

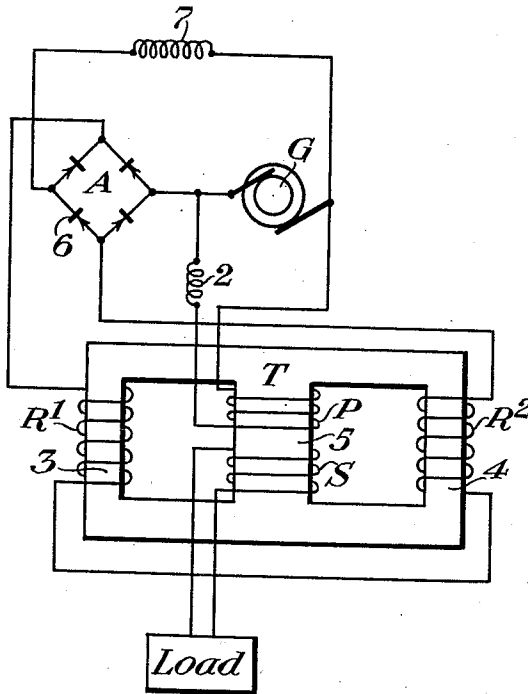
Dec. 9, 1930.

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1,784,030

TRANSFORMER

Filed Aug. 30, 1928



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UNITED STATES PATENT OFFICE

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TRANSFORMER

Application filed August 30, 1928. Serial No. 303,039.

My invention relates to transformers, and has for an object the provision of novel and improved means for regulating the output of a transformer during variations in the input voltage.

I will describe one form of transformer regulating means embodying my invention, and will then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view showing one form of regulating means embodying my invention.

Referring to the drawing, the reference character T designates a transformer having a magnetizable core provided with three parallel legs 3, 4 and 5, which legs are connected together at each end. The middle leg 5 carries a primary winding P and a secondary winding S. The primary winding P is connected with an alternating current generator G, and the primary circuit includes an impedance 2 which is of the same order of magnitude as the impedance of the primary winding P under load conditions. The secondary S is connected with a load which may be of any suitable character.

The outside legs 3 and 4 of the transformer core are provided with a regulating winding comprising two coils R^1 and R^2 having equal numbers of turns. These coils are connected in series in such manner that current flowing therein creates no flux in the middle leg 5. The regulating winding is connected with the output terminals of a full-wave rectifier A, and the input terminals of this rectifier are connected with the generator G through a ballast impedance 7. The rectifier A may be of the copper oxide type disclosed in Letters Patent of the United States granted to L. O. Grondahl on August 23, 1927, No. 1,640,335.

The operation of the apparatus is as follows: I will first assume that the voltage delivered by generator G increases above the normal value. If the impedances in the primary circuit remain substantially constant, the voltage applied to the primary winding will increase, and, consequently, the voltage delivered by the secondary winding will also tend to increase. The current in the regu-

lating winding increases, however, due to the rise of the voltage applied to this winding, with the result that a decrease occurs in the impedance of the primary winding P, and this counteracts the tendency of the secondary voltage to increase because under this condition the impedance 2 takes a relatively larger part of the voltage than when the voltage of generator G is normal. Perfect compensation is obtained when the change in primary impedance is just great enough to completely offset the change in the voltage applied to the primary circuit.

After a suitable value has been given to the impedance 2, there are two factors that control the voltage compensation. The first factor is the amount of direct current normally flowing in the circuit of the regulating winding, and the second factor is the characteristic of the rectifier A.

With regard to the first factor, the change in the impedance 2, there are two factors that control the voltage compensation. The first factor is the amount of direct current normally flowing in the circuit of the regulating winding, and the second factor is the characteristic of the rectifier A. With regard to the first factor, the change in the impedance 2, there are two factors that control the voltage compensation. The first factor is the amount of direct current normally flowing in the circuit of the regulating winding, and the second factor is the characteristic of the rectifier A. I have found, however, that perfect compensation cannot be obtained by this factor alone, that is, assuming that the changes in the regulating current are proportional to the changes in the supply voltage, only partial compensation is possible. I have also found, however, that by proper choice of the rectifier A and its normal working voltage, it is possible to arrange the apparatus in such manner that changes in primary voltage may be compensated to any desired degree. It is even possible to arrange the apparatus so that the secondary voltage will fall when the primary voltage rises. This accuracy of compensation is due to the fact that when the alternating input voltage of the copper oxide rectifier increases, the direct current output of the rectifier increases much more rapidly. Within a certain range the increase of direct current output is almost proportional to the square of the increase in the alternating input and voltage.

When direct current is flowing in the reg-

ulating circuit, an alternating electromotive force is induced in the regulating coils. The alternating current in the regulating circuit due to this induced electromotive force is rectified by the rectifier A and is therefore added to the regulating current. This may be termed regeneration, and the increase in the regenerative current with increase in applied direct current depends on the direct current already present. Furthermore, the amount of current obtained by regeneration depends on how well the rectifier matches the impedance of the regulating coils. It follows that the additional voltage compensation obtained by proper choice of the rectifier is due partly to the regenerative current and partly to the change in the resistance of the rectifier with changes of the voltage applied to it.

Although I have herein shown and described only one form of regulating means embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a transformer, a primary circuit for said transformer including a source of alternating current and a secondary circuit including a load, a regulating winding on said transformer, and a circuit for said regulating winding including said source of alternating current and a copper oxide rectifier.

2. In combination, a transformer, a secondary circuit for said transformer including a load, a primary circuit for said transformer including a source of alternating current and an impedance of the same order of magnitude as that of the primary winding under load conditions, a regulating winding on said transformer, a full wave rectifier, an input circuit for said rectifier including said source of alternating current and a ballast impedance, and an output circuit for said rectifier including said regulating winding.

3. In combination, a transformer comprising a core having three legs connected together at each end, a primary winding and a secondary winding on the middle leg, a circuit for said primary winding including a source of alternating current, a circuit for said secondary winding including a load, a regulating winding including two coils located on the two outside legs respectively of said core and connected in series in such manner that current flowing therein creates no flux in said middle leg, and a circuit for said regulating winding including said alternating current source and a rectifier.

In testimony whereof I affix my signature.