Aug. 11, 1925. 1,549,247

F. DE WILLY

RADIO APPARATUS

Filed May 17, 1924

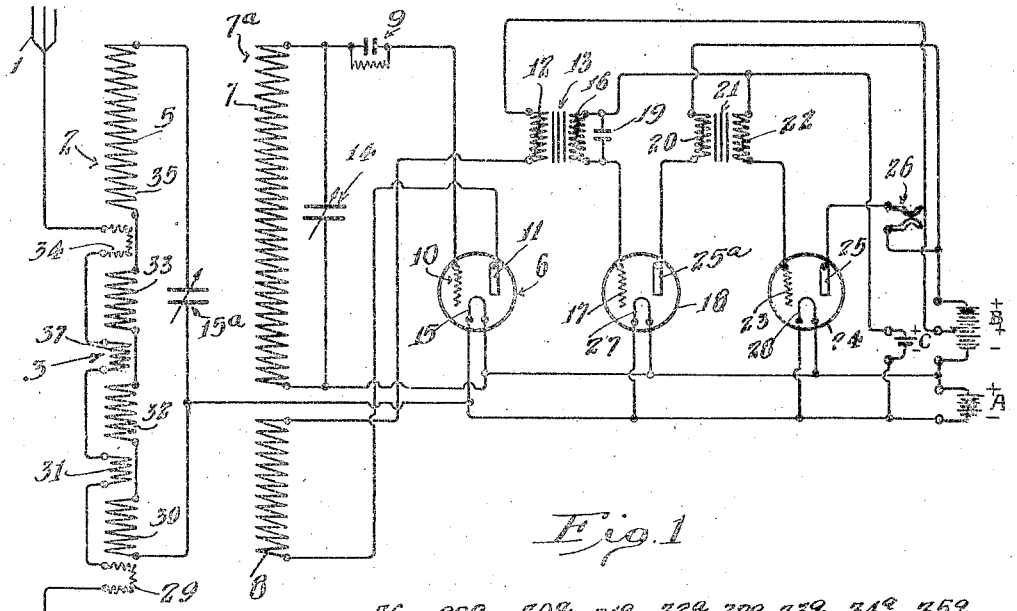

Fig. 1

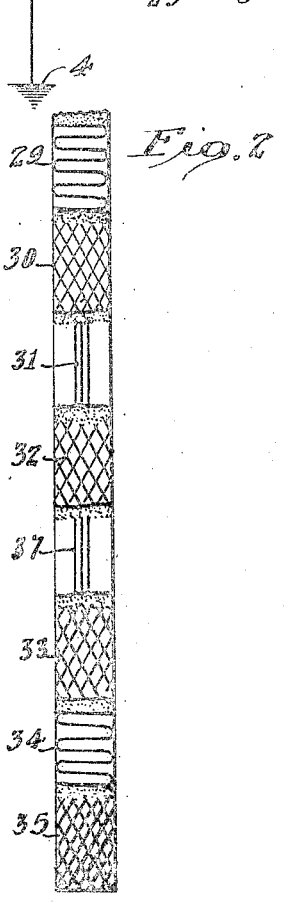

Fig. 2

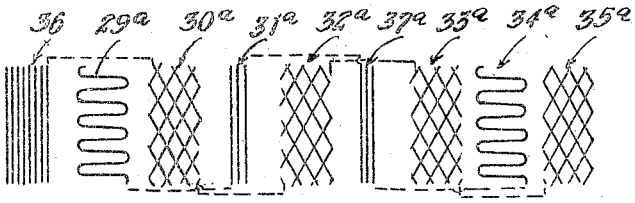

Fig. 4

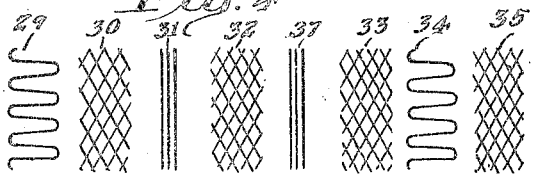

Fig. 3

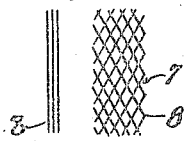

Fig. 5

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UNITED STATES PATENT OFFICE.

FRANCIS DE WILLY, OF LOS ANGELES, CALIFORNIA.

RADIO APPARATUS.

Application filed May 17, 1924. Serial No. 713,995.

To all whom it may concern:

Be it known that I, FRANCIS DE WILLY, a subject of the King of Belgium, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Radio Apparatus, of which the following is a specification.

This invention relates to electrical apparatus and refers particularly to apparatus for use in wireless or radio transmitting or receiving systems.

One object of the present invention is to provide a transformer for an electrical circuit or radio apparatus which is exceptionally efficient in operation in comparison with the present type transformers.

Other objects of the invention are to provide a transformer operating to prevent reradiation of energy from the receiving apparatus; operative to absorb or take up a maximum signal strength; operative to reduce the outside magnetic field around the transformer and thus eliminate undesired coupling with other units of the receiving system; and operative to provide a coupling for a radio apparatus tending to stabilize the action of the apparatus and to increase the range and signal strength.

Another object of the present invention is to provide a simple form of detecting circuit for a wireless receiving set, operative to efficiently amplify signals received while providing a sharp tune and stable apparatus which may be constructed at a relatively low cost.

Various other objects and advantages of the present invention will be apparent from the description of a preferred example of an apparatus embodying the invention, and will be apparent through the use or practice of the invention.

In the accompanying drawings, the invention is shown in its preferred form or forms in which Figure 1 is an electrical diagram of a wireless receiving apparatus embodying the invention.

Fig. 2 is a development of a coil or transformer employed with the above invention, different parts being broken away to show the manner of winding the coil.

Fig. 3 is a diagrammatical view of different windings employed on the coil or transformer of Fig. 2.

Fig. 4 is a similar view of a somewhat modified form, and

Fig. 5 indicates diagrammatically the character of winding on another coil employed in the circuit or apparatus as shown in Fig. 1.

Referring to the drawings, 1 represents the ordinary grounded aerial or antenna connected through a tuning coil or radio frequency transformer 2, the antenna 1 being connected through the primary winding 3 of the transformer, and grounded as indicated at 4. 5 indicates a secondary of the transformer which may, if desired, be connected as usual directly with a detector tube vacuum or audion bulb 6, but in the preferred form of circuit shown the secondary 5 is inductively coupled with a separate pick-up coil 7^a, the separate pick-up coil 7^a preferably having wound thereon separate coil windings 7 and 8. The winding 7 is preferably connected as usual in a grid circuit of such apparatus, one side being connected through a grid leak 9 to the grid 10 of the detector vacuum or audion tube 6.

The plate circuit of the detector tube 6 preferably connects through the excitation coil 8 through a primary 12 of a transformer 13 employed for connecting the tube 6 with succeeding stages of amplification, a positive potential being impressed upon the plate 11 of the detector tube from a suitable source indicated by the "B" battery. The coil 7 preferably is shunted by a condenser 14 and the grid circuit is completed through the filament 15 of the audion tube 6, the filament 15 being heated by an "A" battery. The secondary 5 of the transformer 2 is likewise preferably shunted by a tuning element such as a condenser 15^a and one side of the secondary 5 is preferably connected to one of the leads from the battery "A" to the filament 15.

The remainder of the apparatus is shown in the usual form of cascade audio frequency amplification, the transformer 13 having its secondary 16 in a grid circuit connected to a grid 17 of an amplifying tube 18, and also connected through a "C" battery with one of the leads to the filaments 27. Preferably a small capacity 19 is shunted across the secondary 16 of the transformer 13. The plate 25^a from the first amplifying tube 18 is connected through a primary 20 of an audio frequency transformer 21 to positive lead from the "B" battery or similar source of electric potential. The secondary 22 of the transformer 21 is connected in a grid circuit with the grid 23 of an

amplifying tube 24, the secondary 22 likewise being connected with the said "C" battery. The plate 25 of the tube 24 is connected through a jack 26 or other suitable device for connecting the apparatus to a horn or phone, with a positive lead from the "B" battery or similar source of electrical current, the tubes 18 and 24 being provided with filaments 27 and 28 connecting with the "A" battery as is customary in such cascade amplification.

The transformer or coil 2 is particularly designed to absorb the maximum signal strength from such means as the antenna 1 and designed also to provide an apparatus in which exceptionally sharp tuning may be effected and to provide an apparatus of stable receiving characteristics, the transformer or coil 2 being operative to reduce outside magnetic field and eliminate coupling with other units in the apparatus.

To illustrate the construction of the coil, certain specific details of the practical coil will be hereinafter described, it being understood that such details are given for the purpose of clearness and description and are not essential to the use of the invention. The coil 2 is preferably wound upon a tube, (for illustration a tube three inches in diameter and about three eighths inch long) part of the primary winding 3 of the coil being first wound thereon. The first winding upon the coil is termed a "retardation" winding, indicated by 29. This winding is wound zig-zag or in wave form back and forth across the length of the tube until one complete turn of such zig-zag or wave winding is placed upon the coil. Over such turn of zig-zag winding is then placed some suitable means to insulate or separate such winding from the succeeding winding, paper being suitable for such purpose. Over the covering of paper a part or unit 30 of the secondary winding of the coil is then placed, such winding being a lattice form of winding, preferably being one in which the successive turns cross each other at angles approaching a right angle so as to prevent inductance or capacity between separate winding of the secondary. For illustration, six turns of such lattice work windings are wound in the first unit 30 of the secondary winding. Such unit 30 may then be covered by paper or other suitable material and a part or unit 31 of the primary 3 of the coil is then wound thereover. The unit 31 of the primary is wound straight around the tube in customary solenoid form of winding, for example, three straight turns being wound coil upon coil. The unit 31 of the primary is then also covered with material such as paper and a second unit 32 of the secondary 5 of the coil then wound thereover in the lattice form of winding. For example, six turns of lattice winding might comprise the unit 32 of the secondary. Such a unit is then also covered and a second unit 37 of solenoid winding for the primary of the transformer is wound thereover, three turns of such winding being found satisfactory for this unit. This unit being covered, a further unit 33 of the secondary winding 5 of the transformer is wound thereover. This unit 33 likewise being of lattice type and twelve turns of such winding may be employed in the unit 33. This unit 33 being covered, a second retardation winding 34 for the primary 2 is wound thereover in zig-zag or wave form, one complete winding being sufficient, and this retardation winding being covered a further unit 35 of the secondary is wound in lattice type over the same, the unit 35 being of sufficient turns to provide the desired wave length for the coil, for example, twenty-three turns of such lattice winding may be employed in the unit 35.

The separate units of the primary and secondary are connected as shown in Fig. 1, the units 29, 31, 37 and 34 being connected in series as the primary winding of the coil and the units 30, 32, 33 and 35 being connected in series as the secondary winding of the coil.

It is thus seen that the transformer 2 embodies retardation windings at each end of its primary winding. Each retardation winding being found zig-zag or in wave form provides an impedance in the coil which operates to prevent re-radiation back from the apparatus to the aerial and thus operates to permit the development of high amplification and regeneration desired in the apparatus. The retardation windings 29 and 34 act as sort of a back for the coil operative to positively direct energy from the excitation coil 8 to the grid circuit of the detecting unit and preventing energy from being transformed from the excitation winding 8 through the transformer and hence radiated out through the aerial.

Each of the windings of the coil is constructed to perform the maximum efficiency of their different functions or operations in that the units 31 and 37 of the primary winding are constructed by straight or solenoid winding which provides a minimum resistance to feeble currents supplied thereto, whereas the coils 32, 33 and 35 of the secondary are constructed in such form that inductance between the various turns is greatly reduced if not eliminated and thus distributed capacity between the turns of the secondary reduced.

Moreover, the elimination of distributed capacity or inductance between the different windings of the secondary 5 of the transformer producing an apparatus which may be more sharply tuned by such means

as condenser 15ª and also an apparatus which is more stable in operation. The primary and secondary of the transformer being constructed in units interwoven one between the other substantially increase the amplification possible within such a transformer and such a coil or transformer will develop or impart to the set a maximum amount of energy.

The coil 2 may, of course, have its secondary 5 connected directly in a grid circuit or detector tube and when so employing the coil it may also be desirable to provide an excitation coil or winding therefor, in which case such excitation is wound in solenoid form and below the first retardation winding 29 of the coil as indicated in Fig. 4, the coil shown in Fig. 4 being illustrated diagrammatically as similar to that shown in Fig. 3 but with the addition of an excitation coil 36. For example, eight turns of the solenoid winding first wound may be around and then windings 29ª, 30ª, 31ª, 32ª, 37ª, 33ª, 34ª and 35ª wound thereover similarly to the windings 29, 30, 31 and 32, 37, 33, 34 and 35 of Fig. 3.

In Fig. 5 the preferred form of winding of the pickup coil 7 and its excitation winding 8 are illustrated, the excitation winding 7 being first wound upon a tube in solenoid form of winding of, for example, eight turns and then the winding 7 wound lattice form thereover of sufficient turns to bring the winding to the desired wave length, for example, forty-three turns of the wire in connection with the coil 2 being found to provide a proper proportion. The combination with the coil or transformer 2 of the coil including the windings 7 and 8, provide minimum signal strength with maximum stability and selectivity in the apparatus. The solenoid form of winding permitting the maximum return of energy from the plate circuit, whereas the lattice form of the winding 7 prevents distributing the capacity within the coil, and thus provide selectivity in the apparatus.

The coil 2 is not limited to its application to the detector circuit, but coil or transformer 2 is generally adapted wherever radio frequency amplification is to be employed in a radio apparatus.

This invention is not limited to the details of construction given to illustrate the invention and to clearly disclose the same, but variations in forms and proportions may be made without departing from the spirit of the invention.

The invention is of the full scope set forth in the accompanying claims.

I claim:

1. In a radio frequency coil or transformer, a primary and secondary, the primary winding being of solenoid type and the secondary of lattice type winding, the primary and secondary being constructed in a plurality of units interwoven one between the other.

2. In a means of the character described, a transformer having a primary and secondary, the primary formed of solenoid winding and the secondary of lattice type winding, the primary and secondary winding being formed in units interwoven one between the other, and impedance or retardation windings at ends of the primary winding.

3. In a radio coil or transformer a primary comprising two or more units of solenoid winding interwoven between units of secondary winding, the units of the secondary winding being connected in series and the units of the primary winding being connected in series, and retardation or impedance winding at the ends of the primary winding connected in series with such primary winding.

4. An air core transformer comprising a primary and secondary, the primary having retardation windings at its ends, the primary and secondary being formed in a plurality of units interwoven one between the other, means for insulating the windings, one from the other, the primary winding being of solenoid type and the secondary winding being of lattice type.

5. A radio coil or air-core transformer comprising two windings, insulated from one another and forming a primary and a secondary in inductive relationship, said windings being interwoven in a plurality of units, one between the other, the units of the primary and secondary being of unlike types and separately connected in series.

Signed at Los Angeles, Calif., this 8th day of May, 1924.

FRANCIS DE WILLY.