

March 2, 1943.

I. A. MITCHELL

2,312,768

VOLTAGE REGULATOR

Filed Aug. 6, 1941

2 Sheets-Sheet 1

FIG. 1.

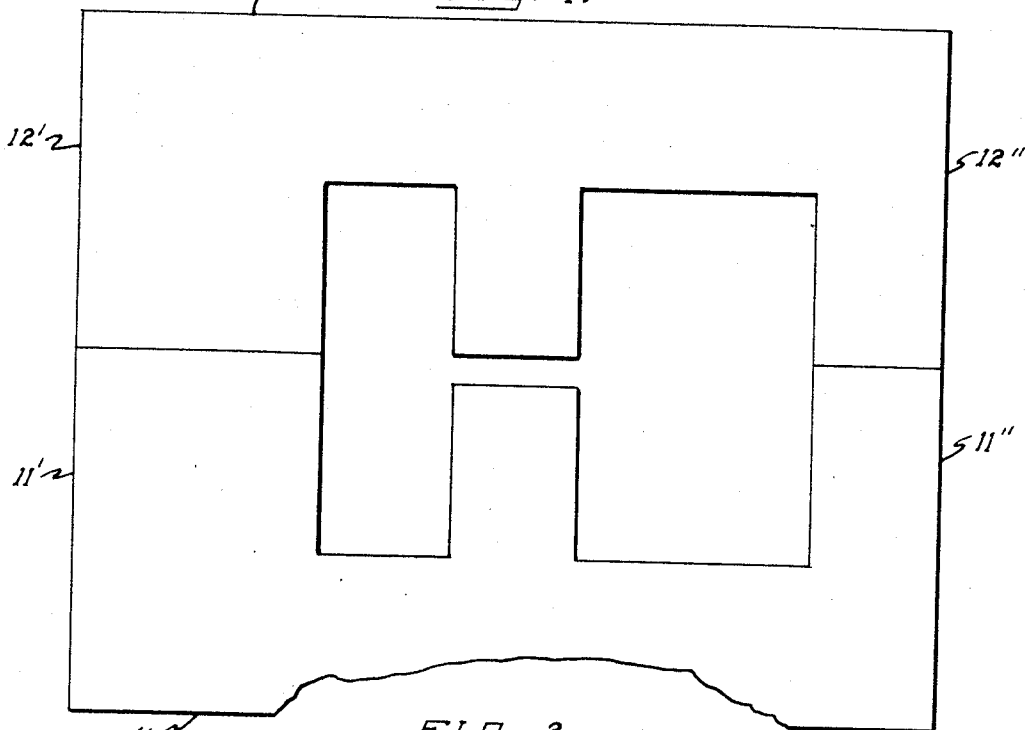
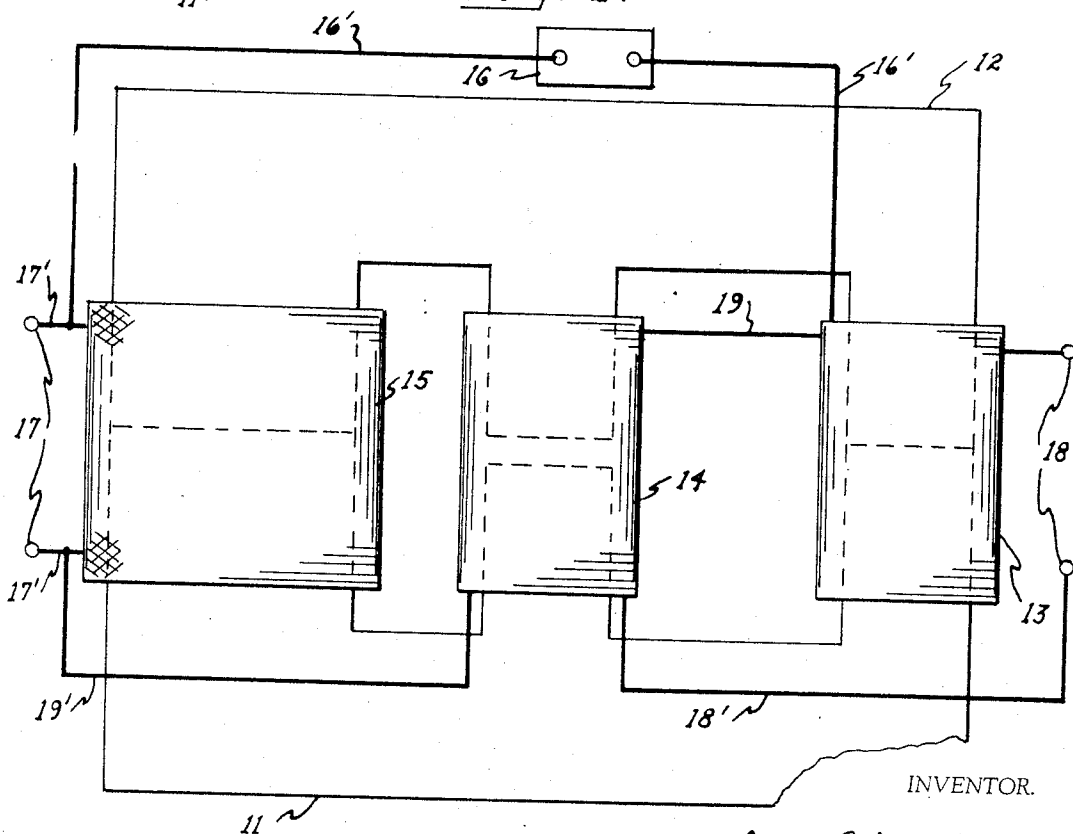


FIG. 2.



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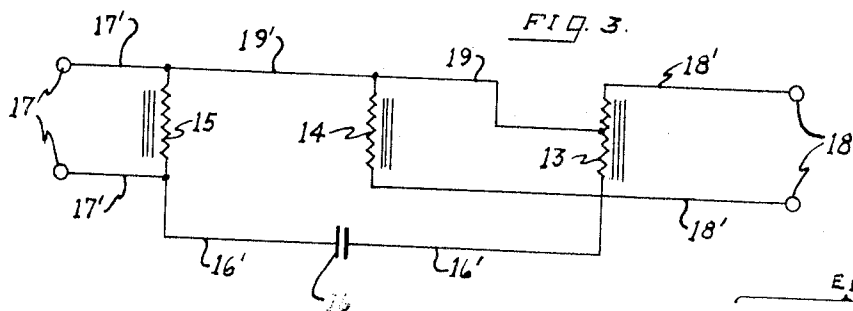


FIG. 4.

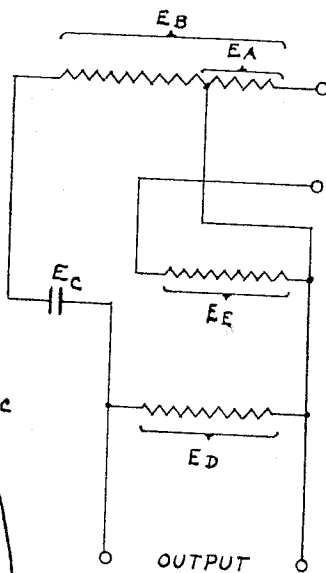


FIG. 5.

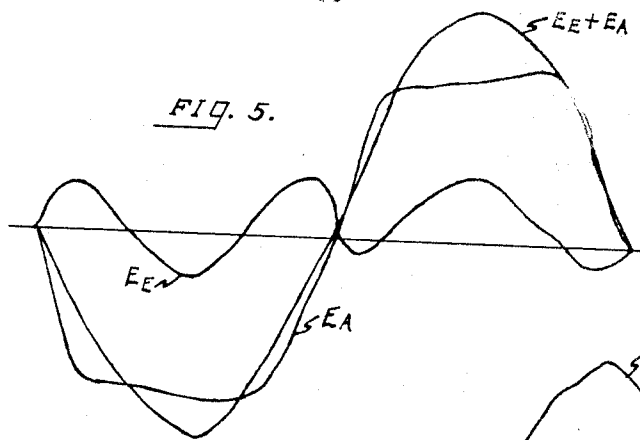
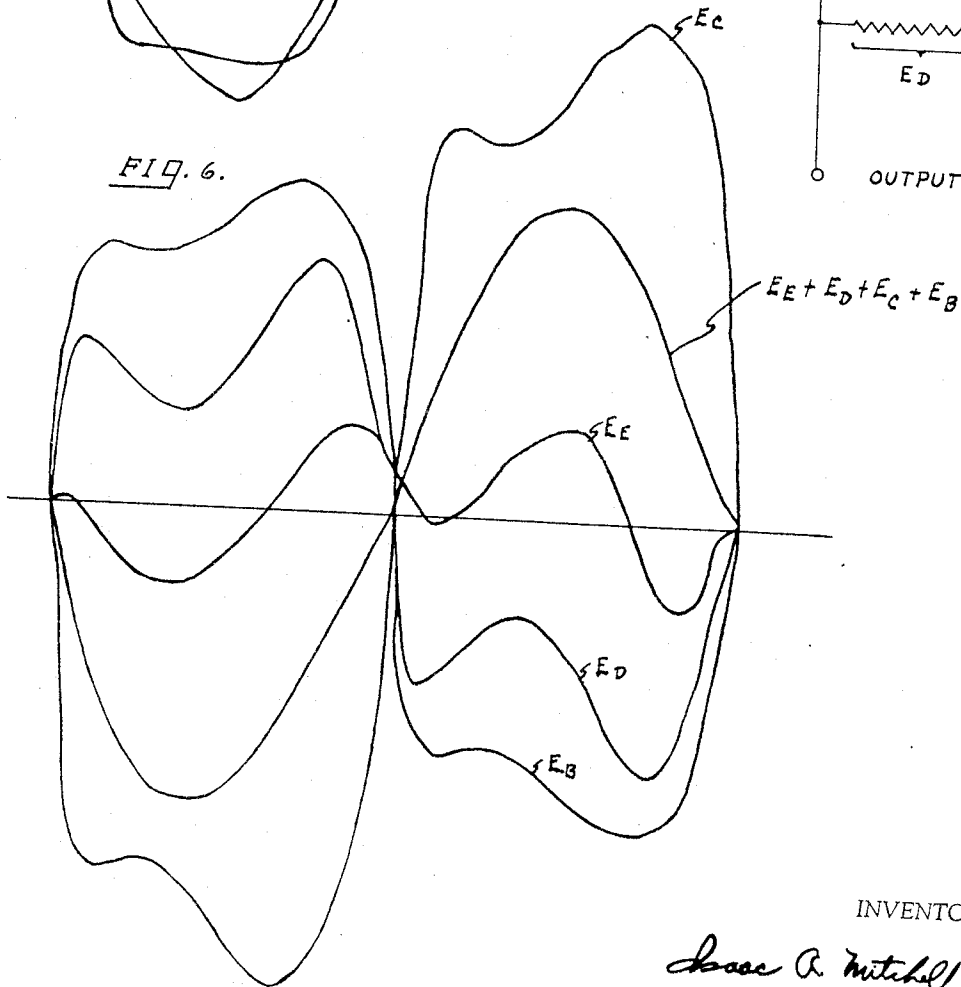


FIG. 6.



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UNITED STATES PATENT OFFICE

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VOLTAGE REGULATOR

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Application August 6, 1941, Serial No. 405,683

2 Claims. (Cl. 171-119)

This invention relates to voltage regulators and more particularly to voltage regulators in which the regulating action is obtained by electrical means only and no mechanical linkages are employed.

An object of this invention is to provide an electrical four terminal network across two terminals of which the potential will remain substantially constant regardless of the value of alternating current potential impressed across the other two terminals, providing the latter is within the limits of a predetermined range.

A further object of this invention is to maintain such substantially constant voltage with varying loads connected to the constant potential terminals.

Still further objects will appear upon consideration of the following description of my invention and the accompanying drawings in which

Figure 1 is a plan view of the magnetic core employed in the voltage regulator;

Figure 2 is a plan view of the core and coils mounted thereon together with the interwiring and auxiliary condenser;

Figure 3 is a schematic diagram of the regulator; and

Figure 4 is another schematic diagram with various potentials designated to agree with those illustrated in the curves of Figures 5 and 6.

Figures 5 and 6 are curves of the potentials which originate in Figure 4.

Basically my regulator is constructed in the form of an autotransformer on a three leg closed magnetic core constructed from core sections 11 and 12. Each half of the core consists of the outer legs, 11' and 11'' and 12' and 12'' respectively, and a central leg. An air gap is provided for the central leg to prevent saturation of that portion of the magnetic circuit. In addition, legs 11'' and 12'' are reduced in cross section as compared to 11' and 12' and the balance of the magnetic circuit in order to permit saturation of 11'' and 12''. Windings 13, 14 and 15 are mounted on the core as shown and are interconnected with condenser 16, input terminals 18 and output terminals 17 by means of conductors 16', 17', 18', 19 and 19'. Condenser 16 is connected in series with windings 13 and 15 in order to provide the high values of current for saturation of legs 11'' and 12''.

The above construction provides a substantially constant voltage at terminals 17 by means of combining several distorted wave shapes in the various portions of the autotransformer. The amount of distortion introduced depends upon

the impressed voltage and the various sub-potentials combine to furnish a constant R. M. S. value of output potential. The phase relationships between the various sub-potentials remain substantially constant.

In Figure 4 the various potentials in the circuit are designated as E_A , E_B , E_C , E_D and E_E . Oscilloscope curves of these potentials under different conditions are given in Figures 5 and 6. There are two distinct continuous electrical paths between the two input terminals. The first includes potentials E_A and E_E in series and the second includes potentials E_B , E_C , E_D and E_E in series. Under no load and a sine wave potential impressed on the input potentials E_E and E_A appear as in Figure 5. Their sum produces the sine curve $E_E + E_A$. With 50% of full load, potentials E_B , E_C , E_D and E_E appear as in Figure 6 where the scale of E_B and E_C is 2.33 times the scale of the remaining three curves. Again the sum of all four produces a sine curve. E_D represents the constant output potential. As the impressed voltage and load are varied, the distortion ratios vary, the phase relationships remain constant.

I have disclosed my invention in the foregoing form merely as one desirable method of accomplishing its purpose. It is obvious that certain changes can be made. For instance, the core could be constructed as a combination of I and E shapes instead of two E shapes. Other modifications and changes will also occur to those skilled in the particular art involved. Such modifications and changes, however, will fall within the spirit and scope of my invention as defined by and limited only in the following claims.

I claim:

1. In a voltage regulator, input terminals, a core of magnetic material, said core being of the closed type and having multiple magnetic paths, said paths including multiple parallel legs and one of said legs being saturable and another unsaturable; coil windings mounted upon said multiple parallel legs, one end of the saturable leg winding connected to an input terminal, one end of the unsaturable leg winding connected to the other input terminal, the other end of the saturable leg winding connected through a condenser to a third winding, and the other end of the third winding connected to a point on the saturable leg winding and the remaining end of the unsaturable leg winding.

2. In a voltage regulator, input terminals, a core of magnetic material, said core being of the

closed type and having multiple magnetic paths, said paths including multiple parallel legs and one of said legs being saturable and another unsaturable; coil windings mounted upon said multiple parallel legs, one end of the saturable leg winding connected to an input terminal, one end of the unsaturable leg winding connected to the other input terminal, the other end of the satu-

5 rable leg winding connected through a condenser to a third winding, the other end of the third winding connected to a point on the saturable leg winding and the remaining end of the unsaturable leg winding, and output terminals, said output terminals being connected across said third winding.

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