

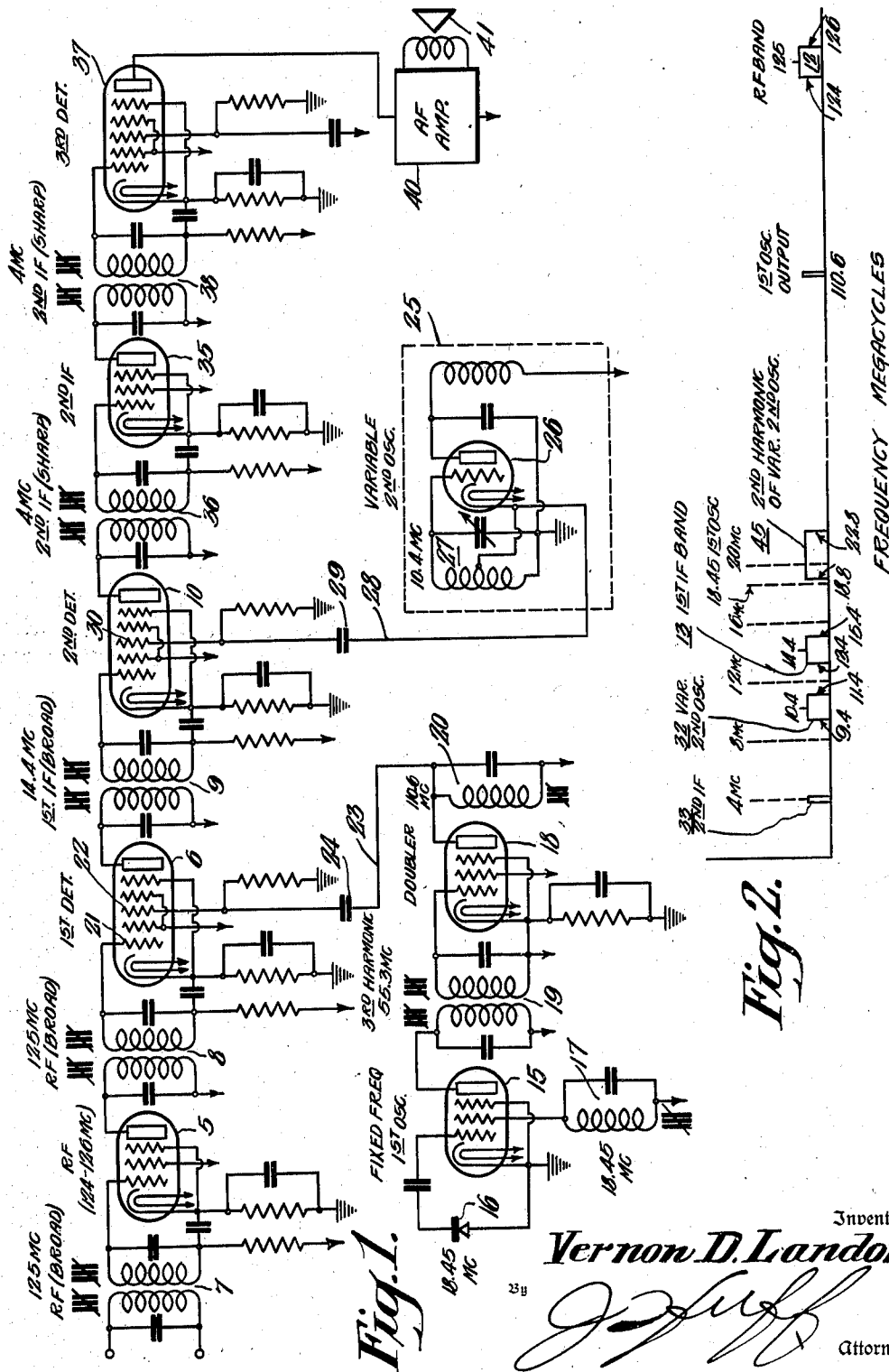
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ULTRA HIGH FREQUENCY RECEIVER

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ULTRA HIGH FREQUENCY RECEIVER

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This invention relates to ultra high frequency receivers, and has for its primary object to provide a receiver of the heterodyne type which may operate with good frequency stability in a narrow tuning band in the upper ranges of the radio frequency spectrum.

More particularly it is an object of the present invention to provide a radio signal receiving system of the heterodyne type which is readily tunable with good frequency stability to any one of a plurality of signal waves substantially of the order of 100 kc. apart in an ultra high frequency signal range below 5 meters, such, for example, as in the range from 124 to 126 mc.

It is known that in variable tuning systems of the heterodyne type, the highest frequency at which a variable oscillator of conventional design will give a required frequency stability to maintain the tuning constant at any given wave length or signal frequency is of the order of 10 mc. Therefore, it is a further object of the present invention, to provide an improved radio tuning system of the heterodyne type for signals in the ultra high frequency ranges which is not limited by the operating range of the oscillator, while at the same time providing a high degree of frequency stability.

It is a still further object of the invention, to provide an ultra high frequency superheterodyne radio signal receiving system wherein the tuning is accomplished at a relatively low frequency by a variably tunable oscillator and wherein a second intermediate frequency is provided, the second and third harmonics of which fall at such points in the frequency spectrum that they fall outside the tuning range of the variable oscillator and the frequency band of the first intermediate frequency amplifier.

The invention will, however, be further understood from the following description when considered in connection with the accompanying drawing, and its scope is pointed out in the appended claims.

In the drawing:

Figure 1 is a schematic circuit diagram of a radio signal receiving system embodying the invention, and

Figure 2 is a graphic illustration of the relation between the various signal and other frequencies employed in the circuit of Fig. 1.

Referring to Fig. 1, the radio signal receiving system illustrated may be considered by way of example, to operate in the ultra high frequency signal receiving band between 124 and 126 mc.

for receiving signals in that band, separated by substantially 100 kc.

The receiving system is of the superheterodyne type having a tuned radio frequency amplifier 5 at the input end thereof coupled to a first detector 6 which is also tuned to the same frequency as the R. F. amplifier 5.

The tuning is of the band pass type and is provided preferably by a tuned R. F. input transformer 7 for the R. F. amplifier 5 and a tuned coupling transformer 8 between the R. F. amplifier 5 and the first detector 6, both transformers having two tuned coupled circuits broadly responsive to the radio frequency band between 124 and 126 mc. about a mean frequency, as indicated, of 125 mc. The transformers are also preferably of the movable iron core type, as indicated, for greater stability in tuning, although any suitable and stable band pass tuning means may be employed for the R. F. circuits of the receiving system.

From the foregoing it will be seen that the R. F. or signal input circuits for the signals applied to the first detector are substantially fixed to a desired pass band, and likewise the first oscillator provides a fixed frequency of such a value that through the first detector the entire incoming R. F. signal band is transferred to a lower frequency in a step-down ratio of the order of 10:1 in a first intermediate frequency output coupling means for the first detector.

The first I. F. coupling means comprises a tuned coupling transformer 9 providing tuned primary and secondary circuits responsive to the lower frequency and being of the variable inductance type similar to the R. F. coupling transformer. This provides a band pass coupling means between the first detector and a second detector 10 having the same pass band characteristic as the input coupling means as will be seen more clearly from Fig. 2, to which attention is now directed along with Fig. 1.

In Fig. 2 the R. F. pass band is indicated at 42, while the first intermediate frequency pass band is indicated at 13, the former including the frequency range between 124 and 126 mc. about a mean frequency of 125 mc. while the corresponding band of intermediate frequencies at 13 include the frequency range between 13.4 and 15.4 mc. about a mean frequency of 14.4 mc. as the first intermediate frequency.

Thus the signal receiving channel of the receiving system is made relatively broad in its response to include the full width of the re-

ceiving spectrum desired, down to the second detector, with a reduction in the frequency band to which the system is responsive between the first and second detectors thereby providing improved frequency stability, and as an aid in establishing a certain desirable frequency relation between the various signal and other frequencies employed in the system as will hereinafter be seen from a further consideration of Fig. 2 and the circuit of Fig. 1.

As a further aid in establishing a high degree of frequency stability in the receiving system, the first oscillator operates at a relatively low frequency with respect to the R. F. signal receiving band and may be fixed in frequency by reason of the fact that the first I. F. circuits are broadly tuned to the entire signal receiving band.

In the present example, the first oscillator indicated at 15, is tuned to a fixed frequency of 18.45 mc. by a crystal 16 and a tuned circuit 17 resonant to the same frequency, and is coupled to a frequency doubler stage 18 through a tuned coupling transformer 19 which is responsive to a harmonic of the oscillator, such as the third harmonic, as shown, of 55.3 mc. so that in the tuned output circuit 20 of the doubler stage an output frequency of 110.6 mc. is provided for beating with incoming signals in the first detector to produce the first intermediate frequency having a mean frequency of 14.4 mc. By providing crystal control for the first oscillator frequency operating at a relatively low frequency, a high degree of stability is provided in the tuning of the system which is further aided by the fact that all of the circuits preceding the second detector are fixed tune.

Signal mixing in the first detector is provided by electron coupling, the detector device being of the type having a signal grid 21 connected with the R. F. input circuit for receiving incoming signals and having a second signal input grid 22 in the electron stream coupled to the oscillator output circuit 20 through a connection 23 and a suitable coupling capacitor indicated at 24. However, as the specific circuits employed do not concern the invention, further description of the input system is believed to be unnecessary.

The second detector is preferably of a similar type to the first detector, providing electronic mixing of the incoming signal and oscillations, the latter being provided by a variably tunable oscillator 25 including an oscillator tube 26 and a variably tunable oscillator circuit 27 coupled through a lead 28 and coupling capacitor 29 to the oscillation input grid 30 of the second detector 10. The lead 28 and ground may be extended to permit the variable second oscillator 25 to be located at any suitable controlling point for tuning the system, thereby adapting it readily for remote control tuning, if desired.

The second oscillator 25 is variably tunable in the frequency range indicated, to select the desired signal from the incoming frequency band of signals applied to the second detector from the first I. F. circuits. This frequency range indicated at 32 in Fig. 2 between 9.4 and 11.4 mc. about a mean frequency of 10.4 mc. thereby providing in response to the incoming first intermediate frequency signal of a mean frequency of 14.4 mc., a second intermediate frequency of 4 mc. indicated at 33.

The second intermediate frequency system includes an intermediate frequency amplifier stage 35 which is coupled to the second detector through a tuned coupling transformer 36 and

to a third detector 37 through a second tuned coupling transformer 38, both transformers having tuned primary and secondary circuits preferably of the variable or movable core type as indicated, and providing relatively sharp tuning to the second intermediate frequency of 4 mc. as indicated in Fig. 2 at 33.

The third detector operates as a demodulator and is followed by a suitable audio frequency amplifier 40 and an output device such as the loudspeaker 41.

The variable second oscillator 25 operates at a frequency of the order of 10 mc. and is therefore within the range of stability referred to hereinbefore. Its operation in the range provided, therefore, does not cause instability of the tuning on the receiving system, while at the same time, the second intermediate frequency is of such low value that highly efficient amplification and sharp tuning may be provided in the second I. F. amplifier, thereby imparting substantially all of the selectivity and gain desired for the system at that point.

It will be seen also, that the second intermediate frequency is so chosen that the second and third harmonics thereof of 8 and 12 mc., respectively, fall outside the frequency band covered by the variable second oscillator. Likewise the third and fourth harmonics of 12 and 16 mc. of the second I. F. fall outside the pass band of the first I. F. amplifier.

The second harmonic range 45 of the variable second oscillator is relatively widely spaced from the first I. F. band so that it may not beat with signals in that band to produce the frequency of the second intermediate frequency amplifier. In general, the harmonics of the second intermediate frequency are such that they fall outside of the various tuning ranges and the fifth harmonic of the second intermediate frequency of 20 mc. is sufficiently low in amplitude to have no effect upon the stability or operation of the system, although it falls within the range of the second harmonic of the variable second oscillator.

From the foregoing description, it will be seen that a radio signal receiving system of the superheterodyne type may be provided for tuning in the ultra high frequency signal ranges with improved frequency stability, and with a simplified variable tuning system involving a single tuning control, such as a variable second oscillator which operates in a frequency range insuring stability of tuning.

Furthermore, the first oscillator may be fixed in frequency, together with the tuning of the input circuits preceding the second detector, the tuning being stabilized by crystal control not ordinarily deemed expedient in signal receiving systems, particularly for high fidelity reception of broadcast signals, and in this manner the frequency band of the variable oscillator of the first intermediate frequency occupy portions of the frequency spectrum between the various harmonics of the second intermediate frequency thereby preventing undesired heterodyne beats and interference.

I claim as my invention:

1. In a radio signal receiving system for ultra high frequency signals in a predetermined narrow frequency band, the combination of tuned band pass signal circuits, a first detector for receiving signals therefrom, a stabilized first oscillator providing a fixed frequency, means for selecting and applying to said detector a harmonic of said fixed frequency to provide first

intermediate frequency signals corresponding to and lower than signals in said narrow band, a second detector coupled to said first detector, a band pass circuit providing said coupling, a variable oscillator for said second detector providing a relatively low second intermediate frequency signal, the harmonics of which fall outside of the tuning range of said variable second oscillator and the response band of said first intermediate frequency.

2. A double heterodyne receiver for ultra high frequency signals in a relatively narrow band, comprising a fixed frequency crystal controlled first oscillator, means for selecting a harmonic of said oscillator frequency, a first detector, means for applying said harmonic to said detector to provide intermediate frequency signals in a predetermined broad relatively low frequency band, a second detector for said first intermediate frequency signals, a variably tunable second oscillator coupled thereto to provide a second intermediate frequency signal, the variable second oscillator tuning range and the first intermediate frequency band falling between the second and third, and third and fourth harmonics, respectively, of the second intermediate frequency signals.

3. In an ultra high frequency signal receiving system, the combination of a band pass radio frequency amplifier, a crystal controlled fixed frequency first oscillator, means for selecting a harmonic of said oscillator, a first detector for receiving radio frequency signals and said selected harmonic to produce a first intermediate frequency in a relatively low frequency band corresponding to the signal band passed by said radio frequency amplifier, means providing broadly tuned first intermediate frequency signal circuits responsive to said band, and means

for variably tuning said system comprising a variably tunable second oscillator having a relatively low frequency variable tuning range whereby stable operation is provided throughout the tuning range thereof, a second detector coupled to said second oscillator and to said first intermediate frequency circuits, and a low frequency second intermediate frequency amplifier coupled to said second detector including a plurality of sharply tuned signal circuits for imparting a predetermined selectivity to said system and being tuned to a frequency such that the lower harmonics thereof fall outside the tuning ranges of said second oscillator and first intermediate frequency circuits.

4. An ultra high frequency double heterodyne signal receiving system comprising, in combination, an ultra high radio frequency amplifier broadly responsive to signals in a predetermined frequency band, a plurality of first intermediate frequency circuits broadly responsive to a corresponding band of signal frequencies in a lower frequency band, a stabilized low frequency first oscillator, means for deriving a harmonic of the first oscillator frequency for converting signals to said lower frequency band, a variably tunable second oscillator for tuning said system through said first named band of signal frequencies, said second oscillator being variably tunable through a relatively low frequency range wherein the operation of said second oscillator is stabilized, and a second intermediate frequency amplifier providing a plurality of tunable signal circuits sharply responsive to a predetermined intermediate frequency, the harmonics of which fall outside the tuning ranges of said second oscillator and first intermediate frequency circuits.

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