

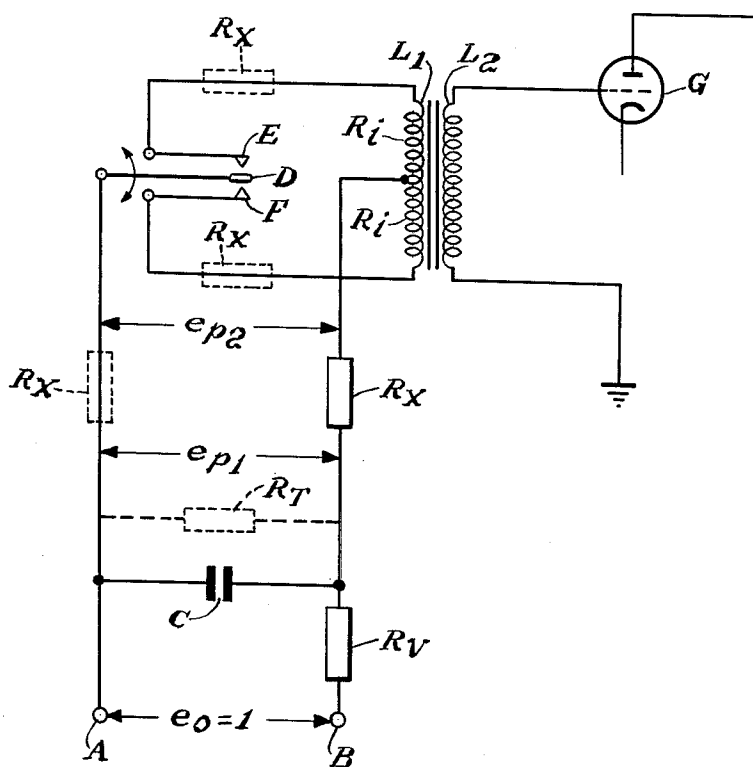
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VIBRATOR SYSTEM

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VIBRATOR SYSTEM

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1 Claim. (Cl. 321-49)

The present invention relates to a vibrator system supplying an interrupted direct current to a transformer for producing alternating current.

It is an object of this invention to provide a vibrator system of the kind which operates at maximum efficiency when the source of direct current or the circuit including this source is of high resistance.

When measuring or registering certain electric values with direct current apparatus A.C. amplifiers are frequently used, which are supplied over a vibrator and which are provided with an input transformer as coupling element between the vibrator and the first electron valve of the amplifier. The use of resistance or capacitor coupling brings a number of drawbacks. In most cases, there is required a large input impedance which may be only to a certain degree achieved by the increase of the impedance of the input transformer, for instance by increasing the number of turns of the coils, by the use of larger iron cores of special material and similar.

A substantial increase of the input impedance cannot be however achieved by this method, as a correctly functioning vibrator is short circuited within a certain interval which amounts approximately to 5% of one cycle. In the course of this time the source of the direct current is short circuited over the relatively low ohmic resistance of the primary winding of the input transformer.

In accordance with this invention a substantial increase of the input impedance is achieved by introducing an ohmic resistance into the circuit of the primary winding of the input transformer. This resistance may be placed at different places of this circuit and may be even represented by an increased ohmic resistance of the primary winding of the input transformer.

The accompanying drawing shows by way of example a wiring diagram of an arrangement according to this invention.

The measured D.C. value is supplied to the terminals A, B and charges a condenser C over a resistance R_v . From the terminals of this condenser C the primary winding L_1 of the input transformer is supplied over the contacts D, E, F of a vibrator and over a resistance R_x , which is connected to the central tap of the primary winding L_1 of the transformer. The secondary winding L_2 of this transformer supplies the grid circuit of an electron valve G.

Let it be assumed that the input impedance of the transformer, i.e. of half of the primary winding, is R_1 , that the corresponding ohmic resistance of this part of the winding is R_s , the period within which all contacts D, E, F of the vibrator are short circuited is z , expressed as a fraction of the entire cycle, R_x the additional resistance, R_{T1} the resulting resistance of the circuit during the short circuit period (z), and R_{T2} the resulting resistance of the circuit during the remaining part of the cycle ($1-z$).

The said resistance R_{T1} is equal to

$$\frac{R_s}{2} + R_x$$

as current passes through both branches of the primary winding L_1 . The resistance R_{T2} is equal to $R_1 + R_x$. On the terminals of the capacitor C of sufficient magnitude a voltage e_{p2} is present, which corresponds to the mean

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value of the resistance of the circuit within the whole cycle.

The mean value of the resistance

$$R_T = \frac{R_{T1} \cdot R_{T2}}{R_{T1}(1-z) + z R_{T2}} = \frac{\left(\frac{R_s}{2} + R_x\right) \cdot (R_1 + R_x)}{\frac{R_s}{2} + R_x + z(R_1 + R_x)}$$

if the voltage of the source of direct current $e_0=1$, then the voltage e_{p1} on the terminals of the capacitor C will be

$$e_{p1} = \frac{R_T}{R_T + R_v}$$

and the voltage behind the resistance R_x , i.e. on the terminals of the primary winding L_1 of the transformer

$$e_{p2} = \frac{R_1}{(R_T + R_v)(R_1 + R_x)}$$

e_{p2} achieves its maximum value for

$$\frac{de_{p2}}{dR_x} = 0$$

for which condition we obtain the equation

$$R_x = -\frac{R_s}{2} + \sqrt{z \cdot R_v \left(R_1 - \frac{R_s}{2}\right)}$$

If for instance

$$\begin{aligned} z &= \frac{1}{20} \\ R_1 &= 200 \text{ K ohm} \\ R_s &= 2 \text{ K ohm} \\ R_v &= 200 \text{ K ohm} \\ R_x &= 43.5 \text{ K ohm} \\ e_{p2} &= 0.41 \end{aligned}$$

for $R_x=0$, i.e. if there is no additional resistance introduced into the circuit of the primary winding of the transformer

$$e_{p2} = 0.083$$

We have therefore a five time increase of the voltage on the primary winding as compared to the same circuit without resistance.

The said vibrator system is particularly useful when measuring voltages of sources of direct current with high internal resistance, or over a high resistance, for instance over a filter with RC elements, where the introduction of the additional resistance R_x into the circuit of the primary winding of the transformer represents a substantial increase of the voltage across the input terminals of the transformer and therefore a substantial increase of the sensibility of the apparatus.

The said resistance R_x may be placed at any suitable place in the circuit of the primary winding of the transformer, for instance into both branches leading from the outer terminals of the primary winding L_1 to the contacts E, F or into the branch leading to the vibrator contact D, as shown on the drawing in broken lines. Finally the resistance R_x may be represented by the winding L_1 of the transformer, which may be wound of a resistance wire.

What I claim is:

In combination in a system for converting a direct-current voltage to be measured into an alternating-current voltage, a vibrator including two spaced contacts and vibratable contact means movable relative to said contacts between successive positions of engagement with only one of said contacts, of simultaneous engagement with both of said contacts, and of engagement with only the other one of said contacts, a transformer including a primary and a secondary winding, said primary winding having two outer terminals and a center tap terminal intermediate said outer terminals, two conductors respectively connecting said outer terminals with said contacts, conductor

means for respectively connecting said center tap terminal and said contact means to the two poles of a source of direct-current voltage to be measured, said contacts, contact means, primary winding, conductors, and conductor means constituting an input circuit, said input circuit including fixed resistance means for maintaining the impedance of said circuit above a predetermined minimum value when said vibratable contact means is engaged with both of said contacts, said resistance means having the value

$$-\frac{R_s}{2} + \sqrt{zR_v \left(R_i - \frac{R_s}{2} \right)}$$

where R_s is the direct-current resistance of one-half of said primary winding, z is that fraction of a complete cycle of operation of said vibrator during which said contact means is in simultaneous engagement with both of said contacts, R_v is the internal direct-current resistance

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of the source whose voltage is to be measured, and R_i is the input impedance of one-half of said primary winding, and a capacitor one of whose terminals is connected to said contact means and the other of whose terminals is connected to a point between said fixed resistance means and R_v , whereby the average voltage appearing across said secondary winding during a complete cycle of operation of said vibrator is optimized.

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