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K. SCHERER ET AL

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CRYSTAL CONTROLLED TUBE GENERATOR

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Fig. 1

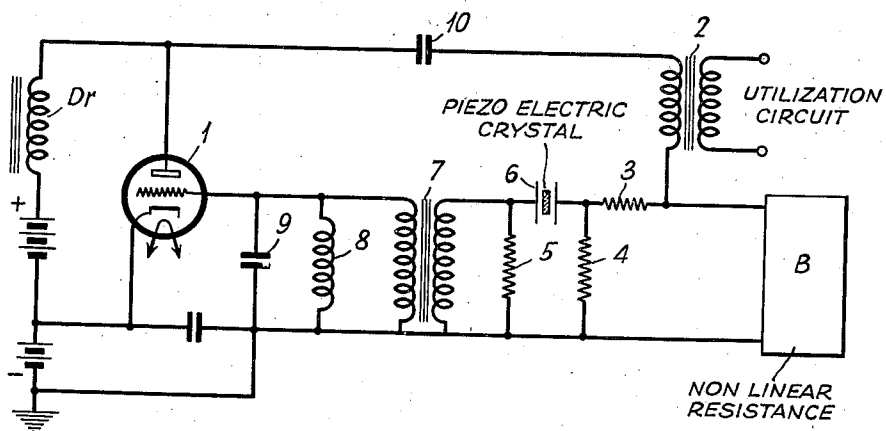
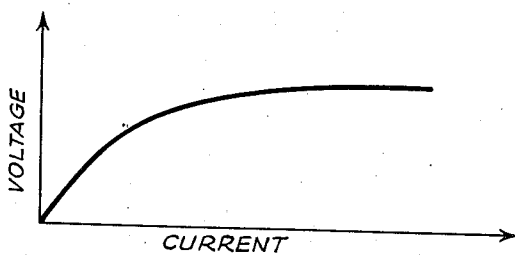


Fig. 2



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CRYSTAL CONTROLLED TUBE GENERATOR

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2 Claims. (Cl. 250—36)

When employing crystal controlled generators it is of advantage to an increase of the selectivity of the quartz crystal if the resistance in the circuit in which the crystal is inserted, is maintained as low as possible. Now, if the circuit containing the crystal operates across a transformer upon the grid circuit of the tube, and if the oscillation can develop itself up to the full control of the tube, a comparatively high voltage appears in the grid circuit. The required value of the potential at the grid is suitably attained by a large transformation ratio of the transformer. On the other hand, there is a limit as regards the transformation ratio of the transformer, especially when operating with high frequencies, so that comparatively high voltages are also required at the primary side whereby a comparatively large current flows in the low-ohmic crystal circuit, which current may easily assume such a high value that there is danger of breaking the crystal. Since the crystal withstands a certain maximum current only and breaks when this current is surpassed, there exists a limit value for the potential which is produced at the primary side of the transformer.

In accordance with the invention, the danger to the crystal is avoided in that the produced oscillations are maintained by means of a delimiting circuit, substantially below the value which corresponds to the full control of the tube.

Delimiting arrangements are already known in connection with generators such as, for instance, generator circuits in which aside from producing an oscillation, the tube has to fulfil a further function such as, for instance, that of an amplifier or generator of another frequency. In such generators care must be taken to prevent the oscillation from developing up to the limit point of the amplitude established by the bend of the tube characteristic, since otherwise the tube could no longer exert any further function. Tube generators have also been suggested in which the amplitude limiting means are placed in the feed-back path, but in these generators the purpose of employing limiting means was to obtain a lower noise factor so as to obtain an alternating current relatively free from harmonics and suited, for instance, for measurements.

In contrast to such arrangements the present invention relates to the use of limiting means in crystal controlled generators to the end of protecting the crystal against excessive loads. The delimiting can be carried out by measures that

are known as such. For instance, as limiting devices, non-linear resistors may be provided whereby a limiting of the voltage may be brought about, the same as when used as detectors or hot conductors. But a limitation of the current may also be obtained through resistors in which the resistance increases when the amperage increases. Iron resistors may be used in this manner. Furthermore, devices which limit the voltage may be combined with those which limit the current.

The invention will be explained in greater detail by reference to the accompanying drawing in which,

Figure 1 is a circuit diagram illustrating a preferred embodiment of the invention, and

Fig. 2 is a graphic plot of the limiting action to be obtained by the use of certain means constituting a part of the invention.

Referring to Fig. 1, the output circuit of the tube 1 contains the coupling capacitor 10, the primary of the output transformer 2 and the resistors 3 and 4 in series with each other. Resistors 4 and 5 are both of low ohmic value and between them the crystal 6 is placed. This may be a quartz crystal, for instance, whereby in maintaining a low resistance in this circuit a high selectivity is to be attained. The oscillatory circuit containing the crystal operates across a transformer 7 having a high transformation ratio. The secondary of this transformer constitutes part of the grid circuit of the tube, which circuit is tunable by means of the inductance 8 and condenser 9. The voltage necessary for controlling the tube is developed at the secondary winding of the transformer 7. This transformer should have a high transformation ratio in addition to a comparatively high voltage across the primary. But since this primary is in a low-ohmic circuit, including the crystal, the current carried by the crystal may readily become destructive. Hence, a limiting means B is preferably placed in shunt with the resistors 3 and 4. This limiting means B is preferably constituted by a non-linear resistor whose characteristic is shown in Fig. 2. It prevents an increase of its terminal voltage beyond a certain value and hence a limited voltage also appears across the resistor 4 so that the current passing through the crystal 6 cannot assume a destructively high value. In place of the non-linear resistor B, a rectifier, hot conductor, or other known non-linear conductor may be employed.

We claim:

1. An oscillation generator comprising an electron tube having input and output elements, an input circuit comprising a resonant circuit connected between said input elements, an output circuit comprising a load impedance, a piezo-electric crystal, and a coupling means in series, connected between said output elements, means for coupling said resonant circuit and said coupling means, a resistor connected in shunt with said first mentioned coupling means and said crystal, a non-linear resistor, and means for connecting said non-linear resistor across said first mentioned resistor.
2. In an oscillation generator, an electron discharge device having a cathode, an anode and a grid, a resonant input circuit interconnecting the cathode and grid and including a capacitor in shunt with a secondary winding of a transformer, a primary winding of said transformer

connected in a feed-back circuit which is capacitively coupled to said anode, said feed-back circuit having a piezo-electric device in series with said primary winding, a resistor shunting said primary winding alone, a second resistor shunting the series circuit of said primary winding and said piezo-electric device, a third resistor and the primary of an output transformer series connected in said feed-back circuit, the three said resistors constituting means for maintaining a normal flow of feed-back energy less than that which traverses said output transformer primary, and means including a non-linear resistor in shunt with other portions of said feed-back circuit including particularly said piezo-electric device, for protecting said device from excessive excitation.

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