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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

REPLY TO
ATTN OF: GP

TO: USI/Scientific & Technical Information Division
Attention: Miss Winnie M. Morgan

FROM: GP/Office of Assistant General Counsel for Patent Matters

SUBJECT: Announcement of NASA-Owned U. S. Patents in STAR

In accordance with the procedures agreed upon by Code GP and Code USI, the attached NASA-owned U. S. Patent is being forwarded for abstracting and announcement in NASA STAR.

The following information is provided:

U. S. Patent No. : 3,588,359

Government or Corporate Employee : U.S. Government

Supplementary Corporate Source (if applicable) : N/A

NASA Patent Case No. : KSC-10164

NOTE - If this patent covers an invention made by a corporate employee of a NASA Contractor, the following is applicable:

Yes ☐ No ☑

Pursuant to Section 305(a) of the National Aeronautics and Space Act, the name of the Administrator of NASA appears on the first page of the patent; however, the name of the actual inventor (author) appears at the heading of Column No. 1 of the Specification, following the words ". . . with respect to an invention of . . . "

Elizabeth A. Carter

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Enclosure
Copy of Patent cited above

United States Patent

[11] 3,588,359

[72] Inventor **Herbert E. Cribb**
Satellite Beach, Fla.

[21] Appl. No. **782,955**
[22] Filed **Dec. 11, 1968**
[45] Patented **June 28, 1971**

[73] Assignee **The United States of America as represented by the Administrator of the National Aeronautics and Space Administration**

[54] **PROTECTIVE SUIT HAVING AN AUDIO TRANSCEIVER**
1 Claim, 3 Drawing Figs.

[52] **U.S. Cl.** **179/1R,** 179/1VC
[51] **Int. Cl.** **H04r 1/44**
[50] **Field of Search** ..... 179/157.1, 1 (VC), 1 (A), 183, 156, 1 (UW)

[56] **References Cited**

UNITED STATES PATENTS

2,819,340	1/1958	Brody	179/1(VC)
2,951,123	8/1960	DeVito	179/1(VC)
3,174,129	3/1965	Laughlin et al.	179/157X
3,347,229	10/1967	Heitman	179/156X
3,423,531	1/1969	Doddington	179/1(VC)
2,819,340	1/1958	Brody	179/1(.4)
3,003,136	10/1961	Burnett	179/1(UW)
3,337,841	8/1967	Wainwright et al.	179/1(UW)

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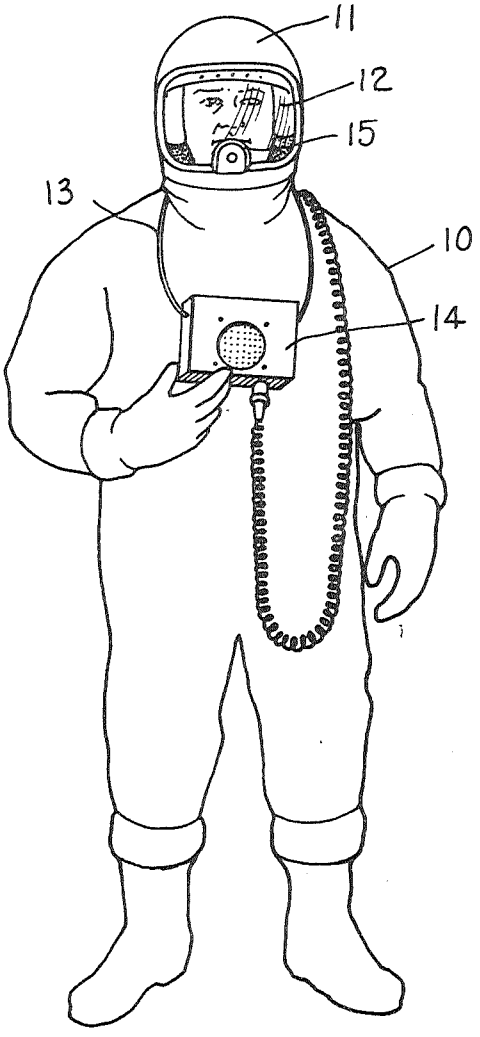
ABSTRACT: A voice-operated receiving and transmitting system for a wearer of a protective suit which can be automatically changed from a receiving condition to a transmitting condition responsive to the wearer's voice. The system is provided with a control for regulating the audio level at which the switching operation takes place.



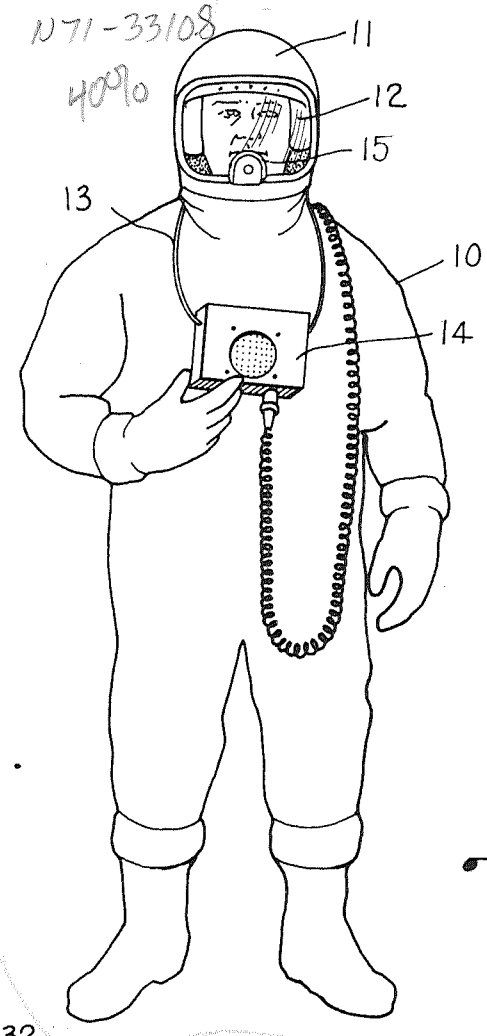


Fig. 1.

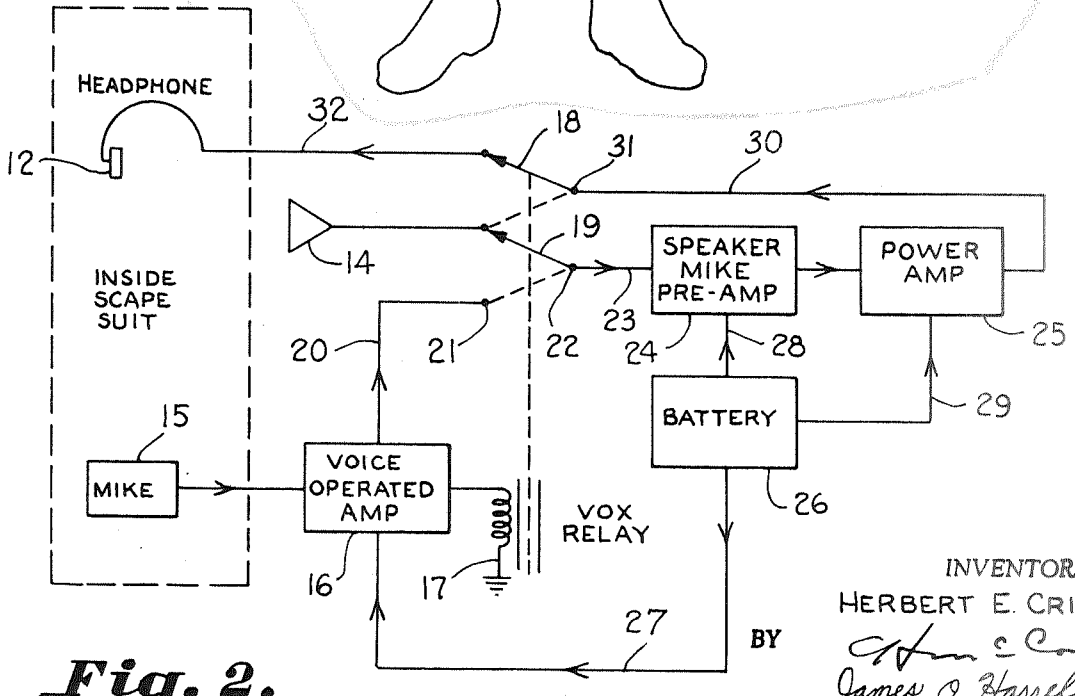


Fig. 2.

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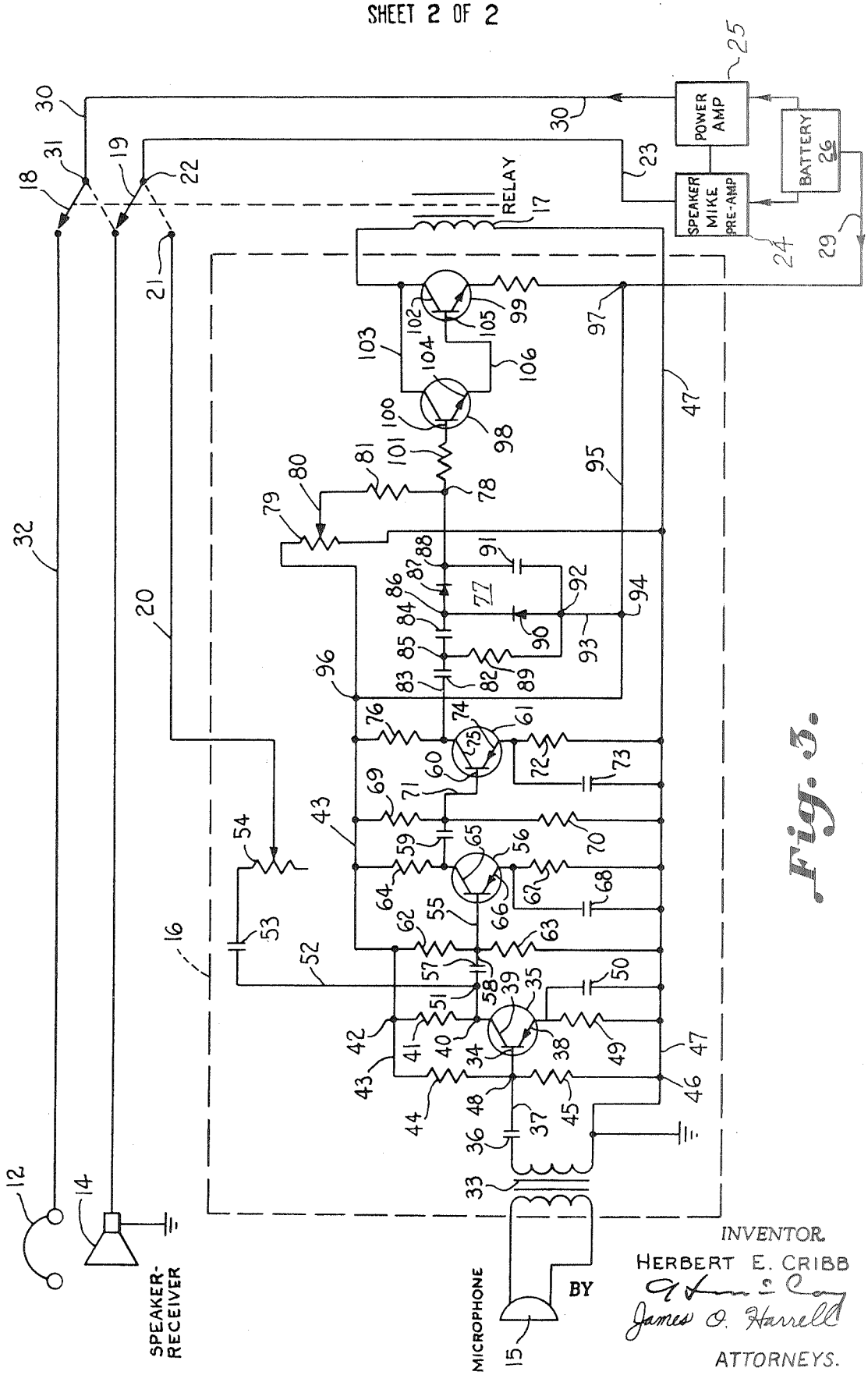

Fig. 3.

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PROTECTIVE SUIT HAVING AN AUDIO TRANSCEIVER

This invention described herein was made by an employee of the United States Government, and may be manufactured and used by or for the Government for Governmental purposes without the payment of any royalties thereon or therefor.

One of the problems encountered in wearing protective suits which completely encompasses the wearer's body is communicating with others without directly connecting a hard-line to the suit. This is particularly true where the suits are provided for resisting highly corrosive substances and temperatures. Such requires suits made of several layers of material, thus restricting voice communication between the wearer of the suit and others. This problem also is encountered by astronauts who wear space suits during launching and space exploration missions.

Some suits, such as disclosed in U.S. Pat. No. 3,003,136 granted to Burnett et al., on Oct. 3, 1961, and U.S. Pat. No. 3,076,174 granted to Wainwright et al., on Jan. 29, 1963, are provided with a system in which the wearer of a suit can receive and transmit normal voice communication. However, one problem is that in order to switch from the transmitting condition to the receiving condition a switch has to be manually operated. This mode is not practical where the wearer is using his hands to perform other functions.

Radio frequency type units have been tried, however, they present a possible hazard around pyrotechnic devices which can be activated by the radio frequency signal. Furthermore, radio frequency signals are only received from a particular mike and would not detect sounds remote from the location of that mike. Moreover, radio frequency signals are often jammed by external sources, such as broadcasts to emergency vehicles, taxis, airports, etc. Problems would also arise where the wearer is working within confined areas, such as in tanks, which act as a shield against the radio frequency signals.

The fact that the wearer of a protective suit cannot communicate with other persons working with him and cannot hear noises in the immediate vicinity frequently has an adverse psychological effect on the wearer. It is desirable to be able to hear all noises in the immediate working vicinity so that the wearer can be alerted to dangers which may be out of his visible spectrum. It is also desirable that when an emergency arises to be able to communicate readily with others in the immediate vicinity without tying up the wearer's hand or being encumbered with a cork or hard-line.

In accordance with the present invention, it has been found that difficulties encountered in the above-mentioned communicating apparatus may be overcome by providing a novel communicating system for wearer's of protective suits. This voice operated receiving and transmitting system for a wearer of protective suits includes the following basic parts: (1) a microphone carried in the suit for transmitting the wearer's voice, (2) a combination speaker and receiver provided for receiving external sounds and transmitting the wearer's voice externally of the suit, (3) a headphone carried adjacent the wearer's ears for broadcasting sounds received by the combination speaker and receiver to the wearer's ears, (4) an amplifier means for amplifying sounds passing through the receiving and transmitting system, (5) switching means for connecting the amplifying means between the microphone and the combination speaker and receiver when in a second position, and (6) a voice-operated actuating means coupled to the output of the microphone for causing a switching means to be switched from the first position to the second position responsive to the wearer speaking into the microphone. Thus, the voice of the wearer of the protective suit automatically switches the receiving and transmitting system from a receiving mode to the transmitting mode.

Accordingly, it is an important object of the present invention to provide a voice-operated receiving and transmitting system for a wearer of a protective suit which automatically enables him to speak and hear normal sounds, such as conversation.

Another important object of the present invention is to provide a receiving and transmitting system which can be regulated to be activated by the human voice and not by low volume noises.

Still another important object of the present invention is to provide a protective suit with a communication system which does not require manual manipulation of switches and is rugged and reliable.

Other objects and advantages of this invention will become more apparent from a reading of the following detailed description and appended claims taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a perspective front view illustrating a protective suit equipped with a receiving and transmitting system constructed in accordance with the present invention,

FIG. 2 is a block diagram illustrating schematically the components of the receiving and transmitting system constructed in accordance with the present invention, and

FIG. 3 is a circuit diagram illustrating in detail certain portions of the receiver and transmitting system.

Referring in more detail to the drawings wherein like reference numerals designate identical or corresponding parts throughout the views, and with special attention to FIG. 1, reference numeral 10 generally designates a protective suit on a wearer having a head portion 11 with a transparent window therein. Headphones 12 are carried inside the head portion 11 for broadcasting to the wearer signals received. Hanging around the wearer's neck by means of a wire 13 is a combination speaker and receiver means 14 which enables the wearer of the protective suit to communicate with others in the near vicinity. The major components of the receiving and transmitting system are shown in the block diagram illustrated in FIG. 2 and include a microphone 15, which is positioned in the face mask of the suit adjacent the user's mouth for transmitting his voice to a voice-operated amplifier 16. When the user desires to speak he speaks into the microphone 15 and the normal level of his voice is sufficient to activate the voice-operated amplifier 16. This causes a relay 17 to be energized to pull the contacts 18 and 19 down to the broken line position shown in FIG. 2 which allows the signal coming from the mike to pass through the voice amplifier 16, line 20, terminal 21, terminal 22, lead 23, to the speaker mike preamplifier 24. This speaker mike preamplifier 24 may be any conventional or suitable speaker mike preamplifier and it, in turn, feeds the amplified signal to a power amplifier 25. The purpose of the speaker mike preamplifier 24 is to amplify the very weak signal produced by the microphone 15 and voice-operated amplifier 16 so that the power amplifier 25 can amplify such further. It is noted that a battery pack 26 is provided for energizing the voice-operated amplifier 16, the speaker mike preamplifier 24, and the power amplifier 25, by means of leads 27, 28 and 29, respectively. The signal coming out of the power amplifier 25 passes through lead 30 to terminal 31 through contact 18, which is now in the lower position, to the combination speaker and receiver 14. The combination speaker and receiver can be any conventional speaker and receiver which is capable of transmitting and receiving audio signals.

When the user stops speaking into the microphone 15 the relay 17 is deenergized and the contacts 18 land 19 returned to the full line or up position illustrated in FIG. 2. In this position the system is in the receive condition, i.e., it will receive any audio signals above a certain predetermined level and such signals will be transmitted to the headphone 12. Thus, when the speaker 14 is in the receiving state the audio signals pass through the speaker 14, contact 19, lead 23, the speaker mike preamplifier 24, the power amplifier 25, lead 30, contact 18, lead 32, and is heard by the user through the headphones 12 located inside of the protective suit. There is a conventional impedance mismatch out of the power amplifier 25 feeding the headphone 12 when the system is in the receive position. This impedance mismatch attenuates the signal to a normal headphone receiving audio level. Such power

mismatch is conventional in many audio devices, or circuits which incorporate a speaker and a headphone.

From the block diagram it can be seen that when the user desires to speak he merely speaks into the microphone 15 and such is transmitted externally of the protective suit by the combination speaker and receiver 14. When he is not talking the system is in the receive position so that he can hear noises above a particular audio level in the immediate vicinity. In one particular device users of the system can communicate at normal voice level at a distance of approximately 50 feet. It is desired that the voice-operated amplifier 16 be biased to a certain level so that such is not activated by noises inside the protective suit, such as the hissing of air rushing into the suit, etc. This is to maintain the system in a receive condition except when the user speaks.

Since the preamplifier 24 and the power amplifier 25 are conventional items, only a detailed description will be given of the voice-operated amplifier 16 and relay 17. The audio signal produced by the user is spoken into the microphone 15 and is fed into an impedance matching transformer 33 which has its secondary winding coupled to the base electrode 34 of a PNP-type transistor 35. The signal is coupled through the coupling capacitor 36 interposed in lead 37. The signal is amplified via current flowing in an emitter electrode 38 and out collector electrode 39 and is fed to junction 40. A voltage dropping resistor 41 is coupled between junction 40 and junction 42 interposed in lead 43. A voltage dividing network which includes resistors 44 and 45 is connected between junction 42 and junction 46 interposed in the grounded lead 47. The base electrode 34 of the transistor 35 is coupled to the junction 48 intermediate the voltage dividing resistors 44 and 45, respectively. The biasing resistor and capacitor network, which includes resistor 49 and capacitor 50, is interposed between the emitter electrode 38 and the ground lead 47.

At junction 51 the amplified signal is divided and a portion of such is fed through lead 52, coupling capacitor 53, potentiometer 54, to lead 20, which is connected to the preamplifier via lead 23 and contact 19 when such is in the down position. The purpose of the potentiometer 54 is to provide a means to control the level which audio signals will activate the preamplifier so that noises inside the suit, such as produced by the air coming into the suit, will not activate the preamplifier.

The signal at junction 51 is also applied to the base electrode 55 of another PNP amplifying transistor 56 through a coupling capacitor 57 interposed in lead 58 connected between the base electrode 55 and the junction 51. The amplifier 56 amplifies the signal and feeds such through a coupling capacitor 59 to the base electrode 60 of still another PNP amplifying transistor 61.

A voltage dividing network including resistors 62 and 63 is connected between common lead 47 and lead 43, and to lead 55. The voltage dropping resistor 64 is connected between the collector electrode 65 of transistor 56 and lead 43. Connected between the emitter electrode 66 and ground lead 47 is a biasing resistor and capacitor network which includes resistor 67 and capacitor 68. Another voltage dividing network which includes resistors 69 and 70 is connected between lead 43 and ground lead 47 and is joined by lead 71 connected to base electrode 60 of transistor 61. A biasing resistor capacitor network which includes resistor 72 and capacitor 73 is interposed between the emitter electrode 74 and the ground lead 47. A collector electrode 75 is connected through a voltage dropping resistor 76 to lead 43.

After the signal leaves the amplifying transistor 61 it is then fed through a rectifying circuit generally designated by reference character 77 which rectifies the signal and feeds such to junction 78. The potentiometer 79 is interposed between lead 43 and ground lead 47, and has its movable contact 80 connected through resistor 81 to junction 78 so that the level of the signal for controlling the energization of relay 17 can be set to a predetermined value. The potentiometer can be adjusted to take into consideration the fact that certain users speak lower than others.

The rectifier network 77 includes a coupling capacitor 82, interposed in lead 83, extending between the collector 75 of transistor 61 and junction 78. Another coupling capacitor 84 is connected between junction 85 and junction 86 in lead 83. A diode 87 is connected between junction 86 and a junction 88 with the anode being adjacent junction 86. Parallel circuits which include resistor 89, diode 90, and capacitor 91, respectively, are connected between junction 92 and junctions 85, 86 and 88, respectively. The anode of the diode 90 is adjacent junction 92. Junction 92 is connected by means of lead 93 to junction 94 which is interposed in lead 95 which is coupled between junctions 96 and 97. Junction 97 is, in turn, connected to lead 29 coming from the battery 26 for providing a biasing voltage for the transistors 98 and 99. The NPN transistors 98 and 99 are coupled together to amplify the current so that such will be sufficient to activate the relay 17 when the user speaks into the microphone 15. The signal coming into the base electrode 100 of transistor 98 via resistor 101 is amplified by the substantially parallel arrangement of the current amplifying transistors 98 and 99 and is fed out the collector 102 of transistor 99 through the relay coil 17 to the grounded lead 47. As the current flows through the relay coil 17 it energizes the relay pulling down the contacts 18 and 19 to the dotted line position. In this position the voice of the user passes through the speaker mike preamplifier, the power amplifier to the speaker receiver 14 externally of the suit.

Transistors 98 and 99 are NPN transistors and the collector of transistor 98 is coupled to the collector of transistor 99 by lead 103. The emitter 104 of transistor 98 is coupled to the base electrode 105 of transistor 99 by lead 106.

When the user of the suit stops speaking the relay 17 is deenergized allowing the contacts to move back to the full line position so that external sounds can be picked up by the speaker-receiver 14 and heard by the user by means of the headset 12. It is noted that when the user is speaking through the microphone 15 the relay 17 disengages the headset from the circuit via moving the contacts 18 and 19 to the broken line position.

In summarizing the operation, it can be seen that the user of the suit can communicate readily with others in the immediate vicinity by merely speaking into the microphone 15 carried on the face mask of his head gear. As soon as he stops speaking the system returns to a receiving condition wherein he can hear through the headset 12 sounds in the immediate vicinity. The system is provided with means for adjusting the level at which the switching relay 17 is energized.

While a preferred embodiment of the invention has been described using specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

I claim:

1. A protective suit in which a wearer is completely encompassed and thereby normally unable to hear and speak externally of said suit comprising, in combination:

A. a microphone carried inside said suit for transmitting the wearer's voice;

B. a combination speaker and receiver means located outside of said suit for both receiving external sounds and transmitting the wearer's voice externally of said suit;

C. a headphone carried inside said suit adjacent the wearer's ears for transmitting sounds received by said combination speaker and receiver means to the wearer's ears;

D. amplifier means for amplifying sounds passing through said combination speaker and receiver means;

E. switching means for connecting said amplifying means between headphone and said combination speaker and receiver means when in a first position and for connecting said amplifying means between said microphone and said combination speaker and receiver means when in a second position;

F. said switching means normally being in said first position for said combination speaker and receiver means to receive sounds externally of said suit;

G. a voice-operated amplifier coupled to the output of said microphone for receiving and amplifying voice signals from said microphone;

H. a relay means coupled to said voice-operated amplifier for automatically switching said switching means from said first normal position to said second position; and

I. control means coupled to said voice-operated amplifier for setting the noise level at which said relay means is actuated to switch said switching means from said first normal position to said second position.