

Nov. 21, 1939.

H. BÄHRING

2,180,659

MULTIPLE VOLTAGE DIVIDER

Filed March 3, 1938

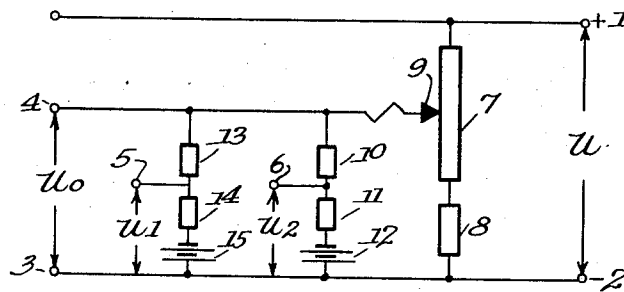


Fig. 1.

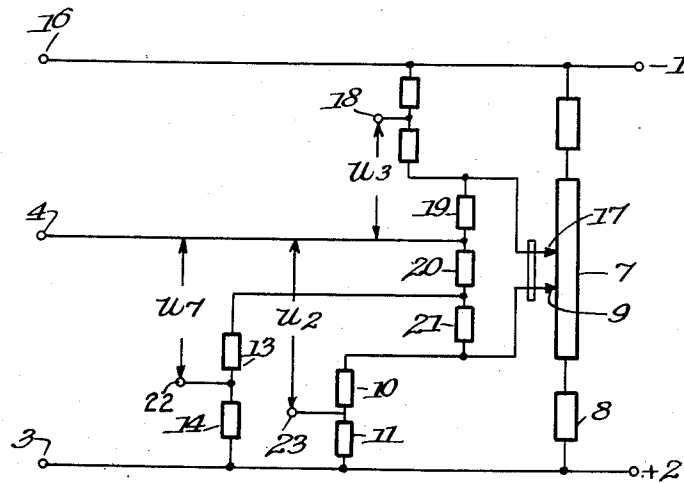


Fig. 2.

Herbert Bähring ^{Inventor}

By *Lippincott & Metcalf*

Attorneys

UNITED STATES PATENT OFFICE

2,180,659

MULTIPLE VOLTAGE DIVIDER

Herbert Bähring, Berlin-Zehlendorf-Mitte, Germany, assignor to the firm of Fernseh Aktiengesellschaft, Zehlendorf, near Berlin, Germany

Application March 3, 1938, Serial No. 193,801
In Germany March 3, 1937

3 Claims. (Cl. 171-229)

This invention relates to voltage dividers and particularly to multiple voltage dividers, by means of which a plurality of different voltages can be developed and altered in certain relations to one another.

In measuring and control apparatus in the high frequency transmitting and receiving art, as well as in broadcasting and television receivers, the problem is often encountered to vary two or more voltages in relation to each other through ranges of different magnitude and of different percentage of variation by operating one control alone, whereby the variation may be required to be linear, in the same sense, or in the opposite sense.

It is known in the art, to use, for this purpose, one or a plurality of potentiometers with the desired ranges, and to couple these with a main potentiometer so that all sliding contacts are moved simultaneously. In many cases, however, such an arrangement is undesirable because the arrangement of several potentiometers on one axis causes spatial difficulties, and also requires careful mechanical adjustment.

It is the object of the present invention to provide a purely electrical arrangement in which the adjustment of one potentiometer alone causes the variation of a plurality of voltages as may be desired, for example, in linear relation to each other, in the same sense or in the opposite sense. According to the invention, the voltage to be varied simultaneously with a main voltage is developed across a voltage divider and a constant voltage source, which are both connected in series relation between the sliding tap or voltage adjusting means of the main voltage divider and one terminal of the main voltage source. In order to vary simultaneously a plurality of voltages through ranges of different magnitudes and at different rates by the operation of one control element only, this invention provides certain rules, which will be set forth in the following, particularly in connection with Fig. 1 of the drawing.

Figure 1 is one modification of the apparatus which is the subject matter of this invention, while Figure 2 is a second modification of the invention.

Fig. 1 shows the principle of the circuit. Voltage U is applied at the points 1 and 2. The variable voltages U_0 , U_1 and U_2 are taken off at the points 3 and 4, 3 and 5 and 3 and 6, respectively. The main voltage divider consists of the resistances 7 and 8. Voltage U_0 is adjusted to a desired value by means of the sliding contact

9 on the resistance 7. The tap 9 is connected to a resistance 10 of the value R'_1 , and a resistance 11 of the value R'_2 , which together constitute a fixed voltage divider with a tap 6. The additional voltage 12, provided in accordance with the invention, may have the value U_{v2} . Correspondingly, resistance 13 and 14, with values R_1 and R_2 and a voltage source 15 of the value U_{v1} are provided for the generation of voltage U_1 .

If a change in the main voltage U_0 from the value U_{01} to U_{02} is to cause the voltage U_1 to change from the value U_{11} to U_{12} , the following two equations must be fulfilled:

$$(I) \quad U_{v1} = \frac{U_{01} \times U_{12} - U_{02} \times U_{11}}{U_{01} - U_{02} + U_{12} - U_{11}}$$

$$(II) \quad R_2 = \frac{(U_{12} - U_{11}) \times (R_1 + R_2)}{U_{02} - U_{01}}$$

whereby, for instance, the sum of $R_1 + R_2$ may be chosen as may seem suitable. The value for R_1 can then be computed from the equation

$$R_1 = (R_1 + R_2) - R_2.$$

If, for instance, the voltage between points 3 and 4 is to be varied between 370 and 600 volts, the voltage between points 3 and 5 varied between 3 and 20 volts, and the voltage between points 3 and 6 varied between 70 and 100 volts, it is necessary that $U_{v1} = -26.3$ volts in accordance with Equation I. Assuming a value of $R_1 + R_2 = 1$ megohm, Equation I yields $R_2 = 74,000$ ohms, and $R_1 = 926,000$ ohms. From Equations I and II the following values are derived: $U_{v2} = +25.0$ volts, $R'_2 = 130,000$ ohms and $R'_1 = 870,000$ ohms.

In Fig. 2 a circuit is shown in which the voltage between points 4 and 16 is varied in the opposite sense to the variation of the voltages between the points 3 and 4, 22 and 4, 23 and 4. The maximum bias voltage lies between sliding contacts 9 and 17, which are held at a constant distance from each other. A voltage divider 19, 20, 21 develops the required constant bias voltages for the individual voltage dividers. The voltage U_3 between points 4 and 18 varies in the same sense as the voltage between the points 4 and 16.

This method of multiple voltage control by means of one potentiometer alone is applicable, for instance, to scanning wave generators for television transmitting and receiving tubes for amplitude variation independent of frequency. The plate and grid voltages of the scanning wave generating discharge tube can be varied through

ranges of different magnitudes, as well as through ranges of different percentages of variation.

I claim:

1. A circuit for simultaneous variation of a plurality of voltages through ranges of different magnitude and of different percentage of variation by operation of one control element only, comprising a variable voltage-divider possessing a tap, means for producing a voltage drop between the tap and one terminal of said voltage-divider, means for applying said voltage to a work circuit, a series combination of a source of substantially constant voltage and a fixed voltage-divider possessing a tap, said series combination being shunted across said variable voltage-divider between the tap thereof and said terminal, and means for applying the voltage produced between the tap of said fixed voltage-divider and said terminal of said variable voltage-divider to another work circuit.

2. A circuit for the simultaneous variation of a plurality of voltages through ranges of different magnitude and at different rates by the operation of one control element only, comprising a potentiometer including voltage adjusting means, a source of substantially constant potential in series with another potentiometer having a plurality of sections of fixed value and a tap intermediate two of said sections, said source of potential and said potentiometer in series therewith being connected in shunt to a portion of said first mentioned potentiometer between said voltage adjusting means and another point at a different voltage value with respect thereto, and means enabling connection of work circuits between said adjustable voltage means and said

other point, and between said tap and said other point.

3. A circuit for the simultaneous variation of a plurality of voltages through ranges of different magnitude and at different rates by the operation of one control element only, comprising a potentiometer including voltage adjusting means, a source of substantially constant potential U_{v1} in series with a potentiometer of an overall arbitrary value having a pair of resistance sections R_1 and R_2 of fixed value and a tap intermediate said sections, said source of potential U_{v1} and said potentiometer in series therewith being connected in shunt to a portion of said first mentioned potentiometer between said voltage adjusting means and another point at a different voltage value with respect thereto, and means enabling connection of work circuits between said adjustable voltage means and said other point, and between said tap and said other point, the value of U_{v1} and R_2 in said circuit being equal respectively to

$$\frac{(U_{01} \times U_{12}) - (U_{02} \times U_{11})}{U_{01} - U_{02} + U_{12} - U_{11}} \quad 25$$

and

$$\frac{(U_{12} - U_{11}) \times (R_1 + R_2)}{U_{02} - U_{01}} \quad 30$$

where U_0 and U_{02} are desired changes in the potential across the adjustable potentiometer, U_{11} and U_{12} are the corresponding changes in potential desired across the resistor R_2 and said source of potential U_{v1} .

HERBERT BÄHRING. 35