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3 TO 8 MEGAHERTZ MINIATURE TUNER

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FIG. 1

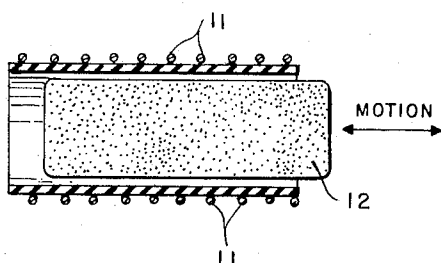


FIG. 2

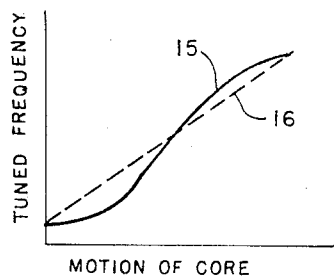
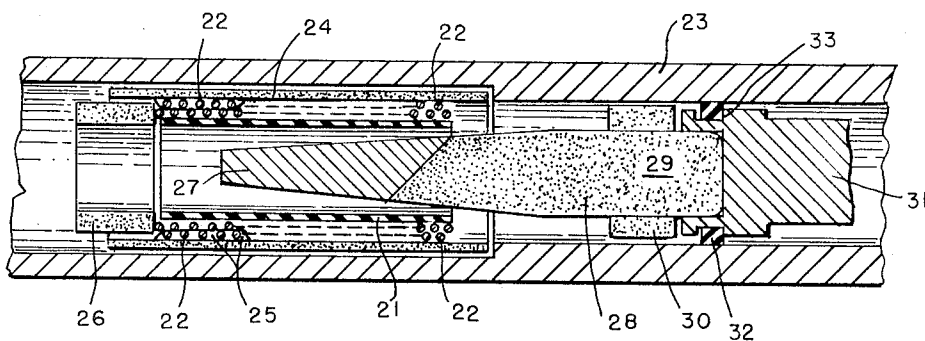


FIG. 3



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This invention relates to a variable inductance tuner and more particularly to a passive, miniaturized, linear tuner for use in a micromodule receiver.

In the past, inductance type tuners have relied upon variable turn density coils to provide a linear change in tuned frequency with respect to the motion of the movable inner core. The turn density is made less dense in the middle of the coil and more dense at its ends. However, as the tuner to be described herein is to be used in a micromodule receiver, its outside diameter is limited. It is, therefore, impossible to provide sufficient relative change in turn density to permit a linear change in frequency with respect to inner core motion, since a non-uniform turn density increases the outside diameter of the tuner. A new design in the magnetic circuit therefore became necessary.

It is, therefore, an object of this invention to provide a tuner for use in a micromodule receiver which exhibits a linear frequency change characteristic due to its magnetic circuit.

A further object of this invention is to provide a passive miniaturized tuner having a constant turn density and which exhibits a linear relationship between tuned frequency and inner core motion.

This tuner comprises a coil which is surrounded by a ferrite cylinder. A ferrite ring is located at one end of the coil. The inner core is tapered, being smallest at its end which is inserted in the coil. A portion of this smaller diameter end is made of carbonyl iron while the remainder of the core is made of ferrite. A second ferrite ring is located on the ferrite end of the inner core. A metallic shield surrounds the entire tuning element. At the lowest tuned frequency the magnetic circuit is nearly closed by the ferrite cylinder, the two ferrite rings, and the inner core. The resulting tuner has a high Q due to the small amount of magnetic leakage.

Other objects and advantages will be apparent and the invention itself will be best understood by reference to the following specification and to the accompanying drawing wherein:

FIG. 1 is a basic uniform pitch coil having a uniform cross-section core,

FIG. 2 is a graph showing a plot of tuned frequency as a function of the core motion, and

FIG. 3 is a preferred embodiment of a tuner designed in accordance with this invention.

FIG. 1 shows a basic core and coil construction wherein a uniform pitch coil 11 is associated with a uniform cross-section core 12. Linear motion of the core through the coil produces the well known S-shaped curve 15 which appears as a solid line in FIG. 2. Since the tuned frequency is inversely proportional to the square root of the inductance, and inductance is proportional to flux-turn linkages, and the end turns of coil 11 are less tightly coupled to all the other turns than are the turns in the middle thereof, the change in frequency is less at each end of the core motion than at the middle. Therefore, turn density is usually made less dense near the center of the coil and more dense at the ends in order to make the change in tuned frequency linear with respect to core motion, as is indicated by the dashed line 16 in FIG. 2.

However, the present invention is concerned with a shielded core and coil, the outside metallic shield of which

is limited in size by the thickness dimension of a micro-module receiver in which the tuner is to be used. Furthermore, the overall permissible volume of the tuning element limits the extent of the core motion. Due to these restrictions on the size of the tuner, a sufficient relative change in turn density is impossible, and therefore core shaping and other improvements in the flux path become necessary.

FIG. 3 shows a tuner designed in accordance with this invention to produce linearity between frequency and core motion, and yet be small enough for use in a micromodule receiver. This tuner comprises a coil form 21 on which a coil is wound. The maximum turn density permitted by coil form and core clearances is two layers in thickness and tightly wound, thus requiring drastic core shaping. An outer metallic shielding shell 23 surrounds the entire tuning element. In order to keep the diameter of the shell 23 within acceptable limits, it is necessary to have little clearance between the coil 22 and shell 23. In order to reduce magnetic leakage and thus maintain a high Q and also keep the outer metallic shell losses low, it is necessary to place a thin ferrite shell 24 closely around the coil and to cement it to the coil as indicated at 25. An inner ferrite ring 26 is fixed to one end of coil 22 so that the outer ferrite shell 24 overlaps it for a short distance.

An inner movable core 29 is tapered at the end thereof which is inserted into the coil. A portion 27 of the tapered end is made of carbonyl iron while the remainder of the inner core is made of a ferrite piece 28. The junction between the two inner core parts is made at an angle of 45 degrees with respect to the longitudinal axis of the core. This particular construction of inner core gives much better mid-band Q's than inner cores which are made entirely of ferrite, and yet it permits an adequate tuning range. A second ferrite inner ring 30 is attached to the ferrite portion of the inner core 29 at such a place that part of it moves within the outer ferrite shell 24 when the inner core 29 is moved to its innermost position within the coil.

A drive bushing 31 is attached to the ferrite end of the inner core. A guide ring 32, made of polytetrafluoroethylene resin or other suitable material, is located in a groove 33 which is located in the drive bushing in the vicinity of its connection to the inner core. As the drive bushing moves axially within the shell 23 to impart motion to the inner core 29, the Teflon guide ring keeps the inner core properly aligned with the coil.

At the lowest frequency the magnetic circuit is nearly closed by the outer ferrite shell 24, the inner ferrite rings 26 and 30, and the inner core 29.

In the operation of a tuner designed in accordance with this invention, a linear motion of 0.1 inch per megacycle is imparted to the inner core by the drive bushing 31. Thus a total of 0.5 inch is required for the 3 to 8 MHz range for which the tuner is intended to be used.

What is claimed is:

1. A variable inductance tuner comprising: an inductance coil having a first end and a second end; a thin ferrite shell surrounding said coil and extending beyond both ends thereof; a first ferrite ring abutting the first end of said coil, a portion of said first ring extending within said ferrite shell; an inner movable tuning core; moving means connected to one end of said core for moving said movable core within said coil from the second end thereof; and a second ferrite ring being mounted on the end of said movable core which extends from said coil, the magnetic circuit being nearly completed by said movable core, said first and second ferrite rings and said ferrite shell at the lowest tuned frequency.

2. A tuner as described in claim 1 which further comprises: an outer metallic shielding shell which completely

3

surrounds said ferrite rings, ferrite shell and moving means; and wherein said moving means comprises a drive bushing to which said movable core is connected, a groove extending around said drive bushing, and a Teflon guide ring located in said groove and making contact with the inner wall of said shielding shell.

3. A tuner as described in claim 2 wherein said movable core is tapered at its end which extends into said coil, a portion of the tapered end of said core consisting of carbonyl iron, the remainder of said core consisting of ferrite.

4. A variable inductance tuner comprising: a cylindrical inductance coil having a first end and a second end; a thin, cylindrical ferrite shell cemented to the outside of said coil and extending beyond both ends thereof; a first ferrite ring abutting the first end of said coil, a portion of said first ring extending within said ferrite shell; an inner movable tuning core which is tapered at one end, a portion of said tapered end consisting of carbonyl iron, the remainder of said movable core consisting of ferrite, a second ferrite ring mounted on the ferrite portion of said movable core near the end opposite said tapered end; an outer metallic shielding shell which surrounds said ferrite

4

shell and extends beyond both ends thereof; a drive bushing having a hole in one end thereof and a groove around the circumference thereof in the vicinity of said hole, the non-tapered end of said core being firmly mounted in said hole, and a guide ring in said groove and making slidable contact with the walls of said shielding shell, so that said guide bushing will accurately guide said core within said second end of said coil.

5. A tuner as described in claim 4 wherein the juncture of said ferrite portion and said carbonyl iron portion of said core occurs at a plane which lies at an angle of forty five degrees with respect to the longitudinal axis of said core.

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