Aug. 6, 1946. A. H. NEYZI 2,405,515

AMPLIFIER COUPLING DEVICE

Filed Sept. 23, 1944

FIG. 1.

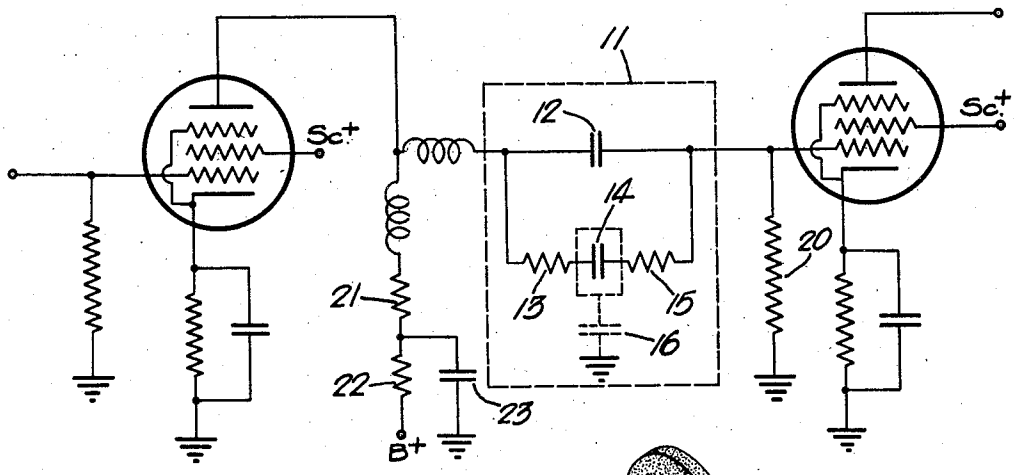


FIG 2.

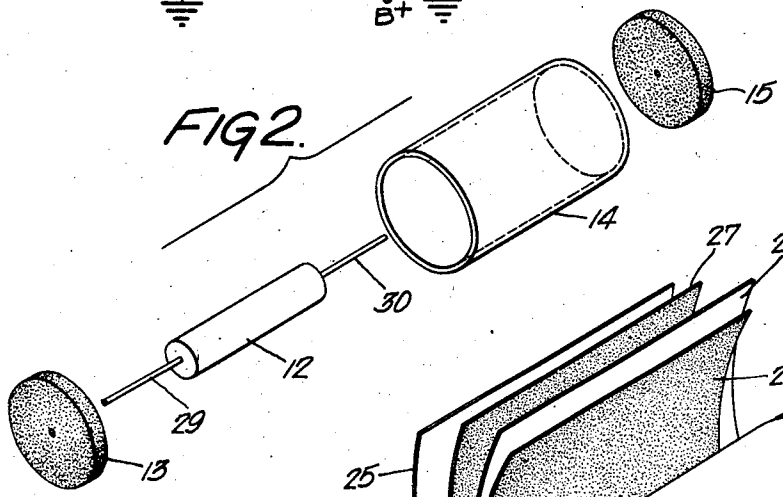


FIG. 4.

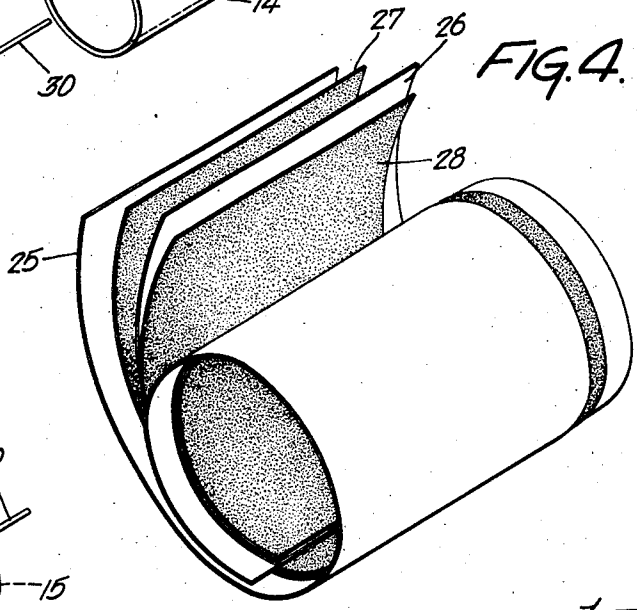
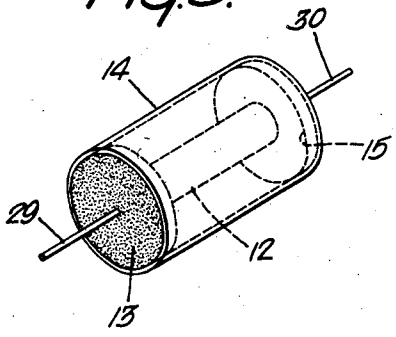


FIG. 3.



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AMPLIFIER COUPLING DEVICE

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3 Claims. (Cl. 250—16)

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This invention relates to amplifier coupling networks and has to do particularly with an improved self-contained coupling unit for use in wide band amplifiers.

In vacuum tube amplifying systems employing capacitors for coupling the output of one tube to the input of the succeeding tube the effect of such a capacitor upon the frequency response characteristic of the amplifying system at the low end of the frequency band, and the effect of the stray capacities to ground of the circuit elements and wiring upon the response at the high frequency end of the band are well known. The gain at the lower frequencies may be noticeably reduced by the increased impedance of the coupling condenser at the lower frequencies. A comparatively large capacity coupling condenser is, then, generally used to minimize the loss of amplification at the lower end of the frequency band. However, a large capacity coupling condenser has, necessarily, relatively large physical dimensions, which results in considerable stray capacity to ground. In video or wide band amplifiers the additional stray capacity introduced by the larger size coupling condenser has, of course, an adverse effect upon the frequency response of the system unless some means is provided, as in the present invention, to isolate and thus render it largely innocuous.

One method for isolating the stray capacity to ground of the larger coupling condenser by means of a resistance-capacitance coupling network is disclosed in U. S. Patent No. 2,270,764, granted to Donald E. Norgaard, January 20, 1942. However, in a coupling network of the type described in the above patent, which is composed of standard resistors and condensers, the stray capacities of the coupling circuit elements and particularly the stray capacities of the element leads and wiring still remain. Any reduction in these latter capacities will, of course, improve the frequency response characteristic of the amplifying system at the higher frequency end of the band.

It is, therefore, an object of the present invention to provide a novel and efficient resistance-capacitance amplifier coupling unit having substantially lower stray capacities to ground than the usual coupling means.

Another object of this invention is to provide a wide band amplifier resistance-capacitance coupling unit which permits fewer assembly operations, when installing the coupling unit in an amplifier, than would be required for the usual resistance-capacitance network.

It is also an object of the present invention to

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provide a novel and compact resistance-capacitance amplifier coupling unit requiring a minimum amount of installation space.

Other objects and advantages of the present invention will become apparent during the course of the following description taken in conjunction with the accompanying drawing, in which:

Fig. 1 illustrates schematically a wide band amplifier circuit employing a resistance-capacitance coupling network;

Fig. 2 is an isometric exploded view of a self-contained unit comprising the component elements of the coupling network;

Fig. 3 is an isometric assembly view of said unit; and

Fig. 4 illustrates the structure of one of the capacitors.

Referring to Fig. 1, there is represented schematically a typical wide band amplifier employing a resistance-capacitance network for coupling the output circuit of the first amplifier tube to the input circuit of the second tube, such as described in the previously mentioned U. S. Patent No. 2,270,764. Since the elements of the amplifier other than those enclosed in the dot-dash rectangle 11 may be arranged in conventional wide-band amplifier fashion it is deemed unnecessary to describe in detail any portion of the amplifier of Fig. 1 except that part in the rectangle 11 to which the present invention pertains. A resistance-capacitance network enclosed in the dot-dash rectangle 11 would preferably be composed of small coupling condenser 12, made small in order to minimize its stray capacity to ground, shunted by a series connection of a high resistance 13, large coupling capacitor 14 and a high resistance 15 preferably of the same value as resistance 13. The stray capacity of the large coupling condenser 14 to ground is diagrammatically represented by the dotted line capacitor 16. It will be noticed that the resistors 13 and 15 isolate this strap capacity from the conductors on each side of condenser 12, hence from the output circuit of the first tube. According to prior practice the coupling network would be composed of standard parts and, in consequence, the stray capacity due to the connecting leads and wiring, plus the stray capacities of the separate component parts, would be sufficient to materially diminish the gain of the amplifier at the higher frequencies.

The present invention contemplates a self-contained resistance-capacitance unit so constructed that stray capacities due to circuit elements, con-

necting leads, and wiring are substantially reduced.

Referring to Fig. 2, the parts of the self-contained coupling unit corresponding to the equivalent elements in the network within dot-dash rectangle 11 of Fig. 1 are identified by corresponding reference numerals. Thus, the small coupling condenser, which may be a small standard tubular condenser, is shown at 12. The large coupling condenser 14 may be a "wrapper" wound condenser which will hereinafter be described with reference to Fig. 4. Condenser 14 is wound in the form of a tube and has an interior diameter of such size that the resistors 13 and 15, which are in the form of thin carbon discs, may be inserted in opposite ends thereof. Each carbon disc contains a suitable opening, preferably in the center, to permit one of the lead wires 29, 30 on the small condenser 12 to pass therethrough.

Referring to Fig. 3, which shows the relative positions of the coupling unit elements when assembled, each lead from the small coupling condenser 12 is suitably fastened in electrical contact with one of the carbon discs 13 and 15; and one plate or terminal of large condenser 14 is suitably fastened in electrical contact with the periphery of one of the carbon discs. It is readily apparent then that the device illustrated in Fig. 3 is electrically equivalent to the resistance-capacitance network included in the dot-dash rectangle 11 of Fig. 1. That is, each terminal of capacitor 12 is connected to a terminal of capacitor 14 through a high resistance formed by the path from the center to the periphery of each carbon disc.

By reducing to a minimum the length of element lead wires and wiring associated with the coupling network included within rectangle 11 of Fig. 1, the coupling unit of the present invention substantially reduces the stray capacities to ground of the coupling network. Furthermore, it is obvious that the construction here illustrated and described, reduces the number of operations required to assemble the coupling network in an amplifier. Since the coupling unit of this invention is so constructed that capacitor 12 and resistors 13 and 15 are within the large coupling condenser a substantial saving in installation space is possible.

Referring to Fig. 4, one method of constructing the large capacitor 14 of Fig. 2 is illustrated. From Fig. 4 it will be noted that capacitor 14 may be wound in a manner similar to that employed in the manufacture of the usual paper wound condenser; that is, alternate strips of thin conducting material, such as aluminum foil, and thin insulating material, such as oiled paper, are rolled or wound to form the condenser. Thus, in Fig. 4 the two strips of conducting material are shown at 25 and 26 and the two strips of insulating material are shown at 27 and 28. In accordance with usual practice the conducting sheets 25 and 26 extend from opposite sides of the insulating sheet 27 thereby providing a terminal at each end of the condenser when it is wound. The second insulating strip 28 is placed on top of conducting sheet 26 as shown in Fig. 4, or alternately on the underside of conducting sheet 25, to insulate the two conducting strips 25 and 26 from each other when the condenser is wound. Also the insulating strips 27 and 28 are preferably slightly wider than the overlapping portion of the conducting sheets, as shown in Fig. 4, in order to remove the possibility of the two conducting sheets coming in contact with each other and to reduce the possibility of arc-over.

As previously stated, the large condenser 14 is wound so as to have an inside diameter such that one of the carbon discs can be inserted in each end of the condenser, thereby providing a means of direct connection between each plate of said condenser and the periphery of one disc.

It is apparent from Fig. 3 that the length of the wound condenser 14 should be such that with the carbon discs 13 and 15 in place the distance between said discs must be at least equal to the length of the small condenser 12.

Any suitable means may be employed as a protective covering for condenser 14. Likewise, the coupling unit as a whole may be encased within a housing of dielectric material.

In practicing this invention, typical circuit values for the various components of the coupling unit may be:

Condenser 12	3000 micro-microfarads
Condenser 14	0.25 microfarad
Resistors 13 and 15	500,000 ohms each

The precise values used in an amplifier circuit would, of course, depend upon the type of tubes, voltages and circuit constants of the particular amplifier. For good frequency response and phase shift characteristics, certain relations should be maintained between the circuit values of the coupling network and the values of the other elements of the amplifier circuit as explained in the U. S. patent previously mentioned.

It is to be understood that this invention is capable of a variety of physical embodiments and is, therefore, not limited to the specific disclosure, but only by the scope of the appended claims.

I claim:

1. A self-contained electrical coupling unit comprising a pair of spaced elements composed of high resistance material, a first condenser bridging the gap between said elements, a pair of lead wires each connected individually to a plate of said condenser and forming the terminals thereof, said lead wires each contacting one of said elements individually and projecting outwardly therefrom, and a tubular wound condenser having a pair of plates, one of said spaced elements being inserted in one end of the bore of said tubular condenser and in contact with one only of the plates thereof, the other of said spaced elements being inserted in the other end of the bore of said tubular condenser and in contact with the other only of the plates thereof.

2. A self-contained electrical coupling unit comprising a pair of discs of high resistance material spaced apart in face-to-face relation, each of said discs having a central aperture, a first condenser disposed between said discs and having a pair of terminal lead wires extending individually through said apertures and outwardly therefrom, each of said lead wires being in electrical contact with the disc through which it extends, and a tubular wound condenser, said discs being inserted individually in the two ends respectively of the bore of said tubular condenser and forming closures for the two ends of said bore, the peripheries of said discs contacting respectively the two plates of said tubular condenser.

3. A self-contained electrical coupling unit comprising a pair of discs of high resistance material spaced apart in face-to-face relation, each of said discs having a central aperture, a first

condenser bridging the gap between discs and forming a separator therebetween, said condenser having a pair of terminal lead wires extending individually through said apertures and outwardly therefrom, each of said lead wires being in electrical contact with the disc through which it extends, and a tubular wound condenser forming

a wall of said unit, said discs being inserted individually in the two ends respectively of the bore of said tubular condenser and forming closures for the two ends of said bore, the peripheries of said discs contacting respectively the two plates of said tubular condenser.

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