

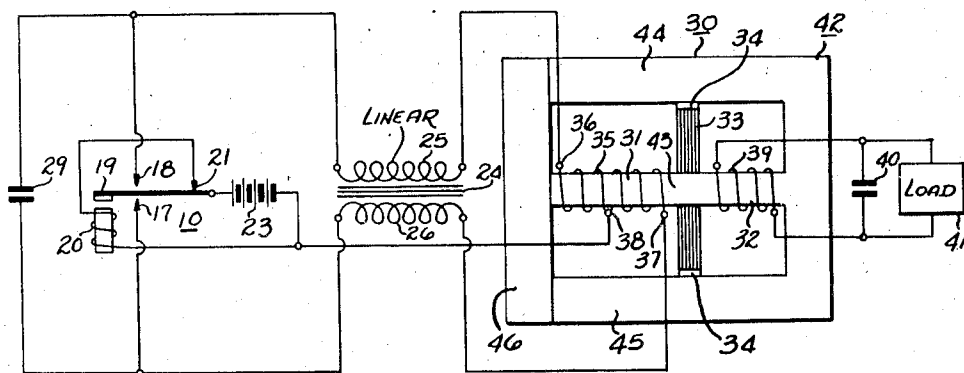
Dec. 21, 1948.

H. J. BROWN

2,456,910

VIBRATOR REGULATING SYSTEM

Filed June 19, 1944



INVENTOR.

Harold J. Brown

BY

Goodling and Kroat
attys.

UNITED STATES PATENT OFFICE

2,456,910

VIBRATOR REGULATING SYSTEM

Harold J. Brown, Indianapolis, Ind., assignor to
Electronic Laboratories Incorporated, a cor-
poration of Indiana

Application June 19, 1944, Serial No. 540,933

2 Claims. (Cl. 175—365)

1

My invention relates, in general, to an electrical regulating system and, more particularly, to a vibrator operated magnetic regulating system.

Heretofore, in electrical regulating systems embodying vibrators, it has been considered common practice to have a system wherein it required, for example, 600 volt-ampere capacity in the secondary output circuit in the system to regulate, for example, a 100 watt load under the normal range of input voltages required of a battery operated power supply. This requirement resulted in an uneconomical power pack as the advantages of regulation were very greatly off-set by the increased cost. It should be observed that the volt-ampere capacity rating of the secondary circuit dictates the size and cost of the principal elements, i. e., the transformer and condenser of the conversion system. It is noted that a 600 volt-ampere capacity in the secondary circuit of the system with respect to the 100 watt load, in the example given above, is a ratio of 6 to 1 of input to output capacity and this ratio has been considered common practice.

An object of my invention is to provide for reducing the above ratio to no more than 3 to 1 or lower and thus reducing the cost.

Another object of my invention is to provide for operating a vibrator in conjunction with the primary of a transformer whereby a primary flux density may be maintained at a relatively large value to decrease the above mentioned ratio.

Another object of my invention is to excite the primary of the transformer through a vibrator whereby the primary of the transformer has a relatively high flux density which reduces the large amount of flux additions to be added through the magnetic shunt of the transformer.

Another object of my invention is to provide for reducing the secondary volt-ampere capacity of the secondary circuit of the transformer.

Another object of my invention is to provide an impedance element between the primary winding of a leakage reactance transformer and the vibrator, wherein the transformer secondary circuit has a condenser in shunt across itself which, when starting the vibrator under a condition when the condenser is discharged, the inductance element reduces the value of the primary current which is out of phase with the primary voltage to render the condition for the operation of the vibrator satisfactory and whereby after the condenser becomes charged the regulative effect of the leading current in the condenser reflects itself in the primary circuit of the transformer and produces substantially-unity power factor

2

whereby the effect of the inductance element is such that it does not act to take care of variations in the primary voltage.

Another object of my invention is to cause the impedance between the vibrator and the primary winding of the transformer to become less effective in voltage regulation by accommodating variations in the input voltage and to have a system whereby the secondary circuit of the transformer takes care of substantially all of the voltage regulation.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claims, taken in conjunction with the single Figure 1 of the drawing which illustrates a vibrator electrical regulating system embodying the feature of my invention.

With reference to the drawing, my invention comprises in general a vibrator 10, a transformer 30 energized by the vibrator 10 and arranged to supply a load 41. The vibrator 10 comprises two opposed contacts 17 and 18 between which a vibrating contact 19 is actuated by an actuating coil 20 controlled by an actuating contact 21. A condenser 29 is connected across the two opposed contacts 17 and 18. The vibrator 10 may be of any suitable form so long as it provides the necessary switching action.

The transformer 30 comprises a core 42, having a center leg 43 and two outside legs 44 and 45. The left-hand end of the center leg 43 and the outside legs 44 and 45 are bridged by an I-piece 46 which completes the magnetic circuit. The center leg 43 has a primary core portion 31 and a secondary core portion 32. Magnetic shunts 33 are placed between the center leg 43 and the outside legs 44 and 45, respectively. The magnetic shunts 33 are disposed between the primary core portion 31 and the secondary core portion 32. As illustrated, the magnetic shunts are provided with air gaps 34. Mounted around the primary core portion 31 is a primary winding 35 and mounted around the secondary core portion 32 is a secondary winding 39 which is connected to the load 41. A capacitor 40 is effectively in shunt with the load. The primary winding 35 has first and second terminals 36 and 37 and a center tap 38, and is arranged to be energized by the vibrator 10. The first terminal 36 is connected to the vibrator contact 18, the second terminal 37 is connected to the vibrator contact 17 and the center tap 38 is connected to one side of the battery 23 which has its other side connected to the vibrator element 19 of the vibrator. A linear inductance 24 having windings 25 and 26 is con-

connected between the vibrator and the primary winding 35 in the transformer. The two windings 25 and 26 have a common core and the windings are effectively connected in series with the primary winding 35.

In my invention, the primary flux density is maintained at a relatively high value with the result that the additive flux passing through the magnetic shunts sustained by the condenser current of capacitor 40 is relatively low with the result that the secondary volt-ampere capacity of the secondary circuit is relatively low for a relatively high output load and gives regulation to the relatively high output load. In ordinary practice, a vibrator cannot be made to work with high primary flux density because, generally, a large lagging current is associated with the starting cycle of the vibrator and particularly a large lagging current is associated with the establishment of the steady-state condition in the secondary circuit of the leakage reactance transformer. In other words, in the starting of a vibrator in combination with a regulating transformer, there are two conditions to contend with:

(1) the surge associated with the establishment of steady-state condition in the primary, and

(2) the establishment of a steady-state current and voltage in the secondary.

Thus, in the early stages of the starting of my vibrator, the capacitor 40 across the secondary winding 39 is effectively a short circuit upon the secondary winding and as such the primary surge condition is aggravated with the result that a large primary current tends to flow. The inductance element 24 reduces the amount of the current which tends to flow. Moreover, it is to be observed that in the early stages of the starting cycle the large primary current which tends to flow lags the voltage, with the result that at the moment the contacts break, the current is a maximum. Therefore, my inductance element 24 limits the amount of this out-of-phase lagging current which prevents any damage to the contacts. As the capacitor 40 in the load circuit assumes a steady-state condition, the reflected current causes the transformer itself to operate at substantially unity power factor with the result that the primary voltage of the transformer and the voltage converted by the vibrator are about the same. Therefore, the steady-state operation of the unit is substantially not affected by the presence of the inductance element 24. In other words, when the capacitor 40 reaches a steady-state condition, it causes the inductance element 24 to have very little regulating effect upon the system. The regulation which takes care of variations in the battery voltage is accomplished primarily in the leakage reactance transformer. Inasmuch as the inductance element 24 limits the regulating current in the primary winding during the early stages of the starting cycle, I am able to operate the primary at relatively high flux density. Consequently, the reduction in the flux required through the magnetic shunts 33 means that my volt-ampere requirement is accordingly greatly reduced.

In actual practice, I find that the volt-ampere capacity in my secondary circuit is substantially one-half that required in prior practice and will regulate the same output watt load circuit. More particularly, I have been able to have a 300 volt-ampere capacity secondary to regulate a 100 watt load which formerly required 600 volt-ampere

capacity in the secondary circuit to regulate the 100 watt load.

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

I claim as my invention:

1. In a vibrating system having a vibrator with contact means energized by a direct current source and producing a pulsating current, the improvement of a regulating circuit energized by said pulsating current, said improvement comprising a leakage reactance transformer having a primary core portion with a continuous permeable circuit, a secondary core portion, and magnetic shunt means disposed between the primary and secondary core portions, primary winding means mounted on the primary core portion and energized by the pulsating current, secondary winding means mounted on the secondary core portion and adapted to supply an alternating current, inductance means for limiting the surge of primary current during the starting period of said vibrating system, said inductance means being connected between the contact means of the vibrator and the primary winding means, and capacitive means for producing substantially unity power factor operation of said transformer during steady-state conditions, whereby said inductance means thereafter has little regulating effect upon the system, said capacitive means being connected in parallel with the secondary winding means.

2. In a vibrating system having two opposed contact means with vibrating contact means operating therebetween energized by a direct current source and producing a pulsating current, the improvement of a regulating circuit energized by said pulsating current, said improvement comprising a leakage reactance transformer having a primary core portion all parts of which are in direct contact with each other to form a substantially continuous ferro-magnetic circuit, a secondary core portion, and magnetic shunt means having an air gap disposed between the primary and secondary core portions, split primary winding means with two ends and a center tap mounted on the primary core portion, secondary winding means mounted on the secondary core portion and adapted to supply an alternating current, said center tap being connected to one side of the direct current source and said vibrating contact means being connected to the other side of the direct current source, first substantially linear inductance means, second substantially linear inductance means, one of said oppositely disposed contact means of the vibrator being connected through the first inductance means to one end of the primary winding means and the other said oppositely disposed contact means being connected through the second inductance means to the other end of the primary winding means, and a capacitor connected in parallel with the secondary winding means, said first and second linear inductance means having a common core, said first and second linear inductance means operating to limit the lagging primary current which tends to flow prior to the time that the capacitor reaches a steady-state condition, thereby preventing damage to the contact means during this period, said capacitor in its steady-state condition drawing a leading cur-

rent to oppose the lagging primary current to produce substantially unity power factor operation of the transformer, whereby the first and second linear inductance means thereafter have very little regulating effect upon the system.

HAROLD J. BROWN.

REFERENCES CITED

The following references are of record in the file of this patent:

Number	Name	Date
2,036,399	Comstock et al. _____	Apr. 7, 1936
2,327,579	Brown _____	Aug. 24, 1943
2,329,224	Short _____	Sept. 14, 1943
2,338,079	Huge _____	Dec. 28, 1943
2,338,080	Brown _____	Dec. 28, 1943

UNITED STATES PATENTS