

Nov. 5, 1940.

P. D. ZOTTU

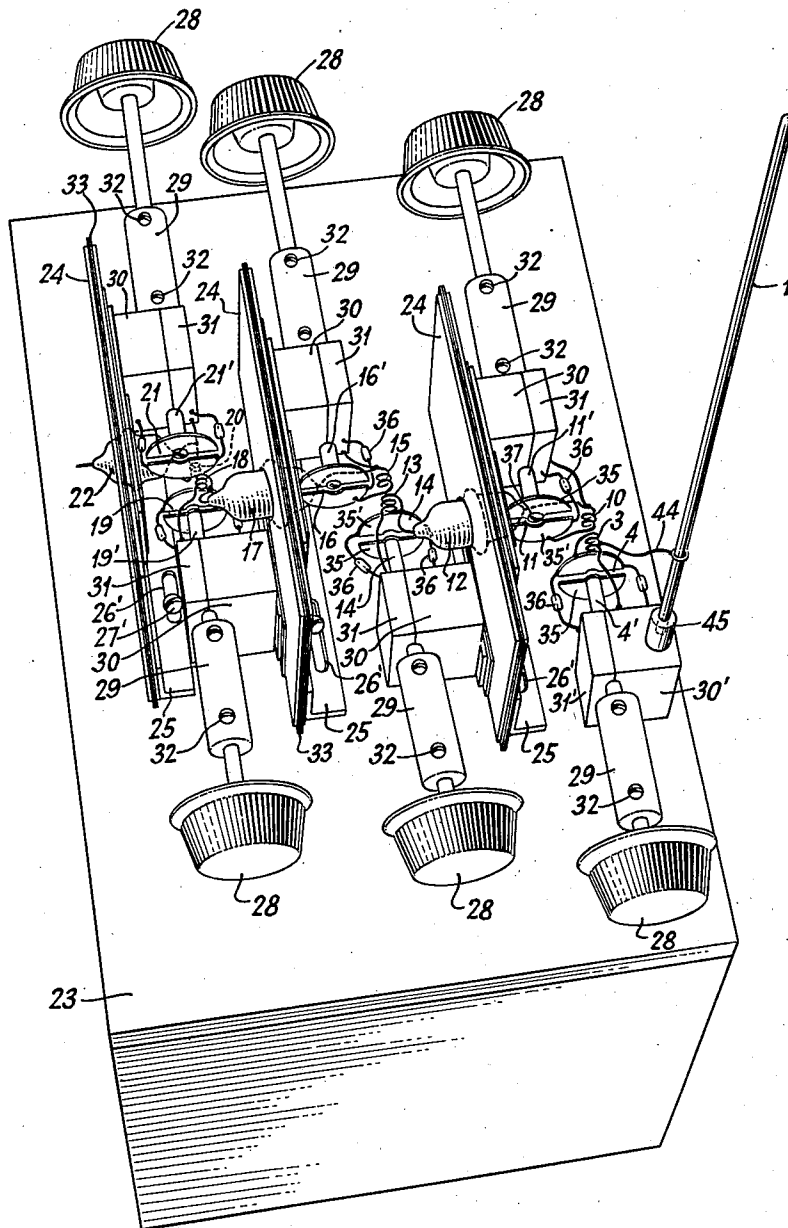
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ULTRA HIGH FREQUENCY SYSTEM

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2 Sheets-Sheet 1

Fig. 1



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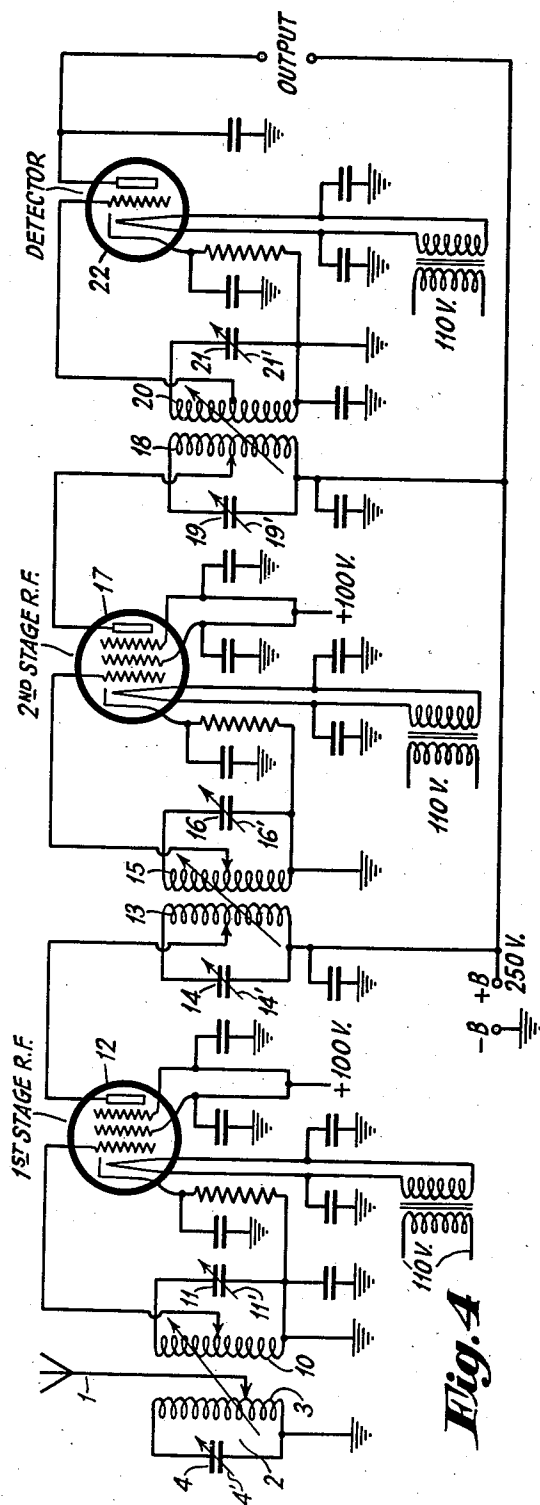
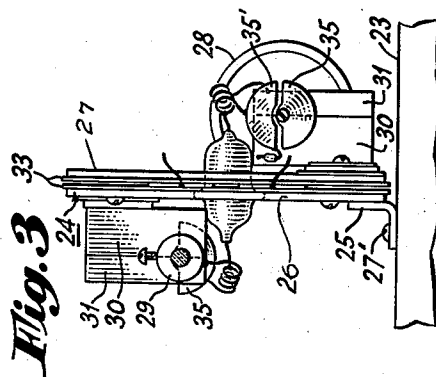
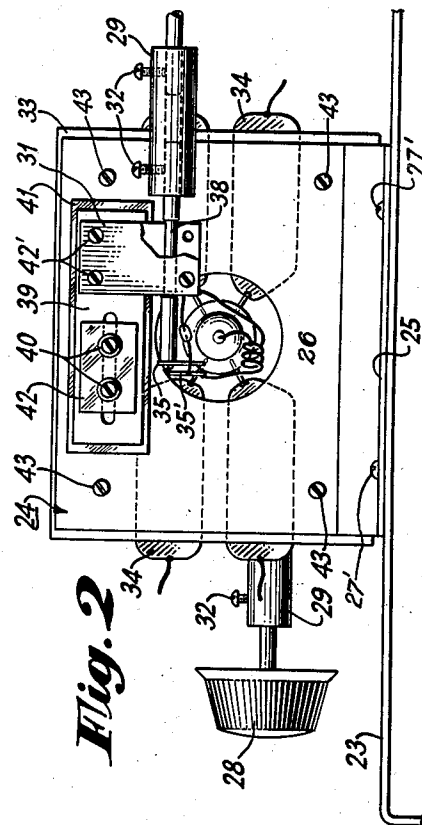
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2 Sheets-Sheet 2



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ULTRA HIGH FREQUENCY SYSTEM

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8 Claims. (Cl. 179—171)

This invention relates to an ultra high frequency communication system, and particularly to such a system capable of receiving waves of the order of one meter and less.

5 An object of the present invention is to provide a portable, compact short wave receiver employing lumped tuned circuits, as distinguished from tuned circuits using substantially uniformly distributed constants.

10 Another object is to provide a novel mechanical construction for a short wave receiver employing lumped tuned circuits wherein the lengths of the connections between the circuit elements and stages are a minimum.

15 A further object is to provide a novel mechanical construction for an ultra short wave receiver which enables mechanical adjustment of the various stages relative to one another, thus permitting variation of the mutual coupling between stages.

20 A still further object is to provide a short wave system wherein each stage, including the electron discharge device and associated input and output tuned circuits, can be easily removed from the system.

25 A still further object is to provide a mechanical construction such that the electrical impedance of the input and output circuits, as viewed from the respective electron discharge device elements, can be conveniently varied.

30 A feature of the invention lies in the use of a slidable support for each evacuated electron discharge device stage and its associated tuned input and output circuits. This feature enables mechanical adjustment between each stage and its adjacent stages, and simultaneously therewith any desired degree of electrical coupling to the adjacent stages.

35 A further feature resides in positioning the various electron discharge devices in parallel, though in staggered relation, thus reducing the overall dimensions of the system to a minimum.

40 One advantage of the mechanical arrangement of the present invention is the fact that the electrodes of the electron discharge devices can be connected to the various points on the coils of the tuned circuits with a minimum of lead connections.

45 Other objects, features, and advantages will appear from a reading of the following description which is accompanied by drawings wherein the same or equivalent parts are labeled with the same reference numerals.

50 Fig. 1 illustrates the mechanical construction of a substantially complete ultra short wave re-

ceiver system embodying the principles of the present invention;

Fig. 2 is a side view, and Fig. 3 is an end view of Fig. 2 showing details of the mechanical supports for the circuit elements of the receiver; 5 and

Fig. 4 shows the equivalent circuit diagram of the system of Fig. 1.

Referring to Fig. 1 in more detail, there is shown a multi-stage ultra high radio frequency receiver comprising two stages of radio frequency 10 amplification 12 and 17 and a detector 22. Each of these stages comprises an evacuated small electron discharge device preferably of the type known as the acorn or shoe-button type. The 15 receiver is shown mounted upon a metallic base 23, under which is provided the power supply equipment, not shown. This base is grounded or maintained at zero radio frequency potential.

Since the construction of the radio frequency 20 stages and the detector is similar and said stages have associated lumped tuned input and output circuits which are also similar, except for the output circuit of the detector, it is believed that a description of only one of these stages is necessary for an understanding of the mechanical constructions of the other stages. Considering the first radio frequency stage 12 as an example of the construction of the other stages, it will be seen that this stage comprises an evacuated 30 electron discharge device, here designated 12, mounted substantially in the center of a composite plate 24 extending in the vertical plane, which composite plate is horizontally adjustable in position along a portion of the length of the 35 metallic base 23. A more detailed description of this composite plate and the manner in which the electron discharge device is mounted therein appears hereinafter, particularly in connection with Figs. 2 and 3.

40 Radio frequency stage 12 comprises an input circuit consisting of an inductance 10 and a capacitance 11, the inductance having one or more turns of wire while the capacitance consists of two or more spaced semicircular metallic plates 35, 35', one plate of which, namely 35', is 45 stationary while the other plate 35 is rotatable on shaft 11' for varying the value of its capacitance. It will be obvious, of course, that where several sets of interleaving plates are employed for the 50 condenser 11 that one set of plates will be stationary while the set of interleaving plates will be rotatable or adjustable in known fashion. Of course, other types of known condensers are also contemplated for use instead of the type shown 55

herein. Stationary plate 35' is supported in fixed relation to its associated element by means of one or more ceramic insulators 36 which have separate wires supported from the insulator and extending from opposite sides of the insulator, one to the plate 35' and the other to a metallic block 30, 31. The rotatable plate 35 is fastened by means of a screw 37 to metallic shaft 11', which is supported by and rotatable in block 30, 31, this shaft having a continuation thereof extending to dial 28. The output circuit of electron discharge device 12 has a tuned lumped circuit similar to the input circuit, this tuned output circuit also comprising a stationary plate 35' and a rotatable plate 35, the stationary plate being supported by ceramic beads 36 while the rotatable plate 35 is fastened by means of a screw to its associated shaft, herein labeled 14', which in turn is similarly mounted in another metallic block 30, 31 and adjustable by means of its dial 28.

By referring to Figs. 2 and 3 it will be observed that the condenser element 35, 35' of the input circuit of one stage is displaced vertically from the condenser element of the output circuit of the same stage. This is achieved by vertically displacing the rotatable shaft of the input circuit with respect to the rotatable shaft of the output circuit, both shafts in turn being journaled in their respective metallic blocks 30, 31 which are also so displaced. In the preferred construction, it is desired that the inductance coils of the input and output circuits be substantially in the same horizontal plane and with their axes parallel to the rotatable shafts of their respective tuning condensers.

Each of the dials 28 is coupled to the shaft of the tuning condenser, such as 11', 14' etc., by means of an insulating coupling sleeve 29 which is secured to the condenser shaft and to the dial shaft by means of set screws 32, 32. The condenser shaft has a portion 38 of reduced diameter which is rotatable in an aperture extending through the entire width of blocks 30 and 31, in the manner shown most clearly in Fig. 2. This condenser shaft is metallic and is prevented from moving in a direction along its axis by the portions thereof of larger diameter which are on opposite sides of the blocks 30 and 31.

Blocks 30 and 31 comprise two pieces of metal of unequal width which are fastened to another plate 39 in a suitable manner, such as by soldering, brazing, or by means of screws, said plate being in turn mechanically fastened to the composite plate 24 by means of screws 40. Metallic plate 39 is insulated from the composite plate 24 and from screws 40 by means of mica spacers 41 and 42. These spacers enable the blocks 30, 31 to be insulated from a direct current standpoint, while simultaneously providing a by-pass condenser to the plate 24 for the radio frequency energy. Four screws 42' are employed for fastening the metal pieces 30 and 31 together and for adjusting the pressure of the metal pieces 30 and 31 upon the reduced portion 38 of the condenser shaft.

Composite plate 24 comprises two outer metallic plates 26, 27, which have between them and adjacent to each other suitable insulating spacers such as mica sheets 33, 33, there being provided between the mica sheets physically separated small metallic plates 34, 34, these in turn being connected to the electrodes of the electron discharge device stage and being provided with terminals extending to the edges of the composite plate for connection with associated circuit elements.

Fig. 2 shows four of these small plates 34, 34, although, if desired, there may be as many more small plates provided as are necessary for connecting the electrodes to the electron discharge device. The outer metallic plates 26 and 27 are electrically connected together by means of screws which serve to clamp these two outer plates together in such fashion as to hold the mica sheets and the separated smaller plates 34 in fixed relation to each other. Plates 34, 34 are, of course, insulated from each other and from the outer metallic plates 26 and 27 from a direct current standpoint. To one of the outer metallic plates of the composite assembly, such as 26, there is attached an angle iron 25 which in turn is fastened to the metallic base 23 by means of one or more screws 27'. Angle iron 25 supports the composite plate 24 slightly above the base 23 to enable easy movement of the composite plate over the base 23. For this purpose there are provided in each angle iron slots 26' (note Fig. 1) which enable mechanical adjustment of the various stages to one another, thus permitting variation of the mutual coupling between stages. By removing screws 27', any one stage with its associated tuned elements can be conveniently removed from the receiver. In this manner the composite plate 24 provides a single slidable support for the electron discharge device stage and associated tuned circuits which are mounted thereon, and simultaneously a radio frequency by-pass condenser to ground for the electrodes of this stage.

It should be noted, from an inspection of Fig. 1, that the electron discharge device stages are arranged physically parallel to each other and in staggered relation, thus reducing the overall dimensions of the system to a minimum and minimizing the lengths of the lead connections. The convenient mechanical arrangement and adjustability of the composite plates 24 enables the stages and associated tuned circuits to be moved relative to one another, thus providing any desired degree of electrical coupling between adjacent stages. Easy accessibility of the elements enables the operator to connect the input or output terminal of the electron discharge device stage to any point on the lumped inductance coil of the associated tuned circuit, thus providing a convenient means for varying the electrical impedance of the input and output circuits.

In order to receive the electromagnetic waves, there is provided a rod-like antenna 1 (note Fig. 1) which is insulatingly mounted by an insulator 45 to a metallic block 30', 31', in turn fastened to the base plate 23. An adjustable electrical connection 43 is employed to couple the antenna 1 to coil 3 of the tuned lumped input circuit 3, 4. The tuned circuit 3, 4, with its associated condenser shaft 4', block 30', 31', and dial 28, are of substantially the same construction as the similar elements of the electron discharge device stages, as will be obvious from a mere inspection of the drawing of Fig. 1. It will be apparent of course, that instead of an antenna 1 there may be provided any other desired type of means for supplying energy to the receiver, such as a transmission line which connects a remote energy collector to the input circuit of the first radio frequency amplifier stage.

For the sake of simplicity the connections from the composite plates to the power supply system have not been shown in the drawing of Fig. 1, inasmuch as the present invention is primarily concerned with the constructional details of the

receiving apparatus. Where desired, there may be provided a direct connection between a metallic block 30 and 31 to one of the outer plates of the composite plate 24, in order to directly ground one terminal of the coil of a tuned circuit. Such an arrangement may be desirable, particularly in connection with the input circuits of the electron discharge device stages 12, 17 and 22, in the manner shown in the circuit diagram of Fig. 4.

Fig. 4 is an equivalent circuit diagram for the receiver of Fig. 1 and shows a well known type of conventional circuit employing two ultra high frequency amplifier stages and a detector stage. The signal energy which is collected on any suitable type of antenna 1 is fed into a resonant circuit 2 comprising a coil 3 and a variable condenser 4, this coil in turn being coupled to coil 10 which with variable condenser 11 forms the input circuit of the first radio frequency stage comprising a pentode electron discharge device 12. The output circuit of electron discharge device 12 comprises coil 13 and variable condenser 14, which are coupled to the anode of the vacuum tube 12, this circuit in turn being coupled to the input circuit of the second ultra high frequency amplifier stage, comprising coil 15 and variable condenser 16.

The second amplifier stage, which includes a pentode electron discharge device 17, is a substantial duplicate of the first radio frequency amplifier stage 12 and has its output comprising coil 18 and variable condenser 19 coupled to the input circuit 20, 21 of the triode detector 22. Output energy from the detector is coupled to any suitable type of utilization circuit.

Although evacuated electron discharge devices 12 and 17 have been shown as pentodes and detector 22 as a triode, it will be understood, of course, that these electron discharge devices are not limited to the particular number of electrodes illustrated in the drawings, for example, the first and second radio frequency amplifier stages 12 and 17 may employ tetrodes or triodes, while the detector 22 may comprise a diode or tetrode or pentode.

From what has been said before, it is believed that the operation of the equivalent electrical circuit of this figure will be apparent from a mere inspection of the drawings, for which reason it is not deemed necessary to enter into a more detailed description thereof.

It should be distinctly understood that the invention is not limited to the precise arrangements of parts shown since various modifications may be made therein without departing from the spirit and scope of the appended claims.

What is claimed is:

1. A multistage ultra high radio frequency electron discharge device amplifier with tuned lumped circuits as coupling impedances between stages, each of said coupling impedances having an inductance coil of at least one turn, the electron discharge devices being arranged with their axes substantially parallel to each other and in staggered relation, the axes of said inductance coils being parallel to one another, and movable

supports for said stages for varying the degree of stagger of said devices with a consequent variation in the coupling between said coils.

2. A multistage ultra high radio frequency electron discharge device amplifier with tuned lumped circuits as coupling impedances between stages, the electron discharge devices being in staggered relation, each of said stages with its associated input and output circuits being mounted on a vertical support which is adjustable with respect to the other supports.

3. A multistage ultra high radio frequency electron discharge device amplifier with tuned lumped circuits as coupling impedances between stages, the electron discharge devices being in staggered relation, each of said stages with its associated input and output circuits being mounted on a single support, said supports being adjustable in position with respect to one another, whereby the mutual coupling between stages may be varied.

4. A multistage ultra high radio frequency electron discharge device amplifier with tuned lumped circuits as coupling impedances between stages, the electron discharge devices being in staggered relation, each of said stages with its associated input and output circuits being mounted on a vertical support, said supports being parallel to one another.

5. A multistage ultra high radio frequency electron discharge device amplifier with tuned lumped circuits as coupling impedances between stages, each of said stages with its associated input and output circuits being mounted on a single support which is adjustable with respect to the other supports.

6. A multistage ultra high radio frequency electron discharge device amplifier with tuned lumped circuits as coupling impedances between stages, the electron discharge devices being in staggered relation and having their longitudinal axes arranged parallel, each of said stages with its associated input and output circuits being mounted on a single support, and shafts for tuning said associated input and output circuits of each stage also mounted on said single support.

7. A multistage ultra high radio frequency electron discharge device amplifier with tuned lumped circuits as coupling impedances between stages, the electron discharge devices being in staggered relation and having their longitudinal axes arranged parallel, each of said stages with its associated input and output circuits being mounted on a single support, and shafts for tuning said associated input and output circuits of each stage also mounted on said single support, said shafts being arranged perpendicular to the longitudinal axes of said electron discharge devices.

8. A multistage ultra high radio frequency electron discharge device amplifier with tuned lumped circuits as coupling impedances between stages, each of said stages with its associated input and output circuits being mounted on a vertical support which is adjustable with respect to the other supports.

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