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VOLTAGE REGULATORS FOR ELECTRIC GENERATORS

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2 Sheets-Sheet 1

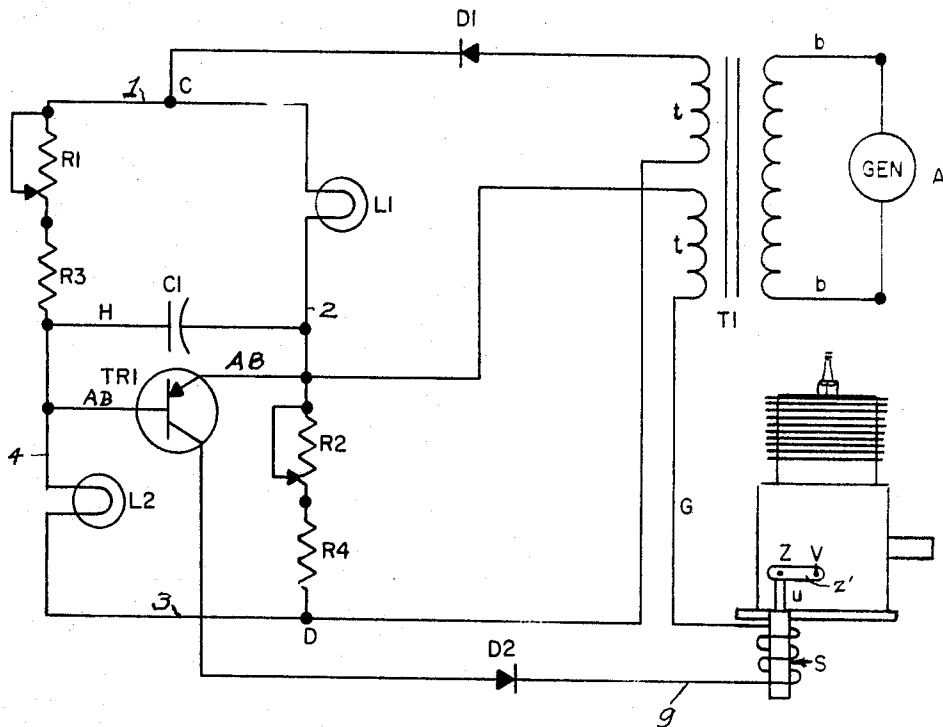


FIGURE 1

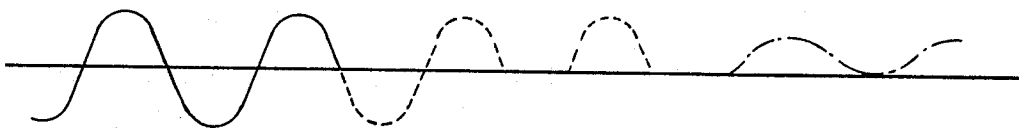


FIGURE 1A

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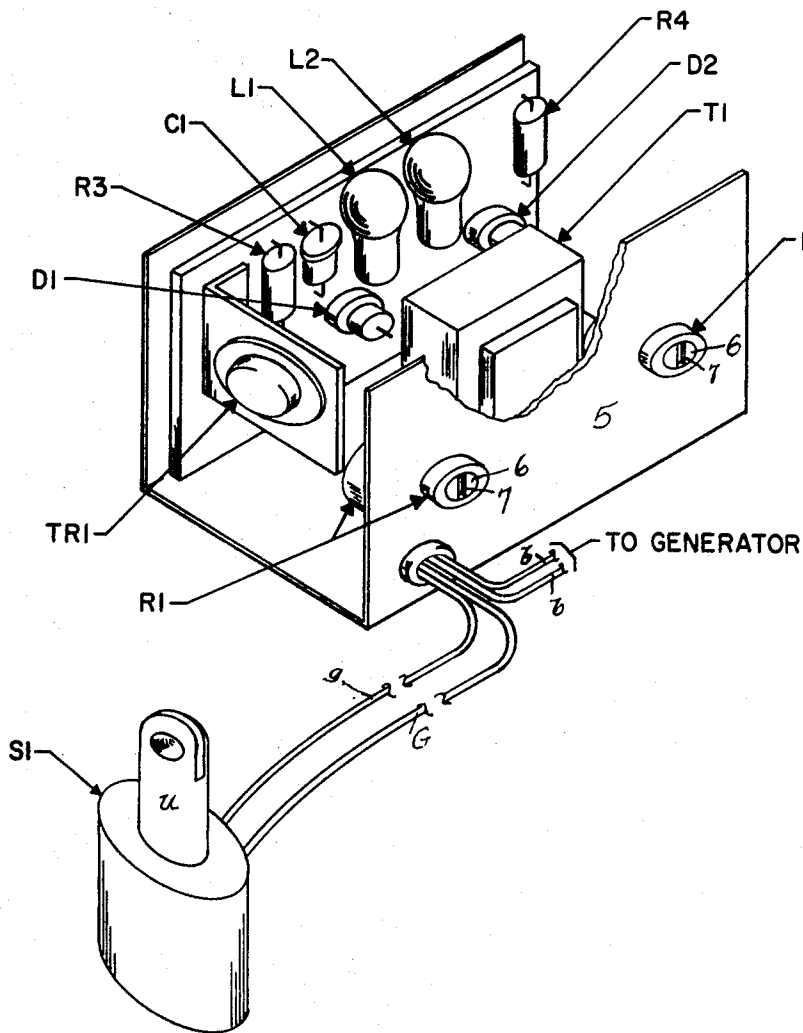
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- FIGURE 2 -

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VOLTAGE REGULATORS FOR ELECTRIC GENERATORS

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5 Claims

ABSTRACT OF THE DISCLOSURE

A voltage regulator for electric generators which are driven by power elements, such as internal combustion engines, including a bridge circuit composed of two sensitive lamp sensors, two fixed resistances and two adjustable resistances and including a transistor whose base emitter circuit is connected across the bridge. The bridge is so arranged as to exercise continuous control of the power elements throughout all variations of load upon the generators.

This invention relates, broadly, to a voltage regulator for electric generators, and it has for its object to provide new and improved means for not only controlling the voltage, but also the cycle formation of the current delivered from the generator to whatever electrical appliance the generator may be servicing.

As this description proceeds, it will be seen that the desired objects are accomplished through the use of extremely sensitive sensors, which constitute a part of the current controlling devices.

The invention will be best understood by reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic view illustrating the component parts of the voltage regulator;

FIG. 1A is a diagrammatic view illustrating the manner in which the regulator modifies the cycle formation of the current delivered from the generator; and

FIG. 2 is a diagrammatic, broken view illustrating one manner of assembling the component parts in a supporting and housing box.

Like numerals designate corresponding parts throughout all of the figures of the drawings.

In the drawings, A designates an electric current generator, and Z designates the propelling means for said generator. The output leads *b* from the generator are connected to a transformer T1 and the output windings *t* of said transformer lead, respectively, to the connections C and D of a Wheatstone bridge. This bridge comprises the legs, or runs, 1, 2, 3 and 4 of said bridge. The bridge includes a balancing run A, B in the length of which a transistor TR1 is disposed. The legs 2 and 4 of the bridge have extremely sensitive sensors L1 and L2 disposed in their lengths.

Some of the elements designated by identifying reference characters may be housed and supported by a box-like support 5. Screw-like elements 6, having slotted ends 7 are parts of the adjustable resistors R1, R2 (FIG. 2), and provide minute adjustment for said resistors and for holding them securely in the positions at which they may be set.

The structure as so far described is that used in regulating voltages, and its efficiency is brought about primarily by using electric lamps as the sensors. These lamps are of the conventional type comprising a tungsten filament which is heated when electric current is flowing there-through, and the extreme sensitivity of these sensors arises from the fact that the resistance of the tungsten filament varies with the variations of temperature of the filament, which temperature varies in turn with the speed of the motive power which drives the generator.

The elements D1 and D2 are one-way rectifiers which change alternating current to direct current, but because they are diodes, they are half-way rectifiers which yield a pulsating current. As shown in FIG. 1A, the described construction modifies the cycle formation of the generated current. In this figure, the wave formation, as unmodified, is shown in full lines. As modified by the elements D1 and D2, it is shown in dotted lines; while as modified by this invention, the final wave form is shown in dot-and-dash lines. Thus, as indicated in full lines, the line presents a conventional wave formation in which the peaks of the waves extend above and below the center line; as indicated by the dotted lines, the peaks of the waves appear only above the center line; while as indicated by the dot-and-dash lines, the wave formation has been flattened enough to render it a merely undulating line, instead of the pronounced peaks indicated by the dotted lines.

The advantages flowing from the very great sensitivity of the electric lamp sensors L1, L2 are inherent in the use of this regulator in the control of voltages alone, as well as in the control of cycle formation. The ultimate control in both cases resides in modifying and controlling the generator speed. The manner in which the cycle formation is controlled is effected by replacing lamp elements L1 and L2 with capacitors of the proper size. Decreasing impedance of capacitor with increasing frequency allows the bridge to respond to changes in frequency in essentially the same manner that it responds to changes in voltage when the lamps are used. When this change is made, it is necessary to reverse the solenoid linkage.

While this modification of generator speed may flow from any form of propelling means for the generator, the particular way shown, for purposes of illustration only, resides in the use of the regulator to move the throttle *z'* of the engine Z by which the generator is driven. This, in turn, is effected by the actuation of throttle *z'* through the movable core *u* of a low-voltage solenoid S. This solenoid is energized through a lead G which connects the solenoid with the power-yielding winding *t* of the transformer T1 and another lead *g* which connects said solenoid with said power-yielding winding, through the transistor TR1.

The movement of throttle *z'*, which is a lever that is pivoted at V, is controlled by this arrangement to increase or decrease the speed of the engine, this in turn controlling the voltage output of the generator. The voltage desired may be set at 110, or any other voltage, by adjustment of the adjustable resistor R1 or R2. At this set point, no voltage exists across the central connector AB and consequently through the resistor TR1. Therefore, there is no actuation of solenoid S to move throttle *z'* of engine Z. If, because of increase in the load upon the generator, the voltage drops, the lamp resistances are reduced, and voltage will appear in connection A, B and transistor TR1. The transistor then increases the current supply to solenoid S to actuate the throttle of engine Z to speed up said engine.

Should the voltage rise above the set point, its effect through the transistor is reversed, and the engine speed is reduced until no voltage appears through said transistor. The speed of this response is determined by the thermal response of the lamp filaments, and may be varied by using lamps whose filaments yield the desired speed of response. The capacitor C1 may also be employed to further control the response.

Some of the advantages of the use of incandescent lamps as sensitive sensors include the fact that: they are of low cost; they have a high sensitivity to changes of temperature; they are uniform and commonly available; and they lend themselves to highly sensitive control of both voltage and cycle formation.

An inherent difficulty with a system of this type is the unavoidable over voltage which will occur when a heavy load is removed from the generator. The magnitude and duration of this over-voltage is common to engines and generators generally. The magnitude of this over-voltage can be reduced to some extent by using a relay which puts in additional field resistance when the generator voltage exceeds some upper limit, say 140 volts. This, however, being common practice and not part of this invention, is not illustrated.

It is to be understood that this invention is not limited to the precise construction set forth, but that it includes within its purview whatever changes fairly come within either the terms or the spirit of the appended claims.

I claim:

1. A regulator for use in connection with an electric current generator assembly, which assembly comprises an electric current generator, a power element for driving said generator and an output work circuit leading from said generator, and which regulator comprises an electric circuit which receives current from said output work circuit and the flow current in which acts upon the said power element, and means for continually varying the flow of current in said electric circuit either under the influence of variations of voltage in the current flowing in said electric circuit, or in variations in cycle formation of said current flowing in said electric circuit, whereby to cause continuous control of the power element throughout all variations of load upon the generator.

2. An assembly as recited in claim 1, in which the electric circuit includes a Wheatstone bridge, said bridge comprising a plurality of legs, in which legs very sensitive sensors are located, and which sensors are composed of incandescent electric lamps.

3. A structure as recited in claim 1, in which the power element consists of an internal combustion engine comprising a throttle and means for moving said throttle to control the speed of said engine under the action of an electrically actuated element, which element in turn is actuated by electricity from said electric circuit.

4. Assembly as recited in claim 1 wherein the means for varying the flow of current in said electric circuit either under the influence of variations of voltage in the current flowing in said electric circuit, or in variations in cycle formation of said current in said electric circuit; consists of a Wheatstone bridge which forms a part of said circuit, said bridge comprising separate side legs, in each of which legs a sensitive sensor is included, and two transverse balancing conductors connecting said two legs, in one of which conductors a transistor is included and in the other of which a capacitor is included.

5. Assembly as recited in claim 1 wherein the means for varying the flow of current in said electric circuit either under the influence of variations of voltage in the current flowing in said electric circuit, or in variations in cycle formation of said current in said electric circuit; consists of a Wheatstone bridge which forms a part of said circuit, said bridge comprising separate side legs, in each of which legs a sensitive sensor is included, and two transverse balancing conductors connecting said two legs, in one of which conductors a transistor is included and in the other of which a capacitor is included, the said sensors consisting of conventional incandescent electric lamps having filaments; the degree of heating of which filaments varies the strength of the current passing through the legs of the Wheatstone bridge in which the sensors are located.

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