

Dec. 23, 1952

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VOLTAGE REGULATING SYSTEM

2,623,205

Filed May 19, 1950

FIG. 1

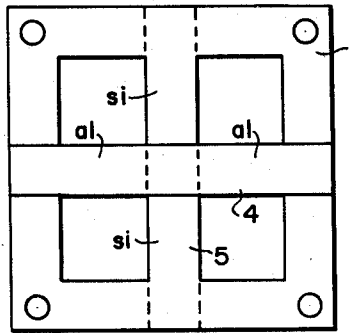


FIG. 2

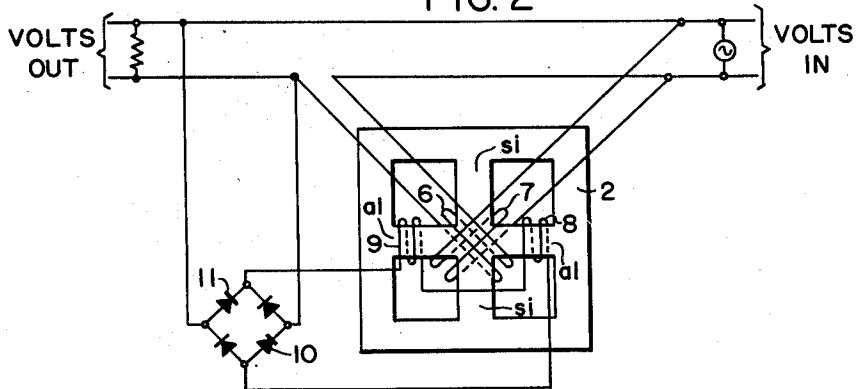
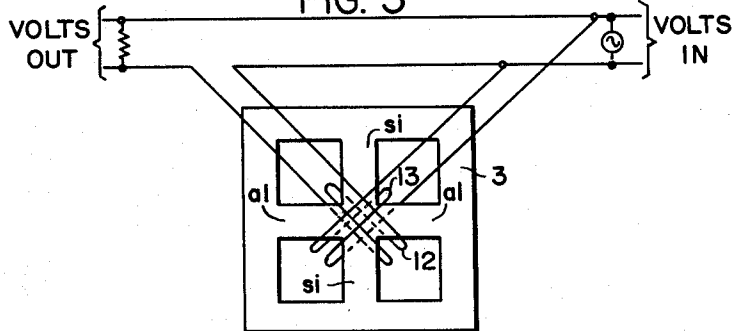


FIG. 3



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2,623,205

VOLTAGE REGULATING SYSTEM

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Application May 19, 1950, Serial No. 163,044

7 Claims. (Cl. 323-45)

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This invention relates in general to magnetic voltage regulators, but is more particularly concerned with a magnetic voltage regulator utilizing the magnetic cross valve.

An object of the present invention is to provide a magnetic voltage regulator utilizing the magnetic cross valve.

Another object of the present invention is to provide an electromagnetic induction device in which the mutual induction between the voltage coil and a booster coil can be reversed or regulated in degree by saturation in order to produce the constant voltage output with a variable power supply to a constant load.

Another object of the present invention is to provide an electromagnetic device in which the saturation of two different magnetic materials on two different intersecting core elements is utilized to reverse the mutual induction of two coils placed thereon.

Other objects of the invention will appear upon a further perusal of the specification taken in conjunction with the accompanying drawings which illustrate several embodiments of the invention in the form of schematic circuit diagrams.

Fig. 1 is a diagrammatic representation of the magnetic cross valve structure.

Fig. 2 is a diagrammatic representation of the voltage regulator utilizing the magnetic cross valve in which a biasing flux is used.

Fig. 3 is a diagrammatic representation of the voltage regulator utilizing the magnetic cross valve in which the magnetic cross valve core is saturated by an alternating flux.

In the magnetic cross valve which is herein used, the windings on the cross valve core are displaced by 90° so that there is substantially no mutual inductance between the respective windings. However, when a differential flux is produced in the core of the magnetic cross valve, a voltage is induced in one of the coils. In the present invention two ferromagnetic metals are used in which there is a different flux density for the respective metals. The ferromagnetic metals herein used are Allegheny electric metal and silicon iron. The result of the magnetizing current in one cross winding would be that the Allegheny electric metal would first carry the flux and when it becomes saturated, the flux would then be carried by the silicon iron. This provides a reversing of the direction of flux with respect to the other cross winding.

Referring now to Fig. 1, this is an illustration of the magnetic cross valve herein used. The

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structure for the magnetic cross valve is shown in detail in Patent No. 2,455,078, issued November 30, 1948, to the present inventor. Two intersecting members 4 and 5 are made of two different ferromagnetic materials. For example, intersecting member 4 is composed of Allegheny electric metal, while the intersecting member 5 is composed of silicon iron. The center intersecting square, shown in the center of the cross valve core at the intersection of members 4 and 5, is interlaced with the two ferromagnetic metals.

Referring now to Fig. 2, the magnetic cross valve 2 is the same as the aforementioned magnetic cross valve 1. In the upper right hand corner of Fig. 2 is shown the alternating generator which supplies the input voltage. A primary winding 7 is wound through a pair of opposite diagonal corners of the intersecting members. The secondary winding 6 is wound through the other pair of opposite diagonal corners of the intersecting member and is serially connected to the voltage output circuit. The voltage output circuit, which is shown in the upper left hand corner of Fig. 2 is therefore connected to the input circuit in series with winding 6.

Saturating windings 8 and 9 are wound around the intersecting member 9 of the cross valve 2 and are serially connected to the bridge rectifier at points opposite from which the voltage output circuit is connected. In more detail, let us assume that the voltage input generator is operating at the normal load condition. At this time, current is flowing from the voltage input circuit to the voltage output circuit through the secondary winding 6. Concurrently, a direct current is fed to the saturating windings 8 and 9 over the following path: voltage input circuit, rectifier 11, saturating winding 9, saturating winding 8, rectifier 10 and back to the voltage output circuit. As a result thereof, a biasing flux is produced in the core of the magnetic cross valve. There is no voltage variation in the voltage input generator when the system is at normal operating condition. Therefore, no voltage differential is induced in the secondary winding 6.

At the normal operating voltage, the flux density of the silicon iron metal is equal to the flux density of the Allegheny electric metal. Therefore there is no flux differential in the core to induce a voltage in the secondary winding 6. The point of equal flux density is provided by the saturating windings 8 and 9, which bias the flux to the desired operating point at normal input voltage. It is to be noted that at a voltage below the normal operating voltage, the permeability of

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the Allegheny electric metal is greater than the permeability of the silicon iron. Therefore, practically all the flux at this condition is flowing through the Allegheny electric metal. However, when the voltage is above the normal operating voltage, the Allegheny metal is saturated and therefore, the permeability of the silicon iron at this condition is greater than the permeability of the Allegheny metal. As a result thereof, the additional flux flows through the silicon iron to produce the reversal of direction of the flux.

The voltage induced in the secondary winding 6 depends upon a flux differential in the magnetic core structure 2, which is produced by the different flux densities of the intersecting members.

At normal operating voltage, there is not any flux differential in the magnetic cross valve core to induce a voltage in the secondary winding 6. When the generating voltage is below the normal operating voltage, a flux differential is produced which induces a voltage in the secondary winding 6 to aid the voltage generated. When the generating voltage is above the normal operating voltage, a flux differential is produced with a reversal of direction which induces a voltage in the secondary winding 6 to oppose the voltage generated.

Let us assume at this point that the voltage input generator is producing a voltage above the normal condition. In a manner hereinbefore described, a biasing flux is produced by the saturating windings 8 and 9. The biasing flux produced by the saturating windings 8 and 9 is adequate to saturate the horizontal intersecting member composed of Allegheny electric metal. When the input voltage generated rises above the normal value, additional flux is produced to increase the flux in the vertical intersecting member composed of silicon iron. As a result thereof, a reversal of flux is induced in the secondary winding 6 bucking the current flow through the output voltage circuit to provide a constant voltage output.

Let us assume at this point that the voltage of the voltage generator falls below the normal value and a biasing flux is produced by the saturating windings 8 and 9, in a manner hereinbefore explained. Again the Allegheny electric intersecting member is partially saturated. Since the current flow through the primary winding is below normal, there is no additional flux to saturate the silicon iron intersecting member, and therefore there is no reversal of induced voltage in the secondary winding 6. However, a differential flux is produced by the difference of permeability of the two intersecting members. The differential flux will induce a voltage in the secondary winding 6 to aid the current flow in the voltage output circuit.

Referring now to Fig. 3, the magnetic cross valve structure 3 is the same as hereinbefore described in reference to Fig. 1. An output voltage generator is shown in the upper right hand corner of Fig. 3. A primary winding is connected thereto and is wound through a pair of opposite diagonal corners of two intersecting members of the magnetic core 3. At right angles to the primary winding 13 is wound a secondary winding 12. The secondary winding is wound through the other pair of opposite diagonal corners of the intersecting members and is serially connected to the output voltage circuit. The output voltage circuit is shown in the upper left hand corner of Fig. 3.

It is to be noted that the current flow through the primary winding 13 is adequate to partially

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saturate the Allegheny electric metal intersecting member under normal conditions. When the voltage input generator produces a voltage above the normal value, the current flowing through the primary winding 13 is increased. As a result thereof, the silicon iron intersecting member now has flux partially saturating it, since the Allegheny electric metal intersecting member is saturated. This causes a reversal of flux in the magnetic cross valve core. As a result thereof, a reversed voltage is induced in the secondary winding 12. The current flow through the secondary winding 12 opposes the current flow through the generator to provide the constant output voltage circuit. It is to be noted that under condition of no flux differential, there is no mutual inductance between the respective windings. However, when the magnetic cross valve core becomes partially saturated, an alternating flux produces a differential flux in the magnetic cross valve core which induces a voltage in the secondary winding. The flux differential is produced by the permeability of the two intersecting members.

Let us assume that the generator is operating below the normal value. Thereupon a current flows through the primary winding 13. As a result thereof, an aiding voltage is induced in the secondary winding 12. The current flow through the secondary winding now aids the current flow of the input generator to thereby maintain a constant voltage in the voltage output circuit. Since the Allegheny electric metal intersecting member is partially saturated, the flux produced by the current flow of the primary winding 13 provides a differential flux in the magnetic cross valve core which is adequate to induce a voltage in the secondary winding 12. The flux differential is produced by the difference of permeability of the two intersecting members. It is to be noted that under this condition there is no reversal of flux through the silicon iron intersecting member. Therefore, the current flow in the secondary winding 12 is aiding.

Although I have described my invention with a certain degree of particularity, it should be understood that the present disclosure has been made only by way of example and that numerous changes in the details of the construction and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

I claim:

1. In a voltage regulator, a magnetic core structure having two intersecting members, a primary winding wound through a pair of opposite diagonal corners of the intersection, a source of current connected to said primary winding, an output circuit connected to said source of current, and a secondary winding wound through the other pair of diagonal corners of said intersection and serially connected to said output circuit whereby any fluctuation in said source of current would produce a voltage in said secondary winding to provide a constant output voltage in said output circuit.

2. In a voltage regulator, a magnetic core structure having two intersecting members, a primary winding wound through a pair of opposite diagonal corners of the intersection, a source of current connected to said primary winding, an output circuit connected to said source of current, and a secondary winding encompassing said magnetic core substantially at right angles to said primary winding so that there is substantially

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no mutual induction between the windings unless a degree of saturation is reached and thereupon any variation in said source of current will provide a differential flux in said magnetic core to induce in said secondary winding a voltage to provide a constant voltage output in said output circuit.

3. A voltage regulator as claimed in claim 1 wherein said two intersecting members have different flux densities within a certain degree of magnetization for providing a differential flux path.

4. A voltage regulator as claimed in claim 2 wherein said two intersecting members are composed of two different types of ferromagnetic material.

5. In a voltage regulator, a magnetic core structure having two intersecting members, a primary winding wound through a pair of opposite diagonal corners of the intersection, a source of current connected to said primary winding, an output circuit connected to said source of current, a saturating winding wound around one of said intersecting members to provide a biasing flux in said magnetic core, a rectifier interconnecting said output circuit and said saturating winding to provide a direct current for said saturating winding, and a secondary winding wound through the other pair of opposite corners of said intersection and serially connected to said output circuit whereby a variation in said source of current would produce a voltage in said secondary winding to provide a constant voltage in said output circuit.

6. In a voltage regulator, a magnetic core structure having two intersecting members, a primary winding wound through a pair of opposite diagonal corners of the intersection, a source of current connected to said primary winding, an output circuit connected to said source of current,

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means for providing a biasing flux in said magnetic core, and a secondary winding wound through the other pair of opposite corners of said intersection and serially connected to said output circuit whereby a variation in said source of current would produce a differential flux in said magnetic core to induce a voltage in said secondary winding to provide a constant voltage in said output circuit.

7. In a voltage regulator, a magnetic core structure having two intersecting members, a primary winding wound through a pair of opposite diagonal corners of the intersection, a source of current connected to said primary winding, an output circuit connected to said source of current, means for providing a biasing flux in said magnetic core, and a secondary winding wound around said core so as to be substantially at right angles to said primary winding so as to have no mutual inductance between the windings unless a degree of saturation is produced by said biasing flux, and said secondary winding serially connected to said output circuit whereby any variation in said source of current would produce a flux differential in said core to induce a voltage in said secondary winding to provide a constant voltage in said output circuit.

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