March 29, 1932. C. HORTON 1,851,514

RADIO CIRCUIT CONTROL

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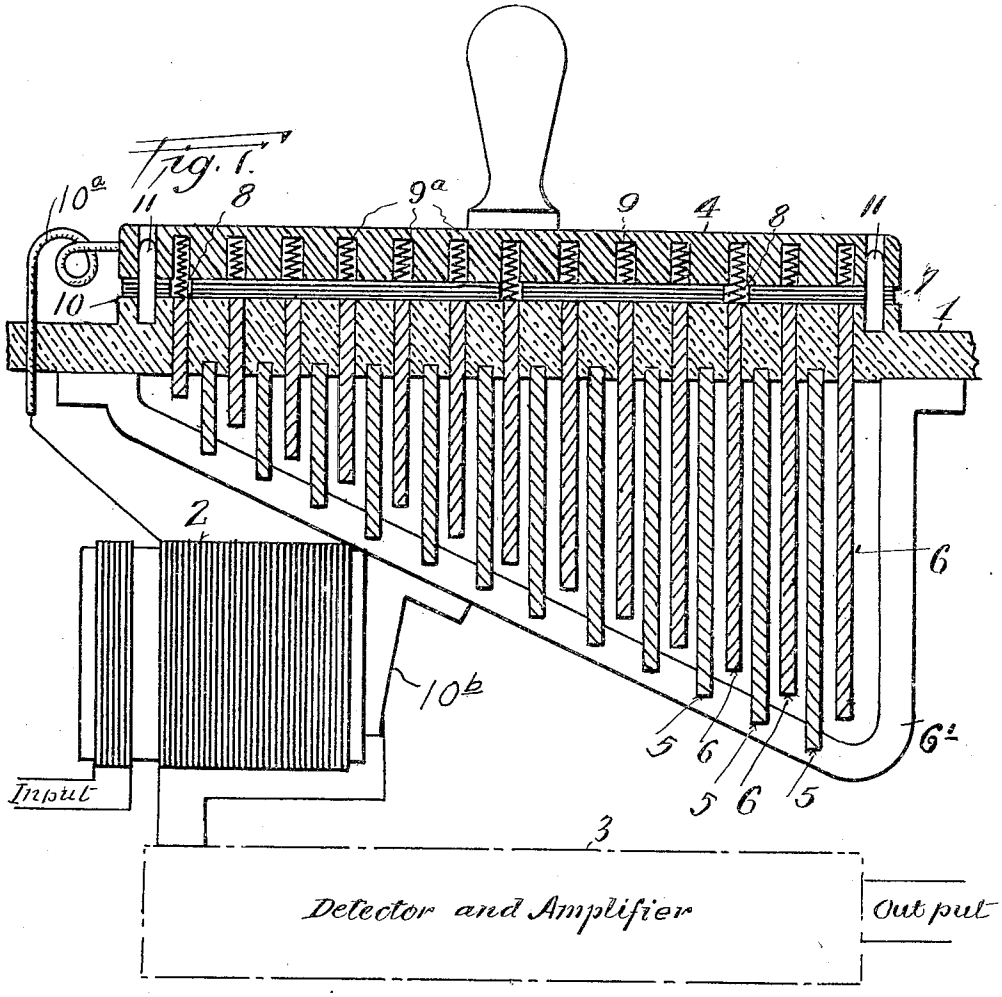

Fig. 1.

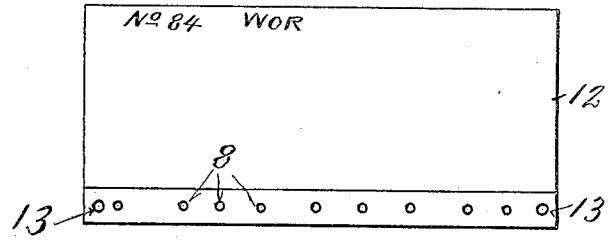

Fig. 2.

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RADIO CIRCUIT CONTROL

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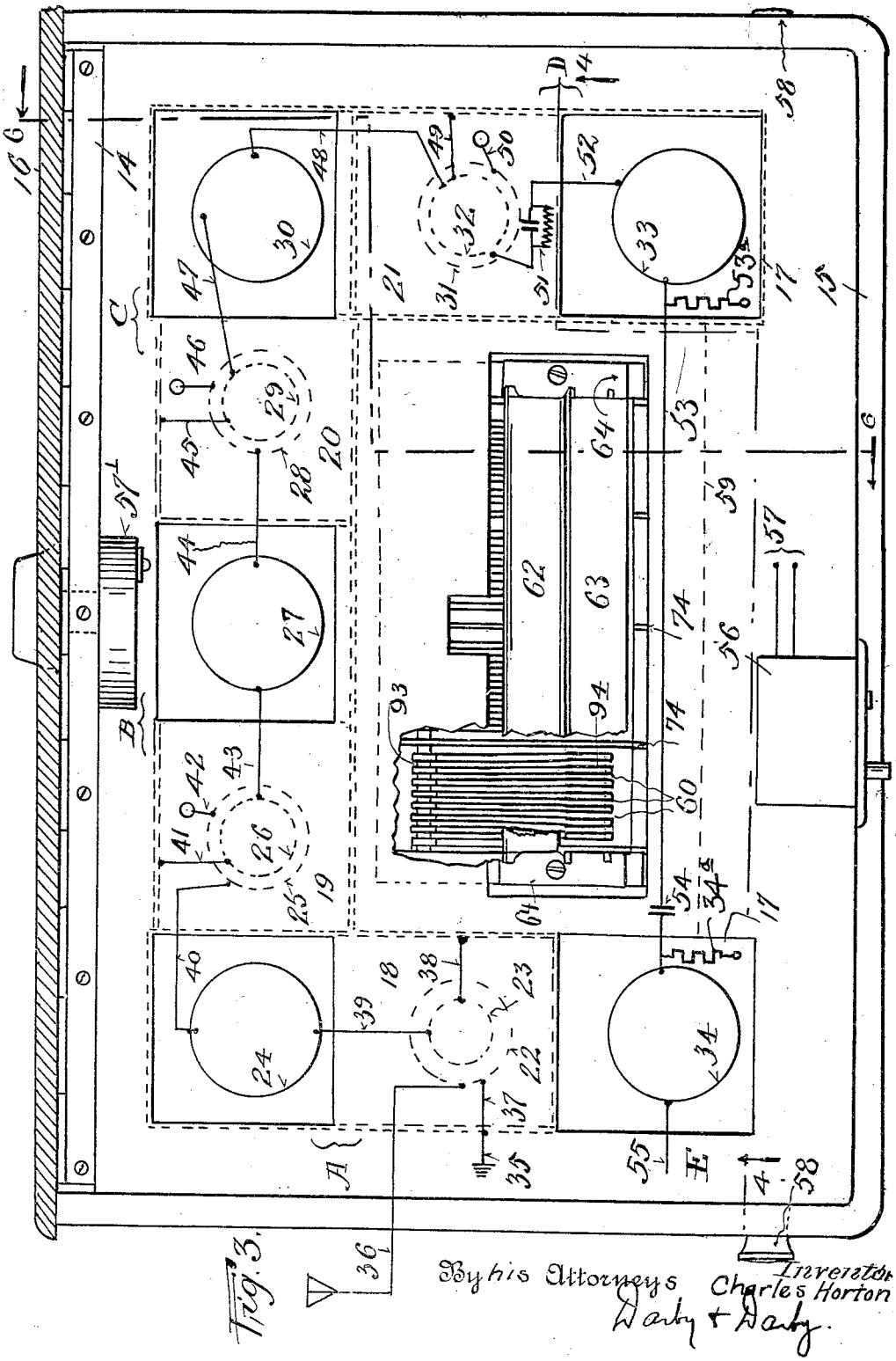

Fig. 3.

By his Attorneys Inventor Charles Horton
Darby & Darby.

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RADIO CIRCUIT CONTROL

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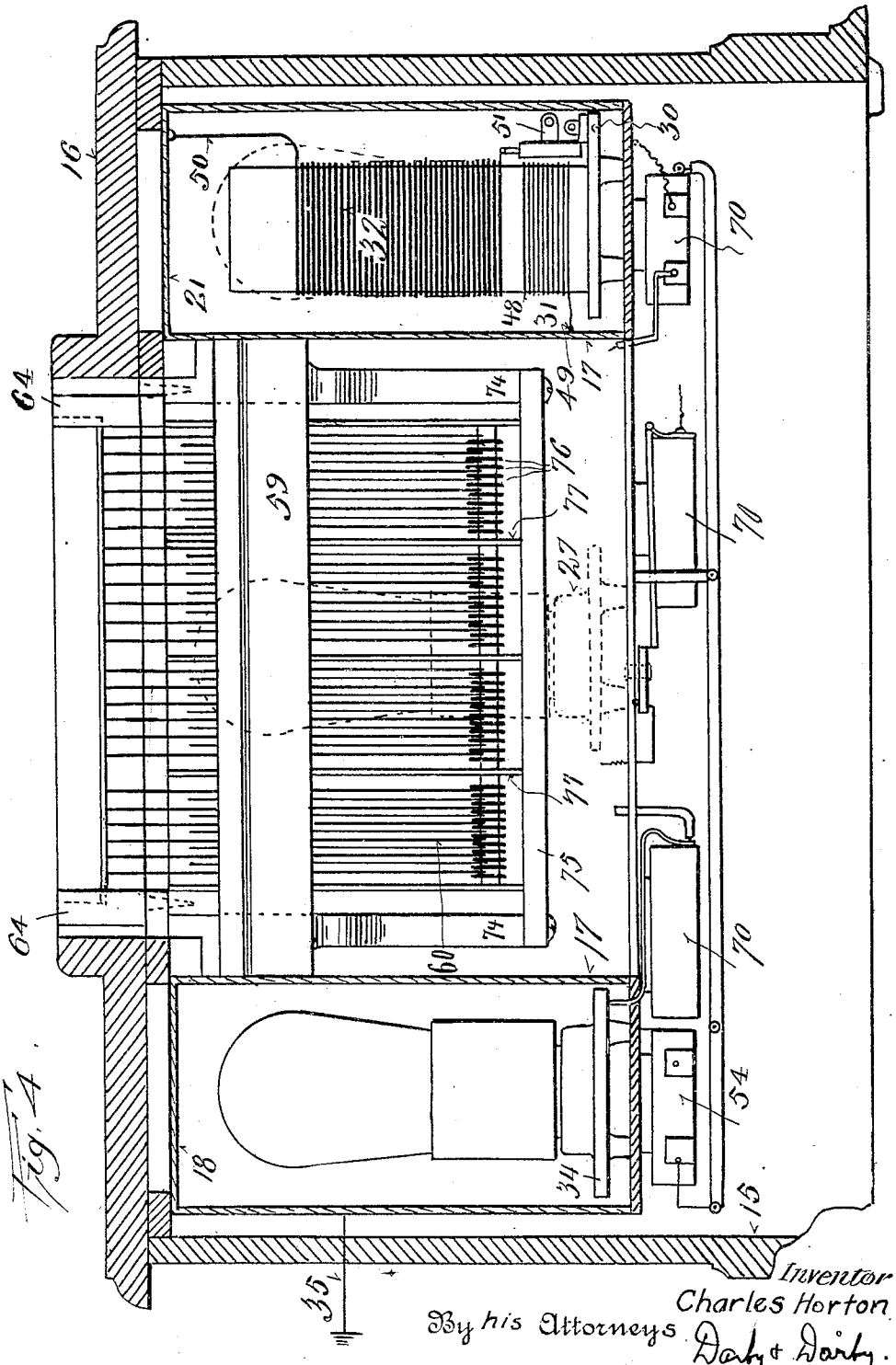

Fig. 4

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RADIO CIRCUIT CONTROL

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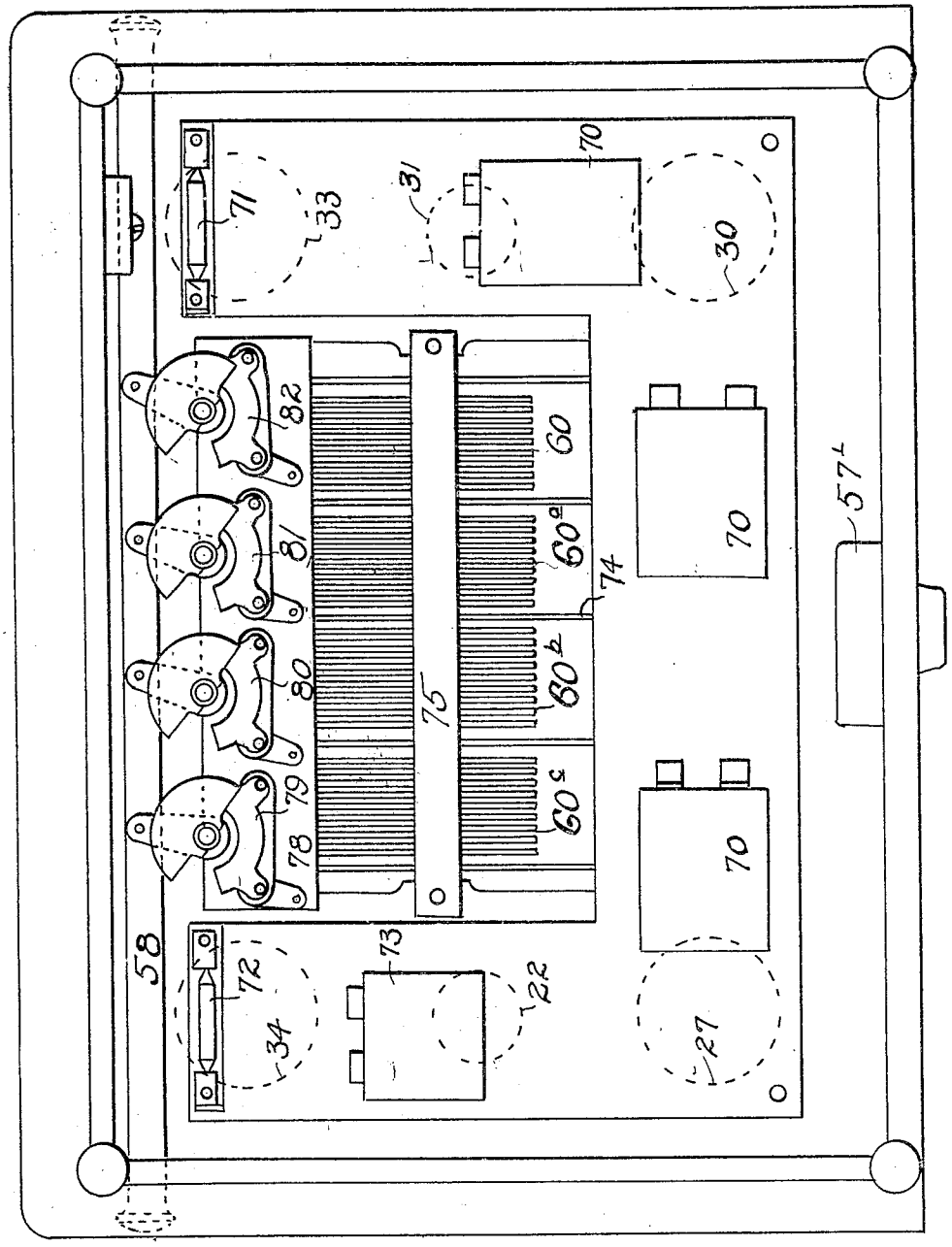

Fig. 5

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RADIO CIRCUIT CONTROL

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Fig. 6.

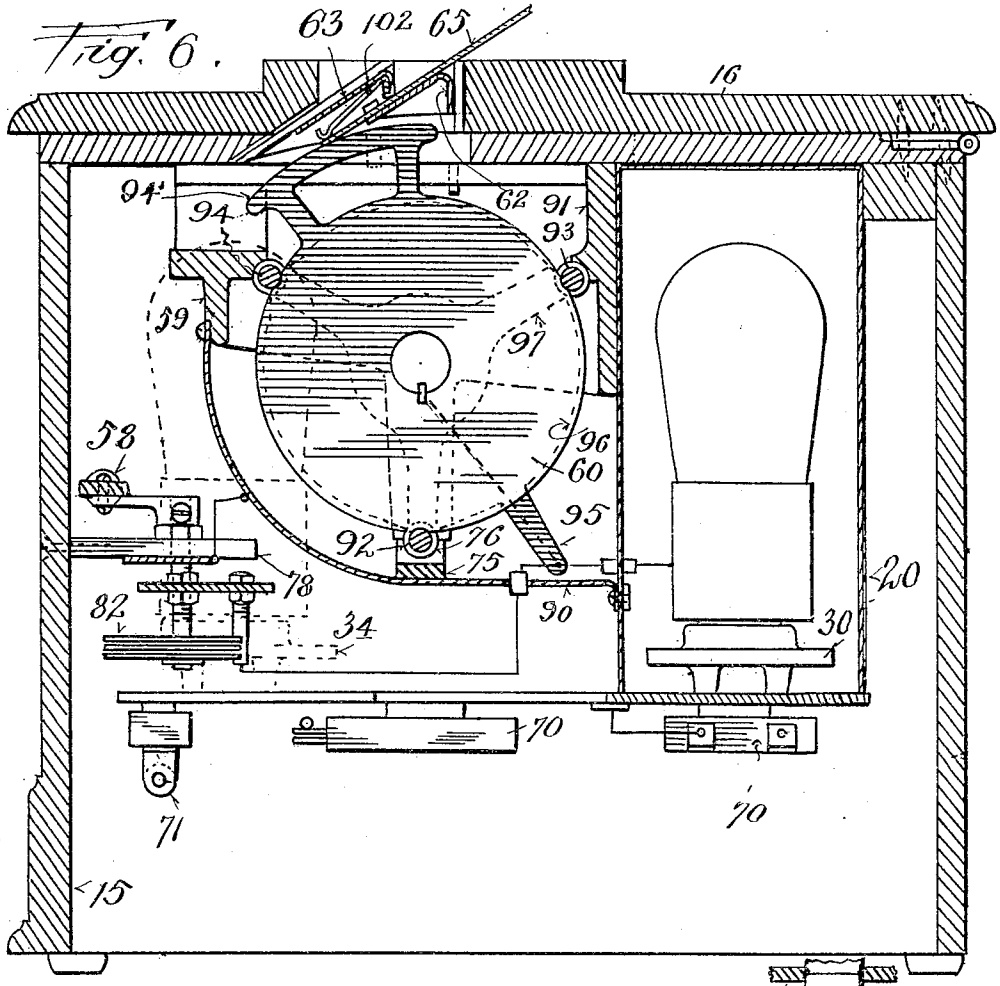


Fig. 7.

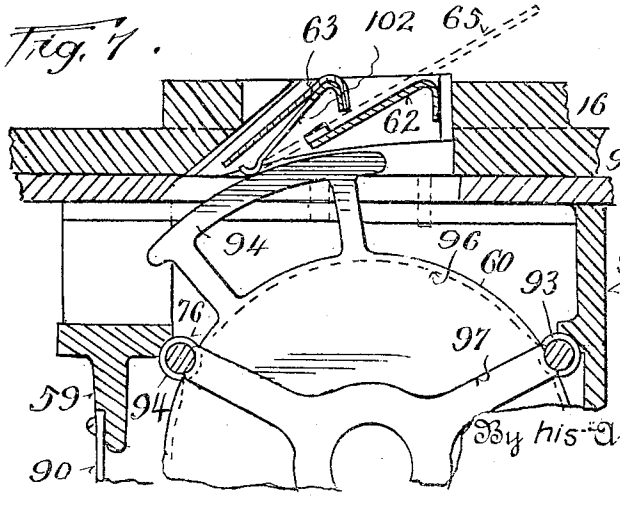
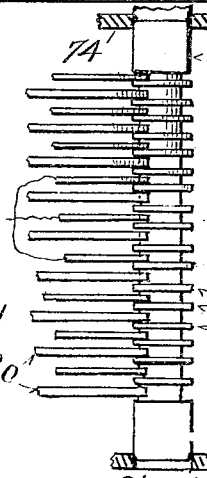


Fig. 8.



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Darby & Darby

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RADIO CIRCUIT CONTROL

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Fig. 13.

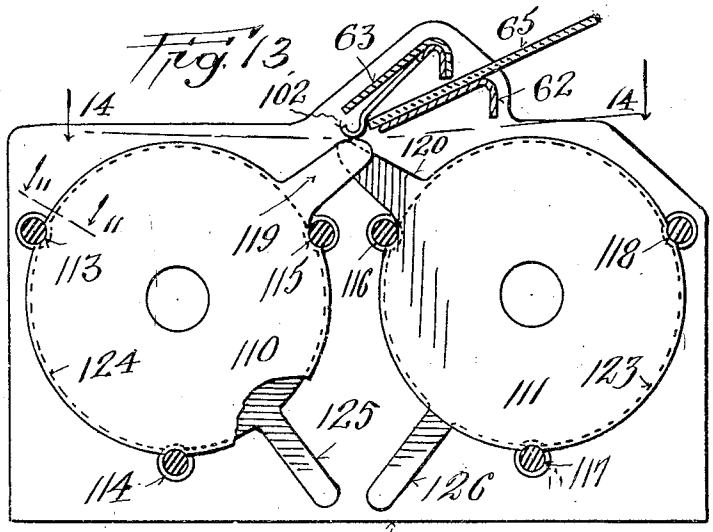


Fig. 10.

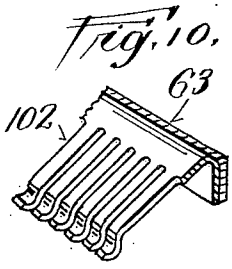


Fig. 9.

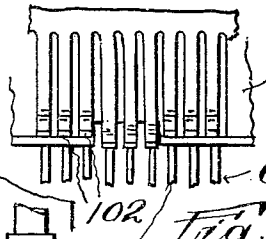


Fig. 14

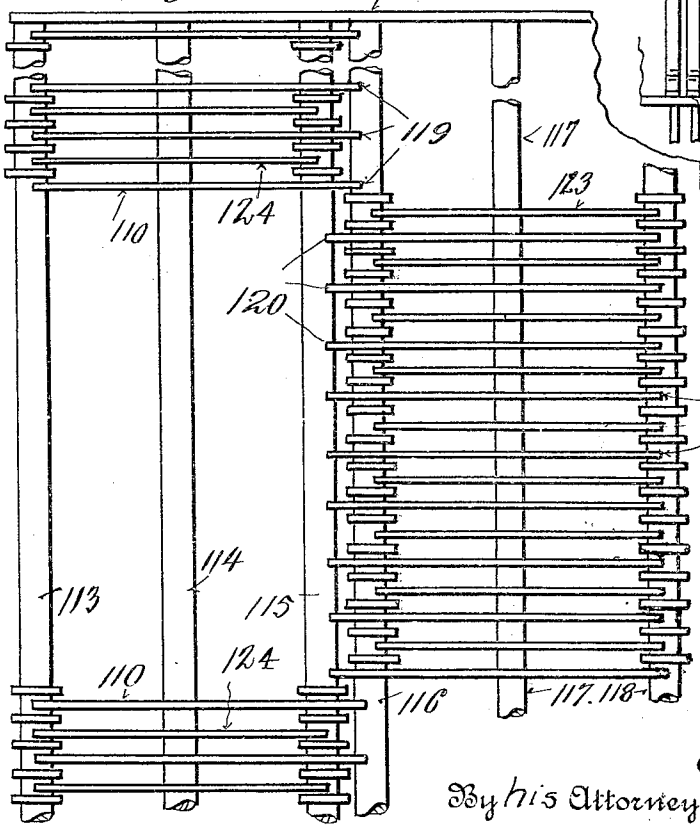


Fig. 11.

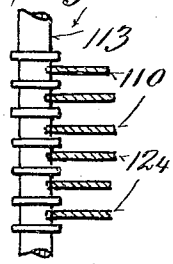
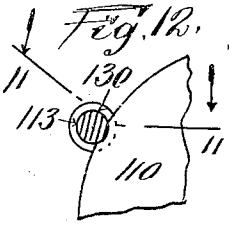


Fig. 12.



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RADIO CIRCUIT CONTROL

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Fig. 16a.

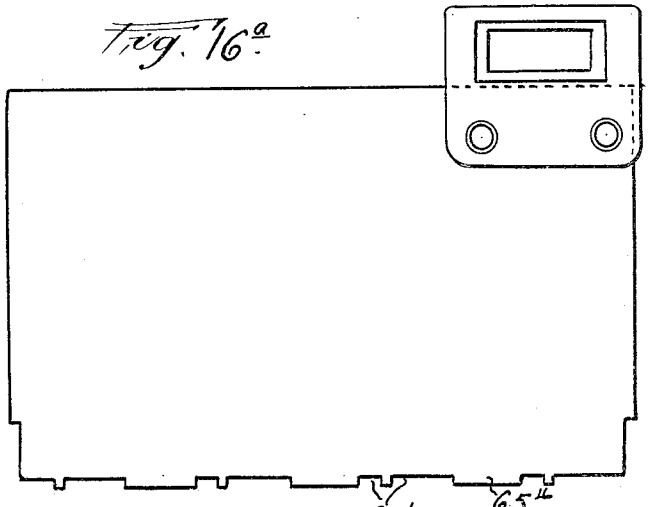
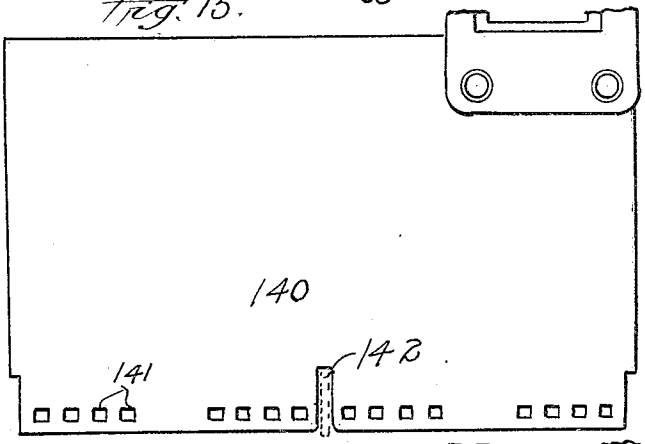


Fig. 15.



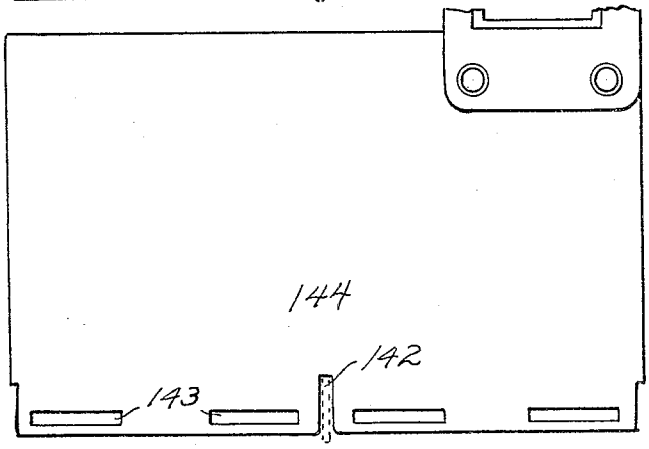


Fig. 16.

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RADIO CIRCUIT CONTROL

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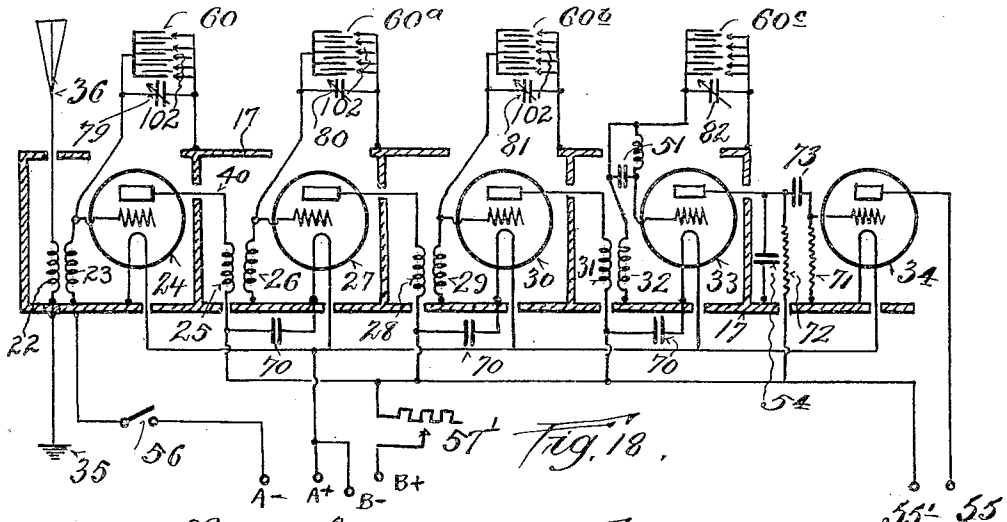

Fig. 18.

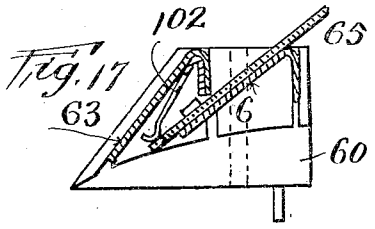

Fig. 17

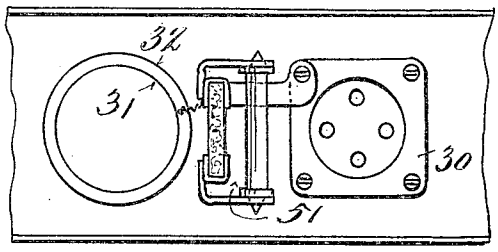

Fig. 19.

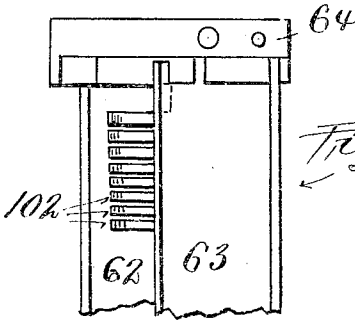

Fig. 20.

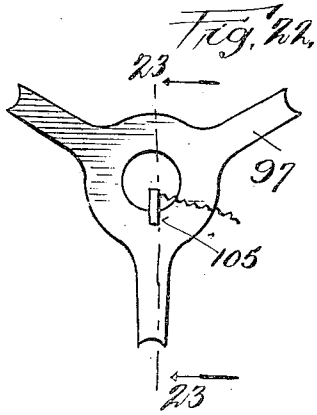

Fig. 22.

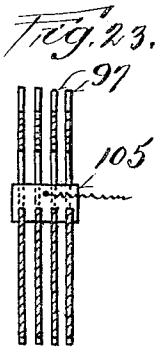

Fig. 23.

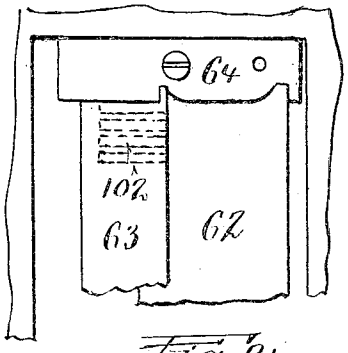

Fig. 21.

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Patented Mar. 29, 1932

1,851,514

UNITED STATES PATENT OFFICE

CHARLES HORTON, OF RIDGEFIELD PARK, NEW JERSEY, ASSIGNOR TO HORTON RADIO CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

RADIO CIRCUIT CONTROL

Application filed March 5, 1927. Serial No. 173,093.

This invention relates to radio or other wireless means of transmitting and receiving intelligence and seeks to provide in general an improved method of selecting a predetermined wave length upon which the energy is to be transmitted or received.

In general, it is the aim of this invention to provide for a radio receiving apparatus a novel arrangement of tunable elements and extremely simple means for tuning these elements to any predetermined wave lengths, without requiring any particular knowledge of the use and operation of the mechanism by the operator.

It is also broadly the object of this invention to provide means adapted in its application to radio reception devices to intercept at all times a signal on a particular wave length by the mere application to a particular type of movable elements a key or key card of predetermined characteristics.

Among the objects of this invention it is aimed to provide a novel form of tuning mechanism in association with general radio reception apparatus whereby the selection of any particular signal being transmitted at a particular wave length may be carried out by the application of a key card to the tuning element, which is constructed so as to always tune the tunable elements to the same wave length.

It is a further object of this invention to provide mechanism of the type described generally above which has no moving parts and which does not require a series of manual operations to effect its adjustment.

A still further object of this invention is the provision of apparatus adapted to tune radio circuits to any desired wave length without requiring any element of human skill in the tuning operations.

Another object of this invention is to provide radio reception apparatus with my novel form of tuning mechanism, which is operated or adjusted by means of a system of key cards or perforated plate members.

A still further object of this invention is to provide a method of tuning which is carried out by the simple selection of a key card or plate member from a group of differently constructed cards or members and association with a tunable element of a radio circuit which render the circuits selective for the particular wave length represented by the construction of the card or member.

A still further object of this invention is to provide radio reception apparatus employing the features described above and disclosing the tunable element as a bank of condensers constructed in a particular manner and associated with the rest of the equipment to provide a rapid and accurate arrangement for tuning the apparatus upon the application of a key card.

Further objects of this invention comprise novel features of construction of such apparatus as will be more fully described hereinafter.

This application is a continuation in part of my copending application, Ser. No. 144,039, filed Oct. 25, 1926, which is now abandoned.

This invention resides substantially in the construction, combination, arrangement and relative location of parts as will appear more fully hereinafter.

Referring to the drawings in which the same reference numerals will be used where possible in the different views to indicate the same or similar parts,

Figure 1 represents a cross-sectional view of my device, embodying the broad principles of my invention, showing it associated with radio apparatus, which has been disclosed diagrammatically.

Figure 2 is a side elevational view of a key card employed in my invention.

Figure 3 represents a top plan view of a radio receiving set to which the principles of my invention have been applied showing the parts within a casing having a cover shown raised in this view.

Figure 4 is a vertical cross sectional view taken on the line 4—4 of Fig. 3 looking in the direction of the arrows giving further illustration of my invention.

Figure 5 is a bottom plan view of the device of Figs. 3 and 4.

Figure 6 is a vertical cross sectional view

taken on the line 6—6 of Fig. 3 looking in the direction of the arrows.

Figure 7 is an enlarged cross sectional view of a portion of Figure 6 showing the relative arrangement of the spring fingers, condenser units and key cards.

Figure 8 is an enlarged side elevational view of one of the supporting rods for the condenser unit showing how the condenser plates are assembled and held together.

Figure 9 is an enlarged detailed view showing the relative arrangement of the spring fingers, condenser plates and key cards.

Figure 10 is an enlarged perspective view of the spring fingers and their mounting.

Figure 11 shows an enlarged elevational view partly in cross section of the method of mounting the plates of the modified form of condenser unit taken on the line 11—11 of Fig. 12.

Figure 12 is a side elevational view showing more clearly this method of mounting.

Figure 13 is an end elevational view of the modified condenser unit showing the method of supporting the parts.

Figure 14 is a top plan view of the arrangement of Fig. 13.

Figures 15, 16, and 16*a* show various forms of key cards.

Figure 17 is a cross sectional view of the key card slot device showing the method of mounting the spring fingers.

Figure 18 shows the circuit arrangement of the apparatus disclosed by me.

Figure 19 is a plan view of the detector tube socket, grid condenser, grid leak and transformer.

Figure 20 is an enlarged bottom plan view of the slot forming members showing the spring fingers.

Figure 21 is a top plan view somewhat enlarged of the slot forming members.

Figure 22 is a side elevational view of one form of condenser plate, and

Figure 23 is a vertical cross sectional view taken on the line 23—23 of Figure 22 looking in the direction of the arrows.

The present common practice in tuning radio circuits whether they be of the sending or receiving type is to provide adjustable inductances or condensers for tuning one circuit to resonance with respect to another. This requires a number of moving parts which must be constructed with considerable accuracy in order to provide sharp tuning. As soon as these parts begin to wear the apparatus does not function properly, and the circuits cannot be properly tuned with respect to each other. I have, therefore, devised a novel form of apparatus for adjusting either tuning inductances or tuning condensers which has no relatively moving parts as they are known, and therefore, the circuits may always be tuned to resonance.

I have also provided by reason of the constructions used by me a means which is particularly adapted for use in connection with the secret transmission and reception of radio intelligence. After the apparatus has been described its particular adaption to secret signalling will be pointed out.

Referring to Figure 1, I have shown one form of apparatus, embodying the principles of my invention. A suitable supporting plate 1 of insulating material is provided in which are secured a number of condenser plates 6 supported apart from each other and having their upper edges lying in the plane of the platform 10, comprising part of the support 1. A suitable metallic bracket 6′ depends from the support 1 and provides means for positioning the lower ends of a second series of condenser plates 5 which are interleaved with the first set. The upper edges of these plates are mounted in slots in the support 1.

A plate member 4 is shown having a plurality of recesses 9 within which are secured a number of springs 9*a*. These springs extend beyond the surface of the plate member 4.

When I speak of a key card, I intend to cover all possible forms of a controlling member for adjusting the tuning elements. I intend to include under this term, for instance a plate member or key card, such as cards of the type shown in Figures 2, 15, 16 and 16*a*. I also contemplate using an endless tape having a series of holes or notches therein, or even a series of conducting portions forming a part thereof. I will for the sake of brevity refer both in the specification and claims to these members as a key card.

All of the springs on the plate member 4 are electrically connected together and to the cable 10*a*, which is connected to one terminal of the secondary of the tuning inductance 2. The other terminal of this inductance is connected by the wire 10*b* to the metallic frame 6′. The primary of the tuning inductance 2 is connected in the well known manner to the antenna system by means of the wires marked "input". The pins 11 on the support 1 are adapted to be received by holes in the plate member 4, so as to correctly align the springs with their respective condenser plates. A key card 7 is shown having a number of holes 8 therein. When the key card is placed on the platform 10 and centered upon the pins 11 and the plate member 4 placed over it, the springs adjacent the holes in the key card will extend therethrough and make contact with the adjacent plates. It will be evident then that the particular capacity value of the condenser which is to be used will depend upon the number and arrangement of holes in the key card, since these holes control the contact of the springs within the plates. For each particular wave

length to which the secondary is to be tuned, there will be a single key card having the correct perforations to provide sufficient capacity to tune the circuit to this wave length. The output of the secondary is shown connected to a diagrammatic illustration of a detector and amplifier device having the output terminals marked "output" in the drawings.

It is evident that the particular type of apparatus and circuit used is entirely independent of the tuning device which I have disclosed and I have, therefore, merely illustrated these parts diagrammatically to show their association with the tuning devices. One form of key card is shown in Figure 2 and comprises a thin plate or card member 12 of any form of insulating material. Near one edge of the card is shown a plurality of holes 8 and at each end is shown a hole 13 through which the centering pins 11 pass. It will be evident that for each card as stated above, there will be a definite number of perforations 8. Each card then represents a particular wave length, and in the modern broadcasting systems will represent a particular station. I have indicated this by the letters WOR.

I may point out now that while I have particularly shown my device as applied to receiving apparatus it will be evident that it is equally well adapted for the adjustment of sending apparatus and I intend that my broad claim shall cover both.

In Figure 3 I have shown a complete radio receiving set to which my invention has been applied. A suitable container or cabinet is shown at 15 provided with a cover 16 hingedly attached thereto by means of the hinge 14. Mounted within this cabinet is a U-shaped metal container 17. This container is intended as a shield for the various parts of the device, and comprises the sections A, B, C, D, and E. Each section is provided with a cover which extends half way across as shown at 18, 19, 20 and 21. Within the section A is a transformer having a primary 22 and the secondary 23. Within the open portion of section A is diagrammatically represented a vacuum tube socket and tube at 24. Section B contains a transformer having the primary 25 and secondary 26 and a socket 27. Section C has a transformer comprising primary 28 and secondary 29 and the socket 30. Section D has a transformer comprising primary 31 and secondary 32 and vacuum tube socket 33. Section E consists solely of an open ended section having a socket 34. This metallic shielding casing is shown grounded at 35. The antenna system is connected to the primary 22 by means of the wire 36 and the other end of the primary is grounded to the shield by means of wire 37. The secondary is grounded by the wire 38 to the shield and has its other terminal 39 connected to the grid terminal of the vacuum tube socket 24. The output or plate lead of this socket is connected by a wire 40 to one terminal of the primary 25 which has its other terminal connected to the plate battery positive bus wire by the wire 42. The wire 41 grounds one terminal of the winding 26 and the other terminal is connected by the wire 43 to the grid terminal of vacuum tube socket 27. Wire 44 extends from the plate terminal of this socket to one terminal of the primary 28 which has its other terminal connected to the positive bus of the plate battery by the wire 46. One terminal of the secondary 29 is grounded at 45 and the other terminal is connected by the wire 47 to the grid terminal of the vacuum tube socket 30. The output terminal of this socket is connected by the wire 48 to one terminal of the primary 31, which has its other terminal connected to the positive bus of the plate battery by the wire 50. Wire 49 grounds one terminal of the secondary 32 while its other terminal is connected to the grid leak and grid condenser 51 which in turn connects to the grid or in-put terminal of vacuum tube socket 33. The plate or output terminal of this socket is connected by wire 53 through the condenser 54 to the input or grid terminal of vacuum tube socket 34. The wire 55 connected to the plate terminal of this socket comprises one of the output terminals to be applied to the loud speaking device or other suitable sound reproducing device. At 72 is shown the repeating resistance which connects from the lead 53 to the plate battery bus wire. A grid leak 71 is provided for socket and tube 34.

A suitable filament switch is shown at 56 having the terminals 57. At 57′ is shown a volume controlling device which is to be connected in the B battery circuit. At 58 is shown the two ends of a rod which extends through the cabinet for purposes to be described later. A suitable casting 59 is shown mounted within the casing to provide support for the plurality of condensers comprising the plates 60 and 96. This casing has the two end members with projecting arms 74, Fig. 4. The slot forming members 62 and 63 are mounted in guide members 64 at each end.

In Figure 4 is more clearly shown the arrangement of the framework for supporting these plates and at 65 is shown a key card held in the slot between the members 62 and 63, Fig. 3. At 70 are shown a number of radio frequency by-pass condensers which are shunted across the plate battery leads. It will be noticed from Figure 4, that the condenser plates 60 are arranged in several groups which are separated from each other by means of shield plates 77. The condenser plates are mounted at proper distances from each other by means of small insulating ridges 76.

Referring to the bottom view shown in Figure 5, I have shown mounted from a suitable support 78 a number of small adjustable vernier condensers 79, 80, 81 and 82, which are pivotally connected by means of levers to the slidable rod 58 which extends longitudinally of the casing. At 71 is shown a grid leak resistance, and at 72 is shown an impedance resistance for coupling the output of the detector tube to the input of the single audio stage. I have not attempted to disclose and describe all of the various wire connections in Figure 5, since the complete circuit arrangement is clearly shown in Figure 18, and will be described there.

In Figure 6 is more clearly shown the relative arrangement of several of the parts. The condenser sections comprise a number of plates 60 having the arcuate projections 94′. Interleaved between these plates are another set of plates 96, which have the integral projection tabs 95. As is more clearly shown in Figures 7 and 8, these plates are provided with notches at the periphery in which rest the insulating and supporting rods 92, 93 and 94. The plates are clearly shown maintained in their supported position by means of insulating ridges 76. At 90, I have shown a suitable metallic shield for the condenser sections. One of the vernier variable condensers 82 is clearly shown, and its method of mounting and connecting to the sliding rod 58. Figures 6 and 7 also clearly disclose the arrangement of the slot forming plates 63 and 62, and their methods of guiding the tuning card 65. Secured under the plate 63 are a plurality of spring fingers, one for each of the plates 60. As will be noted from these figures, when the card is pushed into place all the spring fingers are moved out of contact with the plates with the exception of those which are permitted to remain in contact with the arcuate members 94′ by reason of the slots or holes in the card.

I have found that in arranging the condenser sections in alignment that in order to prevent interference between the various circuits that these sections must be separated. If these sections are arranged in alignment and separated sufficiently the tuning condenser becomes bulky, and I have, therefore, devised an arrangement as shown in Figures 13 and 14, whereby the units are staggered. These units comprise the alternate plates 110 having the integral tabs 119, and the plates 111 having the integral tabs 120. The ends of these tabs are arranged in alignment, as is clearly shown in the Figure 13. Interlaced between the plates 110 and plates 111 are a series of plates 124 and 123, respectively, which have the tabs 125 and 126, respectively. As before these plates have notches in their peripheries and are clamped between the rods 113, 114, 115, 116, 117 and 118, which are held in suitable supports 121. The card slot construction is also clearly shown in these figures.

Figure 9 shows the relative arrangement of the spring fingers, plates and card. The alternate arrangement of plates 60 and 96 are shown and the card 65 discloses how the spring fingers 102 are permitted to rest on the plates at a notched portion of the card. In Figure 15 is shown the card 140 having a series of perforations 141 which may be used instead of the notches.

Figure 16 shows a modified form of notch at 143 on the card 114. It may be pointed out in connection with these cards, as shown at 142, in Figure 15 that a guide member may be provided for guiding the card into correct position in seat.

Figure 16*a* is an enlarged view of the card 65 showing its edges notched at 65′ and having a series of projections 65″. Those fingers 102 which are in alignment with the projections 65″ are raised out of contact with the plates, while those in alignment with the notches are permitted to remain in contact and are, therefore, connected in the electrical circuit. It is believed that specific reference is not necessary to describe the arrangement of the elements in Figs. 17, 20 and 21, since they merely disclose more clearly the arrangement of the slot forming members.

Figure 19 shows one method of associating the grid leak and grid condenser of the detector tube with its socket 30 and with the transformer comprising primary 32 and secondary 31.

In Figures 22 and 23 I have shown one form which the condenser plates may take in that portion of the condenser which provides the smaller increments of capacity.

I have found it advisable to shape the plates as shown in these figures. They consist of a central portion having the projection arms 97 with notches in the ends, so that they may be mounted between the supporting rods as described above. These plates may be electrically connected together by means of a bus bar 105, as shown in these figures.

I may point out here that by shaping the plates in the proper manner any suitable set of capacities may be arranged for the condenser. Thus, in Figure 6, the plate 60 is shown with a hole in the center. Where it is desired to have less capacity between the plates 60 and 96, this hole may be considerably enlarged. Thus, by cutting away or adding more surface area to the plates any suitable amount of capacity may be had between any adjacent set of plates. I have found that by suitably selecting these capacities, I may secure any capacity between the minimum and maximum limits of the condensers by the proper selection of the plates. I have also arranged these capacities so that this adjustment may be secured by very small steps. The smaller values of capacity are secured by means of the plates

shown in Figures 23 and 22, which have relatively little metallic area.

Referring to Figure 18, the various electrical connections of the parts are clearly shown. It may be pointed out that there are three sets of radio frequency stages, as represented by the vacuum tube sockets 24, 27 and 30, the detector tube socket at 33 and one stage of audio amplification represented by the tube socket 34. The audio amplifier is connected to the output of the detector tube by means of the resistance coupling 72. The output terminals from the audio stage are shown at 55 and 55′ and the volume control resistance is shown at 57′. The filament switch is shown at 56.

It will be noted that by means of the connections, the condensers 60, 60*a*, 60*b* and 60*c* are connected across the secondaries, of the transformers 23, 26, 29 and 32, respectively. As pointed out the particular card inserted in the slot selects the correct number of plates of each of these condensers to tune the circuit to resonance for a given wave length as represented by that card.

The condensers 79, 80, 81 and 82 are connected in parallel with condenser units 60, 60*a*, 60*b* and 60*c* respectively. This permits the final adjustment of the circuits for sharper tuning when the sending station is not sending its signals on the exact wave length that it should. Also should the units get out of adjustment slightly or should any other factor vary to throw the set out of adjustment I have found that these condensers permit a rapid adjustment of the circuits to provide any small correction of capacity values to correctly tune the various circuits to which they are respectively connected to resonance.

It will be evident that this device is particularly adapted for operation by means of a time clock. It is evident that if a particular station is to be heard at a certain time that a card having a perforation for time may be slipped into the slot and a time operated switch connected at 56, so that when the clock indicates the particular time at which the station is to send, the switch 56 will be closed and the signals from that station will immediately be heard. It will be understood that the card may also be adapted to not only select the desired program, but also to perform functions of selecting the proper resistance to prevent oscillations, on each wave length, the lighting of the filaments and in fact all necessary adjustments except the volume control.

The arrangement of this type is well adapted for secret signalling. Thus a sending station may send out signals at a definite wave length, which is not disclosed to those having a receiving set constructed in accordance with the principles of my invention. The sending station may, however, mail to those who possess one of these sets a card suitably notched to tune the sets to receive the signals sent out on this secret wave length. Thus, only those possessing this particular form of card may listen in on the signals, and it is at once apparent that this system is adapted for selling radio service. The cards are admirably adapted for advertising purposes, and it will be evident that a manufacturer could arrange to have a program sent out on the secret wave length, and then distribute cards adapted to tune the set to this wave length, and provide the cards with advertising matter.

I have found that with one simple arrangement of plates which I have devised and constructed in accordance with the present disclosure, that I can get approximately five hundred practical combinations of capacity, so that the set can be tuned to five hundred different wave lengths. This means that there are five hundred practical combinations of notches which may be used and it will be at once clear that if signals are sent out on an unknown wave length that it would be practically impossible to construct a card which would tune the set to that wave length, without at least, a vast quantity of cut and try experiments to determine the proper combination of notches to tune the set to that wave length.

I am, of course, aware that many changes in the detail of construction and relative arrangement of parts will readily occur to those skilled in the art, and I do not, therefore, desire to be limited to the arrangements shown for purposes of illustration. Thus, for instance, it is evident that this invention is applicable to any form of radio circuit and that any arrangement of condenser plates may be used to get any desired capacity. It is also evident that, instead of using condensers, tuning inductances may be used in place thereof.

I, therefore, consider my invention to be defined by my appended claims rather than the illustrations and description given above.

What I seek to secure by United States Letters Patent is:

1. The combination with means for detecting and amplifying radiant energy and a plurality of condenser plates of a key card for selecting a particular group of said plates.

2. The combination with means for detecting and amplifying radiant energy and a plurality of condenser plates of a key card adapted to select a particular group of said plates to adapt the detecting and amplifying means for operating on a particular wave length.

3. The combination with a container and a plurality of devices connected to provide a radio receiver one of said devices comprising a plurality of condenser plates, of a notched card for grouping said plates to adapt said receiver for operation at one frequency.

4. In radio receiving apparatus, the combination with a container and radio receiving apparatus in said container including a plurality of condenser plates, of a key card for grouping said plates to tune said apparatus to a definite wave length.

5. The combination with a plurality of condenser plates of a contact finger for each plate and means for selecting the particular group of fingers for contact with their associated plates to give a particular capacity.

6. In a radio receiving apparatus the combination with a container and radio receiving apparatus in said container including a plurality of condenser plates of a card for grouping said plates to tune said apparatus to a definite wave length, and means including condensers for varying the tuning of said apparatus to compensate for any differences between the wave length selected and the wave length to which the apparatus is tuned.

7. The combination with a plurality of condenser plates of a contact finger for each plate and a notched card for cutting out certain of said fingers to permit adjusting said condenser to a definite capacity.

8. The combination with a plurality of devices connected to provide a radio receiver, one of said devices comprising a plurality of tuning elements of key means for grouping said tuning elements to adapt said receiver for actuation on a particular wave length, and additional means for tuning the receiver to exact syntony with any wave length sought to be intercepted.

9. The method of tuning a radio receiver which comprises inserting a key card into a tuning mechanism and thereby, by the single act of inserting the key card, selecting one fixed frequency range for reception determined by the form of the key card.

In testimony whereof I have hereunto set my hand on this 16th day of February, A. D. 1927.

CHARLES HORTON.