Feb. 8, 1949. W. H. NEWBOLD 2,460,900

WIDE BAND SUPERHETERODYNE RECEIVER

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FIG. 1.

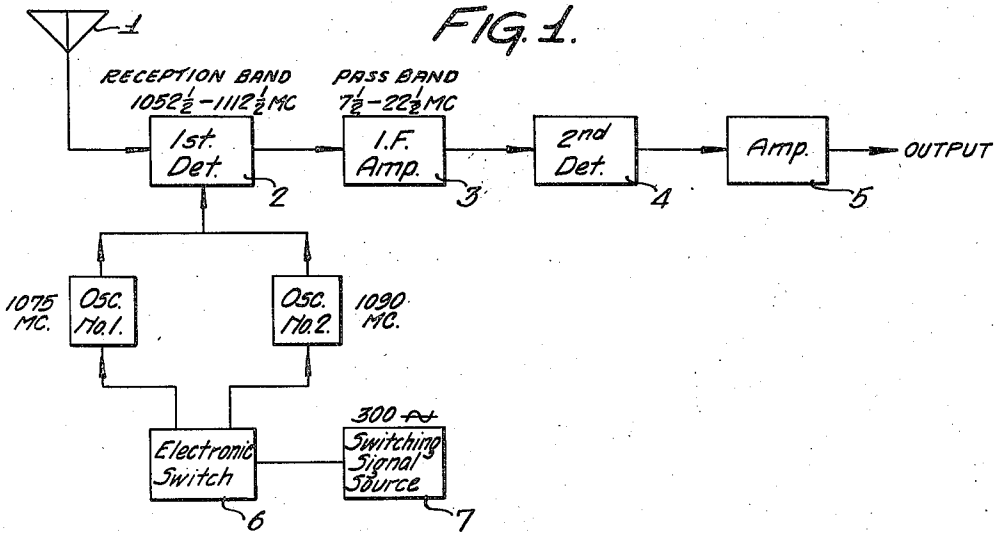


FIG. 2.

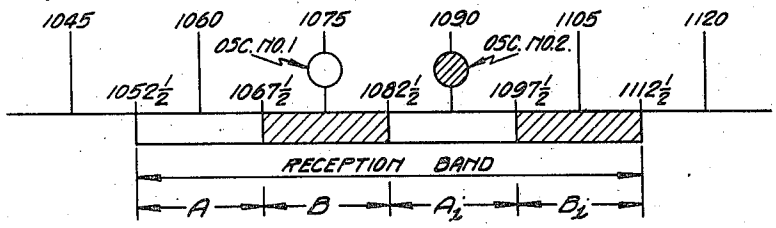
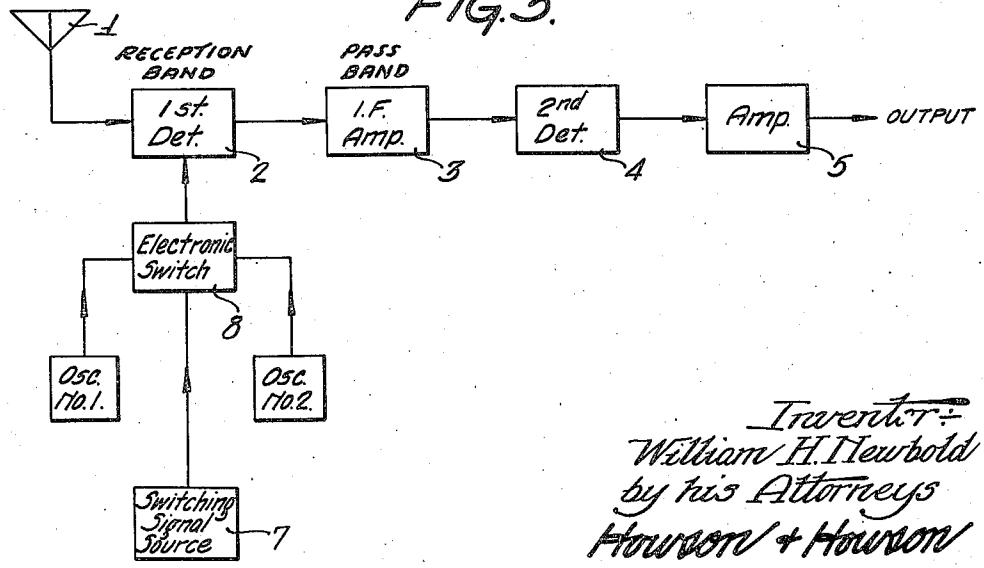


FIG. 3.



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FIG. 4.

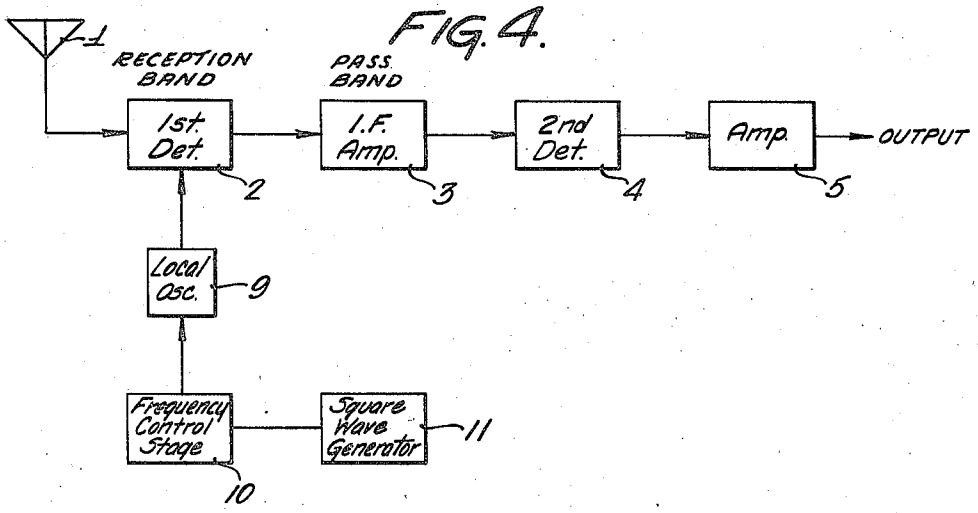
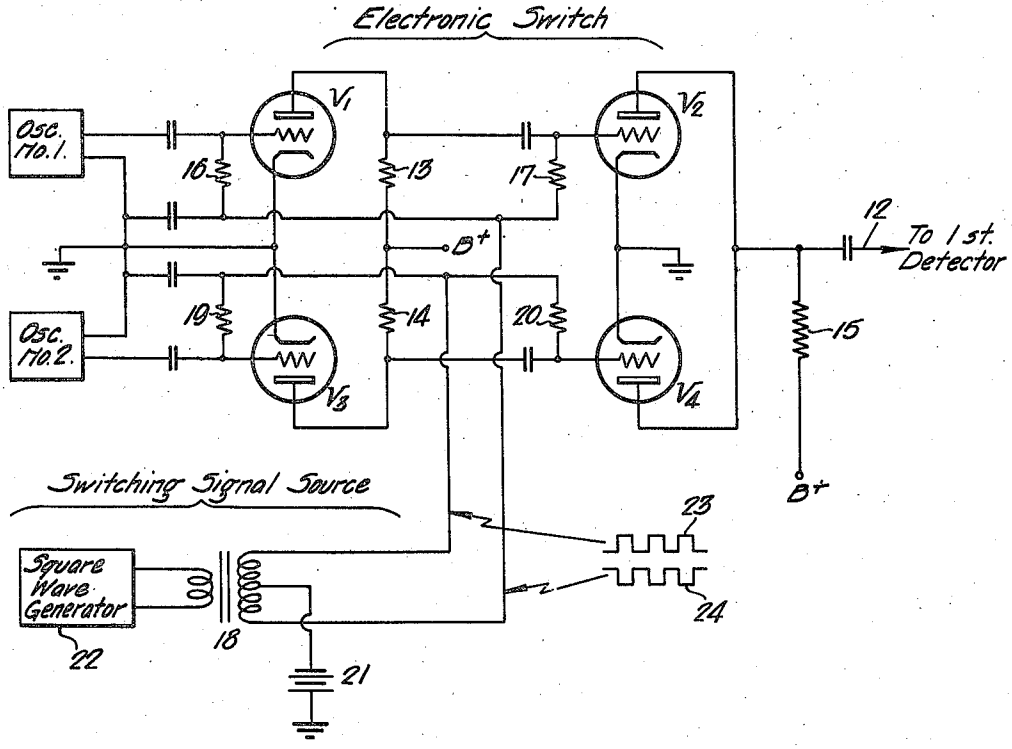


FIG. 5.



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FIG. 6.

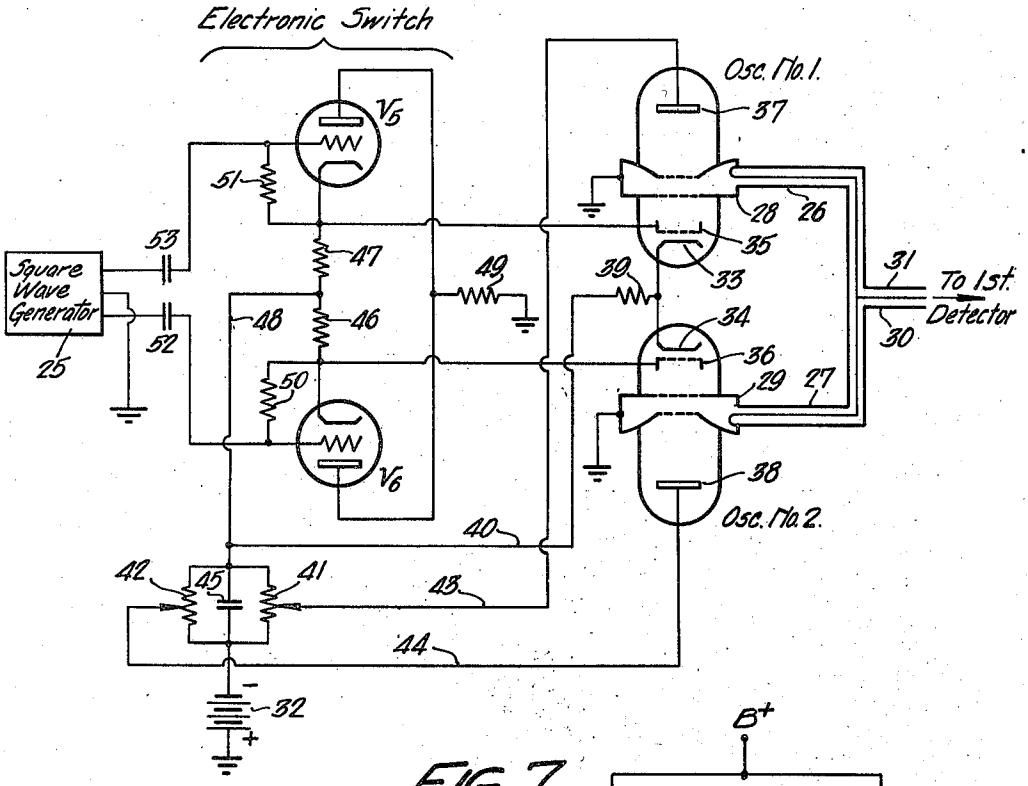


FIG. 7.

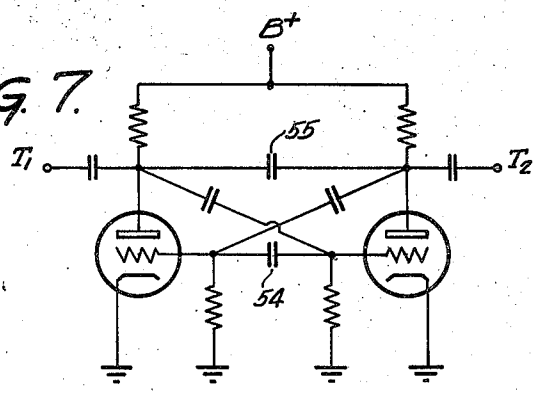
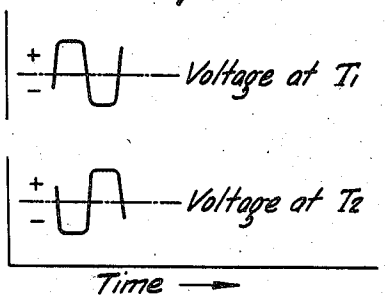


FIG. 8.



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Patented Feb. 8, 1949 2,460,900

UNITED STATES PATENT OFFICE

2,460,900

WIDE-BAND SUPERHETERODYNE RECEIVER

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Application December 31, 1943, Serial No. 516,479

4 Claims. (Cl. 250—20)

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This invention relates to improvements in superheterodyne radio receivers, and more particularly to superheterodyne receivers which are capable of receiving wave signals over wide frequency bands.

Wide-band receivers of the type contemplated by the present invention have been found to be highly advantageous as aircraft beacon receivers, where the beacon receiver, stationed at an airport and associated with a cooperating transmitter, is required, in response to a prearranged code, signal, or interrogation, from an aircraft, to effect, or institute, the transmission of a respondent signal which identifies the airport in question. The aircraft may, of course, be provided with means for determining the range and azimuth of the transmitting station, i. e. of the airport.

Ordinarily these aircraft beacon systems operate in the ultra-high frequency regions, and, for various practical reasons which need not concern us here, operate—at least insofar as the airborne transmitting equipment is concerned—at carrier frequencies which may vary over substantial limits from time to time, and from aircraft to aircraft. Thus an airborne transmitter employed for beacon purposes, and having a nominal assigned carrier frequency of 1080.5 megacycles, may operate anywhere in the band extending from, say, 1052.5 to 1112.5 megacycles. Although the included band is 60 megacycles in width, it is important that the beacon receiver at the airport be capable of responding to the aircraft's transmission at once and without special preadjustment.

Wide-band receivers of the type contemplated by the present invention are also advantageous as monitoring devices for continuously indicating the presence, or absence, of wave signals in a predetermined wave band. In the past it has been customary to monitor very wide frequency bands by manually (or automatically) tuning a conventional receiver back and forth across the band in question, while aurally noting, or automatically recording, the presence of signals as they are encountered during the band-sweeping process. For certain types of band monitoring service, a receiver embodying the present invention offers very substantial advantages.

It is possible, of course, for either of the above-mentioned services, to design a conventional superheterodyne radio receiver having very broad radio frequency and intermediate frequency pass-bands so that the entire band of interest may be continuously received or monitored without having to resort to a tuning or band-sweeping process. This has been tried in the past, but efforts in this direction have met with no substantial success, because conventional receivers having very wide pass-bands are

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notoriously insensitive. It is well known, for example, that the gain which can be expected from a single amplifier stage is, at least to a fair degree of approximation, inversely proportional to the width of the amplifier's pass-band. Hence such conventional wide-band receivers require a large number of amplifier stages to provide the desired overall gain, and in consequence they are excessively complicated and costly.

By the present invention there is provided a novel system for passing a wide band of frequencies (hereinafter termed the "reception band") through a high sensitivity narrow-band receiver. This is accomplished through the agency of a special type of superheterodyne circuit having two or more local oscillators, which operate at a corresponding number of different fixed frequencies, and which are switched on and off in predetermined time sequence to provide, in the narrow-band output circuit of the converter stage, a series of individual segments of the desired band (hereinafter termed "band segments"), which are coextensive as regards their intermediate frequency band limits, and which, in one complete cycle of oscillator switching, represent the reception band to be covered. The invention also contemplates the simultaneous reception of two such band segments, this being accomplished by making use of both the "primary" and "image" segments.

The invention also contemplates the use of a single local oscillator, with means for periodically changing its frequency to simulate the action of the plurality of oscillators hereinbefore referred to.

It is, accordingly, a principal object of the invention to provide a novel frequency converter system for passing a wide reception band through a high sensitivity narrow-band intermediate frequency amplifier.

It is another object of the invention to provide a wide-band superheterodyne radio receiver having novel local oscillator circuits adapted to divide a desired reception band into a plurality of band segments, and to pass said band segments through a narrow-band I. F. amplifier.

It is a further object of the invention to provide a high gain superheterodyne receiver capable of giving a substantially instantaneous indication of the presence of signals at any point in a relatively wide reception band.

It is still another object of the invention to provide a superheterodyne receiver having unique qualities which adapt it to the monitoring of wide frequency ranges without the use of manually or mechanically movable parts.

Other objects and features of the invention will be understood with reference to the accompanying drawings, in which

Fig. 1 is a diagrammatic illustration of a preferred embodiment of the invention;

Fig. 2 is an explanatory diagram to which reference will be made in the description of the subject invention;

Fig. 3 is a diagrammatic illustration of an alternative embodiment of the invention;

Fig. 4 is a diagrammatic illustration of another embodiment of the invention;

Fig. 5 is a schematic diagram of a portion of the system illustrated diagrammatically in Fig. 3;

Fig. 6 is a schematic diagram of a portion of the preferred embodiment of Fig. 1;

Fig. 7 is a schematic diagram of a multivibrator of preferred design for generating square waves having rounded corners; and

Fig. 8 shows the type of switching signals which can be derived from the multivibrator of Fig. 7.

Reference may now be had to Fig. 1 which illustrates, by means of a block diagram, a preferred embodiment of the invention. The superheterodyne receiving system shown comprises an antenna 1, a wide-band first detector (frequency converter) 2, a narrow-band intermediate frequency (I. F.) amplifier 3, a second detector 4, and a suitable modulation-frequency amplifier 5. The superheterodyne's local oscillator stage comprises a plurality of separate oscillators adjusted to operate at predetermined different frequencies. Two such oscillators, designated "oscillator No. 1" and "oscillator No. 2" are employed in the embodiment of Fig. 1. An oscillator switching device 6, preferably electronic in character, is operatively associated with the two local oscillators for the purpose of switching them alternately on and off in opposite time sequence. A switching signal source 7 may be connected to the device 6 to control the switching operation thereof.

The operation of the system of Fig. 1 may best be understood by referring to the explanatory diagram of Fig. 2. Let us assume that the receiver illustrated is to be used in the aircraft beacon system hereinbefore referred to, and that it is desired to receive a signal in a reception band extending from, say, 1052.5 to 1112.5 megacycles, the said reception band having an over-all bandwidth of 60 megacycles. The desired signal may, of itself, occupy a band-width of only a few megacycles, but since it may occur anywhere in the 60 megacycle reception band it is important that the receiver be capable of responding to the desired signal whatever its carrier frequency.

The antenna 1 and the input circuits to the first detector 2 should be designed to respond to and pass the entire 60 mc. reception band extending from 1052.5 mc. to 1112.5 mc. These, however, are the only wide-band circuits in the entire receiver. By the practice of the present invention the band-width of the receiver's I. F. amplifier 3 (which, for the purpose of the present discussion may be thought of as including the output circuit of the first detector 2) may be reduced by a factor of

$$\frac{1}{2N}$$

where N is the number of local oscillators associated with the first detector 2. In the system of Fig. 1 there are two such oscillators, and hence the required band width of the I. F. amplifier is reduced by a factor of one-fourth, or, in the example under discussion, to an over-all bandwidth of 15 mc. A suitable I. F. amplifier for the system under discussion will have a pass-band extending from approximately 7.5 to 22.5 mc.

According to the invention the 60 mc. reception band is divided into four 15-mc. band segments, designated A, B, A_1 and B_1 in Fig. 2. These four relatively narrow band segments are supplied to the I. F. amplifier 3 by a novel process of frequency conversion involving the use of the local oscillators designated "oscillator No. 1" and "oscillator No. 2." Oscillator No. 1 may be adjusted to operate at 1075 mc., a frequency midway between the band segments A and A_1. This oscillator is so related to the band segment A as to convert it to an I. F. band extending from 7.5 to 22.5 mc. This follows from the fact that the differences between the oscillator frequency and the upper and lower frequency limits of the band segment A are respectively 7.5 and 22.5 mc. The band segment A may, for purposes of identification, be referred to as a "primary" band segment, since it corresponds to the band which is normally utilized in conventional superheterodyne receivers, it being customary to operate the local oscillator at a frequency which is higher than the frequency of the desired signal by an amount equal to the receiver's intermediate frequency. Oscillator No. 1 is also so related to band segment A_1 as to convert this band segment to the same I. F. band. This follows from the fact that the differences between the oscillator frequency and the lower and upper frequency limits of the band segment A_1 are respectively, 7.5 and 22.5 mc. The band segment A_1 may, for purposes of identification, be referred to as an "image" band segment, since it corresponds to the band of similar name which, in a conventional superheterodyne, is not utilized, and which, in fact, has heretofore been eliminated by means of pre-selectors and the like. By the present invention, however, both the primary and the image band segments may be utilized, although both are not necessarily utilized.

The remaining band segments, B and B_1, may be converted in like manner through the agency of a second oscillator, oscillator No. 2, adjusted to operate at 1090 mc., a frequency midway between the band segments B and B_1. As before, the band segment B may be regarded as a "primary" band segment, and the band segment B_1 as an "image" band segment.

In the normal operation of the system of Fig. 1, the oscillators Nos. 1 and 2 are switched alternately on and off in opposite time sequence, so that while oscillator No. 1 is operative band segments A and A_1 are received, and while oscillator No. 2 is operative band segments B and B_1 are received, and thus in a complete oscillator switching cycle the entire reception band is received. The particular oscillator switching rate employed will ordinarily depend upon the type of signal to be received. In one particular use of the invention where the signals to be received were in the nature of interrupted continuous waves comprising carrier periods (pulses) of 2 microseconds duration, occurring at the rate of 400 per second, and separated by zero-carrier (no signal) periods of approximately 2500 microseconds, an oscillator switching rate of 300 cycles per second was found to be suitable. Under these conditions the complete oscillator switching cycle has a period of about 3330 microseconds, each oscillator being individually operative for periods of about 1665 microseconds. In practice, however, in order to avoid the possibility of both oscillators being operative simultaneously during the change-over period, it is preferred that each oscillator be on

only, say, 49% of the time, or about 1630 microseconds per switching cycle. Should both oscillators operate simultaneously a strong 15 mc. beat signal would be produced in the output of the first detector 2. Since this frequency falls in the middle of the pass-band of the I. F. amplifier 3, such an occurrence should be avoided, preferably in the manner described.

Summarizing, it is emphasized that, by means of the present invention, an unusually wide reception band has been broken up and converted into a plurality of relatively narrow band segments, all having identical frequency limits, and thus capable of amplification in a common narrow-band, high-gain, intermediate frequency amplifier.

Where two local oscillators are employed, and where it is desired to utilize both the primary and image bands, as in the system described with reference to Figs. 1 and 2, the pass-band of the I. F. amplifier will, in the general case, extend between limits having a 3-to-1 frequency relation. Thus where a pass-band of 15 mc. is specified, the band-limits satisfying this condition are 7.5 and 22.5 mc. The construction of an I. F. amplifier covering such a frequency range, and having such a high ratio of maximum to minimum frequency limits, should be accorded special care and precision, and it is therefore preferred that the said amplifier be constructed in accordance with the methods disclosed in the copending application of C. T. McCoy, Serial No. 473,989, filed January 29, 1943, Patent No. 2,375,309 granted May 8, 1945, employing the band pass transformer disclosed and claimed in the said McCoy application.

Referring generally to the system of Fig. 1, it is apparent that the increased R. F. band width (or, conversely, decreased I. F. band width) is obtained at the expense of "duty factor" at any specific frequency. When two oscillators are employed this "duty factor" is approximately 0.5, meaning that reception of a given band segment obtains only 50% of the time. In the examples mentioned above this is not a disadvantage, and in other cases it may be minimized by proper choice of switching rate.

With proper modification of the I. F. pass-band and oscillator frequencies, the system may be modified to cover still greater reception-band widths. For instance with three local oscillators, a duty factor of 33%, and an I. F. amplifier having a pass-band extending from 20 to 40 mc., it would be possible to provide a reception band of 120 mc. Or if, in the twin-oscillator system first described, an I. F. pass-band from 10 to 30 mc. were used, a reception band of 80 mc. would be obtained.

If, in the system described with reference to Fig. 2, it is desired to use only the primary band segments A and B, the image band segments A_1 and B_1 may be excluded by providing antenna and first detector input circuits with pass bands extending from only 1052.5 to 1082.5 mc. Of course in this case the band-reduction effect is only 2-to-1 as compared to 4-to-1 in the preceding case.

The embodiment of Fig. 3 is generally similar to that of Fig. 1, except that instead of turning a pair of local oscillators alternately on and off in opposite time sequence, oscillators Nos. 1 and 2 of Fig. 3 are themselves continuously operative, an electronic "single-pole double-throw" switch 8 being interposed between the local oscillators and the first detector 2 in a manner such as to connect first the one and then the other local oscillator to the first detector 2. As was the case with the embodiment of Fig. 1, precautions should be taken to ensure that at no time are the local oscillators both coupled simultaneously to the first detector 2. The electronic switch 8 may be controlled, as in Fig. 1, by a switching signal from the source 7. The explanatory diagram of Fig. 2 may be applied to the embodiment of Fig. 3 in the same way that it was applied to Fig. 1, since the two systems are generically identical.

The embodiment of Fig. 4 is identical in principle to those described above. It differs chiefly in that, instead of a plurality of local oscillators, only a single local oscillator 9 is provided. This single oscillator, however, performs completely the functions of the dual oscillators hereinbefore described. In order to permit such operation there is connected to the oscillator's tank circuit (not shown) a frequency control stage 10 adapted to tune the oscillator periodically from one to the other of the predetermined oscillator frequencies. Operation of the frequency control stage 10 may be effected by the application thereto of a suitable square wave derived from the source 11. All of the components of Fig. 4 are familiar to those skilled in the art, and hence it is deemed unnecessary to illustrate them in detail.

Reference may now be had to Fig. 5 in which there is illustrated schematically an electronic switch and switching signal source suitable for use with the system of Fig. 3. The continuously operating local oscillators, Nos. 1 and 2, are illustrated diagrammatically, since they may be conventional in every respect. Connected between the two local oscillators and the common conductor 12 (which leads to the first detector 2 of Fig. 3) is a two-channel "electronic switch" which operates, in response to a switching signal from the "switching signal source," to connect first the oscillator No. 1, and then oscillator No. 2, to the common conductor 12 in predetermined alternating time sequence.

Since electronic switches are well known to those skilled in the art only a brief description of the operation of the device of Fig. 5 is deemed necessary. The upper channel of the electronic switch comprises a two-stage resistance-coupled amplifier employing the vacuum tubes V_1 and V_2. This channel is connected between the output of oscillator No. 1 and the common output conductor 12. The lower channel of the electronic switch comprises a second two-stage resistance-coupled amplifier employing the vacuum tubes V_3 and V_4. This latter channel is connected between the output of oscillator No. 2 and the common output conductor 12. Vacuum tubes V_1 and V_3 are each provided with individual load resistors 13 and 14 respectively, but the tubes V_2 and V_4 are provided with only a single, or common, load resistor 15. Tubes V^1 and V^2 are provided with grid input resistors 16 and 17 respectively, which, at their lower extremities, are connected to the lower terminal of the split secondary winding of the switching signal transformer 18. Similarly tubes V_3 and V_4 are provided with grid input resistors 19 and 20 respectively which, at their upper extremities, are connected to the upper terminal of the split secondary winding of the switching signal transformer 18. A bias voltage source 21 may be connected between the center-tap of transformer 18 and ground; the bias provided is preferably of a magnitude such that in the absence of a switching signal the

tubes V_1 to V_4 are biased at or below plate-current cut-off.

The switching signal may be supplied by a suitable square wave generator 22, the output terminals of which are connected to the primary winding of transformer 18. The secondary of this transformer then supplies a pair of square wave switching signals, 23 and 24, which are equal in magnitude, but opposite in phase. The application of these signals to the control grid circuits of the electronic switch effects a mode of operation in which, during odd alternations (i. e. half-cycles) of the switching signal, oscillator No. 1 is connected by way of tubes V_1 and V_2 to the output conductor 12, while during even alternations oscillator No. 2 is connected thereto by way of tubes V_3 and V_4.

Although triodes have been shown for convenience, in practice it will ordinarily be preferred to use pentodes in the circuits just described. Similarly, in order to reduce to a negligible quantity any possible leakage of signal from an undesired oscillator to the output conductor 12, it may be desirable to shield the several stages from each other in accordance with methods of common practice.

The circuit of Fig. 5 is particularly adapted for use at medium and medium-high frequencies where conventional vacuum tubes and circuit components are applicable. At higher frequencies, and particularly in the so-called microwave regions, the system of Fig. 6 is more applicable. The circuit shown schematically here is representative of an adaptation of the system of Fig. 1 for use at ultra-high frequencies.

In Fig. 6 the square wave generator 25 corresponds to the switching signal source 7 of Fig. 1. Similarly the electronic switch, comprising the tubes V_5 and V_6, corresponds to the electronic switch 6 of Fig. 1, while the oscillator tubes, designated "Osc. No. 1" and "Osc. No. 2," correspond to the similarly designated components of Fig. 1. The square wave generator 25 is preferably of the type illustrated in Fig. 7 and will be described hereinafter. The oscillators are conveniently of the Reflex Klystron type (see Sarbacher and Edson, "Hyper and ultra-high frequency engineering," Wiley, 1943, pages 602 et seq.), and they are so represented in the drawing.

Signals are derived from the oscillator tubes by means of coaxial lines 26 and 27 which are inductively coupled into the cavity resonators 28 and 29 of oscillators No. 1 and No. 2 respectively. The coaxial lines 26 and 27 may then be connected individually to separate elements of the first detector of the superheterodyne, or, as illustrated in Fig. 6, they may be interconnected at the junction 30, a single coaxial line 31 passing thence to the first detector. By means of the electronic switch, so designated in the drawing and hereinafter to be described, only one of the oscillators is operative at any given time, and hence the design of the coaxial line system is not critical. In general, however, the two line lengths, 26 and 27, extending from the cavity resonators to the junction 30, should be such that an unused line presents a high impedance to the oscillator then in operation. In other words, the lines should be of such length that the junction 30 will look like a high impedance to the oscillating Klystron. In practice, suitable line lengths are most readily found by trial. It has also been found that, in practice, best results are obtained through the use of coaxial lines 26 and 27 which are somewhat lossy. Line losses of 6 db. from each cavity resonator to the junction 30 were found satisfactory.

If desired, band-pass filters may be inserted in the lines 26 and 27 for suppressing undesired oscillator harmonics. Amplitude metering means may also be inserted in these lines to assist in balancing the magnitude of the output signal from the two oscillators. Frequency metering means for checking the operating frequency of each oscillator may also be provided.

Reference is now made to the electronic switch, and to the circuit connections between the said switch and the oscillators. Since it is desirable to operate the cavity resonators 28 and 29 at ground potential, it is convenient to connect the positive high-voltage terminal of the source 32 to ground, the cathodes 33 and 34 and other low potential Klystron elements such as the grids 35 and 36 and repeller plates 37 and 38 being connected to points in the system which are at negative potentials with respect to ground. Thus the cathodes 33 and 34 are connected through the common cathode resistor 39, the conductor 40, and the parallel potentiometers 41 and 42, to the negative terminal of the source 32. The repeller plates 37 and 38 are connected by way of conductors 43 and 44 to adjustable points on the potentiometers 41 and 42. Through adjustment of these devices, the potentials on the repeller plates 37 and 38 may be individually fixed. A condenser 45, connected in shunt with potentiometers 41 and 42, may be required to prevent feedback between the repeller plates. The control grids 35 and 36 of the Klystron oscillators are connected directly to the cathodes of triodes V_5 and V_6 respectively. As will be explained hereinafter, it is from the cathode load resistors 46 and 47, associated with these triodes, that control voltages are derived which effect operation of the two oscillators in alternating sequence.

The electronic switch comprises a pair of triodes V_5 and V_6 each provided with individual cathode load resistors 46 and 47, respectively, and connected through a common conductor 48 to the upper junction of the potentiometers 41 and 42, and thence to the negative terminal of the source 32. The anodes of the tubes V_5 and V_6 are connected to B+, i. e. to ground, through a common current limiting resistor 49. Grid leaks 50 and 51 are connected directly between the grid and cathode electrodes of the triodes V_5 and V_6. The control grids are also coupled, through condensers 52 and 53, to a source of switching signals 25. The source 25 preferably supplies a pair of relatively reversed, modified square-wave signals of the type illustrated generally in Fig. 8, the multivibrator of Fig. 7 (to be described hereinafter) being particularly well adapted to the generation of signals of this character.

In the operation of the system of Fig. 6, a pair of square-wave switching signals are supplied by the generator 25 to the electronic switch in push-pull relation. When the grid of V_5 is driven in the positive direction plate current is caused to flow, and the upper end of cathode load resistor 47 assumes a positive potential with respect to the lower end thereof. Since this resistor is in the grid-cathode circuit of oscillator No. 1, a positive voltage is applied to the grid of the said oscillator, permitting the previously blocked plate current to flow, and thereby enabling oscillation to commence. Simultaneously with these events the grid of V_6 is driven in the negative direction, cutting off the flow of plate current in V_6, and reducing the voltage existing across the cathode

load resistor **46** to substantially zero. The only voltage in the grid-cathode circuit of oscillator No. 2 is, under these conditions, the bias across the common cathode resistor **39** produced by the flow of space current in oscillator No. 1. This bias is preferably of a magnitude such as to bias oscillator No. 2 to, or below, space current cut-off, thus effectively preventing oscillation of the latter oscillator. During the following half-cycle, the events described above are reversed, oscillator No. 2 being operative, and oscillator No. 1 being inoperative. Thus the electronic switch, including tubes V_5 and V_6, comprises means for periodically effecting operation of the two oscillators in alternating sequence. Through the use of a switching signal of the character illustrated in Fig. 8, i. e. one having rounded corners and sloped sides, it is insured that only one of the two oscillators shall be operative at any given instant, there being, in fact, a short interval between the half-cycles of the switching wave when neither of the oscillators is functioning.

The resistor **49**, which has already been referred to as a current limiting resistor, is also useful as a means for fixing the maximum positive voltage excursions of the upper and lower ends of the cathode load resistors **47** and **46** respectively.

In one physical embodiment of the circuit of Fig. 6 utilizing Reflex Klystrons each drawing 15 to 20 ma. during oscillation, and employing a 6SN7GT (double triode) tube for the tubes V_5 and V_6 in the electronic switch circuit, resistors of the following values were used:

Resistor **39**=1000 ohms
Resistor **41**=10,000 ohms
Resistor **42**=10,000 ohms
Resistor **49**=50,000 ohms
Resistor **46**=6800 ohms
Resistor **47**=6800 ohms
Resistor **50**=1 megohm
Resistor **51**=1 megohm

The condenser **45** had a capacity of 0.25 microfarad. The source **32** provided a potential of 700 volts.

Reference may now be had to Fig. 7 in which there is illustrated, schematically, a multivibrator of preferred design for generating square waves with rounded corners, and suitable particularly for use with systems of the type illustrated in Figs. 1 and 6. This multivibrator circuit differs schematically from conventional systems only in the provision of the grid-to-grid condenser **54** and the plate-to-plate condenser **55**. These condensers should be of a magnitude just large enough to slightly round the corners and slope the sides of the output signals, as illustrated, for example, in Fig. 8.

The multivibrator of Fig. 7 is fully described and claimed in my copending application, Serial No. 516,480, filed December 31, 1943, now abandoned, and since it is not a part of the present invention a detailed description of its operation is deemed unnecessary here.

Although the invention has been described with particular reference to various specific embodiments, it is to be understood that the invention is susceptible of considerable modification,

and is not limited to the disclosed embodiments.

I claim:

1. In a superheterodyne radio receiver, a frequency converter having a signal input circuit responsive to a reception band of predetermined width, local oscillator means for selectively generating local oscillations of N different frequencies, N being any small integer other than one, coupling means for applying said local oscillations to said frequency converter, an intermediate frequency amplifier connected to the output circuit of said frequency converter, the pass band of said amplifier being only

$$\frac{1}{2N}$$

as wide as said reception band, and automatic means operatively associated with said local oscillator means for effecting, sequentially and at a rapid rate of repetition, cyclical selection of local oscillations at said N different frequencies, the frequencies of said local oscillations being so related to the frequency limits of said reception band that said reception band is effectively divided into N primary band segments and N image band segments, all of said band segments being converted by said frequency converter into one common intermediate frequency band, said intermediate frequency band being substantially identical to the said pass band of said intermediate frequency amplifier.

2. A superheterodyne radio receiver as claimed in claim 1, wherein said local oscillator means comprises N continuously operating individual oscillators, and wherein said automatic selection means comprises a switching system for sequentially connecting said individual oscillators to said frequency converter.

3. A superheterodyne radio receiver as claimed in claim 1, wherein said local oscillator means comprises N individual oscillators, and wherein said automatic selection means comprises a switching system for effecting sequential operation of said individual oscillators.

4. A superheterodyne radio receiver as claimed in claim 1, wherein said local oscillator means comprises a single oscillator circuit, and wherein said automatc selection means comprises a frequency control device operative—in response to an electrical control signal—sequentially to change the operating frequency of said oscillator circuit.

WILLIAM H. NEWBOLD.

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