Oct. 25, 1949. K. C. DE WALT ET AL 2,486,129

TEMPERATURE COMPENSATING MECHANISM

Filed July 26, 1946

Fig. 1.

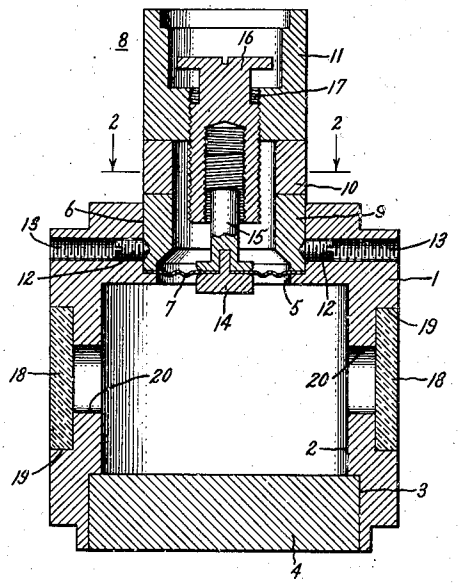
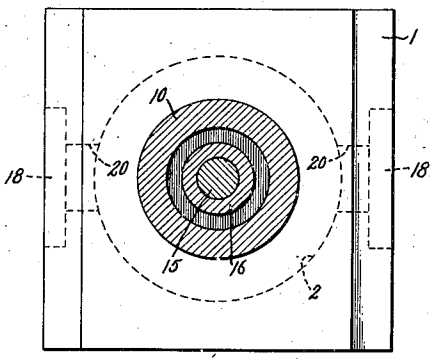


Fig. 2.



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TEMPERATURE COMPENSATING MECHANISM

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2 Claims. (Cl. 178—44)

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Our invention relates to temperature compensating mechanisms and particularly to an improved mechanism for maintaining a predetermined or constant electrical characteristic of a device with variations in operating temperature.

Temperature compensating mechanisms have been employed in connection with capacitors and cavity resonators for the purpose of maintaining constant characteristics with varying operating temperatures. Many of these mechanisms employ materials having different coefficients of thermal expansion in mechanical contact. With changes in temperature the contacting surfaces become loose and are difficult to maintain in the desired positional relation.

In accordance with an important aspect of our invention all parts which have purely mechanical interengagement have the same coefficient of thermal expansion. The temperature compensation is accomplished by providing an insert in one of the members of the mechanism which is bonded to the end portions of that member. With this construction variations in the clearance between the relatively movable parts with temperature changes is avoided and the adjustment of the device is relatively easy to maintain.

It is an object of our invention to provide a new and improved temperature compensating mechanism.

It is another object of our invention to provide a new and improved temperature compensating mechanism for a cavity resonator.

It is a still further object of our invention to provide a new and improved temperature compensating mechanism in which all interengaging parts have the same coefficient of thermal expansion.

Our invention will be better understood by reference to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. In the drawing, Fig. 1 is an elevational view, in section, of a cavity resonator embodying our invention, and Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1.

Referring now to the drawing, we have shown our invention as applied to a cavity resonator which may, for example, be employed as the automatic frequency control of a microwave oscillator. As illustrated, the body of the cavity is provided by a generally rectangular metallic block 1 which is bored from one end to provide a cylindrical cavity 2. The block is also counterbored as at 3 to receive a disk-like member 4

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which forms one end of the cavity. The opposite end of the block 1 is also provided with a bore 5 of considerably smaller diameter and a counterbore 6. As indicated, a deformable metallic wall 7 is bonded to the ledge provided at the junction of the bore 5 and counterbore 6. A generally hollow tubular support, designated by the numeral 8, extends from the end of the resonator and is received within the counterbore 6. As illustrated, this support is fabricated from three hollow cylindrical members. An inner member 9 is formed of the same material as the resonator body 1 and may to advantage be of Invar steel. The intermediate section 10 of the support 8 is preferably formed of a material having a higher coefficient of thermal expansion than the cavity and may to advantage be formed of Monel metal. The outer section of the supporting member 8 is provided by a second cylinder 11 of Invar. The Monel cylinder 10 is bonded at its ends to the inner cylinders 9 and 11 in any suitable manner, such as by brazing. The lower end of the hollow support 8 is received within the counterbore 6 of the cavity body with the lower end thereof abutting the flexible wall 7. The support is mechanically secured in position by suitable set screws 12 which are threadingly received in transverse openings 13 provided in the cavity body 1. The flexible wall 7 and a tuning plunger 14 secured to the lower face thereof are supported from the outer cylinder 11 of the support in adjustable relation thereto by a differential screw mechanism including an elongated externally threaded bolt-like member 15 bonded at its lower end to the deformable wall 7 and engaging at its upper end an internal thread provided on an adjusting screw 16. The adjusting screw is received in a threaded opening 17 provided at the lower end of the upper cylinder 11 of the support 8. The threads between the members 15 and 16 and between the members 16 and 11 are of different pitches so that these members cooperate to provide a differential screw mechanism which as is well understood provides a fine adjustment of the flexible wall 7 and tuning plunger 14.

In order that high frequency energy may be introduced and extracted from the cavity suitable dielectric windows are provided on opposed side walls of the cavity body. As illustrated, glass windows 18 are received in recesses 19 which communicate with the interior of the cavity through openings 20.

From the foregoing detailed description of the illustrated embodiment of my invention it will

be apparent that changes in operating temperature of the cavity will result in movement of the tuning plunger 14 and the deformable wall 7 with which it is connected. For example, if the operating temperature rises the operating frequency of the cavity tends to decrease. However, since the coefficient of thermal expansion of Monel considerably exceeds that of Invar, the support 8 increases in length a greater amount than the adjusting screw 16 and elongated supporting member 15, with the result that the tuning plunger 14 and supporting wall 7 are moved outwardly, in this way decreasing the effective capacity of the cavity and restoring the operating frequency for which the cavity has been adjusted. It is apparent that the axial length of the Monel cylinder 10 must be accurately determined for the particular cavity construction with which it is employed. It is also apparent that all of the parts of the compensating mechanism which are mechanically interconnected have the same coefficient of thermal expansion. This has been found to be extremely important in that it eliminates all looseness or binding between these parts and makes it possible to maintain a setting of the mechanism once it has been made. It is possible to lock the threaded parts without accidental movement by filling the threads with a thermal setting compound of suitable character. This locking of the adjustment cannot be accomplished satisfactorily with the usual mechanisms where materials having different thermal coefficients of expansion are in threaded engagement.

While we have shown and described a particular embodiment of our invention, it will be obvious to those skilled in the art that changes and modifications may be made without departing from our invention in its broader aspects, and we, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

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

1. A cavity resonator including a hollow metallic structure which changes dimensions with changes in temperature, a member movable with respect to said hollow structure for compensating for said changes in dimensions, an elongated hollow support extending from one wall of said hollow structure and surrounding said movable member, said support including an intermediate section of material having a different coefficient

of thermal expansion than the end portions thereof, an elongated member connected at one end with said movable member, and means including differential screw means connecting said elongated member to the outer end portion of said support, said elongated member having the same coefficient of thermal expansion as the outer end portion of said support whereby the engaging threads of said screw means are of material having the same coefficient of thermal expansion.

2. A mechanism for compensating for the changes in the electrical characteristics of an electrical device as a result of changes in temperature, said device including a hollow metallic structure having a flexible wall, said mechanism including a hollow elongated support having end portions formed of a material of one coefficient of thermal expansion and an intermediate portion bonded at opposite ends to said end portions and formed of a material having a coefficient of thermal expansion different from said end portions, said hollow metallic structure including a wall portion joined to said flexible wall, said wall portion having the same coefficient of thermal expansion as the end portions of said hollow elongated support, one of said end portions being joined to said wall portion adjacent said flexible wall and means for adjusting the positional relation of said flexible wall with respect to said metallic structure comprising an elongated member having a coefficient of thermal expansion equal to the coefficient of thermal expansion of the end portions of said hollow support and connected at one end to said flexible wall, and means connecting said elongated member in adjustable positional relation with the other end portion of said hollow support.

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