Aug. 20, 1935. M. OSNOS 2,012,018

PIEZO ELECTRIC CRYSTAL APPARATUS

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Fig 1

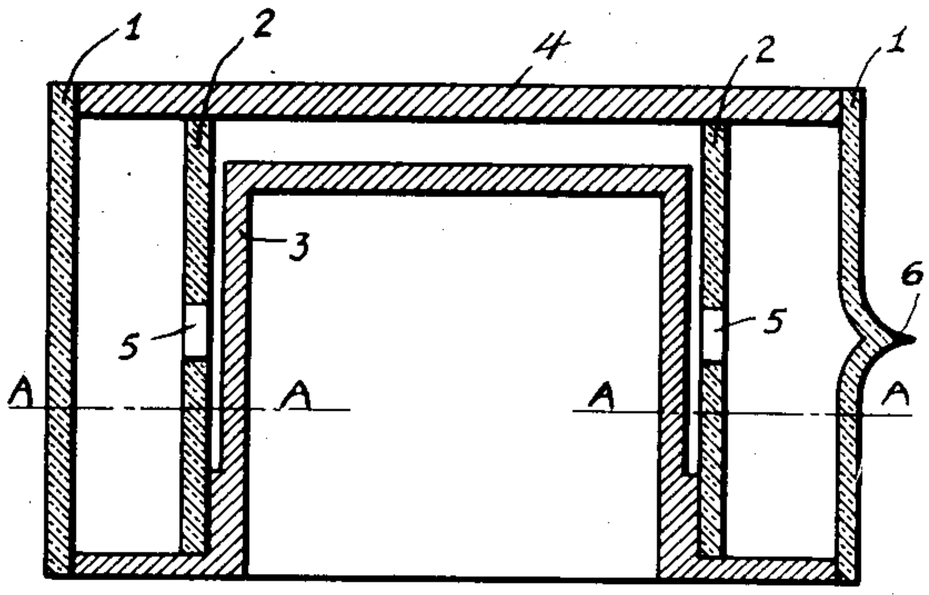
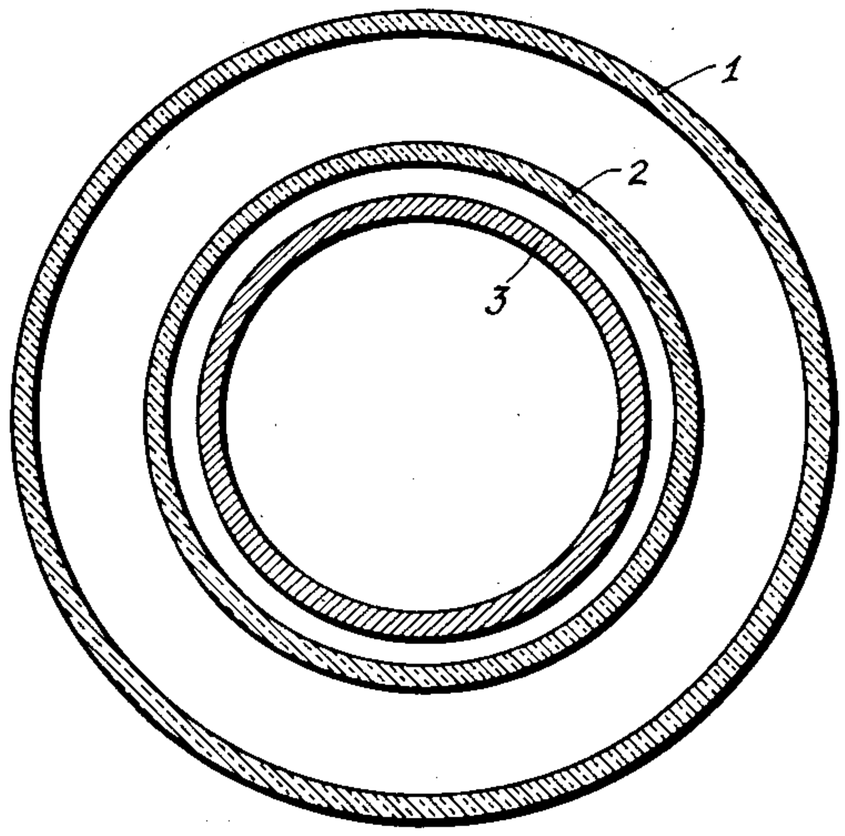


Fig 2



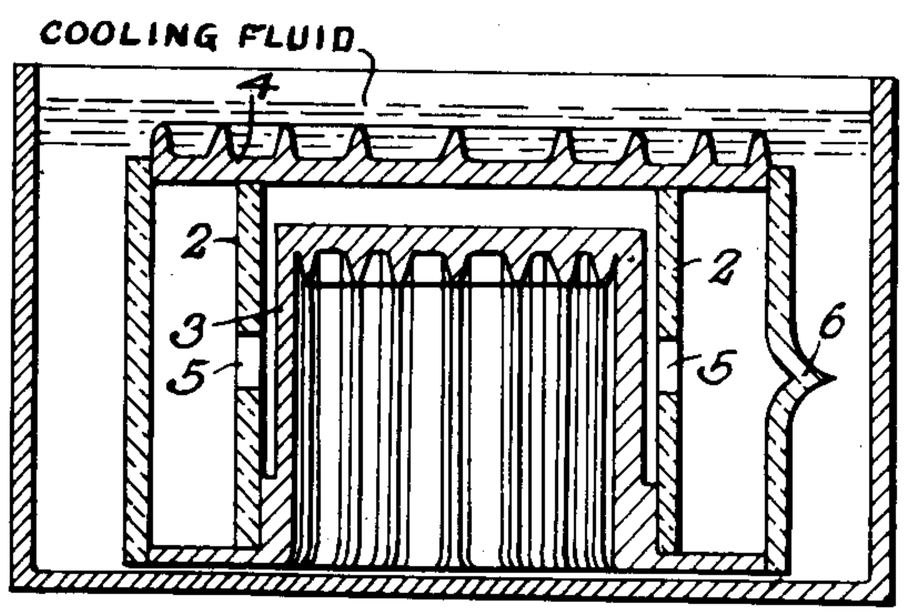


Fig 3

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PIEZO-ELECTRIC CRYSTAL APPARATUS

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8 Claims. (Cl. 171—327)

This invention relates to piezo-electric crystal holders, and more particularly to a method of and apparatus for cooling the crystal elements contained within the holder.

An object of this invention is to improve the cooling of the crystal element by carefully shaping and arranging the crystal electrodes with respect to the cooling medium.

Heretofore radio apparatus used for transmission has been mainly cooled by placing the electrodes in contact with circulating water. This method of cooling results in many losses, such as, for example, the eddy-currents in the water, and in addition there is a good deal of wear and tear in rubber hose. Another disadvantage has been that such cooling was never perfect, for the reason that only the electrodes were cooled and not the entire unit. This disadvantage was especially noticed where relatively large devices were involved, the glass envelope or tank containing the apparatus remained very hot and this resulted in an impairment in the vacuum and in low life of the apparatus. Such deficient glass cooling became of particularly great inconvenience in the case of transmitter apparatus for short wave work.

I have found that these disadvantages may be entirely or at least a major portion of them eliminated by having the various devices such as piezo-electric crystals, inductance coils, condensers, resistances and vacuum tubes immersed in a tank containing oil, the oil in the tank being optionally cooled in any well-known manner.

In the case of short wave transmitters more particularly, one advantage offered by such arrangement is that if the resistance losses of the apparatus are constant, the wavelength will be maintained at a constant value. It is advisable to make the tank of highly conductive material, such as copper, aluminum, etc., so as to provide reliable shielding.

One advantageous plan is to secure the apparatus and tuning means to the cover of the oil tank so that, on removing or lifting the cover the entire transmitter outfit is taken out of the oil.

It is a well-known fact that the frequency of a valve transmitter, particularly in the case of short waves, varies with the temperature of the electrodes of the apparatus and of the tuning means. In the arrangement described above, the temperature of the transmitter is maintained constant wholly, or practically so, in that the temperature of the oil is kept at a constant value by means and ways well known in the prior art.

When apparatus, such as piezo-electric crystals, is set in a vessel containing oil, it is essential that the oil be absolutely precluded therefrom. As a general rule, a piezo-electric crystal will fail to oscillate in the oil. Now, in order to provide conditions allowing of oscillating, the crystal and more particularly also its electrodes and crystal-setting means, is oil-tightly enclosed or encased by an insulating envelope, the leads brought to the electrodes being passed through said envelope in a manner which will insure tightness.

To diminish the losses occasioned by air which participates in the oscillations, it is desirable to make the envelope of the crystal and the seals of the leads connected to the electrodes not only oil-tight, but also heremetically sealed, and to exhaust the air or gas from the neighborhood of the crystal in order that the crystal may oscillate inside a space being as free from air or gas as possible.

However, such an arrangement as above described would render it harder to carry off such heat as is dissipated by the crystal.

Therefore, according to the present invention the crystal alone is shut off from the outer surroundings while the electrodes constitute part of the enclosing envelope which at the same time serve to secure more efficient abduction of heat from the crystal to the ambient.

The invention will be more completely understood by referring to the accompanying drawing, in which

Fig. 1 is an axial cross-sectional view of a simple form of piezo-electric crystal holder;

Fig. 2 is a sectional view taken on lines A—A of Fig. 1;

Fig. 3 is an axial cross-sectional view of another modification of my invention, wherein the crystal holder is located within a vessel containing a liquid.

Referring now in detail to Figs. 1 and 2 of the drawing, 1 is a glass body, 2 a body made of glass or some other refractory insulation material, 3 and 4 metallic electrodes consisting most preferably of copper. In the space between 3 and 4 there is to be mounted the crystal (not shown in the drawing). 2 is a spaced piece adapted to preserve, for instance, a suitable distance between 3 and 4, though not being rigidly united with 3 and 4 in any other manner.

The part 1 is fused together with 3 and 4, or is cemented in an oil and air-tight manner. The air is exhausted by way of the pumping stem 6, whereupon the latter is sealed off.

The openings 5 serve the purpose of enlarging the vacuous space in which the crystal is con-

fined by the provision of the connection of the space between electrodes 3 and 4 with the space between 1 and 2, whereby the vacuum around the crystal is rendered less sensitive to such air as may happen to enter.

The modifications shown in Fig. 3 illustrates an improved manner in which the entire crystal holder is located within a vessel containing a cooling fluid, such as for example a high-grade insulation oil, or any other suitable liquid. The piezo-electric crystal electrodes are arranged in a manner to secure more efficient cooling conditions by furnishing the portion of the electrodes which is exposed to the cooling fluid with radiator ribs or fins.

Having now described my invention, I claim:

1. A piezo-electric crystal holder comprising two electrodes, a piezo-electric crystal interposed between said electrodes, one of said electrodes being in the form of a flat plate, the other electrode being of the same perimeter as the first electrode and having a base portion from which a cylindrical portion extends upward for supporting the crystal, an inner spacing member to insulate and space said electrodes apart from each other, and an outer insulating side wall for closing the inner surfaces of said electrodes.

2. A piezo-electric crystal holder comprising two electrodes, a piezo-electric crystal interposed between said electrodes, one of said electrodes being in the form of a flat plate, the other electrode being of the same perimeter as the first electrode and having a base portion from which a cylindrical portion extends upward for supporting the crystal, an inner spacing member concentric with said cylindrical portion to insulate and space said electrodes apart from each other, and an outer insulating side wall for closing the inner surfaces of said electrodes.

3. A piezo-electric crystal holder comprising two electrodes, a piezo-electric crystal interposed between said electrodes, one of said electrodes being in the form of a flat plate, the other electrode being of the same perimeter as the first electrode and having a base portion from which a cylindrical portion extends upward for supporting the crystal, an inner spacing member concentric with the cylindrical portions so as to insulate and space said electrodes apart from each other, an outer insulating side wall for closing the inner surfaces of said electrodes, and at least one of said electrodes immersed in a cooling liquid.

4. A piezo-electric crystal holder comprising two electrodes, with cooling ribs, a piezo-electric crystal interposed between said electrodes, one of said electrodes being in the form of a flat plate, the other electrode being of the same perimeter having a base portion from which a cylindrical portion extends upward for supporting the crystal, said cylindrical portion having a greater exposed internal and external area than that of the crystal so as to serve as an efficient heat conducting surface for transferring the heat from the crystal to the ambient atmosphere, an inner spacing member contained within the cylindrical portion to insulate and space said electrodes apart from each other, and an outer insulating side wall for closing the inner surfaces of said electrodes.

5. A piezo-electric crystal holder for use in a system adapted to keep the crystal at substantially constant temperature comprising two electrodes, a piezo-electric crystal interposed between said electrodes, one of said electrodes being in the form of a relatively flat plate, the other electrode lying directly below the first mentioned electrode and having a base portion from which a cylindrical portion extends upwardly for supporting the crystal, said cylindrical base portion having a greater exposed external area than that of the crystal so as to serve as an efficient heat conducting surface to transfer the heat from the crystal to the ambient atmosphere, an inner spacing member contained within the confines of the cylindrical support member to space the electrodes apart from each other, and an outer insulating side wall for closing the inner surfaces of said electrodes.

6. A piezo-electric crystal holder comprising two electrodes, a piezo-electric crystal interposed between said electrodes, one of said electrodes in the form of a flat plate, the other electrode being of the same perimeter as the first electrode and having a base portion from which a cylindrical portion extends upward for supporting the crystal, an insulating spacing member concentric with the cylindrical portion, an insulating enveloping member for closing the inner surfaces of both electrodes, said enveloping member being exhausted of air and sealed.

7. A piezo-electric crystal holder comprising two electrodes, a piezo-electric crystal interposed between said electrodes, one of said electrodes being in the form of a flat plate, the other electrode being of the same perimeter as the first electrode and having a base portion from which a cylindrical portion extends upward for supporting the crystal, an inner insulating spacing member to insulate and space said electrodes apart from each other, said inner insulating spacing member having a plurality of apertures and an outer insulating side wall for closing the inner surfaces of said electrodes.

8. A piezo-electric crystal holder for use in a system adapted to keep the crystal at substantially constant temperature, comprising two electrodes, a piezo-electric crystal interposed between said electrodes, one of said electrodes being in the form of a relatively flat plate, the other electrode lying directly below the first mentioned electrode and having a base portion from which a support member upwardly extends for supporting the crystal, said support member having a greater exposed area than that of the flat plate electrode so as to serve as an efficient heat conducting surface to transfer the heat from the crystal to the ambient atmosphere, an inner spacing member contained within the confines of the support member to space the electrodes apart from each other, and an outer insulating side wall for closing the inner surfaces of said electrodes.

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