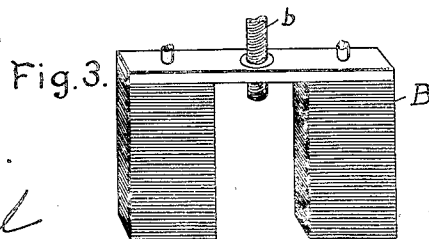
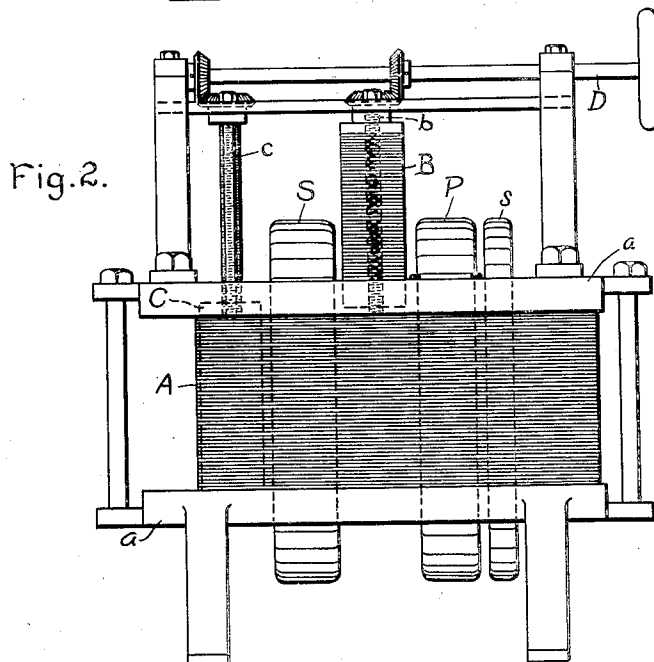
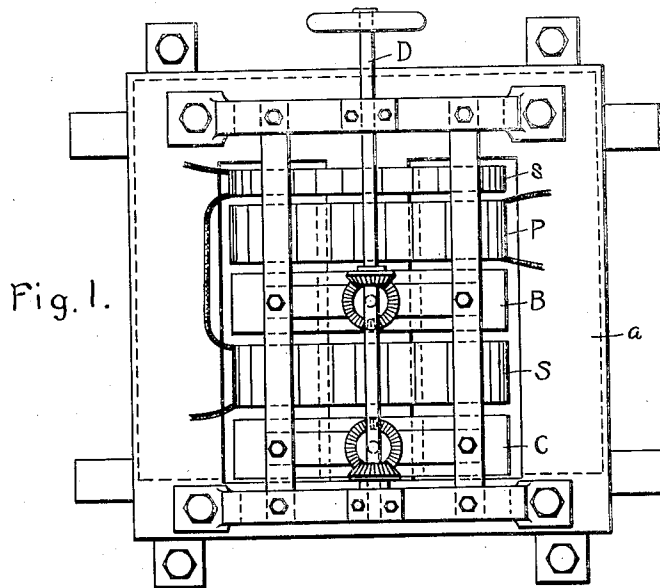


No. 851,743.

PATENTED APR. 30, 1907.

E. F. GEHRKENS.
VARIABLE VOLTAGE TRANSFORMER.
APPLICATION FILED JULY 9, 1906.



Witnesses:

Irving E. Steers.
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Inventor

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by *Albert G. Davis*
Att'y.

UNITED STATES PATENT OFFICE.

EDWARD F. GEHRKENS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

VARIABLE-VOLTAGE TRANSFORMER.

No. 851,743.

Specification of Letters Patent.

Patented April 30, 1907.

Application filed July 9, 1906. Serial No. 325,193.

To all whom it may concern:

Be it known that I, EDWARD F. GEHRKENS, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Variable-Voltage Transformers, of which the following is a specification.

My invention relates to variable-voltage transformers of the type in which the variation in secondary voltage is obtained by varying the inductive effect of the primary on the secondary coil. One form of transformer which has been developed heretofore for this purpose is arranged with a portion or portions of the core movable so as to divert a portion of the primary flux from the secondary coil. I have found that in such transformers it is very difficult and practically impossible to divert the entire primary flux from the secondary coil, so that even when the transformer is set for minimum voltage a certain induced voltage still exists in the secondary coil.

The object of my invention is to provide a transformer of this type in which the secondary voltage may be reduced absolutely to zero. I accomplish this by providing a third coil in inductive relation to the primary and connected in series with the secondary coil. This third coil may be arranged in constant inductive relation to the primary coil and may be so proportioned as to produce an inductive voltage approximately equal to the minimum induced voltage in the secondary coil. By connecting this third coil in series with the secondary coil the resultant of the electromotive force of the two coils is zero when the transformer is adjusted for minimum voltage.

My invention will best be understood by reference to the accompanying drawings, in which

Figure 1 shows a plan view of a variable-voltage transformer arranged in accordance with my invention; Fig. 2 shows a side elevation of the same; and Fig. 3 shows a perspective view of one of the flux shunts.

In the drawings, A represents the magnetic core, which is composed in the usual way of laminations clamped between the end-plates *a, a*. This core is shown arranged for a so-called "shell-type" transformer, the core having three legs with the primary and secondary coils mounted on the central leg.

P represents the primary and S the secondary coil. These coils are spaced apart on the core, and a flux shunt B is arranged to move vertically between the primary and secondary coils so as to divert variable portions of the primary flux from the secondary coil. The construction of this shunt is shown clearly in Fig. 3. As will be seen from this figure, it consists of two magnetic laminated masses movable between the central leg and the two outer legs of the transformer core so as to form a magnetic short-circuit for the primary flux. A second similar member C is placed at the secondary end of the magnetic core and acts to open and close the magnetic circuit that threads both primary and secondary coils. The member C moves up as the member B moves down; the position shown in Fig. 2 being that of maximum secondary voltage. The members B and C are operated by the screw-threaded rods *b* and *c*, respectively, which are provided with beveled gears actuated from a shaft D which is provided with a hand-wheel.

With the members B and C in position shown in Fig. 2, nearly all the primary flux passes through the secondary coil, but as the member C is raised and the member B lowered, more and more of the primary flux is shunted around the secondary coil so as to reduce the secondary voltage. It will be seen, however, that when the member B is in its lowest position and member C in its highest position, a certain small portion of the primary flux will still leak through the secondary coil, closing itself through the air-gaps at the secondary end of the core. Consequently, even when the flux shunts are in the position for minimum voltage a certain amount of voltage still exists in the secondary coil S.

In order to render it possible to obtain a varying voltage that may be reduced fully to zero, I provide a third coil *s* which is placed close to the primary coil P and in constant inductive relation thereto; that is, the induced voltage in the coil *s* is not affected by the movement of the flux shunts. This coil *s* is connected in series with the main secondary coil S and opposes the voltage induced in the main secondary coil. By proportioning the coil *s* so that it has a constant induced voltage equal to the minimum induced voltage in coil S, the resultant voltage when the flux shunts are in the position of minimum

voltage will be zero. Obviously, the number of turns in the coil *s* should bear to the number of turns in the coil *S* the same ratio that the portion of the primary flux which threads the coil *S* under minimum voltage conditions bears to the total primary flux.

While I have shown my invention applied to a variable voltage transformer of a particular type, it will of course be understood that my invention is not limited to this particular construction. If the auxiliary coil *s* is maintained permanently in opposition to the main secondary coil, it will of course be understood that the main secondary coil should be given an excess number of turns for a given maximum voltage, in order to compensate for the opposing voltage of the auxiliary coil.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. In a variable-voltage transformer, primary and secondary coils, means for varying the inductive effect of the primary on the secondary coil, and a third coil in inductive relation to the primary and connected in series with the secondary coil.

2. In a variable-voltage transformer, primary and secondary coils, means for varying the inductive effect of the primary on the secondary coil, and a third coil in inductive relation to the primary and connected in series with and opposing the secondary coil, said third coil being proportioned to give an induced voltage approximately equal to the minimum induced voltage in the secondary coil.

3. In a variable-voltage transformer, a magnetic core, primary and secondary coils thereon, means for moving a portion of the core to vary the inductive effect of the primary upon the secondary coil, and a third coil on the core in series with the secondary coil.

4. In a variable-voltage transformer, a magnetic core, primary and secondary coils thereon, means for moving a portion of the core to vary the inductive effect of the primary upon the secondary coil, and a third coil in constant inductive relation to the primary and proportioned to give an induced voltage approximately equal to the minimum induced voltage in the secondary coil.

5. In a variable-voltage transformer, primary and secondary coils, means for varying the proportion of total primary flux threading the secondary coil, and a third coil in inductive relation to the primary and connected in series with the secondary coil.

6. In a variable-voltage transformer, primary and secondary coils, means for varying the proportion of total primary flux threading the secondary coil, and a third coil in inductive relation to the primary and connected in series with and opposing the secondary coil, said third coil being proportioned to give an induced voltage approximately equal to the minimum induced voltage in the secondary coil.

7. In a variable-voltage transformer, primary and secondary coils, means for varying the proportion of total primary flux threading the secondary coil, and a third coil in constant inductive relation to the primary coil, the product of the number of turns of the third coil and the primary flux by which it is threaded being approximately equal to the product of the number of turns of the secondary coil and the minimum primary flux by which it is threaded.

8. In a variable-voltage transformer, primary and secondary coils, a core adapted to afford two magnetic circuits, one passing through both coils and the other shunting the secondary coil, means for varying the relative reluctances of said circuits, and a third coil in constant inductive relation to the primary coil and connected in series with the secondary coil.

9. In a variable-voltage transformer, a core, primary and secondary coils spaced apart on said core, means for shifting the flux from one portion of the core to another, and a third coil in series with and opposing the secondary and arranged on a portion of the core in which the flux is not shifted by said means.

In witness whereof, I have hereunto set my hand this 6th day of July, 1906.

EDWARD F. GEHRKENS.

Witnesses:

BENJAMIN B. HULL,
HELEN ORFORD.