April 27, 1937. J. B. MOORE 2,078,769

SELECTIVE RECEIVING SYSTEM

Filed Dec. 8, 1933 3 Sheets-Sheet 1

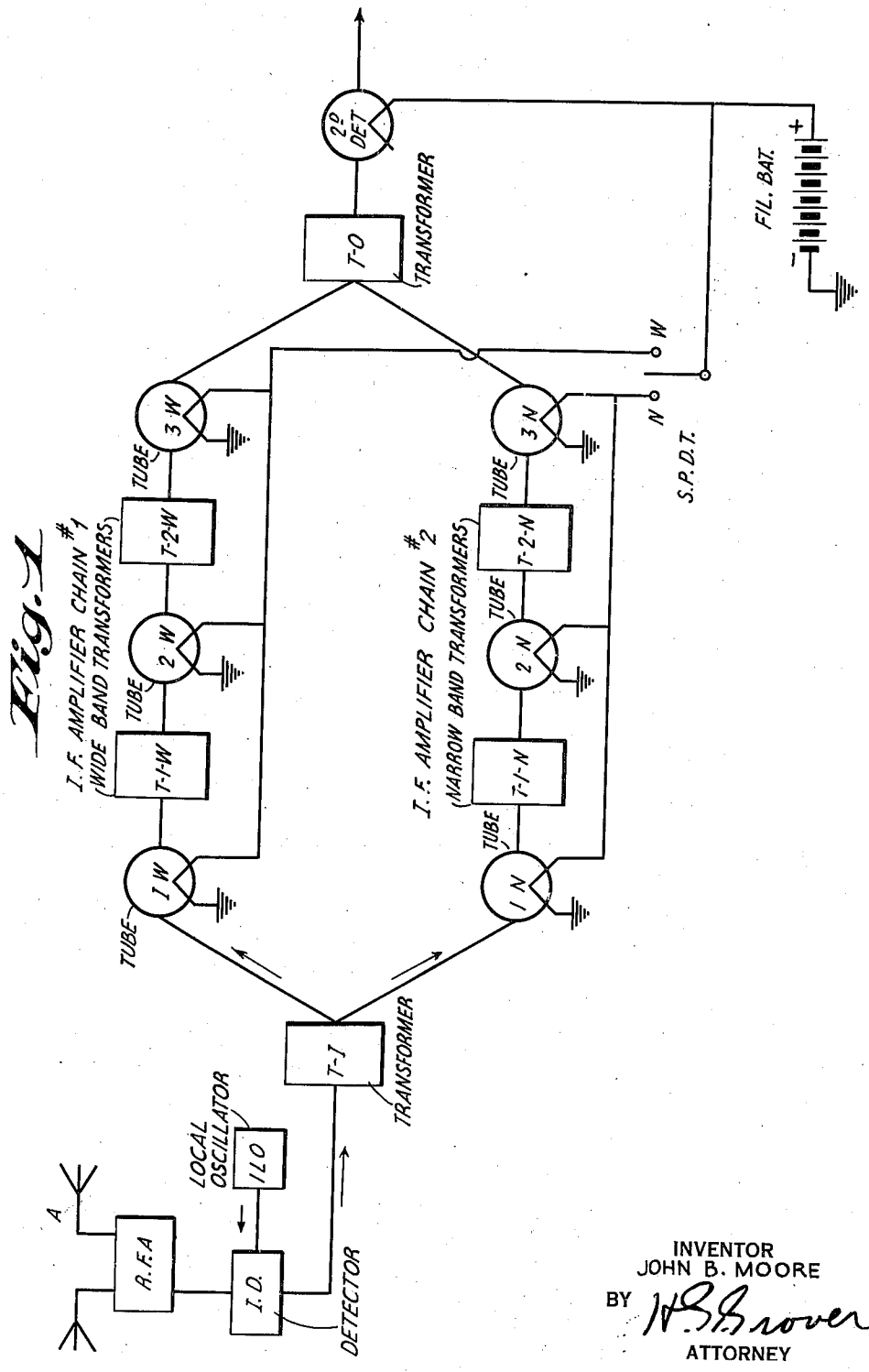


Fig. 1

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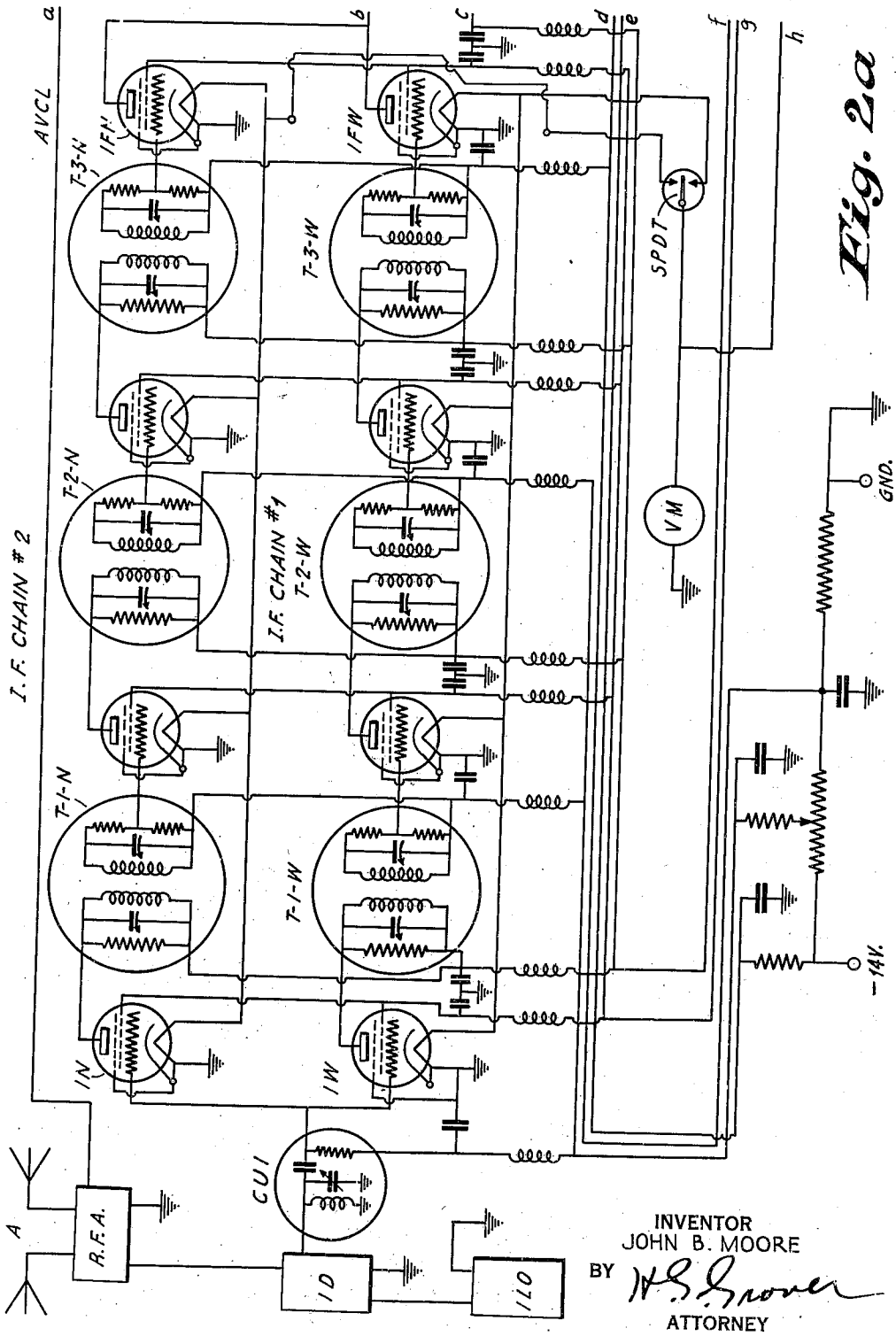


Fig. 2a

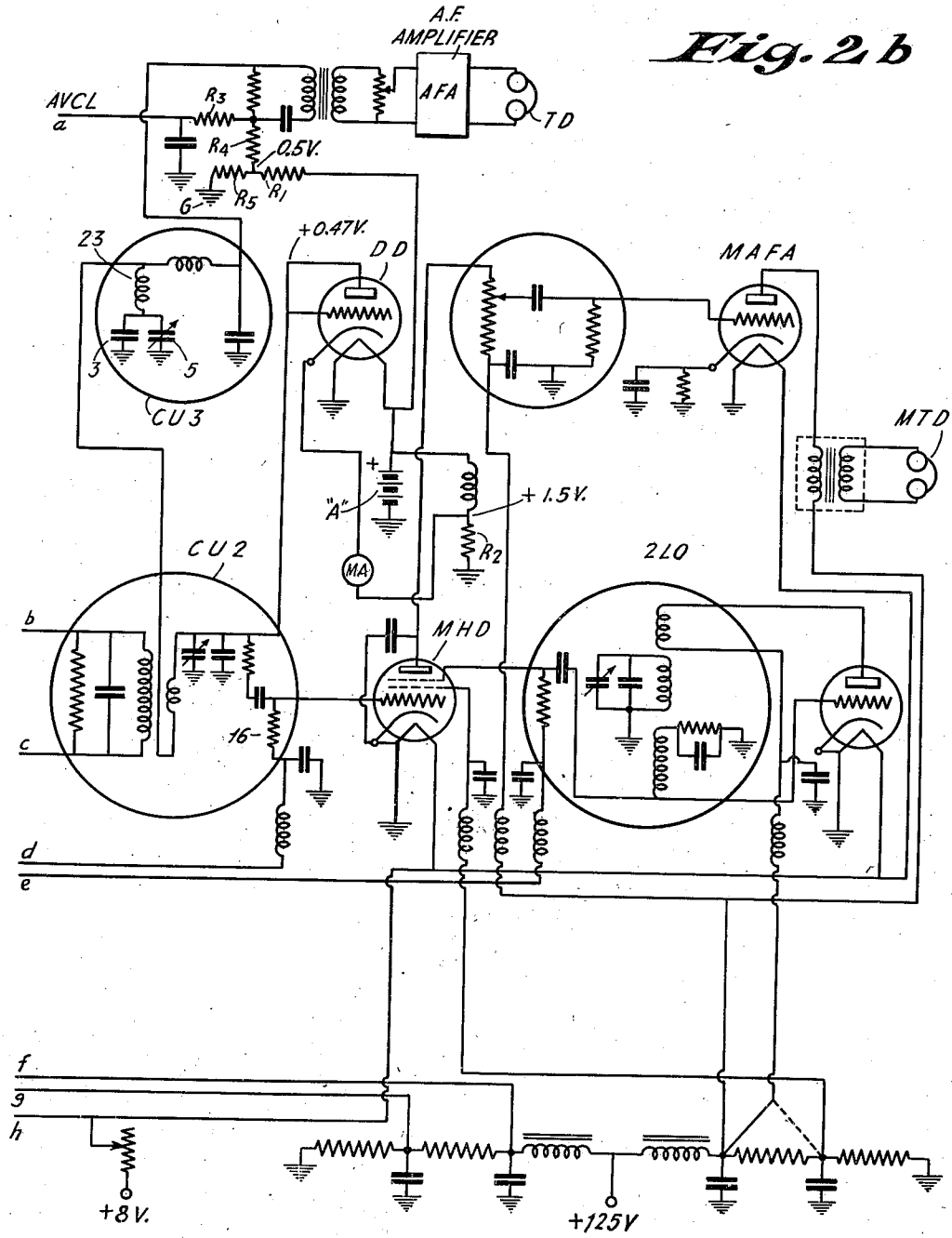
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Fig. 2b



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UNITED STATES PATENT OFFICE

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SELECTIVE RECEIVING SYSTEM

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Application December 8, 1933, Serial No. 701,435

5 Claims. (Cl. 250—20)

My present invention relates to a receiving system particularly adapted for short wave communications work.

Frequently, short wave communications receivers are called upon to intercept and translate both telephonic and telegraphic radio waves. For telephony it is desirable that the receiver have a wide frequency pass band so that the translated waves will accurately reproduce all of the modulation frequencies. If such a receiver, however, is subsequently used for radiated telegraphic signals, it will be found that due to the wide pass band, noise level will be unduly raised. Consequently, one object of my present invention is to provide a "universal" receiver, so to speak, which shall be adapted for the reception of both telephonic and telegraphic messages without having the objectionable feature just referred to. Briefly, this object is satisfied, according to my present invention, by providing a receiving system in which the effective pass band, preferably that of the intermediate frequency amplifying system of a superheterodyne receiver, may be simply and quickly changed. More specifically, I provide in duplicate a portion of the intermediate frequency system of the double detection type of radio receiver; one chain of tubes and transformers for wide band operation and the other for narrow band. In order to simplify construction and shielding problems, especially where a high overall voltage gain is used, the switching is accomplished by means of a single pole double throw switch which turns off the filaments of one chain of tubes and turns on the filaments of the other. The amplifier tubes themselves thus act as the actual switches, merely being controlled by means of their filaments (or heaters).

Heretofore, I have used intermediate frequency amplifiers utilizing tuned transformers as interstage coupling systems, and to obtain the desired selectivity I have employed, in general, two means of changing the band width passed; namely, (1) by changing the coupling between the coils of each and every transformer and, (2) by the use of plug-in transformers permanently adjusted for the desired width of pass band.

The first method has two chief disadvantages. To get the best characteristic from a given number of tuned transformers, the damping of each and every one should be adjusted to the proper value corresponding to the coupling employed. This is not, ordinarily, done as it further complicates an already rather laborious task.

The use of plug-in transformers solves the disadvantages listed above. They are, however, more expensive to manufacture and cannot readily provide such good shielding, besides being subject to damage and to the disadvantage of changing the circuit constants due to mechanical handling.

Consequently, the specific arrangement of the present invention solves most of the difficulties heretofore encountered. A choice of two band widths is sufficient for most commercial applications. The idea can, of course, be extended to provide the choice of more than two band widths if desired. Tuned transformers of standard construction are employed, thus reducing the cost and providing good shielding. No transformer adjustments need be touched or changed in changing from wide band to narrow band operation. This saves considerable time and eliminates a certain element of uncertainty. The transformers, being permanently installed and having fixed adjustments, can be originally adjusted to give the best possible selectivity characteristic in each case. As the tubes act as switches for the actual I. F. signal, there are no special switches of a ganged or shielded construction required. A completely effective changeover is thus accomplished by the use of a simple switch which may be located anywhere within a reasonable distance of the tube sockets and filament supply battery busses.

In the accompanying drawings,

Figure 1 is a schematic block diagram of one particular arrangement of my present invention; and,

Figs. 2*a* and 2*b* when joined together, comprise a more detailed wiring diagram of my present invention applied to the intermediate frequency stages of a superheterodyne radio receiver.

Turning to Figure 1, energy collected upon an antenna A is fed to a radio frequency amplifier RFA. The output of the radio frequency amplifier is fed into a first detector 1D of a superheterodyne receiver which detector is also supplied with waves from a first local oscillator 1LO. The first detector 1D feeds the intermediate frequency energy into an input transformer T1. Transformer T1 is always connected in circuit with both intermediate frequency amplifier chains number 1 and number 2. Intermediate frequency amplifier chain number 1 has a relatively wide frequency pass band and is adapted for telephone work whereas intermediate frequency amplifier number 2 passes a relatively narrow band of frequencies and is particularly adapted for telegraphic work tending to reduce

noise level. That is to say, the transformers labeled T1W and T2W are adjusted for wide band operation and those labeled T1N and T2N are adjusted for narrow band operation. The filaments or heater circuits of tubes 1W, 2W and 3W are connected to one side of a single pole double throw switch SPDT and the filaments or heaters of tubes 1N, 2N and 3N are connected to the other side of the switch. The output transformer T0 is always connected to the output electrodes of tubes 3W and 3N and to the second detector 2D which is always in use.

The component parts of the system are all housed in a single unit and battery supply filters for corresponding tubes in the two chains are provided. Preferably screen grid or pentode tubes are used as amplifiers.

In operation, to change from wide band to narrow band operation or vice versa, it is merely necessary to throw the filament switch SPDT to the proper position, the amplifier tubes in the intermediate frequency amplifier chains performing the actual switching of the intermediate frequency signal path.

My present invention may be extended to provide the choice of three or more band widths by merely changing the switch SPDT to a suitable multi-point switch and by permanently connecting between the transformers T1 and T0 additional suitable tube filter circuits or systems. The number of stages in each amplifier chain may be varied depending upon the amount of gain or selectivity desired.

In the arrangement shown in Figs. 2*a* and 2*b* energy collected upon the antenna A is fed to a radio frequency amplifier RFA. The output of the radio frequency amplifier RFA together with waves from a first local oscillator 1L0 is fed into a first detector 1D acting to heterodyne the collected energies and local energies together. The heterodyne energies are fed into a coupling unit CU1 permanently connected to feed intermediate frequency energies to the first tubes 1N and 1W of two intermediate frequency tube filter chains or systems passing the same intermediate frequency but passing frequency bands of narrow and wide widths respectively.

By the actuation of the switch SPDT either chain #1 or chain #2 is selectively rendered effective for transmitting intermediate frequency energy from the permanently connected coupling unit CU1 to the coupling unit CU2 which is permanently connected to the output tubes or final tubes 1FN and 1FW of the two intermediate frequency filter chains. That is to say, by energizing the filaments of the tubes of one chain or network, that filter circuit is enabled to pass intermediate frequency energies, but the filter circuit or intermediate frequency chain whose tube cathodes are deenergized are unable to pass any intermediate frequency energy because of the high impedance offered by the extinguished tubes.

Intermediate frequency energy from coupling unit CU2 is fed as indicated into a diode detector DD. Rectified output from the diode detector DD is fed through a third coupling unit or low pass output filter CU3 to an audio frequency amplifier AFA in turn actuating any suitable translating device TD. For automatically volume controlling the received signal, an automatic biasing control lead AVCL is connected as illustrated to the output of the diode detector and to the control grids of the tube or tubes in the radio frequency amplifier RFA.

In order to monitor the received signals, a second local oscillator 2L0 is provided which feeds waves into the monitoring heterodyning detector MHD. The monitoring heterodyning detector MHD is also supplied as indicated with intermediate frequency energy from the coupling unit CU2. The output of the monitoring heterodyning detector MHD is then fed through a suitable monitoring audio frequency amplifier MAFA to a suitable monitoring translating device MTD.

Particular attention is directed towards inductor 23 and capacitors 3 and 5 of coupling unit CU3. These elements are adjusted so as to constitute a series resonant circuit for the intermediate frequency carrier which may be, for example, 300 kilocycles. This series tuned circuit offers a low impedance to ground at the incoming signal carrier frequency and greatly improves the efficiency of the diode rectifier DD serving to help translate the received signals.

It should be clearly understood that while a single diode detector DD has been illustrated for detecting the received signals and for supplying an automatic volume controlling potential, separate diode detectors may be used, or, a triode detector having an independent plate voltage supply may be used for automatic volume control and a diode detector for signals or vice versa. Or, a single triode detector may be used for supplying both signal voltages and automatic volume controlling potentials.

To further remove the possibility of flow of waves from the second local oscillator 2L0 into the diode detector or rectifier DD, the monitoring heterodyning detector MHD has its control grid supplied through a voltage divider circuit in which resistor 16 is of relatively low impedance. This resistor serves the double purpose of providing an appropriate input voltage to the monitoring heterodyning detector and of making the grid to ground impedance relatively low which in turn greatly reduces the oscillator frequency voltage on the grid thereby reducing the amount of oscillator voltage feeding back through the monitoring heterodyning detector into the diode circuits.

Also, attention is directed to the voltage dividing circuits across the secondaries of transformers T1N, T2N, T3N, T1W, T2W and T3W. By this means, the gain per stage is reduced in all of the stages, or, if desired, in only the first stages T1N and T1W. Such action is desirable in that the benefits of several stages of selectivity are obtained before building the signal up to a voltage level at which troubles from intermodulation of the desired signal by undesired signals would otherwise result.

As it is desirable to have the radio frequency amplifiers highly sensitive during the periods when no signals are received so that even the smaller signals will be quickly amplified and made itself manifest in the translating device TD, it is to be noted that a novel automatic volume control circuit is used. Thus, turning to Figure 2*b*, the plate of the diode detector is maintained normally, that is to say, in the absence of signal at a positive potential for example at +0.47 volt. This positive potential is supplied from the plus side of the A battery which not only supplies heating current to the filament of the diode detector DD but also impresses a potential across the resistances R1, R2,

the approximate voltages at different points being as indicated. As a consequence the automatic volume control lead AVCL does not, in the absence of signal, maintain the grids of the radio frequency amplifiers RFA highly negative, but on the other hand maintains the grids of the radio frequency amplifiers at a relatively small negative potential rather close to zero D. C. potential with respect to the cathodes of the radio frequency amplifiers whereby during periods of time when no signal is impressed upon the antenna A, the radio frequency amplifiers are in condition to produce maximum amplification of the received signals. This desirable result follows by virtue of the fact that the output electrode or plate of the diode detector is normally maintained at a positive potential.

That is to say, while the lefthand side of resistance R1 is at approximately plus 0.5 volt, the grids of the radio frequency amplifiers to which the automatic volume control lead AVCL–*a* are not positive by this amount but in fact are at a small negative potential with respect to the cathodes of the radio frequency amplifiers. This seeming paradox is explained by virtue of the fact that when the filaments of the radio frequency amplifier are heated to an electron emitting condition, electrons leave the filament at such high velocities that they impinge upon the control grids of the radio frequency amplifiers. This causes a certain amount of rectification, the rectified grid current flowing through the resistors R3, R4 and through R5 to ground G. Normally this rectified grid current would put the grids of the radio frequency amplifiers at a fairly high negative potential with respect to their cathodes in the absence of signal, but this negative potential is reduced by the opposition of the positive voltage of 0.5 volt applied through the lefthand side of resistance R1. Consequently, the negative voltage upon the grids of the radio frequency amplifiers is reduced, in the absence of signal by the positive voltage applied through the lefthand side of resistance R1. Because of this fact, the radio frequency amplifiers in the no signal state are operated with small negative bias on their input or control grids rendering them highly sensitive to even small signals—a condition which is highly desirable.

Having thus described my invention, what I claim is:

1. In a receiving system, an antenna, means to heterodyne energies collected by the antenna to a band of intermediate frequencies, a single output circuit, a pair of vacuum tube filters each having inductive and capacitive reactances therein and each adapted to pass a common intermediate frequency but having different frequency pass bands, means simultaneously connecting the reactances of said tube filters in circuit between said heterodyning means and said output circuit, and means for selectively energizing the cathodes of the tubes of said filters whereby intermediate frequency energies are transferred through only one of said tube filters to said output circuit at a time.

2. In a receiving system, an electron discharge device having an input circuit, an electron discharge device having an output circuit, a plurality of frequency selective units having different band-pass characteristics and comprising multi-electrode tubes, said units being permanently connected in parallel between said input and output circuits, a source of energy for rendering the tubes of said units operative, and switching mechanism for selectively associating said source with the tubes of any desired unit for causing same to pass waves of predetermined frequencies.

3. In a multi-detection receiver, an intermediate frequency amplification system comprising two permanently connected band pass units having the same mid-band frequency but different band widths, each of said units including a plurality of multi-electrode tubes separated from one another by transformers, said transformers being arranged to efficiently pass the particular band of frequencies for which the unit is intended, a source of potential for energizing the cathodes of said tubes, and switching mechanism for connecting said source only to the cathodes of the tubes of one of said units at a time.

4. A heterodyne radio receiver having a first and a second detector and a plurality of parallel-connected frequency selective networks permanently interconnecting said detectors, each of said networks being adapted to pass a band of frequencies different from that of the others, and means for rendering said networks selectively operable one at a time.

5. A heterodyne radio receiver having a first and a second detector and a plurality of parallel-connected frequency selective networks, means for operatively and permanently connecting the inductive and capacitive components of said networks in circuit between said detectors, each of said networks being adapted to pass a band of frequencies different from that of the other, and means for rendering said networks selectively operable one at a time.

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