

July 10, 1928.

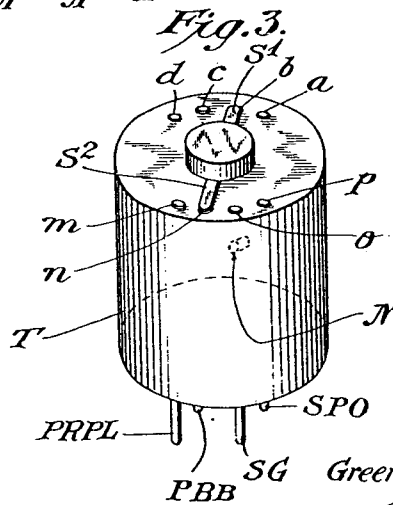
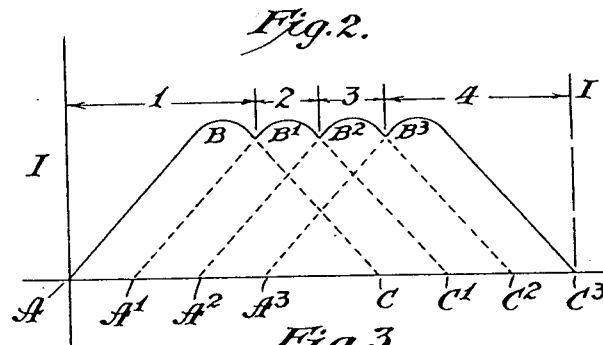
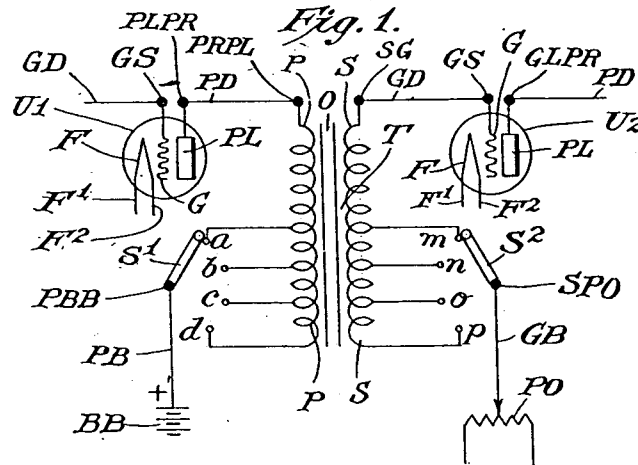
1,676,744

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ELECTRICAL AMPLIFIER

Filed Feb. 5, 1923

6 Sheets-Sheet 1



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Fig. 4.

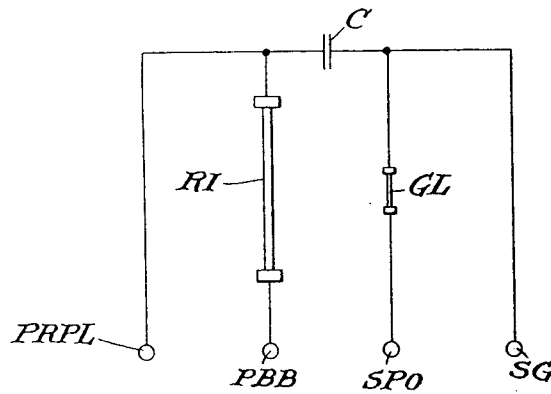


Fig. 6.

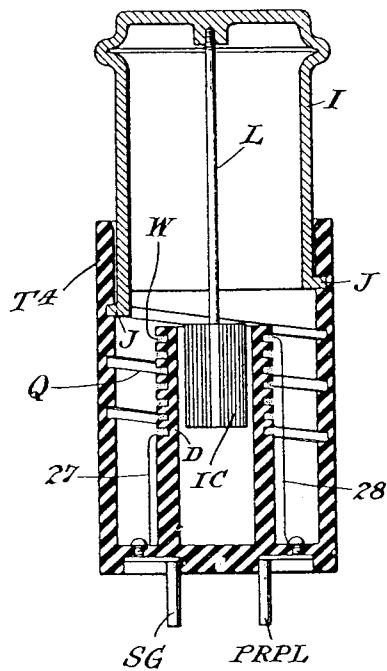
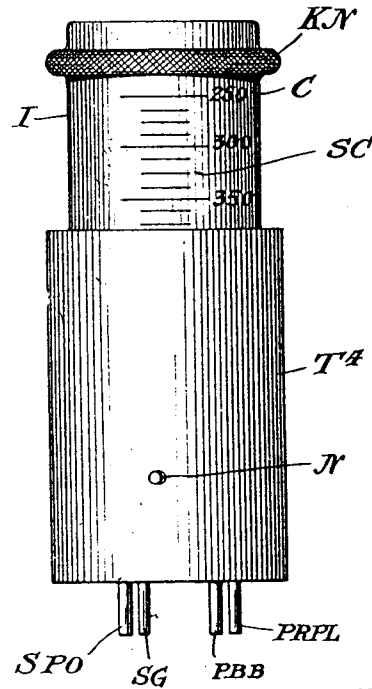


Fig. 7.



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Fig. 8.

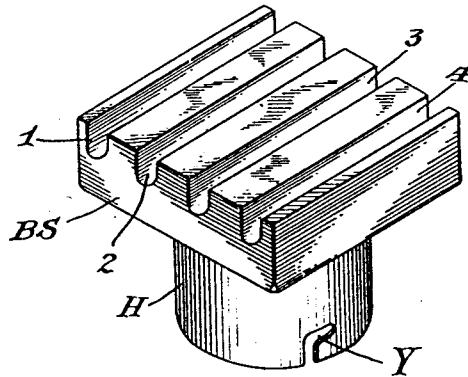


Fig. 9.

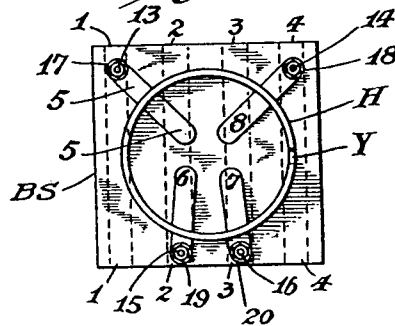
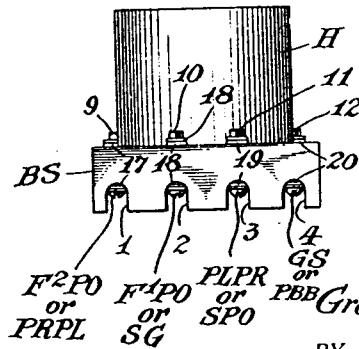


Fig. 10.



F^2P0
or
PRPL
 F^1P0
or
SG
PLPR
or
SP0
GS
or
PBB

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Fig. 12.

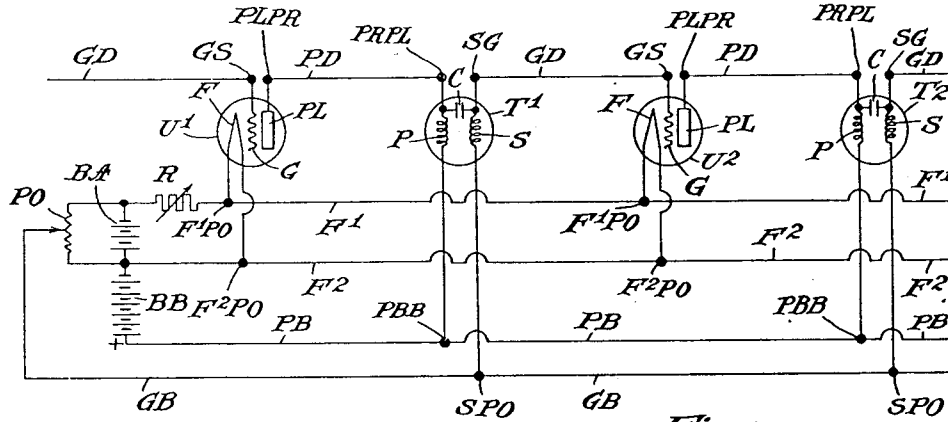


Fig. 5.

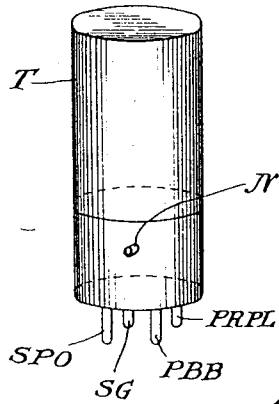


Fig. 11.

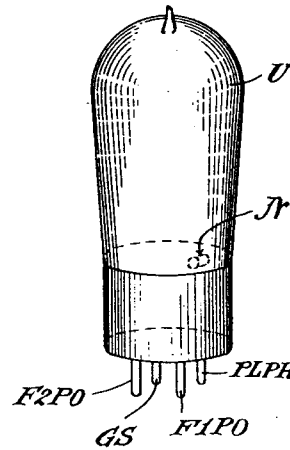
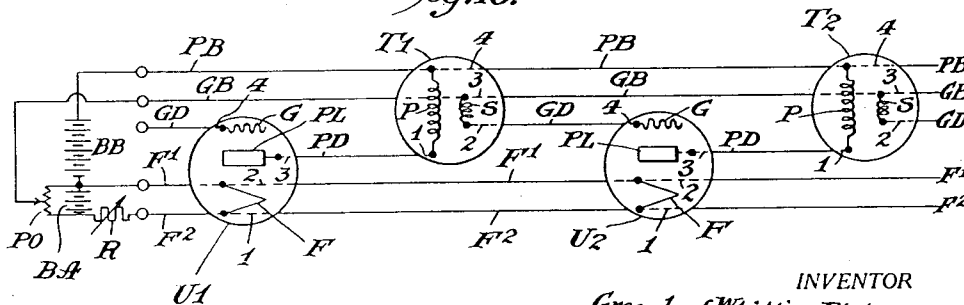


Fig. 15.



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Fig. 13.

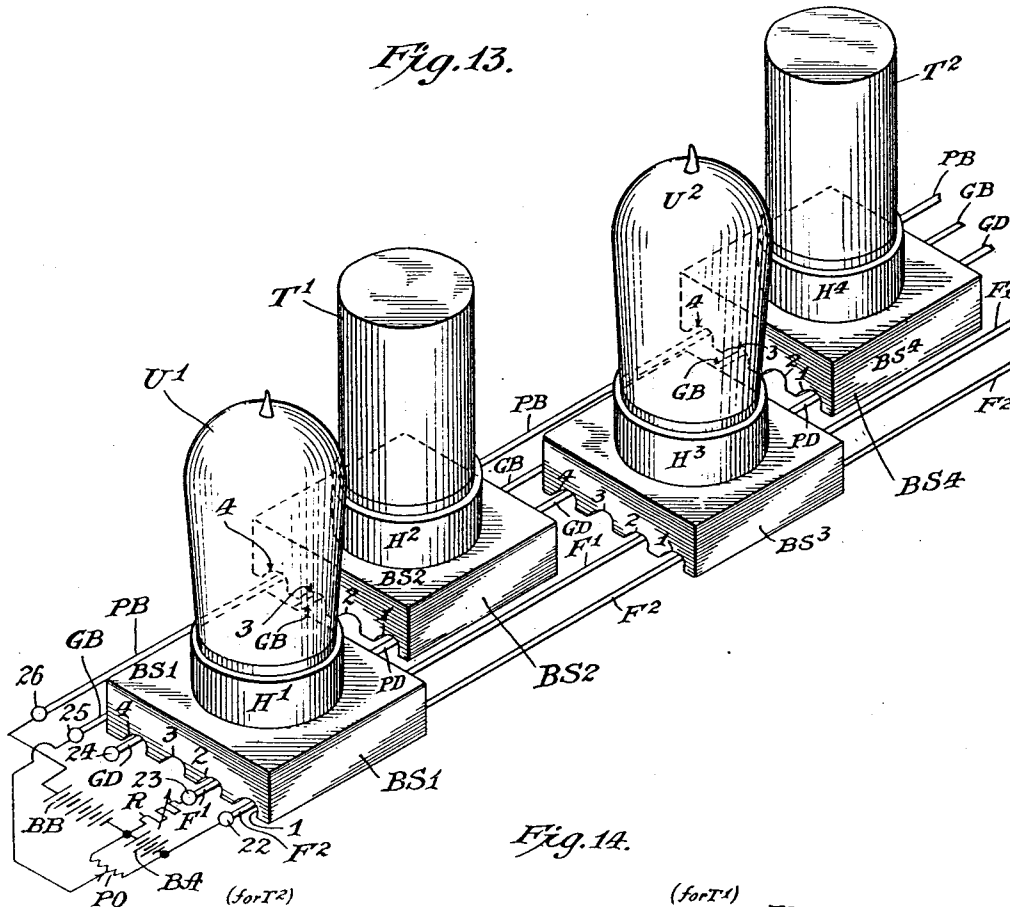
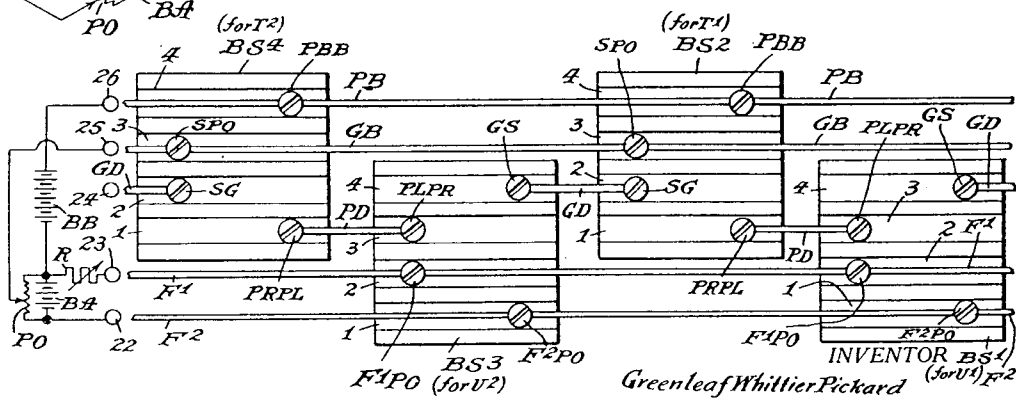


Fig. 14.



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Fig. 16.

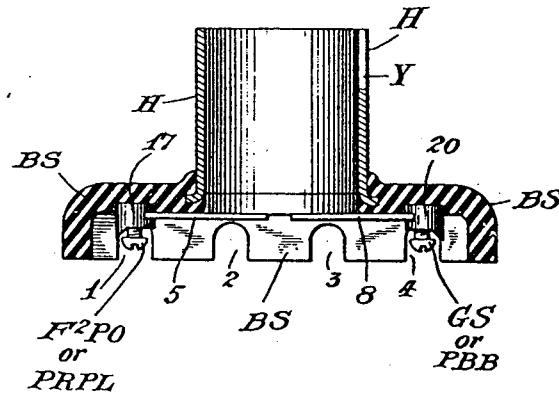
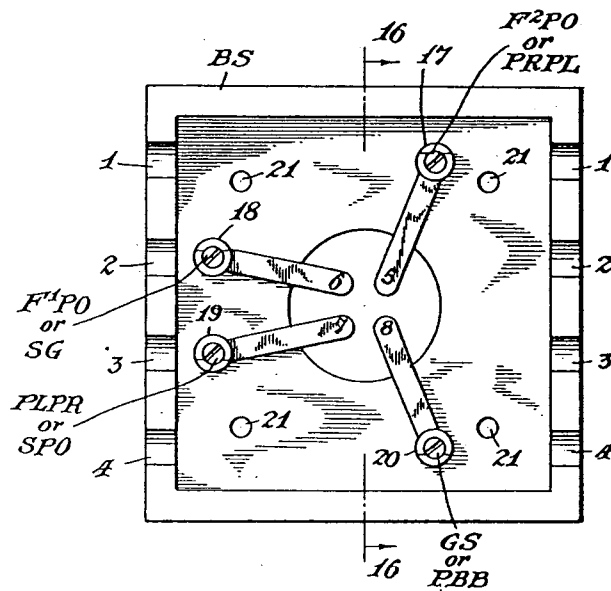


Fig. 17.



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UNITED STATES PATENT OFFICE.

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ELECTRICAL AMPLIFIER.

Application filed February 5, 1923. Serial No. 616,923

This invention relates to improvements in electrical amplifiers of the thermionic type; and more particularly relates to improvements in the construction of the co-operating parts of such amplifiers of existing forms whereby the user may construct his own amplifying set to be adapted for use at various wave lengths and orders of wave lengths.

The object of the invention is as just stated and with particular reference to the tube-socket bases and the tube-couplers or transformers in order that the user himself may adapt his receiving and amplifying set to use with various wave lengths of a given order (as for receiving radio broadcasting reception) and may alternate transformers or couplers of a given wave length range with others of a different wave length range, all with a facility equal to that heretofore enjoyed in respect of the removal and replacement of the tubes themselves.

The invention comprises the various constructions and arrangements disclosed herein, all with the view of providing an amplifier set as a whole wherein the various parts are adapted for both mechanical and electrical co-operation with one another and wherein the tube-couplers or transformers as well as the tubes themselves are capable of ready replacement and wherein the transformers may be adjusted for degree of wave length variation within a given band of wave lengths.

Heretofore, the unskilled user or amateur has been confronted with equally unsatisfactory alternatives. Either, by the use of a complete set manufactured in permanent form for use with a given limited range of wave lengths, he could operate within that wave length band more or less advantageously by the ordinary radio circuit tuning adjustments; or, at the cost of very considerable trouble even after considerable experience, he could, after purchasing the various like parts, himself assemble them in more or less fixed wave length conditions. The invention hereof makes it possible to furnish separate parts to such persons at very little expense, who then by little trouble can assemble them under conditions as readily replaceable as heretofore in respect of the tubes themselves, and also under conditions of adjustability of the wave length of the trans-

formers (couplers), if desired, so that the wave length conditions of the transformers may be precisely adapted to the wave length to which the radio circuits otherwise may be adjusted. Thereby the user not only may adjust his set as to any desired wave length, in respect of both the transformer couplers and the radio circuits otherwise, but by replacement of the transformers with transformers adapted for wave lengths of a very different order, such replacement being very readily accomplished, he may adapt his set for use with bands of wave lengths of very different orders, transmitted from various different stations.

There will be described first the transformers or couplers hereof, then the constructions of sockets adapted for use with either the tubes themselves or with such couplers (the couplers being adapted to said sockets); and finally the set as a whole will be described, comprising such couplers, sockets and tubes, the circuits of the set and the entire set itself being very greatly simplified in a mechanical sense, so that on the basis of a simple plan of circuit, a tyro without previous experience may obtain the most nearly perfectly operating set possible,—for the inventions hereof permit the reduction to an apparently simple form of the circuit arrangements heretofore used, which have been apparently as well as actually of a complicated nature.

Of the drawings, Figs. 1-7 show transformers or couplers adapted for use with the sockets of the invention; Figs. 8-10 and 16-17 show the sockets constructed to be adapted for use with such couplers or transformers; Fig. 11 shows the present standard thermionic tube to which said sockets are adapted and to which the couplers are assimilated; Fig. 12 is a diagram of the circuits of one of the various forms of amplifier "hookups," showing in general the arrangement heretofore employed wherein the transformers or tube-couplers have been of fixed values or in permanently fixed locations; Fig. 15 is a diagram showing the same circuits of Fig. 12 but illustrating the relative simplicity of arrangement permitted by the inventions hereof, this diagram showing the successively alternating tubes and couplers as being offset or staggered with respect to one another; Figs. 13 and 14 showing in

perspective and bottom plan the completed structures assembled together and with the circuits of Figs. 12 and 15.

In perspective in Fig. 13, the input portion of the receiving set is shown at the left, and contains the permanently fixed devices of that part of the amplifier set as distinguished from the replaceable tubes and couplers shown at the right in the four sockets of the invention. In Fig. 14 the permanent parts of the set (other than the sockets) are shown at the left as in Fig. 13, but all the sockets shown in bottom plan at the right have been rotated 180° as a whole about a longitudinal axis for the purpose of showing the complete extent of the circuit leads and their connections in the grooves in the bottoms of the sockets, in a clear manner, and in general correspondence with the diagram of Fig. 15.

The couplers T¹ and T² of Fig. 13 may be like that of either Figs. 3, 5 or 7.

The special transformers will be described first, then the sockets, and finally the details of construction of each of them whereby they are combined as shown in the assembly of Figs. 13 and 14.

Fig. 1 is a circuit diagram of one form of the coupler, which is a transformer. Primary P, P and secondary S, S, with a permissive iron core O, are interposed between tubes U¹ and U². Primary P, P is provided with taps *a, b, c, d*, and secondary S, S with similar taps *m, n, o, p*, connected to parts of the winding as shown. Over terminals of these taps operate two switches S¹, S² which are mechanically connected (Fig. 3) so that they move together. The connections of the taps with the transformer are so chosen that the transformer may be used as desired over quite a wide band of wave lengths without material change in efficiency. At the point where the efficiency falls off considerably and where it therefore may be desirable to replace a given transformer with one wound for efficient use with another order of wave lengths, such replacement may be effected by arrangements to be described later. The exterior connections of this transformer to the circuit leads to the tubes U¹, U² are shown diagrammatically in Fig. 1. The upper end P of the primary is connected to plate PL of tube U¹. The upper terminal S of the secondary is connected to grid G of tube U², these tubes U¹, U² being taken to illustrate an amplifying set using one or more tubes. Switches S¹, S² are connected respectively to the positive terminal of battery BB (the "B" battery) via lead PB, and to potentiometer PO via lead GB. This potentiometer is for the purpose of establishing a suitable biasing voltage on the grids of the tubes.

Fig. 2 shows in curve ABC the relation between amplification-intensity I (ordinates)

and wave-length (abscissæ). When switches S¹, S² of Fig. 1 are respectively on switch points *a* and *m*, the performance of the transformer for the switches on the other tap points may be made to correspond with the successive Fig. 2 curves A¹B¹C¹, A²B²C² and A³B³C³, by properly choosing the connections to the windings of the leads from taps (Fig. 1) *b, c, d* and *n, o, p*. As the wave length of the received signals may vary, switches S¹, S² are to be moved to corresponding taps and therefore the transformer will operate over a wide range of wave lengths, with satisfactory efficiency, as indicated by the full-line curve ABB¹, B²B³C³. That is, the amplification is practically uniform and high between the wave-length limits corresponding to B and B³.

In Fig. 3 is shown in commercial form a variable radio-frequency amplifier transformer such as that shown diagrammatically in Fig. 1 and operating at different degrees of variation of wave lengths within a wave length band as is diagrammed in Fig. 2. In Fig. 3 T is a metal casing enclosing the primary and secondary windings of Fig. 1 suitably insulated and disposed therein, the switches S¹, S² of Fig. 1 being mounted on the top of casing T and combined to be operated simultaneously by a common central member in which they are mounted, the ends of these switches operating over contacts *abcd* and *mno*. On one side of the casing is a pin N, the purpose of which is to be described, as also the four contact prongs extending from the bottom of the casing and connected respectively to the terminals of the two transformer windings. This Fig. 3 construction constitutes a self-contained unit of about the size of the ordinary thermionic tube (Fig. 11).

The transformer of Fig. 3 is preferably employed for wave lengths not exceeding one thousand meters, although such construction may be used for longer waves. But above that length it is possible to use a tube-coupler of the type known as a resistance-coupler. The elements of such a coupler are shown in Fig. 4 as being disposed properly with reference to one another and connected to the four terminals indicated. In Fig. 4 RI is a non-inductive resistance such as a carbon rod. C is a fixed condenser of suitable capacity, as of the order of .0005 microfarad. GL is a grid leak which may consist of a strip of cardboard dipped in India ink, or the like. These elements herein are placed and mounted inside a casing T, Fig. 5, similar to casing T of Fig. 3, and like that casing provided with a pin N and with four contact prongs projecting out of the casing below its bottom, corresponding with the bottom contacts of Fig. 4 and connected to the devices RI, C and GL of Fig. 4 within the casing T, Fig. 5.

For some purposes, it is useful to have an amplifying transformer with a continuously variable adjustment instead of the step-by-step adjustment of the constructions of Figs. 1-3. Such a continuously variable transformer is shown in section in Fig. 6 and in elevation in Fig. 7. Insulating-material casing T^4 has a slot Q cut helically on its inside wall. In this slot Q engage projecting portions J, J of a metal cap I . When cap I is rotated, it will move up and down in casing T^4 . A rod L is screwed into the lower face of the top of cap I . Rod L at its lower end carries a laminated iron core IC . Surrounding IC is a slotted winding form D . In the slots of form D are primary and secondary windings W of a radio-frequency amplifying transformer (similar to that of Fig. 1). These windings are connected by the leads shown to the four contact prongs projecting from the bottom of casing T^4 . On the outside of cap I is marked conveniently a wave-length scale SC (Fig. 7) corresponding to the optimum wave length at each position of core IC (Fig. 6). When IC is nearly at the bottom of form D of transformer winding W , the permeability of the space inside the windings is at a minimum. So also is the wave length. When core IC is raised (by rotation of cap C by the knurl KN , Fig. 7) until it fills the space inside winding W (in the position shown in Fig. 6), the permeability and hence the optimum wave length is at a maximum. Casing T^4 also is provided with the pin N , which, as in Figs. 3 and 5, is disposed at a certain point having reference to the four bottom contact prongs, as will be described.

In Fig. 15 is shown a portion of a multi-tube amplifier train embodying the invention, the showing being diagrammatic and illustrating the systematic compactness and ease of setting up which are attained by the invention. This is to be contrasted with the arrangement of circuits employed heretofore as shown in Fig. 12, where the circuits themselves are the same as in Fig. 15. In Figs. 12 and 15 are shown two tubes U^1, U^2 of an amplifier set or radio receiver, the input being assumed to be at the left, and the conductors at the right leading to further tubes and couplers or to receiving apparatus such as telephones. Between the two tubes U^1, U^2 is shown a coupler T^1 which may be of any of the types hereof as shown in Figs. 3, 5 or 7. The same is true of the coupler T^2 shown at the right.

The increased mechanical simplicity of the system diagrammed in Fig. 15 is made possible, in connection with the above construction of couplers by the use of the novel features of the sockets for both tubes and couplers, which features are shown in Figs. 8-10 and 16-17. The assembly of these sockets with the circuits, and with the

couplers and tubes, is shown in Figs. 13 and 14. In Fig. 13 is shown the assembly of the tubes of Fig. 11 with the sockets, couplers and circuits; and Fig. 14 is a bottom view of the four sockets of Fig. 13, turned bodily end for end 180° about a left-to-right axis, the circuits at the left of Fig. 14 remaining as at the left in Fig. 13. Fig. 14 illustrates the staggering of the sockets indicated in Fig. 15, and the connections of the leads to the terminals in the sockets to constitute the same circuit arrangement electrically as in Figs. 12 and 15.

In Fig. 8 is shown the general form of socket of Figs. 13 and 14.

From end to end of a tube amplifier set, there are four continuous buses, and also, successively, the leads from a tube plate to a tube coupler, and from a tube coupler to a tube grid. In Fig. 12 said successive leads are shown as in a single discontinuous line, lettered GD, PD, GD, PD, GD . In Fig. 15 are shown the four buses F^1, F^2, GB and PB ; also, out of alignment with one another, said alternating leads GD, PD , etc. Thus in Fig. 15 there are six separate rows of leads. These six leads are taken care of by this invention by way of the socket devices, each of which has four grooves (1-4, Fig. 8) in its base, one groove for a lead or bus. This socket device consists (Fig. 8) of two parts, the socket base BS and the socket sleeve H . The four grooves 1-4 are shown as arches formed in the bottom of base BS . Base BS may be molded of porcelain or other suitable material as heretofore. Metal shell or sleeve H is formed as heretofore with the bayonet joint Y adapted to receive joint-pin N (Fig. 11), of the standard tube, and adapted also to the standardized coupler heretofore also provided with pin N (Figs. 1-3, 4-5 and 6-7). Base BS may be molded to be maintained by the molding in a unitary structure with shell H by means of some such construction of the lower end of shell H as that shown in Fig. 16 to be described. The circuit leads (Fig. 8) pass through the grooves 1-4. In Figs. 13-14, four socket devices like that of Fig. 8 are arranged in a row, with all the grooves in the same general direction, but the bases staggered so as properly to receive the six lines of circuit leads. All four bases BS^1-BS^4 may be secured to a common insulating base (not shown) as usual, by screws passing through the four holes 21 (Fig. 17) in the insulating base BS of each socket device.

In Figs. 9 and 10 are shown additional details of the socket device. The four grooves 1-4 in the bottom are shown in dotted lines in the top plan Fig. 9. The four contact springs 5-8 have their inner ends disposed as usual substantially equidistant from the center of shell H , such that

such spring ends will be engaged by the contact prongs of the tubes (Fig. 11) as heretofore, and of course by the contact prongs of the couplers of this invention, as in Figs. 3, 5 and 7 (see the appropriate terminal lettering at the bottom of Fig. 10, corresponding with the coupler-prong lettering of Figs. 3, 5 and 7 and the tube prong lettering of Fig. 11). The outer ends of the four flat springs 5-8 are disposed irregularly with respect to the center of shell H, being located respectively over the four grooves 1-4, at which points the ends of the springs are secured under the heads of binding screws 9-12 on the upper ends of the terminal bolts lettered at the extreme bottom of Fig. 10. Said bolts extend up through metal connectors 17-20 mounted or molded in base BS. Said connectors 17-20 may be molded to the base as shown in Fig. 16. In Figs. 9, 10, these connectors extend up above the top of base BS so that springs 5-8 resting on them are held above the base so that they can yield to the contact prongs of tube or tube-coupler.

The alternative letter-designation of the terminal bolts at the bottom of Fig. 10 indicate the fact that any base-connected socket device like that of Figs. 8-10 is adapted for use with either a tube or a coupler, notwithstanding that the circuits of the tube and coupler are different from one another; this being the result of the lead-arrangement of Figs. 13-15 and the staggered relation of the tubes and couplers with their respective bases. The upper or first of the alternative lettering of the terminal bolts of Fig. 10 is that pertaining to the wiring (Fig. 14) for either of the second and the fourth sockets from the left (BS^2 and BS^4), i. e., for the couplers T^2 and T^4 (Fig. 13). That is, those four wires or leads of the total of six lines of leads, which extend to the four grooves of sockets BS^2 and BS^4 in the positions of the latter shown in Fig. 14, are to be connected under the heads of the terminals of Fig. 10 in the respective grooves 1-4. Similarly, as to the same construction of socket duplicated (Fig. 14) at BS^1 and BS^3 (first and third from the left, for the tubes U^1 and U^3), these sockets being set off by two grooves from or staggered with respect to the other alternating pair of sockets BS^2 and BS^4 , so that the four straight lines of leads which extend to the grooves 1-4 of the sockets, properly are to be connected under the heads of the terminals of Fig. 10 in said grooves. Pin N on the tubes and couplers (Figs. 3, 5, 7 and 11) when engaged in bayonet joint Y of the base-connected sockets (Figs. 8, 9 and 16), will guide the prongs of tube or coupler to the contact springs (Figs. 9 and 17) which are connected to the leads (Figs. 13 and 14) appropriate for the respective contact prongs. Take, for ex-

ample, Figs. 11, 9, 10 and 14 or 15, i. e., the case of a tube (Fig. 11), but similar to the case of a coupler. Pin N (Fig. 11) is on the same side of the tube-base as prongs PLPR and GS on its left and right respectively. Joint Y of Fig. 9 is on the same side of socket shell H as groove 4 in base BS, and springs 7, 8 (connected to terminals PLPR and GS, in Fig. 10) are on the left and right respectively of said joint Y. Thus when pin N is caused to engage in joint Y, the tube-prongs PLPR and GS will make electrical connection with the like-lettered base-terminals of Fig. 10. Also prongs F^1PO and F^2PO of Fig. 11 will make electrical contact with like-lettered terminals of Fig. 10. Assuming that the base-socket in question is BS^1 (at the right, Fig. 14), such tube will be properly connected in the system, i. e., with its grid G (Figs. 1, 12, 14 and 15) connected via terminal GS to input lead GD; its plate PL connected to lead PD via terminal PLPR, and the legs of its filament F connected via terminals F^1PO and F^2PO to leads F^1F^2 respectively. To illustrate the case of a coupler, consider Figs. 3, 9, 10 and 14, being the case of a transformer coupler but similar to the case of a tube (Fig. 11). Pin N (Fig. 3) is located on a part of casing T which is on the side nearer to prongs SPO and PBB, on its left and right respectively; so that when pin N is engaged in joint Y, Fig. 9, nearest groove 4 and between springs 7 and 8 on its left and right respectively, these prongs SPO and PBB will make contact with said springs 7 and 8 respectively, these being the springs which are connected to the terminals located above grooves 3 and 4 respectively and lettered correspondingly with prongs SPO and PBB of Fig. 3. The remaining two prongs of Fig. 3 (SG and PRPL on the opposite side from pin N) then naturally make electrical connection with the correspondingly lettered terminals SG and PRPL of Fig. 10 in grooves 2 and 1 respectively. Assuming that the base-socket in question is BS^2 (Fig. 14, next to right-hand socket), for the reception of transformer coupler T^1 (Figs. 13 and 15, second socket from left), such coupler (T^1 of Figs. 1 and 3) will be properly connected in the system, i. e., with the upper end of its primary (Fig. 1) connected (Figs. 1, 12, 14 and 15) via terminal PRPL to lead PD from plate PL of the first tube U^1 , and the lower end of its primary (Fig. 1) connected (Figs. 1, 12, 14 and 15) via terminal PBB to lead PB from plate battery BB; the upper part of the secondary of the transformer (Fig. 1) being connected via terminal SG to lead GD to the terminal GS of the grid of the second tube U^2 ; and the lower part of the secondary of the transformer (Fig. 1) being connected via terminal SPO to lead GB to potentiometer PO.

The connections of the second tube U^2 (like that of Fig. 11) to its socket BS^3 , and of the second transformer (like T of Fig. 3) to its socket BS^4 (of Figs. 14 and 15) may be traced similarly, in connection with the transformer construction of Fig. 3 and the circuit diagrams referred to above.

If transformers like T^4 of Figs. 6-7 be used in Figs. 13-15, they are placed in the sockets as just above described for transformers like Fig. 3 and for the standard tubes of Fig. 11. The same is the fact if resistance-couplers like that of Figs. 4-5 be desired to be used in lieu of the transformers of Figs. 3 or 7.

In Fig. 12 (showing the prior general arrangement of the circuits) there are only four true buses, i. e., leads which extend from end to end of the set,—these four being the two filament buses (F^1 and F^2), the third being bus PB from transformer primary P to plate or "B" battery BB, the fourth bus being GB from transformer secondaries S to potentiometer PO. There are two other kinds of leads, as stated, which successively alternate from one end of the set to the other, i. e., the grid leads GD and the plate lead PD. In Fig. 12 both sets of leads GD and PD are shown in a discontinuous straight line. In Fig. 15 is shown in diagram the manner in which the four-groove socket of this invention is adapted to this situation (Fig. 15 being a simplified showing of Figs. 13-14). In Fig. 15 the two buses PB and GB (of plate and grid) are shown as located alongside one another at the top of the diagram; the two filament buses F^1 , F^2 being shown at the bottom; and the sets of leads PD and GD being located between said two pairs of buses. Thus, turning to Fig. 13 (where bases BS^1 and BS^3 are offset from bases BS^2 and BS^4 by the distance of two grooves), the two upper buses PB and GB lie in grooves 4 and 3 of bases BS^1 and BS^3 . Grooves 3 and 4 of bases BS^1 and BS^3 are aligned with grooves 1 and 2 of bases BS^2 and BS^4 (due to the staggered relation of bases), so that one of the short leads GD lies in groove 4 of base BS^1 , one of four short leads PD lies in offset groove 1 of base BS^2 , a second of short leads GD lies in groove 4 of base BS^3 , and a second one of short leads PD lies in groove 1 of base BS^4 ; said short leads GD and PD being staggered alternately and successively by one groove's distance from one another, and a groove 3 or 4 of each successive socket base being unoccupied by any lead, there being in effect six lines of leads as indicated in Fig. 15. Thus, by the construction of sockets and transformers hereof, the entire arrangement is systematized and simplified to a very great degree as compared with the arrangements heretofore.

From the above, it is apparent that the

invention provides a comparatively simple means for enabling the amateur to build his own set, and such a set which can be made readily to do the duty of several separate sets (on different occasions and for widely different wave lengths bands) merely, by the substitution of transformers so wound as to be adapted for very different orders of wave lengths, the result being that the user may listen in on the various wave lengths other than the short ones now used in popular broadcasting, such as those of greater length which may in future be employed in the broadcasting of entertainment, education, etc., of those of greater length for other communication.

In Figs. 16-17 is shown another practical form of socket device embodying the principles of that of Figs. 8-10. Fig. 16 is a vertical section at 16-16 of Fig. 17; Fig. 17 being a bottom plan of the device, the grooves in 1-4 in insulating base BS constituting little arched tunnels above an insulating floor (not shown) of the complete amplifier set, to which main floor or base the socket base BS is to be secured as by bolts through holes 21. The base BS is molded about the lower flared end of shell H (Fig. 16), so as to be combined permanently therewith. Likewise, the four terminals 17-20 (two shown in Fig. 16), threaded for the binding screws, are molded in base BS which may be of porcelain or other suitable insulating material. Contact springs 5-8 (Fig. 16) may be set into and soldered to terminals 17-20, as indicated. The four binding posts are lettered as in Fig. 10 to correspond with the same parts of Fig. 14 in accordance with the location of joint Y (Fig. 16) in shell H on the same side of the device with groove 4. The contact springs 5-8 (Fig. 16) are located below the lower wall of base BS and with their inner ends centering in the lower opening of shell H, although their outer ends secured to terminals 17-20 are located at different distances from the center in accordance with the location of said terminals in grooves 1-4 respectively; so that the four contact prongs of either tube or tube-coupler (whichever happens to be inserted in a given socket) will make electrical connection with the proper lead when the sockets and leads are assembled as in Fig. 14.

It is clear that in simplifying the system by this invention, advantage has been taken of the fact that the transformer (and the resistance coupler of Figs. 4-5) has four terminals, as in the case of the tube itself; and it is that fact which lies at the base of the invention. Also the grooves of the socket bases may take any desired form such as perforations through the bases. The amplifier set may comprise one or more of each of a tube and a coupler.

The socket devices of Figs. 13-15 may be of any of the forms of Figs. 8-10, 16-17 or any other form involving the principles thereof. The contact springs for each of these socket devices are preferably all of the same length, as a standard part, it being a simple matter to locate the metallic connectors at the particular point of the length of each groove which will permit the use of such springs of uniform lengths.

I claim:—

1. In a thermionic tube amplifier, the combination with the thermionic tube, a tube-coupler and the amplifier circuit leads arranged in six rows, each of the tube and coupler having four exterior contact terminals, of duplicate sockets comprising receptacles which, together with the tube and coupler are constructed for the detachable reception of such tube and coupler, and comprising bases formed with four grooves for the reception of the leads; said sockets being provided with contact terminals arranged to-operatively with the arrangement of the four contact terminals of the tube and coupler respectively for the mutual engagement of said contact terminals when the tube and coupler are held in the receptacle; said sockets being provided also with connectors electrically connected with the contact terminals of the sockets and constructed for detachable connection with the leads in the grooves of the socket; and said duplicate sockets being arranged in relatively staggered positions for the conjoint reception of the six rows of leads in the eight socket-grooves.

2. In a thermionic tube amplifier, the combination with the thermionic tube, a tube-coupler and the amplifier circuit leads arranged in six rows, each of the tube and coupler having four exterior contact terminals, of duplicate sockets comprising receptacles which, together with the tube and coupler are constructed for the detachable reception of such tube and coupler; said sockets comprising bases formed with four grooves to receive the circuit leads; and said sockets being provided with contact terminals arranged to-operatively with the arrangement of the four exterior contact terminals of the tube and coupler respectively to permit mutual contact of the respective contact terminals when the tube and coupler are held in the receptacles; and said sockets being arranged in relatively staggered positions for the conjoint reception of the six rows of leads in their eight grooves; the leads of the grooves of each of the sockets being electrically connected with the contact terminals of the sockets whereby when the tube and coupler are held in the receptacles, they will be electrically connected with the six circuit leads.

3. In a thermionic tube amplifier, the com-

bination with a thermionic tube, of a transformer-coupler comprising primary and secondary windings in mutually inductive relation, and the amplifier circuit leads arranged in six rows, of a casing enclosing the windings of the transformer; duplicate sockets comprising receptacles which together with the tube and casing of the transformer are constructed for the detachable reception of such tube and casing; said sockets also comprising bases for the reception of the circuit leads each base being formed with four lead-receiving grooves; said sockets being provided with contact terminals electrically connected with the leads in the grooves; said transformer casing and tubes being provided with exterior contact terminals arranged for engagement with the contact terminals of the sockets when in the receptacle thereof; and said sockets being arranged in relatively staggered positions so that their grooves receive the six rows of leads.

4. In a thermionic tube amplifier, the combination with a thermionic tube and a coupling transformer as self-contained units separate from one another and from their sockets; circuit leads for said tube and transformer, and contact terminals on said tube and transformer corresponding with said circuit leads; of means for adjusting the primary and secondary windings of said transformer to vary its effective wave length; and substantially duplicate sockets for receiving the tube and transformer respectively and connecting them with said circuit leads of the amplifier; the construction and arrangement of the contact terminals of said transformer being similar to those of said tube, whereby either socket may be employed with either the tube or the transformer; and whereby different transformers having substantially the same construction and arrangement of contact terminals may be placed successively in circuit in a given socket.

5. In a thermionic tube amplifier, the combination with electrical circuits and contact-carrying amplifier elements including a tube and a coupler, of a socket for such an element which comprises an insulating base formed with substantially parallel grooves for the reception of the circuit leads, and a receptacle combined with said base and constructed for the detachable reception of such amplifier element; and contact terminals carried by the socket and arranged to be engaged by the contact terminals carried by the amplifier element when such element is in place in the receptacle; said socket contact terminals being constructed for detachable electrical connection with the amplifier leads in the grooves of said insulating base of the socket.

6. In a thermionic tube amplifier, the

combination with electrical circuits and contact-carrying amplifier elements such as a tube and a coupler, of a socket which comprises an insulating base formed with
5 grooves for the circuit leads, and a receptacle constructed for the detachable reception of such amplifier element; said socket carrying contact springs centering toward the receptacle and arranged to make contact with
10 the contact terminals carried by such amplifier element when in the receptacle; and connectors mounted on said base adjacent the grooves therein and constructed for detachable electrical connection with the circuit
15 leads in the grooves; the outer ends of said contact springs being mounted in electrical connection with said connectors adjacent said grooves.

7. In a thermionic tube amplifier, the
20 combination with electrical circuits and contact-carrying amplifier elements such as a tube and a coupler, of a socket which comprises a receptacle constructed to detachably receive such amplifier element, and a
25 base of moldable insulating material molded about the receptacle to constitute a unitary structure of base and receptacle, said receptacle being shaped to cooperate with the moldability of the base to that end; and
30 said base being formed with grooves for the reception of the circuit leads; connectors molded in said base adjacent to the grooves therein and constructed for detachable connection with the leads in the grooves; and
35 contact springs arranged substantially radially in said socket, having their outer ends mounted in electrical connection with said connectors adjacent said lead-grooves in the socket; and said contact springs having
40 their inner ends located to be engaged by the contacts carried by the amplifier element when the latter is in place in the receptacle of the socket.

8. In a thermionic tube amplifier, the
45 combination with a thermionic tube and a tube coupler as separate self-contained structural units, of substantially duplicate sock-

ets for said tube and coupler, said sockets being constructed for detachable connection respectively to the coupler circuits and tube
50 circuits of the amplifier set; and said sockets being formed with grooves for the reception of their respective sets of circuit leads; the sockets being also constructed with contact
55 springs extending from points over said grooves radially inward to central mutually neighboring points; and said coupler having contact terminals and an arrangement thereof which simulate those of the tube, said socket terminals being constructed in
60 each case to make circuit contact with the centrally disposed portions of the contact springs of the sockets; and said coupler being provided with means for guiding it to position in its socket to assure engagement
65 of its terminals with the appropriate contact springs of the socket.

9. In a thermionic tube amplifier system having a given number of buses for tube
70 and tube coupler extending from end to end of the amplifier set, the combination with a plurality of sockets having a like number of grooves receiving said buses and having a like number of contact connectors between
75 said buses and tube and coupler, the tubes and amplifiers corresponding in number to said sockets, each tube and coupler having a number of contact terminals which corresponds with the number of said buses, the
80 number of grooves in each socket, and the number of socket contact connectors.

10. In a thermionic tube amplifier, the combination with the tubes and coupling means therefor, and the four continuous
85 buses and the tube plate leads and the tube grid-leads arranged in two lines of leads; of sockets for the respective tubes and coupling means each socket comprising a sleeve and a base, each base being formed with four
90 grooves, and the bases and their grooves receiving the two lines of leads; said sleeves of the sockets receiving the respective tubes and coupling means.

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