gap 2*c*, however, being introduced in the magnetic circuit of the core upon which the winding 9*a* is wound. The legs 1*a* and 2*a* carrying their respective windings are sufficiently spaced apart to permit the application of these windings thereon, but in some cases the cores shown in the drawing may be partially joined, if desired. The output

winding 11′ supplying the output circuit wires 13′ envelopes both legs 1*a* and 2*a* and is therefore subjected to the resultant flux passing through the legs 1*a* and 2*a*. The direction of the turns of the windings 6*a* and 9*a* around their cores is such as to cause the flux created by the winding 9*a* to be in the opposite direction to the direction of the flux created by the winding 6*a*, as regards passage of the flux through the output winding 11′, as indicated by the full line and dotted line arrows on the drawing. The cross-section of the leg 1*a* and the ampere turns of the main primary exciting winding 6*a* are proportioned, for securing substantially constant output voltage, such that, under normal conditions of supply voltage, the leg or core 1*a* is working near or below the knee of the saturation or permeability curve. In operation under abnormally high voltage supply, the excitation of the core 1*a* is carried along the knee of the curve so that the magnetic flux is not increased in proportion to the increase in voltage supply, whereas the opposing influence of the winding 9*a* under abnormally high voltage has full effect in tending to keep down the total flux within the output winding 11′. Under abnormally low voltage conditions, the magnetization of the leg 1*a* is below the knee of the permeability curve and on the straight part thereof, and therefore the somewhat decreased exciting effect of the main primary winding 6*a* is permitted to have full effect, and the decreased supply voltage causes a decreased opposing effect in the winding 9*a* with the result that the total flux within the output winding 11′ remains substantially constant under variations in the supply voltage. Although the main exciting winding 6*a* and the bucking winding 9*a* are shown connected in series with each other, they may in some cases be connected in parallel across the supply lines, or the bucking winding may be connected across the supply lines and the main exciting winding connected in series with a portion of the bucking winding across the supply lines. The series connection of the two exciting windings, or partial series connection, has the advantage that, upon increase of the supply voltage above normal, the tendency is to reduce the watt-less current in the main exciting winding. This, of course, results in improving the regulation, because less watt-less current means less primary ampere turns and less flux which the bucking winding must overcome. A further advantage results in permitting the bucking winding to be made with fewer turns. A further advantage results from the fact that by reason of the core of the bucking winding being less saturated than the core of the primary winding, an increase in the input voltage will produce a greater proportionate reactance drop on the bucking winding than on the primary winding. As a result, an increase in input voltage produces a lesser increase on the primary winding than would be the case if the primary reactance increased proportionally to the bucking coil reactance. This lesser proportionate change of supply voltage in affecting the primary winding requires a correspondingly less amount of regulation in giving the desired results.

It will be understood that my improved apparatus may be operated in the reverse manner to that described, that is, if energy of variable voltage be supplied to the secondary or output winding, the exciting windings will then deliver current with the voltage controlled within limits. Such a reversal of operation will not, however, be as efficient, or secure as desirable results, as when the apparatus is operated in the normal manner.

It will be evident to those skilled in the art that the invention may be embodied in various forms of apparatus and various modifications may be made therein without departing from the scope thereof; and, by suitably proportioning the parts, the output voltage may be caused to change as desired upon variation in the supply voltage, or upon change of frequency, according to the requirements for any particular case.

I claim:

1. A controller comprising a core in two parts having adjoining portions and having independent paths for the passage of magnetic flux, a main alternating current exciting winding on one of said adjoining portions, an alternating current exciting winding on the other of said adjoining portions, the path of the flux in said adjoining portions due to said exciting windings being in opposite directions, and an output winding embracing said adjoining portions and also embracing said alternating current exciting windings.

2. A controller comprising a core in two parts having adjoining portions and having independent paths for the passage of magnetic flux, a main alternating current exciting winding on one of said adjoining portions, an alternating current exciting winding on the other of said adjoining portions, the path of the flux in said adjoining portions due to said exciting windings being in opposite directions, said main alternating current exciting winding being connected in series with at least a portion of said second alternating current exciting winding, and an output winding embracing said adjoining portions and also embracing said alternating current exciting windings.

3. A controller comprising a core in two parts having adjoining legs and having independent paths for the passage of magnetic flux, a main alternating current exciting winding on one of said legs of one of said parts, an alternating current exciting wind-

ing on the other leg of the other of said parts, the path of the flux in said adjoining legs due to said exciting windings being in opposite directions with reference to each other, and an output winding embracing both of said legs.

4. A controller comprising a core in two parts having adjoining legs and having independent paths for the passage of magnetic flux, a main alternating current exciting winding on one of said legs of one of said parts, an alternating current exciting winding on the other leg of the other of said parts, the path of the flux in said adjoining legs due to said exciting windings being in opposite directions with reference to each other, said main alternating current exciting winding being connected in series with at least a portion of said second alternating current exciting winding, and an output winding embracing both of said legs.

5. A controller comprising a core in two parts having adjoining legs and having independent paths for the passage of magnetic flux, a main alternating current exciting winding on one of said legs of one of said parts, said leg being near saturation under normal exciting conditions, an alternating current exciting winding on the other leg of the other of said parts, the path of the flux in said adjoining legs due to said exciting windings being in opposite directions with reference to each other, and an output winding embracing both of said legs.

6. A controller comprising a core in two parts having adjoining legs and having independent paths for the passage of magnetic flux, a main alternating current exciting winding on one of said legs of one of said parts, an alternating current exciting winding on the other leg of the other of said parts, said last-named leg being below saturation under working conditions, the path of the flux in said adjoining legs due to said exciting windings being in opposite directions with reference to each other, and an output winding embracing both of said legs.

7. A controller comprising a core in two parts having adjoining legs and having independent paths for the passage of magnetic flux, a main alternating current exciting winding on one of said legs of one of said parts, said leg being near saturation under normal exciting conditions, an alternating current exciting winding on the other leg of the other of said parts, said last-named leg being below saturation under working conditions, the path of the flux in said adjoining legs due to said exciting windings being in opposite directions with reference to each other, and an output winding embracing both of said legs.

8. A controller comprising a core in two parts having adjoining legs and having independent paths for the passage of magnetic flux, a main alternating current exciting winding on one of said legs of one of said parts, said leg being near saturation under normal exciting conditions, an alternating current exciting winding on the other leg of the other of said parts, said last-named leg being below saturation under working conditions, the path of the flux in said adjoining legs due to said exciting windings being in opposite directions with reference to each other, said main alternating current exciting winding being connected in series with at least a portion of said second alternating current exciting winding, and an output winding embracing both of said legs.

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