March 6, 1956 N. FELICI 2,737,625

DEVICE FOR SUPPLYING STEPPED D. C. VOLTAGES

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Fig. 1

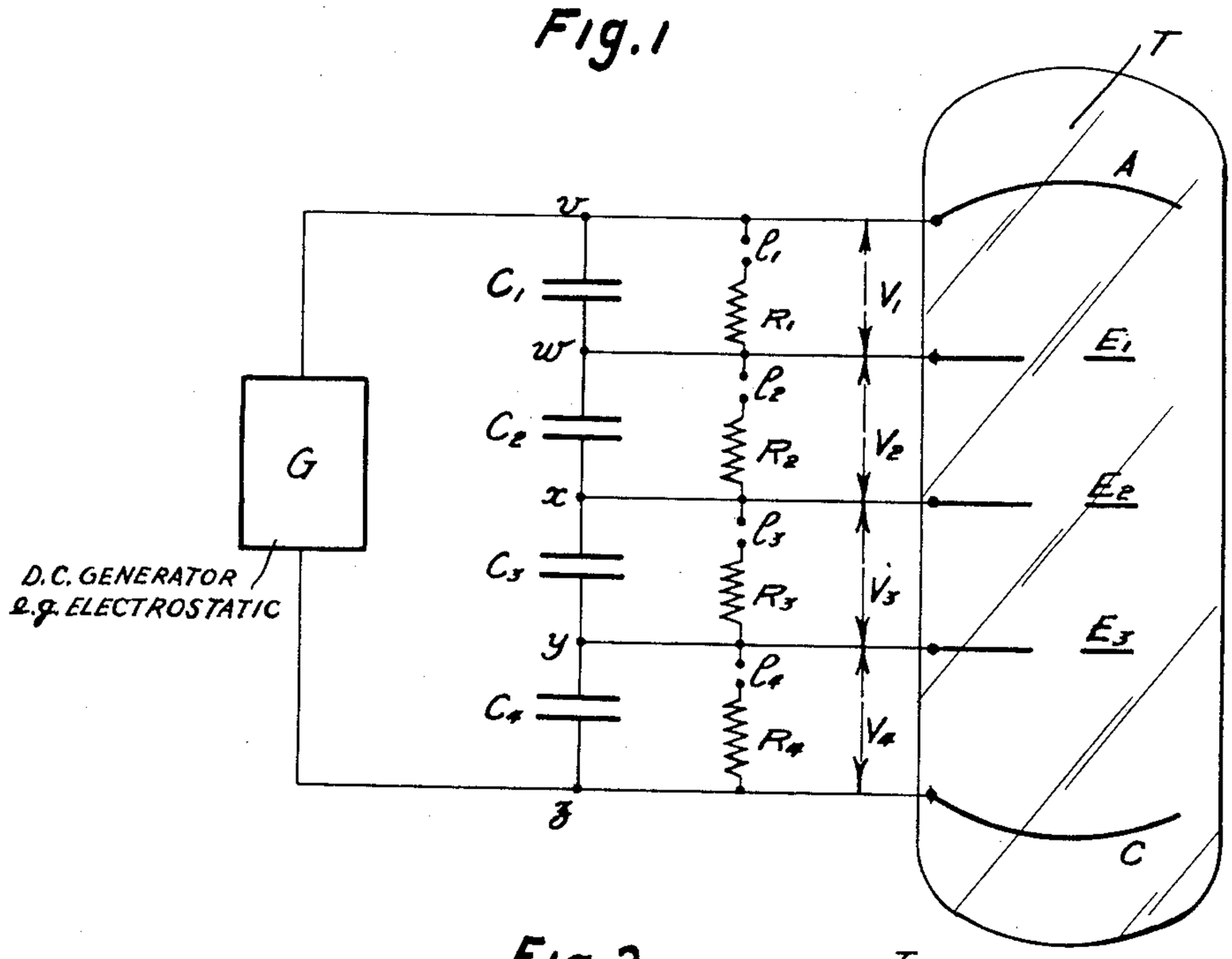
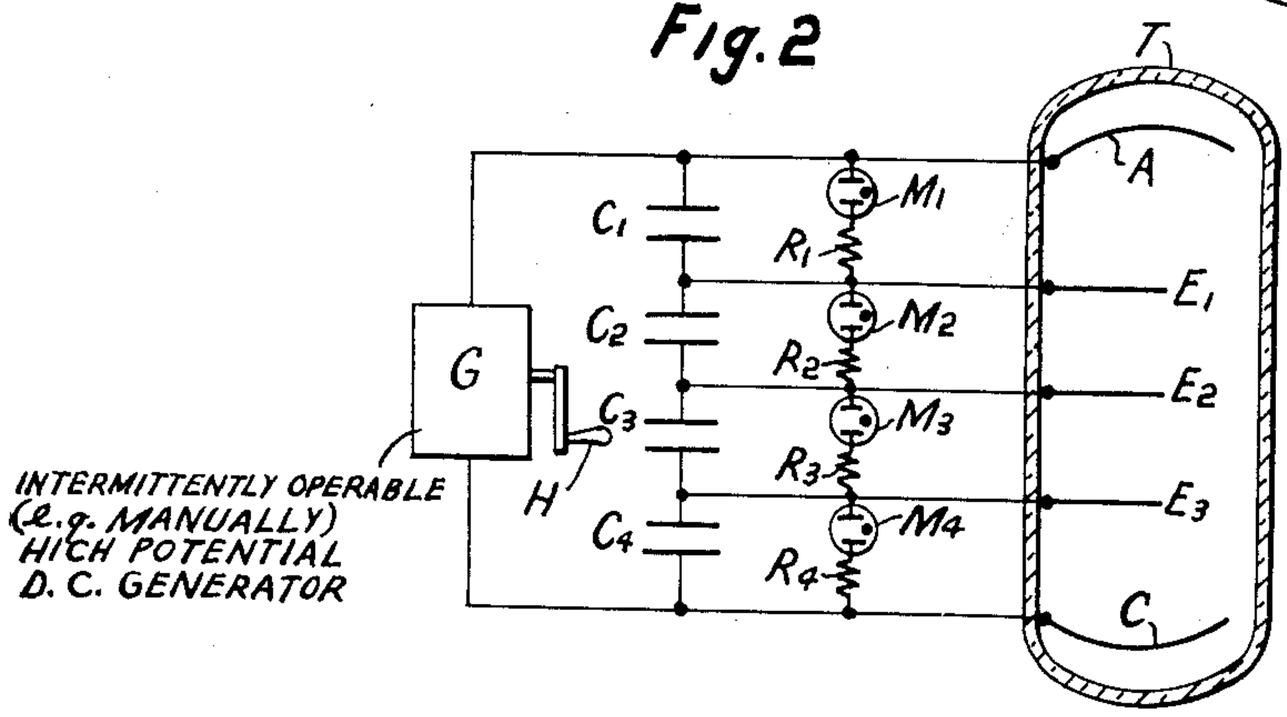


Fig. 2



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DEVICE FOR SUPPLYING STEPPED D. C. VOLTAGES

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8 Claims. (Cl. 323—79)

The present invention concerns apparatus for providing a plurality of voltages of predetermined stepped values, and in given ratios with respect to one another.

Such stepped voltages are used in particular for feeding certain electron tubes provided with several electrodes.

Voltage supply systems are known constituted by an association of resistors and of discharge tubes of the ionized gas type. The operation of such systems is satisfactory but the drawback occurs of an absorption of energy which in some cases may be considerable as compared with the useful energy. This is the case, for example, with certain photo-electric tubes provided with several electrodes each of which only draws a very low current. Feeding such tubes by means known heretofore would thus lead to an excessively large voltage supply.

The present invention removes this difficulty by the provision of a group of condensers associated in series, acting as storing devices and capable of being discharged and charged again at intervals. Such a supply is suitable for feeding tubes which are intended to operate satisfactorily within two predetermined voltage values, provided the ratios between the voltages applied to the various electrodes are kept constant. This is a prerequisite for certain types of electron tubes.

In order to point out more clearly the technical characteristics and adavantages of the invention, an application of it now will be described which concerns the feeding of a photo-electric tube adapted to transform low visible or invisible light into light to which the eye is responsive. Such a photo-electric tube is often referred to as an electronic telescope.

For a clearer and more complete understanding of my invention, reference should be made to the accompanying drawing, in which: Fig. 1 is an electrical circuit diagram embodying the invention in one form, while Fig. 2 is an electrical circuit diagram embodying the invention in a second form.

The electronic telescope T, shown in Fig. 1 of the appended drawing comprises a photo-cathode C and an anode A, between which three electrodes E_1, E_2, E_3 are arranged, for accelerating and focussing the electrons transmitted by the cathode. A voltage generator G, an electrostatic machine, for instance, is connected to the points v, z, of a chain of condensers c_1, c_2, c_3, c_4 connected in series. The anode is connected to the point v, the electrode E_1 to the point w common to c_1 and c_2, the electrode E_2 to the point x common to c_2 and c_3, the electrode E_3 to the point y common to c_3 and c_4 and finally the cathode is connected to the point z. A voltage limiting device l_1, l_2, l_3, l_4 is arranged in parallel with each condenser. The resistance of said voltage limiting device becomes reduced from an extremely high value to a relatively low value corresponding to the difference of potential across the terminals of the limiting device at which discharge between these terminals takes place. This is realized with certain electric discharge devices: fixed spark gaps, ionized gas tubes, etc. Some semi-conducting elements may also offer this property. To limit the value of the current in

such a way that it pracically does not interfere with the charge of the condenser, resistors R_1, R_2, R_3, R_4 are arranged in series with the respective limiting devices. Such an arrangement, which is an important feature of the invention, makes it possible to maintain the voltage across the terminals of each condenser, after each charging period of time, at the required value however great has been the previous discharge. In other words, the limiting devices make it possible to calibrate the voltages each time a charge is resumed. Let V_1, V_2, V_3, V_4 designate the respective charging voltages of the condensers c_1, c_2, c_3, c_4 corresponding to discharge of the respective limiting devices l_1, l_2, l_3, l_4. The values of capacity of the condensers are selected in such a manner that the following equation is satisfied:

$$c_1V_1=c_2V_2=c_3V_3=c_4V_4$$

In accordance with this equation the capacities of the several condensers are inversely proportional to the respective potential differences across the terminals of the respective condensers.

When the group of condensers has been charged again after a discharge, the output of the generator G may be interrupted, if the capacity of the condensers is great enough to feed, during a certain period of time, the electrodes of the tube. The voltages applied to these electrodes decrease gradually but the ratios between these voltages are substantially maintained during the period of time during which this decrease occurs. The brilliancy of the image in the telescope decreases down to a value considered as acceptable but the focussing is maintained and the sharpness is not affected.

An equipment of this type is very valuable, for instance, in the case of portable apparatus for which the high voltage can only be supplied through a hand operated machine but which requires complete freedom of the hands during the observation period of time. Such apparatus operable by handle H is diagrammatically shown in Fig. 2 in which also, by way of modification, the voltage limiting devices are represented as ionized gas tubes, specifically glow discharge tubes, M_1, M_2, M_3, M_4. With an apparatus utilizing the means of the present invention, the charging of the group of condensers will merely be performed previous to the utilization period.

It should be understood that the examples above described are in no way limitative and that other embodiments for putting into practice the present invention may be foreseen without departing from the scope of the present invention.

What I claim is:

1. In apparatus for supplying an electrical load device having a plurality of terminals to which respectively a plurality of direct current potentials that are progressively in stepped relation to each other are to be supplied, the combination with said device, of a source of direct current potential difference between two terminals, a plurality of condensers connected in series with each other across said terminals of said source, means connecting the respective terminals of said source to the terminals of said load device to which respectively the highest and lowest potentials are to be supplied, the successive common terminals of said condensers intermediate between adjacent condensers being connected respectively to the other terminals of said load device that are to be supplied with progressively different intermediate potentials, and a resistor and a potential difference limiting means associated with each condenser and connected in series with each other as a set, said sets respectively being connected across the terminals of said condensers for limiting the potential differences between the successive terminals of said load device, said sets being connected in series with each other across said terminals of said source with the respective

terminals of adjacent sets that are common connected to the respective common terminals of said condensers.

2. In apparatus for supplying a load device the combination as defined in claim 1 in which the respective capacities of said condensers are in inverse proportion to the respective potential differences to be supplied between the terminals of said load device to which the respective condenser terminals are connected.

3. In apparatus for supplying a load device the combination as defined in claim 1 which comprises means providing said source of direct current potential difference and operable for intermittently charging said condensers.

4. In apparatus for supplying a load device the combination as defined in claim 3 in which said means providing said source of direct current potential difference is manually operable.

5. In apparatus for supplying a load device the combination as defined in claim 1 in which at least one of said potential difference limiting means is provided by a nonlinear conductivity member connected in series with said resistor across the terminals of the corresponding condenser.

6. In apparatus for supplying a load device the combination as defined in claim 1 in which at least one of said potential difference limiting means is provided by an electric discharge device connected in series with said resistor across the terminals of the corresponding condenser.

7. In apparatus for supplying a load device the combination as defined in claim 6 in which said electric discharge device is provided by a spark gap.

8. In apparatus for supplying a load device the combination as defined in claim 6 in which said electric discharge device is provided by an ionization tube.

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