Feb. 23, 1971 A. E. FLANDERS 3,566,347

PSYCHO-ACOUSTIC PROJECTOR

Filed April 27, 1967 2 Sheets-Sheet 1

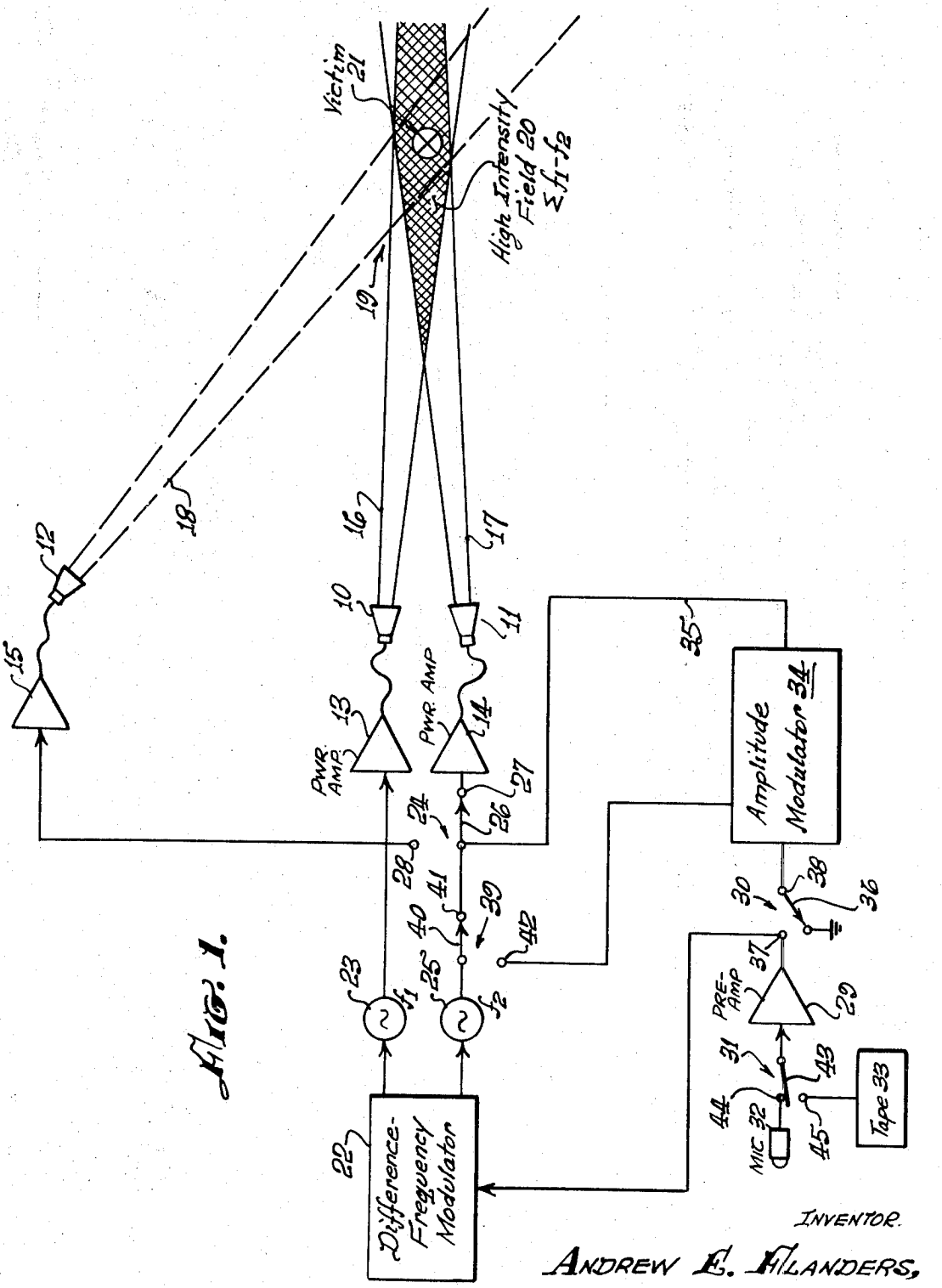


FIG. 1.

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PSYCHO-ACOUSTIC PROJECTOR

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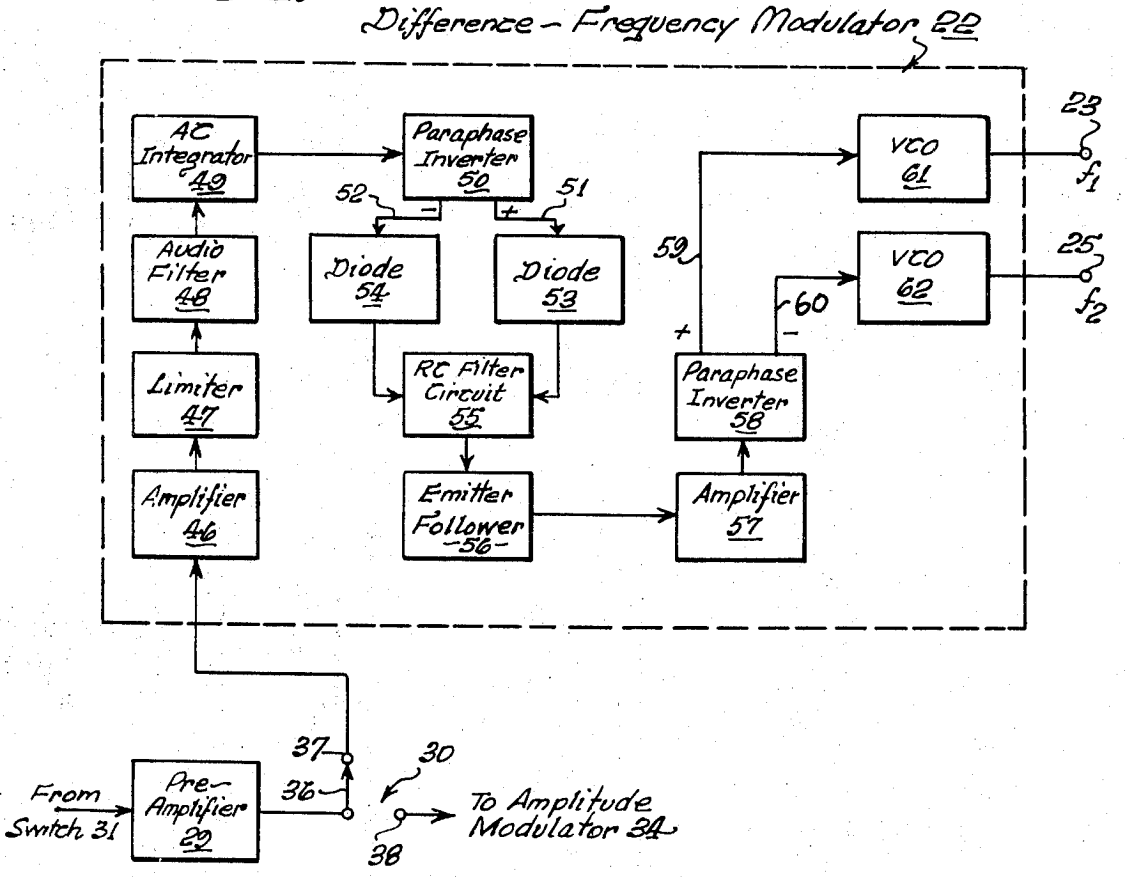
FIG. 2.



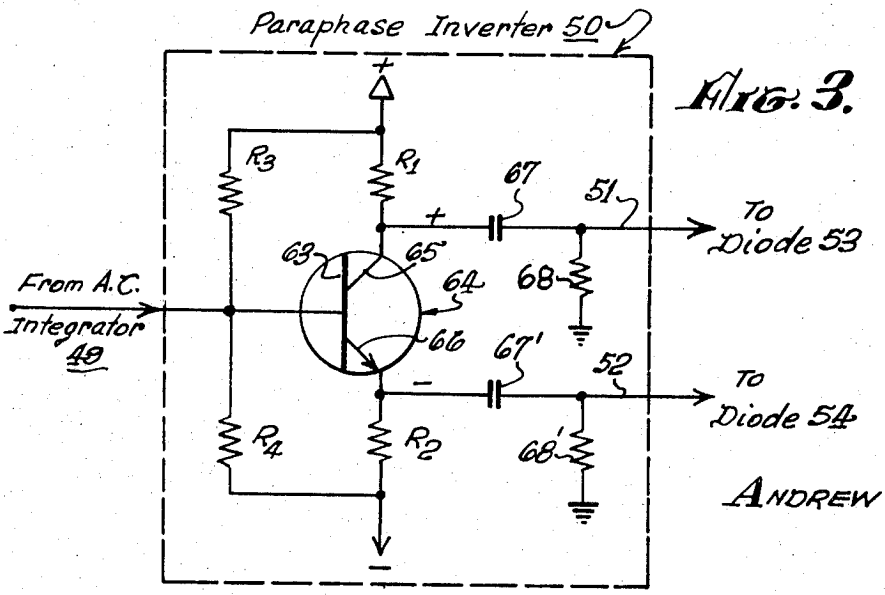




FIG. 3.

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United States Patent Office

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# PSYCHO-ACOUSTIC PROJECTOR

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U.S. Cl. 340—15 7 Claims

## ABSTRACT OF THE DISCLOSURE

Broadly, this disclosure is directed to a system for producing aural psychological disturbances and partial deafness of the enemy during combat situations. Essentially, a high directional beam is radiated from a plurality of distinct transducers and is modulated by a noise, code or speech beat signal. The invention may utilize various forms and may include movable radiators mounted on a vehicle and oriented to converge at a desired point, independently positioned vehicles with a common frequency modulator, or means employed to modulate the acoustical beam with respect to a fixed frequency. During combat, friendly forces would be equipped with a reference generator to provide aural demodulation of the projected signal, thereby yielding an intelligible beat signal while enemy personnel would be rendered partially deaf by the projected signal as well as being unable to perceive any intelligence transmitted in the form of a modulated beat signal.

## BACKGROUND OF THE INVENTION

This invention is directed to means for producing undesirable noise, and more particularly to a means for providing intense aural psychological disturbance and temporary partial deafness as an aid in personal type combat while additionally providing long distance voice communication.

Many prior devices have been developed wherein physically damaging noises are employed to rid a given area of undesirable pests as exemplified by U.S. Pats. 2,922,-999; 3,058,103; and 3,113,304. Other prior efforts have been directed to providing ear filters which are employed to block damaging signals while allowing desired signals to be heard as illustrated by U.S. Pat. 3,098,121, while other prior efforts have been directed to ambient noise reduction systems such as found in U.S. Pats. 3,057,960 and 3,133,990. However, no known prior effort has been directed to the modulation of an undesirable, unwanted or noise signal by a desired intelligible signal nor the use of such a system in a combat environment.

## SUMMARY OF THE INVENTION

The present invention advances the state of the art by providing a means for producing intense aural psychological disturbance and temporary partial deafness as an aid in personal type combat, while being utilized for voice communication by properly equipped friendly personnel.

Therefore, it is an object of this invention to provide a system capable of producing aural psychological disturbance while simultaneously providing voice communication.

A further object of the invention is to provide a means for radiating a highly directional beam from a plurality of distant transducers which is modulated by a noise, discretely coherent tone or beat, code or speech beat signal.

Another object of the invention is to provide intense aural psychological disturbance and temporary partial deafness as an aid in personal type combat.

Another object of the invention is to provide intense aural psychological disturbance to certain individuals



while simultaneously providing effective communication with other individuals (while maintaining radio silence).

Other objects of the invention will become readily apparent from the following description and accompanying drawing wherein:

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a view illustrating an embodiment of a system for carrying out the invention;

FIG. 2 is a block diagram illustrating an embodiment of the circuitry which composes the FIG. 1 difference frequency modulator; and

FIG. 3 is a schematic illustration of an embodiment of the FIG. 2 paraphase inverter.

As illustrated in the drawings, a highly directional acoustic beam is provided by a plurality of moderately high frequency, high power radiators. Each one of the radiators may consist of an array of transducers operating on an acoustical "carrier" frequency in the vicinity, for example, of 5 or 6 kc. The carrier frequency region of operation is selected to provide a maximum of directivity with a minimum of attenuation with distance. One carrier frequency differs from the other by the amount desired to convey the signal of interest. The resulting "beat" or combination frequencies supplied by virtue of ear non-linearity may be irritating noise, code or speech. Amplitude modulation may also be employed as desired.

Referring now to FIG. 1, the illustrated embodiment comprises three (3) high power radiators or speaker units **10**, **11** and **12** operating in the frequency range, for example, of 5 to 6 kc. and with a difference frequency of about 100 c.p.s. Units **10**, **11** and **12** are operatively connected to power amplifiers **13**, **14** and **15**, respectively, and positioned so as to direct acoustic beams **16**, **17** and **18**, respectively, to a single area indicated generally at **19** to provide a high intensity field **20** within which the person or victim indicated at **21** is located. Each of the power amplifiers **13**, **14** and **15** are electrically connected to a difference-frequency modulator **22**, while the input to pre-amplifier **29** is connected via a switch generally indicated at **31** to either of a pair of transducers, such as a microphone **32** or a tape recorder unit **33**. An amplitude modulator **34** is positioned such that it is adapted to be connected intermediate the difference-frequency modulator **22** and the power amplifiers **14** and **15**, and to the pre-amplifier **29**. The output of the amplitude modulator **34** indicated at **35** is operatively connected to switch **24**. Switch **30** is constructed such that the blade **36** thereof is movable to interconnect a terminal **37** connected to difference-frequency modulator **22** and a terminal **38** connected to the amplitude modulator **34**, such that the output of pre-amplifier **29** may be operatively connected to both modulators **22** and **34**. The amplitude modulator **34** may also be connected to the output signal **25** of difference-frequency modulator **22** via a switch generally indicated at **39** which includes a blade element **40** movable between a terminal **41** connected to switch **24** and a terminal **42** connected to the input of modulator **34**. Switch **31** includes a blade **43** which is movable between a terminal **44** connected to microphone **32** and a terminal **45** connected to tape recorder **33**.

While not shown, it is within the scope of this invention to gang the switches **30** and **39** such that the output signal **25** from the difference-frequency modulator **22** and the output from the pre-amplifier **29** may be simultaneously directed into the amplitude modulator **34**. Also, switch **24** may be modified such that the output from either the amplitude modulator **34** and/or the output signal **25** from the difference-frequency modulator **22** may be directed simultaneously to radiators **14** and **15**. While the switches have been illustrated and described

as blade type switches for simplicity of explanation, these switches may also be of push-button, micro-switch or any of the other various electronic switches adaptable for the specific circuits in which they are utilized.

An embodiment of the difference-frequency modulator **22** is illustrated by block diagram in FIG. 2. The output signal from the pre-amplifier **29** is directed via terminal **27** to an amplifier **46** which increases the strength of the signal as known in the art. The amplifier **46** may be any amplification-producing device capable of increasing the strength of the signal by transferring power to the signal from an external source without appreciably altering its characteristic waveform. The output from amplifier **46** is fed into a limiter **47**, which as known in the art, is a circuit that limits the amplitude of its output signal to some predetermined threshold level. The signal from limiter **47** is fed into an audio filter **48** which, as known in the art, functions to transmit a desired range of energy while substantially attenuating all other ranges. The output from filter **48** is then fed through an AC integrator **49** which, in this instance, may be an RC circuit with the capacitor to ground, which supplies a signal inversely proportional to frequency into a paraphase inverter **50**. The paraphase inverter **50** described in detail hereinbelow with respect to FIG. 3, may, for example, be a transistor with equal emitter and collector resistors wherein the gain is 1 and in which the two output signals indicated at **51** and **52** differ in phase by 180°. As seen in FIG. 2, the signal **51** is positive while the signal **52** is negative. The paraphase inverter output signals **51** and **52** are fed, respectively, into diodes **53** and **54** wherein the signals are rectified, as known in the art, and the output from the diodes **53** and **54** are combined in a full-wave RC filter circuit indicated at **55** and the combined signal is fed into an emitter follower **56**. The RC filter circuit **55** may comprise, for example, a resistance to ground in parallel with a bypass capacitor. The emitter follower **56** is a grounded-collector transistor amplifier which functions as known in the art. The output signal from the emitter follower **56** is fed through an amplifier **57** into a paraphase inverter **58** which may, for example, be identical to the previously described paraphase inverter **50** and illustrated in FIG. 3. As in the inverter **50**, the output signals from the paraphase inverter **58** indicated at **59** and **60**, differ in phase by 180° with the signal **59** being positive while the signal **60** is negative. The output signals **59** and **60** are fed, respectively, into voltage-controlled oscillators **61** and **62**. As known in the art, the frequency of oscillation of each of the oscillators **61** and **62** can be varied by changing the applied voltage. By way of example, oscillators **61** and **62** are set such that their output signals **23** and **25**, respectively, have a difference of 100 cycles per second (c.p.s.), and are utilized as described above with respect to FIG. 1.

Referring now to FIG. 3, an embodiment of the paraphase inverter **22** of FIG. 2 is illustrated, the FIG. 3 embodiment also being illustrative of the paraphase inverter **58** of FIG. 2. The output signal from the AC integrator **49** is fed to the base **63** of a transistor generally indicated at **64**. The collector **65** of the transistor **64** is conductively connected through a load resistor $R_1$, to a positive source, while the emitter **66** is conductively connected through a load resistor $R_2$ to a negative source. Resistors $R_3$ and $R_4$ function as bias resistors for the transistor **64** as known in the art. The output **51** is taken intermediate collector **65** and resistor $R_1$ while output **52** is taken intermediate emitter **66** and resistor $R_2$. Each of the output signals **51** and **52** are fed through an RC coupling network composed of blocking capacitors **67** and **67'** and resistors **68** and **68'** connected to ground. As indicated in FIG. 3, the output signals **51** and **52** are then fed into similarly polarized diodes **53** and **54**, respectively, as described above with respect to FIG. 2.



While not shown, appropriate power sources are utilized for the various circuits and components as required.

The invention may be utilized in many different applications. One application may use two movable radiators or speaker units mounted on a single vehicle or aircraft and which are directed so as to converge at the appropriate range. Another application may use two independently positioned vehicles, aircraft, tripods, or combination thereof with a common difference frequency modulator. Another application used for communication purposes would modulate the acoustical beam with respect to a fixed frequency, wherein a small audio generator (not shown) carried by the listener (receiver) would mix aurally via the ear with the projected modulated carrier to provide intelligible messages, the carrier by itself being unintelligible by virtue of high frequency transposition.

As an aid to pointing compensation for beam deflection caused by atmospheric temperature gradients, it is within the scope of this invention to deploy down range microphones or microphone-transmitter combinations.

Friendly personnel in the vicinity of the sound field **20** can use narrow band audio filter ear muffs or plugs, as known in the art, so as to maintain reasonable hearing threshold sensitivity. On the other hand, enemy personnel not similarly equipped for the transmitted pass band would lose about 40 db in hearing sensitivity similar to partial deafness. This would place the enemy at a distinct aural acuity disadvantage during close-in operations.

For speech transmission, the elemental vowel formant frequencies are provided by the carrier difference $f_1-f_2$. The carriers **23** and **25** may be frequency modulated differentially or one remained fixed. The consonant sounds are contained in the amplitude modulation of one or both carriers as described with respect to FIG. 1. The listener needs no fixed frequency sound source in this mode of operation.

It has thus been shown that this invention provides intense aural psychological disturbance and partial deafness as an aid in personal type combat, while being adapted to simultaneously provide voice communication.

While a particular embodiment of the invention has been illustrated and described, modifications and changes will become apparent to those skilled in the art, and it is intended to cover in the appended claims all such modifications and changes as come within the true spirit and scope of the invention.

What I claim is:

**1.** A system for producing an intelligible signal, aural psychological disturbances and partial deafness comprising:

(a) a plurality of radiator means capable of transmitting a highly directional acoustic beam;

(b) a difference-frequency modulator means for generating a pair of carrier signals, each of said carrier signals being of a different frequency;

(c) a separate power amplifier means for amplifying each of said carrier signals, each of said power amplifier means operably connected to said difference-frequency modulator means, each of said plurality of radiator means operably connected with an output from an associated one of said power amplifier means;

(d) each of said plurality of radiator means being positioned so that the acoustic beam transmitted therefrom converges in a common area to produce a high intensity field;

(e) an amplitude modulator operably connected to an input of an associated one of said power amplifier means;

(f) means operatively connected to said difference-frequency modulator means for selectively feeding one of said carrier signals through said amplitude modulator;

(g) audio signal generating means operably connected to said difference-frequency modulator means for feeding an audio signal into said difference-frequency modulator means; and

(h) selective means operatively connected to said amplitude modulator for additionally feeding and audio signal into said amplitude modulator;

whereby the resulting combination of frequencies in the common area of convergence produce both an irritating noise and an intelligible signal within said high intensity field.

2. The system defined in claim 1, wherein said audio signal generating means includes a pre-amplifier operably connected to said difference-frequency modulator means; at least one audio signal transducer; a switch means operatively connected to said at least one audio signal transducer and to said pre-amplifier for feeding an audio signal to said pre-amplifier, the output of said pre-amplifier being fed to said difference-frequency modulator means.

3. The system defined in claim 2, wherein said audio signal transducer is a microphone.

4. The system defined in claim 2, wherein said audio signal transducer is a tape recorder unit.

5. The system defined in claim 1, wherein said plurality of radiator means includes at least three radiator means, each of said three radiator means being fed from an associated power amplifier means, one of said power amplifier means being operatively connected with said difference-frequency modulator means such that one of said carrier signals therefrom is fed to said one power amplifier means, and wherein a switch means is operatively connected to the other two of said power amplifier means and to said difference-frequency modulator means such that the other of said pair of carrier signals therefrom is selectively directed to said other two power amplifier means.

6. The system defined in claim 1, wherein said difference-frequency modulator means comprises: an amplifier means operatively connected to receive the audio signal from said audio signal feeding means, a limiter fed by the output from said amplifier means, an audio filter means operatively connected to receive the output signal from said limiter and feeding the output thereof to



an AC integrator, a paraphase inverter operably connected with said AC integrator and fed by the output signal therefrom, said paraphase inverter functioning to produce a pair of output signals which are fed into a pair of diodes, the output from said diodes being combined in an RC filter circuit and fed to an emitter follower, a second amplifier means operatively connected to said emitter follower so as to receive an output signal therefrom, a second paraphase inverter being fed by the output from said amplifier means and functioning to produce a pair of output signals which are fed into a pair of voltage controlled oscillators, the output thereof constituting said carrier signals.

7. The system defined in claim 6, wherein said paraphase inverters each include a transistor unit having a base, an emitter and a collector, the input to the transistor unit being fed into the base, said collector being connected through a first load resistor means to a positive voltage source, said emitter being connected through a second load resistor means to a negative voltage source, a pair of bias resistor means operatively connected to said base, one of said bias resistor means being also operatively connected intermediate said first load resistor means and said positive voltage source, the other of said bias resistor means being also operatively connected intermediate said second load resistor means and said positive voltage source, a first RC coupling network operatively connected intermediate said collector and said first load resistor means, a second RC coupling network operatively connected intermediate said emitter and said second load resistor means, the output signals from said RC coupling networks constituting said pair of output signals.

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U.S. Cl. X.R.

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