

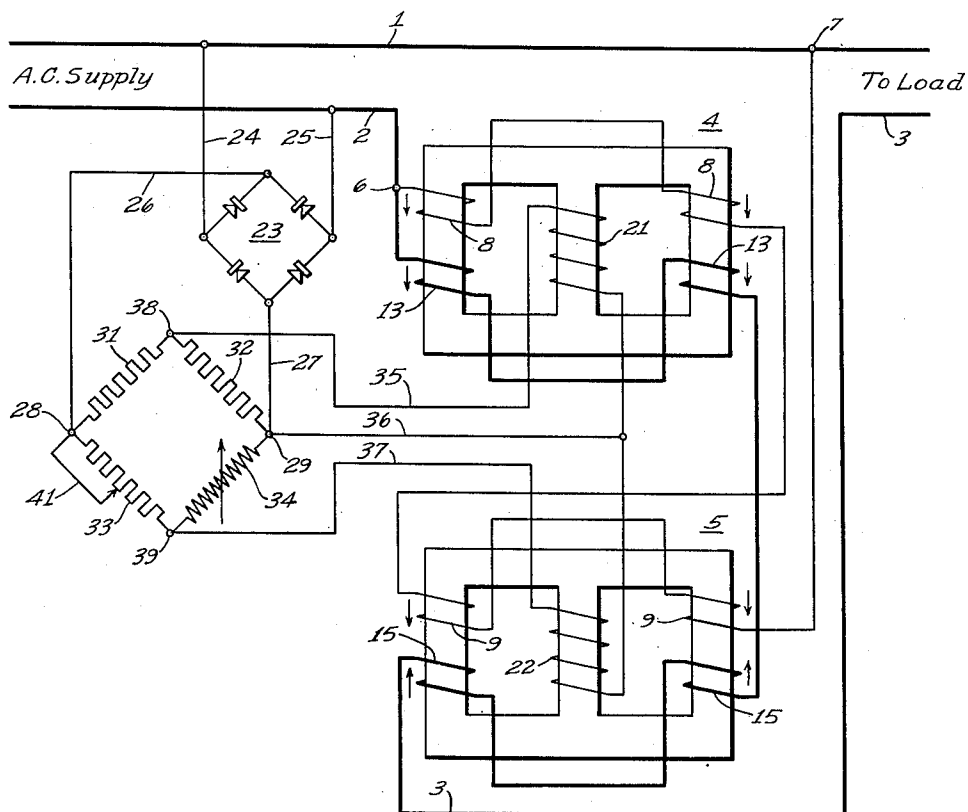
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VOLTAGE STABILIZER

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WITNESSES:

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VOLTAGE STABILIZER

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5 Claims. (Cl. 171-119)

My invention relates to voltage regulators of the type employed to supply alternating current and a constant voltage to a load circuit from a source in which the line voltage varies.

Such regulators are frequently provided employing saturable core reactors and condensers connected in circuit in such manner as to provide a plurality of variable voltage vectors which vary in different senses, as the line voltage varies, but which add vectorially in such manner that their vector sum remains substantially constant upon variations in line voltage.

The use of such saturable core reactors usually results in low power factor, low efficiency and ventilating problems and are critically dependent upon the frequency of the alternating current circuit.

It is an object of the invention to provide a regulator of the above-indicated character which is free from the above-stated limitations.

It is a more specific object of the invention to provide a regulator having two magnetic core structures each provided with primary and secondary windings and a saturating winding, the saturating winding being controlled from a bridge loop circuit supplied with unidirectional current that is a measure of the voltage of the alternating current circuit being regulated, the loop circuit having linear and non-linear resistor elements included therein for differently varying the saturation of the two core structures.

Referring to the drawing, the single figure illustrates a diagrammatic view of circuits and apparatus illustrating one preferred embodiment of the invention. In the drawing, conductors 1 and 2 are supplied with alternating current electric energy from a suitable source, the voltage of which varies somewhat and delivers alternating current to a load circuit represented by conductors 1 and 3. The regulating apparatus includes two saturable core reactors 4 and 5 each provided with three winding legs, the reactors being of a well-known type. A primary circuit for energizing the magnetic circuit of the reactors is provided connected across the circuit between junction points 6 and 7 and including two primary windings 8 on the two outer legs of the core structure 4 and two primary windings 9 on the two outer legs of the core structure 5, the four windings being connected in series circuit relation. A secondary winding circuit is provided extending from the junction point 6 to the load circuit conductor 3 and including two windings 13 on the two outer legs of the core structure 4 and two windings 15 on the two lower outer legs of the

core structure 5, the four windings being connected in series circuit relation. Saturating windings 21 and 22 are provided on the middle leg of the two core structures 4 and 5 respectively, and are energized with unidirectional current from a full wave rectifier 23 connected by conductors 24 and 25 across supply conductors 1 and 2. The unidirectional or output terminals of the rectifier are connected by conductors 26 and 27 to junction points 28 and 29 of a loop circuit bridge network including four resistor elements 31, 32, 33, and 34. The resistor elements 31 and 32 have fixed values of resistance equal to each other and the element 33 has an adjustable tap circuit 35 for varying the resistance in that leg of the circuit. Material such as Nichrome, advance, or similar metals might be chosen. The fourth resistor element 34 has a non-linear characteristic so that its resistance varies with variations in the voltage impressed thereacross. This element might be formed from a dry type rectifier, material such as Thyrite, a vacuum tube, or other suitable device having the desired non-linear resistance characteristic.

The saturating winding 21 is connected by conductors 35 and 36 across the fixed resistor 32 between junction points 38 and 29 and the saturating winding 22 is connected by conductors 36 and 37 across the non-linear resistor element 34 between junction points 29 and 39. The polarities of the primary and secondary windings on core structures 4 and 5 are such that the voltage induced in the windings 13 add to the alternating current supply line voltage, while the voltage induced in the windings 15 oppose the line voltage. The directions of the arrows on the drawing indicates directions of the voltages induced in each winding.

When the bridge circuit is balanced, that is, when the ratio between the resistance of the resistors 31 and 32 is the same as the ratio between the resistors 33 and 34, the same degree of magnetic saturation exists in both core 4 and 5, and hence the voltages induced in windings 13 and 15 cancel each other, leaving the load voltage across 1 and 2. The bridge circuit may be adjusted to vary the exact nature of the load voltage desired by adjusting the tap circuit connection 41. If the voltage across supply conductors 1-2 increases above its normal value, the voltage supplied to the bridge circuit through the rectifier 23 will correspondingly increase. Because of the linear characteristic of the resistor element 32 and the non-linear characteristic of the resistor 34, the voltage increase upon the winding 22 of

the core structure 5 increases less rapidly than does the voltage applied to the winding 21 of the core structure 4 thus causing a greater degree of saturation of the core structure 4 and a relatively greater increase in the voltage induced in the secondary windings 15. These windings are of such polarity in the circuit as to decrease the voltage applied to load circuit conductors 1 and 3, thus preventing the increase in voltage across the supply conductors 1 and 2 from being felt across the load conductors 1 and 3. Likewise, if the voltage across conductors 1 and 2 drops below the normal value for which the regulator is adjusted, the decrease in voltage across resistor 34 is less than the decrease in the voltage across resistor 32, thus causing the voltage applied across the winding 21 to decrease more than the voltage across the winding 22. It follows that that saturation of the core 5 remains relatively greater than that of the core 4 so that the voltage induced in the secondary windings 13 of the core structure 4 is relatively greater than the voltage induced in the windings 15 of the core structure 5 thus causing a voltage between the load and circuit conductors 1 and 3 to increase above the voltage across conductors 1 and 2.

It will thus be seen that I have provided a regulator without moving parts that is connected and accurate in its operation and is effective to boost or buck the voltage of the supply circuit in accordance with variations in the voltage thereof from a desired value to be supplied to load circuit conductors in order to maintain a substantially constant voltage across the load circuit conductors.

Modifications in the circuits and apparatus will occur to those skilled in the art without departure from the spirit of my invention and I do not wish to be limited otherwise than by the scope of the appended claims.

I claim as my invention:

1. In a regulating system, an alternating current circuit, two magnetic core structures, a primary winding on each of said core structures connected to be energized from said circuit, a secondary winding on each of said core structures connected in series with said alternating current circuit, the windings being so connected in circuit that the voltages induced in the secondary windings associated with one core structure add to the line voltage of the alternating current circuit and the voltages induced in the secondary windings associated with the other core structure oppose the line voltage of the said alternating current circuit, a pair of saturating windings for controlling, respectively, the saturation of said two core structures, means for supplying direct current to said pair of windings comprising a bridge circuit including a linear resistance arm and a non-linear resistance arm connected respectively to said pair of windings, and a full-wave rectifier energized in accordance with the voltage of the alternating current circuit for supplying direct current to said bridge circuit.

2. In a regulating system, an alternating current circuit, two magnetic core structures, a primary winding on each of said core structures connected to be energized from said circuit, a secondary winding on each of said core structures connected in series with said alternating current circuit, the windings being so connected in circuit that the voltages induced in the secondary windings associated with one core structure add to the line voltage of the alternating current circuit and the voltages induced in the secondary windings

associated with the other core structure oppose the line voltage of the said alternating current circuit, a pair of saturating windings for controlling, respectively, the saturation of said two core structures, means for supplying direct current to said pair of windings, comprising a bridge circuit having four elements connected to form a closed loop circuit, and a source of unidirectional current connected between two diagonally opposite connecting points of said loop circuit, said pair of saturating windings being connected, respectively, between one of said connecting points and the other two remaining connecting points of said loop, two of the four sides of said loop having a constant value of resistance, one side having an adjustable resistance, and the other side having a non-linear resistance.

3. In a regulating system, an alternating current circuit, two magnetic core structures, a primary winding on each of said core structures connected to be energized from said circuit, a secondary winding on each of said core structures connected in series with said alternating current circuit, the windings being so connected in circuit that the voltages induced in the secondary windings associated with one core structure add to the line voltage of the alternating current circuit and the voltages induced in the secondary windings associated with the other core structure oppose the line voltage of the said alternating current circuit, a pair of saturating windings for controlling, respectively, the saturation of said two core structures, means for supplying direct current to said pair of windings comprising a bridge circuit having four resistor elements connected to form a closed loop circuit and a source of unidirectional current connected between two diagonally opposite connecting points of said loop circuit, one path through the loop circuit between said connecting points including two fixed linear resistor elements of equal value, and another path through the remaining two of the four resistor elements of the loop circuit including an adjustable linear resistor element and a non-linear resistor element.

4. In a regulating system, an alternating current circuit, two magnetic core structures each having three winding legs, a primary winding circuit connected across the alternating current circuit and including a winding on each of the two outer legs of each of the two core structures, a secondary winding circuit in series with one of the alternating current circuit conductors including a winding on each of the two outer legs of each of the two core structures, the primary and secondary windings being so positioned on the core structures that the voltages induced in the secondary windings on one core structure add to the line voltage of the alternating current circuit and the voltages induced in the secondary windings on the other core structure oppose the line voltage of the alternating current circuit, a saturating winding on the middle leg of each of said two core structures, means for supplying direct current to said pair of windings comprising a bridge circuit having four elements connected to form a closed loop circuit, and a source of unidirectional current connected between two diagonally opposite connecting points of said loop circuit, said pair of saturating windings being connected, respectively, between one of said connecting points and the other two remaining connecting points of said loop, two of the four sides of said loop having a constant value of resistance, one side having an adjustable resistance,

and the other side having a non-linear resistance.

5. In a regulating system, an alternating current circuit, two magnetic core structures each having three winding legs, a primary winding circuit connected across the alternating current circuit and including a winding on each of the two outer legs of each of the two core structures, a secondary winding circuit in series with one of the alternating current circuit conductors including a winding on each of the two outer legs of each of the two core structures, the primary and secondary windings being so positioned on the core structures that the voltages induced in the secondary windings on one core structure add to the line voltage of the alternating current circuit and the voltages induced in the secondary windings on the other core structure oppose the

line voltage of the alternating current circuit, a saturating winding on the middle leg of each of said two core structures, means for supplying direct current to said pair of windings comprising a bridge circuit having four resistor elements connected to form a closed loop circuit and a source of unidirectional current connected between two diagonally opposite connecting points of said loop circuit, one path through the loop circuit between said connecting points including two fixed linear resistor elements of equal value, and another path through the remaining two of the four resistor elements of the loop circuit including an adjustable linear resistor element and a non-linear resistor element.

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