Jan. 21, 1936. H. R. HAYDEN 2,028,717

VACUUM TUBE SYSTEM AND CONTAINER

Filed May 27, 1930 6 Sheets-Sheet 1

Fig. 1.

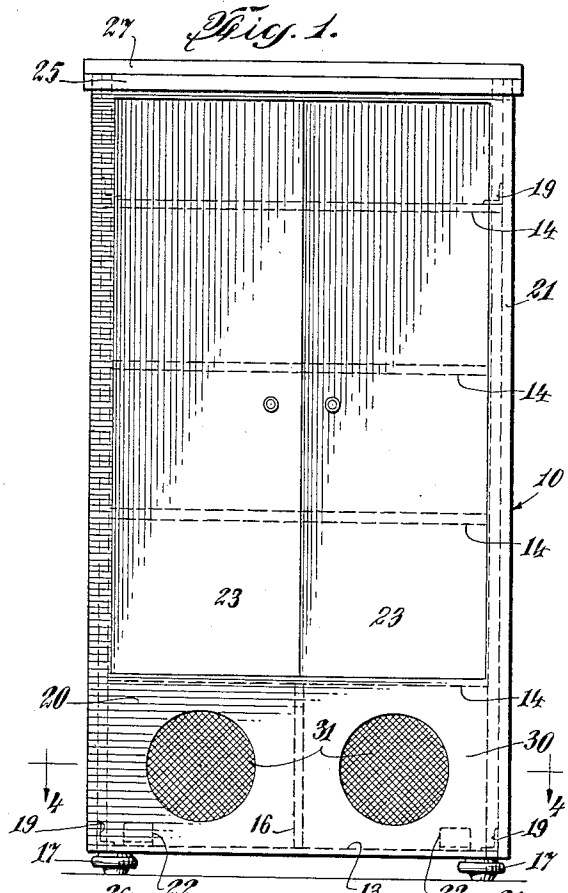


Fig. 2.

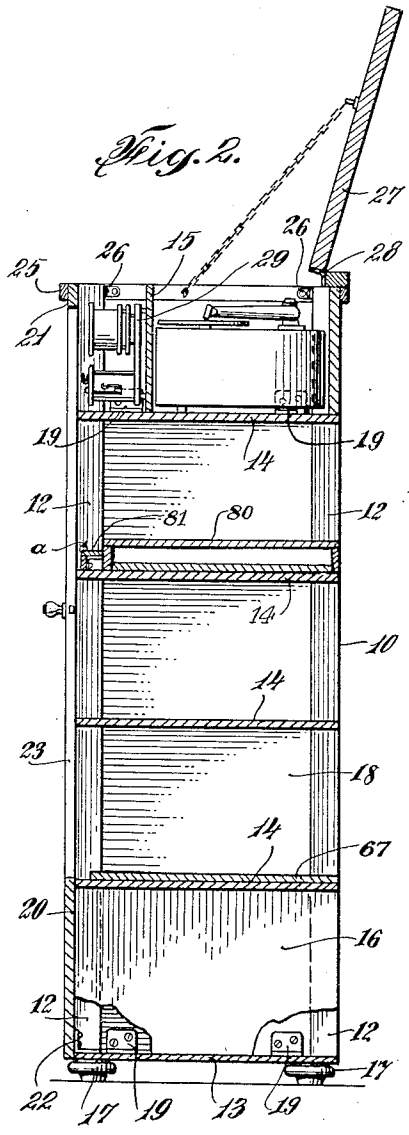


Fig. 3.

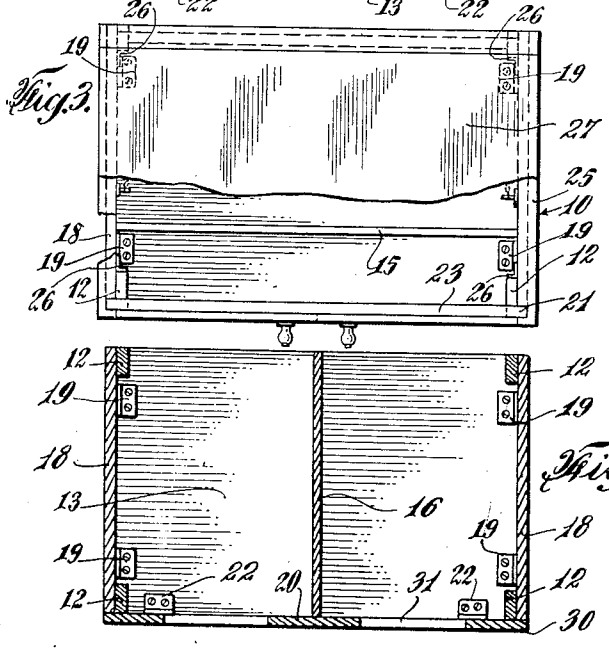


Fig. 4.

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VACUUM TUBE SYSTEM AND CONTAINER

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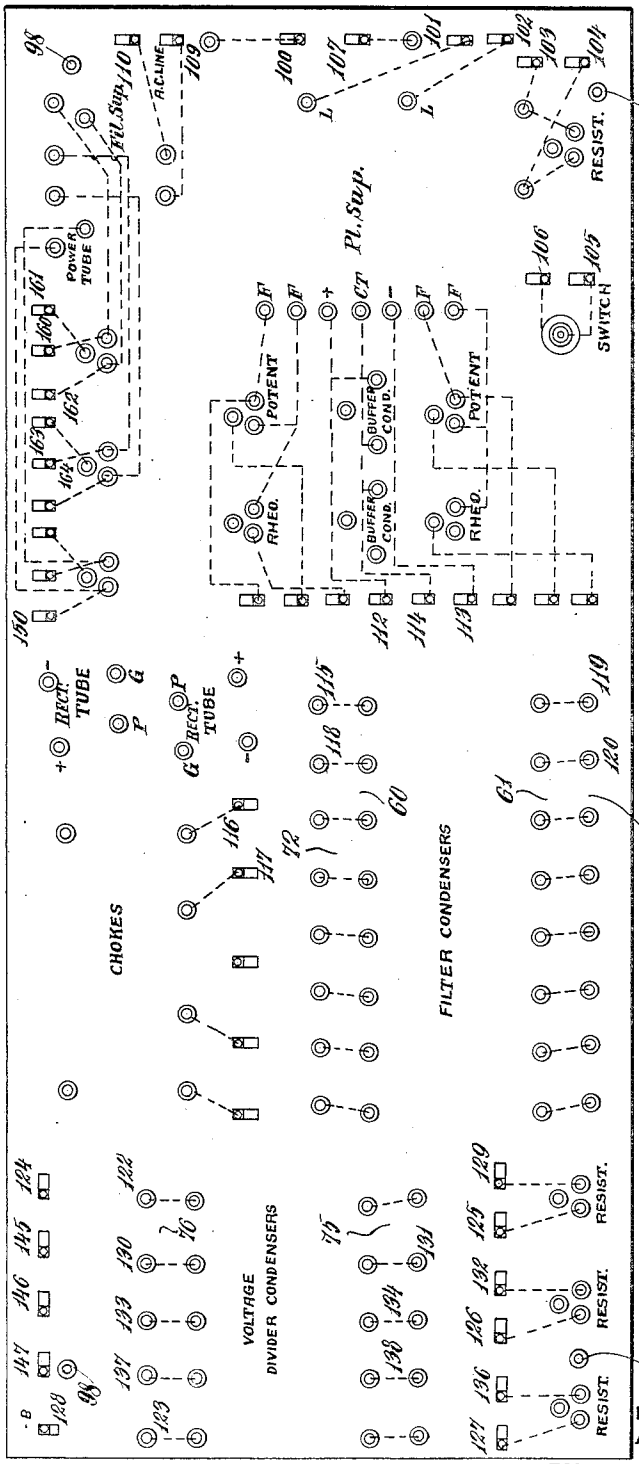


Fig. 2.

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VACUUM TUBE SYSTEM AND CONTAINER

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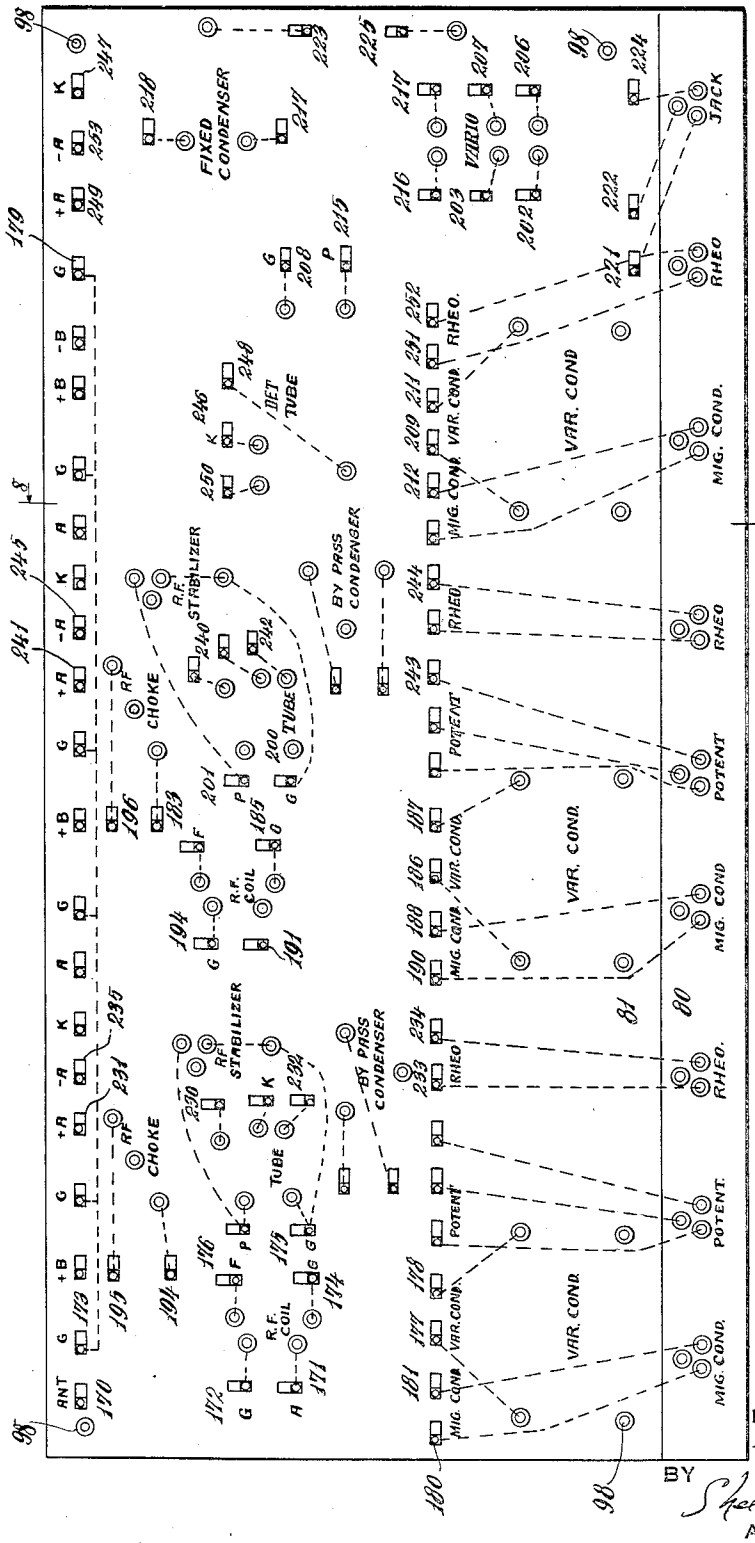


Fig. 6.

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VACUUM TUBE SYSTEM AND CONTAINER

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Fig. 13



Fig. 14

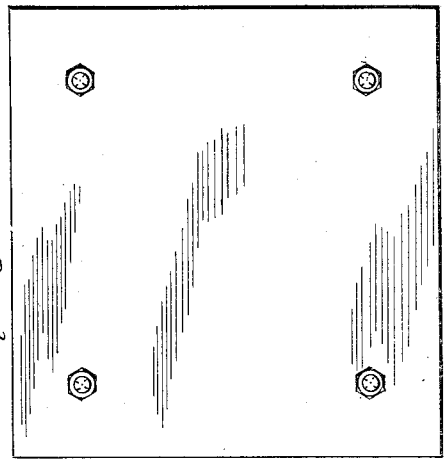


Fig. 7

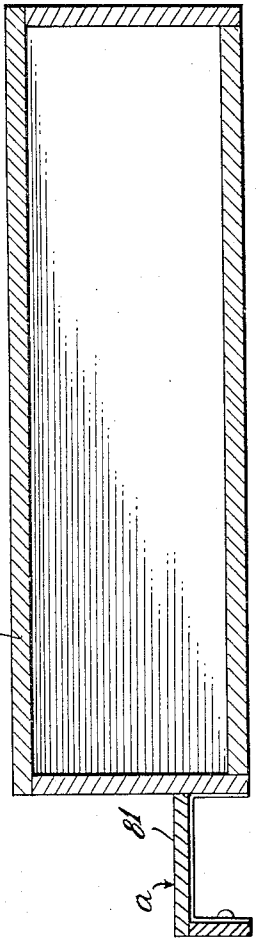


Fig. 11.

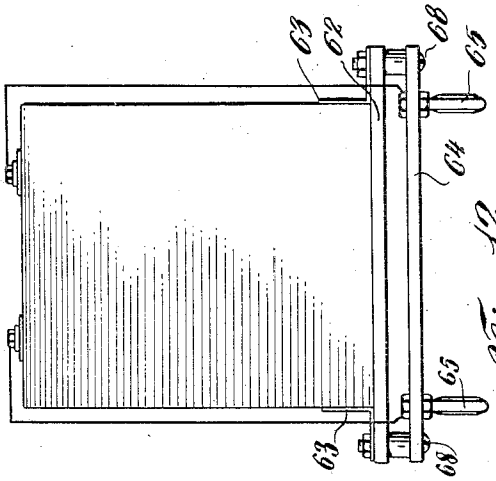
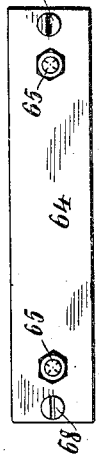


Fig. 12



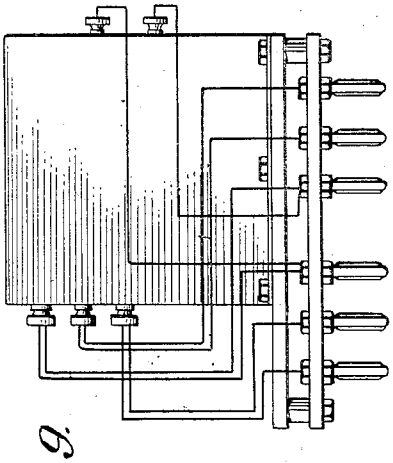


Fig. 9.

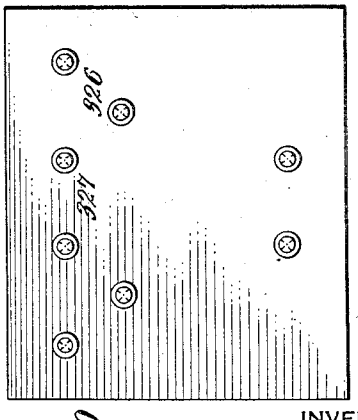


Fig. 10

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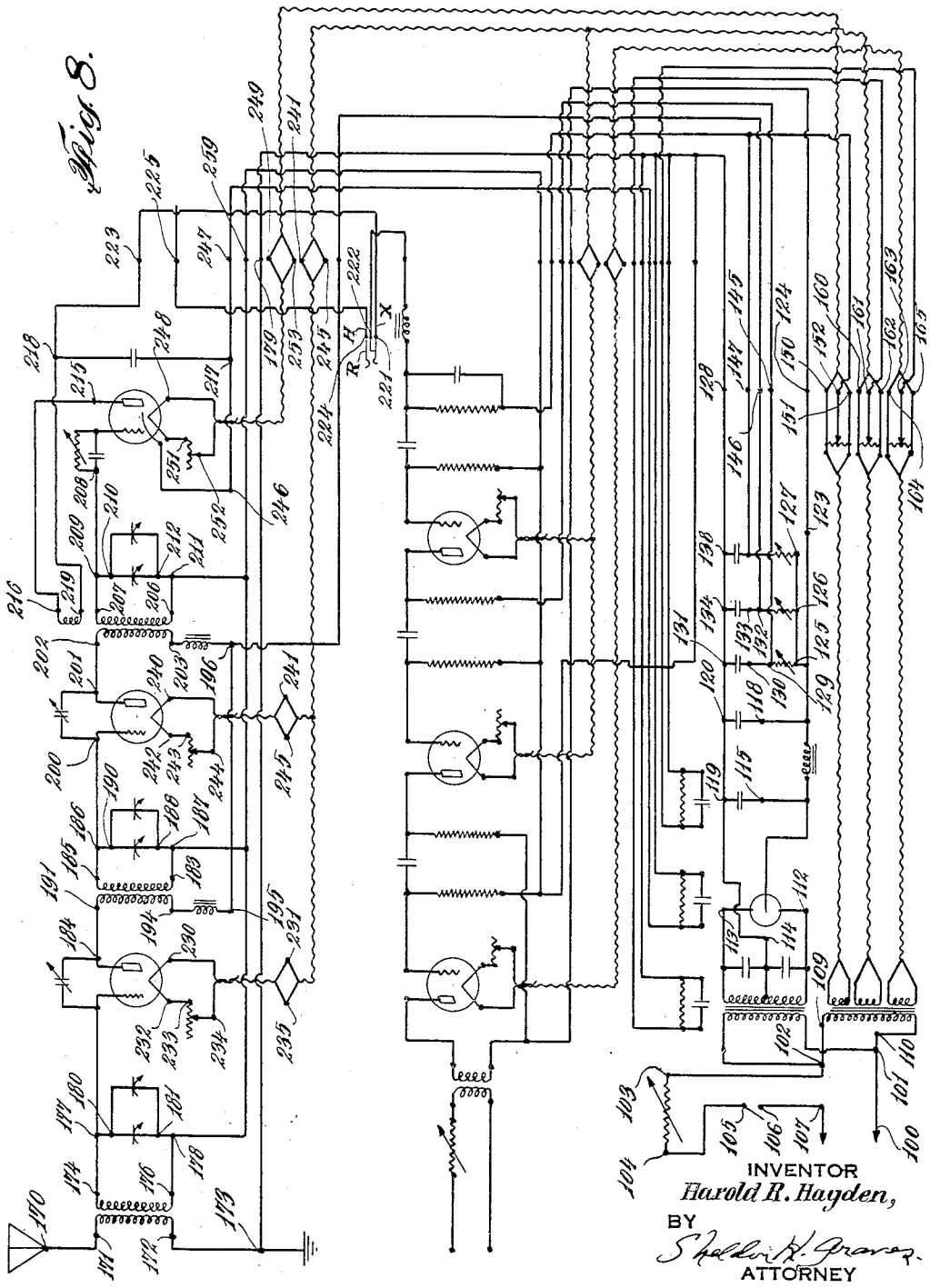


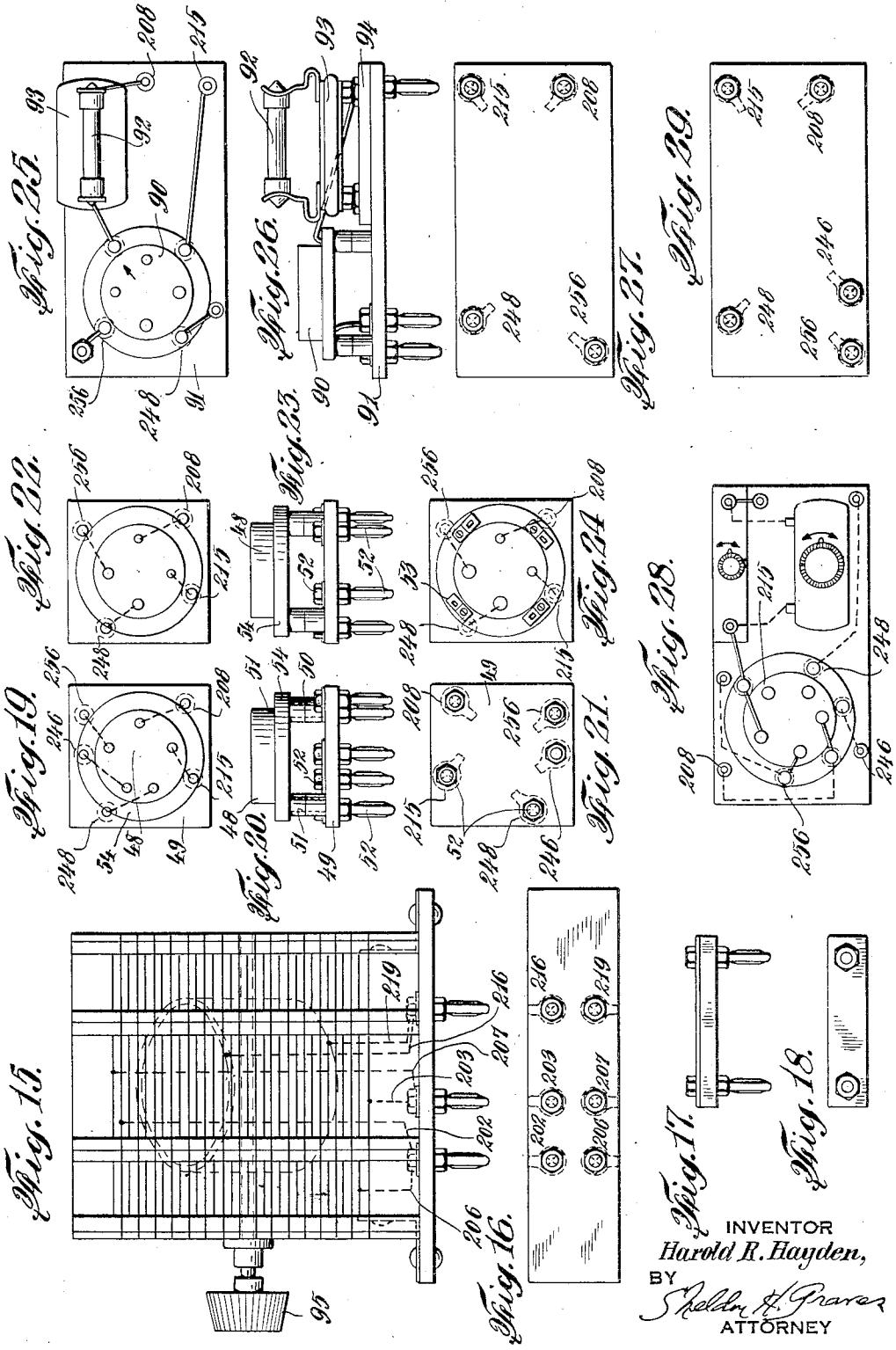
Fig. 8.

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VACUUM TUBE SYSTEM AND CONTAINER

Filed May 27, 1930 6 Sheets-Sheet 6



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Patented Jan. 21, 1936

2,028,717

UNITED STATES PATENT OFFICE

2,028,717

VACUUM TUBE SYSTEM AND CONTAINER

Harold R. Hayden, Brooklyn, N. Y.; Elsie G. Hayden executrix of said Harold R. Hayden, deceased

Application May 27, 1930, Serial No. 456,043

8 Claims. (Cl. 250—14)

This invention relates to vacuum tube repeating systems such as may be employed for signal reception and amplification or sound reproduction, and more particularly to an arrangement and a means for supporting or holding the various electrical elements forming parts of such system.

One object of my invention is to provide in a single cabinet, or other supporting or holding structure, a receiving or amplifying system which is adapted for a variety of uses, such as the reception, detection and amplification of the so-called long wave and short wave signals as well as the amplification and reproduction of selections from phonograph records.

A further object of my invention is to provide a system of this character wherein changes in the electrical connections between various parts of the system may be easily effected to the end that the system may be employed as desired for one or another of the uses above mentioned. A further object of my invention is to provide a system as above described wherein the electrical elements constituting the complete system are arranged in groups, the different elements of each group being arranged on a common base or supporting structure which base or supporting structure is separate from that of some other group, and to provide means whereby selected groups may be electrically connected with one another, the groups selected being dependent upon the use to which the system is put. Thus in the form of invention illustrated I provide a group of elements forming a power plant which may be supplied from a commercial source of current and is adapted to supply currents to the cathodes and other circuits of the system. Connected to the power plant is an audio frequency amplifying group, these two groups in the form of invention illustrated being employed whenever the system is in use. For the purpose of receiving and amplifying and detecting long and short wave signals I provide separate groups of elements which alternately may be connected with the power plant and audio amplifier depending upon which type of signal it is desired to receive.

In the form of invention illustrated the various groups of elements and their respective bases or supporting structures are removably mounted in a cabinet which contains a phonograph having a suitable pick-up device which may be detachably connected to the input circuit of the audio amplifier. Also preferably in the same cabinet is a compartment designed to contain a loud speaker which is electrically connected to the output circuit and the audio amplifier. Both a magnetic and dynamic speaker may be mounted in the cabinet with means for connecting the audio amplifier alternately to one or the other of the speakers.

Another feature of my invention is a detachable mounting of the various electrical elements comprised within the different groups on their respective supports. In the form of invention disclosed the individual elements for the most part are supported on bases or mounts having prongs or jacks with which the terminals of the elements are connected and the common base is provided with corresponding sockets or openings for the reception of the prongs, thus permitting the element to be attached to or removed from the common base as desired. By this construction any one of the elements may be removed and replaced by a different element of the same type. Thus if it is desired to change from a transformer of one kind to a transformer of another kind it is merely necessary to remove the transformer and substitute a different one in its place. This construction permits a great range in the selection of individual elements of each group assembled and is of particular value in experimental work where it is desired to determine the relative effects in the system of different elements of the same general character.

In general also each socket or jack is permanently connected with a clip mounted on the common base or supporting box and adapted to receive the terminal of a flexible or other connector so as to permit electrical connections to be made between the different electrical elements through their respective plugs and sockets. By the use of a plurality of separate connectors each of which may be attached to or detached from any desired clip or clips independently of the others a wide variety of selection in making the circuit connections between the elements is permitted and this does not require the use of expensive or complicated tools. Furthermore the labor required to build up any desired system is reduced to a minimum.

In the building up of any particular system in this manner the various elements of the system will be plugged into the sockets adapted to receive them and these elements will be connected to one another by ordinary flexible wires cut into proper length and secured to the proper terminal clips.

I find it desirable in many cases to adopt a special arrangement of prongs for elements of one type which arrangement is different from the ar-

rangement of prongs for the elements of another type. By this means placing the elements in an improper position on the common supporting base is avoided.

The cabinet for holding the parts is preferably provided with compartments, each of which is adapted to hold one group of elements, such for example as a power plant group or unit. The compartments are comparatively of sufficient size to accommodate a common supporting base and the elements mounted thereon and in addition one or more similar bases which, when desired, are secured in position on the top of the first mentioned base. In this manner I may provide in one compartment of the cabinet a plurality of bases which are respectively wired for different circuit arrangements, using the upper base with the proper elements attached thereto in one system and one of the lower bases with the upper base removed in another system.

Other objects of my invention include the provision of improved mounts or bases for the individual electrical elements employed.

Other objects of my invention include an improved cabinet provided with compartments conveniently arranged for the various parts of the system, and particularly a cabinet having removable walls for obtaining ready access to all portions of its interior.

Other objects and advantages of my invention will appear from the following description taken in connection with the accompanying drawings, wherein:

Figure 1 is a front elevation of one form of cabinet for holding the several parts of the apparatus,

Figure 2 is a side elevation, partly in section, of the structure shown in Figure 1,

Figure 3 is a top view of the cabinet with a portion of the cover broken away and showing parts of the phonograph and meter compartments,

Figure 4 is a sectional view on the line 4—4 of Figure 1,

Figures 5 and 6 are diagrammatic top plan views of common supporting boards or boxes for holding groups of electrical elements, these figures showing respectively the supporting boards for a power plant, radio frequency amplifier and detector group, and audio frequency amplifier group,

Figure 7 shows diagrammatically in transverse section the construction of the supporting box of Figure 6,

Figure 8 is a circuit diagram illustrating one of the many radio receiving systems which may be constructed on the bases illustrated in Figures 5 and 6,

Figures 9 and 10 are respectively diagrammatic side elevation and bottom plan view of the filament supply transformer together with its mounting or base by means of which it is attached to the common supporting board or box,

Figures 11 and 12 are views similar to Figures 9 and 10 respectively but showing one form of filter condenser and its mount,

Figures 13 and 14 are respectively side and bottom views of a mount adapted to support any one of a number of different devices, as for example, the meter shown diagrammatically in Figure 2,

Figures 15 and 16 are side elevation and bottom plan views respectively, showing a three-circuit tuner adapted to be included in the detector stage,

Figures 17 and 18 are a side elevation and bottom plan view respectively of a connecting strip and its mounting adapted to be removably positioned on the board,

Figures 19, 20 and 21 are respectively a top plan view, a side elevation and a bottom plan view of a five electrode tube socket and its mount, the mount being provided with five conducting prongs for insertion into corresponding sockets in a common supporting base,

Figures 22 and 23 are views similar to Figures 19 and 20 but showing a four electrode tube socket and its mount,

Figure 24 is a top plan view of a tube socket and mount showing a modification,

Figures 25, 26 and 27 are views similar respectively to Figures 19, 20 and 21 but showing a four electrode tube socket and a combined fixed grid leak condenser and resistance carried on a single mount,

Figures 28 and 29 are views similar respectively to Figures 25 and 27 but showing a five electrode detector tube and adjustable grid leak condenser and adjustable grid leak resistance.

Referring to Figures 1 to 4 of the drawings, 10 represents a cabinet adapted to contain the various electrical elements of the system. The cabinet 10 comprises a supporting structure consisting of an open frame work formed of vertical bars 12 located at its corners and secured to one another by a bottom board 13 and a series of horizontal boards 14 all of which form shelves of the cabinet. The space above the upper shelf 14 is divided by a partition 15 parallel to the front of the cabinet and secured in any suitable manner to the upper shelf 14. The space above the bottom 13 is also divided by a partition 16 extending from front to back. The shelves are secured to the uprights 12 in any suitable manner as by brackets (not shown) and the cabinet is provided with short legs 17.

The cabinet, which is open at the back, is provided with removable sides 18 which are secured to the shelves 13, 14 by means of brackets 19 which, as shown, are adapted to be attached to the shelves and sides by screws or the like. If desired, instead of screw brackets 19 I may provide spring catches which permit the more ready removal of the sides from the frame of the cabinet.

The cabinet 10 is also provided with a removable front 20 which consists of an outer frame 21 secured to the shelves by brackets 22 and doors 23 which are hinged to the outer frame 21 and extend from the top of the cabinet down to the bottom shelf 14.

The cabinet is also provided with a top 25 secured to the uprights 12 by brackets 26. The top 25 consists of an outer frame and a cover 27 hinged at 28 to the outer frame. The space between the bottom 13 and the lower shelf 14 forms two compartments for loud speakers. This space is closed at the front by a board or panel 30 forming part of the front 20 and having openings 31 over which are secured screens 32.

In practice I may, if desired, employ two loud speakers with means for connecting them alternately in circuit with the audio frequency amplifier. One of the loud speakers may be magnetic and the other a dynamic loud speaker. I find that one speaker is better adapted for the reproduction of a selection of one kind than another speaker and it is understood that I may provide switching means for connecting the output cir-

cuit of the amplifier with one or the other of the speakers as desired.

The space above the upper shelf **14** forms a rear compartment adapted to contain a phonograph including a magnetic pick-up which normally will be connected through the audio frequency amplifier to one or the other of the loud speakers as desired. This space also includes a front compartment which may conveniently contain a number of meters removably secured to a board **29** together with jacks or other connecting devices for connecting the meters with parts of the system whose voltage or current it is desired to measure.

The spaces above the remaining three partitions **14** are normally occupied by supporting bases or boxes upon which are mounted the electrical elements forming the receiving and amplifying system. In the form of invention disclosed these elements are divided into three groups, these groups being carried by their respective supporting base.

One of these groups is the group of elements comprising the power plant, including transformers adapted to be supplied with current from the usual alternating current house lighting circuit and adapted to furnish current for the plate circuits and the filaments or heaters of the several amplifier and detector tubes. This group of elements comprises transformer, rectifier and filter sub-groups, the last including reactances and condensers for smoothing out the current supplied to the plate circuits.

A second group comprises stages of radio frequency amplification and a detector tube and the third group comprises the several stages of audio frequency amplification.

In Figure 5 I show diagrammatically a top plan view of a base for supporting the first of the above mentioned group of units, namely that constituting the power plant. This base, as well as the other bases, it will be understood, rest on the shelves of the cabinet and are removable through the front doors.

For the purpose of making clear the arrangement of supporting and making the desired electrical connections between the various elements, reference may be had to the right hand end of Figure 5 on which two terminal clips **101** and **102** are shown diagrammatically, these clips being of any suitable type such as the usual bent metal spring clips for the attachment of wire terminals. These clips are respectively connected permanently with sockets marked L, L, the connections, indicated by dotted lines, being made by suitable connectors located beneath the board and soldered or otherwise permanently secured at their ends to the clip and the socket. These sockets L, L form two of a group of nine sockets indicated by the legend Pl. Sup., the remaining sockets of the groups being lettered F, F, + CT, —, FF. The sockets of this group are adapted to hold the prongs of a power transformer which is adapted to receive current from the supply mains and deliver current from three secondaries, two being connected respectively with the prongs adapted for insertion in the pairs of sockets marked FF and the remaining secondary having its terminals connected to the pairs marked + and — and the remaining secondary having a center tap prong adapted to be received in the socket marked CT.

It will be seen that by connecting terminals of an alternating current supply system to the terminal clips **101** and **102** and inserting the power transformer having the three secondaries, in position in the group of sockets marked Pl. Sup. that the primary of the transformer will be energized from the supply mains and the respective secondaries will supply the requisite voltages to the sockets at the left of this group. These sockets are permanently connected to other sockets or to terminal clips in the manner indicated in dotted lines in Figure 5.

In many cases it will be desirable instead of using a single transformer with three secondaries, to use a number of transformers, one for supplying the plate circuits and another or others for supplying the filament or heater circuits. In this case a part only of the sockets at the left of this group will be used. When a separate transformer is desired for the filament supply, I make use of a group of sockets designated Fil. Sup., in Figure 5 which includes a lower pair of sockets connected respectively to the clips **109** and **110**, and across which the heater or a supply transformer primary will be connected, and three pairs of the remaining sockets for connection to three independent secondaries; one for the detector tube for supplying low voltage heating current, one for supplying intermediate voltage current for the amplifying tubes and one for supplying high voltage heating current for the power tubes. One form of heater transformer is shown in Figures 10 and 11.

Connected with the secondary sockets of the group designated Fil. Sup. at the upper right hand corner of Figure 5, are three groups of three sockets each in which may be mounted potentiometers connected across the A supply secondary, and sockets of these three groups are connected to a series of clips in which are secured the flexible lead to the boards carrying the amplifier and detector tube stages.

Certain features of the arrangement and connection above described are repeated throughout the entire scheme disclosed in Figures 5 and 6. Thus from an inspection of Figure 5 it will be seen that permanent connections extend from most of the sockets shown, either to other sockets or to terminal clips, and in connecting the several elements to one another to form a complete system, the terminal clips will be connected to one another by flexible conductors and the proper elements mounted in the several groups of sockets. While it will be understood that in many cases elements of various types may be mounted in a group of sockets, I have, for the sake of clearness, designated groups of sockets employed, by indicating the character of elements supported in the socket.

Provision is made on the board shown in Figure 5, for two rectifier tubes shown by the groups of sockets marked Rect. Tube at the upper center of this figure. One or both of the tubes may be used as desired. Each group of sockets for the tubes consists of a pair of widely spaced sockets marked + and — adapted for connection with the filament, in case a tube of the filament type is employed, and a pair of closely spaced sockets marked respectively P and G, these sockets being designed respectively for connection to the plate and grid.

Mounts for the rectifier tube sockets, or other tube sockets, are shown diagrammatically in Figures 19 to 24 inclusive, Figures 19, 20 and 21 showing a mount for a five electrode tube wherein the tube socket **48** is supported from the plate **49** by insulating collars **50** which surround the

screws 51, the prongs 52 being connected through the plate 54 and arranged as shown in Figure 21.

Ordinarily for a rectifier tube five prongs will not be required and one prong may be omitted as indicated in Figure 23. Connection between the prongs and the tube socket carried by the mount will ordinarily be by conductors having one end connected to a prong by one of the nuts 52 and its other end connected to the terminal of the socket.

The input circuit of the rectifier tubes will ordinarily be connected to the B output circuit of the power supply transformer through the clips designated 112 and 113, in Figure 5, and conductors leading to the sockets + and —. Provision is made in the output circuits of the secondaries of the power supply transformer Pl. Sup. for the insertion of resistances in series with the output circuit and potentiometers and buffer condensers in shunt to the output circuits as indicated by the abbreviations for the elements in Figure 5. In the filter circuit are provided sockets for filter chokes and for filter condensers as indicated. Provision is made for a possible eight filter condensers, opposite terminals of which are connected respectively in a socket in an upper row of sockets 60 and a socket in a lower row of sockets 61.

One form of filter condenser and its mount is shown in Figures 11 and 12 wherein the mount comprises an upper plate or strip 62 of insulating material carrying brackets 63 between which the condenser is secured and a lower plate or strip 64 having prongs 65 and which supports the upper strip on insulated collars through which the bolts 68 are secured.

In filter circuits now in use it is customary to connect corresponding terminals of the condensers to one side of the filter output circuit and for this purpose I provide, below the row of sockets 61, a second row of sockets 67, each socket of which is electrically connected to a corresponding socket of the row 61.

The connector shown in Figures 17 and 18 may be used for example as a shunt or direct connection substitute for the resistance indicated in the lower right hand corner of Figure 5.

For the purpose of controlling the voltage from the filter to the several tubes of the system, it is the practice to include in the filter circuit one or more resistances, which may, if desired, be adjustable. At the lower right hand corner of Figure 5, marked Resist., I show three groups of three sockets, each of which is adapted to hold a rheostat, the terminals of which are connected with spring clips as shown. At 75 and 76 I show double rows of sockets between which additional filter condensers or voltage divider condensers of the filter may be connected. Sockets of each outer row are adapted to be connected by the suitable means not shown.

In the lower right hand corner of Figure 5 I show three sockets adapted for insertion of the prongs of the resistance unit and at the left of these sockets, a switch. These elements may be used as desired, as for example, in the primary circuit of one or another of the power transformers.

In Figure 6 I show a top plan view of a supporting board or box for the elements of a radio frequency amplifier and detector. The diagrammatic transverse section of this base is shown in Figure 7 from which it will be seen that the base comprises an elevated board or panel 80 and a front shelf or step 81. In the front shelf is mounted a series of groups of three sockets designated variously on Figure 6 as Mig. Cond., Potent., Rheo., Jack. These various devices which are of relatively small size and require manual control or adjustment, are conveniently mounted on the shelf 81 so as to be readily accessible from the front of the cabinet. Immediately above the groups of sockets in the shelf 81 are groups of sockets designated Var. Cond. which are adapted to receive the tuning condensers in the successive stages of radio frequency amplification. Four sockets are employed for each condenser, two of which are designed for electrical connection, respectively, with the fixed and movable condenser plates, and the remaining two are employed for properly securing the condenser elements to the board.

The sockets of the groups marked Var. Cond., which are connected with the condenser terminals, as well as the sockets on shelf 81, which are connected to the terminals of the elements mounted on the shelf, are permanently connected to a row of spring clips located back of the variable condensers and extending longitudinally of the base. These various clips are designated in a similar manner to the elements with which they are connected. Immediately back of this series of clips just mentioned are groups of sockets which are marked from left to right R. F. coil, tube, R. F. coil, tube, Det. tube and at the right of the row of clips just mentioned is a group of six sockets marked Vario.

The groups marked R. F. coil comprise four sockets which hold the elements of the interstage couplings between the several radio frequency stages of amplification. When these couplings are of the transformer type, a transformer carried on a suitable mount and provided with four prongs, is employed. If a resistance coupling is employed one of the coupling resistances will be connected in the two sockets to the right of the R. F. coil group and the other resistance in the two sockets to the left, these resistances preferably being mounted on a strip of insulating material and the coupling condenser will be connected between the upper sockets of the group in any convenient manner.

The two groups of sockets designated Tube in Figure 6, each comprise five sockets and may be employed with mounts of the character shown in Figures 19 to 21, inclusive. When a four electrode tube is employed instead of a five electrode tube, the form of mount illustrated in Figures 22 and 23, may be employed. As shown in Figure 6 each of the sockets of the Tube group is connected to a terminal clip on the supporting base. In certain cases I find it desirable to mount the terminal clips on the tube socket as designated in Figure 24, in which case, as previously explained, the prongs will be employed merely for supporting the tube and tube socket.

The group of sockets marked Det. Tube comprises five relatively widely spaced sockets which are intended to receive the prongs of a mount designed to carry the detector tube socket, the grid leak resistance and the grid leak condenser. One form of this tube socket, resistance and condenser assembly is shown in Figures 25, 26, and 27 wherein the tube socket 90 is supported as shown on the insulating plate 91 and the grid leak resistance 92 is mounted on the grid leak condenser 93 which in turn is carried by a plate 94 mounted on the plate 91. Connections between the terminals of the tubes and the resistance and condenser unit with the prongs are as indicated

in Figures 25 and 26. Figures 25 and 26 show a four electrode detector tube socket and fixed grid leak condenser and resistance. In Figures 28 and 29 I show a similar assembly adapted, however, for supporting a five electrode detector tube and an adjustable grid leak condenser and an adjustable grid leak resistance. In the form of mount shown in Figures 28 and 29 five prongs are employed and all five of the sockets which are designed Det. Tube are utilized when this type of tube is employed.

The group of six sockets designated Vario. at the right of Figure 6 is adapted to receive the prongs of a so-called three circuit tuner, having three windings which are connected respectively in the plate circuit of the last radio frequency tube and the grid and plate circuits of the detector tube. One form of such a three circuit tuner and its mount is illustrated in Figures 15 and 16 wherein the tickler coil included in the plate circuit of the detector tube is rotatably adjustable by means of a knob **95**. The remaining cylindrical coils comprise an inner secondary mounted on a Bakelite tube secured to the supporting strip shown and primary coil supported on vertical strips secured to the Bakelite. In the form of mount shown the prongs for the terminals of the tickler coil are received in the two upper sockets of Figure 6 and the remaining coils are respectively connected between the sockets of the pair of lower sockets to the right and to the left, these connections being illustrated diagrammatically in Figure 16.

Figure 6 shows other groups of sockets designated variously, by-pass condenser, fixed condenser, R. F. choke and R. F. stabilizer. These sockets are adapted to receive prongs of mounts upon which are carried condensers or chokes adapted for connection in various ways in the tube circuits. It will, of course, be understood that while designating a group of contacts by any particular legend, it is intended to indicate that the element mentioned may be employed in these contacts. It will be understood that other elements in certain cases may be employed as occasion may require.

Along the top of the board shown in Figure 6 are a series of terminal clips designated variously Ant., G, +B, +A, K, A. These clips are designated to be connected with the antenna, ground, +B supply, connections for tubes of different voltage and the A supply for the filament or heating circuits of the various tubes. Certain of these clips are duplicated along the top of the board so as to provide for attachment of the connections at convenient points. Normally the output circuit of the detector, for connection with the audio frequency amplifying base, will be connected to the terminal clips 223 and 225 shown at the extreme right of Figure 6. In practice when the radio frequency amplifier and detector is used as in a radio receiving system, these contacts will be connected through the cabinet with contacts on a board or base similar to that shown in Figure 6, but designed to support the audio frequency units. This other base is supported on a separate shelf from that which supports the base shown in Figure 6.

For the purpose of illustrating the manner in which the various terminal clips or detachable connectors may be utilized in building up a plate vacuum tube system, I have illustrated in Figure 8 one such system which may be easily built up, utilizing the arrangement of conductors and contacts shown on the bases disclosed in Figures 5 and 6 and the audio unit supporting base. The terminal clips which may be used in the system shown in Figure 8 are designated by reference numerals on Figures 5 and 6 and the same reference numerals are applied to Figure 8 to show the points in the circuit where these terminal clips occur. It will be understood, in general in Figure 8 that the points designated by the reference characters are terminal clips and that each of these clips will be connected in one direction or the other along the circuit by another clip by means of a flexible or readily removable connector. In Figure 8 the entire figure is divided into three sections, a lower section which represents the power plant, an upper section which represents the radio frequency amplifier and detector, and an intermediate section which represents the audio frequency amplifier. The connecting wires extending between the three sections will in actual practice extend from the base of one shelf of the cabinet to the base on another shelf and the remaining flexible connectors will be secured at their ends to different terminal clips on one or another of the bases.

By reference to the points of the system in Figure 8 which are designated by reference characters, and the clips of Figures 5 and 6 which are designated by the same reference characters, the entire system shown in Figure 8 may be readily traced.

In Figures 5 and 6 I show certain definite arrangements of clips, sockets and connecting conductors and on the three bases shown a very large number of systems may be built and readily altered as may be desired. Should it be desired to preserve a complete circuit arrangement with the flexible connectors in place of one or both of the radio frequency and audio frequency bases I have provided means whereby other bases may be employed with the same or with other and different arrangements of sockets, clips and connectors. For this purpose I have provided at the corner of each of the boards shown, sockets or jacks **98** which are adapted to receive prongs or plugs secured to another board or base of the same general dimensions as that shown in Figure 5 or 6, which latter board or base has mounted thereon sockets, connectors and clips arranged in the same or in a different manner from the arrangement on the board or base upon which it is placed. The spaces in the cabinet for holding the boards may be of sufficient height to contain two or more boards with the various electrical elements carried by the top board.

In Figures 24 and 25 I show a blank mount which may be used for supporting any of a variety of elements which it may be desired to use in the system.

Having now described my invention, what I claim and desire to secure by Letters Patent is:

1. A multistage vacuum tube repeating system comprising a common base having groups of prong sockets, elements comprising tubes and interstage couplings, said elements having bases, additional bases for supporting said second named bases, each of said last named bases having a group of prongs adapted to be fitted into prong sockets of corresponding groups, electrical connections between the prongs and corresponding terminals of the elements and quick independently detachable and independently removable connections outside said base for electrically connecting prong sockets corresponding to different elements, whereby elements of different

types may be interchangeably connected on the common base.

2. The combination of a cabinet having a plurality of shelves, removable supporting bases carried by said shelves, said bases comprising bases for supporting respectively a power plant and amplifier units of a receiving system, conductors secured to said bases, electrical elements of said receiving system being removably mounted on said bases and adapted to form electrical connections with said conductors on attachment to said bases, and readily accessible removable connectors having clips for connecting the conductors, whereby the various elements on the same and different bases may be connected in circuit.

3. A base for detachably holding the different electrical elements of a vacuum tube repeating system, said base comprising a top board having groups of sockets for the reception of prongs attached to said elements, wire terminal clips secured to said board, connections permanently secured beneath said board and connecting said clips respectively each to a socket.

4. A cabinet having shelves, bases removably positioned on said shelves for detachably holding the various electrical elements of a vacuum tube system, each base comprising groups of sockets, each group being adapted to receive prongs secured to and electrically connected with the terminals of an element, and independently detachable connectors on said bases electrically connected respectively with said sockets.

5. A base for detachably holding various elements of a vacuum tube repeating system, said base comprising a top board and a front shelf below the top board, groups of sockets supported by said top board and shelf, electrical connectors secured to said sockets, adjustable electrical elements of said system having prongs adapted to be seated in the sockets on the shelf and non-adjustable elements having prongs adapted to be seated in the sockets on the top board, and electrical connectors between the terminals of said elements and said prongs.

6. A base for detachably holding various elements of a vacuum tube repeating system, said base comprising a top board and a front shelf below the top board, adjustable electrical elements of said system removably mounted on said shelf, and non-adjustable elements mounted on said top board, and quick-detachable conductors on said base for electrically connecting said elements.

7. In combination, two bases for detachably holding the different electrical elements of a vacuum tube repeating system, each base comprising groups of sockets, and each group being adapted to receive prongs secured to and electrically connected with the terminals of an element of said system, quick detachable connectors, adapted to connect sockets on one base corresponding to different elements, whereby the elements on either base may be connected in circuit relation to one another, one of said bases having other sockets and the other base having prongs adapted to be seated in said other sockets, the last named prongs and sockets being so positioned that on said seating of the prongs in said sockets said bases are assembled in face to face relationship.

8. A base for supporting the elements of a power plant filter for a vacuum tube repeating system, said base having two parallel rows of sockets, corresponding sockets of the two rows being adapted to receive prongs connected to the terminals of a filter condenser, and means for connecting the sockets in the filter circuit, said means consisting of two other rows of sockets electrically connected with corresponding sockets of said first named rows, and removable supporting strips having rows of prongs adapted to be secured in the sockets of said other rows, conducting strips mounted on said supporting strips and connecting prongs to one another, and terminal connectors connected to said conducting strips.

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