July 2, 1946. C. E. DOLBERG 2,403,349

COMBINATION COIL AND CONDENSER

Filed Feb. 26, 1944

FIG. 1.

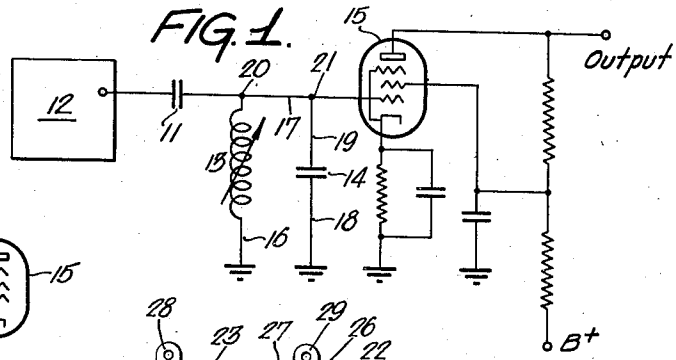
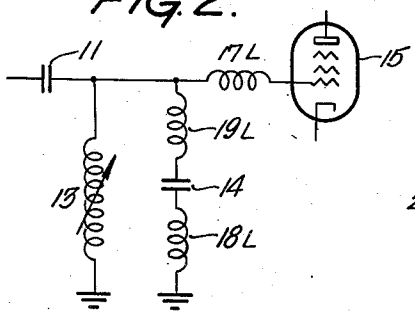


FIG. 2.



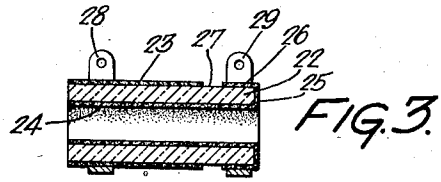


FIG. 3.

FIG. 5.

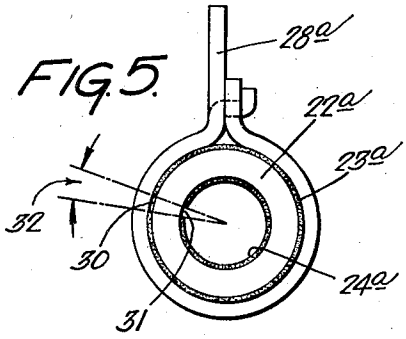


FIG. 4.

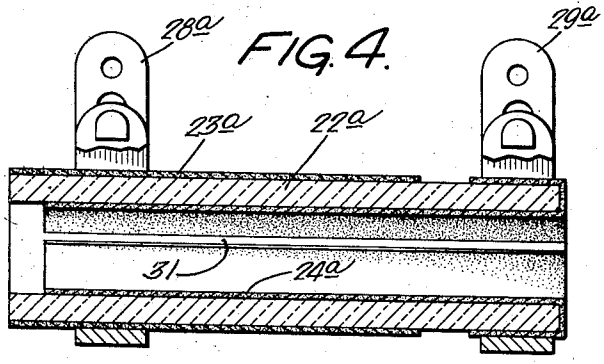
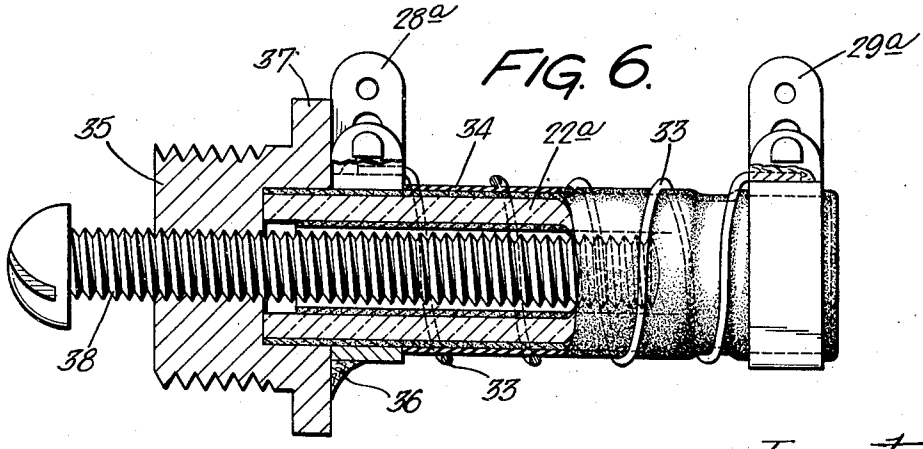


FIG. 6.



Inventor:
Charles E. Dolberg
by his Attorneys
Howson & Howson

Patented July 2, 1946 2,403,349

UNITED STATES PATENT OFFICE

2,403,349

COMBINATION COIL AND CONDENSER

Charles E. Dolberg, Philadelphia, Pa., assignor to Philco Radio and Television Corporation, Philadelphia, Pa., a corporation of Delaware

Application February 26, 1944, Serial No. 524,047

2 Claims. (Cl. 250—40)

1

This invention relates to improvements in the arrangement and construction of the inductance and capacitance elements commonly employed in a resonant combination in high frequency signalling circuits, such as radio circuits and the like. More particularly, the invention relates to a novel combination coil and condenser unit adapted to be employed in such circuits.

In high frequency circuits employing lumped circuit parameters, the tuning elements generally comprise the inductance of a coil and the capacitance of a condenser. Where such a circuit is operated at substantially fixed frequency, as in the case of an intermediate frequency amplifier circuit, the resonant circuit usually comprises a coil of fixed inductance together with a capacity which is variable within a limited range, or alternatively a coil whose inductance may be varied to a limited extent and a fixed condenser.

At very high frequencies, for example those in the range from 30 megacycles to 300 megacycles, the inductance and capacitance of the tuning elements are, of course, necessarily small. For such frequencies the tuned circuit may comprise an inductance coil of very few turns and a small condenser of fixed capacity, such as a condenser of the hollow ceramic tube type. In such case, the leads connecting the coil to its associated condenser may themselves have inductances which are not negligible compared to the coil inductance and which may even be comparable with the coil inductance. Therefore, the lead inductances may produce undesirable effects which are detrimental to the proper functioning and efficiency of a tuned circuit operating at such high frequencies.

The principal object of the present invention is to provide a novel arrangement and construction of the inductance and capacitance elements which eliminates the lead inductances and their detrimental effect.

Another object of the invention is to provide a novel combination coil and condenser unit which not only serves the above purpose but also enables economy of manufacture and assembly.

A further object of the invention is to provide a novel unit of this character in which the condenser serves as the support for the coil, and in which a single mounting means is provided for the entire unit.

Still another object of the invention is to provide a novel means for varying the inductance of the coil in a unitary assembly of this character.

Other objects and advantages of the invention

2

will be apparent from the following detailed description and the accompanying drawing, in which:

Fig. 1 is a diagrammatic illustration of a conventional high gain, high frequency, amplifier stage;

Fig. 2 is a diagrammatic illustration of a portion of the same circuit showing the lead inductances which are normally present;

Fig. 3 is a sectional view of a condenser of the conventional hollow ceramic tube type;

Figs. 4 and 5 are sectional and end views, respectively, of a modified form of such condenser employed according to the present invention; and

Fig. 6 is a part section and part side elevational view of the complete combination coil and condenser unit of the present invention.

Referring now to Fig. 1, there is shown in schematc form a conventional intermediate frequency amplifier stage for a high gain, high frequency circuit, coupled by means of coupling condenser 11 to a preceding stage represented at 12. A variable inductance 13 and an associated condenser 14 form a conventional tuned input or grid circuit of amplifier tube 15. The lower end of coil 13 is connected to ground through conductor 16, and the other end of the coil 13 is connected to the grid of tube 15 by conductor 17. One terminal of condenser 14 is grounded through conductor 18, and conductor 19 connects the other condenser terminal to the upper end of coil 13. It may be noted that points 20 and 21 in Fig. 1 are usually one connection at the upper terminal of coil 13.

The remaining elements of the amplifier are also conventionally connected and since they have no bearing on the invention, no reference to them is necessary.

In accordance with usual practice, coil 13 is a form wound coil and its associated condenser 14 is connected across the coil 13 at some outside points, as indicated in Fig. 1 by the connections between the condenser 14 and coil 13 comprising conductors 16, 18 and 19. As previously mentioned, at the higher frequencies the inductance of the leads or conductors may be appreciable in comparison to the coil inductance. The objectionable lead inductances, in relation to the grid circuit elements of the amplifier stage, are indicated in Fig. 2.

In Fig. 2, the inductance of conductor 18 is represented at 18L, and that of conductor 19 is represented at 19L, while the inductance of grid conductor 17 is represented at 17L. Since con-

ductor 16 is effectively a part of coil 13 its inductance has been included with the inductance of coil 13 in Fig. 2.

For the conditions illustrated in Fig. 2, that is, in situations where the lead inductance is comparable to the coil inductance, or where the lead inductance is not negligible compared to the coil inductance, the inductance with which condenser 14 resonates is the total inductance of coil 13 and lead inductances 18L and 19L.

In any resonant circuit consisting of an inductance and capacity the maximum voltage developed in the tuned circuit is the voltage across the total inductance of the tuned circuit, or the voltage across the terminals of the condenser. It is apparent then from Fig. 2 that the voltage across coil 13 is not the maximum voltage available from the tuned circuit 13—19L—14—18L. Since only the voltage developed across coil 13 is applied to the grid lead 17 of tube 15, the maximum voltage gain of the tuned circuit is not realized in conventional arrangements of the tuning elements. At the higher frequencies, therefore, the inductance of the leads or conductors connecting the circuit elements of a tuned circuit have a deleterious effect upon the gain of an amplifier stage.

By the present invention, there is provided a novel arrangement of the inductance and capacitance elements of a tuned circuit which eliminates the above mentioned lead inductances, as will now be described. According to the preferred embodiment of the invention, a novel combination coil and condenser unit is constructed, utilizing a conventional condenser of the hollow ceramic tube type, modified as hereinafter described. For this reason a clear understanding of the invention will be facilitated by first describing briefly a conventional condenser of the type mentioned, as shown in Fig. 3.

Referring to Fig. 3, the condenser there shown comprises a hollow ceramic tube 22 which constitutes an insulating support for the condenser plate elements. A metallic coating 23, e. g. silver, is provided on the outer surface of the tubular support 22, and a similar coating 24 is provided on the inner surface of the support. As shown in Fig. 3, the inner coating 24 is extended over one end of the support 25 and also over a part of the outer surface of the support as at 26, there being an uncoated annular area 27 between one end of the outer coating 23 and the extended portion 26 of the inner coating. The outer and inner metallic coatings 23 and 24 constitute the condenser plate elements. Terminal elements in the form of metallic collars or clamps 28 and 29 are applied to the metallic coatings as illustrated. The reason for extending the inner coatings as described will now be apparent.

In constructing such a condenser, the tubular support 22 may be coated on all of its surfaces with a silver deposit, and the latter may then be machined away from the areas which are to be uncoated, as shown in Fig. 3. Alternatively, the areas which are to be uncoated may be covered during the depositing process, thus eliminating the machining operation.

According to the preferred embodiment of the present invention, a condenser of the type shown in Fig. 3 and described above is modified as shown in Figs. 4 and 5. It is contemplated, according to the invention, to wind an inductance coil about the outer coated surface of the condenser and to provide suitable insulation between the coil and the metallic coating of the condenser; but if a coil were wound upon a conventional condenser such as shown in Fig. 3, the metallic coatings on the inner and outer surfaces of the ceramic tube would act as short-circuited turns which would materially lower the efficiency or "Q" of the coil. In order to prevent this undesirable effect, the condenser is modified, as shown in Figs. 4 and 5, to adapt it for the purposes of the present invention.

The silver deposit is omitted from narrow longitudinal areas 30 and 31 of the outer and inner surfaces of the ceramic tube 22a, thus interrupting the circular continuity of the silver coatings throughout their entire length. As shown in Fig. 4, the uncoated portions of the inner and outer surfaces may be defined by the sides of a small angle 32.

The complete device provided by the present invention is shown in Fig. 6, utilizing the modified form of condenser illustrated in Figs. 4 and 5. A coil 33 is wound thereabout and is suitably insulated from the metallic coatings. For example, the exterior surface of the condenser may be coated or covered with a suitable insulating material 34 prior to the winding of the coil thereon. Since the device is particularly adapted for use at very high frequencies, the coil 33 may comprise only a few turns, as illustrated. The ends of the coil may be secured to the terminal members 28a and 29a in any suitable manner. It will be seen that this arrangement eliminates the lead inductances represented at 18L and 19L in Fig. 2. The lead inductance represented at 17L in Fig. 2 may be eliminated or greatly reduced, if desired, by mounting the coil-condenser combination very close to the socket terminal of the associated tube, and using a large diameter wire for connecting the resonant circuit to the grid of the tube.

In further accordance with the invention, a hollow mounting member 35 is attached to one end of the device, as shown in Fig. 6. This member is preferably electrically connected to the adjacent terminal member 28a as by solder shown at 36. It preferably comprises a threaded bushing which may be inserted in an opening in the supporting medium, such as a receiver chassis, and fastened thereto by means of a lock-washer and nut.

The invention further contemplates the provision of a tuning element carried by the mounting member 35. Accordingly the said member is provided with internal threads for the reception of a screw 38 formed of non-ferrous metal, which extends into the hollow condenser structure and is adapted to be moved longitudinally to vary the inductance of the coil 33.

It will be noted that bushing 35 provides a convenient means for grounding one terminal of the coil and condenser combination, and the bushing may be inserted in its mounting opening or hole from below the receiver chassis, thus permitting ready access to the adjusting screw 38 whenever it is desired to tune the device.

In a specific embodiment of the invention, in which the condenser had a capacity of 100 micromicrofarads, the ceramic tube was approximately ¼" in diameter and about 1" in length. The coil comprised four turns of No. 18 silver plated copper wire, the combination being resonant at 60 megacycles. The turns of the coil were wound with a constant pitch and were evenly distributed between the two terminals. In this embodiment the terminal 28a was fastened to the outer metallic coating and to the bushing 35, while the ter-

minal 29a was fastened to the inner metallic coating.

From the foregoing description, it will be seen that the invention provides a novel device which eliminates the objectionable effects of the lead inductances above mentioned and which also effects economies in manufacture and assembly. Further the device is advantageous in that it conserves space and facilitates the tuning process.

It will be apparent, of course, that the invention is not limited to the specific embodiment shown, but is capable of various modifications within the scope of the appended claims.

I claim:

1. A combination coil and condenser unit, comprising a tubular insulating support, external and internal conductive elements on said support forming a condenser, a coil wound about the external conductive element and insulated therefrom, a hollow mounting member attached to one end of said support for mounting the unit on a supporting medium, and a tuning element threadedly supported by said mounting member and extending within said insulating support for varying the inductance of said coil.

2. A combination coil and condenser unit, comprising a tubular insulating support, metallic coatings on the internal and external surfaces of said support adapted to serve as condenser plate elements, there being an uncoated area on each of said surfaces extending longitudinally of the insulating support, a coil wound about the external coating and insulated therefrom, terminal means on said support for said condenser elements and said coil, a hollow mounting member attached to one end of said support and adapted for threaded attachment to a supporting medium, and a tuning element threadedly supported by said mounting member and extending within said insulating support for varying the inductance of said coil.

CHARLES E. DOLBERG.