Jan. 26, 1932. M. A. GIBLIN 1,842,937

RADIO SIGNALING

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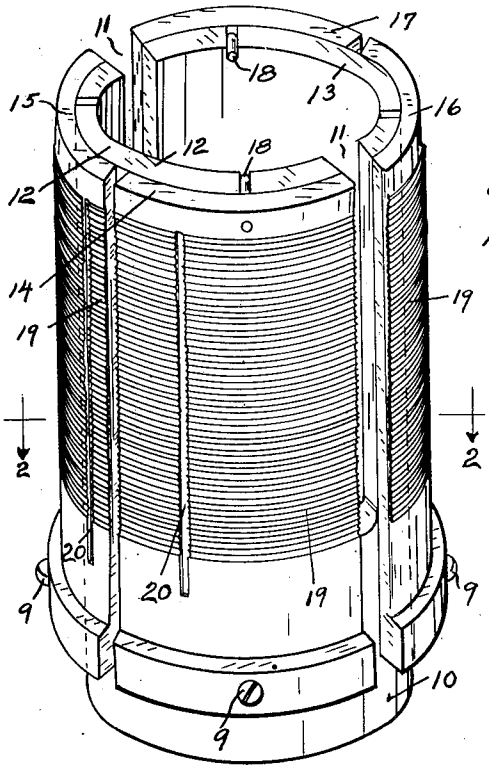


Fig. 1.

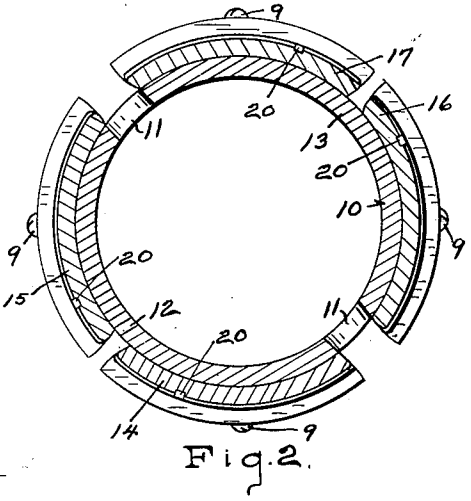


Fig. 2.

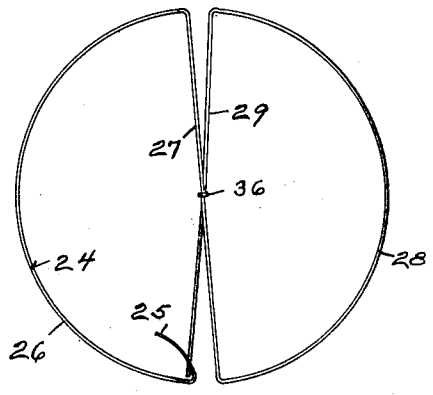


Fig. 3.

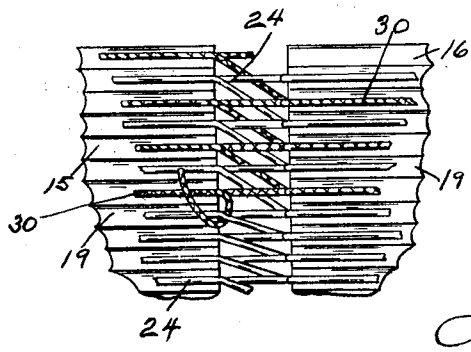


Fig. 4.

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Fig. 5.

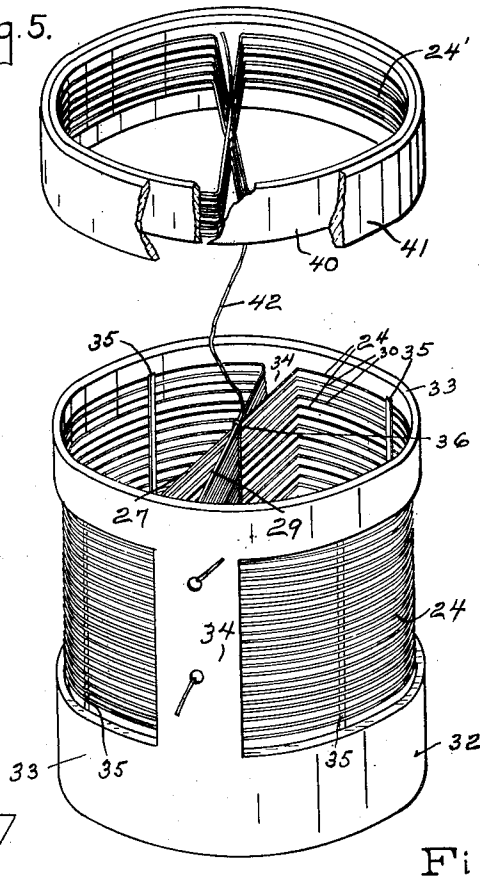


Fig. 6.

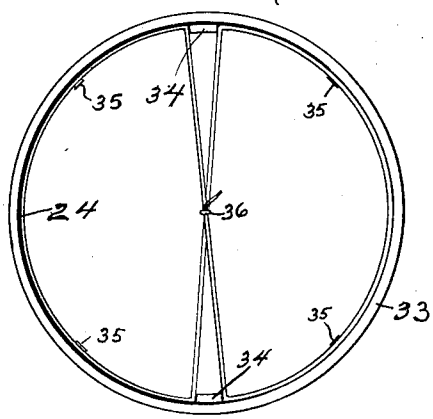


Fig. 7.

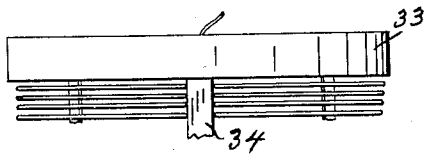
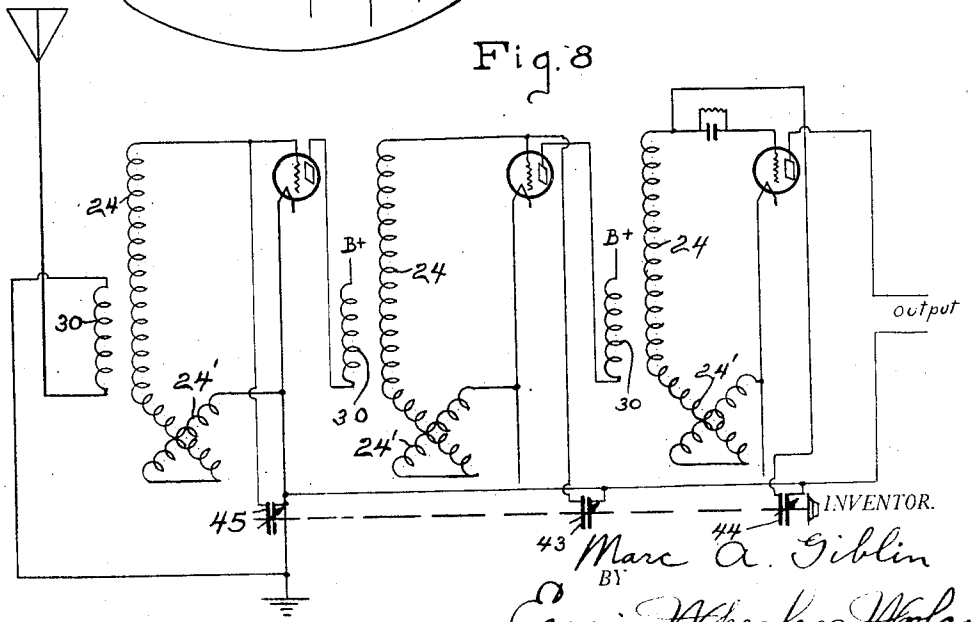


Fig. 8



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UNITED STATES PATENT OFFICE

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RADIO SIGNALING

Application filed February 26, 1926. Serial No. 90,787.

This invention relates to improvements in the art of radio signaling and more particularly to broadcast receivers, radio frequency transformers therefor, and methods and forms for the construction of such transformers.

While the transformer herein to be described is capable of general application to any standard circuit, it is perculiarly adapted to uni-control receivers in which the transformers used in coupling successive stages of amplification must be accurately balanced with each other both as to their initial capacity and as to their ratio of capacity to inductance as affecting their respective increments of change during tuning.

It is the primary object of this invention to provide a transformer economically and by methods so susceptible of standardization as to ensure the accurate reproduction of any required number of transformer instruments of like characteristics and capable of receiving a slight degree of initial adjustment which will harmonize their respective inductance values without appreciable changes in their predetermined capacities. In achieving this result the design of the transformer itself is important and the manner of its construction and the form used in its manufacture are of primary importance.

In the drawings:

Figure 1 is an isometric view of a form for the manufacture of coils in accordance with this invention.

Figure 2 is a section taken on line 2—2 of Figure 1.

Figure 3 is a diagrammatic representation of the manner in which each successive turn is wound upon the form shown in Figures 1 and 2.

Figure 4 is a fragmentary detail in side elevation of the winding form and a few turns of the secondary and primary windings thereon.

Figure 5 is an isometric view of a completed transformer, its adjustable section being spaced away from the first unit thereof in order more clearly to show the construction.

Figure 6 is a plan view of the top of the first unit of the transformer section embodying a slight modification.

Figure 7 shows in side elevation a fragment of the unit appearing in Figure 6.

Figure 8 is a conventional circuit diagram illustrating the manner in which this invention is used in making commercial radio receivers and illustrating conventionally the relative positions and connections of the primary and secondary windings of the several transformers and the manner in which the secondaries of the number of transformers made in accordance with this invention may be tuned to resonance to a common frequency by means of a set of condensers having movable plates interconnected as by mounting on a single shaft.

Like parts are identified by the same reference characters throughout the several views.

The form upon which the coils are wound is shown in Figures 1 and 2. It includes a tubular core 10 which is provided with slots 11 opening to one end thereof and extending in substantial parallelism on opposite sides of the axis to divide the body of the core into two parts 12 and 13. Below the lower ends of the slots, these two parts of the core are connected integrally by an unslotted annular portion.

Upon core 10 are mounted a plurality, preferably at least four, of segmental form sections circumferentially spaced from each other to be readily collapsible when the core is drawn from between them. It will be noted that segmental winding form sections 14 and 15 are mounted on part 12 of the body and sections 16 and 17 are carried by part 13. In order to fix the positions of the several segments accurately on the core while providing for the ready withdrawal of the core the upper margins of the core parts 12 and 13 are notched to receive the keys or positioning pins 18 carried centrally by the several segments in a centripetally projecting direction. Co-operating with these pins are the screws 9, one for each segment, threaded to the core.

The space between segments 15 and 17 and that between segments 14 and 16 are aligned

with the slots between the several parts of the core and are adapted to receive the windings. The spaces between the segments on any given core part, however, have the sole function of facilitating collapse of the form.

Each of the winding form segments is grooved at 19 to facilitate the winding operation. The grooves 19 may take the form of threads projected from one segment to the other but preferably they are segments of true circles. They are preferably spaced slightly to separate the windings for the purpose of reducing distributed capacity in the coils. In addition to grooves 19, it is convenient to provide axially extending grooves at 20 for the purpose of receiving stays which may enter into the construction of the coils. Grooves 20 are spaced equally about the circumference of the coil on either side of slots 11 which may perform the same function.

It is very important to note that the winding form above described, and particularly the core portion thereof, should be absolutely rigid. Otherwise the tension of the wire wound thereon will gradually contract the form by drawing parts 12 and 13 toward the center. This will change the characteristics of the coil and the desired uniformity of successive coils will be impossible. It is preferred to use solid metal for the form.

The form described is adapted to permit the winding of D-coils or figure 8 coils. The completed unit is in effect two air core windings of opposite polarity and constructed from a conductor or conductors to form alternately a turn in each.

In practice, the method of winding the coils is as follows:

The secondary 24 is wound first. With its end 25 held in the bottom of one of the slots 11, a conductor is wound about the two segments on core part 12 as at 26 (see Figure 3) and thence diametrically across the form through the two slots 11, as at 27, to the margin of segment 16. From there the wire passes around the two segments 16 and 17 as at 28 and is carried back through the two slots 11 on a slightly different diameter 29 of the form to a winding groove in segment 14 immediately about the point of beginning. This operation is repeated at the levels defined by this and successive grooves until the major portion of the secondary winding is in place. When the secondary winding reaches the point at which the primary is to begin, the two windings can be placed simultaneously in alternate grooves. This results in very close inductive coupling with little capacity coupling proportionately.

The primary 30 is preferably so disposed with reference to the secondary that when the end of the primary winding is reached a few turns of the secondary will remain to be wound. These turns are separately mounted for reasons to be specified hereafter.

At this stage of the winding operation, a skeleton support 32 of some kind is associated with the turns already wound and is fastened thereto with a suitable adhesive. This support may comprise a tube of such a size as to fit closely over the winding and having portions of its side walls cut away to leave integrally the end annuli 33 and spacing bars 34. The support may also be constructed as shown in Figures 6 and 8 of separate annuli and spacing bars suitably fastened together as by adhesion.

It is particularly to be noted that in each of the two constructions illustrated for support 32, the arrangement is such as to space positively the corners of the two D-coils which comprise each transformer unit. As has already been indicated, the spacing between the corners of the D-coils is determinative of selection, and for the purposes of this invention accuracy in spacing is most important. In the Figure 5 construction the arcuate extent of the spacing bars 34 is sufficient to bridge the gap between the corners of the D-coils and to overlap adjacent peripheral portions of the D-coils to such an extent that such peripheral portions can be cemented thereto. In the construction shown in Figures 6 and 7 the spacing bars have considerably less peripheral extent and are so designed as to fit between the corners of the D-coils, as is clearly shown in Figure 6. A convenient method of construction involves the use of celluloid strips at 34 in the device shown in Figure 6. These strips when treated with acetone or banana oil soften and become highly adhesive. As the banana oil evaporates the strips solidify in adhesion to the adjacent corners of the coils, and their location between such corners is such as to ensure accurate and permanent spacing. The construction of the form is such as to facilitate the practice of this method of spacing the D-coil windings and simultaneously connecting and spacing the annuli 33.

Ribs or stays are also applied to the winding at this time if desired and may under some circumstances be sufficient support for the coils without member 32. A convenient manner of applying these stays is to insert strips 35 of celluloid into the grooves 20 during the winding operation. If these strips are now brushed with a small quantity of acetone or banana oil they will soften and adhere to the adjacent portions of the windings. If further re-enforcement is necessary, a tie 36 may be used at the axis of the coil where the two diagonal portions 27 and 29 of the windings cross each other.

When the windings thus far made have been adequately strengthened and supported, the screws holding the form segments to the core are withdrawn and the core is pulled axially from the two D-shaped coil sectors. The use of four or more segments ensures that

there will be at least two in each sector coil of the transformer and the spacing between each such pair of segments permits their ready collapse for removal. This leaves a unitary assembly of skeleton support and winding suitable for commercial use in that it will withstand a considerable degree of handling.

The remaining turns 24′ of the secondary winding (which may comprise about one quarter of the total number in winding 24) are wound in the same way and inserted in the supplemental support 40, which takes the form of an annulus corresponding in diameter to annulus 33. A sleeve 41 guides the supplemental support for relative rotative movement on top of the main support. The two parts of the secondary winding are so connected in series at 42 as to permit of such rotation to the extent of 180° if necessary. The primary winding and adjustable portion of the secondary are preferably at the end of the transformer at which the secondary is grounded or connected to the filament return lead. By rotation of the transformer unit assembled in the supplemental support 40, the field of the secondary winding therein may be made to re-enforce or oppose the field of the secondary winding in the first unit so as to vary the algebraic sum of the inductances of these two parts of the secondary.

When a number of transformers made as above described are used for antenna or interstage coupling between audions or "tubes" in a radio signal receiver they may be tuned with a set of gang condensers 45, 43 and 44 interconnected as by mounting on a single shaft in the manner indicated by the dotted line in the conventional wiring diagram in Figure 8. Adjustment of supplemental supports 40 to vary the inductances of individual transformers may then be made to correct for any slight discrepancies without material change in the original distributed capacity. Thus each stage may be sharply tuned for high selectivity and perfect unity of resonance with other tuned circuits throughout the range of adjustment of the tuning control.

Those skilled in the art will recognize in the form above disclosed a solution for the problems incident to the form winding of D-coils. Not only can the coils be made to duplicate with great accuracy a desired and predetermined structure, but it will be noted that the coils are of an extremely low loss type with no material whatever within their fields and very little extraneous material near them. The spacing between successive turns of the windings is rendered permanent by stays 35, which ensures a permanently low distributed capacity.

It will be understood that this invention is not to be limited to the specific constructions disclosed except insofar as limitations are contained in the appended claims. I have not attempted to state the many forms in which this invention may be practiced, and the disclosure herein is to be understood as illustrative only. I have not attempted to indicate the number of turns required in the different windings of transformers made in accordance with this invention since the number of turns will necessarily be varied to suit various requirements. By way of illustration, however, I will state that the broadcast wave band is satisfactorily covered by a transformer made in accordance with this invention, wherein portion 24 of the secondary winding contains 35 turns throughout both of the D-coils, and portion 24′ of the secondary is made up of 9 turns throughout both of the D-coils, the primary winding comprising 8 turns throughout both D-coils. The diameter of a coil having the above number of turns may be approximately 2⅞ inches, the wire used may be No. 24 D. C. C., and the condenser used for tuning may have approximately a capacity of .0005 mmf. With the above mentioned values as a guide, other values can readily be determined by known formulas.

By way of further illustration of the fact that the above specific disclosure is to be taken merely as representative of the manner in which this invention may be used, I wish to point out that instead of placing a portion of the secondary on the rotatable support 40 it is possible to place all of the secondary upon the skeleton support 32 and to place the primary on the relatively rotatable support 40. The rotative adjustment of the primary with reference to the secondary will have the effect of varying the inductance of the transformer sufficiently to balance the several transformers of any given set, each with the other, in the manner above pointed out and I have further found that in such cases the balance will be less critical than the balance obtained by adjusting a portion of the secondary. The less critical adjustment is to be preferred for some purposes.

I claim:

1. The combination operatively in the tuning circuits of a radio receiver, of an audion, a plurality of coupling transformers in the input and output circuits of said audion having primaries and secondaries, said secondaries being substantially identical in predetermined capacity, means for adjusting the inductance value of the secondary of one of said transformers without varying the predetermined capacity thereof, and means subject to single control for varying simultaneously the capacities of the secondaries of said transformers, whereby to tune each secondary simultaneously to resonance with a signal of a given frequency.

2. The combination with an audion tube

having a grid and a plate, of first and second transformers having portions connected respectively to said grid and said plate, a grid circuit including a secondary of one of said transformers, a plate circuit including a primary of the other transformer, a secondary inductively coupled to the primary in said last mentioned transformer, both of said secondaries being of substantially identical distributed capacity and one of said secondaries including means for varying its inductive effect without altering its said capacity, and means for tuning said secondaries simultaneously to vary the frequency at which they are resonant, said means comprising like variable condensers shunted across said secondaries and provided with rotor blades subject to a common control.

3. The combination with an audion having a grid and a plate, of transformers having portions connected respectively with said grid and said plate, each of said transformers including figure 8 primaries and secondaries and having portions of their respective secondaries rotatably adjustable about the respective axes of the transformers, whereby to vary the inductive effect of the secondary without materially altering the distributed capacity thereof, together with like condensers of variable capacity shunted across each of said secondaries and each including a set of movable plates connected together for simultaneous movement and adapted to vary simultaneously and equally in the several secondaries the frequencies to which said secondaries are resonant.

4. The combination of a plurality of tuned circuits, each including an inductance, a variable capacitance associated with each said inductance, means connecting said capacitances for simultaneous variation, and means for independently adjusting and fixing the value of each of said inductances, whereby said inductances may be rendered uniform as to their respective values so as to have uniform increments of change in resonance during the simultaneous control of said capacitances.

5. In successive tuned circuits the combination with a plurality of inductances having approximately identical distributed capacity, and each having portions adjustable with reference to other portions thereof in a direction to vary their respective inductance values without materially varying such capacity, of means for substantially synchronously varying the capacities of said circuits, said means including inter-connected variable condensers associated with respective inductances, whereby said circuits will have substantially uniform increments of change in resonance under the control of said condensers.

6. The combination with an audion tube having a grid and a plate, of a grid coil connected with said grid, a transformer including a primary and a secondary and having its primary connected with said plate, variable means for tuning said grid coil to resonance at a desired frequency, variable means for tuning said secondary to resonance at a desired frequency, the respective means having similar increments of change and being inter-connected for simultaneous operation, said grid coil and secondary having substantially like values of distributed capacity and each being provided with a relatively adjustable portion adapted to vary the inductance value of said coil without materially affecting its capacity.

7. The combination of a plurality of tuned electrical circuits including simultaneously variable capacities and individually adjustable inductances fixed at like values.

8. The combination of a plurality of tuned electrical circuits including simultaneously variable capacities and individually adjustable inductances, said capacities comprising inter-connected variable condensers having like increments of change of capacity, and said inductances comprising coils shunting respective condensers, wound in the form of a figure 8 and having like distributed capacities, each of said coils having an individual adjustable portion rotatable with reference to another portion thereof, whereby to vary the interaction of fields of said portions, and to modify the total inductance without materially altering the distributed capacity.

9. The combination in a plurality of tuned circuits, of synchronously variable resonance, said circuits including figure 8 D-coils having successive portions of their respective windings intersecting at relatively acute angles at the common axis of said coils, said coils being of similar distributed capacity, similar variable condensers in the respective circuits connected together for simultaneous variable operation whereby simultaneously to vary the capacity and points of resonance of the respective circuits and means for supporting a portion of the winding of one of said figure 8 D-coils for rotative adjustment about said axis, whereby to vary the total inductance of said coil without material variation of its distributive capacity.

10. In combination, a plurality of tuned circuits, each comprising an inductance and a variable capacity, of single control means provided with means for synchronously varying the capacities of the several circuits, and inductance varying means for co-acting individually with the inductance of each circuit for separately adjusting and fixing said circuit in resonance.

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