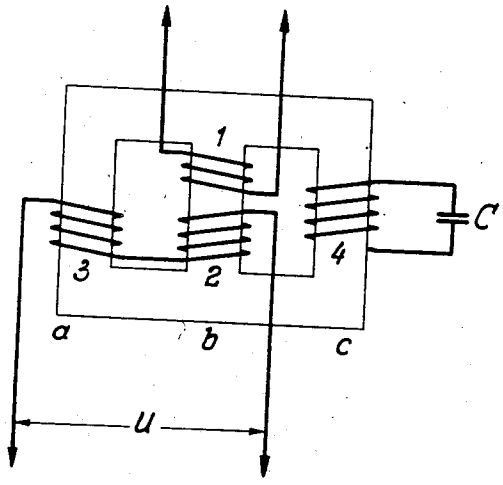
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H. BÖHM

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VOLTAGE REGULATING DEVICE

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VOLTAGE REGULATING DEVICE

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1 Claim. (Cl. 171—119)

This invention relates to new and useful improvements in voltage regulating devices, and has for its object to provide means in order to maintain the voltage delivered to the secondary circuit substantially constant even in cases that the voltage applied to the primary circuit thereof is subjected to considerable fluctuations.

It is a known expedient in connection with voltage regulating systems to employ transformer means having a multi-legged iron core in which the magnetic flux is translocated from one to any other leg or legs of the core in response to a magnetic bias imparted by means of a direct current in order to facilitate the voltage regulation. For instance, assuming a transformer having a three-legged iron core, the main winding of this transformer is generally applied about the central leg and the opposing or counteracting winding together with the biasing current winding are arranged on either of the outer legs, while no winding is provided on the other of the outer legs. In cases that the load becomes increased, the opposing voltage in the winding applied on the outer leg of the core decreases on account of the effect of the direct current flow through the biasing winding. Due to the fact that the counteracting winding is connected in opposition to the secondary main winding, the total voltage is caused to increase with increased load.

The counteracting winding on the first hand and the biasing winding on the other hand in devices of the aforementioned type require considerable expenditure of copper which is five to six times higher than for conventional transformers. Moreover, a large percentage of the resultant voltage gain in the direct current winding becomes nullified on account of the ohmic voltage drop across the counteracting winding when the apparatus is adapted to feed a rectifier device, in which case smooth means are inevitably required for the biasing winding since the biasing impulses would otherwise be subjected to a time lag which would substantially limit the effectiveness of the biasing current.

It is the object of this invention to provide new and useful means in order to overcome the above mentioned difficulties and disadvantages offered by the heretofore known devices of the above mentioned kind.

According to the main feature of my invention a voltage regulation is effected without the heretofore employed direct current biasing effect in a useful, simple and reliable manner by the provision of a condenser being connected across a particular winding applied on one of the legs of a three-legged transformer core.

The invention will be more readily understood from the following description taken in conjunction with the accompanying drawing, in which the single figure diagrammatically shows one embodiment of my present invention.

This figure shows a magnetizable transformer core comprising the three legs or portions *a*, *b* and *c*. The primary winding 1 of this transformer and the secondary winding 2 thereof are both arranged on the middle or central leg *b*. One of the outer legs, i. e., the leg *a* in the device embodied, carries a counteracting winding 3 connected in series with the secondary winding 2 while being connected in opposition to this winding. The other of the outer legs, that is the leg *c* in the drawing, is provided with a further winding 4, the ends of which are connected with a condenser C.

The main flux set up by the winding 1 threads with the turns of the secondary winding 2 without involving substantial stray losses so that the voltage across this winding may be considered as practically constant at constant voltage supply to the primary winding 1. In an unloaded or idle condition of the secondary circuit indicated at *u* in the drawing, this main flux is uniformly distributed in the two legs or core portions *a* and *c*, while it is possible when the secondary circuit is effectively under load by suitably dimensioning the condenser C to cause the voltage across the counter-winding 3 to decrease within increasing load, from which follows that the total voltage of the secondary circuit increases with increasing load.

If the secondary circuit is connected with a rectifier device, such as dry rectifiers for example, the above described transformer may be used for balancing the inner voltage drop of the dry rectifiers in order to attain a constant direct current. It is also possible to so adjust the partial fluxes in the transformer core that either a sloped or a curved characteristic having ascending and descending portions is obtained. This possibility is specifically advantageous in cases that the voltage regulating device serves for charging batteries when it is desirable to automatically apply and disconnect the charge current to and from the batteries without the use of relays.

In the circuit arrangement under consideration, the direct current thus produced is not necessarily to be conveyed to the transformer in order to effect premagnetization. It is obvi-

ous that in the heretofore known devices in which the resulting direct current was used for obtaining the biasing effect, this direct current was subjected to considerable distortions. Moreover, the disadvantage introduced on account of the ohmic voltage losses in the direct current biasing winding is completely eliminated since the new arrangement is in the favour to omit this winding in contradiction to the heretofore known devices of this type.

With reference to the known transformer circuits having a direct current biasing winding, the continuous current resulting at the output circuit of a cooperating rectifier is used for energizing this biasing winding, so it will be necessary to accommodate this winding to the rectifier. However, since the electrical values of this winding cannot be determined by computation due to the variety of different influences, such as magnetic stray, core losses, ohmic voltage drops across the windings, etc., individual experimental tests must be carried out for each separate device. In the past it has been necessary to provide a number of separate interchangeable test coils with different numbers of turns in order to simplify such accommodation and to make the actual transformer coils equal to the test coil involving the best of results, but it is obvious that this procedure requires much time and trouble by bearing in mind that the biasing winding must be tested for different cross sections and saturation degrees of the core which in turn require a plurality of calibration transformers in which the ratio of the main winding to the counteracting winding likewise varies within certain limits.

In contradiction to the difficulties as set forth in the last paragraph, the arrangement according to the present invention merely requires that the number of turns of the winding 4 on the leg c of the drawing permits the reactive power of condenser C to be fully utilized. The desired characteristic is easily determinable by a suitable choice of the capacity of this condenser and this capacity may be ascertained without difficulty by means of a calibration condenser, the capacity of which may be varied step by step.

The arrangement according to my invention may likewise be employed for voltage regulation even in cases that other apparatus than rectifiers are used as load. Since this arrangement does not employ any contact means which easily introduce difficulties in mechanically controlled circuit arrangements, the invention is preferably well adapted in systems which are attended only at long intervals of time.

Although the arrangement embodied has been shown in connection with a single phase apparatus associated with the primary winding, it is obvious that this arrangement may be likewise accommodated to polyphase operation.

What is claimed is:

A voltage regulating transformer comprising a magnetizable core of rectangular figure-8-shape forming one central and two outer core portions, a primary input winding on said central core portion, a secondary main winding likewise on said central core portion, a secondary counteracting winding applied on either of said outer core portions and connected in series with but in electrical opposition to said secondary main winding to form an output circuit therewith, a further winding on the other of said outer core portions, and a condenser shunted across said further winding, the magnetic saturation of said core portions, the ratio of the number of turns of said secondary main winding to the number of turns of said secondary counteracting winding and the magnitude of said condenser being so chosen that the voltage across said counteracting winding is caused to decrease in response to a load increase across said output circuit for increasing the resultant voltage across said output circuit, and vice versa.

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