

July 2, 1940.

H. A. MOORE ET AL
VARIABLE TUNED TRANSFORMER

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2 Sheets-Sheet 1

Fig. 1

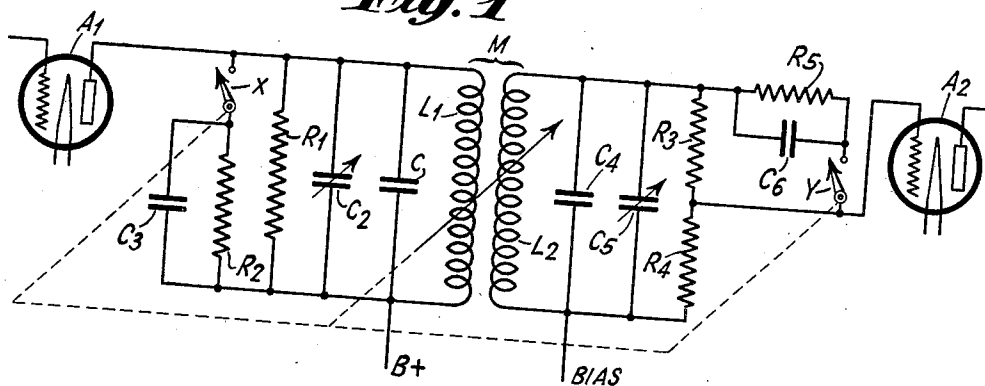


Fig. 2

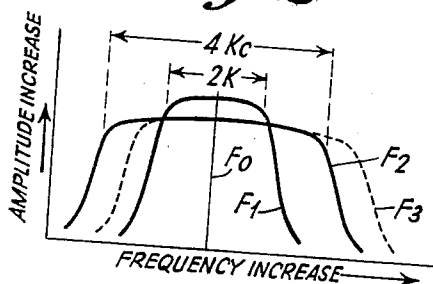


Fig. 4a

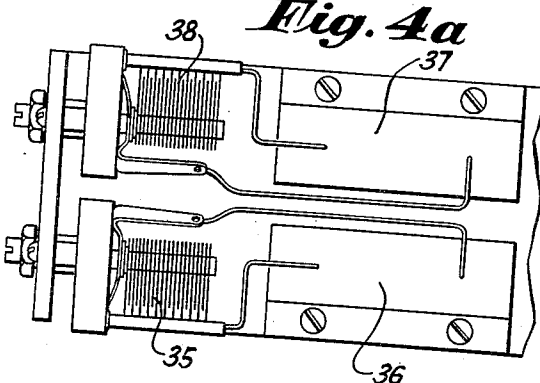
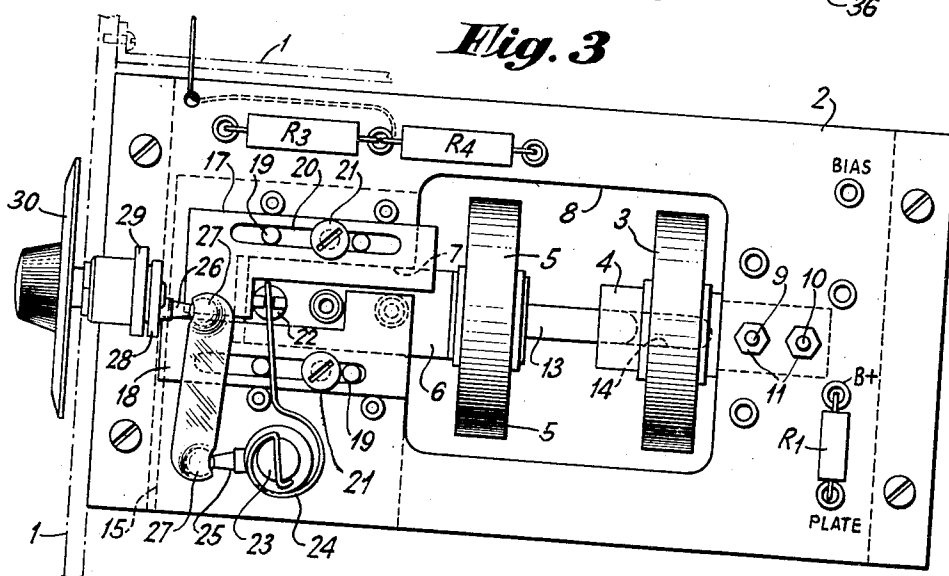


Fig. 3



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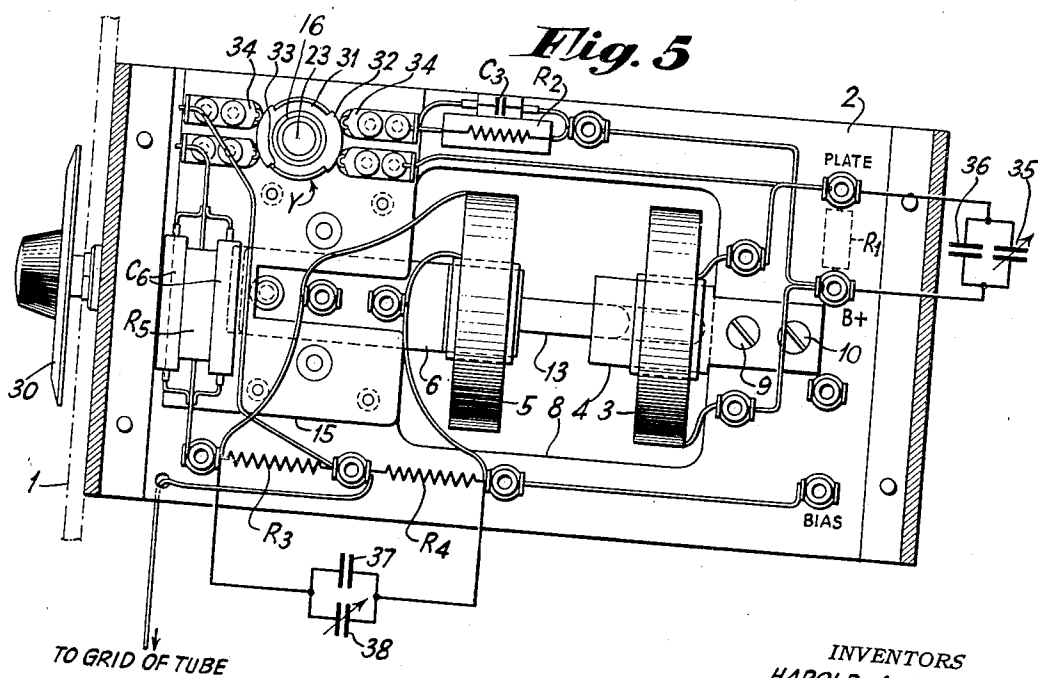
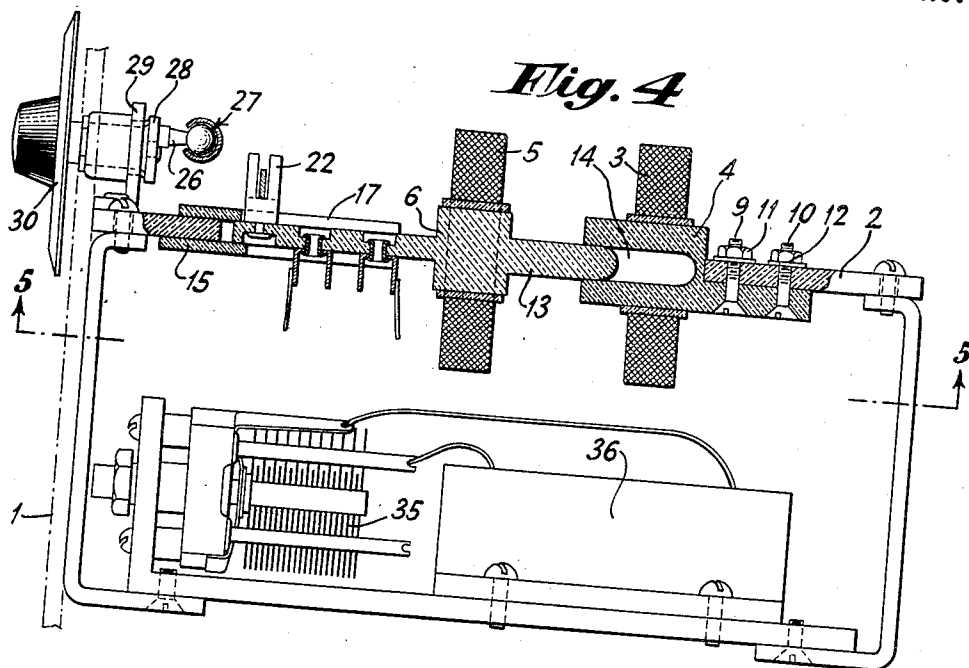
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UNITED STATES PATENT OFFICE

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VARIABLE TUNED TRANSFORMER

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Application August 12, 1937, Serial No. 158,756

7 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.

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 characteristic 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; while

Fig. 5 is an underside elevation of Figs. 3 and 4.
Referring now 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 transformer, 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 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 midband frequency FO, 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 FO, 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 mechanical 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 engage-

ment 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 31 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 38, 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 circuit 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 means for simultaneously changing coupling and electrical circuit constants, comprising a flat base member, a fixed coil secured to said base member by an insulating rod having a central bore, a slot in said base, an insulating movable member arranged to have one end slide in said slot, a movable coil secured to the central portion of said movable member, the other end of said movable member arranged to slide in the bore of said insulating rod to ensure perfect alignment for said coils, an operating knob, and a linkage system arranged between said operating knob and said movable member to move said coil in coupling relationship with said fixed coil.

2. A tuned transformer having means for simultaneously changing coupling and electrical circuit constants comprising a container for said transformer having located therein a flat base member, a fixed coil secured to said base member by an insulating rod having a central bore, a slot in said base, an insulating movable member arranged to have one end slide in said slot, a movable coil secured to the central portion of said movable member, the other end of said movable member arranged to slide in the bore of said insulating rod to ensure perfect alignment for said coils, an operating knob, and a linkage system arranged between said operating knob and said movable member to move said coil in coupling relationship with said fixed coil.

3. A tuned transformer having means for simultaneously changing its coupling and electrical circuit constants comprising a container having located therein a flat base member, a fixed coil secured to said base member by an insulating rod, a slot in said base, an insulating movable member arranged to have one end slide in said slot, a movable coil secured to the central portion of said movable member, an operating knob, a linkage system arranged between said operating knob and said movable member to move said movable coil in such a manner as to change its coupling relationship with said fixed coil, and a switch contact member secured to said base and coupled to said linkage system for switching in or out of the circuit a plurality of resistances and capacitance elements when said coupling is changed.

4. A tuned transformer having means for simultaneously changing coupling and electrical circuit constants comprising a fixed and a movable coil, both of which are mounted on a common base plate by two rod-like members one of which telescopes within the other, means for moving said movable coil in coupling relationship with said fixed coil, said means comprising an operating knob, a link system connecting said movable coil and said operating knob in operative engagement, a flat strip guide member for guiding said movable coil, and a switch contact member mounted on said base member and coupled to said link system for switching in shunt with at least one of said coils a resistance and

2,206,041

capacitance element when the coupling of said coils is changed.

5 5. A tuned transformer having means for simultaneously changing coupling and electrical circuit constants comprising a base member by two rod-like members one of which telescopes within the other, a fixed coil secured to said base member, a slot in said base, a movable member arranged to slide in said slot, a movable coil secured to the central portion of said movable member, an operating knob, a linkage system arranged between said operating knob and said movable member to move said coil in coupling relationship with said fixed coil, and a switch contact member mounted on said base plate and coupled to said link system for switching in circuit a plurality of resistances and capacitances when the coupling of said coils is changed.

10 6. A tuned transformer having means for simultaneously changing coupling and electrical circuit constants, comprising a base member, a fixed coil secured to said base member by an insulating rod having a central bore, a slot in said base, an insulating movable member arranged to have one end slide in said slot, a movable coil secured to the central portion of said movable member, the other end of said movable member

arranged to slide in the bore of said insulating rod to ensure perfect alignment for said coils, an operating knob, and a linkage system including a ball and socket member arranged between said operating knob and said movable member to move said coil in coupling relationship with said fixed coil. 5

7. A tuned transformer having means for simultaneously changing coupling and electrical circuit constants, comprising a base member, a fixed coil secured to said base member by an insulating rod having a central bore, a slot in said base, an insulating movable member arranged to have one end slide in said slot, a movable coil secured to the central portion of said movable member, the other end of said movable member arranged to slide in the bore of said insulating rod to ensure perfect alignment for said coils, an operating knob, and a linkage system including a rotatable shaft on said base, a spring member secured to said shaft, a ball and socket member arranged between said operating knob and said movable member to move said coil in coupling relationship with said fixed coil. 10 15 20 25

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