

April 30, 1935.

A. J. ALEXONIS

1,999,313

RADIO RECEIVING SYSTEM

Filed Aug. 8, 1932

3 Sheets-Sheet 1

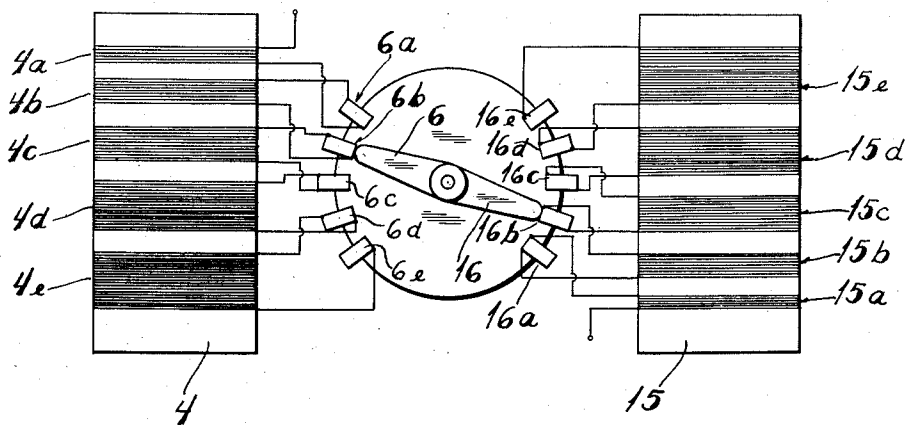
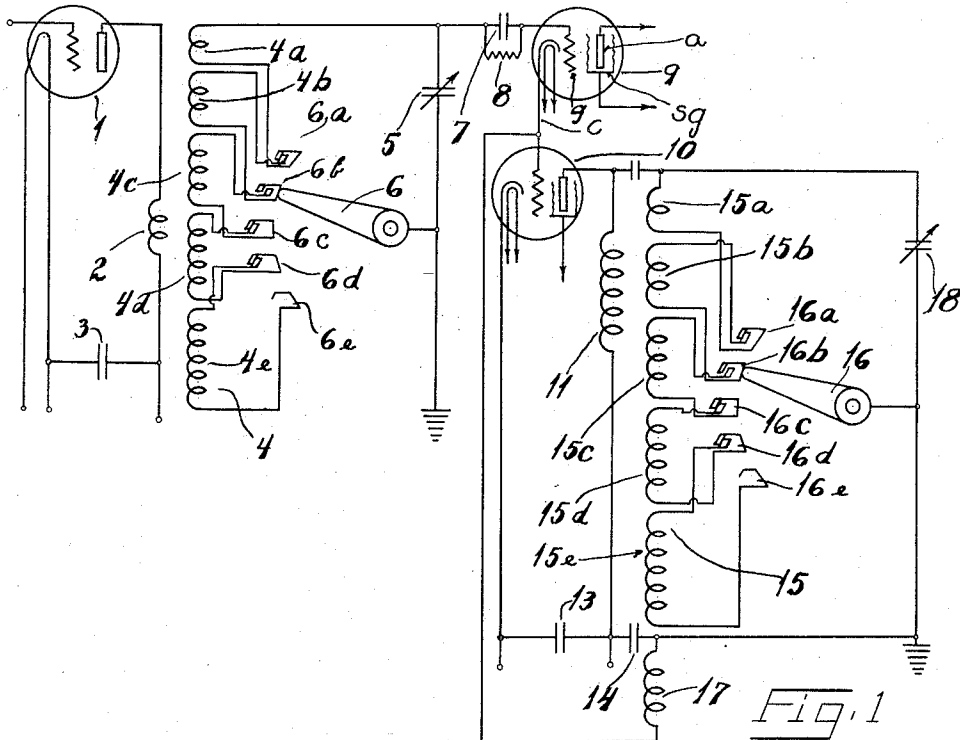


Fig. 2

Inventor

Anthony J. Alexonis

By

Ben J. Ghomy his Attorney

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A. J. ALEXONIS

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3 Sheets-Sheet 2

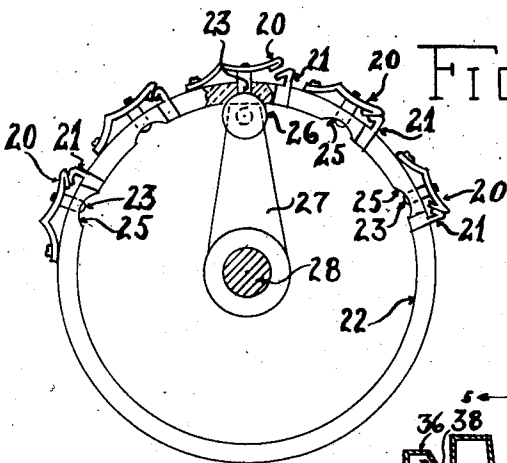
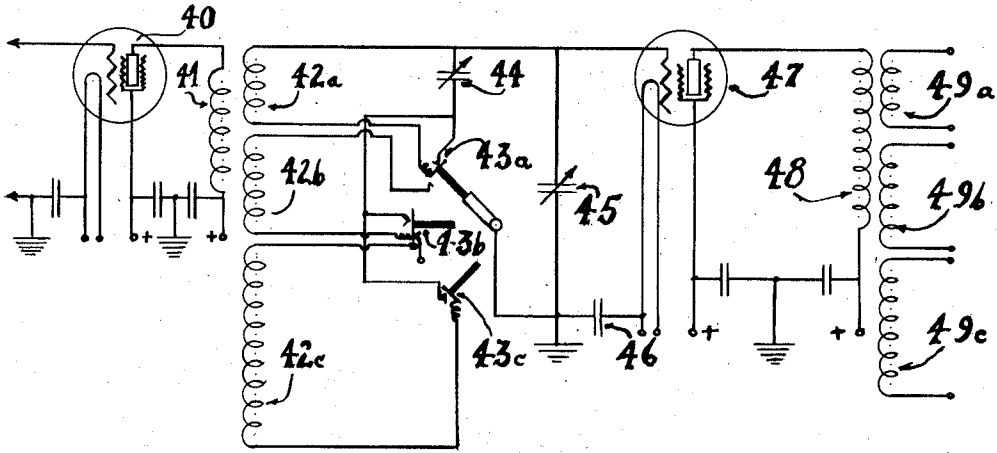


FIG. 3

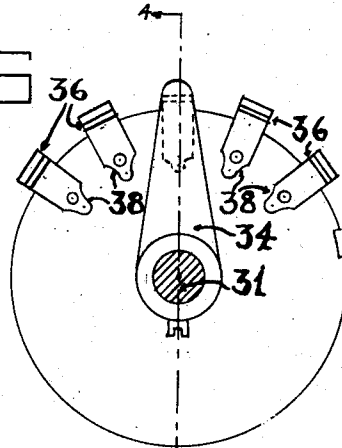


FIG. 5

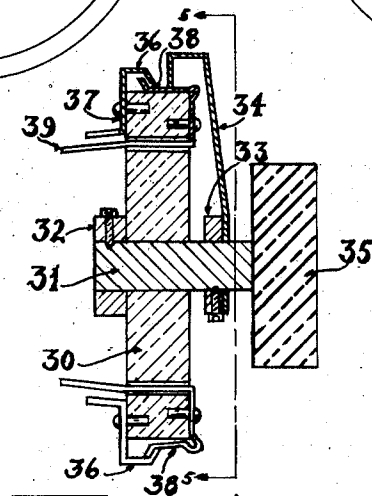


FIG. 4

By

Inventor

Anthony J. Alexonis

Ben J. Chany Attorney

April 30, 1935.

A. J. ALEXONIS

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3 Sheets-Sheet 3

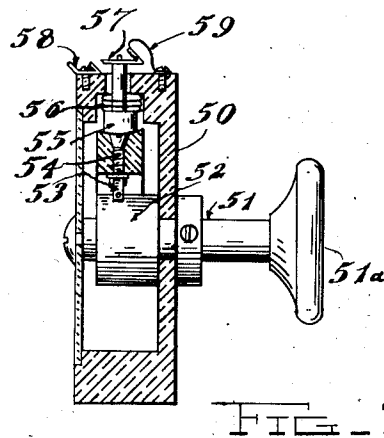
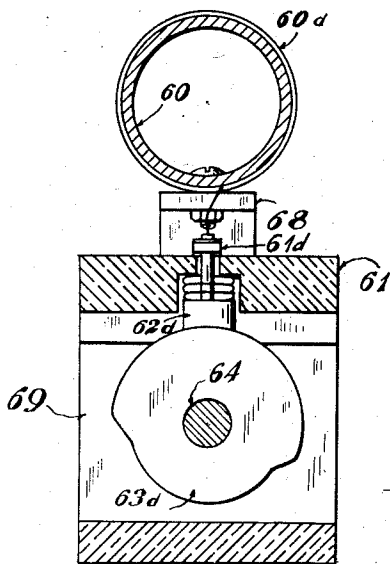
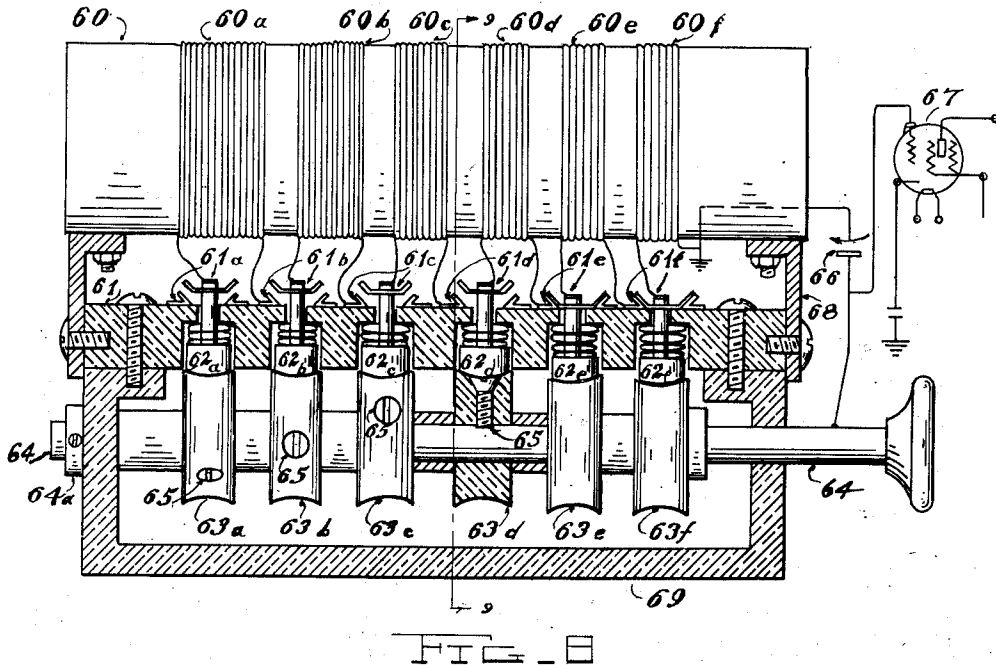


FIG. 9

FIG. 7

Inventor

Anthony J. Alexonis

By

Ben J. Blum

his Attorney

UNITED STATES PATENT OFFICE

1,999,313

RADIO RECEIVING SYSTEM

Anthony J. Alexonis, Waukegan, Ill.

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4 Claims. (Cl. 250—20)

This invention relates to electrical apparatus generally. More specifically this invention relates to low loss inductance varying apparatus for radio circuits.

5 An object of this invention is to provide tuning apparatus including an inductance coil and a circuit changing device wherein different sections of the inductance coil are used in receiving signals of different frequencies and wherein the optimum value of inductance is provided for use in the signal receiving circuit at the different signaling frequencies.

10 Another object of this invention is to provide an inductance unit with a plurality of winding sections, each of a different size, and each connected to a pair of terminals associated with a switch mechanism in which different winding sections of the inductance coil are used for receiving signals of different frequencies and in which the minimum of electrical capacity is introduced into the circuit of the winding sections not in use.

15 Still another object of this invention is to provide a multiple inductance unit having winding sections of different values each connected to a switch mechanism with a minimum of electrical capacity, for simultaneously controlling the inductance values of a plurality of signal receiving circuits.

20 A further object of this invention is to provide a device for adjusting the inductance values of inductances associated with the tuning circuits and frequency adjusting circuits of signal receiving apparatus by connecting into these circuits different sections of inductance coils associated therewith, electrically disconnecting sections of those inductance coils not in use and introducing the minimum of electrical capacity between the section in use and the sections having the closest harmonic relation thereto.

25 Other and further objects of this invention will be apparent to those skilled in the art to which it relates from the following specification and the appended claims.

30 In accordance with my invention I provide a multiple switching mechanism associated with the inductance units of a signal receiving apparatus, for the purpose of readily changing the effective values of the inductance unit or units in use. My arrangement facilitates the use of a single set of inductance coils in the signal receivers for a large portion of the frequency spectrum without introducing excessive losses in signal strength. The apparatus of my invention is arranged so that a minimum of capacity exists between sections which in themselves are of such

physical size that they are resonant to the same frequencies or lower harmonics thereof. I accomplish this by dividing the inductance units into several sections of unequal inductance; these sections may be so divided that at least two sections are employed to cover the frequency tuning range between any given frequency and the second harmonic thereof. The different sections of the inductance unit are thus made with a minimum distributed capacity for any given frequency and the loss ratios between adjacent sections of the inductance unit are minimized. Adjacent sections of the inductance unit may be so related that they will act as shields to stray fields rather than resonant absorption circuits.

35 Compact receiving circuits covering the portion of the communication frequency spectrum from the frequency corresponding to five meters wavelength to that corresponding to five hundred meters wavelength may be made to function efficiently in accordance with my invention as set forth in more detail in the following specification.

40 In the drawings Fig. 1 illustrated schematically the application of my invention to the superheterodyne receiver; Figure 2 illustrates a structural embodiment of one form of my invention; Fig. 3 shows a detail view of the switching mechanism; Figs. 4 and 5 illustrate details of a modified form of switch mechanism; Fig. 6 illustrates schematically a modified form of this invention; Fig. 7 shows a modified form of switch adapted for use with the circuit illustrated in Fig. 6 and Figs. 8 and 9 show an inductance and switch mechanism constructed as a unit.

45 Referring to the drawings in detail reference numeral 1 designates an electron discharge device of the type used in radio receiving circuits. Device 1 is provided with an input circuit which may be connected to receive signaling energy either from an antenna circuit or from the output circuit of a preceding electron discharge device of a cascade amplifier. An inductance unit 2 is connected to the anode of device 1. Condenser 3 is connected between the inductance 2 and the cathode. The cathode of the device 1 may be energized either from a direct or alternating current supply. Where it is desired, a vacuum tube having an additional heater unit for heating the cathode may be used.

50 A secondary inductance 4, having sections of various sizes 4a, 4b, 4c, 4d, and 4e is coupled to the primary inductance 2. Each of the sections of the secondary inductance is connected to one or more contacts of the switch 6 which is connected to the variable condenser 5.

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Contacts 6a of switch 6 are connected to one end of section 4a and section 4b; the other end of section 4b and one end of section 4c are connected to contacts 6b. Inductance sections 4d and 4e are connected to contacts 6c, 6d, and 6e. The connection between these inductance sections and the switch are such that one or more of the sections may be used at will as follows:

When switch 6, which comprises an arm made of resilient conducting material, such as copper, brass or the like, is rotated to engage contact 6a the member 21, illustrated in Fig. 2, disengages the member 21 and opens the circuit between the secondary inductance sections 4a and 4b. Simultaneously as the circuit between the sections 4a and 4b is opened the switch arm 6 closes the circuit between the inductance 4a and the variable condenser 5. Likewise, other sections 4b, 4c, 4d and 4e of the inductance 4 may be successively added into circuit with the section 4a by rotating the arm 6 to engage different ones of the contacts.

Electron discharge device 9, having anode a, cathode c, grid electrode g, screen grid electrode sg, and heater electrode, is connected to receive signaling energy from the circuit of the inductance 4 and condensers 5. Grid condenser 7 and grid leak 8 are connected to the grid electrode of device 9. The grid electrode of another electron discharge device 10 is connected to the cathode c of the device 9 which is employed in the case illustrated as a detector tube of a superheterodyne receiver. The vacuum tube 10 is employed as a dynatron type oscillation generator.

A pick-up coil 17 is connected to the grid of tube 10 and is coupled to the inductance 15 which consists of sections 15a, 15b, 15c, 15d and 15e. The anode of the tube 10 is connected to the choke coil 11 which is connected to the positive terminal of a source of current supply and to the fixed condensers 13 and 14.

Connections are also provided between the condenser 14, the pick-up coil 17, the switch 16, variable condenser 18, and ground, which may be the metal chassis of the radio receiver. The switch 6 and the condenser 5 are also connected to ground.

Sections of the inductance 15 and the switch 16 are made similar to the inductance 4 and the switch 6. Connections are also provided between the sections 15a, 15b, 15c, 15d and 15e and the contacts 16a, 16b, 16c, 16d and 16e, respectively, whereby different sections of the inductance may be used in conjunction with the variable condenser 18 to adjust the frequency of the oscillations generated by the vacuum tube 10.

Connections are provided between the screen grid electrodes of the tubes 9 and 10 and appropriate sources of current supply, the potential of which may or may not be adjusted as desired. The output of the detector tube 9 is coupled to an intermediate frequency amplifier (not shown) of any of the conventional types.

The switches 6 and 16 may be made into a unit as illustrated in Fig. 2. In the circuit arrangement illustrated in Fig. 1 the switch arms 6 and 16 are both connected to ground or to a common point and may be made into a unitary member.

In Fig. 2 of the drawings the inductances 4 and 15 and the switches 6 and 16 are illustrated in vertical elevation. The different sections of each of the inductance units 4 and 15 are designated by the same reference numerals in Fig. 2 as in Fig. 1. Where it is desired to eliminate coupling

effects between the two inductance units 4 and 15 one of the units may be placed in vertical position while the other may be placed in horizontal position. Suitable shields of aluminum or similar materials may also be provided to each of the inductance units.

Slightly modified forms of the switch employed in accordance with this invention are illustrated in Figures 3, 4 and 5. A ring shaped member 22 is provided with a plurality of contacts 20 and 21 which are connected to different sections of an inductance unit as illustrated in Figure 1. These contacts may be made of material such as brass, bronze and the like. Contact 20 is provided with a small actuating member 23 attached thereto and positioned in a small hole formed in the ring 20. As the shaft 28 which supports the arm 27 of metallic material, is rotated the metal contact roller 26 is caused to engage the actuating members 23 and open the contacts 20 and 21. Small recesses 25 are provided to the surface of the inner circumference of the ring 22 in such a way that the actuating members 23 protrude therefrom thus permitting more positive engagement between these actuating members and the roller 26. The arm 27, roller 26 and actuating member 23 are all made of metallic material such as copper, brass or the like.

Referring to Figures 4 and 5 in detail, the member 30 of insulating material is provided with a shaft 31 retained in place by metallic collars 32 and 33. Contact arm 34 and knob 35 are also supported by the shaft 31. Contacts 36 and 38 are positioned along the outer edge of the member 30 in such a way that circuits between these contacts are interrupted as successive ones of the contact members 38 are engaged by the contact arm 34. External circuits to the contacts 36 and 38 are connected to the terminals 37 and 39, respectively. While only a part of the actual number of contacts provided to the members 22 and 30 have been illustrated it is of course, understood that various numbers of contacts may be used in practice and that the whole circumference of these members 22 and 30 may be provided with contacts.

In Figure 6 of the drawings another embodiment of this invention is schematically illustrated. The anode of the vacuum tube 40 is connected to the primary inductance coil 41 which is coupled to the inductance 42. Sections 42a, 42b and 42c of the inductance 42 are connected to contacts 43a, 43b and 43c respectively, of the switch 43. A small variable condenser 44 is connected to contacts 43a and 43b. This condenser is also connected to one end of the inductance section 42a. Another variable condenser 45 which is of considerably larger maximum capacity than the condenser 44 is connected to the variable condenser 44, to one end of the inductance section 42a and to the switch arm of switch 43. The input circuit of the vacuum tube 47 is connected to the inductance 42 and the variable condensers 44 and 45. A small fixed condenser 46 is connected between the cathode of the vacuum tube 47, the condenser 45 and the switch arm 43. An inductance 48 is connected to the anode of the vacuum tube 47 in the same manner as inductance 41 is connected to the anode of the vacuum tube 40. A secondary inductance 49 comprising the sections 49a, 49b and 49c is coupled to the primary inductance 48. A switch similar to the switch 43 may be provided to the inductance 49 or if desired this inductance 49 may be made in one section and tuned by a variable condenser together

with small auxiliary variable condensers, as a unit.

In operation different sections of the inductance 42 are employed by the use of the switch 43 in receiving signals of different frequencies or wavelengths. For example, when signals of relatively short wavelengths are to be received the variable condenser 45 is set at minimum capacity adjustment and the switch 43 is adjusted so that the circuit between it and the variable condenser 44 and the inductance section 42a is completed. The circuit between the section 42a and the section 42b of the inductance unit is then interrupted and the section 42a may be tuned to different signaling frequencies of relatively short wavelengths at will. In order to receive signals of a longer wavelength and a lower frequency the switch 43 is adjusted to close the circuit between the inductance section 42b and the variable condenser 44 through the contacts 43b. In this case the circuit between the inductance sections 42a and 42b is complete through the contact 43a but the circuit between the inductance section 42b and section 42c is interrupted at the contact 43b. The variable condenser then functions to tune the inductance sections 42a and 42b. It is of course, obvious that both the variable condensers 44 and 45 may be used in tuning the circuits to the proper signaling frequencies; in that case the variable condenser 45 may be used to obtain the adjustment roughly and the small variable condenser 44 may be used to obtain the finer adjustment. Where it is desired to receive signals of frequencies within for example, the present broadcasting band, all of the sections 42a, 42b, and 42c of the inductance 42 may be used. In this case the variable condenser 45 is preferably used in obtaining the proper tuning adjustments in the circuit and the small variable condenser 44 is used as a trimmer device.

A form of the switch employed in conjunction with the modification of this invention illustrated in Figure 6 is shown in Figure 7 wherein the frame member 50 of insulating material such as hard rubber, phenol condensation products, synthetic porcelain or the like, is employed to support the rotatable shaft 51 and the contacting members 52, 54, 55, and 57. A pair of contacts 58 and 59 is provided to cooperate with each of the members 57. A plurality of the members 57 are supported by the annulus of the member 50; each of the members 55 associated with the contactors 57 being retained in proper operating position by a spring 56 in such a way that when the member 52 is rotated through the operation of the shaft 51 and the knob 51a, these members 55 are successively engaged and caused to interrupt the circuits at the contacts 58. In the operation of the switch the contact 59 is connected to the small variable condenser 44 (Fig. 6) while the contacts 58 are connected to sections of the inductance units corresponding to inductance 42 of Figure 6. Each of the contactors 57 is also connected to a section of the inductance unit 42.

As the shaft 51 of the switch mechanism is rotated the arm 52 is caused to engage different ones of the contactors 55. Electrical contact is made between the desired one of these contactors 55 and the conducting member 54, which is connected to an external circuit through the lug 53. When the contactor 55 corresponding to the unit 43a of Fig. 6 is engaged the circuit to the variable condenser 44 and the inductance unit section 42a is completed through the con-

tact 59, which is connected to the variable condenser 44, and the member 57. The circuit between the member 57 and the contact 58, which is connected to the inductance unit section 42b of Fig. 6, is simultaneously interrupted.

The circuits between the inductance unit sections 42a and 42b are completed when the switch arm of switch 43 is caused to engage the contact 43b. Accordingly different ones of the inductance unit sections may be connected into circuit for use and the apparatus adjusted for use with different parts of the signaling frequency spectrum.

A complete unit embodying the form of this invention is illustrated in Figure 8 of the drawings wherein a tubular member 60 is provided with sections of an inductance unit 60a, 60b, 60c, 60d, and 60e. Each of these sections are made with a different number of turns whereby different signaling frequencies may be selected by employing different ones of the sections in circuit. A supporting member 61 for supporting contacts 61a, 61b, 61c, 61d, 61e and 61f is provided adjacent to the tubular member 60. Small recesses are formed in the member 61 for receiving the contactors 62a, 62b, 62c, 62d, 62e, and 62f and suitable springs are provided to these contactors to maintain them in frictional engagement with cam members 63a, 63b, 63c, 63d, 63e, and 63f, respectively, which are mounted on the shaft 64 of conducting material. Suitable spacers are provided between the different cam members to retain these members in proper spaced relation. Each of the cam members supported by the shaft 64 is provided with a screw 65 of metallic material such as brass for the purpose of retaining the cams in definite relation upon the shaft 64 and also for the purpose of providing electrical connections therebetween. These screws 65 are slightly countersunk into the cams in such a way that when any one of them is brought into engagement with any one of the contactors the latter are caused to occupy a portion of the recess formed in countersinking the screw. The circuit between any particular contactor which is in engagement with the screw 65 and the corresponding contact, supported by member 61, however, is not closed until after the contactor is caused to disengage the screw 65 and enter the cut-away portion of the cam operating with that particular contactor. This is more readily understood from the vertical sectional view of my invention illustrated in Figure 9 of the drawings. This sectional view is taken along the line 9-9 of Figure 8 and illustrates the position of the cam 63d with its corresponding screw 65 when in engagement with the contactor 62d. In this case the circuit is completed between the shaft 64, the screw 65 and the contactor 62d, however, the circuit between the contactor and the contact 61d is maintained interrupted while the circuits between the contactors 62e and 62f and the contacts 61e and 61f, respectively, is closed. Thus the sections 60e and 60f of the inductance unit are connected into circuit with the variable condenser 66 and the electron discharge device 67 for use.

If the shaft 64 is rotated until the screw 65 of the cam 63a is in engagement with the contactor 62c the circuit between the contact 61d and the contactor 62d is closed and the inductance unit sections 60d, 60e, and 60f are connected together for use.

In practice I have found it desirable to wind the different sections of the inductance unit to

such physical proportions that the distributed capacity of the different sections during open circuit, is not of such dimensions as to produce resonant conditions in any of the unused sections to the band of signaling frequencies being received. In this way losses introduced into the circuit are kept at a minimum.

It is apparent that other modifications of this invention may be made without departing from the spirit and scope thereof and I do not, therefore, desire to limit this invention to the exact details as set forth in the foregoing specification except in so far as they may be defined by the following claims.

What I claim and desire to secure by Letters Patent of the United States is:

1. In signaling apparatus the combination of a pair of electron discharge devices having input and output circuits, one of said devices being adjusted to operate as a detector and the other of said devices being adjusted to operate as an oscillator, a grid electrode of said oscillator being connected to the cathode of said detector, an inductance unit comprising a plurality of sectional windings coupled to the output circuit of said oscillator, an inductance unit comprising a plurality of sectional windings coupled to the input circuit of said detector, means for coupling different numbers of said sectional windings of said first mentioned inductance unit to said oscillator output circuit, means for connecting different numbers of said sectional windings of said second mentioned inductance unit to the input circuit of said detector and means for electrically connecting said last two mentioned means together.

2. In signal receiving apparatus the combination of a pair of electron discharge devices having input and output circuits, one of said devices being connected as a detector and the other of said devices being connected as an oscillator, connections between the input circuit of said oscillator and the input circuit of said detector,

an inductance unit comprising a plurality of sectional windings coupled to the output circuit of said oscillator, an inductance unit comprising a plurality of sectional windings coupled to the input circuit of said detector, means for coupling different numbers of said sectional windings of said first mentioned inductance unit to said oscillator output circuit, means for connecting different numbers of said sectional windings of said second mentioned inductance unit to the input circuit of said detector and means for electrically connecting said last two mentioned means together.

3. In signal receiving apparatus the combination of a pair of electron discharge devices having input and output circuits, one of said devices being connected as a detector and the other of said devices being connected as an oscillator, an inductance unit comprising a plurality of sections connected to the output circuit of said oscillator, a second inductance unit comprising a plurality of sections connected to the input circuit of said detector and means for electrically interconnecting both of said inductance units and for controlling the number of said sections to be connected to said detector input circuit and said oscillator output circuit.

4. In signal receiving apparatus the combination of a pair of electron discharge devices having input and output circuits, one of said devices being connected as a detector and the other of said devices being connected as an oscillator, a tapped inductance unit connected to said detector for selecting the signaling channel to which said detector is responsive, a tapped inductance unit connected to a circuit of said oscillator for controlling the frequency range thereof and electrical conducting means for each of said inductance units for selecting the desired tap on each of said inductances and connections between said last mentioned means whereby the tapped sections of said inductances are connected together.

ANTHONY J. ALEXONIS.