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DEVICES SUPPLYING STABILISED FEED VOLTAGES

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2 Sheets-Sheet 1

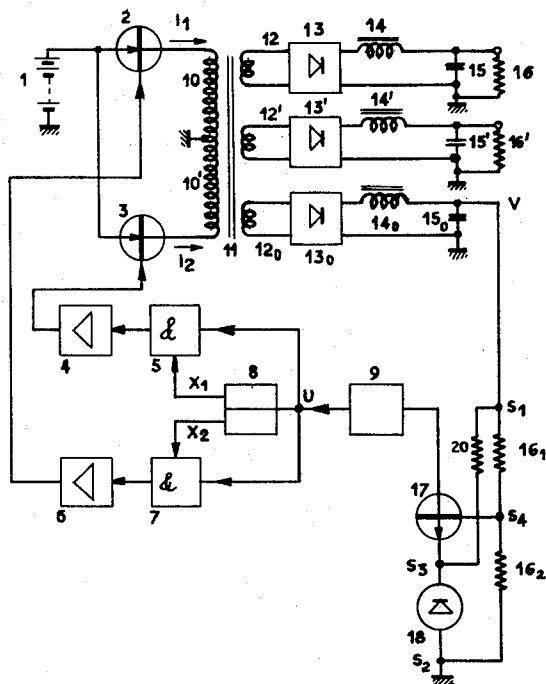


FIG. 1

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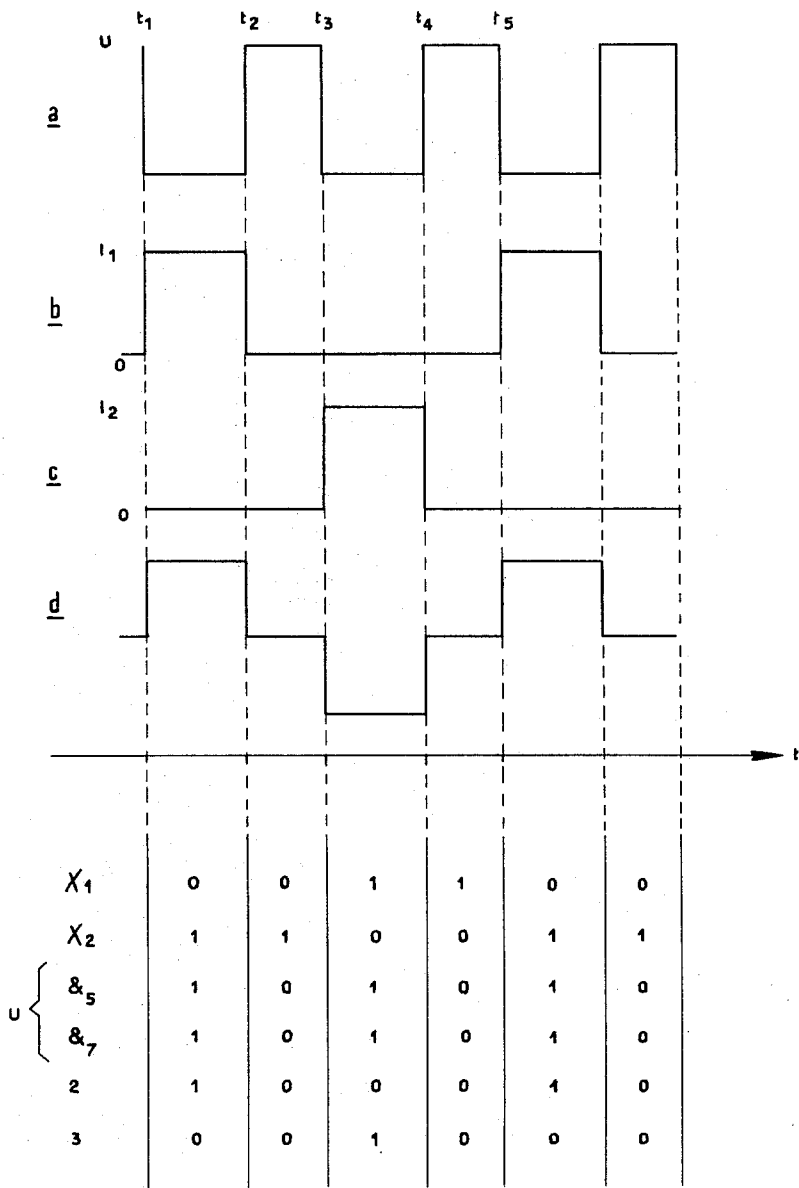


FIG.2

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DEVICES SUPPLYING STABILISED FEED
VOLTAGES

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1 Claim. (Cl. 321—2)

The present invention relates to a device which supplies, from a D.C. voltage source, one or more D.C. voltages of any predetermined values, which are constant despite the variations of the voltage of the D.C. source. This device utilises oscillating, transforming, rectifying and integrating members.

In their French patent, applied for on the 20th April, 1961, for "Improvements in Voltage-Stabilising Devices" (Invention Joseph Leostic), applicants have described a device for regulating D.C. voltage which supplies across the terminals of an impedance a D.C. voltage of lower value than that of the source, obtained by integrating an unsymmetrical square wave emanating from the cut-off of the voltage of the source by a power switching transistor, which transistor is controlled by a wave of like form supplied by a multivibrator and having a utilisation factor which varies as a function of the level of an error signal applied to a non-linear element of the multivibrator circuit.

A regulating device thus constructed has a high efficiency, which may reach 85–95%, because the power switching transistor employed for cutting off the voltage from the source has very low losses.

The device according to the present invention is based upon the same principle, but its form of construction is different.

The regulating device according to the invention is characterised by the fact that it comprises a transformer of which the ends of the primary winding are connected to the collectors of two transistors whose emitters are connected in parallel to one pole of the D.C. voltage source, the other pole of which is connected to the mid-point of the said winding. The bases of these transistors are connected respectively to the outputs of two AND circuits whose first inputs are directly connected to the output of a multivibrator and whose second inputs are connected respectively to the two outputs of a bistable trigger circuit whose input is connected to the multivibrator. The secondary windings of the transformer are connected through symmetrical rectifiers and integrating networks to the impedances at the terminals of which it is desired to obtain stabilised voltages. An additional secondary winding is connected through a rectifier and an integrator to one of the diagonals of a bridge whose other diagonal is connected to the emitter-base circuit of a transistor whose collector is connected to the input of the multivibrator.

One possible form of construction of the device according to the invention is illustrated by way of example in the accompanying figures.

FIGURE 1 is the functional diagram of a device according to the invention designed to supply two stabilised voltages. FIGURE 2 is a diagram indicating the variation, as a function of time, of various electrical and magnetic quantities involved in the operation of the device according to FIGURE 1.

In FIGURE 1, there is denoted by 11 the transformer, the ends of the two halves 10, 10' of the primary winding of which are connected to the collectors of two transistors 2 and 3 respectively. The D.C. voltage source 1 is connected between the emitters of the transistors 2, 3 on the one hand and the common point of the two windings 10, 10', general earth, on the other hand. The bases

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of the transistors 2 and 3 are connected respectively through two amplifiers 4 and 6 to the outputs of two AND circuits 5 and 7. The first inputs of these two circuits are connected in parallel to the output of a multivibrator 9, and their second inputs are connected respectively to the two outputs of a bistable trigger circuit 8 whose input is connected to the output of the multivibrator 9.

The transformer 11 generally comprises secondary windings 12, 12' equal in number to the stabilised voltages which it is desired to obtain. The case of two voltages is here taken by way of example. The said secondary windings are connected through rectifiers and integrating networks 14, 15 and 14', 15' to impedances 16, 16', across the terminals of which it is desired to obtain the said voltages.

The transformer comprises in addition a further secondary winding 12₀ which is connected to a rectifier 13₀ and an integrating circuit 14₀, 15₀ to one diagonal S1, S2 of a bridge circuit formed of three resistances 16₁, 16₂ and 20 and a Zener diode 18. There are connected to the other diagonal S3, S4 of this bridge the emitter and the base, respectively, of a transistor 17 serving as a load impedance for one of the two transistors of the multivibrator 9.

This device operates as follows: the voltage V across the terminals of the diagonal S1, S2 of the bridge will be called the "pilot voltage," and the potential V₃ at the apex of S3 of the bridge will be called the "reference voltage." The potential at the apex S4 of the bridge will be denoted by V₄.

The "error signal" V₄–V₃ collected in the diagonal S3, S4 of the bridge is therefore the difference between a fraction of the pilot voltage and the reference voltage. This error signal controls the value of the output impedance of the transistor 17, which constitutes the load impedance of one of the halves of the multivibrator, that of the other half being a fixed resistance. The multivibrator supplies an unsymmetrical square wave, the ratio of the duration of the high potential level of which to the duration of the low potential level thus depends upon the error signal. This wave controls the trigger circuit and the AND circuits in such manner that the transistor 2 is conductive and the transistor 3 non-conductive, then vice versa, and so on in alternating sequence, the ratio between the duration of the conductive state and the duration of the non-conductive state depending upon the relative duration of the levels of the said square waves.

The operation of the device as a follow-up system tends to reduce the error signal to a minimum, thus adjusting the output D.C. voltages to the predetermined values.

FIGURE 2 is a diagram illustrating the operation of the device according to FIGURE 1, completed by a table of the logical functions symbolically representing the state of the various parts.

Diagram 2a represents the square wave with levels of unequal durations supplied by the multivibrator. This wave comprises a low potential level having the symbolic logical value 1, between t₁ and t₂, a high potential level of shorter duration having the symbolic logical value 0 between t₂ and t₃, and again a low level between t₃ and t₄, and a high level between t₄ and t₅, and so on. Diagrams 2b and 2c show, respectively, in the course of the same period the variation of the current I₁ supplied by the transistor 2 (FIGURE 1), and the variation of the current I₂ supplied by the transistor 3. Finally, diagram 2d shows the variation of the resultant ampere-turns in the primary winding of the transformer 11. These ampere-turns have between t₁ and t₂ a given polarity corresponding to the passage of the current I₁, through the primary winding 10. Between t₂ and t₃, the currents I₁ and I₂ are both zero and the value of the total ampere-turns is therefore zero. Between t₃ and t₄, the current I₂ flows through the winding 10' and the ampere-turns therefore have a level of oppo-

site polarity equal in duration and in amplitude to the level of duration t_1-t_2 . The same cycle is indefinitely repeated. It will therefore be seen that the energy flows through the transformer 11, in accordance with an alternating function having no continuous component, and having a fundamental frequency equal to half the relaxation frequency of the multivibrator.

In the lower table, it has been assumed that the output S1 of the bistable trigger circuit had at the commencement of the cycle the logical state 0 and the output S2 the logical state 1. It has also been assumed that the trigger circuit changed its state for the application of a negative flank of the voltage U, that is to say, at the times t_3 , t_5 , etc. Since the transistors 2 and 3 are assumed to be conductive (function 1) for the concomitant application of functions 1 to the two inputs of the respective AND circuits, and non-conductive (function 0) for any other condition, it will be seen that the transistor 2 has one conductive period out of every four periods of the cycle of the total primary current, and the transistor 3 one period out of four of the same parity as the conductive period of the transistor 2.

Starting from a very unsymmetrical basic adjustment (t_1-t_2 long, t_2-t_3 very short) for a zero output voltage, the correcting voltage applied to S_4 has the effect of rendering the multivibrator more and more symmetrical, that is to say, when the output voltage (and therefore the voltage at S_4) increases, the level t_1-t_2 tends to decrease and the level t_2-t_3 tends to increase.

I claim:

Device supplying, from a D.C. voltage source, stabilised voltages, comprising a multivibrator, in the input circuit of which a transistor is so connected that its impedance is

a function of the difference between a reference D.C. voltage and a fraction of the stabilised D.C. voltage, the said multivibrator supplying an unsymmetrical square wave applied to a switching transistor device so designed that the ratio of the durations of the "conductive" level and of the "non-conductive" level is such that the stabilised D.C. voltage is proportional to the reference D.C. voltage, the said device comprising a transformer, the ends of the primary winding of which are connected respectively to the collectors of two transistors whose emitters are connected in parallel to one pole of the D.C. voltage source, the other pole of which is connected to the mid-point of the said primary winding, characterised in that the bases of these two transistors are connected respectively to direct-current amplifiers which are connected to the outputs of two AND circuits, and of which the first inputs are connected directly to the output of the multivibrator and the second inputs are connected respectively to the outputs of a bistable trigger circuit which changes over once to each cycle of the unsymmetrical square-wave voltage supplied by the multivibrator, so that during one cycle of the said voltage only one of the transistors is rendered conductive during one of the levels of this voltage, the other transistor being maintained in the non-conductive condition, while, during the succeeding cycle of the said voltage, the second transistor is rendered conductive during the same level as before, the first transistor being maintained in the non-conductive condition.

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