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RADIO RECEIVING APPARATUS

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2 Sheets-Sheet 1

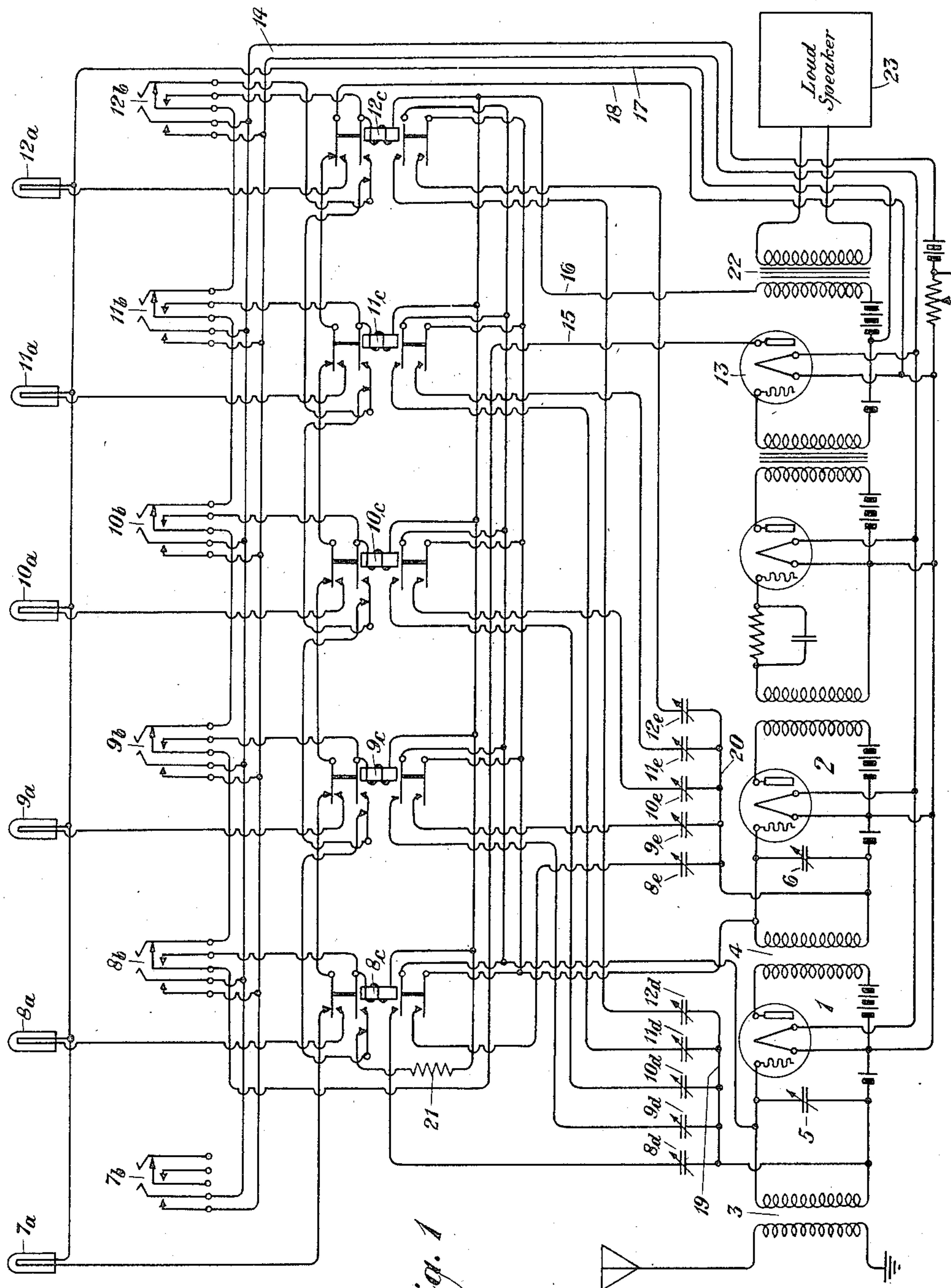


Fig. 1

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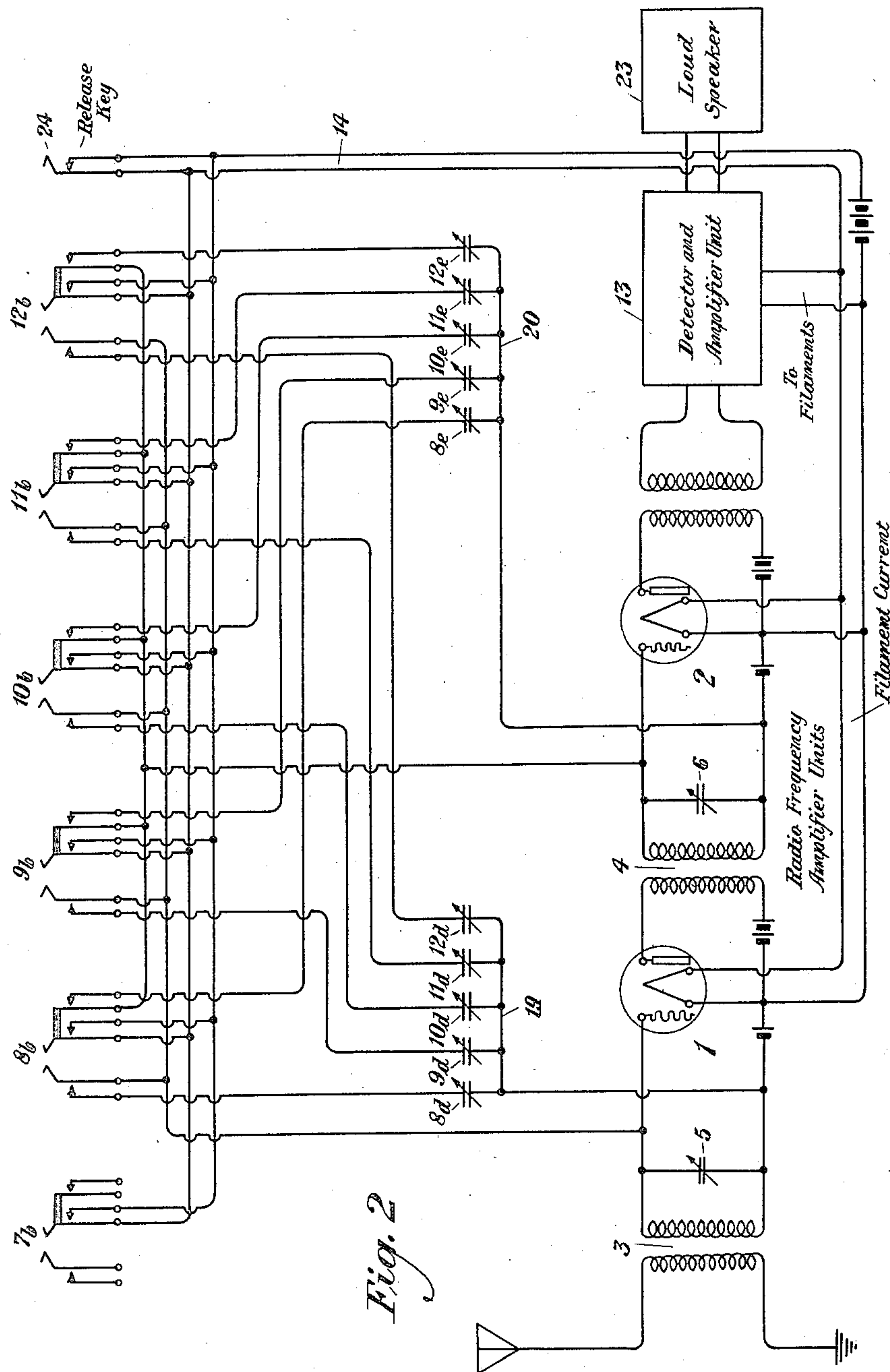
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RADIO RECEIVING APPARATUS

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13 Claims. (Cl. 250—20)

This invention relates to the art of radio communication and more specifically to improvements in radio receiving apparatus whereby said receiving apparatus may be instantly tuned to any of a predetermined group of wave lengths by simply operating suitable switches, and whereby said receiving apparatus may be tuned with great accuracy to a wave length intermediate such predetermined wave lengths. Other features of the invention will appear in detail below.

In a number of existing receiving circuits tuning is accomplished by means of variable condensers located at one or more points in said circuit, each such capacity having a sufficient range of variation to tune the receiving set to a wide range of wave lengths. In order to meet this requirement, the construction of the condenser is such that a small angular displacement of the dial, changes the capacity by a relatively large amount thus making accurate tuning difficult. In addition, each time a different transmitting station is desired, the condensers must be carefully reset and even though a record is kept of the settings required to tune in the various transmitting stations, nevertheless, a certain amount of trial tuning is necessary to obtain optimum reception. Both of these factors introduce a source of inconvenience in receiving set operation which it is desirable to eliminate.

In the present invention each point in the receiving circuit which requires tuning capacity is equipped with a variable vernier type condenser of relatively small range of variation permanently connected in the receiving circuit and a plurality of variable condenser elements, each of which is adapted for use in conjunction with a similar element at each of the other tuning points thus constituting a number of combinations of such elements. Each such combination is controlled by a switch which permits a predetermined combination to be instantly connected in the receiving circuit in such manner that at each tuning point a variable condenser is connected in shunt with the corresponding vernier condenser located at such point. For a given combination thus connected the variable condensers are individually adjusted to tune the receiving circuit to a given wave length with the vernier condensers set on zero. The wave length thus selected is such as will tune in a given transmitting station at optimum reception. In a similar manner with each combination connected, a different transmitting station is tuned in. The group of transmitting stations thus tuned in are selected to furnish a series of wave lengths the successive values of which are sufficiently close together that the intervening wave lengths may be tuned in by adjusting the vernier condensers with a suitable wave tuning combination connected. In

this manner, a very accurate tuning of an intermediate wave length may be obtained.

Two specific embodiments of the invention will now be given. In the drawings, Figure 1 shows an arrangement whereby key switches control the operation of relays which in turn connect the proper combinations of variable capacities in the receiving circuit, at the same time lighting a lamp to indicate the band of wave lengths the set is connected to tune in. Fig. 2 shows a simple circuit in which the operation of the key switches control directly the connection of combinations of variable capacities in the receiving circuit. In this case, the key operated indicates the range of wave lengths that may be tuned in.

Referring to Fig. 1, the lower portion of the drawing represents in schematic form the essential elements of a radio receiving set utilizing two stages of tuned radio frequency in which are placed the variable tuning capacities. Condensers 5 and 6 are vernier condensers of relatively small capacity range of the order, say of 75 mmf., while 19 and 20 represent groups of variable condensers, the corresponding condensers in each group of which are simultaneously adjusted to tune in a given transmitting station with the verniers set on zero. That is the switching mechanism is such that with condenser 8d connected across transformer 3, condenser 8e is simultaneously across transformer 4. With condensers 5 and 6 set on zero condensers 8d and 8e are simultaneously adjusted to tune in a transmitting station furnishing optimum reception with the two condensers set at about 70 mmf. each. The switching means is then operated to disconnect condensers 8d and 8e and to connect condensers 9d and 9e in the circuit. These condensers are adjusted to tune in a transmitting station, the optimum reception of which is obtained with the condensers set at approximately 140 mmf. each. In the same manner, condensers 10d and 10e are adjusted to tune in a station for a setting of about 210 mmf., condensers 11d and 11e, a station at about 280 mf., and condensers 12d and 12e, a station at about 350 mmf. Any intermediate station desired is obtained by operating the vernier condensers in conjunction with the fixed capacities. For example, if a station is desired which is tuned in with about 170 mmf. per stage condensers 9d and 9e are connected in shunt with condensers 5 and 6, respectively, the latter condensers being adjusted to about 30 mmf. each which together with the fixed capacities of 140 mmf. each for 9d and 9e will constitute the desired values.

With reference to the switching mechanism, all apparatus labeled with the numeral corresponding to that of a given key switch is controlled by such key switch. For example, the op-

eration of key 8b controls lamp 8a, relay 8c, and condensers 8d and 8e. The operation of key 8b completes a circuit over leads 14 and through the left operated contacts of switch 8b to light the filaments of the vacuum tubes in the receiving set thus preparing the set for operation. As soon as the filaments begin to glow, the plate current of tube 13 begins to flow from the plate of tube 13, over lead 15, through the right operated contact of key 8b, through the winding of relay 8c, over lead 16, through the left winding of audio-frequency transformer 22, the plate battery of tube 13, out over lead 17, through lamp 7a, through the upper outer back contacts of all the relays in series beginning with 8c, back over lead 18 to the filament of tube 13. Relay 8c thereupon operates and disconnects lamp 7a from the plate circuit at its upper outer back contact, substituting therefor lamp 8a at the upper outer front contact of relay 8c. The operation of relay 8c further connects condenser 8d in shunt with condenser 5 through the lower inner front contact of 8c, and connects condenser 8e in shunt with condenser 6 through the lower outer front contact of 8c. The operation of any of the key switches 8b to 12b, inclusive, will cause the circuit to function as just described; in each case, however, the apparatus having the same numerical designation as the key operated, will be involved in the circuit.

Should key 7b be operated, it will close the circuit through its left operated contacts and over leads 14 to light the filaments of the tubes. As soon as the filaments glow, plate current will flow from the plate of tube 13, over lead 15, through the right non-operated contacts of keys 8b to 12b, inclusive in series, through the upper inner back contacts of relays 8c to 12c, inclusive, in series beginning with relay 12c, through resistance 21, which takes the place of a relay, over lead 16, through the left winding of transformer 22, the plate battery of tube 13, and out over lead 17, through lamp 7a, through the upper outer back contacts of relays 8c to 12c, inclusive, in series, and over lead 18 to the filament. Lamp 7a thereupon lights. No relay or fixed condensers are involved in this case and the lighting of lamp 7a serves to indicate that the vernier condensers alone are connected in the receiving set, thus arranging the set for tuning in the very short wave lengths from zero up to that of the station obtained with condensers 8d and 8e connected. Restoration of any operated key opens the filament circuit at the left operated contact of said relay. This prevents the further flow of plate current, thus releasing the corresponding relay and restoring the circuit to its non-operated condition.

It will be noted that with a key thrown, a lamp is connected in the plate circuit of tube 13 and between the grid and filament of this tube so that the voltage drop due to the plate current flowing through it furnishes part of the grid biasing voltage. This arrangement has several advantages, for in addition to indicating the wave length band for which the set is connected, the lighted lamp shows that the set is functioning properly. A flickering lamp indicates that the set is overloading. Under overload conditions, the negative current-resistance characteristic of the lamp tends to stabilize the grid bias as compared to the result obtained with the lamp replaced by a resistance.

Fig. 2 shows a much simpler circuit for connecting the fixed capacities in the receiver cir-

cuit than that just described. Key switches 7b to 12b, inclusive, are mechanically locking, i. e., the operation of a given key releases any other key operated at the time. The key thus operated, itself remains locked until its subsequent release upon operation of another key. Key 24 is a release key which, upon operation and release, leaves all keys including itself, non-operated. The operation of key 7b lights the filaments of the tubes by closing the circuit through leads 14. Since no other result is accomplished by this key, the set is arranged to tune in the short wave stations obtained with the verniers only. The operation of key 8b in addition to lighting the filaments of the receiving set tubes, connects condenser 8d in shunt with condenser 5 and condenser 8e in shunt with condenser 6. As in Figs. 1, 5 and 6 are vernier condensers, while groups 19 and 20 represent the groups of ordinary, variable condensers adjusted as previously described. The operation of any key in Fig. 2 connects in the receiving circuit the condensers designated by the same numeral as the key operated.

The specific examples of the invention given above disclose applications of the invention to receiving sets which require variable condensers for tuning purposes. The same idea is applicable for sets which require variable inductances, with the slight modification that the vernier and variable condensers be replaced by vernier and variable inductances.

What is claimed is:

1. In a radio system, the combination of a radio receiving circuit requiring tuning capacity at one or more points in said circuit, tuning capacity therefor consisting for each such point of a permanently connected variable vernier condenser and a plurality of variable condensers, a plurality of manually operated mechanically locking key switches such that the operation of any key switch releases any other key switch then operated, and relay means interconnecting said key switches one such key switch upon operation being adapted to light the filament of the vacuum tubes associated with the receiving set, each of the remaining key switches upon operation being adapted to similarly light said vacuum tube filaments and also to connect a predetermined combination of said variable condensers in said receiving circuit in such manner that at each tuning point one of said variable condensers is connected in shunt with the vernier condenser, a different such combination of variable condensers being that controlled by each key switch.

2. In a radio system, the combination of a radio receiving circuit requiring tuning reactance at one or more points in said circuit, tuning capacity therefor consisting for each such point of a permanently connected variable vernier condenser and a plurality of variable condensers; a plurality of manually operated key switches, relay means interconnecting said key switches, a plurality of lamps operated by plate current of the receiving set, and a plurality of relays, one key switch upon operation being adapted to light the filaments of the vacuum tubes associated with the receiving circuit and to connect a lamp in the plate circuit of the audio-frequency amplifier stage of said set in such manner that it also acts as a grid biasing resistance, each of the remaining key switches upon operation similarly lighting said vacuum tube filaments and connecting a lamp in said plate circuit as de-

scribed and also causing the operation of a relay to connect a predetermined combination of said variable condensers in the receiver circuit in such manner that at each tuning point one such condenser is connected in shunt with the vernier condenser, a different lamp and combination of condensers being thus controlled by each of said remaining key switches.

3. In a radio system, the combination of a radio receiving circuit requiring variable tuning reactance at one or more points in said circuit, tuning capacity for each such tuning point consisting of a variable vernier type condenser of relatively small range and a plurality of variable condensers, one of the variable condensers at each tuning point being adapted for use in conjunction with a similar variable condenser at each of the other tuning points, the arrangements at the various tuning points constituting a plurality of combinations of variable condenser elements the individual condensers of which are adjusted to tune the receiving circuit to a given wave length with such a combination connected in said circuit and the vernier condensers set on zero, a different wave length being provided for each such combination when so connected, said wave lengths constituting a series, the successive values of which are sufficiently close that the receiving circuit may be tuned to the intermediate wave lengths by means of the vernier condensers cooperating with a suitable combination, switching means consisting of a plurality of mechanically locking key switches and relay means interconnecting said key switches so that the operation of any one of said key switches will release any other operated at the time, one of said key switches being adapted to light the filaments of the vacuum tubes associated with the receiving circuit, each of the remaining key switches being adapted to connect one of the aforementioned combinations of variable condenser elements in the receiving circuit in such manner that at each tuning point a variable condenser is connected in shunt with the corresponding vernier condenser.

4. In a radio system, the combination of a radio receiving circuit requiring variable tuning reactance at one or more points in said circuit, tuning capacity therefor consisting for each such tuning point of a variable vernier type condenser of relatively small range and a plurality of variable condensers at each tuning point, one of the variable condensers at each tuning point being adapted for use in conjunction with a similar condenser at each of the other tuning points, that arrangement constituting a plurality of combinations of variable condenser elements the individual condensers of which are adjusted to tune the receiving circuit to a given wave length and the vernier condensers set on zero, a different wave length being produced by each such combination when so connected, said wave lengths constituting a series the successive values of which are sufficiently close that the receiving circuit may be tuned to the intermediate wave lengths by means of the vernier condensers cooperating with a suitable combination, a plurality of lamps operative on plate current of the receiving circuit, a plurality of manually operated key switches, and a plurality of relays interconnecting said key switches, one such key switch being adapted to connect a predetermined lamp in the plate circuit of an audio-frequency am-

plifier stage of the receiving set in such manner that it also acts as a grid biasing resistance, said latter key switch being also operated to light the filaments of the vacuum tubes associated with said receiving set, each of the remaining key switches being adapted to similarly light the vacuum tube filaments and connect a predetermined lamp in the plate circuit and also to cause the operation of a relay to connect an aforementioned combination of variable condenser elements in said receiving circuit in such manner that each tuning point contains a variable condenser in shunt with the corresponding vernier condenser, each such remaining keys controlling a different lamp and combination of condenser elements.

5. The combination of a tube having plate, filament and grid electrodes, a circuit for heating the filament, sources of potential connected respectively to the plate and grid electrodes, and a device of negative resistance characteristic connected between a point on the filament heating circuit and a terminal common to said sources.

6. The combination of a tube having input and output circuits, and a lamp having a negative resistance characteristic in common with said circuits for indicating overload conditions.

7. The combination of a tube having input and output circuits, and an indicating device having a negative current-resistance characteristic in common with said circuits.

8. The combination of a tube having plate, filament and grid electrodes, a circuit for heating the filament, plate and grid, batteries connected in series with each other between the plate and grid electrodes so that the positive pole of the plate battery is nearer the plate electrode and the negative pole of the grid battery nearer the grid electrode, and a lamp connected between a point on the filament heating circuit and the terminal common to said batteries.

9. Apparatus for transmitting a band of signals including a tube having input and output circuits, a lamp having a negative resistance characteristic, and means for connecting said lamp in common with said circuits for indicating whether the tube is overloaded by the signals.

10. The combination of a tube having grid, filament and plate electrodes, a battery, a lamp of negative current-resistance characteristic, said battery and said lamp being connected in series between the plate and filament electrodes of the tube, the lamp being also connected in series between the grid and filament electrodes of the tube.

11. The combination of a tube having input and output circuits, and means for indicating whether said tube is overloaded, said means comprising a lamp of negative resistance characteristic connected in series in said input circuit.

12. The combination of a tube having input and output circuits, and means for indicating whether said tube is overloaded, said means comprising a lamp of negative resistance characteristic connected in series in said output circuit.

13. Means for determining whether a tube receiving signaling energy is overloaded by the signaling energy, comprising a lamp of negative resistance characteristic connected in series with and common to the input and output circuits of said tube.

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