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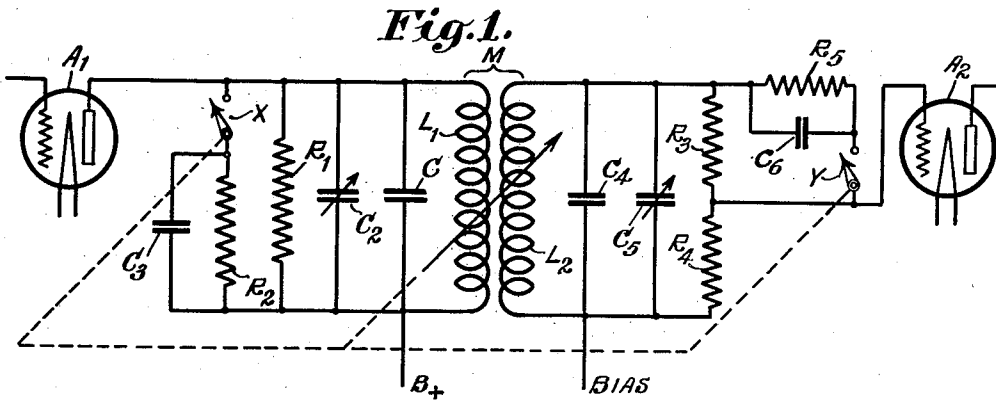
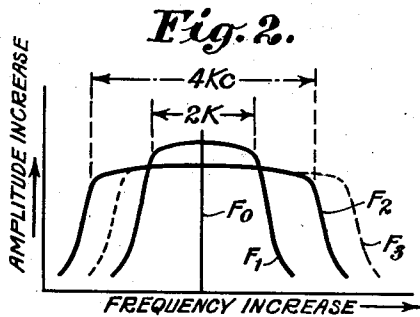
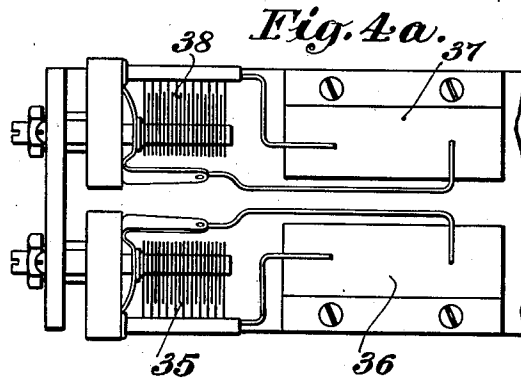
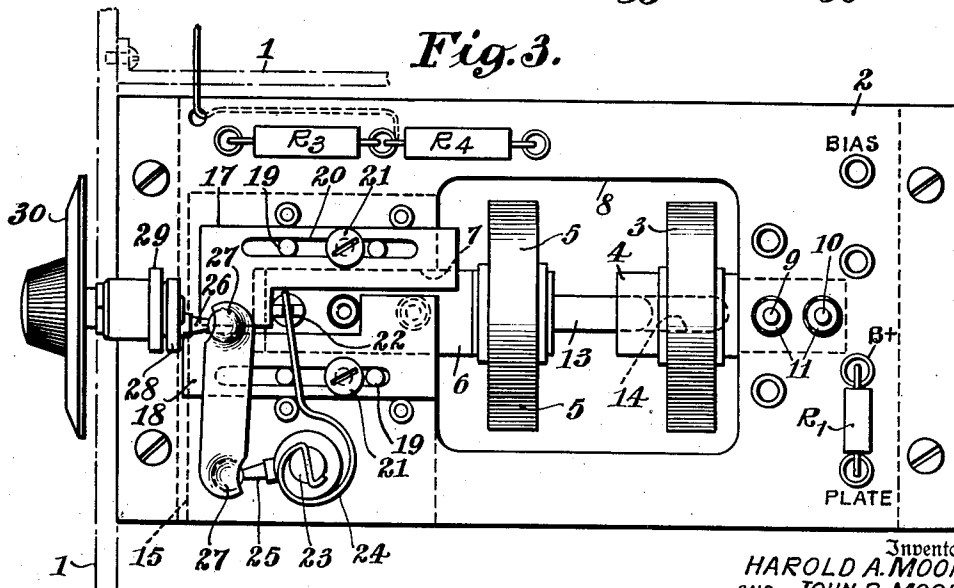
H. A. MOORE ET AL

2,298,498

VARIABLE TUNED TRANSFORMER

Original Filed Aug. 12, 1937

2 Sheets-Sheet 1



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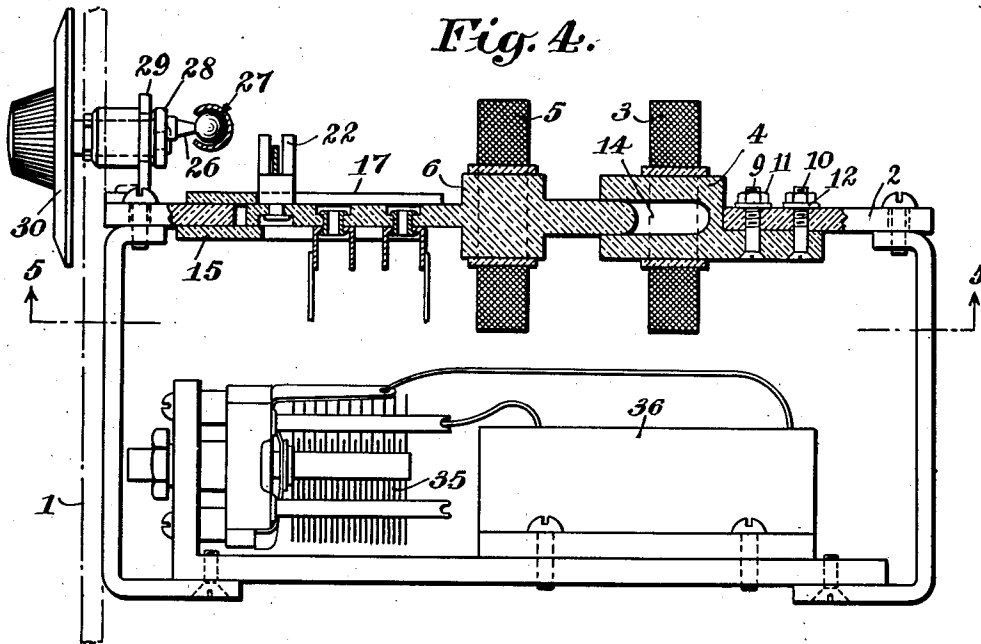
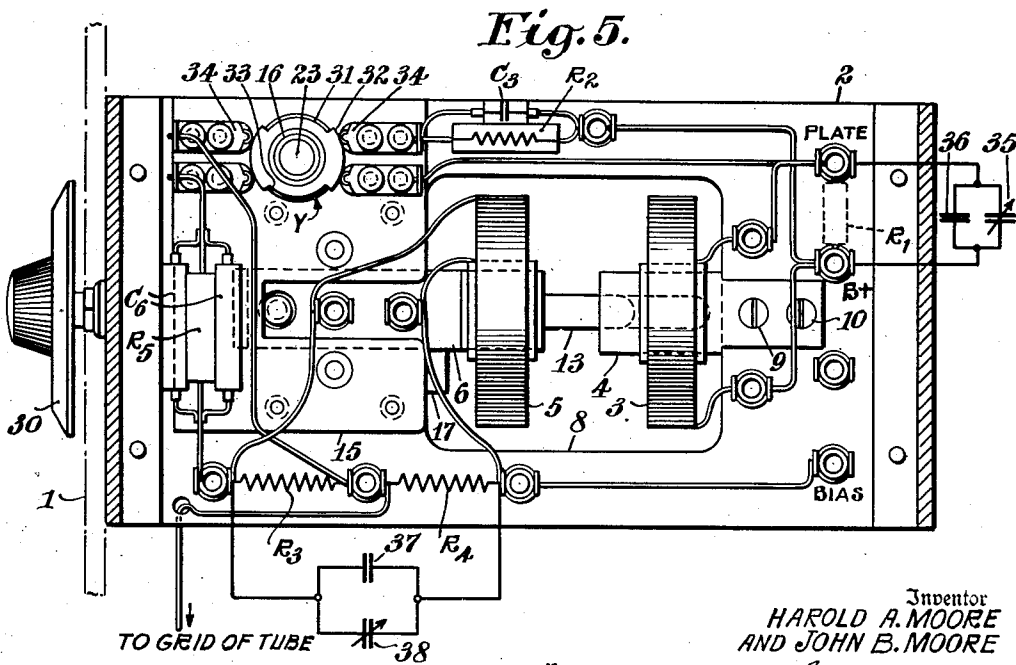
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VARIABLE TUNED TRANSFORMER

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2-Sheets-Sheet 2



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2,298,498

VARIABLE TUNED TRANSFORMER

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Original application August 12, 1937, Serial No.
158,756. Divided and this application May 3,
1940, Serial No. 333,092

12 Claims. (Cl. 178-44)

This invention relates to a new and novel arrangement of tuned transformers; and more particularly to tuned transformers having a variable band-width suitable for use in intermediate frequency amplifier systems of radio receivers.

This application is a division of my copending application Serial No. 158,756, filed Aug. 12, 1937, which is now Patent #2,206,041, issued on July 2, 1940, in which the claims are directed to the structural feature of the invention, whereas this application contains claims directed to the circuit elements.

The object of this invention is to provide a simple means of obtaining two or more band-widths, each having the optimum shape of selectivity characteristics, and each being centered around the same midband frequency.

Prior art methods of changing the band-width of tuned transformers have been such as to obtain the optimum shape of the frequency characteristics at only one value of band-width. Such adjustments were either inaccurate or laborious. The present invention makes it possible to quickly adjust the transformers to give the optimum frequency characteristic at each of the two or more accurately predetermined values of band-width. Briefly, the selection of the desired band-width in accordance with this invention is accomplished by the movement of a knob which simultaneously sets the mutual inductance between the primary and secondary to a predetermined value and either cuts in or out additional damping resistance and tuning capacitance. The object of cutting in and out the preadjusted fixed tuning capacitance and loading resistances is to make the constants of the circuit such that for both conditions of band-width, the midband frequency of the selected band will be constant and the response curve will be essentially uniform (flat topped) throughout the useful pass band.

This invention will best be understood by referring to the accompanying drawings, in which:

Fig. 1 is a schematic circuit diagram of the improved transformer arrangement;

Fig. 2 is a diagram giving a graphic representation of two band-widths;

Fig. 3 is a plan view of the apparatus for accomplishing the purpose of this invention;

Fig. 4 is a side view of Fig. 3, partly in section giving a longitudinal view of the coil coupling arrangement;

Fig. 4A is a plan view of a portion of Fig. 4 showing the variable and fixed tuning condenser arrangement; and

Fig. 5 is an underside elevation of Figs. 3 and 4.

Referring now in detail to Fig. 1 of the drawings, a circuit diagram of a single amplifier stage of a tuned transformer is shown, such as is used in the intermediate frequency amplifiers of radio receivers, and is particularly adapted to what is known as "commercial type" receiving equipment. In this specific embodiment of variable band-width intermediate frequency transformers, the band-width will not be continuously variable (although it is possible by a slight modification of the structure elements to make it so), but the construction will be such that a choice of two or more band-widths is available. The electrical constants of the circuit for each band-width are predetermined. Vacuum tube A1 has its output connected to the primary coil L1 of the intermediate frequency transformer M. Connected in shunt with coil L1 is a fixed capacity C, a trimming condenser C2, a resistance R1, and a switch X which is arranged to switch in an additional shunt resistance R2 and a capacitance C3. A secondary coupling coil L2 is shunted by a fixed capacitance C4, a trimming condenser C5 and terminating resistances R3 and R4. An additional shunt capacitance C6 and resistance R5 are shown as being capable of being switched in circuit by switch Y connected to the junction point of resistances R3 and R4, at which point a connection is made to the grid input of vacuum tube A2.

The particular circuit arrangement shown by Fig. 1 of the drawings provides the same voltage gain on both band-widths. This is accomplished by the combination of loading resistors R1, R2, R3, R4 and R5. In order to keep the characteristic centered around the same mid-band frequency F0, as shown in Fig. 2 of the drawings, when the coupling between coils L1 and L2 is changed, the added capacitances C3 and C6 are switched onto the primary and secondary circuits, respectively, at the same time as are the added resistances R2 and R5. For example, in the graphic representation shown in Fig. 2, F1 represents a two kilocycle per second band-width and F2 represents a four kilocycle per second band-width. If the added capacitances C3 and C6 were not simultaneously switched in by switches X and Y, when the coil coupling is changed, the band-width would be offset from the mid-band frequency F0, as is indicated by the dash lines F3, which would be undesirable from an operating standpoint.

Referring now to Figs. 3, 4 and 5, the mechan-

ical arrangement of the apparatus is shown. The circuit elements are all contained within a suitable shielding can 1 and are mounted upon a base of insulating material 2. The fixed coil 3 is shown supported on base 2 by an insulating rod 4, which has one side cut away for mounting. The movable coil 5 is mounted upon an insulating rod 6, which is cut away on both sides to provide retention means for sliding engagement in a slot 7 of base 2. To provide clearance space for the coils 3 and 5, an aperture 8 is cut out of member 2. Fixed coil support rod 4 is secured to base 2 by a plurality of screws 9 and 10 fastened by nuts 11 and washers 12. Rod 6 is provided with a projecting guide piece 13 which slides or telescopes within a bore 14 of rod 4, ensuring perfect alignment for coils 3 and 5. A plate 15, also of insulating material, is fastened to the underside of base 2. This plate serves the dual purpose of retaining rod 6 in position and also acts as a sub-base for the switch bearing 16. To limit the motion of carrier member 6 and coil 5, two adjustable stop members 17 and 18 are provided. Stop member 17 is shown limiting the movement of coil 5 in its extreme position, which limits the coil 5 in its loose coupled position. Stop member 18 limits coil 5 in its close coupled position. Suitable pins 19 are provided for guiding members 17 and 18 in slots 20, as shown. To vary the amount of movement of coil 5, set screws 21 are loosened, and when the desired coupling positions are secured, stops 17 and 18 are securely fastened in their respective positions by set screws 21. Movement of member 6 and coil 5 is accomplished by a slotted stud 22, which is actuated by a shaft 23 and linked together by a spring member 24 which terminates in a spiral around shaft 23. A ball and socket arrangement 25 is secured to shaft 23 and links together a second ball and socket arrangement 26 by a link 27. A crank shaft 28 passes through a bearing 29, the end of the shaft terminating in an operating knob 30. A switch is provided for connecting in circuit resistance R2, condenser C3, resistance R5 and condenser C6. This switch is in the form of an insulating disc 31 located on the lower end of shaft 23 having contact segments 32 and 33. Contacts 32 and 33 are arranged to connect together a plurality of spring contact members 34 when the switch is rotated to the closed position, which is the position of maximum coupling. Other parts of the transformer comprise the variable condensers 35 and 36, fixed condensers 36 and 37, condensers C1 to C6 inclusive, and the associated resistances R1 to R5, inclusive.

The operation of this improved tuned transformer is as follows: When control knob 30 is turned, for example, from the narrow band to the wide band position, the following functions are performed.

(1) The coupling between coils 3 and 5 is increased by moving them closer together. This increases the percentage coupling and mutual inductance to a predetermined value which is required for the wider band.

(2) Resistance R5 is shunted across a portion of the secondary circuit terminating voltage divider, consisting of resistances R3 and R4, by means of switch Y, completing the circuit between contact members 34. This compensates for the change in gain caused by the change of transformer impedance when the percentage coupling is changed. The total effective damping for the wide band is then made up by shunting another resistance R2 across the primary cir-

cuit by switch X completing the circuit between another pair of contact members 34.

(3) Capacitances C6 and C3 are switched on with the resistances R5 and R2 as mentioned above. The added capacitances increase the effective total capacitance across each coil. The capacity of condensers C6 and C3 are of such value as to make the frequency characteristic of the wide band position center about the same mid-band frequency, as in the case of the narrow band adjustment. These positions were previously described with reference to Fig. 2.

A further modification of this invention is that instead of a choice of only two band-widths, as shown in the drawings, it is possible to provide three or more band-widths by adding additional switch contacts and contact members; also, a detent action should be provided for the various coupling positions.

What is claimed is:

1. A tuned transformer having a variable frequency band width comprising an input and an output circuit, said transformer having a primary and a secondary coil in varying coupling relationship to each other, a fixed and variable condenser in shunt with each primary and secondary coil, an impedance element in shunt with said fixed and variable condensers, and means for simultaneously varying the coupling between said primary and said secondary coil, and for switching additional impedance elements in said input and output circuits for changing the band widths and maintaining the same mid-band frequency for all of said bands.

2. A tuned transformer having a variable frequency band width comprising an input and an output circuit, said transformer having a primary and a secondary coil in varying coupling relationship to each other, a fixed and variable condenser in shunt with each primary and secondary coil, an impedance element in shunt with said fixed and variable condensers, and means for simultaneously varying the coupling between said primary and said secondary coil, and for switching resistance elements in said input and output circuits for changing the band widths and maintaining the same mid-band frequency for all of said bands.

3. A tuned transformer having a variable frequency band width comprising an input and an output circuit, said transformer having a primary and a secondary coil in varying coupling relationship to each other, a fixed and variable condenser in shunt with each primary and secondary coil, an impedance element in shunt with said fixed and variable condensers, and means for simultaneously varying the coupling between said primary and said secondary coil, and for switching capacitance elements in said input and output circuits for changing the band widths and maintaining the same mid-band frequency for all of said bands.

4. A tuned transformer having a variable frequency band width comprising an input and an output circuit, said transformer having a primary and a secondary coil in varying coupling relationship to each other, a fixed and variable condenser in shunt with each primary and secondary coil, an impedance element in shunt with said fixed and variable condensers, and means for simultaneously varying the coupling between said primary and said secondary coil, and for switching resistance and capacitance elements in said input and output circuits for changing the

band widths and maintaining the same mid-band frequency for all of said bands.

5. A tuned transformer having a variable frequency band width comprising an input and an output circuit, said transformer having a primary and a secondary coil in varying coupling relationship to each other, a fixed and variable condenser in shunt with each primary and secondary coil, a resistor in shunt with said fixed and variable condensers, and means for increasing the coupling between said primary and said secondary coils and simultaneously switching reactive elements in said input and output circuits for changing the band widths and maintaining the same mid-band frequency for all of said bands.

6. A tuned transformer having a variable frequency band width comprising an input and an output circuit, said transformer having a primary and a secondary coil in varying coupling relationship to each other, a fixed and variable condenser in shunt with each primary and secondary coil, a resistor in shunt with said fixed and variable condensers, and means for increasing the coupling between said primary and said secondary coils and simultaneously switching a resistance and a capacitance element across said input circuit and a resistance and a capacitance element across a portion of said output circuit for changing the band widths and maintaining the same midband frequency for all of said bands.

7. A transformer having a variable frequency band width comprising a primary coil and a secondary coil in varying coupling relation to each other, a condenser shunting each of said coils, a resistor also in shunt to each of said coils, a switch in circuit with each coil of said transformer and adapted in its closed position to connect an additional resistor in shunt to at least a portion of the associated coil, and unicontrol means for operating both of said switches and for simultaneously changing the coupling between said primary and secondary coils.

8. A transformer having a variable frequency band width comprising a primary coil and a secondary coil in varying coupling relation to each other, a condenser shunting each of said coils, a resistor also in shunt to each of said coils, a switch in circuit with each coil of said transformer and adapted in its closed position to connect an additional condenser in shunt to at least a portion of the associated coil, and unicontrol means for operating both of said switches and for simultaneously changing the coupling between said primary and secondary coils.

9. A transformer having a variable frequency band width comprising a primary coil and a secondary coil in varying coupling relation to each other, a condenser shunting each of said coils, a resistor also in shunt to each of said coils, a circuit composed of a resistor shunted by a condenser associated with each of said coils, and a switch connected to each coil and adapted in its closed position to shunt at least a portion of said coil by its associated circuit of resistor and shunt condenser, and unicontrol means for operating both of said switches and for simultaneously changing the coupling between said primary and secondary coils.

10. A transformer having a variable frequency band width comprising a primary coil and a secondary coil, means for tuning each coil of said transformer, a resistor in shunt to each of said coils, a switch in circuit with each coil of said transformer and adapted in its closed position to connect an additional resistor in shunt to at least a portion of the associated coil, and unicontrol means for operating both of said switches and for simultaneously changing the coupling between said primary and secondary coils.

11. A transformer having a variable frequency band width comprising a primary coil and a secondary coil, means for tuning each coil of said transformer, a resistor in shunt to each of said coils, a switch in circuit with each coil and adapted in its closed position to connect a condenser in shunt to at least a portion of the associated coil, and unicontrol means for operating both of said switches and for simultaneously changing the coupling between said primary and secondary coils.

12. A transformer having a variable frequency band width comprising a primary coil and a secondary coil, means for tuning each coil of said transformer, a resistor in shunt to each of said coils, a circuit composed of a resistor shunted by a condenser associated with each of said coils, and a switch connected to each coil and adapted in its closed position to shunt at least a portion of said coil by its associated circuit of resistor and shunt condenser, and unicontrol means for operating both of said switches and for simultaneously changing the coupling between said primary and secondary coils.

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