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ELECTRICAL TRANSLATING APPARATUS

Original Filed June 20, 1928

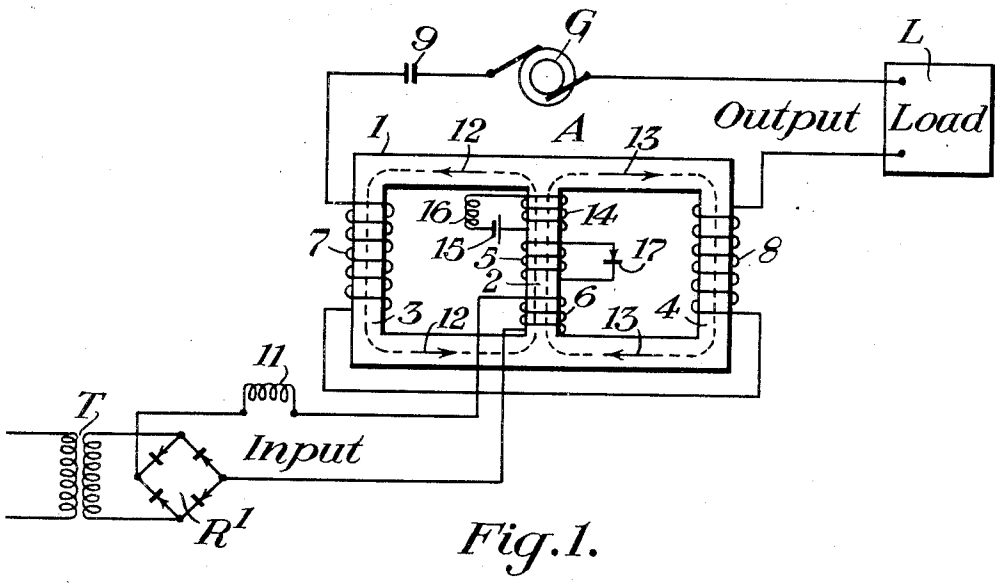


Fig. 1.

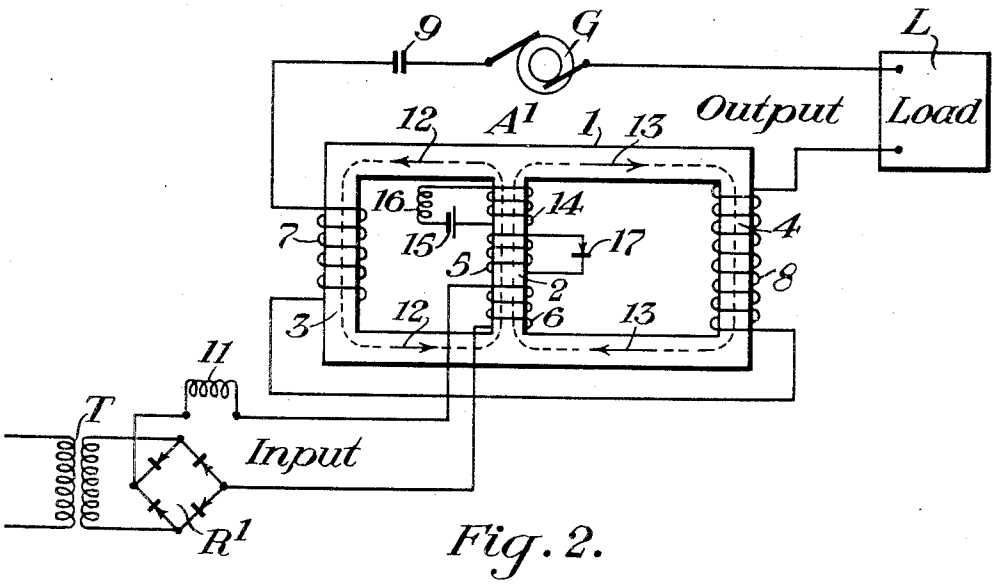


Fig. 2.

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UNITED STATES PATENT OFFICE

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ELECTRICAL TRANSLATING APPARATUS

Original application filed June 20, 1928, Serial No. 286,984. Divided and this application filed July 8, 1929. Serial No. 376,986.

My invention relates to electrical translating apparatus of the amplifier type.

One object of my invention is the provision of amplifying apparatus having no electron tube and no moving parts.

The present application is a division of my copending application, Serial No. 286,984, filed June 20, 1928, for electrical translating apparatus now Patent No. 1,739,579.

In the accompanying drawings, Fig. 1 is a diagrammatic view illustrating one form of translating apparatus embodying my invention. Fig. 2 is a view showing a modified form of the apparatus illustrated in Fig. 1, and also embodying my invention.

Similar reference characters refer to similar parts in both views.

Referring first to Fig. 1, the reference character A designates a transformer comprising a magnetizable core 1 having a bridging member 2 provided with three windings 4, 5 and 6. One leg 3 of this core is provided with a winding 7, and the other leg 4 carries a winding 8. Winding 6 is included in an input circuit which also includes a source of direct current here shown as the secondary of a transformer T and a full wave rectifier R^4. Alternating current is at times supplied to the primary of transformer T, and it will be seen that when current is supplied to this primary unidirectional current will be supplied to winding 6.

Windings 7 and 8 of transformer A are connected in series with a load L in an output circuit which is constantly supplied with alternating current from any suitable source such as an alternator G. This circuit may be tuned to resonance by a condenser 9. The windings 7 and 8 are so disposed and so proportioned that the alternating fluxes produced in core 1 by the alternating currents supplied to windings 7 and 8 traverse member 2 in opposite directions at any instant so that these fluxes do not cause a magnetic potential between the extremities of member 2, and it follows that under normal conditions no electromotive force is induced in windings 4, 5, or 6.

When the current in winding 6 is increased, the unidirectional flux in member 2 is also increased, and as a result, the permeability of the legs 3 and 4 is correspondingly decreased. It follows that the impedances of windings 7 and 8 are thereby decreased, so that the current supplied by generator G to the load L through windings 7 and 8 is increased. Furthermore, the unidirectional flux created in member 2 has another effect which I will now describe. It will be seen that a portion of the flux created in member 2 by current in winding 6 traverses a path including leg 3 and indicated in the drawings by arrows 12. Another portion of this flux traverses the path indicated by arrows 13 and including leg 4. It will be seen that during one-half cycle of the alternating flux created in core 1 by currents in windings 7 and 8, this alternating flux will aid the unidirectional flux in leg 3 and will oppose the unidirectional flux in leg 4. During the other half cycle, however, the alternating flux will aid the unidirectional flux in leg 4 and will oppose the unidirectional flux in leg 3. Since the reluctances of paths 12 and 13 depend upon the density of the flux through these paths, it follows that these reluctances will be varied by different amounts during at least a portion of each cycle. The balance normally existing between the alternating fluxes created in core 1 by windings 7 and 8 is therefore destroyed so that an alternating flux is created in member 2. This alternating flux, of course, induces in winding 5 an alternating electromotive force. Winding 5, however, has its terminals connected across a rectifier 17 which permits current to flow through this winding in one direction and not in the other, and it follows, therefore, that current can flow in this winding only during alternate half cycles. The rectifier 17 is so arranged that the current which is permitted to flow in winding 5 during alternate half cycles creates a unidirectional flux in member 2 which aids the unidirectional flux created in this member by current in winding 6. The impedances of windings 7 and 8 are, therefore, still further decreased and the unbalance between the alternating fluxes in core 1 is still further increased with a consequent further increase in the current in load L. This cycle of opera-

tion continues until a condition of equilibrium is reached for which the current supplied to the load will have been increased by an amount which depends upon the amount of increase in the current supplied to winding 6. When the current in winding 6 returns to its original value, the current supplied to the load L also returns to its original value, the apparatus operating in a manner which will be understood from the foregoing without further explanation.

It should be pointed out that the alternating flux in member 2 induces an alternating electromotive force in winding 6 and, in order to suppress this electromotive force, an impedance 11 is interposed in the input circuit.

Under some conditions of operation, the winding 5 with its associated rectifier 17 may be dispensed with, the function of these parts being performed by the input circuit including winding 6 and rectifier R^1. It will be noted that alternating current induced in winding 6 by the alternating flux in member 2 resulting from an unbalance of the alternate fluxes in core 1 due to the direct current supplied to winding 6 can flow through the circuit including rectifier R^1 in only one direction, and that this direction is such that the induced current thus created in winding 6 assists the unidirectional current supplied to the winding from transformer T. Under proper conditions, therefore, the apparatus will operate regeneratively without the addition of winding 5 and rectifier 17.

The sensitivity of the apparatus depends, of course, upon the initial permeability of core 1, and for the purpose of adjusting this permeability to its optimum value, I connect winding 14 of transformer A in series with a battery 15 and a reactor 16. The current supplied to winding 14 by battery 15 creates in core 1 a unidirectional flux, the magnitude of which may be varied to bring the initial permeability of this core to the desired value. The purpose of reactor 16 is to increase the impedance of the circuit including winding 14 to transient currents, thereby preventing this circuit from absorbing energy when the current in the input circuit is varied.

Referring now to Fig. 2, the transformer A^1 is similar to the transformer A shown in Fig. 1 except that the core 1 is non-symmetrical, member 2 being located closer to leg 3 than to leg 4. It follows, therefore, that the flux path 12 including member 2 and leg 3 has a lower reluctance than path 13 including member 2 and leg 4. The windings 7 and 8 are so proportioned that under normal conditions the magnetomotive force supplied by these windings are proportional to the reluctances of their respective paths so that no alternating flux is produced in member 2. When the current in the input circuit is increased, the increased unidirectional flux in member 2 decreases the impedances of windings 7 and 8 and produces an increase in the alternating current supplied to the load L by generator G. The flux thus supplied to member 2 divides unequally between legs 3 and 4 and it follows that the reluctances of paths 12 and 13 are varied in different degrees. As a result, the balance normally existing between the alternating fluxes created in core 1 by windings 7 and 8 is destroyed, and an alternating flux is created in member 2. This alternating flux in member 2 induces in winding 5 an alternating electromotive force and during alternate half cycles, current flows in winding 5 through rectifier 17 to produce in member 2 a unidirectional flux which assists the unidirectional flux created in the member by current in winding 6. The cycle of operations continues, as in Fig. 1, until a condition of equilibrium is reached at which the output current in load L has a higher value than that corresponding to the initial value of the current in winding 6. When the current in winding 6 is restored to its initial value the current in load L is also restored to its initial value, the operation being obvious from the foregoing description.

It should be pointed out that with apparatus embodying my invention, the current in the output circuit is varied in accordance with the current supplied to the input circuit, and that the apparatus operates regeneratively in response to comparatively small changes in the input circuit to cause enormously larger changes in the output current. Furthermore, this operation is accomplished without the use of moving parts. Apparatus embodying my invention is particularly suitable for, though in no way limited to, use in railway traffic controlling apparatus in which the train is supplied with a device such as a relay which is supplied with current in accordance with variations in the current flowing in a track rail. In my present invention, the train carried relay could be substituted for the load L and the track rail would correspond to the primary of transformer T. The relay would then be energized in accordance with the trackway current.

It should be distinctly understood, however, that my invention is not limited to use with input circuits supplied by an alternating current source. When the input energy is direct current, this current may be supplied directly to the control winding 6, the rectifier R^1 and transformer T then being unnecessary.

My copending application, Serial No. 377,020, filed July 9, 1929 as a division of Serial No. 286,984, now Patent No. 1,739,579, contains certain claims covering broadly magnetic amplifiers having regenerative characteristics.

Although I have herein shown and described only two forms of electrical trans-

lating 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. In combination, a magnetizable core having a bridging member, two windings on said core, a circuit including a source of alternating current and said two windings in series in such manner that the alternating fluxes created by the windings in said bridging member normally balance each other, means for at times creating in said bridging member a unidirectional flux which varies the impedances of said windings and destroys the normal balance between said alternating fluxes, means responsive to an alternating flux in said bridging member for varying said unidirectional flux, and a load receiving energy from said circuit.

2. In combination, a magnetizable core comprising two magnetic paths both including a bridging member, two windings one on each said path, a circuit including a source of alternating current and said two windings in series in such manner that the alternating fluxes in said two paths balance each other in said bridging member, a third winding on said bridging member, a rectifier connected across the terminals of said third winding, means for at times creating a unidirectional flux in said bridging member, and a load receiving energy from said circuit.

3. In combination, a magnetizable core comprising two magnetic paths both including a bridging member, two windings one on each said path, a circuit including a source of alternating current and said two windings in series in such manner that the alternating fluxes in said two paths are in opposition in said bridging member, a third winding on said bridging member, a source of direct current connected with said third winding for creating unidirectional flux in said member, means for at times increasing the unidirectional flux in said member to vary the impedances of said first two windings, and vary the ratio of the reluctances of said paths, a fourth winding on said bridging member, a rectifier connected across the terminals of said fourth winding for permitting current to flow in said winding in such direction as to increase the unidirectional flux in said bridging member, and a load receiving energy from said circuit.

4. In combination, a magnetizable core comprising two magnetic paths both including a bridging member, two windings one on each said path, an output circuit including a source of alternating current and said two windings in series in such manner that the alternating fluxes in said two paths are in opposition in said bridging member, a third winding on said bridging member, a reactor, a first source of direct current connected with said third winding through said reactor for creating unidirectional flux in said member, a fourth winding on said bridging member, a second source of direct current, an input circuit receiving current from said second source and including said fourth winding for at times increasing the unidirectional flux in said member to vary the impedances of said first two windings, and vary the ratio of the reluctances of said paths, a fifth winding on said bridging member, a rectifier connected across the terminals of said fifth winding for permitting current to flow in said winding in such direction as to still further increase the unidirectional flux in said bridging member, and a load receiving energy from said output circuit.

5. In combination, a magnetizable core having two magnetic paths of different reluctances both including a bridging member, two windings one on each said path, a circuit including a source of alternating current and said two windings in series in such manner that the alternating fluxes in said two paths are in opposition in said bridging member, a third winding on said bridging member, a rectifier connected across the terminals of said third winding, means for at times creating in said bridging member a unidirectional flux which divides unequally in said two paths to increase the difference between said two alternating fluxes in said member, and a load receiving energy from said circuit.

6. In combination, a magnetizable core having two magnetic paths of different reluctances both including a bridging member, two windings one on each said path, a circuit including a source of alternating current and said two windings in series in such manner that the alternating fluxes in said two paths are in opposition in said bridging member, a third winding on said bridging member, a rectifier connected across the terminals of said third winding, a fourth winding on said bridging member, means including said fourth winding for at times creating in said bridging member a unidirectional flux which divides unequally in said two paths to increase the difference between said two alternating fluxes in said members, and a load receiving energy from said circuit.

7. In combination, a magnetizable core having a bridging member, two windings on said core, a circuit including a source of periodic current and said two windings in such manner that the periodic fluxes created by said two windings are in opposition in said member, means for at times creating in said bridging member a control flux which varies the impedances of said two windings and alters the ratio of said periodic fluxes, means

responsive to the ratio between said periodic fluxes for varying the flux in said member, and a load receiving energy in accordance with the current in said circuit.

8. In combination, a magnetizable core having a bridging member, two windings on said core, a circuit including a source of periodic current and said two windings in such manner that the periodic fluxes created by said two windings are in opposition in said member, means for at times creating in said bridging member a control flux which varies the impedances of said two windings and alters the ratio of said periodic flues, means for varying the flux in said member in accordance with the ration between said periodic fluxes, and a load receiving energy in accordance with the current in said circuit.

9. In combination, a magnetizable core having a bridging member, two windings on said core, a load, a circuit including a source of periodic current and said load and said windings in such manner that the periodic fluxes created by said two windings are in opposition in said bridging member, means for at times creating in said bridging member a control flux which varies the impedances of said windings and alters the ratio of said periodic fluxes, and means for varying the flux in said bridging member in accordance with the ratio between said periodic fluxes.

10. In combination, a magnetizable core having a bridging member, two windings on said core, a circuit including a source of periodic current and said two windings, a load receiving energy in accordance with the current in said circuit, means for at times creating in said bridging member a control flux which varies the impedance of at least one of said windings and alters the ratio between said periodic fluxes, and means for varying the flux in said bridging member in accordance with the ratio between said periodic fluxes.

11. In combination, a magnetizable core comprising two magnetic paths having a bridging member in common, two windings one on each said path, a circuit including a source of periodic current and said two windings in such manner that the periodic fluxes created by said windings are in opposition in said bridging member, means for at times supplying said bridging member with a control flux, a third winding on said bridging member, a rectifier connected across the terminals of said third winding, and a load receiving energy in accordance with the current in said circuit.

12. In combination, two magnetic paths, two windings one on each said path, a circuit including a source of periodic current and said two windings, means for at times supplying both said paths with control flux which varies the impedances of said windings and alters the ratio of the periodic fluxes created by said winding, means for at time producing in both said paths an additional flux the magnitude of which depends upon the ratio between said periodic fluxes, and a load receiving energy in accordance with the current in said circuit.

13. In combination, two magnetic paths, two windings one on each said path, a circuit including a source of periodic current and said two windings, means for at times supplying both said paths with control flux which varies the impedances of said windings and alters the ratio of the periodic fluxes created by said winding, a third winding linking both said paths in such manner that the electromotive forces induced in such third windings by said two periodic fluxes are in opposition, a rectifier connected across the terminals of said third winding, and a load receiving energy in accordance with the current in said circuit.

14. In combination, a magnetizable core having two magnetic paths of different reluctances both including a bridging member, two windings one on each said path, a circuit including a source of periodic current and said two windings in such manner that the periodic fluxes created by said windings in said bridging member are normally balanced, means for at times creating in said bridging member a control flux which divides unequally between said two paths to vary the ratio between said periodic fluxes, means for varying the flux in said bridging member in accordance with the ratio between said periodic fluxes, and a load receiving energy in accordance with the current in said circuit.

15. In combination, a magnetizable core having two magnetic paths of different reluctances both including a bridging member, two windings one on each said path, a circuit including a source of periodic current and said two windings in such manner that the periodic fluxes created by said windings in said bridging member are normally balanced, means for at times creating in said bridging member a control flux which divides unequally between said two paths to vary the ratio between said periodic fluxes, a third winding on said bridging member, a rectifier connected across the terminals of said third winding, and a load receiving energy in accordance with the current in said circuit.

In testimony whereof I affix my signature.

PHILIP H. DOWLING.