Aug. 27, 1940. L. KÖRÖS 2,212,921

POTENTIAL DIVIDER

Filed May 14, 1936

Fig. 1

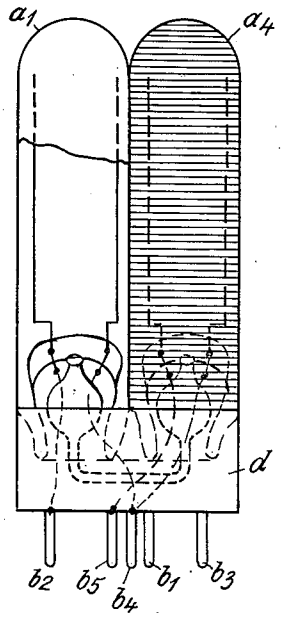


Fig. 2

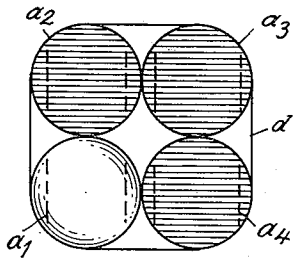


Fig. 3

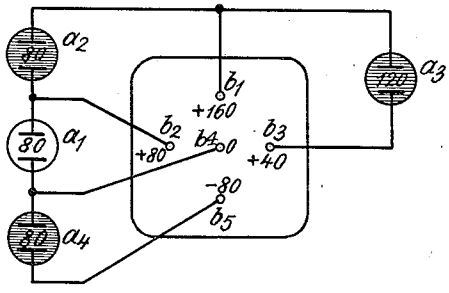


Fig. 4

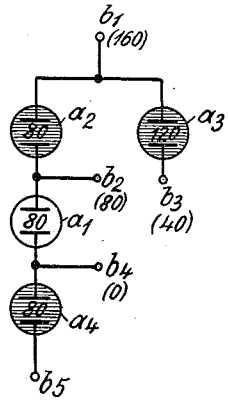


Fig. 5

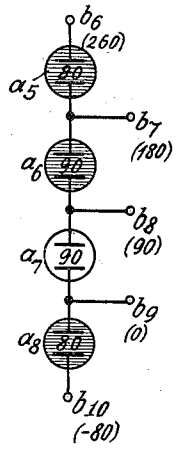


Fig. 6

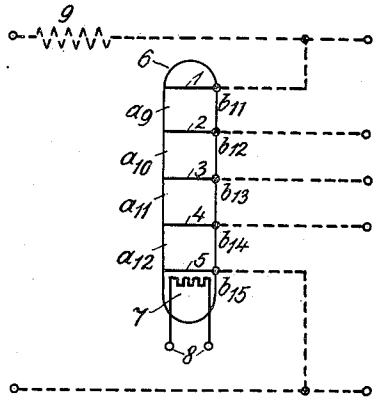
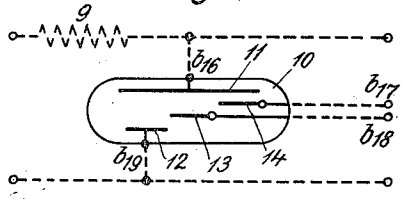


Fig. 7



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POTENTIAL DIVIDER

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Application May 14, 1936, Serial No. 79,722
In Germany June 6, 1928

6 Claims. (Cl. 250—27.5)

This invention relates to a new potential divider and the present application is a continuation in part of my application Ser. No. 667,154, which was issued as Patent No. 2,077,840, being a division of my application Ser. No. 365,324 which was issued as Patent No. 1,973,082 on September 11, 1934.

An object of the present invention is a potential divider which is capable of supplying constant potentials of predetermined values.

The potential dividers used heretofore employed ohmic resistances for the purpose of subdividing the potential of an electric current. The disadvantage of these potential dividers resides in the fact that the potential drop in ohmic resistances depends upon the intensity of the current traversing such resistances at any given moment. It is therefore self evident that the potential drop will thus vary in accordance with the fluctuations in the current intensity.

The present invention overcomes these disadvantages by substituting discharge gaps for the ohmic resistances used heretofore. Discharge gaps, within certain limits, are not affected by fluctuations in the current intensity. In other words, discharge gaps are resistances in which the potential drop remains constant between certain limits of the load. A good example of a discharge gap is found in the so-called "glow discharge tubes". These tubes consist of a pair of electrodes disposed in a container filled with a rarefied gas, such as neon.

The potential divider according to the present invention consists of a plurality of interconnected discharge gaps. These may be disposed either separately in individual containers or together in a common container. If each discharge gap is disposed in an individual container, it is preferable to mount two or more of such containers on a single base or socket and to establish communication between the individual tubes. If several tubes are thus assembled on a common socket considerable savings may be made in the manufacture of the tubes, because they can be jointly evacuated and filled with rarefied gas. This advantage is also present, of course, where all discharge gaps are disposed in a common container. In this event a considerable further saving is produced due to the fact that the same electrodes serve both as anodes and cathodes, as will be more fully explained hereafter. The operation of a potential divider in which all electrodes forming the discharge gaps are disposed in a common container is the same as that of a device where the discharge gaps are disposed in individual containers.

The potential divider according to the present invention is particularly well adapted for supplying the anode circuits of thermionic tubes from a direct current source with a comparatively high internal resistance, as for example a public current supply. An outstanding feature of the present invention resides in the fact that the new potential divider produces potentials without adverse effects upon the operation of thermionic tubes. Likewise, when a potential divider according to the present invention is connected with a thermionic tube, the latter will be supplied with a constant potential independent of the variations in the load. Moreover, it has been found that a considerable ohmic resistance in the anode circuits represents a high resistance for the modulations of the speaking currents, whereby the sensitiveness and amplifying action of the thermionic tubes are reduced. Therefore, in order to conduct the modulations, it has been necessary to connect a condenser in parallel to the ohmic resistance. However, such a condenser transmits the various frequencies in an unequal measure thereby causing distortions in the modulations. Where several anode circuits are connected in parallel, the use of an ohmic resistance disposed in series therewith forms a coupling resistance, whereby the amplifier tubes are easily put in oscillation.

The potential divider according to the present invention, on the other hand, presents an extremely small resistance to the modulations of the speaking currents whose value, moreover, remains independent of the current frequencies. Due to the high conductivity of the new potential divider for modulation currents, neither the above mentioned prejudicial effects on the sensitiveness and amplification of the thermionic tubes nor the adverse effects of the coupling resistance need be feared, and, due to its independence of the changes in current frequency, distortions of the modulation current are avoided. The potential divider of the present invention is therefore particularly adapted for use in circuits for thermionic tubes.

In the drawing,

Fig. 1 is a front elevational view of a potential divider according to the present invention;

Fig. 2 is a top plan view of the device shown in Fig. 1;

Fig. 3 shows diagrammatically the interconnection of the electrodes of the various glow discharge tubes forming the potential divider illustrated in Figs. 1 and 2;

Figs. 4 and 5 illustrate diagrammatically two

forms of a potential divider according to the invention;

Figs. 6 and 7 illustrate potential dividers in which all electrodes are enclosed in a common tube.

The potential divider shown in Fig. 1 consists of a base d on which four pairs of electrodes are mounted. These electrodes are disposed in spaced relation to each other to form the discharge gaps a_1, a_2, a_3 and a_4. The individual discharge gaps are insulated from one another by means of tubes or envelopes made of glass or any other suitable insulating material. The tubes are filled with rarefied gas, such as neon, and mounted together on the base d. The latter is made of insulating material and provided with a hollow inside space in order to establish communication between the tubes. The electrodes forming the discharge gaps a_1, a_2, a_3 and a_4 are connected together and to the contact pins or terminals b_1, b_2, b_3, b_4 and b_5 provided on the base d, as shown in Fig. 3.

In the form of construction illustrated in Fig. 3, each of the discharge gaps or tubes a_1, a_2 and a_4 produces a voltage drop of 80 volts, while discharge tube a_3 produces a voltage drop of 120 volts. The tubes a_2, a_1 and a_4 are disposed in series with respect to one another and connected to the terminals b_1, b_2, b_4 and b_5, respectively, which are provided on the base d. Tube a_3 is connected in such way that its cathode is in connection with the terminal b_3, while the anode is connected with the anode of tube a_2 and the terminal b_1. Electric current is introduced at the terminal b_1. Thus, if e. g. a current of 160 volts is admitted the following voltages may be taken off at the various terminals: +80 volts may be tapped at terminal b_2, the initial potential of +160 volts having been reduced by tube a_2 to +80 volts; the remaining +80 volts are reduced by tube a_1 for another 80 volts, so that terminal b_4 has a zero potential, while terminal b_5 offers a constant negative potential of −80 volts; tube a_3, on the other hand, reduces the initial current potential to +40 volts which may be taken off at the terminal b_3.

The operation of the potential divider according to the present invention is simple and no special instruments or measuring devices are required for adapting the same to different current sources. An ordinary rheostat should be inserted in the feed line and adjusted till the tube a_1 comes to a glow. As soon as this occurs, the potential divider is in proper working order and the potentials indicated in Fig. 3 opposite the terminals b_1, b_2, b_3, b_4 and b_5 may be taken off. In order that tube a_1 may be readily observed, the remaining tubes are preferably provided with an opaque coating while tube a_1 is made transparent as indicated in the drawing by shading.

Instead of assembling the tubes a_1, a_2, a_3 and a_4 on a common base as shown in Figs. 1 to 3, the potential divider may likewise consist of separate tubes with their electrodes connected together in any manner desired. Thus e. g. in Fig. 4 the tubes are interconnected in exactly the same fashion as in the construction shown in Figs. 1 to 3.

In Fig. 5, on the other hand, the tubes of the potential divider are connected in series. The first and last tube, a_5 and a_8, produce a potential drop of 80 volts each, while the two intermediate tubes a_6 and a_7 cause a potential drop of 90 volts each. If e. g. a current of +260 volts is introduced at the terminal b_6, a potential of +180 volts may be taken off at the terminal b_7. A potential of +90 volts may be taken off at terminal b_8 and a zero potential prevails at terminal b_9, while a potential of −80 volts may be tapped at the terminal b_{10}. With the exception of tube a_7, all the tubes are preferably provided with an opaque coating for the reasons stated above. It will be clear, of course, that two or more of the tubes shown in Fig. 5 may be mounted together on a common base as in the construction illustrated in Figs. 1 to 3. In such event, the base should be so constructed as to provide communication between the gas spaces of the individual tubes.

Fig. 6 shows a potential divider comprising a common envelope or tube **6** containing five electrodes **1**, **2**, **3**, **4** and **5** forming discharge gaps a_9, a_{10}, a_{11} and a_{12}. The electrodes **1**, **2**, **3**, **4** and **5** are provided with terminals b_{11}, b_{12}, b_{13}, b_{14} and b_{15}, respectively from which different potentials may be taken off. The operation of this potential divider is as follows: When electric current is supplied from a current source (not shown), the current will enter the tube **6** at b_{10}, and discharge will first take place from electrode **1** to electrode **2**, and then a separate discharge will take place from electrode **2** to electrode **3**, whereupon a separate discharge will take place from electrode **3** to electrode **4** and so on. The discharge gaps a_9, a_{10}, a_{11} and a_{12} thus represent separate, discrete and independent discharge gaps which operate exactly like the discharge gaps a_1, a_2, a_3 and a_4 for inst., shown in Figs. 1 to 3. It will be obvious that in order to achieve stable and reliable service, the electrodes **1**, **2**, **3**, **4** and **5**, forming the discharge gaps of the construction of Fig. 6, should be so constructed and arranged that no leakage between them will occur. It will be clear to all persons skilled in the art that most efficient service will be obtained if the full discharge from the entire surface of one electrode is received by the entire surface of the next following oppositely disposed electrode. The electrodes **1**, **2**, **3**, **4** and **5** of Fig. 6 have been shown merely diagrammatically and it will be understood that the same may be given any desired shape as long as the principle of the present invention is observed, to wit, that the electrodes arranged in a common container shall form discrete discharge gaps which will operate in exactly the same manner as if each pair of electrodes were disposed in a separate tube or container.

It should be noted particularly that in a construction where all electrodes are disposed in a common container, the individual electrodes perform a double function. For eample, in the potential divider of Fig. 6, when the current is turned on, discharge will take place from electrode **1**, acting as anode, to the top surface of electrode **2** serving as cathode; thereafter, discharge will take place from the bottom surface of electrode **2**, acting as anode, to the top of electrode **3** serving as cathode and so on. In other words, the intermediate electrodes **2**, **3** and **4** act both as anodes and cathodes. This fact that a smaller number of electrodes is required simplifies the construction and produces a considerable saving in the manufacture of this potential divider. In the tube shown in Fig. 6 a heating device **7** is disposed adjacent the most negative electrode **5**. Terminals **8** serve for connecting the heater **7** to a source of electric current. It will be clear, however, to those skilled in the art that any other method of heating the electrodes

may be used. One or more electrodes may thus be heated, whereby, due to the heat applied, a reduction in the cathode fall will result, i. e. the potential drop between the electrodes will be decreased. The potential drop may thus be regulated by varying the amount of heat supplied to the electrodes. Moreover, a discharge tube with heated electrodes requires smaller dimensions for a given load than a tube without heated electrodes. The tube or envelope **6** of the potential divider shown in Fig. 6 is filled with a rarefied gas such as neon. A resistance **9** should be inserted in the feed line in front of the potential divider whenever a current of small internal resistance is used.

The potential divider shown in Fig. 7 comprises a common envelope **10** which contains a large electrode **11** and three smaller electrodes **12**, **13** and **14** disposed at varying distances from the electrode **11**. The latter extends over and embraces the smaller electrodes **12**, **13** and **14**. Electrode **11** offers the same polarity to and cooperates with each of the smaller electrodes **12**, **13** and **14**. Due to this arrangement of the electrodes in the container **10**, a distinct and separate discharge gap is formed between each one of the smaller electrodes and the large electrode **11**. Different potentials may be taken off at the terminals b_{16}, b_{17}, b_{18} and b_{19}. Current is admitted through terminal b_{16}. The various discharge gaps set up between the smaller electrodes and the large electrode **11** are distinct and separate from one another and operate in exactly the same way as if each discharge gap were enclosed in a separate container as for inst. shown in Fig. 3 of the drawing. The electrodes used in connection with the present invention may e. g. be solid, imperforate metal plates or cup-shaped structures which are nested one within the other. However, it should be noted that no particular shape is required and that electrodes of any other desired shape may equally well be used.

I claim:

1. A glow discharge device for dividing the potential of electric current supplied from a continuously operating current source, which comprises a base, a plurality of containers disposed on said base, a glow discharge device disposed in each container, each glow discharge device comprising a pair of electrodes spaced apart to form a glow discharge gap, each container being filled with a rarefied gas such as neon, and conducting means interconnecting the said glow discharge gaps in series, whereby, during operation of the device, continuous, constant potentials of predetermined reduced values may be tapped at said discharge gaps.

2. The device claimed in claim 1, in which said containers intercommunicate with one another.

3. The device claimed in claim 1, in which said containers intercommunicate with one another, a current inlet means and a current outlet means being connected to electrodes of separate gaps, the remaining electrodes being provided with tapping means said containers surrounding completely the said individual glow discharge gaps, intercommunication between the said containers being established in said supporting base at points removed from and entirely out of the range of the said discharge gaps, to prevent interference therebetween; the said current inlet, current outlet and tapping means being attached to said base, whereby the device may be operated from a single plug-in socket.

4. A potential divider for electric current, which comprises a base, a plurality of containers disposed on said base, a pair of electrodes disposed in each container and spaced apart to form a glow discharge gap, said containers being filled with a rarefied gas and intercommunicate with one another, and conducting means interconnecting the electrodes of different discharge gaps, said gaps being connected in series, a current inlet means and a current outlet means being connected to electrodes of separate gaps, the remaining electrodes being provided with tapping means; all of said containers except one being light impervious.

5. A potential divider for electric current, which comprises a base, a plurality of containers disposed on said base, said containers being filled with a rarefied gas such as neon, a pair of electrodes disposed in each container and spaced apart to form a glow discharge gap, and conducting means interconnecting the electrodes of different discharge gaps, a current inlet means and a current outlet means being connected to electrodes of separate gaps, the remaining electrodes being provided with tapping means, all of said containers except one being light impervious.

6. The glow discharge device claimed in claim 1, comprising a container, a glow discharge device disposed therein, said glow discharge device comprising a pair of electrodes spaced apart to form a glow discharge gap, and conducting means connecting the latter gap in parallel with the said series interconnected gaps.

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