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ALTERNATING ELECTRIC CURRENT TRANSFORMER

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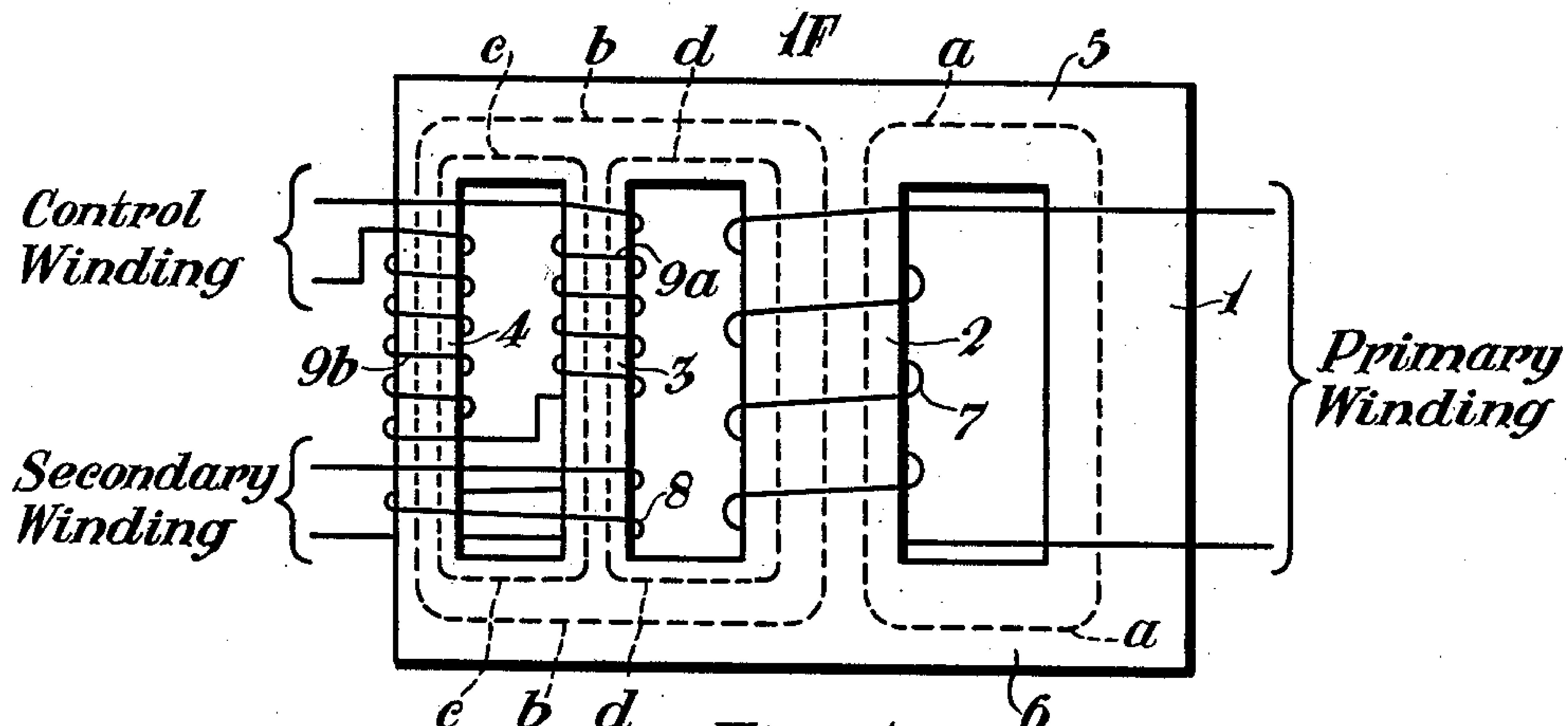

Fig. 1.

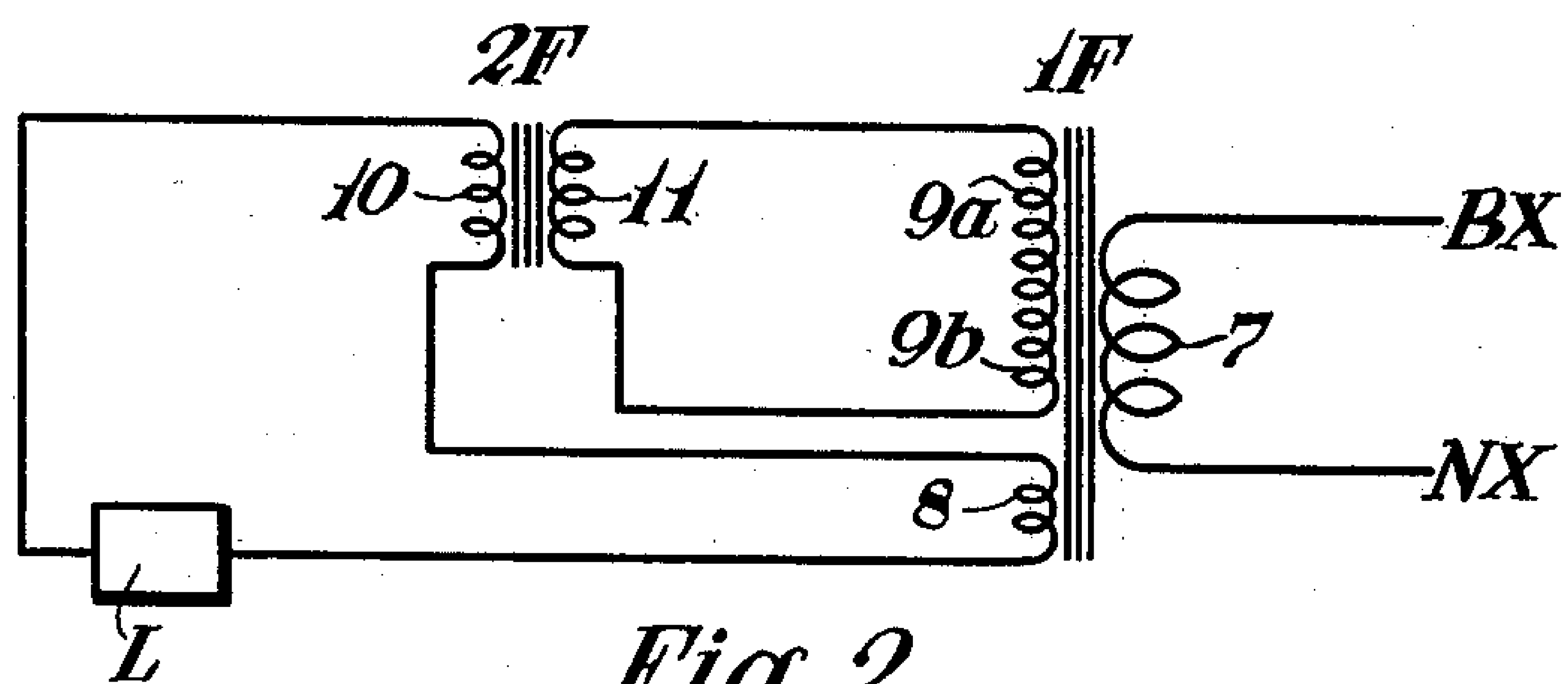

Fig. 2.

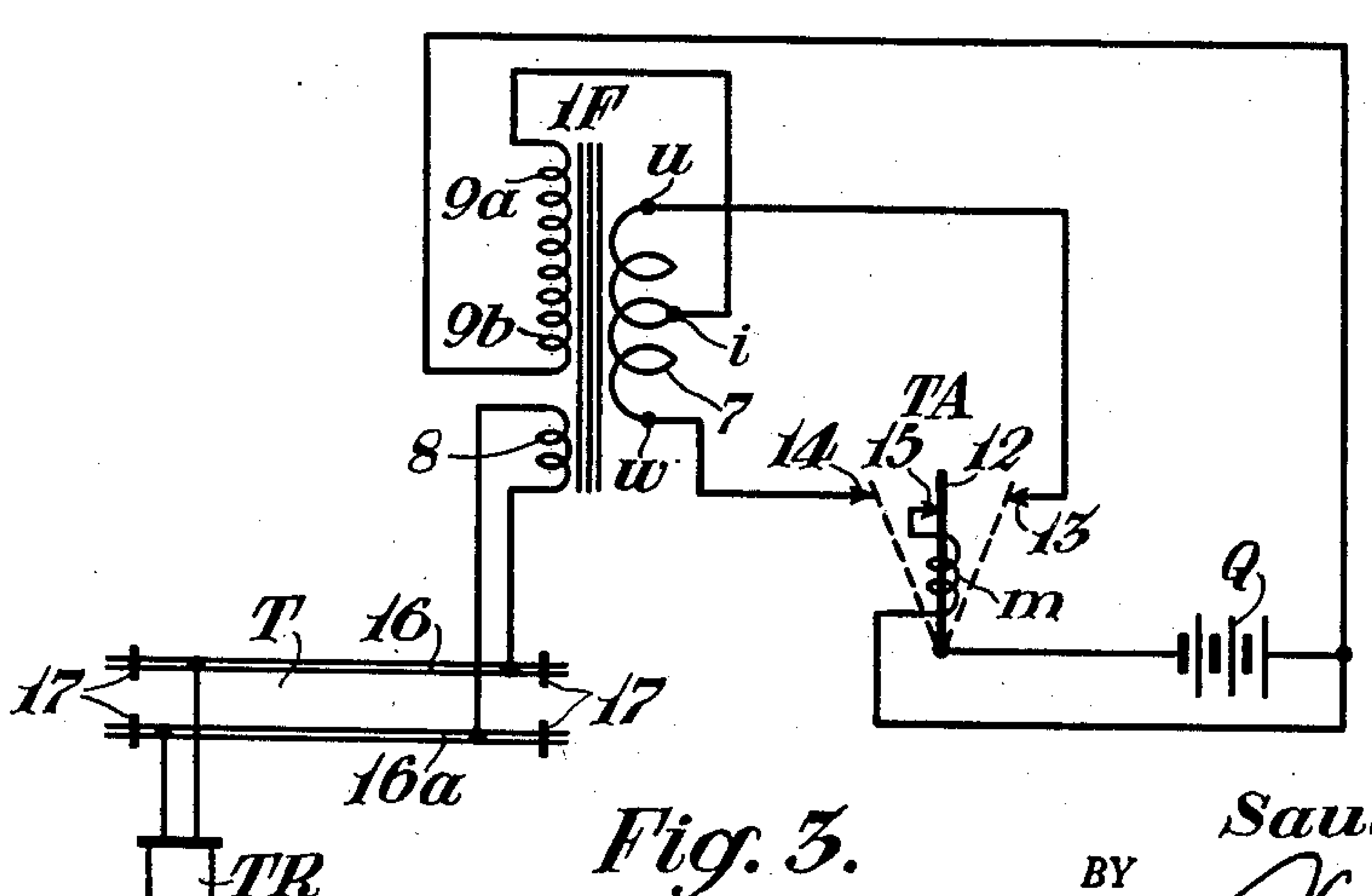

Fig. 3.

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ALTERNATING ELECTRIC CURRENT TRANSFORMER

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8 Claims. (Cl. 171—119)

My invention relates to alternating electric current transformers, and particularly to means for automatically regulating the current output from such a transformer.

For some uses, such, for example, as in railway track circuits, it is desirable to limit or hold down the current output from the secondary winding of a transformer to a greater extent than can be done by means of fixed impedance. In an alternating current track circuit which embodies a limiting resistor or reactor of fixed impedance, the current drawn by the track circuit may increase considerably as a train moves over the track section from the entering or relay end to the leaving or transformer end of the section, especially if the section is a long one. If the primary winding of the track transformer is energized by current from a direct current source passed through contacts of a vibrating device such, for example, as a tuned reed alternator, the contacts of the tuned alternator may be rapidly eroded because of the large increase in current taken at times by the track circuit.

One feature of my invention is therefore the provision of a novel and improved transformer having a control winding as well as a primary winding and a secondary winding.

A further feature of my invention is the provision of a circuit arrangement, embodying the transformer of my invention, for automatically restraining or holding down an increase in current taken by an output circuit which includes the secondary winding of the transformer.

I shall describe three forms of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

In the accompanying drawings, Fig. 1 is a diagrammatic view showing one form of apparatus embodying my invention, in which a transformer comprises a core having four legs, a primary winding, a secondary winding, and a control winding; Fig. 2 is a diagrammatic view showing a circuit arrangement employing the transformer shown in Fig. 1; and Fig. 3 is a modification of the circuit arrangement shown in Fig. 2, also embodying the transformer shown in Fig. 1.

Similar reference characters refer to similar parts in each of the views.

Referring first to Fig. 1, a transformer, designated as a whole by the reference character **1F**, is shown provided with a core having a first leg **1**, a second leg **2**, a third leg **3**, a fourth leg **4**, an end **5** by means of which a given end of each of the legs **1**, **2**, **3**, and **4** is connected with a given end of each of the other legs, and an opposite end **6** by means of which the opposite end of each of the legs **1**, **2**, **3**, and **4** is connected with an opposite end of each of the other legs. A primary winding **7** is wound around leg **2**, and a secondary winding **8** is wound around legs **3** and **4**. A control winding consists of two equal portions **9***a* and **9***b*, one of which, portion **9***a*, is wound around leg **3**, and the other of which, portion **9***b*, is wound around leg **4** which is similar to leg **3**.

Primary winding **7**, when energized, sends magnetic flux through core legs **1**, **4**, and **3** in multiple, by paths shown in dash lines designated by the reference characters *a—a*, *b—b*, and *d—d*, respectively.

Control winding portions **9***a* and **9***b* are connected in series with each other to a source of control current, and are so wound on legs **3** and **4** that they work together to send magnetic flux through legs **3** and **4** in series, by the path shown in the dash line designated by the reference character *c—c*. If the current in the control winding **9***a*—**9***b* increases, so that more flux follows the path *c—c* in legs **3** and **4**, the core material in legs **3** and **4** will become more saturated, so that less flux can be sent by primary winding **7** through the paths *b—b* and *d—d*, and more flux will be sent by winding **7** through the path *a—a*.

The magnitude of the voltage generated in secondary winding **8** of transformer **1F** depends on the magnetic flux passing along paths *b—b* and *d—d*, so when the flux in these paths decreases due to an increase of flux in path *c—c* because of an increase of current in the control winding, the voltage generated in secondary winding **8** will be reduced or held down.

In Fig. 2, a transformer **1F**, constructed as shown in Fig. 1, is energized from a suitable source of alternating current, having terminals BX and NX, connected across primary winding **7**. A second transformer **2F** has a primary winding **10** connected in series with secondary winding **8** of transformer **1F** which supplies current to a load L. Transformer **2F** has also a secondary winding **11** which is connected in a control circuit in series with control winding **9***a*—**9***b*.

If the current taken by load L increases, a higher voltage will be generated in winding **11** of transformer **2F**, so that more current will be supplied to the control winding **9***a*—**9***b*. The flux in path *c—c* produced by winding **9***a*—**9***b* will then increase, and therefore the magnetic flux in paths *b—b* and *d—d* will decrease, so that the voltage generated in secondary winding 8 of transformer 1F will be reduced.

In Fig. 3, a transformer 1F, constructed as shown in Fig. 1, is energized from a suitable source of unidirectional current, such as a battery Q, through contacts of a vibrator TA. The vibrator TA may be of the well-known tuned reed alternator type having a control winding *m*, a movable contact element 12, fixed contact points 13 and 14, and a control contact point 15. Movable contact element 12, in the normal or deenergized position, in which it is shown in the drawing, engages control contact point 15.

The circuit by which control winding *m* of tuned alternator TA is periodically energized passes from the positive terminal of battery Q, through movable contact element 12, control contact point 15, and winding *m*, back to battery Q. With winding *m* energized by the circuit just traced, movable contact element 12 will be moved toward the right, as shown in the drawing, so it will disengage control contact point 15, and will engage contact point 13. Winding *m* is thus deenergized because of the disengagement of movable contact element 12 from control point 15, and therefore element 12 will now swing to the left, and will again engage control contact point 15, and will also engage contact point 14. The cycle of operation just described is then consecutively repeated, causing movable contact element 12 to repeatedly engage fixed contact points 13 and 14 alternately.

When contact element 12 engages contact point 13, a circuit is completed passing from battery Q, through contact element 12, contact point 13, terminal *u* of transformer 1F, the portion of primary winding 7 of transformer 1F between terminal *u* and a mid point *i*, and control winding 9*a*—9*b*, back to battery Q. When contact element 12 engages contact point 14, a second circuit for primary winding 7 is completed, passing from the positive terminal of battery Q, through contact element 12, contact point 14, terminal *w* of transformer 1F, the opposite portion of winding 7 of transformer 1F between terminal *w* and mid point *i*, and control winding 9*a*—9*b*, back to battery Q.

It follows, that the two portions of winding 7 are repeatedly energized alternately by current of opposite polarity, so that magnetic flux is passed by the primary winding 7 through the paths *b*—*b* and *d*—*d* which link with secondary winding 8, and therefore a voltage is generated in winding 8.

Rails 16 and 16*a* of a stretch of railway track are shown divided by insulated joints 17 to form a track section T. A track circuit is shown for section T, including secondary winding 8 of transformer 1F connected across the rails adjacent one end of the section, and a track relay, designated by the reference character TR, connected across the rails adjacent the opposite end of the section.

When the current taken from secondary winding 8 increases as a train moves over section T from left to right, as shown in the drawing, more current is taken from battery Q by primary winding 7. The current passing through winding 9*a*—9*b* is thereby also increased, and causes more magnetic flux to pass through the path *c*—*c*, and less flux to pass through the paths *b*—*b* and *d*—*d*. With less flux in paths *b*—*b* and *d*—*d*, the voltage generated in secondary winding 8 of transformer 1F is reduced, and therefore less current is required from battery Q.

It follows, that the current required to pass through contacts 12—13 and 12—14 is thereby reduced, and there will be less erosion of these contacts.

Although I have herein shown and described only a few forms of apparatus 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. An alternating electric current transformer comprising a core having a first and a second and also a third and a fourth leg arranged with a given end of each of said legs connected with a given end of each of the other legs in the order named and with the opposite ends of said legs also connected together in the order named, a primary winding around said second leg, a control winding consisting of two equal portions one of which is around said third leg and the other of which is around said fourth leg, and a secondary winding around said third and fourth legs.

2. An alternating electric current transformer comprising a core having a first and a second and also a third and a fourth leg arranged with a given end of each of said legs connected with a given end of each of the other legs in the order named and with the opposite ends of said legs also connected together in the order named, a primary winding around said second leg, a control winding consisting of two equal portions connected in series with each other one of which is around said third leg and the other of which is around said fourth leg, and a secondary winding around said third and fourth legs.

3. An alternating electric current transformer comprising a core having a first and a second and also a third and a fourth leg arranged with a given end of each of said legs connected with a given end of each of the other legs in the order named and with the opposite ends of said legs also connected together in the order named, a primary winding around said second leg, a secondary winding around said third and fourth legs, and auxiliary means for passing magnetic flux through said third and fourth legs.

4. An alternating electric current transformer comprising a core having a first and a second and also a third and a fourth leg arranged with a given end of each of said legs connected with a given end of each of the other legs in the order named and with the opposite ends of said legs also connected together in the order named, energizing means for sending magnetic flux through said first and third and fourth legs in multiple with each other, control means for sending magnetic flux through said third and fourth legs in series with each other, and output means controlled by the magnetic flux passing through said third and fourth legs.

5. An alternating electric current transformer comprising a core having a first and a second and also a third and a fourth leg arranged with a given end of each of said legs connected with a given end of each of the other legs in the order named and with the opposite ends of said legs also connected together in the order named, energizing means for sending magnetic flux through said first and third and fourth legs in multiple with each other, control means for sending magnetic flux through said third and fourth legs in series with each other, and an output winding around said third and fourth legs.

6. An alternating electric current transformer comprising a core having a first and a second and also a third and a fourth leg, a primary winding for passing magnetic flux through said first and third and fourth legs in multiple with each other, a secondary winding energizable by magnetic flux passing through said third and fourth legs, and a control winding on said third and fourth legs for limiting the magnitude of current supplied to a load by said secondary winding.

7. An alternating electric current transformer comprising a core having a first and a second and also a third and a fourth leg arranged with a given end of each of said legs connected with a given end of each of the other legs in the order named and with the opposite ends of said legs also connected together in the order named, a primary winding for passing magnetic flux through said first and third and fourth legs in multiple with each other, a control winding for passing magnetic flux through said third and fourth legs in series with each other, and a secondary winding energizable by the magnetic flux passing through said third and fourth legs.

8. An alternating electric current transformer comprising a core having a first and a second and also a third and a fourth leg, energizing means for sending magnetic flux through said first and third and fourth legs in multiple with each other, control means for sending magnetic flux through said third and fourth legs, and output means controllable by the magnetic flux passing through said third and fourth legs.

SAUL STIMLER.

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