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APPARATUS FOR PRODUCING AN ELECTRICAL MAGNITUDE TO BE MEASURED OR CONTROLLED

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Fig. 1

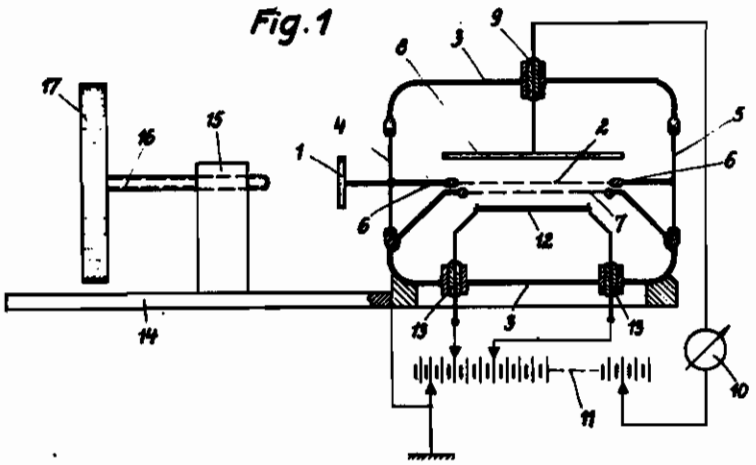
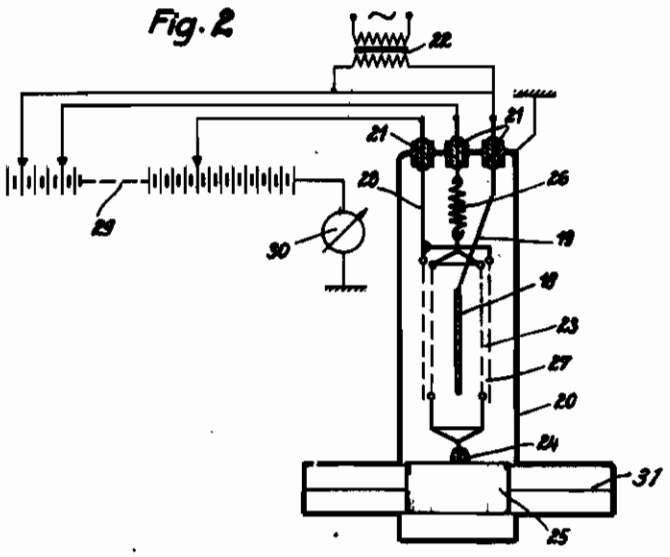


Fig. 2



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APPARATUS FOR PRODUCING AN ELECTRICAL MAGNITUDE TO BE MEASURED OR CONTROLLED

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This invention relates to an apparatus for producing an electrical magnitude to be measured or controlled, such as, for instance, a voltage or a current in accordance with small mechanical displacements, the latter being transmitted to an electrode, for instance, to the grid of an electronic tube. To this end, any electrode of the tube may be employed, for instance, the cathode, the grid or the anode. In this manner the change of the anode current caused by the change in position may directly or indirectly operate a measuring instrument, relay or other measuring apparatus.

A possibility of bringing about relatively great changes in the anode current with the aid of small displacements consists according to the invention in movably arranging a grid of an electronic tube with respect to a second grid in parallel relation to the plane in which the grid lies, i. e., the displacement is effected perpendicularly to the direction of the electron current. The displacements in the direction of the plane in which the grid lies are very advantageous, since the voltage amplification factor of the anode is considerably varied owing to this shearing movement. The grids may be impressed with a different potential, for instance, a control grid and a space charge grid may be employed; however, the grids may also be directly connected to one another.

Further details of the invention will be apparent from the following description taken in connection with the accompanying drawings, in which are shown two forms of the invention.

Fig. 1 shows a measuring apparatus in which the displacement of a plate is to be determined, and

Fig. 2 a measuring apparatus in which the displacement to be measured is directly produced in the electronic tube itself.

Referring to Fig. 1, 1 denotes plate directly connected to the grid 2 of an electronic tube 3 made of metal. The tube 3 is provided with two resilient and gas-tight metal diaphragms 4 and 5 which establish a connection of the plate 1 with the grid 2 while permitting at the same time this grid to be displaced. In this case the grid 2 constitutes the central portion of a rigid frame 6 secured between the diaphragms 4 and 5. By arranging this frame between the diaphragms the apparatus is released of the outer air pressure so that changes in the air pressure do not influence the movement of the control grid 2.

The grid 2 is arranged close to the stationary grid 7 of the electron tube in such a manner that upon the mutual movement of the grids 2 and 7 the voltage amplification factor of the anode 8 may be varied between 10 and 100%. The anode 8 is secured to the casing 3 of the electronic tube with the aid of an insulating member 9 and is connected through a testing instrument 10 to the positive pole of a battery 11, which at the same time supplies the heating voltage to the electron emitting source 12. This is secured to the casing 3 of the electronic tube by means of insulating members 13. The entire electronic tube is connected to ground so that the grids are also impressed with the same voltage, i. e., earth potential.

The testing apparatus is secured to a base plate 14 which carries in the upright 15 a screw spindle 18 whose displacement may be measured with the aid of a drum 17. The apparatus may, for instance, be employed for measuring the thickness of a body in which any bodies may be inserted between the measuring spindle 18 and the plate 1. When reducing the distance between the spindle and plate a contact is brought about at a given moment which causes a displacement of the plate 1 and therefore of the grid 2 with respect to the grid 7. During this displacement the voltage amplification factor of the electron tube varies so that the anode current indicated by the testing instrument 10 varies also. In this manner it is possible to accurately ascertain the moment at which the contact takes place. On the other hand, the instrument may also be employed to determine, for instance, changes in the thickness of the body to be tested which manifest themselves in a displacement of the control grid 2. In the case of a suitable calibration of the apparatus the change in the anode current is directly a measure for the displacement of the plate 1. Care should be taken to attain with the aid of the adjustable battery terminals and of the voltages varied thereby, a suitable position and shape of the characteristic of the electron tube which is adapted as to the sensitiveness and the initial position to the measurements to be carried out.

While in the just described arrangement the movement of the elements displaceable with respect to one another must be introduced into the electronic tube, for which purpose any known movable construction is suitable, the arrangement may also be so designed that the displacements to be measured are directly obtained in the electronic tube or that the latter at least represents the reference element of the displacement to be determined.

Such an arrangement is shown in Fig. 2, in

which 18 denotes an electron-emitting source secured in the metallic tube 20 to a holder 19 with the aid of an insulator 21. The heating filament of the electron-emitting source is supplied with energy produced by the transformer 22. The electron-emitting source 18 surrounds a displaceably mounted grid 23 secured at the one end to a mass 25 through an insulating member 24, the mass being guided in the tube 20, for instance, by a diaphragm 31. At the other end, the grid 23 is secured to a spring 26 which is also supported by the tube 20 through an insulating member 21. The forces of the spring and the mass 25 are so balanced that the grid 23 is maintained in its central position.

The grid 23 is surrounded by another grid 27 which is so designed that the free cross-section for the electrons emitting from the cathode 18 is varied upon the longitudinal displacement of the grid 23.

The grid 27 is also firmly secured to the casing 20 of the tube through the holder 28 and the insulating member 21. The cathode 18, the grids 23 and 27 as well as the tube 20 constitute the electrodes of an electron tube if the space within the tube 20 is completely exhausted. The testing instrument 30 by means of which changes in the anode current may be determined is inserted in the anode circuit which is energized by the battery 29.

The above-described instrument is, for instance, adapted to measure deflections or accelerations of the tube 20 depending upon whether the natural frequency of the oscillatory system formed of the spring 26 and of the mass 25 is higher or lower than the frequency impressed on the tube 20. The mutual displacement of the two grids corresponds directly to the deflections or accelerations of the tube 20 which may be indicated in the testing instrument 30 by varying the anode current. Instead of this instrument also other testing devices may be employed, such as, for instance, relays.

It is also possible to design the grid 23 itself in the form of a mass. Such a grid is particularly advantageous, since the entire construction of the testing apparatus is simplified by the direct combination of the electrodes with the displaceable elements.

Also a layer from which the electrons are released with the aid of the photo-electric effect may be employed as an electron-emitting source in an apparatus according to the invention. Such arrangements are usual in electron multipliers in which an amplification takes place by utilizing the secondary emission. In this case the grid which is so arranged as to carry out a shearing movement and which is controlled by the measurements may be employed to control the secondary stream of electrons, whereby a very high power amplification ratio may be employed in the tube.

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