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C. W. HOUGH

PIEZO ELECTRIC CRYSTAL APPARATUS

Filed March 20, 1926

FIG. 1

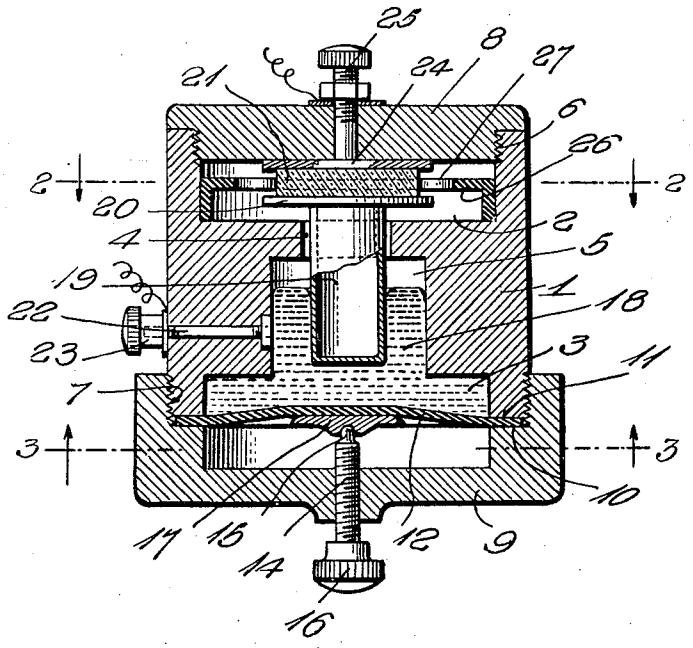


FIG. 2

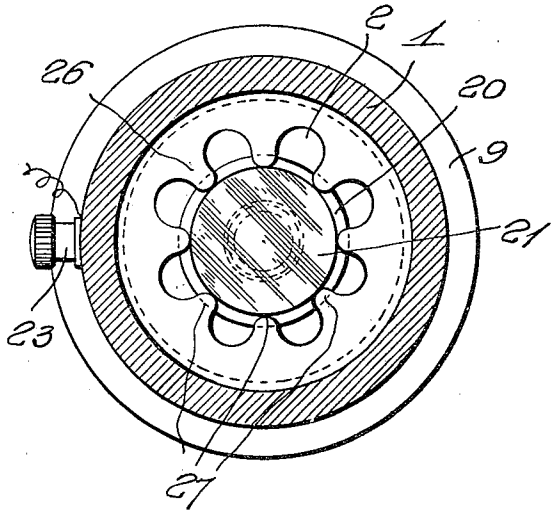
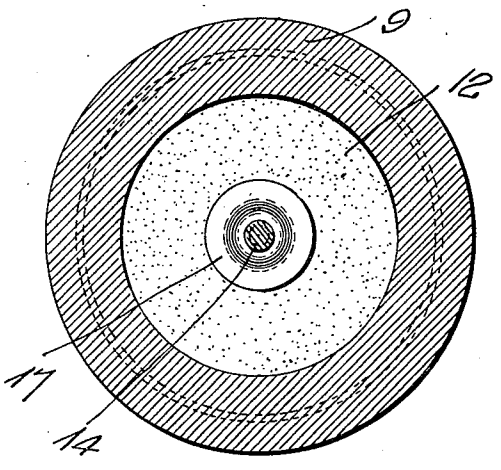


FIG. 3



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UNITED STATES PATENT OFFICE.

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PIEZO-ELECTRIC-CRYSTAL APPARATUS.

Application filed March 20, 1926. Serial No. 96,206.

My invention relates broadly to piezo electric crystal apparatus and more particularly to a construction of piezo electric crystal holder, by which maximum efficiency in the utilization of oscillations generated by the piezo electric crystal may be obtained.

One object of my invention is to provide a piezo electric crystal holder in which the piezo electric crystal may be subjected to the desired pressure for obtaining maximum efficiency in the control of an electrical circuit by constant frequency oscillations generated by the piezo electric crystal.

Another object of my invention is to provide a simplified construction of the piezo electric crystal holder in which hydrostatic pressure is employed for securing a selected pressure on the surface of the piezo electric crystal for obtaining maximum piezo electric effect from the piezo electric crystal.

A still further object of my invention is to provide a piezo electric crystal in which mercury hydrostatic pressure may be employed with means for variably displacing a body of mercury for selectively increasing or decreasing the effective pressure upon a piezo electric crystal element, whereby the maximum piezo electric effect may be obtained from the piezo electric crystal for the control of an oscillatory circuit.

My invention will be more clearly understood from the specification hereinafter following by reference to the accompanying drawings, wherein:

Figure 1 is a cross-sectional view taken through the piezo electric crystal holder of my invention; Fig. 2 is a lateral cross-sectional view taken on line 2—2 of Fig. 1; and Fig. 3 is a cross-sectional view taken through the piezo electric crystal holder on line 3—3 of Fig. 1.

In the operation of oscillatory systems wherein the piezo electric effect of piezo electric crystals is employed for the constant frequency control of the oscillatory system, the effective pressure to which the piezo electric crystal is subjected is directly proportioned to the piezo electric effect which may be utilized from the piezo electric crystal. The securing of a selected pressure upon the piezo electric crystal must be very accurate, and it is with a view of obtaining accuracy in the degree of pressure to which the piezo electric crystal is subjected that I have developed the piezo electric crystal holder of this invention. I provide a casing in which the piezo electric crystal element is housed with means for subjecting the piezo electric crystal to mechanical pressure by means of variable hydrostatic pressure. I provide columns of mercury which may be accurately balanced to vary the effective pressure upon the surfaces of the piezo electric crystal and by accurately choosing a selected pressure maximum piezo electric effect may be secured from the crystal.

Referring to the drawings in more detail, reference character 1 designates the body structure of the piezo electric crystal holder, which may be formed from suitable insulation material. The body structure which is interiorly cut away at each end, as represented by reference characters 2 and 3 with cut away portions 4 and 5 interconnecting the cut away portions 2 and 3. In the construction illustrated the body structure is turned in a lathe and accurately machined and then internally threaded at one end, as represented at 6, and externally threaded at the opposite end, as represented at 7. The internal bore portion 2 is closed by a threaded end plate 8, which engages the screw threads 6. The opposite end of the body structure 1 is closed by a screw cap 9 which engages the threads 7. The screw cap 9 is provided with a shoulder 10 which cooperates with the annular rim 11 of the body structure 1 to grip the resilient diaphragm 12 around its periphery. The resilient diaphragm 12 may be adjusted toward or away from the counterbored portions 3 and 5 by means of a screw device 14, having a head 15 and a control knob 16 by which the head 15 is made to enter a socket formed in a centering plate 17 for imparting movement to the resilient diaphragm 12. The counterbored portions 3 and 5 form columns of differing diameters for a body of mercury 18. The body of mercury 18 serves to support a tubular member 19 of very light material which floats on the body of mercury 18. The tubular member 19 carries a plate 20 at its upper extremity, which in turn supports the piezo electric crystal element 21. The plate 20 establishes electric connection with the lower surface of piezo electric crystal element 21 by virtue of the electrical conductivity of the tubular member 19, the body of mercury 18, by contact member 22 and the terminal post 23. The upper surface of

the piezo electric crystal 21 is touched by plate 24 which establishes with the terminal post 25 electrical connection with the upper surface of piezo electric crystal 21. In order to center the piezo electric crystal with respect to contact plates 20 and 24, I provide a retaining ring structure 26 substantially in the form of a cup which fits within the cut away portion 2. The retaining ring structure 26 has a plurality of inwardly extending nose portions 27 which embrace the periphery of the piezo electric crystal for centering the crystal with respect to contact plates 20 and 24 without impeding the mechanical vibration thereof.

In the operation of the piezo electric crystal holder selected pressure may be applied to the piezo electric crystal by varying the position of control knob 16, which results in variation in position of the resilient diaphragm 12 and displacement of the body of mercury 18 for floating the tubular member 19. By reason of the large diameter of the counterbored portion 3 and the relatively small diameter of the counterbored portion 5, a relatively small displacement of the body of mercury in the counterbored portion 3 results in a change in pressure with respect to the float 19, tending to increase the pressure of contact plate 20 against the surface of piezo electric crystal 21 as the body of mercury 18 is displaced upwardly. By utilizing a screw thread 14 of extremely fine pitch, extreme accuracy in the effective pressure to which the piezo electric crystal element 21 is subjected may be obtained, and accordingly maximum piezo electric effect secured for the control of associated electrical circuits.

While I have described my invention in a particular embodiment, I desire that it be understood that modifications in the construction and arrangement of parts of the piezo electric crystal may be made, and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, is as follows:

1. A piezo electric crystal holder comprising in combination a body structure, a piezo electric crystal element housed within said body structure, means for establishing contact with opposite faces of said piezo electric crystal element, and hydrostatic means for selectively varying the effective pressure between said piezo electric crystal element and said first mentioned means.

2. A piezo electric crystal holder comprising in combination a housing, a piezo electric element positioned within said housing, contact plates for establishing electrical connection with opposite faces of said piezo electric crystal element, and hydrostatic means for varying the effective pressure between said contact plates and said piezo electric crystal element.

3. A piezo electric crystal holder comprising in combination a housing, a piezo electric element positioned within said housing, contact plates for establishing electrical connection with opposite faces of said piezo electric crystal element, a body of mercury contained within said housing and means extending between said body of mercury and one of said contact parts, whereby a selected pressure may be imparted to said piezo electric crystal element by forces exerted between said body of mercury and said last mentioned means.

4. A piezo electric crystal holder comprising in combination a housing, a piezo electric element positioned within said housing, contact plates for establishing electrical connection with opposite faces of said piezo electric crystal element, a body of mercury contained within said housing, a float extending from one of said contact plates and carried by said body of mercury, and means for varying the level of said body of mercury for correspondingly varying the effective pressure between said contact plates and said piezo electric crystal element.

5. A piezo electric crystal holder comprising in combination a housing, a piezo electric element positioned within said housing, contact plates for establishing electrical connection with opposite faces of said piezo electric crystal element, a body of mercury in said housing, an electrically conductive float extending from one of said contact plates and arranged to float on the surface of said body of mercury, and means for varying the level of said body of mercury in said housing for effectively varying the pressure between said contact plates and said piezo electric crystal element.

6. A piezo electric crystal holder comprising in combination a housing, a piezo electric element positioned within said housing, contact plates for establishing electrical connection with opposite faces of said piezo electric crystal element, a body of mercury carried within said housing, a float secured to one of said contact plates and arranged to float in said body of mercury and a resilient diaphragm for displacing said body of mercury in said housing for varying the pressure exerted between said contact plates and said piezo electric crystal element.

7. A piezo electric crystal holder comprising in combination a housing, a piezo electric crystal element positioned within said housing, contact plates for establishing electrical connection with opposite faces of said piezo electric crystal element, said housing being divided into a plurality of internal bores of differing diameters, a pool of mer-

cury contained within said bores, and means for displacing the level of the mercury in said bores, whereby the pressure between said contact plates and said piezo electric crystal element may be varied.

8. A piezo electric crystal apparatus comprising in combination a piezo electric crystal element, a pair of contact plates for establishing electrical connection with said piezo electric crystal element, a pool of mercury; means extending from one of said contact plates and floating in said pool of mercury, and means for varying the level of said pool of mercury for varying the effective pressure between said contact plates and said piezo electric crystal element.

In testimony whereof I affix my signature.

CLINTON W. HOUGH.