

Jan. 17, 1961

L. J. McKESSON
SIGNAL SELECTOR

2,968,718

Filed Jan. 28, 1957

3 Sheets-Sheet 1

FIG. 1

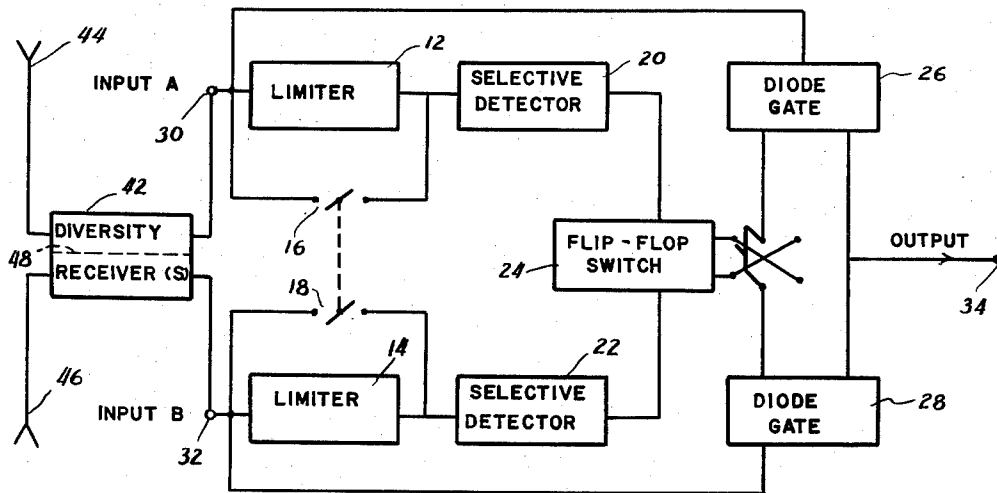
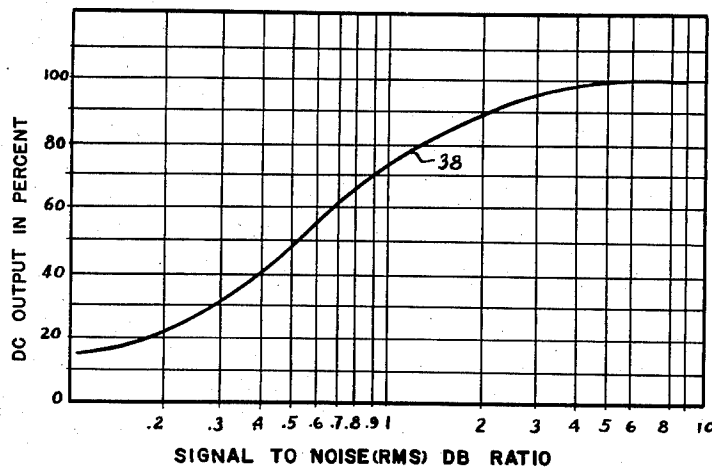


FIG. 2



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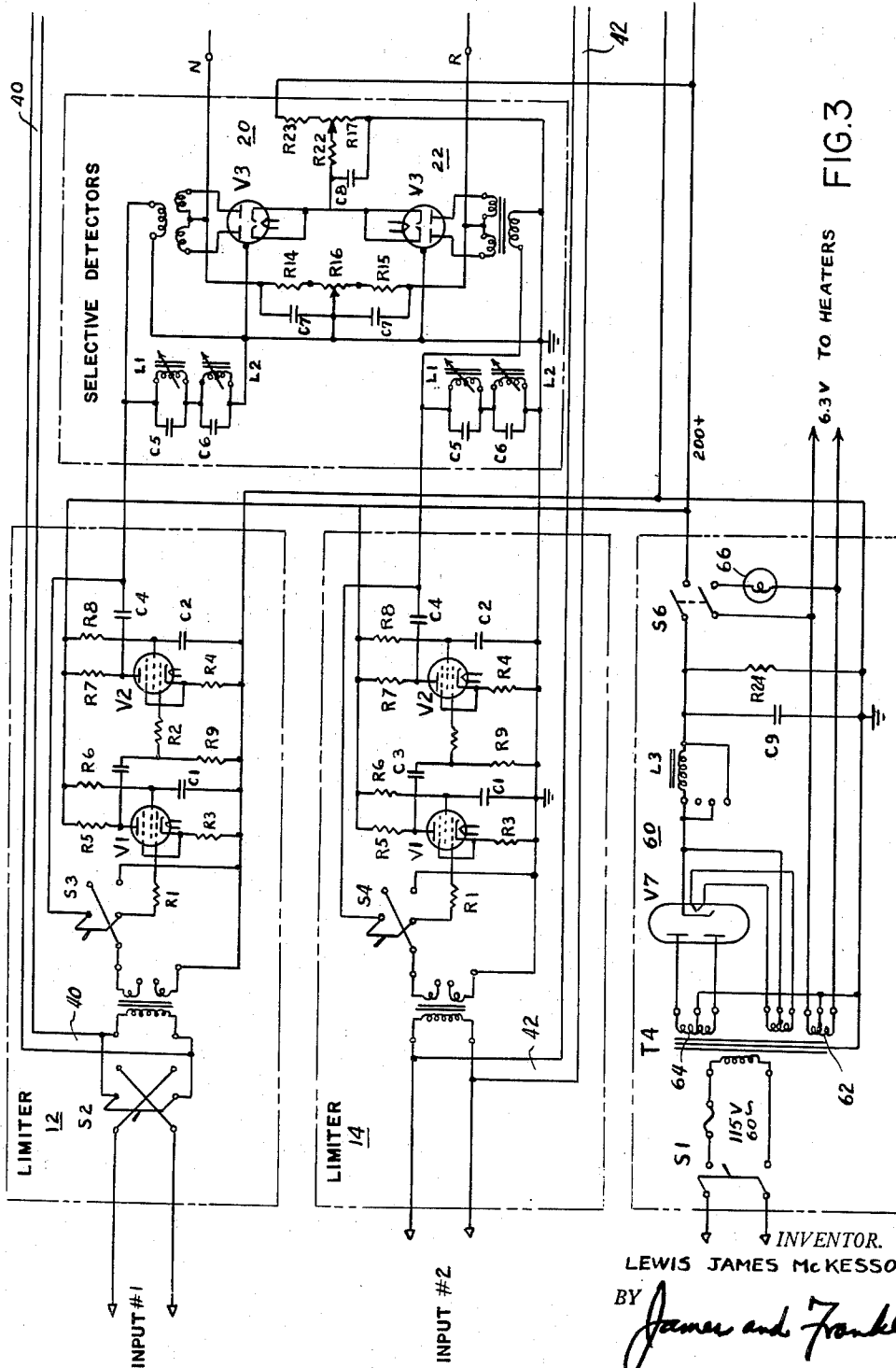


FIG. 3

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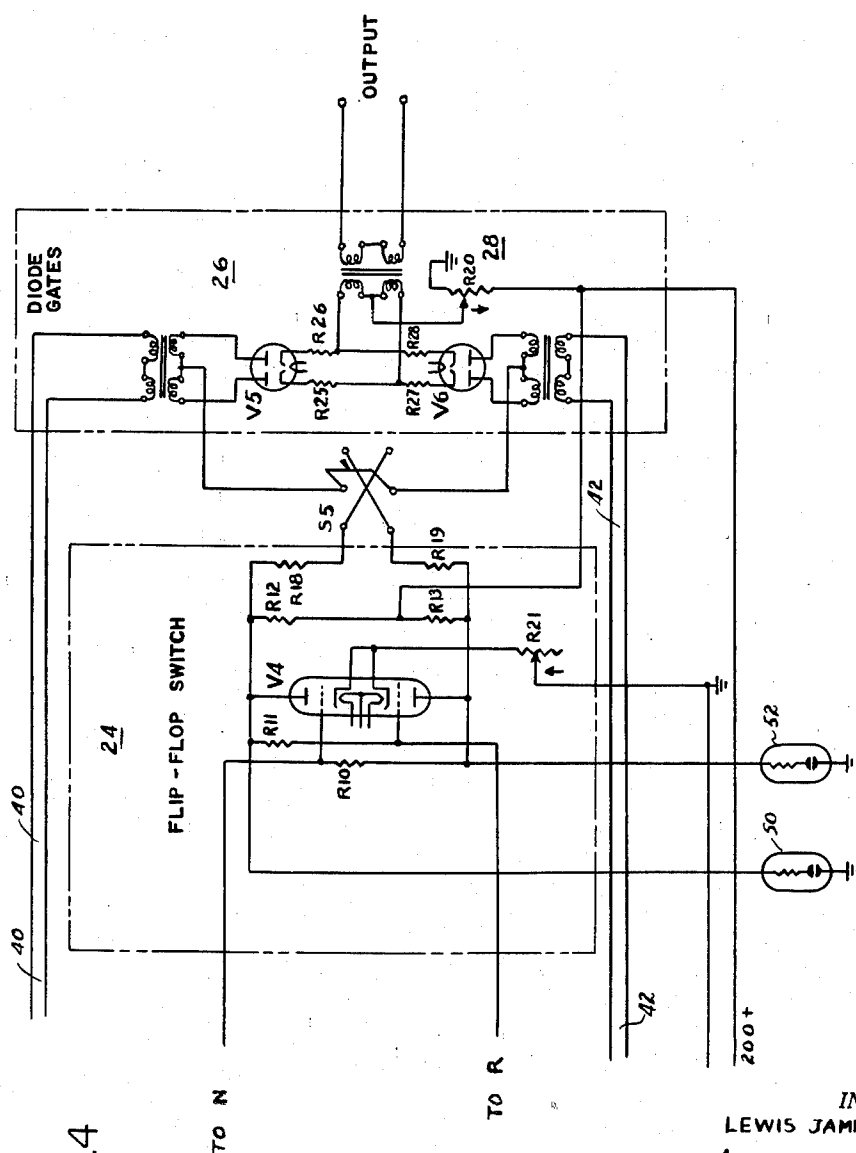


FIG. 4

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18 Claims. (Cl. 250—20)

This invention relates to signalling, especially by voice, and more particularly to improving the degree of intelligence conveyed thereby.

One object of this invention is to improve the percentage of intelligence of a voice radio signal which has been degraded by extraneous causes. Such causes include static interference; intentional interference or jamming; non-intentional interference; fading; and multipath distortion.

A more specific object is to provide a method of selecting the better of two or more voice signals, and delivering this better signal to an output circuit where its intelligence is used. One source of the signals can be two or more receivers operating in conjunction with space or frequency diversity. Another source can be the sidebands of an amplitude or phase modulated signal in which the sidebands have been separated by suitable filters. Other sources may be used for multiple signals from which it is desired to select the one with the greater percentage of usable intelligence.

The type of intelligence transmitted is voice or audio signals. The specific embodiment shown was constructed for use at audio frequencies having a spectrum or range of approximately 30 to 10,000 cycles per second.

Study of amplitude modulated signals shows that because of the different frequency spectrums occupied by the two sidebands, deleterious effects such as jamming, interference, noise and fading do not always affect both sidebands equally. An object of the invention is to provide equipment to select the better sideband, whereby an overall improvement is obtained.

In order for an equipment to decide which is the better sideband, it must be able to recognize the difference between the two. This difference may be on the basis of strength, or it may be on the basis of signal to noise ratio. Ideally, such a device used for a speech signal would always select that one which has the more intelligence, i.e., which is the more understandable; however, an electronic "brain" to satisfy this requirement is beyond practical limits at present.

In accordance with a feature and object of the present invention, the selection is controlled by gates, which are controlled by a flip-flop switch, which in turn are controlled by selective detectors. These are each essentially a filter followed by a rectifier, and the filter provides a flat top or band pass selection of the maximum energy portion of the complete audio spectrum. Thus although the audio spectrum may be from 30 to 10,000 cycles per second, the maximum energy usually is concentrated in a limited range of say 300 to 600 cycles per second. By basing the selection on this maximum energy component, the effect of random noise all over the spectrum is minimized, and maximum intelligence is obtained at the output.

A specific object is to build an electronic device which will operate on either amplitude ratios, or on signal to noise ratios. Such a device can be used to deliver any one of four types of output as follows:

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- (1) The stronger of two signals, or
- (2) The weaker of two signals, or
- (3) The signal with less noise, or
- (4) The signal with more noise.

5 For this purpose I provide limiters ahead of the selective detectors, with means to disable the same at will, and I also provide a phase reversing means between the flip-flop switch and the gates controlled thereby.

10 While this device perhaps is most useful in selecting one sideband of a double sideband amplitude modulated or phase modulated signal, it also may be used to select between the outputs of two space diversity or frequency diversity receivers, or the better output as between an amplitude modulation receiver and a phase modulation receiver. The selection on the latter basis (amplitude modulation versus phase modulation) gives considerable improvement on high frequency signals. Observations indicate that because of selective fading of the two sidebands, phase rotations are such that when an amplitude modulation detector gives maximum undistorted output, a phase modulation detector will usually give a minimum, and vice versa. In other words, amplitude modulation and phase modulation at the input of the receiver tend to be 180° out of phase, so that one is almost always better than the other.

20 To accomplish the foregoing general objects, and other more specific objects which will hereinafter appear, my invention resides in the signal selector apparatus and the elements thereof, and their relation one to another, as are hereinafter more particularly described in the following specification. The specification is accompanied by drawings, in which

Fig. 1 is a block diagram showing one form of the invention;

35 Fig. 2 is a graph explanatory of the invention;

Fig. 3 is a detailed wiring diagram corresponding to the blocks 12, 14, 20 and 22 in Fig. 1; and

Fig. 4 is a detailed wiring diagram corresponding to the blocks 24, 26 and 28 in Fig. 1.

40 Referring to Fig. 1, the two signal inputs may be supplied at terminals 30 and 32. The selected signal is delivered at the output terminal 34. The input signals ordinarily are obtained from a diversity receiver (or receivers) indicated by block 42. If the reception is by space diversity, there will be separate and widely spaced antennas 44 and 46, leading to separate receivers, symbolized in block 42 by the dotted partition line 48. If the reception is single side band diversity, it is customary to think of the receiver as a single receiver, but it has two separate outputs, one for one side band, and one for the other side band, with only one antenna system required. Generally similar remark applies to reception by frequency diversity, or by amplitude modulation—phase modulation (AM/PM) diversity. The reception also may be by amplitude modulation—frequency modulation (AM/FM) diversity. In any case, the block 42 represents any suitable receiver apparatus to deliver the desired two separate outputs, one or the other of which is to be selected by the present apparatus.

50 The apparatus comprises optionally usable limiters 12 and 14, followed by selective detectors 20 and 22, which control a means 24, 26, 28 to select the desired signal in response to a control potential obtained from the selective detectors. As here illustrated I employ a flip-flop switch 24, which in turn controls diode gates 26 and 28. One gate is closed when the other is open, and vice versa, thus feeding one only of the two inputs at 30 and 32 to the output terminal 34.

70 The selective detectors are essentially narrow band-pass filters followed by rectifiers, preferably double diodes providing a D.C. output. The filters provide a substantially flat top resonance curve for selecting a desired nar-

row part of the broad audio frequency spectrum. I believe a range of 440 to 600 cycles per second is the maximum energy part of the usual voice wave.

I shall first describe the selection of either the stronger or weaker of two signals. Referring to the block diagram, Fig. 1, this is accomplished by shorting out the two input limiters, 12 and 14, which is done by closing the switches 16 and 18, and adjusting the input voltages for proper operation. For voice operation, the selective detectors 20 and 22 are tuned preferably to a band pass range of 440/600 cycles per second, as above indicated. The output from the rectifiers in the selective detectors 20 and 22 is used to flip the flip-flop circuit 24, which in turn operates the two gates 26 and 28.

To operate the switching apparatus in a manner based on signal to noise ratios, the limiters 12 and 14 are required. The switches 16, 18 therefore are opened. The limiters will then be applying their limiting process to the combination of the audio signal and the noise. Under such circumstances, I have found that, when a portion only of the bandwidth is selected at the output of the limiter, the detected amplitude of this selected portion decreases as the signal-to-noise ratio decreases. Accordingly, the output of the selective detectors becomes proportional to signal-to-noise ratio. As a result, the potential obtained from the output of the selective detectors may be used to control signal selection in accordance with signal-to-noise ratio.

The curve 38 in Fig. 2 shows a typical measurement of the reduction in D.C. output as the signal to noise ratio is reduced. It will be noted that the output does not go down to zero in the absence of signal. This is so because of the finite bandwidth of the selective detectors. As the bandwidth of the selective detectors is increased, the slope of the output curve 38 changes. The output can be made zero by applying a threshold bias on the rectifiers in the selective detector, so that the effect of infinitely sharp (Q) tuned circuits is simulated.

Normally, this threshold bias is so adjusted that random noise produces no output. Then, theoretically, any signal will produce an output. However, in practice, signals less than 20 db below the noise level are not sufficient to give usable differentials for the switching operation. The actual setting of the threshold and the differential voltage necessary to shift from one channel to the other is dependent on the type of signal and noise. It seems that one setting is not suitable for all operating conditions.

The circuit shown in block form in Fig. 1 is shown in greater detail in Figs. 3 and 4. The upper input #1 (Fig. 3) goes to gate 26 (Fig. 4) by means of conductors 40. The lower input #2 (Fig. 3) goes to gate 28 (Fig. 4) by means of conductors 42. The gates control which input is fed to the output (Fig. 4). The two conductors 40 and the two conductors 42 are each preferably shielded by means of grounded shielding, throughout their length.

The wiring in blocks 12 and 14 is substantially identical, and these units contain the limiters. For strongest/weakest signal operation they are not in use, and are disabled by switches S3 and S4, which correspond in function to the switches 16 and 18 in Fig. 1. Another switch S2 at the upper limiter is used to reverse the phase of one signal with respect to the other. It is closed in such direction that the output does not go through a sudden phase reversal when shifting from one channel to the other, as is discussed later under "Operation." The limiting action of the limiters may be controlled, as by varying the potentials applied to the tubes to obtain saturation at a desired level.

In the particular circuitry here shown the tubes V1 and V2 are type 6AU6; the resistors R1 and R2 are 470K ohms; the resistors R3 and R4 are 220 ohms; the resistors R5, R6, R7 and R8 are all 100K ohms; and the resistor R9 is 1 megohm. The capacitors C1 and C2 are 0.05 mf.; the capacitors C3 and C4 are 0.002 mf. The plate

potential is 200 volts at 6 milliamperes. The transformers are United Transformer Company UTC/LS-26.

The component values in lower block 14 for channel #2 are the same as those in upper block 12 for channel #1. It will be understood that the quantitative values given here, and later on for the other blocks, are solely by way of example, and not intended to be in limitation of the invention.

The next block contains the selective detectors 20 and 22, with a threshold control R17. The matter of adjustment of the threshold bias has been discussed above. A balance control R16 is used to set the output voltages of each channel, and to compensate for unsymmetrical circuitry or balance of the inputs. The band pass filters comprise two resonant circuits preferably tuned to the ends of the desired band. In the present case inductor L1 and capacitor C5 are tuned to 600 cycles, while inductor L2 and capacitor C6 are tuned to 440 cycles. This results in a flattened top for a range of 440 to 600 cycles.

The selective detectors use full wave rectifier tubes V3. In the particular case here shown, the tube V3 is a type 6AL5; the resistors R14 and R15 are 100K; the potentiometer R16 is 50K; the potentiometer R17 has a resistance of 25K ohms; the resistor R22 is 1 megohm; the resistor R23 is 56K; the capacitors C5 and C6 are each 0.05 mf.; the capacitor C7 is 0.03 mf.; the capacitor C8 is 0.01 mf.; and the inductors L1 and L2 are variable tuners made by United Transformer Company as type V1-C13. The potential supplied to potentiometer R17 is 200 volts at 8 milliamperes at resistor R23.

The components in the lower channel #2 (corresponding to block 22 in Fig. 1) have the same values as here given for the upper channel #1 or detector 20.

Referring now to Fig. 4, this contains the flip-flop switch in block 24, and the diode gates in blocks 26, 28. Referring to block 24, the flip-flop tube V4 is a dual triode. The circuit network around the tube may be conventional for this purpose. It applies a positive potential to the plate of one diode gate, and a negative potential to the other. The combination is an inertialess electronic relay with instantaneous changeover. Resistor R21 is the flip-flop cathode resistor, and its setting determines the sensitivity of the flip-flop action, and the differential in input voltages necessary to switch. For signal/noise ratios in the range of zero decibels, this switching can occur on less than one decibel difference.

In the particular flip-flop circuit here shown, the tube V4 is a type 12AT7; the resistors R10 and R11 are 470K, the resistors R12 and R13 are 47K ohms at 2 watts; the resistors R18 and R19 are 33K; and the variable resistor R21 is 5K. The plate potential is supplied at 200 volts.

The apparatus may include the two neon indicator lamps 50 and 52 connected to the switching tube plates. With switch S5 in the normal position, the lighted lamp indicates which channel is furnishing output. With switch S5 in the reverse position, the dark indicator lamp indicates the channel which is in use. The lamps shown are neon lamps, with suitable series resistance.

Switch S5 reverses the action of the circuit, so that one may select either the stronger or weaker signal, when working on a signal strength basis, or one may select the signal with either the greater or lesser noise, when working on a signal to noise ratio basis.

The circuitry of the diode gates is shown in box 26, 28. The potentiometer R20 so adjusts the bias on the cathodes of the double diode gates that the one passing the signal will not distort because of cut-off during part of the cycle. Either gate tube V5 alone or gate tube V6 alone is given positive plate potential by the flip-flop circuit, in order to make one gate tube conductive, while the other gate tube is made non-conductive by negative potential on its plates.

In the specific circuit shown, the tube V5 is a type 6AL5; the three transformers are Kenyon type T26; the

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potentiometer R20 is 25K ohms; the potential supplied to this potentiometer is 200 volts; and the resistors R25 and R26 are 560 ohms. The tube V6 and its surrounding components for channel #2 are the same as those for channel #1.

The power supply is shown in block 60 in Fig. 3. It may be conventional, using a transformer T4 with a low voltage secondary 62 to heat the cathodes of the tubes, and a high voltage secondary 64, rectifier V7 and filter L3, C9, R24 to supply "B" potential for plate supply. This is at 200 volts in the particular case shown, at 33 milliamperes. The filament potential is at 6.3 volts.

In the particular case here shown the transformer is a UTC (United Transformer Company) number HP-123; the tube V7 is a type 6X4; the inductor L3 is a UTC/LS-90; the capacitor C9 is 30 mf.; the resistor R24 is 10K at 10 w.; and the lamp 66 is a pilot lamp or indicator.

It may be mentioned that the previously suggested audio frequency range of 440 to 600 cycles is not critical, and that a range of say 300 to 500 cycles might be used, or 300 to 600 cycles.

Operation

After setting up and applying power, the selective detector tuning should be checked, as by connecting an audio oscillator to one input, and a vacuum tube voltmeter from "N" on the chassis (Fig. 3) behind unit 20 (selective detector) to ground. Adjust the audio oscillator to 440 cycles per second and tune L2 for maximum voltmeter readings. Repeat, using 600 cycles per second from the audio oscillator, but this time tuning L1.

Selective detector 22 is then tuned in the same manner, with the indicator on terminal "R" (Fig. 3).

The operation of each of the limiters 12 and 14 can be checked by reducing the input from 0 dbm to -40 dbm, during which the selective detector outputs should remain essentially constant. The switches S3 and S4 are closed to the left in Fig. 3.

Next parallel the two inputs and apply 600 cycles per second. Set the balance control R16 to center position. Set R17 to about mid position. Adjust R21 until the switcher or flip-flop circuit operates, as indicated by one or the other of the indicator lamps 50, 52 just going out. With S5 in the normal position for signal-to-noise ratio operation, next adjust R20 until minimum distortion is present in the output, as indicated by an oscilloscope. The adjustment of R20 may spoil the flip-flop action of the tube V4, that is, R21 may require readjustment, which should be done.

After making the rough adjustments above, fine adjustments are made until the flip-flop switching can be accomplished by very slight adjustments of R16 to either side of the mid-position.

Using a mixer amplifier, white noise, that is, of many varied frequencies, should next be added to whichever channel is then switched to the output, and the noise level raised until the flip-flop circuit operates to connect the side without noise, to the output. This noise level should be about 15 db below the signal. Transferring the noise to the other channel should reverse the action.

The proper setting of the phase switch S2 can be determined by applying a pure tone (the same tone) to each input and switching back and forth by moving R16 slightly. When the switch S2 is in the wrong position a click will be heard or seen in an oscilloscope. In the right position the click cannot be detected.

To operate on the basis of stronger/weaker signal, one should throw switches S3, S4 and S5 to opposite position, and reduce R17 to zero. (Switches S3 and S4 are closed to the right in Fig. 3. Under these conditions the unit will select the weaker signal, i.e., the signal which has the least energy in the pass band of the selective detector. Some readjustments of R16, R21 and R20 will probably be necessary for optimum operation.

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The dark indicator lamp will indicate the channel switched in.

In either mode of operation care should be taken to keep the input voltages low enough to prevent distortion which otherwise will occur in the diode gates.

The apparatus may then be tested on a radio signal, such as the upper and lower sidebands fed through a sideband adapter, or two space diversity receiver outputs, or an amplitude modulation and a phase modulation output from a Crosby sideband adapter unit, say Type 51. The best mode of operation is dependent on the character of the signal and noise. If the jammer is a discrete carrier staying on one sideband, or wobbling back and forth (even as fast as at audio rates), the switcher will follow, and furnish the best signal. For random noise the operation is less positive.

The operation of the flip-flop and gate control may be explained with reference to Figs. 3 and 4, which may be placed end to end to form the complete diagram. The upper selective detector V3 (corresponding to box 20 in Fig. 1) rectifies the output of the selective filter C5, L1, C6, L2, disposed in the output of the limiter 12. The same applies to the lower half of tube V3 (which corresponds to box 22 in Fig. 1). The output of the upper half of V3 appears on the wire N, and the output of the lower half of V3 appears on the wire R. These two outputs are fed to the grids of the flip-flop tube V4.

If there is a stronger potential on the wire N this causes the upper diode of tube V4 to draw current, and to pass potential through the switch S5, to either the tube V5 or the tube V6 depending on which way the switch S5 has been closed. Tubes V5 and V6 are the diode gates.

If the said potential goes to tube V5, it causes its diode to become conducting and to pass output from the upper pair of wires 40 to the final output terminals, this being done through the transformers and the resistors R25 and R26. On the other hand, if potential goes to the gate tube V6 then the opposite occurs, and output is passed from the lower pair of wires 42 through the transformers and the resistors R27, R28 to the final output terminals. The flip-flop tube V4 acts as an electronic switch which is conductive on one side and completely cut off on the other side, and therefore only one output or the other reaches the final output terminals.

For a signal within the pass band, this unit will select either the signal with the least noise, or the weaker of the two signals. On a signal-to-noise ratio basis, it will operate and select on a noise differential of less than 3 decibels when the noise varies from 15 db below the signal to 10 db above the signal. On amplitude ratios it will select the weaker signal on a differential of less than 2 decibels from about -30 db to 0 dbm (dbm meaning db above one milliwatt across 600 ohms).

When the selection is on the basis of signal strength it is usual to select the stronger signal. However, mention has been made above the rather unusual feature that the apparatus can equally well select the weaker signal, and there are occasions when it may be advantageous to do so. For example, in case the interference is intentional jamming, it sometimes happens that the jamming is more effective against the stronger signal, and less effective against the weaker signal, so that a greater degree of intelligence may be obtained when selecting the weaker signal instead of the stronger signal.

The distortion introduced by the present apparatus is less than 5% on either mode of operation, for a maximum output of 0 dbm.

The above performance is for normal line voltages and frequencies. Tube selection as between one or another of the same type is not required. However, one tube, V4 (the 12AT7), is critical as to balance, and if the two triodes in tube V4 do not age equally, a tube change will be necessary in its socket.

It is believed that the construction and operation of apparatus embodying my invention, as well as the ad-

vantages thereof, will be apparent from the foregoing detailed description. I have discovered that by tuning a selective detector to the maximum energy part of the voice range, I can obtain a selection action which is controlled by the voice wave itself.

It will be understood that while I have shown and described my invention in a preferred form, changes may be made in the circuitry disclosed, without departing from the scope of the invention, as sought to be defined in the following claims.

I claim:

1. Apparatus for selecting from two audio frequency signals, the signal having the greater or lesser signal-to-noise ratio, said apparatus comprising a diversity receiver to provide the signals, limiters receiving the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a limited portion which is the maximum energy portion of the complete audio spectrum, and means connected to said selective detectors for selecting the desired signal in response to a control potential obtained from the said selective detectors.

2. Apparatus for selecting from two voice signals, the signal having the greater or lesser signal-to-noise ratio, said apparatus comprising a diversity receiver to provide the signals, limiters receiving the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum energy portion of the complete audio spectrum, within, say, 300 to 600 cycles per second, means connected to said selective detectors for selecting the desired signal in response to a control potential obtained from the said selective detectors, and a phase reversing switch included in said means whereby the latter may select the signal with more noise or the signal with less noise.

3. Apparatus for selecting from two audio frequency signals, the signal having the greater or lesser signal-to-noise ratio, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to said gates to make either gate conductive and the other non-conductive, limiters receiving portions of the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum energy portion of the complete audio spectrum, and the outputs of the detectors being connected to the flip-flop switch to control the gates.

4. Apparatus for selecting from two audio frequency signals, the signal having the greater or lesser signal-to-noise ratio, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to said gates to make either gate conductive and the other non-conductive, limiters receiving portions of the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum energy portion of the complete audio spectrum, the outputs of the detectors being connected to the flip-flop switch to control the gates, and a phase reversing switch between the flip-flop switch and the diode gates, whereby the latter may select the signal with more noise or the signal with less noise.

5. Apparatus for selecting from two voice signals the signal having the greater or lesser signal-to-noise ratio, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to said gates to make either gate conductive and the other non-conductive, limiters receiving portions of the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum-energy portion of the complete audio spectrum within say 300 to 600 cycles per second,

the outputs of the detectors being connected to the flip-flop switch to control the gates.

6. Apparatus for selecting from two voice signals the signal having the greater or lesser signal-to-noise ratio, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to said gates to make either gate conductive and the other non-conductive, limiters receiving portions of the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum-energy portion of the complete audio spectrum within say 300 to 600 cycles per second, the outputs of the detectors being connected to the flip-flop switch to control the gates, and a double-pole, double-throw reversing switch between the flip-flop switch and the diode gates, whereby the latter may select the signal with more noise or the signal with less noise.

7. Apparatus for selecting the stronger or weaker of two audio frequency signals, said apparatus comprising a diversity receiver to provide the signals, selective detectors receiving the signals from the diversity receiver, said selective detectors being tuned to a narrow maximum energy portion of the complete audio spectrum, said portion having a width of only a few hundred cycles per second, and means connected to said selective detectors for selecting the desired signal in response to a control potential obtained from the selective detectors.

8. Apparatus for selecting the stronger or weaker of two voice signals, said apparatus comprising a diversity receiver to provide the signals, selective detectors receiving the signals from the diversity receiver, said selective detectors being tuned to a maximum energy portion of the complete audio spectrum within, say, 300 to 600 cycles per second, means connected to said selective detectors for selecting the desired signal in response to a control potential obtained from the selective detectors, and a reversing switch included in said means whereby the latter may select either the stronger or weaker signal.

9. Apparatus for selecting the stronger or weaker of two audio frequency signals, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to the gates to make either gate conductive and the other non-conductive, selective detectors receiving a portion of each of the signals from the diversity receiver, said selective detectors being tuned to a maximum energy portion of the complete audio spectrum, said portion having a width of only a few hundred cycles per second, the output of the detectors being connected to the flip-flop switch to control the gates.

10. Apparatus for selecting the stronger or weaker of two audio frequency signals, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to the gates to make either gate conductive and the other non-conductive, selective detectors receiving a portion of each of the signals from the diversity receiver, said selective detectors being tuned to a maximum energy portion of the complete audio spectrum, said portion having a width of only a few hundred cycles per second, the output of the detectors being connected to the flip-flop switch to control the gates, and a reversing switch between the flip-flop switch and the gates, whereby the latter may select either the stronger or the weaker signal.

11. Apparatus for selecting the stronger or weaker of two voice signals, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to the gates to make either gate conductive and the other non-conductive, selective detectors receiving a portion of each of the signals from the di-

versity receiver, said selective detectors being tuned to a maximum-energy portion of the audio spectrum within say 300 to 600 cycles per second, the outputs of the detectors being connected to the flip-flop switch to control the gates.

12. Apparatus for selecting the stronger or weaker of two voice signals, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to the gates to make either gate conductive and the other non-conductive, selective detectors receiving a portion of each of the signals from the diversity receiver, said selective detectors being tuned to a maximum-energy portion of the audio spectrum within say 300 to 600 cycles per second, the outputs of the detectors being connected to the flip-flop switch to control the gates, and a double-pole, double-throw reversing switch between the flip-flop switch and the gates, whereby the latter may select either the stronger or the weaker signal.

13. Apparatus for selecting from two audio frequency signals, the signal having either the greater or lesser signal-to-noise ratio or the stronger or weaker signal, said apparatus comprising a diversity receiver to provide the signals, limiters receiving the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum energy portion of the complete audio spectrum, means connected to said selective detectors for selecting the desired signal in response to a control potential obtained from the selective detectors, and means associated with each of the limiters for disabling the same whereby the selection is changed from one based on signal-to-noise ratio to one based on signal strength.

14. Apparatus for selecting from two voice signals, the signal having either the greater or lesser signal-to-noise ratio or the stronger or weaker signal, said apparatus comprising a diversity receiver to provide the signals, limiters receiving the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum energy portion of the complete audio spectrum within, say, 300 to 600 cycles per second, a first means connected to said selective detectors for selecting the desired signal in response to a control potential obtained from the selective detectors, a second means associated with each of the limiters for disabling the same whereby the selection is changed from one based on signal-to-noise ratio to one based on signal strength, and a reversing switch included in said first means whereby the latter may select the signal with more or less of either noise or strength.

15. Apparatus for selecting from two audio signals the signal having either the greater or lesser signal-to-noise ratio, or the stronger or weaker signal, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to said gates to make either gate conductive and the other non-conductive, limiters receiving portions of the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum-energy portion of the complete audio spectrum, the outputs of the detectors being connected to the flip-flop switch to control the gates, and means associated with each of the limiters for disabling the same whereby the selection is changed from one

based on signal-to-noise ratio to one based on signal strength.

16. Apparatus for selecting from two audio signals the signal having either the greater or lesser signal-to-noise ratio, or the stronger or weaker signal, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to said gates to make either gate conductive and the other non-conductive, limiters receiving portions of the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum-energy portion of the complete audio spectrum, the outputs of the detectors being connected to the flip-flop switch to control the gates, means associated with each of the limiters for disabling the same whereby the selection is changed from one based on signal-to-noise ratio to one based on signal strength, and a reversing switch between the flip-flop switch and the diode gates, whereby the latter may select the signal with more or less of either noise or strength.

17. Apparatus for selecting from two voice signals the signal having either the greater or lesser signal-to-noise ratio, or the stronger or weaker signal, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to said gates to make either gate conductive and the other non-conductive, limiters receiving portions of the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum-energy portion of the complete audio spectrum within say 300 to 600 cycles per second, the outputs of the detectors being connected to the flip-flop switch to control the gates, and means associated with each of the limiters for disabling the same whereby the selection is changed from one based on signal-to-noise ratio to one based on signal strength.

18. Apparatus for selecting from two voice signals the signal having either the greater or lesser signal-to-noise ratio, or the stronger or weaker signal, said apparatus comprising a diversity receiver to provide the signals, diode gates receiving said signals and connected to output terminals, a flip-flop switch connected to said gates to make either gate conductive and the other non-conductive, limiters receiving portions of the signals from the diversity receiver, selective detectors receiving the signals delivered by the limiters, said selective detectors being tuned to a maximum-energy portion of the complete audio spectrum within say 300 to 600 cycles per second, the outputs of the detectors being connected to the flip-flop switch to control the gates, means associated with each of the limiters for disabling the same whereby the selection is changed from one based on signal-to-noise ratio to one based on signal strength, and a double-pole, double-throw reversing switch between the flip-flop switch and the diode gates, whereby the latter may select the signal with more or less of either noise or strength.

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