Nov. 25, 1958 A. A. MacDONALD ET AL 2,862,191

MULTIPLE CAVITY TUNING ARRANGEMENT

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FIG. 1.

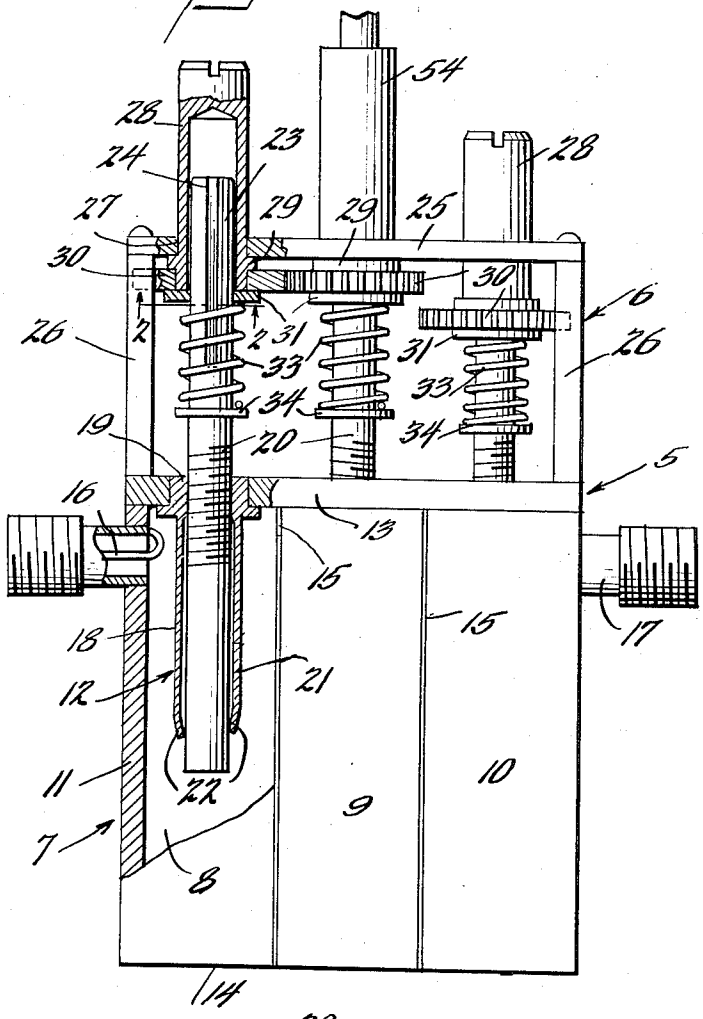
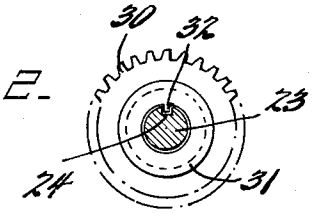


FIG. 2.



INVENTORS
Angus A. MacDonald
Alfred W. Ward
Franklin G. Lee,
BY George Lipkin
B. L. Zangwell
ATTORNEYS

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FIG. 3.

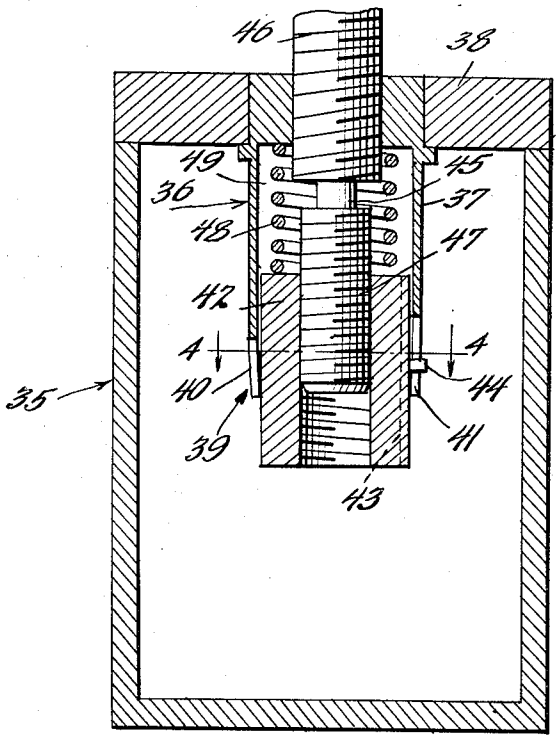
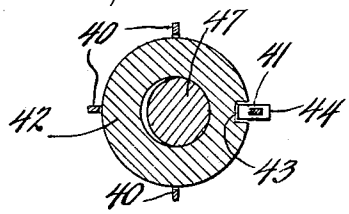


FIG. 4.



INVENTORS

Angus A. MacDonald
Alfred W. Ward
Franklin G. Lee,
George Sipkin
B. L. Zangrilli

BY

ATTORNEYS

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MULTIPLE CAVITY TUNING ARRANGEMENT

Angus A. Macdonald, Hinsdale, Ill., and Alfred W. Ward and Franklin G. Lee, Baltimore, Md., assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

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6 Claims. (Cl. 333—73)

This invention relates to cavity resonator tuning arrangements and more particularly to an arrangement whereby a plurality of cavities tuned to the same frequency may be easily aligned and thereafter gang tuned over a band of frequencies with one control.

In present day ultra high frequency equipment such as receivers in radar safety beacon systems, radio frequency preselection is necessary to attenuate frequencies near the operating frequency of the equipment as well as image responses. Such equipment usually employs coaxial type crystal mixers into which the incoming R. F. signals are fed. Radio frequency preselection must therefore take place between the antenna and the mixer. Cavities have heretofore been used to some extent for this purpose but their use has been limited because of the need of a plurality of cavities to realize a desired selectivity which are difficult to multiple tune. In addition, a plurality of single tuned cavities can not be gang tuned over a band of frequencies inasmuch as selectivity is limited to that obtainable with single tuned circuits. As a result the form factor i. e. ratio of noise bandwidth to skirt selectivity with these single tuned cavities suffered.

While multiple tuned wave guide filters have been experimented with, at frequencies in the order of 1000–3000 megacycles, these filters have been large and are not practicable where compact units are required. Coaxial cavities on the other hand are small and may be designed to give the same selectivity as ordinary multiple tuned circuits.

This invention comprises a multiple tuned coaxial cavity resonator capable of tuning a receiver to a number of preselected frequencies within a predetermined signal band and wherein individual slot coupled coaxial cavities of the resonator may be easily individually aligned and then gang tuned over said band of frequencies with a single control.

An object of the invention is to provide multiple tuned coaxial cavities which may be easily aligned and gang tuned over a band of frequencies.

Another object of the invention is the provision of resonant cavity unit having a plurality of tunable coaxial cavities whereby good selectivity is easily obtained over a band of frequencies.

A further object is to provide a low loss triple tuned cavity resonator unit.

A still further object is to provide a multiple coaxial cavity tuning unit having aligning and gang tuning adjustments.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Fig. 1 shows a front elevation in partial cross-section of a triple tuned cavity resonator unit;

Fig. 2 shows a sectional view along the line 2—2 of Fig. 1;

Fig. 3 shows a cross-sectional front view of a differential thread arrangement for fine tuning; and

Fig. 4 shows a sectional view along line 4—4 of Fig. 3.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown a triple tuned cavity resonator unit, generally designated by 5, comprising an upper portion 6 containing the tuning mechanisms and a lower portion 7 comprising in the preferred embodiment three coaxial cavities 8, 9 and 10. Each of said cavities comprises an outer hollow conductor 11 and an inner conductor generally designated by 12. The outer conductors 11 have closed ends 13 and 14 to prevent radiation from the cavities and are positioned in adjacent contacting relationship to facilitate the transfer of energy between them through slots or irises 15. An input coupling loop 16 is positioned to excite oscillations in cavity 8 by setting up a magnetic field. As is understood by those skilled in the art, the magnetic field builds up around the loop 16 and expands to fill cavity 8. In the frequency of the current in the loop is correct, energy will be transferred from the loop to the cavity. An output coupling loop 17 similar to loop 16 is positioned within cavity 10 and feeds the selected frequency through a coaxial cable (not shown) to a mixer.

The inner conductor 12 of the cavities 8, 9 and 10 includes a hollow member 18 having an internally threaded end 19 fixed to or made a part of end 13 of the cavities. Hollow member 18 is adapted to telescopically receive and threadedly engage a movable rod conductor or tuning slug 20. The free end 21 of member 18, which extends into the associated cavity a predetermined wavelength, comprises a series of resilient conductive fingers 22 adapted to resiliently engage the lower periphery of slug 20 to assure a low impedance path for high frequency currents. Slug 20, as is well known, is adapted to vary the resonant frequency of its respective cavity depending upon the distance it extends into the cavity. The upper portion 23 of slug 20 which extends into the upper portion 5 of the cavity resonator unit has a vertical keyway or spline 24 provided in its periphery.

The upper portion 5 of unit 4 comprises a plate 25 supported a finite distance from cavities 8, 9 and 10 by a plurality of legs 26. Openings 27 in plate 25 are provided to receive a hollow tuning slug adjustor 28 which in turn receives the splined end of tuning slug 20. Shoulders 29 on the lower outer periphery of adjustors 28 are provided to maintain them within and against the lower surface of plate 25 when in their biassed position. The shoulders 29 also serve as a mount for toothed gears 30 to which are secured circular washer like discs 31 having a key 32 adapted to be received in the keyway or spline 24 on the slug 20 (see Fig. 2). As is apparent spline 24 and key 32 prevent rotational movement between slug 20 and adjustor 28 but allow vertical movement of these members with respect to each other.

Springs 33 encompassing slugs 20 are held between discs 31 and stops 34 affixed to the slugs 20 to bias the adjustors 28 so that gears 30 are in meshing relationship to allow the cavities to be gang controlled from a central control shaft 54; the center slug 20 being provided with threads running in an opposite direction to the threads on the outer slugs so as to permit the resonant frequencies of the cavities to be increased or decreased in unison without the necessity of utilizing idling gears. In Fig. 1 the right outer tuning slug adjustor is shown in a depressed condition and it can be seen that the gear attached thereto is taken out of meshing relationship to allow the cavity 10 to be properly aligned.

Figs. 3 and 4 show a differential thread arrangement utilizable with any or all of the cavities of unit 5 whereby fine tuning may be accomplished. There is shown in Fig. 3 a resonator comprising an outer conductor 35 and an inner conductor 36, the latter of which includes a hollow outer member 37 extending into the cavity a predetermined distance. Member 37 is fixed at one end to the top section 38 of outer conductor 35 and has a free end 39 comprising a plurality of fingers 40, one finger 41 of which is longer than the others. Fingers 40 resiliently engage an internally threaded movable tuning slug 42. A vertical keyway 43 formed in the outer periphery of slug 42 is adapted to receive a sliding key 44 mounted for vertical movement on finger 41. A rod 45 of predetermined diameter having an upper threaded portion 46 with a predetermined thread pitch cooperates with internally threaded hollow conductive member 37 and a threaded lower portion 47 of a different predetermined thread pitch cooperates with internally threaded slug 42 to vary the position of slug 42. The pitch of the threads on the upper and lower portions may differ by any predetermined number depending on the tuning accuracy desired. A spring 48 is provided in an annulus 49 formed by hollow member 37 and slug 42 to bias or load the slug. It can be seen that, by turning the rod 45 one or more revolutions, the portion of the rod with the greater number of threads cannot move as far as the other portion and that the difference will be taken up by movement of the slug 42. For example, if the upper portion had one thread per inch and the lower two threads per inch, one revolution of the rod 45 would move the upper part one inch while the lower would move only one-half inch. The one-half inch difference would result in the movement downward of slug 42 one-half inch. Slug 42 is prevented from turning by the sliding key 44 held by finger 41 of hollow member 37 which runs in the groove or spline 43 in slug 42. It is apparent therefore that slug 42 vertically moves a distance into or out of the cavity related to the difference in the pitch of threaded sections to thereby allow very fine vernier adjustments.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In combination, a cavity resonator having input and output coupling means and comprising a plurality of tunable coaxial cavities, a tuning slug individual to each of and adapted to be threaded into said cavities, said slugs being threaded on one end and splined on the opposite end, a spring biased tubular member individual to each of said cavities adapted to receive said splined ends of said slugs, gear means mounted on said tubular members, said gear means being in meshing relationship when said tubular members are in a biassed position, said tubular members adapted to be depressed to overcome said bias thereon whereby said gear means are disengaged.

2. An R. F. preselector comprising a multiple tuned cavity resonator, said resonator having a plurality of slot coupled coaxial cavities and means to align and gang tune said cavities, said means comprising means for movably mounting the inner conductors of said cavities, first means on each of said inner conductors for individually moving said conductors, means for biassing said first means on each of said conductors, and second means for moving said conductors in unison when said first means are in the biassed position, said first means being operable in opposition to said biassing means to release said conductors from being in unison, said first means comprising an adjustor for operating a spline on each of said conductors and said second means comprising a gear mounted on each adjustor and being intermeshed when said first means are in said biassed position.

3. A cavity resonator comprising a plurality of juxtaposed coaxial cavities adapted to be tuned to the same frequency, said cavities having means electrically coupling them, input means to a first of said cavities, output means from another of said cavities, closure means for the end of each cavity, said closure means including a threaded opening at each cavity, inner conductor means comprising a threaded member for each cavity threaded into the associated opening, each threaded member having a portion inside the associated cavity and a portion outside, a gear slidably mounted on each outside portion, spring means biasing said gears into meshing relation, single means for rotating one of said gears, whereby all rotate when the gears are meshed, and means for selectively moving a gear into unmeshed relation with the other gears, whereby the associated slug of the last said gear can be independently rotated.

4. A cavity resonator as defined in claim 3 but further characterized by a tubular adjusting member on the end of each outside slug-portion, each of said tubular members carrying one of said gears.

5. A cavity resonator comprising a plurality of juxtaposed coaxial cavities adapted for multiple tuning to pass the same frequency, said cavities having means electrically coupling them, input means to a first of said cavities, output means from another of said cavities, closure means for the end of each cavity, said closure means including a threaded opening at each cavity, a tubular conductor fixed in each opening and a hollow, internally threaded slug associated with each tubular conductor, contact means between each tubular conductor member and its associated slug, a threaded member threaded in each of said openings, said threaded members and slugs having threads threaded together, the number of threads per unit length of the last said threads being different from that of said threaded openings, and means for preventing rotation between the last said slugs and the associated tubular contact member.

6. A cavity resonator according to claim 5 but further characterized by means for biassing said hollow slug away from said threaded opening whereby said hollow slug will assume a position proportional to the difference per unit length of said threads.

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