Oct. 4, 1949. O. D. DAVIS 2,483,994

VARIABLE COUPLING DEVICE

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Fig. 1.

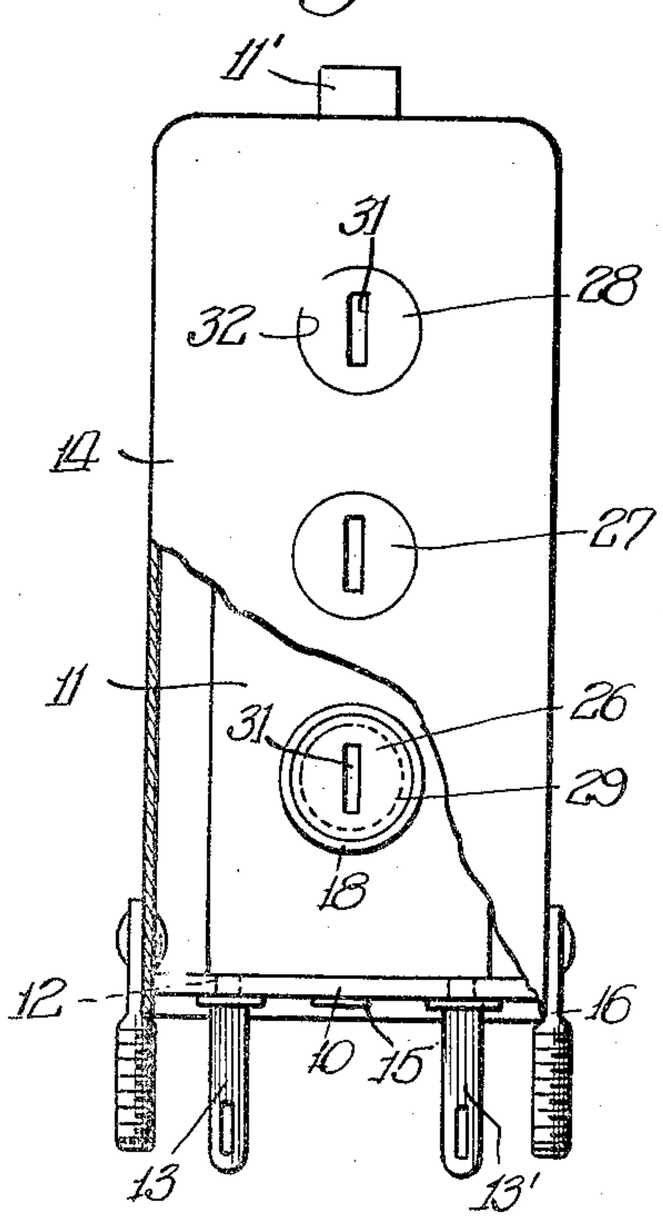


Fig. 2.

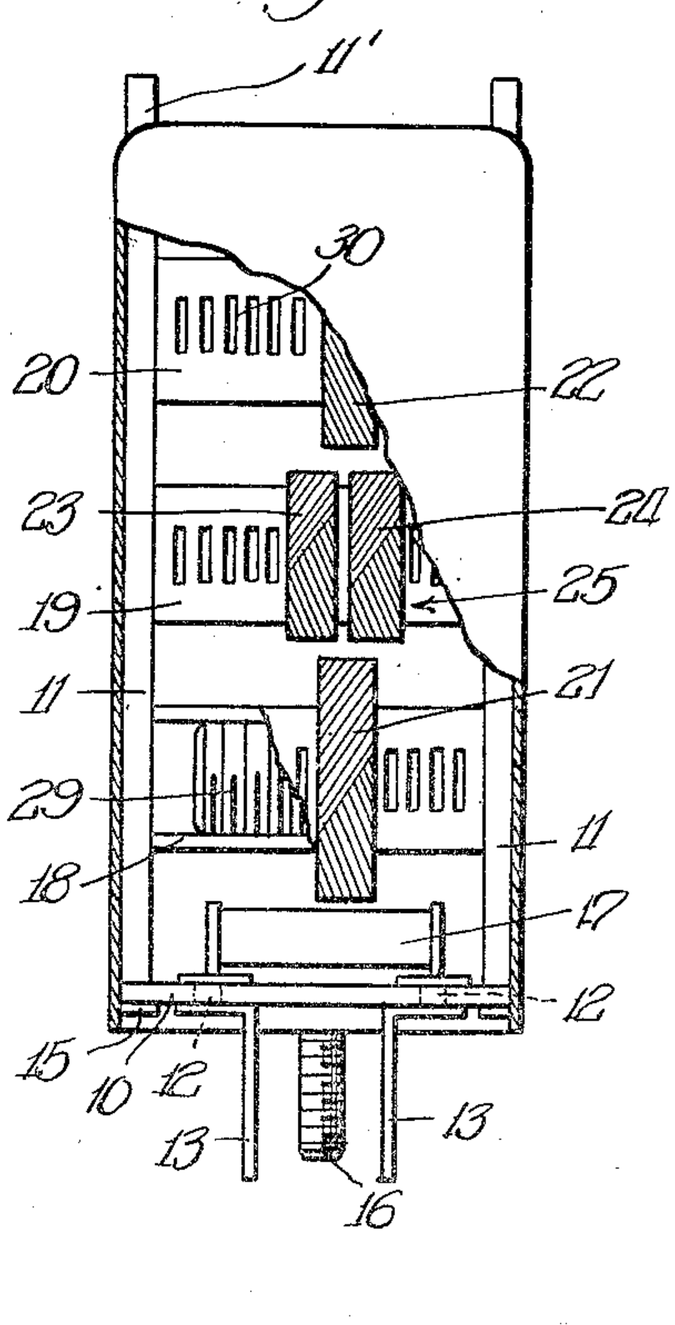
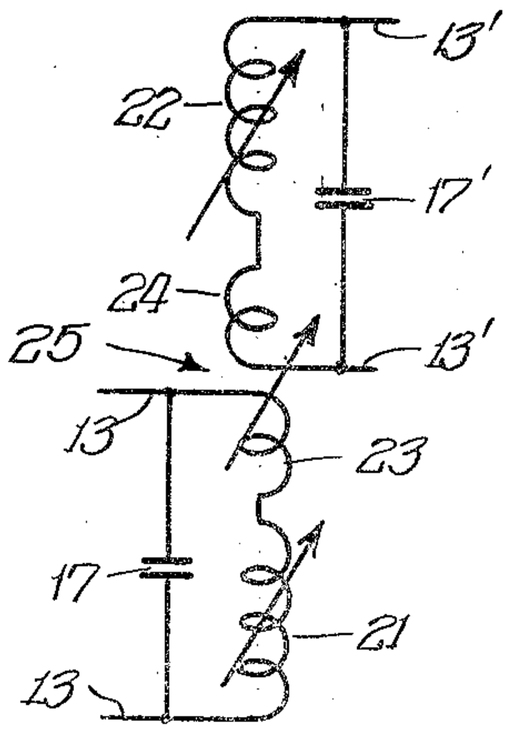


Fig. 3.



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VARIABLE COUPLING DEVICE

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2 Claims. (Cl. 171—119)

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The present invention relates to an improved coupling device or transformer adapted and particularly devised to effect inductive, or inductive-capacitative, coupling at the intermediate frequency stage of a radio circuit. The invention is particularly characterized by provisions for obtaining a variable mutual inductance of the primary and secondary coils of the coupling.

I am aware that it has heretofore been proposed by others to modify existing types of I. F. couplings or transformers to enable individual tuning of the coils thereof by varying the permeability of the individual output and input coils, usually by adjustment of the individual cores thereof, or by splitting the coils into sections or pies. Changes are sometimes effected by the use of tertiary or shading coils as well as by the use of special materials in the coil cores or by special arrangements of the parts.

However, I am unaware of any coupling device which compares to the present in that it enables not only the individual coil inductances to be varied either in the initial tuning of the radio circuit after assembly or in later adjustment, but also permits adjustment of the coupling co-efficient or mutual inductance of the coupling by the manipulation of the permeability of a tertiary coil associated with the primary and secondary. The advantage of such an arrangement resides in the fact that a single I. F. coupling device is thus adapted to regulate all three coupling conditions which are involved in any radio receiver, namely, primary, secondary and mutual inductance.

It is therefore an object of the invention to provide a transformer device for inductive coupling at the I. F. stage of a receiver or the like, wherein provisions are embodied for varying the mutual inductance of the device, without altering the coils thereof.

More specifically, it is an object to provide a coupling device of the foregoing character embodying a tertiary coil in association with the ordinary primary and secondary coils, said tertiary coil being in the form of two distinct and separate windings or pies, which are coaxial and series-connected respectively to said primary and secondary coils and which are adapted to be variably coupled inductively with one another by means of a common adjustable core.

It is a still further object to provide a coupling device of the type described in the preceding paragraph, in which the primary and secondary coils are also provided with individual adjustable core provisions for regulating their respective in-

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dividual inductances and thereby expanding the field of utility of the device.

More generally, it is an object of the invention to provide a coupling device which, by reason of its provisions for adjustment of individual inductances and also of mutual inductance, and resultant large range of performance, is adapted to be installed in practically all types of radio receivers; in which adjustment of the respective coil cores is facilitated; and in which commercial cores and coil windings may be employed.

The foregoing statements are indicative in a general way of the nature of the invention, but other and more specific objects will be apparent to those skilled in the art upon a full understanding of the construction and operation of the device.

A single embodiment of the invention is presented herein for purpose of exemplification, but it will be appreciated that the invention is also susceptible of incorporation in other modified forms coming equally within the scope of the appended claims.

In the drawings:

Fig. 1 is a view in front elevation of the coupling of the invention, being partially broken away in order to more clearly illustrate certain structural features;

Fig. 2 is a similar view in side or end elevation of the device, also partially broken away, showing the special parallel arrangement of the primary, secondary and tertiary coils of the device, the capacitor associated therewith and the provisions for adjusting the coils thereof; and

Fig. 3 is a schematic wiring diagram of the circuit involved in the coupling.

Structural details of the coupling device are illustrated in Figs. 1 and 2. It comprises the opposed pair of end boards and side panels 10, 11 respectively, which are fitted together in opposing relation to one another and rigidly cemented to constitute a rectangular frame. These members are preferably fabricated from a stiff laminated insulating sheet. The lower end board is provided with four apertures 12 through which pairs of primary and secondary terminal leads are brought out and soldered to the grommet-type prong connectors 13, 13 and 13', 13'. These connectors are clinched on the board 10.

Connectors 13, 13' are in turn adapted to have the respective input and output leads at the I. F. stage soldered thereto in an entirely conventional fashion.

The frame constituted by the end boards and side panels 10, 11 is housed in a suitable metallic

shielding can 14, which is apertured at its top to receive the vertical extensions 11' of said panels. The can is secured around the lowermost end board by crimped lugs 15. Threaded mounting posts 16 riveted to the side of said can are provided for securing the coupling on the chassis of the receiver.

A standard condenser 17 is fixedly mounted on the end board 10, being electrically connected in conventional fashion across the input terminals or leads 13, in the manner illustrated in Fig. 3; and a second condenser 17' is similarly mounted and connected across the output terminals or leads 13', i. e., in parallel with the primary and secondary windings, now to be described.

The three tubular coil forms or spools 18, 19 and 20 are fabricated of insulating material and the ends thereof are frictionally received and cemented in holes provided therefor in the opposed side panels 11, said forms extending in spaced, parallel relation between said panels. The forms 18, 20 externally receive respectively, the primary or input coil 21 and the secondary or output coil 22. These coils are of an entirely conventional and standard character, both as to wire gauge, diameter and the number of windings.

The third form 19, disposed between cores 18, 20, receives on its exterior the two windings 23, 24 of a tertiary coil which is generally designated 25. These windings, though coaxial, are entirely separate and distinct, being connected to one another only by their inductive coupling. They are respectively connected electrically in series with the primary and secondary coils 21, 22, as illustrated in Fig. 3.

Mounting of the respective primary, secondary and tertiary coils on three separate axes is advantageous by reason of increased ease of adjustment of the individual inductances, in a manner to be described, as well as due to the fact that this arrangement enables lower coupling than if the coils were arranged, for example, co-axially. In fact, with the present arrangement, zero coupling can be attained if the coils and their cores are pre-determinedly located on their respective axes.

Each of the coil forms 18, 19, 20 internally receives a core of ferromagnetic material, and said cores being designated by the respective reference numerals 26, 27, 28, and in order to enable end-wise adjustment of these cores relative to the respective coils 21, 22, and 25 they are threaded as at 29. Forms 18, 19, 20 are provided with longitudinally spaced indentations 30 for coaction with the threads 29, thereby to enable rotative adjustment of the cores 26, 27, 28 longitudinally of the coils. Elongated slots 31 are formed in the respective cores for the reception of a screw driver or like tool to make said adjustment, and the can 14 is provided with opening 32 in one side thereof in alignment with the respective cores 26, 27, 28, for access thereto.

The primary and secondary coils 21, 22 may be adjusted as to their individual inductances by simple rotative manipulation of the cores 26, 28 respectively, and in addition an adjustment through a wide range of the mutual inductance or coupling coefficient of the device may also be obtained by similar longitudinal adjustment of the core 27 of the tertiary dual-winding coil 25. The variation possible is of the order of 100% and enables a corresponding variation in band width to be obtained. This variation of band width is of such a nature that any one of several different response curves may be selected. Moreover, tests have indicated that the variability of band width made possible by the variable mutual inductance feature extends throughout a considerable range without appreciably changing the gain of the device.

In addition to a wide range of mutual inductance attributable to permeability tuning of the tertiary, different impedances may be optionally realized by connecting any one of a relatively few different values of capacitor 17, 17' across the respective coils. Step-up and step-down ratios between the primary and secondary may be obtained as desired.

Coupled with the fact that the device enables the use of standard coil windings selected from a very few sizes, diameters and gauges, the ready variability of the capacitance value further extends the range of operation of the device, enabling a very few standard, compact models to accommodate the requirements of a large number of different designs and types of radio receiving and related thermionic apparatus.

Following initial setting of the cores of the primary and secondary coils 21, 22, it is only necessary to adjust the core 27 of the tertiary coil 25 upon installation of the transformer for the desired I. F. coupling action. The large number of different transformers heretofore considered necessary to be kept on hand for installation and repair purposes may be replaced by a single coupling of the above described, variable mutual type. A manufacturer need set up production lines to turn out only one or two finished transformer models, instead of a multiplicity. The advantages of this are the obvious advantages of all improvements directed toward manufacturing standardization in any industry.

The simplicity and other advantages of its construction enable a relatively high gain coupling to be constructed in a very compact size to occupy much less space on the chassis than is possible in existing related structures. Furthermore it is adjustable from a single side of the receiver, thereby greatly increasing the ease of tuning.

I am aware that those skilled in the art will appreciate the possibility of various slight modifications of the above described structural features, and of adapting the same for other uses, without departing substantially from the principle involved, and all such modifications and adaptations are regarded as within the scope of the present invention. I consider it novel with me to provide a coupling for I. F. stage installation (although other uses also are possible) which provides constant gain performance while making possible the obtaining of considerably variable band widths, and which is characterized by the feature of variable mutual inductance discussed above.

I claim:

1. A coupling device comprising a support including a shielding container, primary and secondary inductive coils, disposed in said container in parallel, laterally spaced relation on said support, tertiary coil elements in said container disposed in parallel, generally coplanar relation to and between said first named coils said tertiary coil elements being electrically connected respectively with said primary and secondary coils, individual cores disposed coaxially of and within said respective coils and coil elements, and means to adjust said cores individually relative to said respective coils and coil elements to vary the

coupling coefficient of the device and to individually adjust the inductance of said coils and coil elements, said support having openings in one side thereof in alignment with said respective cores for access thereto to adjust the same.

2. A coupling device comprising a support including a shielding container, primary and secondary inductive coils, disposed in said container in parallel, laterally spaced relation on said support, tertiary coil elements in said container disposed in parallel, generally coplanar relation to and between said first named coils, said tertiary coil elements comprising a pair of separate, coaxial windings electrically connected respectively with said primary and secondary coils, individual cores disposed coaxially of and within said respective coils and coil elements, and means to

adjust said cores individually relative to said respective coils and coil elements to vary the coupling coefficient of the device and to individually adjust the inductance of said coils and coil elements, said support having openings in one side thereof in alignment with said respective cores for access thereto to adjust the same.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,180,413	Harvey	Nov. 21, 1939
2,244,025	Schaper	June 3, 1941