Feb. 7, 1933. R. M. PAGE 1,896,417

FREQUENCY DIVISION CIRCUIT

Filed March 13, 1931

FIG. 1

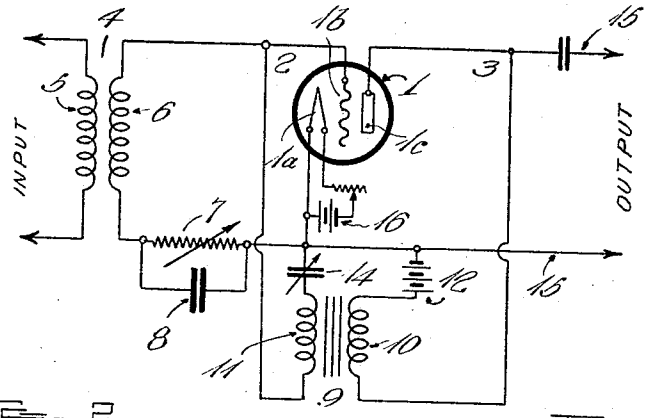


FIG. 2

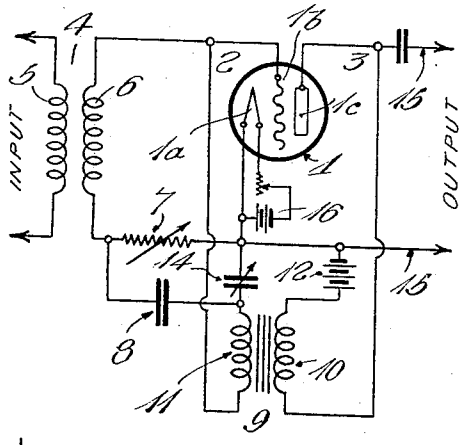


FIG. 3

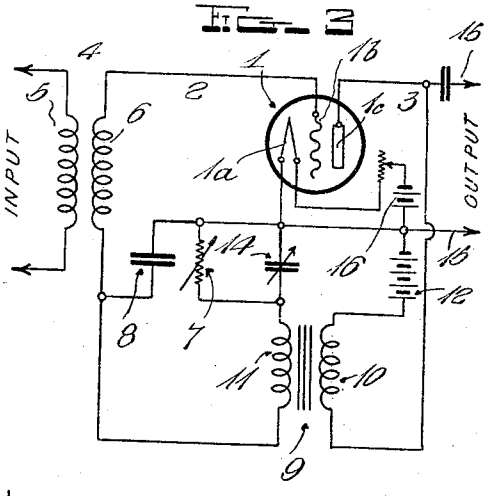


FIG. 4

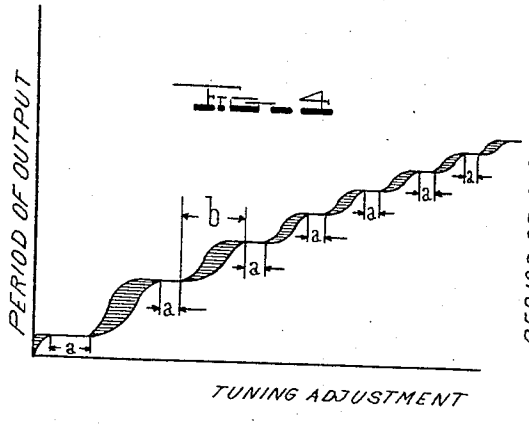
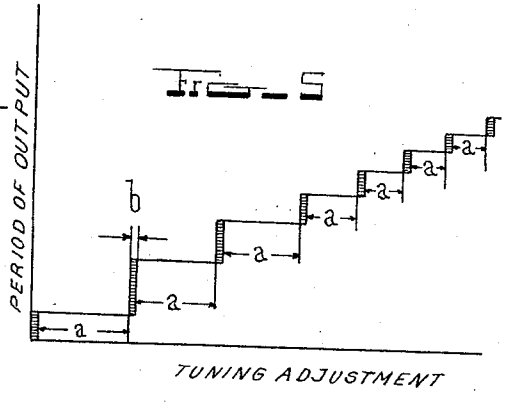


FIG. 5



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FREQUENCY DIVISION CIRCUIT

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My invention relates broadly to high frequency circuits and more particularly to a frequency division circuit.

One of the objects of my invention is to provide a stabilized arrangement of frequency division circuit whereby the frequency division circuit is accurately controlled in operation for deriving a submultiple frequency from a predetermined applied frequency.

Another object of my invention is to provide a circuit arrangement for a frequency division system wherein the operation of the system is stabilized by the association of a condenser with the frequency determining resistance.

Other and further objects of my invention reside in the circuit arrangement for a frequency division system as set forth more fully in the specification hereinafter following by reference to the accompanying drawing, wherein:

Figure 1 diagrammatically illustrates a frequency divider circuit embodying the principles of my invention; Fig. 2 illustrates a modified circuit arrangement constructed according to my invention; Fig. 3 illustrates a further modified form of circuit embodying the principles of my invention; Fig. 4 represents the characteristics of a frequency divider circuit without the arrangement of shunting capacity employed as part of the circuit of my invention; and Fig. 5 shows the characteristic of the circuit of my invention with the shunting capacity connected in the frequency divider circuit according to the principles of my invention.

Referring to the drawing in detail, reference character 1 designates a triode including a cathode 1*a*, a grid electrode 1*b* and a plate electrode 1*c*. The triode is provided with an input circuit 2 and an output circuit 3. The input circuit connects between the grid electrode 1*b* and the cathode 1*a*, and includes the secondary winding 6 of an input transformer 4, the primary winding 5 of which couples with the secondary winding 6 for impressing oscillating energy upon the frequency division system which is to be operated upon by the frequency division circuit. The input system is completed through the variable resistor 7 which is shunted by the capacity 8. I find that the inclusion of the capacity 8 in shunt with the variable resistor 7 operates to stabilize the frequency division circuit. The output circuit 3 of the frequency divider includes the primary winding 10 of an audio frequency transformer 9, the secondary winding 11 of which connects in series through the variable condenser 14 across the input circuit 2 of the electron tube 1 constituting the frequency divider system. The output circuit 3 of the frequency divider is completed through the high potential source 12 as shown. The cathode for the frequency divider tube 1 is heated from suitable source indicated at 16. The output circuit of the frequency divider connects to the terminals indicated at 15 through a suitable coupling condenser as illustrated. The resistance 7 is varied to select the particular division of frequency required for the operation of the frequency division circuit. The resistance is calibrated over a predetermined range in order to effect the desired change in frequency for the derivation of a desired submultiple frequency. That is for an applied frequency of predetermined value at the terminals of the transformer 4, a submultiple frequency is derived from the terminals 15 of the output circuit.

In Fig. 2 of the drawing I have shown a modified circuit arrangement for a frequency division system where the resistance 7 included in the input circuit of the frequency divider is shunted by the condenser 8 which connects across one end of resistance 7 and one end of secondary winding 11 of the transformer 9. Both the resistance 7 and condenser 14 are adjustable to set the frequency divider circuit under a particular condition of frequency division.

Fig. 3 illustrates a further modified form of frequency division circuit operating in accordance with the principles of my invention where resistance 7 is connected across the adjustable condenser 14 and the condenser 8 connected between a point in the input circuit and one end of resistance 7. The condenser 8 functions in the different arrange-

ments illustrated in parallel with the resistance 7.

The frequency characteristic of a frequency divider circuit constructed without the condenser 8 has been illustrated in Fig. 4. The uncontrolled periods of the frequency divider circuit are illustrated by the portions of the curve indicated at *b* while the controlled or stable periods of the frequency divider circuit are designated at *a*. It will be seen that the time of instability of the circuit without the condenser 8 in the system is relatively large. However with the condenser 8 arranged in the circuit a condition of high stability is obtained as has been illustrated in Fig. 5, where the uncontrolled periods are extremely short as designated by the character *b* as compared to the longer stable periods of oscillations designated *a*. It will therefore be seen that the triode frequency divider connected according to the circuit of my invention may be depended upon for stability of operation in which a submultiple frequency is continuously derived from the output terminals 15 of the frequency division apparatus for an impressed predetermined frequency on the primary winding 5 and input transformer 4.

While I have described my invention in certain of its preferred embodiments I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A frequency division circuit comprising an electron tube having cathode, grid, and plate electrodes, input and output circuits interconnecting said electrodes, said input circuit including a pair of branch circuits, one of said branch circuits including inductance and capacity and the other of said branch circuits including a resistance and a condenser connected in shunt thereto, electromagnetic means coupling one of said branch input circuits to said output circuit, means for impressing oscillations upon said input circuit, and connections to said output circuit for deriving currents of a submultiple frequency therefrom.

2. A frequency division system comprising an electron tube having cathode, grid, and plate electrodes, an input circuit extending between said grid and cathode, an output circuit connected between said plate and cathode, said input circuit including a pair of branches, one of said branches including a capacity and inductance and the other of said branches including a resistance and a capacity connected therewith, said branch including capacity and inductance and being coupled to said output circuit, means for impressing oscillations upon said input circuit, and means for deriving currents of a submultiple frequency from said output circuit.

3. A frequency division system including an electron tube having cathode, grid and plate electrodes, an input circuit extending between said grid and cathode, an output circuit extending between said plate and cathode, electromagnetic means coupling said input and output circuits, and means in said input circuit for controlling the operation of said circuits for frequency division comprising a variable resistance and a shunt connected capacity.

4. A frequency division system including an electron tube having cathode, grid and plate electrodes, an input circuit extending between said grid and cathode, an output circuit extending between said plate and cathode, electromagnetic means coupling said input and output circuits, and means in said input circuit for controlling the operation of said circuits for frequency division comprising a variable resistance and a capacity connected in circuit therewith.

5. A frequency division circuit including an electron tube having cathode, grid and plate electrodes, input and output circuits connected with said electrodes, a low frequency transformer electromagnetically coupling said input and output circuits, said transformer including a pair of windings with one of said windings connected in series in said output circuit and the other of said windings connected in series with said input circuit, a condenser disposed in series with said last mentioned winding, a resistance disposed in said input circuit and electrically connected with said condenser, and an auxiliary condenser connected with said resistance.

6. A frequency division circuit including an electron tube having cathode, grid and plate electrodes, input and output circuits connected with said electrodes, a low frequency transformer electromagnetically coupling said input and output circuits, said transformer including a pair of windings with one of said windings connected in series in said output circuit and the other of said windings connected in series with said input circuit, a condenser disposed in series with said last mentioned winding, a resistance disposed in said input circuit and electrically connected with said condenser, and an auxiliary condenser connected in shunt with said resistance.

7. A frequency division circuit including an electron tube having cathode, grid and plate electrodes, input and output circuits connected with said electrodes, a low frequency transformer electromagnetically coupling said input and output circuits, said transformer including a pair of windings with one of said windings connected in series in said output circuit and the other of said

windings connected in series with said input circuit, a condenser disposed in series with said last mentioned winding, a resistance disposed in said input circuit and electrically connected with said condenser, and an auxiliary condenser connected in circuit with said resistance in a series path through said first mentioned condenser.

8. A frequency division circuit comprising an electron tube having cathode, grid, and plate electrodes, an input circuit interconnecting said grid and cathode electrodes, an output circuit interconnecting said plate and cathode, an audio frequency transformer having electromagnetic windings, a source of potential, a circuit through one of said windings and said source of potential extending between said plate electrode and said cathode, a circuit between the other of said windings, said cathode, and said grid electrode, said last mentioned circuit including a condenser, a resistance connected in shunt with said condenser, and an auxiliary condenser extending between one end of said resistance and a point in said input circuit, means for impressing oscillations on said input circuit, and means for deriving a frequency which is a submultiple of the impressed frequency at the output circuit of said frequency divider.

9. A frequency division circuit comprising an electron tube having, cathode, grid, and plate electrodes, an output circuit interconnecting said plate and cathode, an audio frequency transformer having primary and secondary windings, a source of potential, said output circuit being completed through said primary winding and said source of potential between said plate and cathode, an input circuit, said input circuit being completed through a pair of parallel connected paths, one of said paths including said secondary winding and a condenser, and the other of said paths including a variable resistor, a condenser connected across one end of said variable resistor and connected to one end of said secondary winding, means for impressing high frequency oscillations of predetermined frequency upon one of said parallel paths, and means for deriving a submultiple frequency from the output circuit of said frequency divider system.

ROBERT M. PAGE.