A diver-carried underwater communication system employs a visual read-out of transmitted and received messages. The individual message elements are selected by a keyboard control device and are stored in a memory register prior to transmission. Received signals are similarly stored in a memory register for selective display by the diver-operator. Additionally, provision is made for a read-only memory containing frequently used message elements.
FIG. 1

FIG. 2

Diagram showing a submarine and a diver with a bag. The submarine is connected to a network of cables and a floating device. The diver holds a bag, and the scene suggests a communication setup involving a display, message to be transmitted memory, last message receiver memory register, narrow-band transmitter, narrow-band receiver, key board, and read-only memory (prerecorded messages).
UNDERWATER TELETYPE COMMUNICATION SYSTEM

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

FIELD OF THE INVENTION

This invention pertains to the field of communications. More particularly, this invention pertains to underwater communications. In still greater particularity, this invention pertains to a swimmer-carried communication system employing visual read-out of transmitted and received messages. By way of further characterization, but without limitation thereto, this invention pertains to a swimmer-carried transmitter and receiver for transmission of printed message units.

DESCRIPTION OF THE PRIOR ART

Known diver communications systems generally employ underwater electro-acoustic transducers to convert divers voice signals to compressional wave signals having a optimum frequency for underwater transmission. These systems suffer from problems or reverberation, speech distorting ambient noise, and distorted speech caused by extra-terrestrial breathing gas mixtures. U.S. Pat. Nos. 3,076,174 to W. N. Wainwright et al. for “Method and Apparatus to Enable Swimmers to Converse Underwater” issued on Jan. 29, 1963 and 3,621,150 issued to George W. Pappas for “Speech Processor for Changing Voice Pitch” issued on Nov. 16, 1971 are exemplary of this type of system.

Another disadvantage of these type of systems is that personnel on the surface wishing to communicate with the diver are often unaware of the divers activities and choose inopportune times to attempt communication. In these circumstances, the divers attention is diverted from essential and sometimes critical activities to the mundane matters of communication.

SUMMARY OF THE INVENTION

The system of the invention overcomes the aforesaid problem areas of the prior art by providing a visual message which appears as a printed word or phrase on a diver-carried display. Thus, the diver, otherwise occupied, may refer to the communication at a time which is more appropriate to his activities. Further, since such systems may operate on a time coding arrangement it may be transmitted over a narrow band of frequencies. The advantages offered by such narrow band transmission is a high degree of freedom from ambient noise and reverberation caused distortions. The system of the invention employs a memory register containing a variety of prerecorded standard messages as well as a keyboard to permit the diver to have a freedom of expression not constrained by the prerecorded messages. An additional useful feature of the invention is a memory register which receives and displays a message transmitted to the diver which may be selectively recalled from said memory by the diver at a time which is more opportune to his activities.

STATEMENT OF THE OBJECTS OF THE INVENTION

It is accordingly an object of this invention to provide an improved underwater communication system.

Another object of this invention is to provide an underwater communication system employing visual read-out capabilities.

A further object of this invention is to provide a swimmer-carried underwater communication system.

Another object of this invention is to provide a swimmer-carried underwater communication system which has storage capabilities for received and transmitted messages.

Yet another object of the present invention is to provide a swimmer-carried underwater communication system having high reliability and low message distortion.

Still another object of the present invention is to provide a swimmer-carried underwater communication system which may be used by personnel having a language barrier.

These and other objects of the invention will become more readily apparent upon the ensuing specification when taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view showing the system of the invention in use.

FIG. 2 is a diagrammatic showing of the system of the invention indicating the operative inter-relation of the various components.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a surface salvage vessel 11 is shown engaged in a diving operation. Diver 12, working beneath the surface of the water and assisting vessel 11 in recovering a sunken object 13, is shown attaching a lifting net placed about object 13 to the distal end of a line 15 lowered from the surface vessel 11. Diver 12 is in communication with vessel 11 by means of a narrow band, water born compressional wave transmitter as indicated by the arcuate wave fronts 16 radiating upward from diver 12. Wave fronts 16 emanate from a transmitter receiver package 18 which may be conveniently carried on the breathing gas tanks of diver 12. Such communication equipment is well known in the diving arts and is frequently referred to by its military designation as UQC of WQC equipment.

Transmitter-receiver package 18 is connected to a wrist carried keyboard control unit 17.

Modern miniaturization techniques permit transmitter-receiver package 18 to be incorporated with keyboard control units 17, if desired. However, in the interest of lighter weight and freedom from inadvertent doppler shifts or body shielding by diver 12, the separation of the units as illustrated may be desirable.

Referring to FIG. 2, the elements of keyboard control unit 17 and transmitter-receiver package 18 are shown in greater detail. The unit is illustrated as being in communication with a similar unit 20 which may be considered to be identical with the keyboard control unit 17 and transmitter-receiver 18. Transmitter-receiver unit...
includes a narrow band transmitter 21 and a narrow band receiver 22. As previously mentioned, these units may be, for purposes of economy, and expediency modified state of the art WQC or UQC transmitters.

The modifications may include a reduction of a electroacoustic transducers response curve to the desired narrow band of frequencies or, alternatively, this reduction in bandwidth may be accomplished by signal processing, such as filtering, within the units themselves. Keyboard control unit 17 contains a miniature keyboard 24 which is connected to a memory register 25 which is used to store the message to be transmitted. Similarly, a read-only memory 27 is controlled by keyboard 24 and connected to memory register 25 for the selective storage prior to transmission of prerecorded messages.

At this juncture, it should be noted that the individual components of keyboard control unit 17 are selected from standard constructions known in the prior art. Particularly, it should be noted that recent advances in the portable calculator arts have made available a wide variety of storage and memory registers. For example, those registers incorporated in the calculators such as the Huetle Packard HP-45 and the Texas Instrument SR-50 may be satisfactorily employed. Similarly, miniature optical display units using low power have been developed for such application and may be included for display 23 which is connected to memory register 25. Such displays are well known in the art and commonly provide for optical display of 12 to 14 characters. The display may either be of the light emitting diode, LED, or of the liquid crystal, LC, types. For example, the LED units made by Blessey semi-conductors of Santa Ana, California and those sold under the trade name Panaplex by the Burroughs Corporation of Plainfield, New Jersey have proven satisfactory.

Thus, it may be seen that memory register 25 together with read-only memory register 27 comprise a first memory register means which is connected to the keyboard 24 for the receipt and storage of message elements. Upon actuation by a control which may be advantageously carried on keyboard 24, the contents of message memory register 25 is transferred, as indicated by the arrow, to a narrow-band transmitter 21. This transmission, as previously noted, may be effected by means of electrical conductor 19.

Received messages are processed by narrow band receiver 22 and connected to a memory register 26. Memory register 26 may be identical to that of memory register 25. The output of memory register 26 is thereby seen to contain the last received message. This message, of course, is displayed on display 23. Diver 12 may then read at his convenience the received message. As is commonly arranged in such display systems, the message content of memory 26 may be displayed on display 23 for a predetermined period of time and then extinguished to conserve battery life and/or prevent detection when covert operation is desired. Prior to the receipt of another message, the contents of memory register 26 may be displayed on display 23 by command of diver 12.

Display 23 may be alpha-numeric or simply alphabetic as required.

The foregoing description while sufficient to enable persons versed in the micro-electronics and communications field to make and use the invention, will be better understood with reference to the preferred mode of operation.

PREFERRED MODE OF OPERATION

The operation of a communication system of the invention proceeds in a normal command-respond signal transmission sequence wherein each of the component parts described in connection with FIG. 2 are interpreted to effect the desired receipt and transmission of original or prerecorded messages.

As those who are familiar with radio communication techniques are aware, a great variety of information may be transmitted and received by using a limited number of characters to form "Q" signals or acronyms. Thus, the characters "WYD" followed by a question mark may indicate "what is your depth?". This signal is transmitted from surface vessel 11 to receiver 22 in transmitter-receiver package 18 where it is stored in memory register 26. When it is convenient for diver 12 to respond to this inquiry, he may do so by combining a prerecorded message from read-only memory 27 and a manually entered message from keyboard 24. Thus, a proper response to the aforementioned exemplary inquiry may be simply a single button selection to display and transmit WYD followed by figures indicating his depth in prearranged units. For example, "WYD 110" may indicate my depth is 110 feet. As will be readily apparent, such a communication technique transcends not only the physical obstacles imposed by the environment but also overcomes language barriers as when diver 12 may be of a different nationality than communicators in surface vessel 11.

If desired, the message stored and displayed on display 23 could be the entire statement rather than the acronym or Q signal which is actually transmitted. Thus, in the above example, display 23 may indicate "what is your depth?". Although the transmitted signal would only be that signal required for address registry purposes. Similarly, different units could be programmed to display the prerecorded messages in a variety of languages. Thus, personnel within surface vessel 11 could employ divers of different nationalities for underwater explorations and oceanographic work. This capability of being programmed in different languages combined with the aforesaid narrow-band width required for transmission would overcome language barriers as well as environmental barriers to communication.

Further, transmission may be made in bursts of time delayed signals rather than in a continuous transmission. Similarly, the transmitter may limit other masking noises to obscure the message, if covert operation is desired. Likewise, transmission and reception may be in other media than seawater with appropriate hardware modifications.

The foregoing description taken together with the appended claims constitutes a disclosure such as to enable a person skilled in the electronics and communication arts and having the benefits of the teachings contained therein to make and use the invention. Further, the structure herein described meets the objects of invention, and generally constitutes a meritorious advance in the art unobvious to such a person befret of the benefits of these teachings.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings, and, it is therefore understood that within
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the scope of the disclosed inventive concept, the invention may be practiced otherwise than specifically described.

What is claimed is:

1. A swimmer-carried underwater communications system comprising:
   - a keyboard for selecting predetermined message elements;
   - first memory register means connected to said keyboard for receipt of said selected message elements and temporal storage thereof;
   - display means connected to said first memory register means for visual display of said selected message elements prior to transmission;
   - transmitter means connected to said first memory register for transmitting said predetermined message elements;
   - receiver means positioned to receive message elements transmitted to said swimmer-carried underwater communications system; and
   - second memory register means connected to said receiver means for receipt and temporal storage of the output thereof and connected to said display means for selectively displaying the stored contents thereof.

2. A swimmer-carried underwater communication system according to claim 1 wherein said first memory register means includes a read-only memory which is connected to said keyboard to selectively recall prerecorded messages.

3. A swimmer-carried underwater communication system according to claim 1 wherein said transmitter means and said receiver means are located remotely from the remaining elements of the swimmer-carried communication system and connected thereto by means of electrical cable connection.

4. A swimmer-carried underwater communication system according to claim 2 wherein said transmitter means and said receiver means are located remotely from the remaining elements of the swimmer-carried communication system and connected thereto by means of electrical cable connection.

5. A swimmer-carried communication system according to claim 1 wherein said transmitter means and said receiver means are narrow-band acoustic devices.

6. A swimmer-carried communication system according to claim 4 wherein said transmitter means and said receiver means are narrow-band acoustic devices.

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