June 21, 1938. J. H. GOUGH 2,121,592

CONSTANT REGULATION TRANSFORMER

Filed Dec. 13, 1935

Fig. 1.

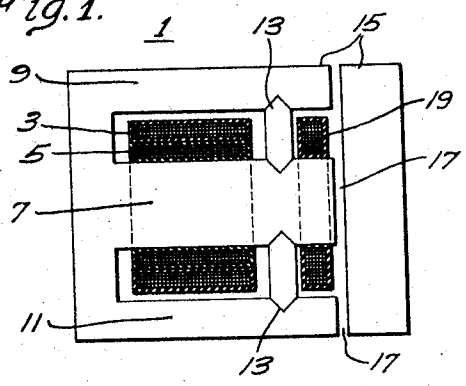


Fig. 2.

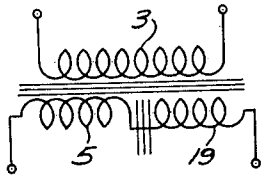


Fig. 3.

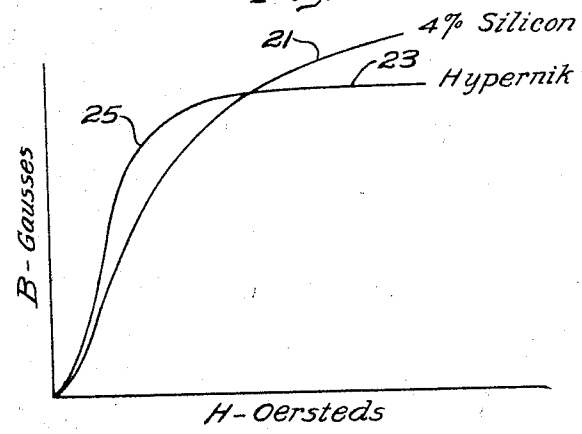
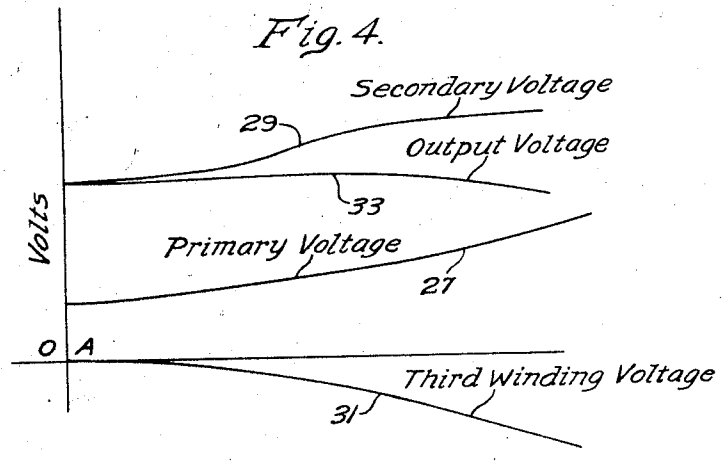


Fig. 4.



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CONSTANT REGULATION TRANSFORMER

John Henry Gough, Bethesda, Md., assignor to Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., a corporation of Pennsylvania

Application December 13, 1935, Serial No. 54,250

4 Claims. (Cl. 171—119)

My invention relates to electrical transformers, more particularly to improvements therein, and has for its principal object to provide an article of this character which shall have constant voltage output on its secondary side, in spite of wide variations of potential applied to its primary winding.

Another object of my invention is to provide a transformer which shall be capable of supplying constant potential output and which shall not require material changes in design from similar structures of the prior art.

A further object of my invention is to provide a transformer of the type described which shall not depart substantially from the physical dimensions and weight of standard transformers of the same rating.

Additional objects of my invention will be disclosed in the following description of the same taken in conjunction with the accompanying drawing wherein I have disclosed, in Figure 1, one form of my invention as embodied in a transformer of the shell type;

In Fig. 2 I have disclosed the connections and relationship existing between the various windings embodied in the transformer of my improved design;

Fig. 3 embodies curves representing the characteristics of the transformer core material, and the manner in which these characteristics are taken advantage of to obtain the constant voltage output from this device; and

Fig. 4 embodies curves of the voltage appearing across the various windings of the transformer and illustrates the mode of operation of the transformer to obtain constant voltage output.

My invention, in general, provides for a transformer core of magnetizable material, a portion of which has different magnetic properties than the remaining portion. These properties, for proper operation of the transformer in accordance with the objects of my invention, call for high permeability and low saturation point, as compared to the characteristics of the material of which the remainder of the core is composed. This high permeable section of the core is so positioned therein, as to shunt a portion of the core, which portion is provided with an air gap. The primary and secondary windings proper of the transformer are mounted on the core to one side of the high permeable insert, and a third winding is mounted on that portion of the core which is shunted by the high permeable section. The transformer is so designed that for minimum normal voltage operation, the shunting insert or yoke will be operating at a point on the beginning of the knee of its characteristic curve.

As the primary impressed voltage increases, the shunting inserts will begin to saturate, causing more and more of the flux to bridge the air gap of the shunted portion of the core and encircle the third winding, the voltage thereby induced in the third winding increasing with the increase in the flux, which is caused to traverse the shunted path. This increase will occur simultaneously with the increase in the voltage across the secondary winding and can be made to be of like value or amplitude for all changes of the impressed voltage within the expected limits. This can be readily obtained by varying the degree of regulation, merely through altering the dimensions of the air gap in the shunted portion of the core.

The potential induced in the third winding can then be utilized to buck out the increase in the potential across the secondary winding caused by the increase of impressed primary voltage, through the simple expedient of connecting the secondary winding and the third winding in series and in such direction that the voltages induced in each of the windings will be 180° out of phase with each other.

Referring to Fig. 1, I have disclosed therein a transformer 1 of the shell type having primary and secondary windings 3 and 5, respectively, mounted on the center leg 7 of the three-legged core. In this position the secondary winding will always be under the influence of the entire flux produced by the primary winding. The outside legs 9 and 11, respectively, as well as the center leg 7, are notched near their extremities to receive inserts or yokes 13 of a high permeable material having a lower saturation point than the material comprising the core proper. If the core proper be of silicon steel, then the inserts could be of such material as Hypernick, this being an alloy of nickel-iron in approximately equal portions. These elements, in bridging across between the outer legs and the center leg of the core, shunt that portion of the core 15 to the right thereof, which portion is provided with air gaps 17 to increase the magnetic reluctance of the circuit therethrough. A third winding 19 is also mounted on the center leg to the right of the shunting elements and in a position where it will be enclosed by a shunted portion 15 of the core.

As illustrated in Fig. 2, the secondary winding and the third winding are connected in series but in such a direction as to induce voltages in phase opposition to each other.

Referring to Fig. 3, the magnetic characteristics of the core material proper may be represented by the curve 21, and the characteristics of the shunting material 13 will be such as to follow the curve 23, which has been illustrated as reaching the saturation point prior to that representing the core material proper. In order to take advantage of the difference in characteristics of the two materials, to obtain constant voltage output, the core is designed so that for lowest value of normal applied potential which one might expect, the shunting elements will be operating at the beginning of the knee on the saturation curve, which point is indicated in the sketch by the reference numeral 25. With the transformer designed to operate at this point, any increase in primary impressed voltage as indicated by the curve 27 of Fig. 4, the voltage developed across the secondary winding will follow some such curve as designated in Fig. 4 by the reference numeral 29. As the shunting elements become more and more saturated with an increase in impressed primary potential, the voltage induced in the third winding will gradually increase in amplitude, but due to the fact that it is connected in phase opposition to the secondary winding, this voltage is represented in Fig. 4 by a curve 31 extending in a direction opposite to that representing the potential developed across the secondary winding. The potential developed across the output terminals of the transformer will be the sum of the potentials across the two windings in series, or with reference to the curves of Fig. 4 it will be represented by a curve 33, each value of which is the sum of the two voltages developed across the two windings as indicated by curves 29 and 31. For wide changes in the primary voltage which one might normally expect, it will be apparent that the output voltage developed across the terminals of the transformer will remain substantially constant in value.

In the above description it will be apparent that my invention will accomplish the objects attributed thereto.

While I have disclosed my invention in great detail, I do not desire to be limited thereto except as may be necessitated by the prior art and the appended claims.

I claim as my invention:

1. In combination, a transformer core of magnetizable material having a section thereof of Hypernick said section being so positioned as to shunt an adjacent section having a higher saturation point than Hypernick, a primary and secondary winding positioned on said core to one side of said Hypernick section, a third winding positioned on said core to the other side of said Hypernick section, said secondary winding and said third winding being connected in series opposition to each other.

2. In combination, a transformer core comprising one portion consisting of a complete magnetic circuit of ferro-magnetic material having one section of its length consisting of "Hypernik", an auxiliary core portion constituting a bypass for magnetic flux about said "Hypernik", two windings on the first-mentioned portion of said core and a third winding on the said auxiliary core portion, said third winding being serially connected with one of the other said windings.

3. In combination, a transformer core comprising one portion consisting of a complete magnetic circuit of ferro-magnetic material having one section of its length consisting of "Hypernik," an auxiliary core portion comprising ferromagnetic material and an air gap constituting a bypass for magnetic flux about said "Hypernik," two windings on the first-mentioned portion of said core and a third winding on the said auxiliary core portion, said third winding being serially connected with one of the other said windings.

4. In combination with a source of variable alternating voltage and a winding supplied thereby, a transformer core comprising one portion consisting of a complete magnetic circuit of ferro-magnetic material having one section of its length consisting of "Hypernik," an auxiliary core portion constituting a bypass for magnetic flux about said "Hypernik," said winding being positioned upon the first-mentioned core portion, a second winding upon the first-mentioned core portion, a third winding upon said auxiliary core portion, and a heater for an electron-emissive cathode connected in series with the two windings last mentioned.

JOHN HENRY GOUGH.