

Sept. 14, 1954

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2,689,328

SATURABLE REACTOR DEVICE

Filed Dec. 1, 1950

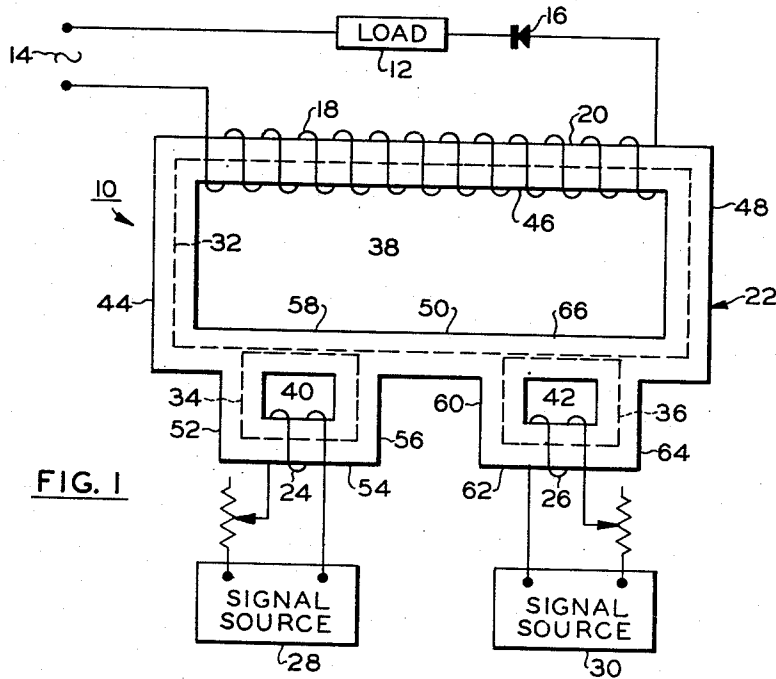
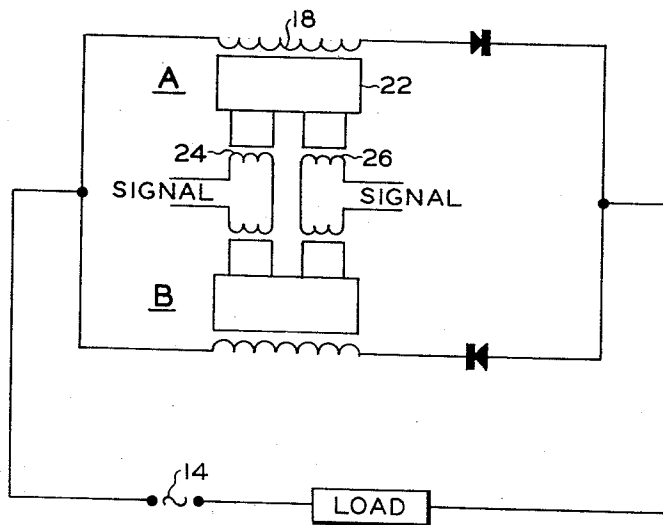


FIG. 2

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2,689,328

SATURABLE REACTOR DEVICE

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Application December 1, 1950, Serial No. 198,609

5 Claims. (Cl. 323-7)

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This invention relates to power transmission and more particularly to inductive reactor elements.

Saturable reactors usually comprise a power winding or windings on one or more legs of a magnetic core and one or more control windings on the same or other legs of the core. The object of the control windings is to control the permeability of the core by means of auxiliary magnetomotive forces and thereby to ultimately control the current through the power windings, that is, the reactor output. In conventional saturable reactors with a plurality of control windings it has been the practice to so locate the control windings that their magnetic circuits are linked and coincide with the magnetic circuit of the power winding so as to affect the saturation of the entire power magnetic circuit. In such reactors which employ a plurality of control windings for mixing signals in a common amplifier, undesirable interaction between the separate signal windings is unavoidable because of the inductive coupling therebetween due to conventional core structures.

In accordance with one embodiment of this invention an integral core structure is arranged to carry a plurality of control windings in such a way as to form a plurality of magnetic control circuits isolated from each other but linked to the magnetic circuit of a power winding whereby either or both of the control windings are effective to control the output of the power winding without any appreciable interaction between the control windings.

It is therefore an object of this invention to provide a new and useful inductive reactor control apparatus with a multiplicity of control windings having a minimum of interaction therebetween.

Another object of the invention is to provide a reactor with a plurality of control windings inductively isolated from each other.

A further object of the invention is to provide a reactor with a plurality of control windings whose respective magnetic circuits are isolated from each other.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of the present invention is diagrammatically shown.

In the drawing:

Fig. 1 is a diagram of a simple inductive reactor control apparatus illustrating the invention; and Fig. 2 is a diagram illustrating a further application of the invention.

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Referring now to Fig. 1, a saturable reactor 10, connected in a self-saturating magnetic amplifier circuit, controls the power supplied to a load 12 from an A. C. source 14 through a one way valve 16 and a power winding 18 of the saturable reactor 10. The power winding 18 is wound on a leg 20 of a core 22, and the inductance and consequent impedance of the winding 18 is determined by the permeability or flux condition of the core 22 which may be controlled by one or both of a pair of control coils 24 and 26 wound on portions of the core 22 and supplied with control current from separate sources 28 and 30 respectively. The core structure and position of the winding is such that although the magnetic circuit of the power winding 18 is coupled to the magnetic circuits of the windings 24 and 26 and is changeable in response to the variation in the magnetic circuits of the windings 24 and 26, the latter windings are substantially isolated inductively from each other and there is substantially no interaction between the magnetic circuits of the coils 24 and 26.

To prevent undesirable interaction between the control circuits of the windings 24 and 26, the magnetizable core 22, preferably of laminated core material, has three magnetic circuits whose paths are diagrammatically indicated by the closed dotted loops 32, 34, and 36, and which are formed by various closed combinations of the many sections of the core. These combinations define three core windows 38, 40 and 42.

The magnetic circuit 32 of the power winding 18 is formed by the core sections 44, 46, 48, and 50; the magnetic circuit 34 of the control winding 24 is formed by the core sections 52, 54, 56, and a portion 58 of the section 50; and the magnetic circuit 36 of the control winding 26 is formed by core sections 50, 52, 54, and a portion 56 of the section 50. Suitable currents are supplied through the control coils 24 and 26 by the control current sources 28 and 30 to provide any desirable degree and type of impedance control of the main winding 18.

Since magnetic circuits tend to conform to the paths of least reluctance, the magnetic circuits of the respective windings will follow the indicated dotted paths with very slight leakage or deviation. Thus it will be seen that although both control magnetic circuits 34 and 36 link the power magnetic circuit 32, they do not link each other, i. e. they are not coupled to each other. Thus there will be substantially no interaction between the control windings 24 and 26.

Although the half-wave circuit of Fig. 1 serves to explain the invention and is an operable circuit,

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it finds more practical use when used as one of a plurality of such units connected to form more practical amplifiers, as for example the "Doubler" self-saturating magnetic amplifier diagrammatically shown in Fig. 2, wherein each of the units A and B is similar to the circuit of Fig. 1; the two units, however, being connected in reverse relation to each other to provide an A. C. output into the load. Each of the units A and B is provided with a reactor core 22 similar to that in Fig. 1 with signal windings 24 and 26 inductively isolated from each other, both however being inductively coupled to the power winding 18 in order to affect the impedance thereof.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A saturable reactor comprising a saturable core having core sections defining a plurality of magnetic paths to provide gapless magnetic circuits for windings on the core, one of said paths having first and second portions, a power winding for insertion as series impedance between a source of power and a load, said power winding embracing a core section of said one path and having substantially its entire magnetic circuit in said core restricted to a path fully intercepted by each of said portions, a first control winding embracing a core section of a second path, said first portion being integral with a portion of the second path whereby the first control winding is operable to control the saturation of said first portion when control current is supplied to the first control winding, a second control winding embracing a core section of a third path, said second portion being integral with a portion of the third path whereby the second control winding is operable to control the saturation of said second portion when control current is supplied to the second control winding, the respective core sections carrying said control windings being substantially isolated magnetically from each other to prevent inductive interaction between said control windings, saturation change of either said first or second portions by the control windings being operable to change the reluctance of the power winding magnetic circuit thereby to change the impedance of the power winding.

2. Reactor control apparatus comprising a source of electrical power, a load circuit, a saturable core having sections defining a plurality of magnetic paths to provide magnetic circuits for windings on the core, one of said paths having portions common to portions of the other paths, said other paths being magnetically isolated from each other, a power winding linking said one path and being connected in series with said power source and said load circuit, the magnetic circuit of said power winding being confined at all times to a magnetic path passing through each of said common portions in series succession, a plurality of control coils, each control coil exclusively embracing a different one of said other paths whereby undesirable interaction between the control coils is avoided, the respective control coils being connected to separate sources of control current, each control coil being adapted to control the saturation of the core portion common to its associated path and said one path, thereby to change the reluctance of the power winding magnetic circuit in order to change the impedance of the

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power winding to current flow from said power source to said load circuit.

3. Reactor control apparatus comprising a source of electrical power, a load circuit, a rectifier, a saturable core having sections defining a plurality of magnetic paths to provide magnetic circuits for windings on the core, one of said paths having portions common to portions of the other paths, said other paths being magnetically isolated from each other, a power winding linking said one path and being connected in series with said rectifier, said power source and said load circuit in a self-saturating arrangement, the magnetic circuit of said power winding being confined at all times to a magnetic path passing through each of said common portions in series succession, a plurality of control coils respectively embracing a different one of said other paths whereby undesirable interaction between the control coils is avoided, the respective control coils being connected to separate sources of control current, each control coil being adapted to control the saturation of the core portion common to its associated path and said one path, thereby to change the reluctance of the power winding magnetic circuit in order to change the impedance of the power winding to current flow from said power source to said load circuit.

4. Reactor control apparatus comprising an electrical line connected to a source of power, and a saturable reactor comprising a saturable core having core sections defining a plurality of magnetic paths to provide magnetic circuits for windings on the core, one of said paths having first and second portions, a power winding embracing a core section of said one path and having substantially its entire magnetic circuit in said core restricted to a path fully intercepted by each of said portions, said power winding being connected in series with said line, a first control winding embracing a core section of a second path, said first portion being integral with a portion of the second path whereby the first control winding is operable to control the saturation of said first portion, a second control winding embracing a core section of a third path, said second portion being integral with a portion of the third path whereby the second control winding is operable to control the saturation of said second portion, the respective core sections carrying said control windings being substantially isolated magnetically from each other to prevent inductive interaction between said control windings, saturation change of either said first or second portions by the control windings being operable to change the reluctance of the power winding magnetic circuit thereby to change the impedance of the power winding in order to control the amount of current flow from said source through said line.

5. Reactor control apparatus comprising an electrical line connected to a source of power, a rectifier, and a saturable reactor comprising a saturable core having core sections defining a plurality of magnetic paths to provide magnetic circuits for windings on the core, one of said paths having first and second portions, a power winding embracing a core section of said one path and having substantially its entire magnetic circuit in said core restricted to a path fully intercepted by each of said portions, said power winding being connected in series with said line and said rectifier in a self-saturating arrangement, a first control winding embracing a core section of a second path, said first portion being integral with

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a portion of the second path whereby the first control winding is operable to control the saturation of said first portion, a second control winding embracing a core section of a third path, said second portion being integral with a portion of the third path whereby the second control winding is operable to control the saturation of said second portion, the respective core sections carrying said control windings being substantially isolated magnetically from each other to prevent inductive interaction between said control windings, and separate sources of control current for said control windings, saturation change of either said first or second portions by the control windings being operable to change the reluctance of

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the power winding magnetic circuit thereby to change the impedance of the power winding in order to control the amount of current flow from said source through said line.

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