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SATURABLE TRANSFORMER DEVICE

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Fig. 1

Fig. 2

Fig. 3

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The present invention relates generally to electrical current flow control apparatus and more particularly to apparatus of a character adapted for developing, in response to a direct current control signal, a proportional alternating current signal.

Heretofore, in applications where it has been desired to operate an alternating current control system in accordance with a controlling direct current signal, involved networks including thermionic tubes were required. The present invention contemplates the provision of a simple arrangement obviating the past requirement for vacuum tubes, etc., which in response to a direct current control signal, such as that provided by a radio receiver carried by an aircraft and constituting a part of a blind landing system including a localizer and glide beam path control, for example, will develop a proportional and properly phased alternating current signal for operating various craft surfaces in accordance with the received radio signal or signals.

An object of the present invention, therefore, is to provide a novel electrical inverter which is adapted for developing an alternating current signal proportional to a direct current signal.

Another object is to provide a novel electrical device which is adapted for developing a workable alternating current signal from an extremely weak direct current signal without the necessity for the use of vacuum tubes or other amplifiers.

A further object is to provide a novel and simplified electrical current flow control device which will provide a workable alternating current signal in response to a relatively weak direct current signal whose phase will be determined by the direction of flow of the direct current signal.

Another object of the present invention is to provide a novel and simple electrical device adapted for use wherever a workable, amplified and properly phased alternating current signal is required in response to a relatively weak direct current signal.

The above and other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawing wherein one embodiment of the invention is illustrated. It is to be expressly understood, however, that the drawing is for the purpose of illustration and description only, and is not designed as a definition of the limits of the invention.

In the drawings, wherein like reference char-
Secondary windings 29, 30, 31 and 32 are further provided on both cores 19 and 21 and are so arranged that they are normally unaffected by the fluxes traversing the long circuits of both cores, i.e., no signal will appear at the secondary output. To this end, secondary windings 29 and 30 arranged on legs 19 and 14, respectively, of core 19 are connected in series by way of a conductor 33 while windings 31 and 32 arranged on legs 16 and 17, respectively, of core 21 are connected in series by way of a conductor 34, the free end of winding 29 being connected by way of a conductor 35 with one side of a device 36 responsive to an alternating current signal and the free end of winding 31 being connected with the opposite side of the signal responsive device by way of a conductor 37. While the secondary windings of each pair are connected with one another in series aiding relation, the pair 29 and 30 is connected in series opposing relation with the pair 31 and 32, this being accomplished through a conductor 35 connected to the free end of winding 30 of the first pair of windings and the free end of winding 32 of the second pair of windings. Thus, for any signal appearing at secondary windings 29 and 30 due to current flow in primary windings 18 and 19 an equal and opposite signal will appear at secondary windings 31 and 32 due to current flow from primary windings 20 and 21 with the net result that no signal will be provided by output conductors 35 and 37 to device 36.

Direct current control windings in the form of coils 33 and 40 are, furthermore, provided on control cores 19 and 21 and are interconnected with each other in series relation by way of a conductor 41 and with a direct current signal generator 42 by way of conductors 43 and 44. With the arrangement thus far described, notwithstanding the amplitude or direction of the D.C. signal developed by generator 42, both cores will have fluxes threading the center legs thereof due to current flow in the control coils which are of equal intensity so that the balance of the electrical system is unchanged and no signal will appear at output leads 35 and 37.

In order that a workable and properly phased alternating current signal may be available at secondary outputs 35 and 37 to energize device 36 in response to a relatively weak direct current control signal applied to coils 29 and 30, a second pair of direct current biasing control windings in the form of coils 45 and 46 are provided on center legs 12 and 15, respectively, of cores 10 and 11, which are interconnected by way of a conductor 47 in series opposing relation, the free end of coil 45 being connected to one side of a suitable source of D.C. current, such as a battery 48, for example, by way of a conductor 49 and the free end of coil 46 being connected to the opposite side of the battery by way of a conductor 50. Although coils 45 and 46 have been described as being connected in series opposed relation, it is to be understood that they could be connected in series aiding relation as well, in which event control coils 33 and 40 would be connected in series opposed relation. Whichever arrangement is selected the ultimate result will be the same.

Assuming D.C. coils 45 and 46 to have been connected in series opposed relation in which event control coils 33 and 40 are in series aiding relation and with no D.C. signal applied to the latter coils, magnetic flux will flow in center leg 12 of core 10 due to D.C. current in coil 45 in the direction indicated by arrow 51 in Figure 2 while magnetic flux in the center leg 15 of core 11 due to D.C. current in coil 40 will flow in the opposite direction as indicated by arrow 52 in Figure 3. While these fluxes are in opposite direction in the two center legs of the cores, both cores are saturated with a similar amount so that the system is undisturbed and no signal will appear at device 36. It will now be readily apparent that the direction of the fluxes designated by arrows 51 and 52 will be determined by the manner that coils 45 and 46 are connected to D.C. source 48.

Assuming, further, that a direct current signal is developed by generator 42 to flow within control coils 33 and 40, additional fluxes will be developed in both center legs to, in one case, aid the flux developed by the other D.C. coil in one of the center legs of one of the cores and to oppose the flux developed by the other D.C. coil in the other center leg of the other of the cores. For example, as shown in Figure 2, the flux resulting from current flow in control coil 39 will be in the direction indicated by the arrow 53 to aid the flux 51 due to current flow in coil 45 and thus saturate core 10 to make core 10 and its windings 18, 19 and 20 to 22, 23, 24, 25, 26 and 27 a poor transformer while the flux produced in control coil 40 will be in the direction indicated by the arrow 54 to oppose the flux 52 due to current flow in coil 46 to neutralize the effect of the latter fluxes produced by current flow in coils 40 and 45 to thereby make core 11 and its associated windings 12 to 15 and 28 to 32 a poor transformer. As a result, the electrical system is unbalanced and an alternating current flow in secondary windings 29, 30, 31 and 32 to energize device 36.

The relation of the magnetic fluxes illustrated in Figures 2 and 3 of the drawing is that due to direct current flow in one direction within control windings 33 and 40 as a result of which an A.C. signal is available at secondary outputs 35 and 37. It will now be apparent that for a reversal in the direction of the current flow, the fluxes in control coils 33 and 40 developed by generator 42, the flux 53 of Figure 2 will be reversed to oppose the flux in center leg 12 due to current flow in coil 45 and thereby make core 10 and its associated primary and secondary windings a good transformer while the flux 54 of Figure 3 will be reversed to aid the flux in center leg 15 due to current flow in coil 46 and thereby make core 11 and its associated primary and secondary windings a poor transformer. The electrical system is, thus, again unbalanced and an alternating current flow in the secondary windings which is substantially 180° out of phase with the current flow induced in the same windings by the direction of current flow in control coils 33 and 46 first considered above.

It will now be apparent to those skilled in the art that a novel electrical device has been provided which is adapted for developing a workable, amplified and properly phased alternating current signal from an extremely weak direct current signal without the necessity for the use of vacuum tubes or other amplifiers. Although but one embodiment of the invention has been illustrated and described, various changes and modifications in the form and relative arrangement of parts, which will now appear to those skilled in the art, may be made without departing from the scope of the invention. Ref-
ference is therefore to be had to the appended claims for a definition of the limits of the invention.

I claim:

1. An inverter of the kind described comprising a pair of core members of magnetically permeable material, a primary winding on each of said core members adapted to be energized by an alternating current source, a secondary winding on each of said core members connected independently of said alternating current source, a biasing winding on each of said core members adapted to be energized by a direct current source independently of said alternating current source and independently of said secondary windings to produce a unidirectional magnetic flux in each of said cores, a signal source for producing direct current signals independently of the alternating current source and independently of the secondary windings, a control winding on each of said cores connected to said signal source and arranged to increase the unidirectional magnetic flux in one of said core members and to decrease the unidirectional magnetic flux in the other core member in response to the direct current signals so that alternating currents corresponding in phase to the polarity of the direct current signals are induced in said secondary windings, and means connected to said secondary windings and controlled by said signal source and responsive solely to the alternating currents induced in said secondary windings.

2. An inverter of the kind described comprising a pair of core members of magnetically permeable material each having a central leg and a pair of spaced outer legs, primary windings on the outer legs of said core members adapted to be energized by an alternating current source, secondary windings on the outer legs of said core members connected independently of said alternating current source so that no signal is induced in said secondary windings solely in response to energization of said primary windings, biasing windings adapted to be connected to a direct current source independently of the alternating current source and independently of said secondary windings for producing a unidirectional magnetic flux in each of said core members, a signal source adapted to produce direct current signals independently of the alternating current source and independently of said secondary windings, control windings on the central legs of said core members connected to said direct current signal source to decrease the unidirectional magnetic flux in one of said core members and to increase the unidirectional magnetic flux in the other core member in response to the direct current signals, and means connected to said secondary windings and controlled by said signal source and responsive solely to the alternating currents induced in said secondary windings.

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