A cavity for a hydrogen maser is disclosed consisting of three parts which provide highly stable mechanical and thermal expansion characteristics for the cavity and ease of tuning. The three parts which are made of a "glass ceramic" material having a very small thermal expansion coefficient (α of ±0.5×10⁻⁷ in/in/°C over 0°-38°) include 1) a top plate, 2) a cylinder with three interrupted helical ramps at its bottom and 3) a base which includes a bottom plate and three ramp lugs on which the helical ramps of the cylinder rest when the cylinder is placed on the base with the bottom plate in the cylinder. Cavity tuning is achieved by rotating the cylinder and thereby raising or lowering it on the base, which results in changing the cylinder volume by changing the distance between the bottom and top plates.

8 Claims, 3 Drawing Figures
The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 305 of the National Aeronautics and Space Act of 1958, Public Law 85-568 (72 Stat. 435; 42 U.S.C. 2457).

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to a hydrogen maser and, more particularly, to an improved cavity therefor.

2. Description of the Prior Art

Atomic hydrogen masers have been developed and described in the literature. These masers have been proven to be useful both as spectroscopic tools and as frequency standards. As is appreciated by those familiar with the art the accuracy and stability of the output frequency of such a maser greatly depends on the stability of various critical elements, particularly the mechanical and thermal stability of the maser's cavity. In addition, the tuning of the latter is very critical for an accurate and stable output frequency. Although to date various cavity structures have been designed none has adequately solved the stringent stability and tuning requirements.

OBJECTS AND SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide an improved hydrogen maser cavity.

Another object of the present invention is to provide a hydrogen maser cavity which exhibits superior mechanical and thermal stability characteristics.

A further object of the present invention is to provide an improved hydrogen maser cavity which is easily and precisely tunable, and which exhibits superior mechanical and thermal stability characteristics.

These and other objects of the invention are achieved by providing a three-part cavity structure made of a material which exhibits extremely low thermal expansion and superior mechanical stability characteristics.

The three parts of the cavity include 1) a top plate, 2) a cylinder with a plurality of interrupted helical ramps or threads at its bottom, and 3) a base which contains the bottom plate of the cavity and a plurality of ramp lugs, which engage the cylinder's interrupted helical threads.

The material from which the top plate 12, the cylinder 14 and the base 16 are manufactured is chosen on the basis of its mechanical and thermal stability characteristics. At present materials are available which exhibit excellent mechanical and thermal stability characteristics. These materials are generally known in the art as “glass ceramics.” Some of these materials have a thermal expansion coefficient, known as $\alpha$, with $|\alpha| < 0.5 \times 10^{-7}$ in in/in$^\circ$C over a temperature range of $0^\circ$C to $38^\circ$C. Thus they are particularly adapted for fabricating the cavity's parts. In one embodiment actually reduced to practice a material sold by Owens-Illinois and known as CER-VIT C-101 was used with excellent results. This material is mentioned herein merely to recite one type of material which may be used, rather than to limit the invention thereto.

In practice the cavity is supported and secured within a metallic hold-down cylinder 25, shown in FIG. 3. Cylinder 25 is fastened at the bottom to the disc 19. A Belleville spring assembly 26 is used to provide uniform downward pressure at the outer circumference of the top plate 12. The tension of the spring assembly is set by means of adjusting screws 28 and a force distributing ring 29 so that thermal movement of the cylinder 25 relative to that of the cavity material does not cause any appreciable change in the compressive force on the top plate 12 of the cavity.

Although particular embodiments of the invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art and consequently it is intended that the claims be interpreted to cover such modifications and equivalents.

What is claimed is:

1. In a tunable cavity the arrangement comprising:
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a hollow cylinder having first and second opposite ends;
a top plate closing said first end; and
a base member including a bottom plate insertable in
said cylinder through said second end and support
means for engaging the cylinder at said second end
so that the distance between said top and bottom
plates varies as said cylinder is rotated about its
longitudinal axis while the cylinder is supported
and engaged by said support means, said support
means comprising n ramp lugs extending upwardly
from said base member, n being an integer, and
said cylinder forms n interrupted ramps at said sec-
ond end, with each interrupted ramp resting on one
of said lugs whereby as said cylinder is rotated in
a first direction the cylinder is lowered on the base
and is raised therefrom when the cylinder is rotated
in a second direction opposite said first direction,
to thereby control the distance between said top
and bottom plates, within said cylinder.

2. The arrangement as recited in claim 1 further in-
cluding means for providing a uniform compressive
force to the outer circumference of said top plate.

3. The arrangement as recited in claim 1 wherein
each of said top plate, said cylinder and said base mem-
ber is of a material which has a thermal coefficient of
expansion definable as \( \alpha \) which is not more than
\( \pm0.5 \times 10^{-7} \) in/in\(^{\circ}\)C over a preselected temperature
range.

4. The arrangement as recited in claim 1 wherein n
is not less than 3.

5. The arrangement as recited in claim 4 wherein
each of said ramps is helically shaped.

6. The arrangement as recited in claim 4 wherein
each of said top plate, said cylinder and said base mem-
ber is of a material which has a thermal coefficient of
expansion definable as \( \alpha \) which is not more than
\( \pm0.5 \times 10^{-7} \) in/in\(^{\circ}\)C over a preselected temperature
range.

7. The arrangement as recited in claim 5 further in-
cluding means for providing a uniform compressive
force to the outer circumference of said top plate.

8. The arrangement as recited in claim 7 wherein
each of said top plate, said cylinder and said base mem-
ber is of a material which has a thermal coefficient of
expansion definable as \( \alpha \) which is not more than
\( \pm0.5 \times 10^{-7} \) in/in\(^{\circ}\)C over a preselected temperature
range.

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