

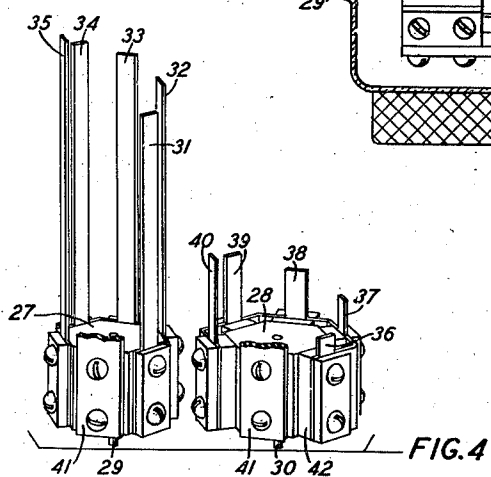
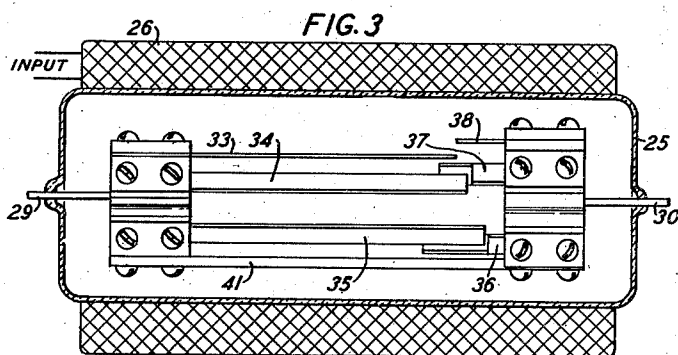
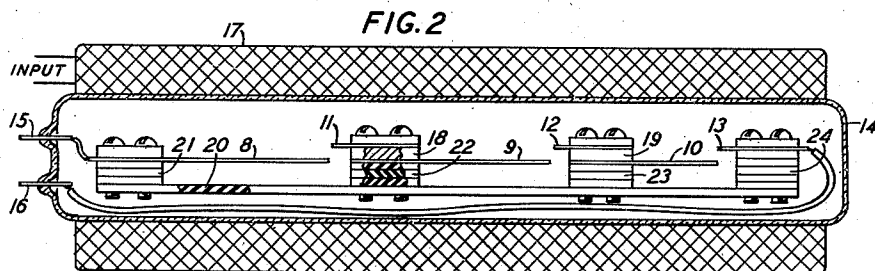
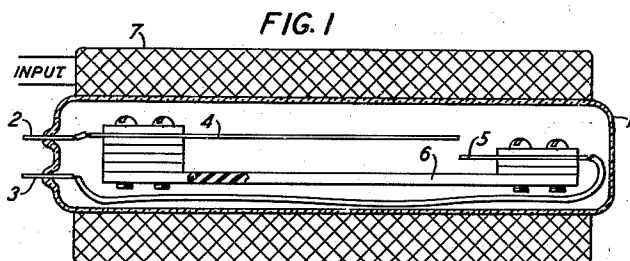
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2,258,437

GAS TUBE

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GAS TUBE

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4 Claims. (Cl. 250—27.5)

This invention relates to circuit makers and breakers and particularly to that type known as trigger tubes wherein an inert gas surrounding a pair of electrodes is caused to ionize and thereby become a conducting path between said electrodes.

The object of the invention is to provide for selective response to some external critical stimulus. Accordingly the tube of the present invention is provided with a pair of electrodes one of which is comparatively long with a free end so spaced in relation to the other of said electrodes that the breakdown potential of the tube is not reached until the free end moves closer to the other electrode. A feature of the invention is a movable electrode by means of which the gap is shortened so that by mechanical movement the tube is fired.

Another feature of this invention is the use of a tuned reed as one electrode of a trigger tube. It is an inherent characteristic of various bodies such as reeds or tuning forks, to respond at comparatively large mechanical amplitude to a driving force if it corresponds to the natural frequency of the body. For other frequencies, the response is small.

In an inert gas-filled tube, the potential necessary to cause ionization of the gas varies with the distance between the electrodes. If the correct gas is used, it is only necessary to increase the separation of the electrodes a small amount in order to cause a large increase in the ionization potential of the gap and by the same token it requires only a slight decrease in the separation of the electrodes to reach the ionization potential. Accordingly, the mechanical response of the tuned reed to a small external stimulus is sufficient to fire the tube. Such a device is sharply tuned to a particular frequency.

In accordance with another feature of the invention a combination frequency device is provided by placing a plurality of gaps in series each controlled by a tuned reed of a different frequency. Such a tube can only be fired by simultaneously stimulating all of its reeds and hence a relay means of a highly selective nature is provided.

Another feature of the invention is a band-pass device in which a plurality of reeds of closely grouped frequency response are connected in parallel whereby the device will respond to a frequency within a band. This device therefore has a broad response and may be used where a sharply tuned device would be disadvantageous.

In accordance with another feature of the in-

vention this device may be used to relay interrupted or alternating current by applying an interrupted or alternating potential to its electrodes.

In accordance with a further feature the external stimulus for causing the resonant vibration of the reed may be supplied by an alternating potential applied to the electrodes which may be in the form of parallel surfaces whereby an electrostatic force between the two is set up and results in the building up of mechanical resonance.

In accordance with another feature of the invention and which forms the specific feature of my copending application Serial No. 354,682, filed on even date herewith other external stimuli may be used to cause mechanical movement of one electrode. In particular an electrode may be provided in the form of a bimetallic strip responsive to temperature changes.

The drawings consist of a single sheet having four figures.

Fig. 1 is a cross-sectional view of a gas tube having a single gap;

Fig. 2 is a cross-sectional view of a gas tube having three gaps in series;

Fig. 3 is a cross-sectional view of a gas tube having five gaps in multiple; and

Fig. 4 is a perspective view of the two elements forming the electrode assemblies used in the device of Fig. 3.

In Fig. 1 a glass envelope 1 encloses an electrode assembly which is surrounded or immersed in an inert gas. Two terminals 2 and 3 connect to the electrodes. One electrode 4 is comparatively long and secured at one end so that the other end is free to vibrate. This electrode is made of magnetic material and has a natural period of vibration which may be adjusted in any well-known manner. Another electrode 5 is short and stationary. Both of these electrodes are mounted upon a piece of insulating material 6 in any convenient and well-known manner. A coil 7, external to the envelope, may be energized by an alternating current whose frequency will set the movable electrode 4 into vibration. The power required for moving the electrode 4 is insignificant due to the resonance effect, since it requires very little energy to set a reed into vibration at its own natural period of vibration.

The terminals 2 and 3 are connected into a circuit arrangement whereby a potential is established across the tube insufficient to cause the tube to break down while the reed 4 is stationary. However, when the reed 4 is set into vibration its

end approaches the other electrode 5 and through this reduction in the gap the tube is caused to break down and current to flow from the terminal 2 to the terminal 3.

In Fig. 2 another type of tube is shown. Here the envelope 14 covers an electrode assembly comprising three movable electrodes 8, 9 and 10 and three corresponding stationary electrodes 11, 12 and 13. The two outside terminals 15 and 16 are connected to the movable electrode 8 and the stationary electrode 13, respectively. When the external coil 17 is energized by composite current containing the frequencies for causing the three different movable reeds 8, 9 and 10 to vibrate, the tube will break down and a current will flow in series from terminal 15 through reed 8, stationary electrode 11, reed 9, stationary electrode 12, reed 10, stationary electrode 13 and terminal 16. The spacer 18 and the spacer 19 are of conducting material, so that stationary electrode 11 is connected to reed 9 and stationary electrode 12 is connected to reed 10. The base 20 is formed of insulating material and the spacers, such as 21, 22, 23 and 24, are also formed of insulating material.

If the coil 17 is energized with alternating current, which will cause only one reed, for instance reed 9, to vibrate, the tube will not break down. It is only when the energization of the coil 17 causes all three movable reeds to vibrate at the same time that the desired effect is achieved.

In Fig. 3 an envelope 25 encloses a reed and stationary terminal assembly whereby a plurality of reeds differing very slightly in their natural periods of vibration are mounted in multiple so that when the external coil 26 is energized by any one of a number of frequencies closely associated with each other the tube will break down. Two hexagonal metal or conducting pieces 27 and 28 are provided and from each of these a conducting terminal 29 or 30 is used for making connection to an external circuit. Upon the hexagonal piece 27 are mounted five reeds 31, 32, 33, 34 and 35. Upon the hexagonal piece 28 are mounted five stationary terminals 36, 37, 38, 39 and 40. The two hexagonal pieces are secured together by an insulating piece 41.

It may be noted that the hexagonal pieces 27 and 28 are of the same size and that proper gap spacing, for instance between the reed 35 and the corresponding stationary terminal 36, is secured by a conducting spacer 42.

This arrangement may be varied in any desired manner so as to have a larger or a smaller number of movable elements, five being shown here merely by way of example.

What is claimed is:

1. A relay comprising a sealed tubular envelope filled with an inert gas, a structure within said envelope comprising a plurality of tuned magnetic reeds each having a different natural

period of vibration, a companion electrode adjacent each of said tuned reeds, said reeds each being mounted with one end thereof secured and the other end thereof free to vibrate, said electrodes each being mounted to form a normal gap with its companion reed transiently diminishable during the vibration of said companion reed, a pair of terminals connected to said structure and sealed through said envelope, and means external to said envelope for setting said reeds into vibration.

2. A relay comprising a sealed tubular envelope filled with an inert gas, a structure within said envelope comprising a plurality of tuned magnetic reeds each having a different natural period of vibration, a companion electrode adjacent each of said tuned reeds, said reeds each being mounted with one end thereof secured and the other end thereof free to vibrate, said electrodes each being mounted to form a normal gap with its companion reed transiently diminishable during the vibration of said companion reed, a pair of terminals connected to said structure and sealed through said envelope, and a coil surrounding said envelope for producing a magnetomotive force in the direction of the axis of said tubular envelope for setting said reeds into vibration.

3. A relay comprising a sealed tubular envelope filled with an inert gas, a structure within said envelope comprising a plurality of tuned magnetic reeds each having a different natural period of vibration, a companion electrode adjacent each of said tuned reeds, said reeds each being mounted with one end thereof secured and the other end thereof free to vibrate, said electrodes each being mounted to form a normal gap with its companion reed transiently diminishable during the vibration of said companion reed, said reeds and said electrodes being connected with said gaps in series, a pair of terminals connected to said structure and sealed through said envelope, and means external to said envelope for setting said reeds into vibration.

4. A relay comprising a sealed tubular envelope filled with an inert gas, a structure within said envelope comprising a plurality of tuned magnetic reeds each having a different natural period of vibration, a companion electrode adjacent each of said tuned reeds, said reeds each being mounted with one end thereof secured and the other end thereof free to vibrate, said electrodes each being mounted to form a normal gap with its companion reed transiently diminishable during the vibration of said companion reed, said reeds and said electrodes being connected with said gaps in multiple, a pair of terminals connected to said structure and sealed through said envelope, and means external to said envelope for setting said reeds into vibration.

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