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COUPLING DEVICE

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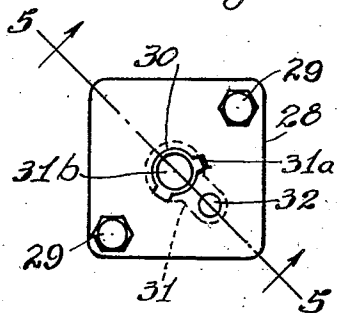
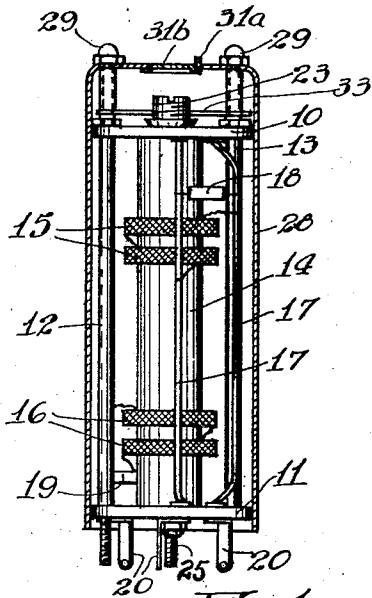
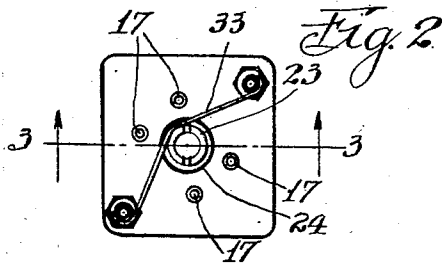


Fig. 4

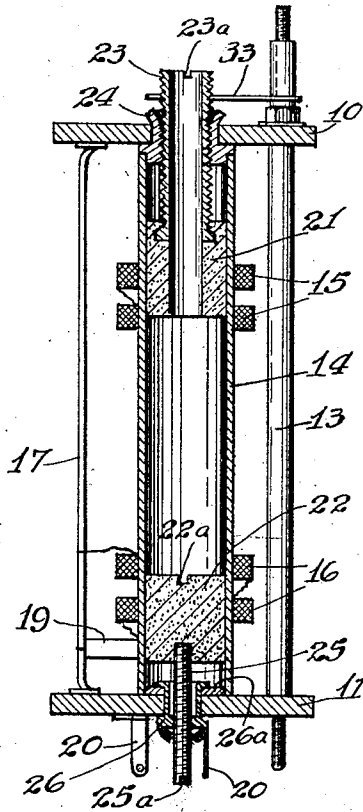


Fig. 3

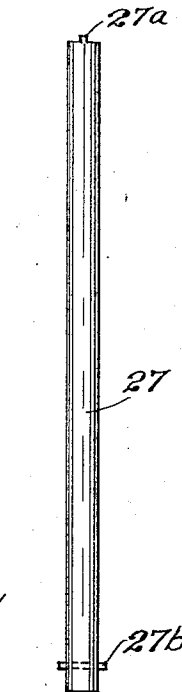


Fig. 6

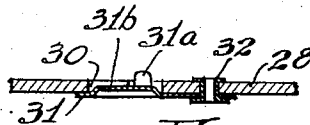


Fig. 5

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COUPLING DEVICE

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9 Claims. (Cl. 171-119)

The invention pertains to an improved form of coupling device including coupled inductors provided with adjustable ferro-magnetic cores for pre-tuning purposes, so that the inductors of the device may be connected respectively in the circuits to be coupled, after which the circuits and included inductors may be pre-tuned to any desired frequency or frequencies. The coupling device of the invention is adapted for use in radio receivers generally, wherever coupled pre-tuned circuits are required, together with facilities for accurately adjusting the inductances of the coupling device when connected in the circuits of which they are parts, to accurately tune the circuits to a predetermined frequency or frequencies, to compensate for inductance and capacitance that may be included in said circuits respectively. The coupling device of the invention is particularly adapted for use as an intermediate frequency transformer for superheterodyne receivers.

The coupling device of the invention consists essentially of two coaxially arranged inductors each including an inductance coil and a ferro-magnetic core adjustable axially relatively to the coil, the coils being preferably arranged in end-to-end relation and so spaced from each other as to secure the desired degree of coupling between said coils. The invention further provides a simple and inexpensive means for independently adjusting the inductance of the inductors from the same end of the coupling device, thereby avoiding the inconvenience in adjusting the inductors after they are mounted in a radio receiver, incident to adjusting the inductance of one of the inductors from one end of the device and adjusting the inductance of the other inductor from the other end of the device, as has frequently been done in the past.

Heretofore, it has been proposed to adjust the coaxially arranged inductors of a coupling device, provided with powdered iron cores for adjusting purposes, in a number of ways, for example, by providing a yoke or framework extending longitudinally of the coupling device for adjusting the inductor remote from the outer end of the coupling device which is readily accessible to the workman, which adjusting devices are relatively expensive to manufacture and tend to introduce undesired losses in the operation of the coupling device; second, to avoid the need for the connecting yokes or frameworks referred to, it has been proposed to avoid the coaxial arrangement and dispose the inductors of the coupling device with their axes in spaced and parallel

relation, which arrangement besides resulting in a larger coupling device, also increases its cost of manufacture and introduces the possibility of zero coupling occurring, as well as requiring for one of the adjustable inductors a long core stud presenting the possibilities of undesired operating effects in connection with the coupling device as a whole.

The difficulties experienced with earlier types of coupling devices of the kinds referred to, are entirely overcome by the construction of the invention, in which the coils of the inductors are mounted coaxially on a single supporting tube in which the cores are disposed for axial movement relatively to the corresponding inductance coils, the invention providing that the core adjacent the outer or readily available end of the coupling device when in use, shall be tubular and be provided with a tubular and externally threaded adjusting stud extending through the outer terminal plate of the coupling device, to be readily accessible so that it may be turned by the workman to adjust the adjacent inductor as desired; the invention also provides the core of the inductor remote from the outer end of the device, which may be a solid core, with a cross-slot or equivalent conformation in its end towards the outer adjustable core, as a result of which a correspondingly shaped tool of suitable material, may be inserted through the tubular adjusting stud of the outer inductor and engage the cross-slot in the other core, to adjust the inductor remote from the outer end of the coupling device as desired.

Another object of my invention, using cores of the construction described, is to so proportion the internal diameter of the tubular core to its external diameter, that its effective core to coil permeability is substantially the same as the effective core to coil permeability of the solid core:

The invention will best be understood by reference to the accompanying drawing illustrating a preferred embodiment thereof, in which:

Fig. 1 shows the coupling device of the invention in side elevation with the shield can thereof in vertical, central, sectional view,

Fig. 2 is a plan view of the coupling device shown in Fig. 1 with the shield can removed,

Fig. 3 is a vertical, sectional view through the coupling device to an enlarged scale, taken along the line 3-3 in Fig. 2,

Fig. 4 is a plan view of the coupling device with the shield can in place thereon,

Fig. 5 is a vertical, sectional view to an en-

larged scale through the upper end of the shield can, taken along the line 5-5 in Fig. 4, and

Fig. 6 shows in elevation and to a scale corresponding to that of Fig. 3, an adjusting tool adapted to the purpose of adjusting the inductors shown in Fig. 3.

Similar numerals refer to similar parts throughout the several views.

As shown in Figs. 1 and 2, the coupling device consists of terminal plates 10 and 11 of insulating material held in parallel and spaced relation by diagonally opposite rods 12 and 13 which are rigidly secured to the corner portions of said plates 10 and 11. A tube 14 of insulating material is mounted between the plates 10 and 11 and centrally thereof to support the windings of a first inductance coil 15 near the plate 10 and to support the windings of a second inductance coil 16 near the plate 11, the windings being shown as concentrated windings in each case in pi form, although it will be understood that the windings of the inductance coils may have any other form as desired. Also extending between the plates 10 and 11 are four conductive bus rods 17 (Fig. 2) two of which are shown in Fig. 1 as connected with the terminals of the windings of the coil 15, and also connected with a tuning capacitor 18. The other two bus rods 17 are similarly connected with the terminals of the coil 16 and with a tuning capacitor 19. The inner ends of the bus rods 17 are connected at the plate 11, which is the mounting end of the coupling device, with terminal lugs 20 for circuit connection purposes.

As more clearly shown in Fig. 3, tube 14 contains a first ferromagnetic core 21 for cooperation with the coil 15 and a second ferromagnetic core 22 for cooperation with the coil 16. The core 21 is tubular and has molded into its outer or upper end, the end of an externally threaded tube 23 having a bore of substantially the same diameter as the bore extending axially through the core 21. The threads on the tube 23 engage internal threads in a sleeve 24 which is shouldered at its inner end to provide a centering seat for the adjacent end of the tube 14, said sleeve 24 extending centrally through and being rigidly secured to the plate 10. As a result of the construction described, turning the tube 23 correspondingly moves the core 21 axially in the tube 14 to change the inductance of the coil 15 for the purpose of tuning the circuit in which the coil 15 may be included.

The core 22 is provided with a threaded stud 25 extending axially therefrom through the plate 11, which is in threaded engagement with a nut 26 secured to said plate, said nut being of any well known construction yieldingly engaging the threads on the stud 25 to prevent accidental turning of said stud. Said nut 26 is preferably provided with a tubular extension through the plate 11 securing a disc 28a in centered relation on the plate 11 to form a centering seat for the adjacent end of the tube 14. The end of the stud 25 outside of the nut 26 is provided with a slot 25a to facilitate initially assembling the stud in the nut 26 before the coupling device is connected for use, and said core is provided at its outer or upper end with a cross-slot 22a for accurately adjusting the core 22 to tune the circuit in which the coil 16 may be connected, by correspondingly moving the core 22 axially in the tube 14.

The outer end of the threaded tube 23 is provided with a cross-slot 23a for engaging a suit-

able adjusting tool, for example of the kind shown in Fig. 6, consisting of a rod 27 of insulating and non-magnetic material, having a diameter slightly smaller than the bore in the tube 23, and provided at one end with a flat extension 27a for engaging the slot 22a in the core 22, said rod 27 being provided adjacent its other end with a slender cross-rod 27b having projecting ends for entering the cross-slot 23a in the tube 23 when it is desired to adjust the core 21.

As a result of the construction described, when the coupling device has been connected in desired circuits, the coil 16 and its circuit may be pre-tuned to a desired frequency by inserting the end 27a of the adjusting tool through the tube 23 and into engagement with the core 22, and turning the rod 27 until the desired tuning of the circuit including the coil 16 is secured; similarly, by reversing the rod 27 and engaging the sleeve 23 with the cross-rod 27b, the core 21 may be moved axially relatively to the coil 15 until the desired pre-tuning of the circuit including the said coil 15 is effected. It will be observed that the construction described is simple and inexpensive to manufacture and that it permits the coupling device to be of minimum size consistent with any contemplated use. The rods 12 and 13 although preferably metallic, by being connected with diagonally opposite corners of the plates 10 and 11 are substantially spaced from the coils 15 and 16 so that their effect on the operation of the inductors is so small as to be negligible; the same is true of the bus rods 17. The invention thus provides a compact and efficient construction of coupling device, and at the same time provides for convenient access for adjustment purposes, to either desired one of the adjustable cores of the coupling device, through the same end of the device, thus avoiding the necessity in using the coupling device, of making any tuning adjustments from the end of the coupling device employed to mount the device on a support or chassis.

As illustrated in Figs. 1 and 4, the coupling device may conveniently be contained in a shield can 28 held in place around the plates 10 and 11 by nuts 29 engaging threaded extensions of the rods 12 and 13. The outer end of the shield can 28 is provided with an aperture 30 of substantially the external diameter of the tube 23, and a shutter 31 is pivotally mounted on the inner surface of the end of the can 28, by a rivet 32 so that said shutter may be moved by a lug 31a to close or open the aperture 30 as desired. The shutter 31 is preferably provided with an offset portion 31b entering the aperture 30 for the closed position of the shutter, to hold the shutter in its closed position unless it is desired to open the aperture 30 at which time the opening movement is permitted by the yielding nature of the material of the shutter 31. As shown in Fig. 2 a spring 33 engages at its mid-portion, the external surface of the tube 23, and extends at its ends into engagement with the extensions of the rods 12 and 13, to hold the tube 23 and core 21 in any adjustment that may be given them.

With the cores 21 and 22 constructed as described, and each having an external diameter of $\frac{3}{8}$ ", and with the tubular core 21 having an internal diameter of .2", I find that the core to coil permeability of the core 21 is substantially the same as the core to coil permeability of the core 22.

While I have shown my invention in the particular embodiment described, I do not limit myself thereto as I may employ equivalents thereof without departing from the scope of the appended claims.

Having thus described my invention, what I claim is:

1. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, and a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection, whereby said second core may be turned and adjusted.
2. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection, whereby said second core may be turned and adjusted, and means independently restraining said cores against accidental turning.
3. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection, whereby said second core may be turned and adjusted, a shield can containing said tube and said cores and having an end wall adjacent said first holding connection and apertured in line therewith, and a shutter pivotally connected with said end wall for closing said can aperture.
4. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, and a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection, whereby said second core may be turned and adjusted, said first screw-threaded holding connection including an externally threaded sleeve extending axially from said first core and having a bore for loosely receiving said adjusting rod.
5. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, and a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection, whereby said second core may be turned and adjusted, said cores having substantially the same external diameters as each other.
6. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, and a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection, whereby said second core may be turned and adjusted, said first core having an internal diameter not substantially in excess of half of its external diameter.
7. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, and a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection, whereby said second core may be turned and adjusted, said cores having substantially the same external diameters as each other, and said first core having an internal diameter not substantially in excess of half of its external diameter.
8. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, and a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection, whereby said second core may be turned and adjusted, said cores having substantially the same high-frequency permeability.
9. An adjustable ferromagnetic core assembly for use with high frequency alternating magnetic fields including in combination a tube of insulating material, a first ferromagnetic core having

an axial aperture and mounted for axial movement in said tube and having a first screw-threaded holding connection, and a second ferromagnetic core mounted in said tube for axial movement and spaced axially from said first core and having a rod-engaging conformation accessible to an adjusting rod extended through said aperture in said first core and having a second screw-threaded holding connection.

whereby said second core may be turned and adjusted, said cores having substantially the same external diameters as each other, and said first core having an internal diameter not substantially in excess of half of its external diameter, said cores having substantially the same high-frequency permeability.

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