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V. D. LANDON

1,930,523

AMPLIFYING SYSTEM

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Fig. 1.

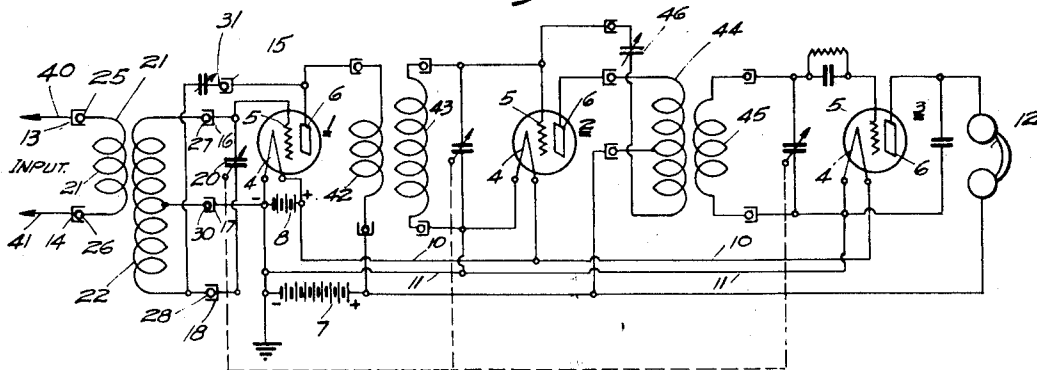


Fig. 2.

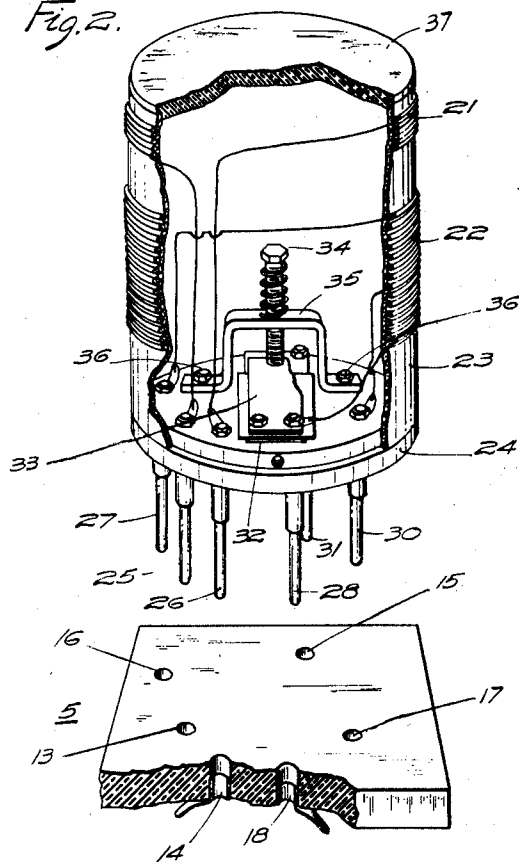


Fig. 5.

Fig. 3.

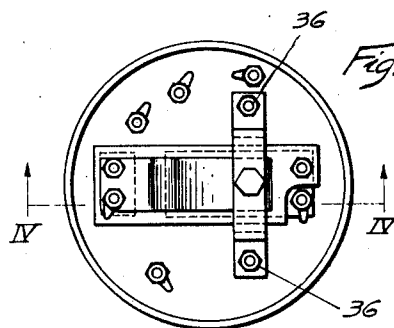
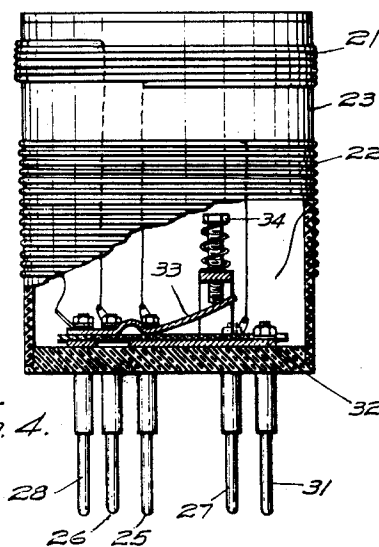


Fig. 4.



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1,930,523

AMPLIFYING SYSTEM

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9 Claims. (Cl. 179—171)

My invention relates to amplifying systems, and it has particular relation to amplifying systems of the type wherein a plurality of thermionic devices are utilized for the amplification of high frequencies, the said devices being interconnected through transformers.

By reason of the fact that commercial radio work is now being carried on over a wide range of frequency-channels, a commercial radio receiver must of necessity be so constructed as to be responsive to many more frequencies than the usual amateur, or broadcast receiver, if the receiver is to be utilized in situations where it is not feasible to maintain separate receivers for each of a plurality of frequency-bands.

A single tunable transformer, of the type generally used for intertube coupling, is usually only efficient over a relatively narrow band of frequencies, and, for that reason, many receivers have been arranged to make use of plug-in coils, or transformers, the characteristics thereof being so chosen that efficient coverage of a large number of frequency-bands may be secured by substituting, in the set, different groups of the said coils.

It is also highly desirable, for convenience in operation, that the receiving set shall be equipped with means for simultaneously adjusting all of the tuning elements thereof by means of a single control device.

When a plurality of thermionic devices are connected in cascade through tuned intertube transformers, and arranged to amplify at radio frequencies, undesired oscillations, caused by the feeding back of energy from the output circuits of the tubes to the input circuits thereof through the interelectrode capacity, become very troublesome. It has previously been proposed to neutralize the tendency toward self-oscillation by feeding back, through a neutralizing circuit, sufficient energy in opposite phase to the undesired feed-back to cancel the latter.

Anti-oscillation systems of many of the conventional types give good results over a somewhat limited tuning range, but necessitates constant re-adjustment when plug-in coils or transformers are used to cover a wider range of frequencies.

It is, accordingly, an object of my invention to provide an amplifying system capable of efficiently covering a much wider range of frequencies than analogous systems constructed according to the teachings of the prior art.

Another object of my invention is to provide an amplifying system wherein any one of a plu-

rality of plug-in coils, or transformers, may be utilized as an inter-tube coupling device without disturbing the neutralization of the system against parasitic oscillations.

Another object of my invention is to provide a plug-in transformer that shall be particularly adapted for use in an amplifying system of the aforementioned type.

In accordance with my invention, I provide a radio receiving system having, as fixed elements thereof, a plurality of variable condensers, each condenser being connected across the input terminals of a thermionic device, and I further provide means whereby all of said condensers may be simultaneously adjusted by a single actuating device. I provide also a plurality of intertube transformers, each transformer being mounted on a base having asymmetrically arranged plug-terminals. Also, I mount one or more small variable neutralizing condensers on the said base, and so arrange the permanent wiring of the receiving set and the connections of the transformer to the neutralizing condenser, that, when the transformer is plugged into an appropriate socket in the receiving set, the said neutralizing condenser is properly connected in the circuit, as well as the primary and secondary windings of the transformer.

The novel features that I consider characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with further objects and advantages thereof, will best be understood from a consideration of the following description of a specific embodiment, taken in connection with the accompanying drawing, in which

Fig. 1 is a diagrammatic view of a portion of a composite amplifying system comprising several embodiments of my invention,

Fig. 2 is a perspective view of a plug-in transformer constructed according to my invention, a portion of the insulating wire-supporting form being broken away to show the manner in which a neutralizing condenser is mounted in the interior thereof,

Fig. 3 is a bottom plan view of the device shown in Fig. 2,

Fig. 4 is an elevational view of the device shown in Fig. 2, a portion thereof being sectionalized along a line corresponding to the line IV—IV of Fig. 3, and

Fig. 5 is a perspective view showing the manner in which the openings in a socket device are so

arranged as to preclude incorrect positioning therein of one of the plug-in transformers.

Fig. 1 illustrates what might well be termed a "composite" amplifying system, in which two modifications of my invention are incorporated. The apparatus shown therein comprises a plurality of thermionic amplifying tubes 1 and 2 and a thermionic detector tube 3. Each of the tubes is of the usual type, having a filament 4, a grid 5, and a plate 6, and all of the tubes are supplied with plate potential from a common source 7. A common source 8 supplies potential to the filaments of the tubes, which filaments are connected in parallel to the source through a plurality of conductors 10 and 11.

A pair of telephones 12, or an analogous device, is included in the output circuit of the detector tube 3. A plurality of plug-terminal receiving elements 13, 14, 15, 16, 17 and 18 are associated with the first amplifying tube, being arranged as shown in Fig. 5, the elements 15, 16 and 17 being conductively connected to the plate, the grid and the filament, respectively. A variable condenser 20 constitutes a fixed component of the amplifying system, the rotary plates thereof being connected to the plug-terminal receiving element 13, and the stationary plates being connected to the grid of the tube and the element 16.

An input transformer, comprising a primary winding 21 and a secondary winding 22, is associated with the first thermionic tube by means of the aforementioned plug-terminal receiving devices 13, 14, 15, 16, 17 and 18. The transformer, which is shown in detail in Figs. 2, 3 and 4, comprises a cylindrical form 23 of insulating material, on which are positioned the primary winding 21 and the secondary winding 22. A cylindrical closure 24, or base-member, is semi-permanently fixed in one end of the insulating form 23 and carries a plurality of plug-terminals 25, 26, 27, 28, 30 and 31. The ends of the primary winding are conductively connected to the terminals 25 and 26, the ends of the secondary winding are connected to the terminals 27 and 28, while an intermediate point on the secondary winding is conductively connected to the terminal 30.

A neutralizing condenser, comprising a fixed plate 32 and a movable plate 33, is mounted on the base-member 24, the movable plate being adjustable toward and from the fixed plate by the rotation of a screw 34 which extends through a saddle-shape element 35 arranged transversely of the condenser and held on the base-member by a plurality of bolts 36. Access may be had to the adjusting screw 34 by removing a closure 37 which fits the end of the insulating form opposite to the base-member, the said closure preventing, to some extent at least, the alteration of the condenser-setting by dust or moisture.

The movable plate of the neutralizing condenser is connected to the terminal 28 and to one end of the secondary winding 22. The fixed plate of the neutralizing condenser is connected to a terminal 31 to which no other part of the coupling device is connected.

A plurality of conductors 40 and 41 are connected to the fixed terminal-receiving elements 13 and 14, respectively, which conductors may be included either in any energy-receptor circuit (not shown) or which may be included in the output circuit of a preceding amplification stage.

It will, accordingly, be apparent that, when the coupling device is inserted in the socket-elements, the inductor 22 is thereby connected in shunt to the tuning condenser 20, and a reversed

feed-back circuit is completed from the plate 6 of the device 1 to the filament 4 thereof, through the neutralizing condenser and that portion of the inductor comprised between the lower end of the inductor and the connection therefrom to the filament. The circuit thus constituted is that known to those skilled in the art as the "Rice" circuit.

The thermionic device 1 is illustrated as being coupled to the thermionic device 2 through an ordinary plug-in transformer, having a primary winding 42 and a secondary winding 43, although a coupling device similar to that just described could be used in this position, if desired.

The thermionic device 2 is illustrated as being coupled to the thermionic device 3 through a plug-in device constructed according to a modification of my invention. The later device comprises a transformer having a primary winding 44, a part of which is included in the output circuit of the thermionic device 2 and a part of which is utilized for neutralizing the tendency of the system toward self-oscillation, and a secondary winding 45, which winding is included in the input circuit of the thermionic device 3. The transformer mounting also carries a neutralizing condenser 46 which serves to complete a neutralizing circuit between the plate and filament of the device, as illustrated.

It lies within the scope of my invention to utilize coupling devices of both of the types hereinbefore described, although, in any given receiver, it may be preferable to couple all of the thermionic tubes carrying high frequencies through devices of the same type.

It also lies within the scope of my invention to utilize either auto-transformers or tuned impedances as coupling devices between thermionic tubes, instead of the transformers illustrated.

When practicing my invention, the neutralizing condensers carried by each of the plurality of coupling devices necessary to cover a range of commercial frequencies are carefully preadjusted while the said devices are in position in the receiving set with which they are later to be used. When, subsequent to the initial adjustment, it is desired to shift from one frequency-range to another, one group of coupling devices may be removed and another substituted therefor with full assurance that the neutralization of the set will not be disturbed in the slightest.

When the thermionic tubes with which the coupling devices are adjusted are replaced by others, the neutralization of the set is substantially unaffected, inasmuch as the tube capacity is, in general, only a small percentage of the total distributed capacity of the inductors comprised in the coupling device.

My invention, therefore, proves of very marked advantage in the commercial reception of radio signals, in situations, such as on ship-board, where it is not feasible to operate a plurality of receiving sets, and where it is often necessary to rapidly shift from one frequency-range to another.

Although I have shown only two specific forms of my invention, it is deemed sufficiently broad in scope to cover all coupling devices for high-frequency amplifying systems, and other amplifying systems, wherein a neutralizing condenser is a constituent part thereof and insertable therewith into a socket-device. My invention, therefore, is not to be limited except insofar as is necessitated by the prior art or by the spirit of the appended claims.

I claim as my invention:

1. As an article of manufacture, a coupling device comprising a plurality of inductors, a supporting element for holding said inductors in inductive relation, a base-member in which said element is mounted and a neutralizing condenser mounted on said base-member.
2. As an article of manufacture, a coupling device comprising a transformer, a base-member on which said transformer is mounted, plug-terminals on said base member, a neutralizing condenser mounted on said base member and connections between said transformer, said condenser and said plug-terminals.
3. In combination, radio receiving apparatus comprising at least two thermionic tubes, a socket device, a coupling device comprising an inductor and a neutralizing condenser, the capacity of which is approximately the capacity between two electrodes of a receiving tube, plug-terminals carried by said coupling device, connections between said thermionic tubes and said socket device and connections between said inductor, said plug-terminals and said neutralizing condenser, whereby when said terminals are properly inserted in said socket device, a circuit is completed for the transfer of energy between said thermionic devices through said inductor and said neutralizing condenser.
4. In combination, radio receiving apparatus comprising at least two thermionic tubes, a socket device therein, connections from said tubes to said socket device, a coupling device comprising an inductor and a neutralizing condenser, plug-terminals carried by said coupling device and connections between said inductor, said plug-terminals and said neutralizing condenser, whereby, when said terminals are properly inserted in said socket device, a circuit is completed for the transfer of energy from one of said thermionic tubes to the other of said tubes through said in-
- ductor and another circuit is completed through said neutralizing condenser for preventing the generation of parasitic oscillations.
5. As an article of manufacture, a coupling device comprising an inductor, an insulating form for said inductor, a base for supporting said form, a neutralizing condenser mounted on said base interiorly of said form and means for substantially preventing dust and dampness from injuriously affecting said condenser.
6. As an article of manufacture, a coupling device comprising an inductor, an insulating hollow form for said inductor, semi-permanent closures for the ends of said form, and a neutralizing condenser mounted on one of said closures interiorly of said form, the capacity of which is approximately the capacity between two electrodes of a receiving tube.
7. As an article of manufacture, a coupling device comprising an inductor, an insulating hollow form for said inductor, semi-permanent closures for the ends of said form, and an adjustable neutralizing condenser mounted on one of said closures interiorly of said form, the other of said closures being removable to permit the adjustment of said condenser.
8. As an article of manufacture, a coupling device comprising an inductor and a neutralizing condenser supported within said inductor, the capacity of said neutralizing condenser being approximately the capacity between two electrodes of a receiving tube.
9. As an article of manufacture, a coupling device comprising a plurality of inductors and a neutralizing condenser, the capacity of which is approximately the capacity between two electrodes of a receiving tube and a common support for both said inductors and said neutralizing condenser.
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