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H04N 7/18

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H4F FAAA

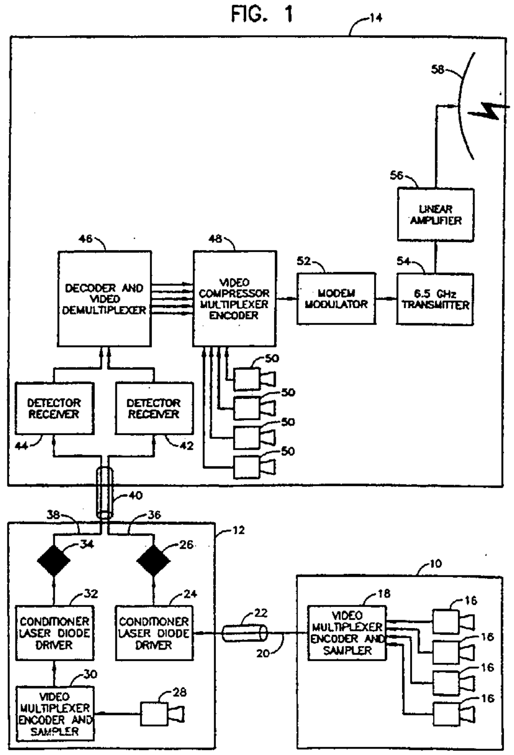
(56) Documents Cited
US 5103306 A **US 4855822 A**
"Motion-based compression of underwater video imagery for the operations of unmanned submersible vehicles", Negahdaripour, Khamene, Computer Vision and Image Understanding, Vol. 79, No. 1, 162-183 (2000).
"DSP hardware implementation of transform-based compression algorithm for AUV telemetry", Kocak, Caimi, IEEE Oceanic Engineering Society (OCEANS '98), Vol. 3, 1624-1628 (1998).

(58) Field of Search
UK CL (Edition S) **H4F FAAA FAAX**
ONLINE DATABASES: WPI, EPODOC, JAPIO, INSPEC.

(54) Abstract Title
Video telemetry apparatus for remotely operated vehicles.

(57) A microwave transmitter 54 is provided on a drone vessel 14 and a microwave receiver 64 is provided on a remote station 60 (Figure 2; vessel or platform). A remotely operated vehicle 10 is connected to and controlled by the drone vessel 14 by an umbilical line 40 that includes cables for power, control, and video signals between the drone vessel 14 and remotely operated vehicle (ROV) or autonomous underwater vehicle (AUV) 10. Video cameras 50,16 are provided on the drone vessel 14 and the remotely operated vehicle 10. Signal conditioners 24,32 and laser-modulated diodes 26,34 are provided on the remotely operated vehicle to condition and transmit multiple video signals to the drone vessel 14 through a single mode optical fiber 36,38 in the umbilical line 40. A multiplexer produces a single output data stream for the optical cable. On the drone vessel 14, the signal is compressed, demultiplexed, conditioned, encoded as necessary, and then transmitted via an antenna 58 to a receiver on the remote station 60 (Figure 2). A receiver 64, demodulator 66, and decoder 68 are provided on the remote station 60 for viewing and/or capturing the video.

FIG. 1



GB 2 366 111 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1

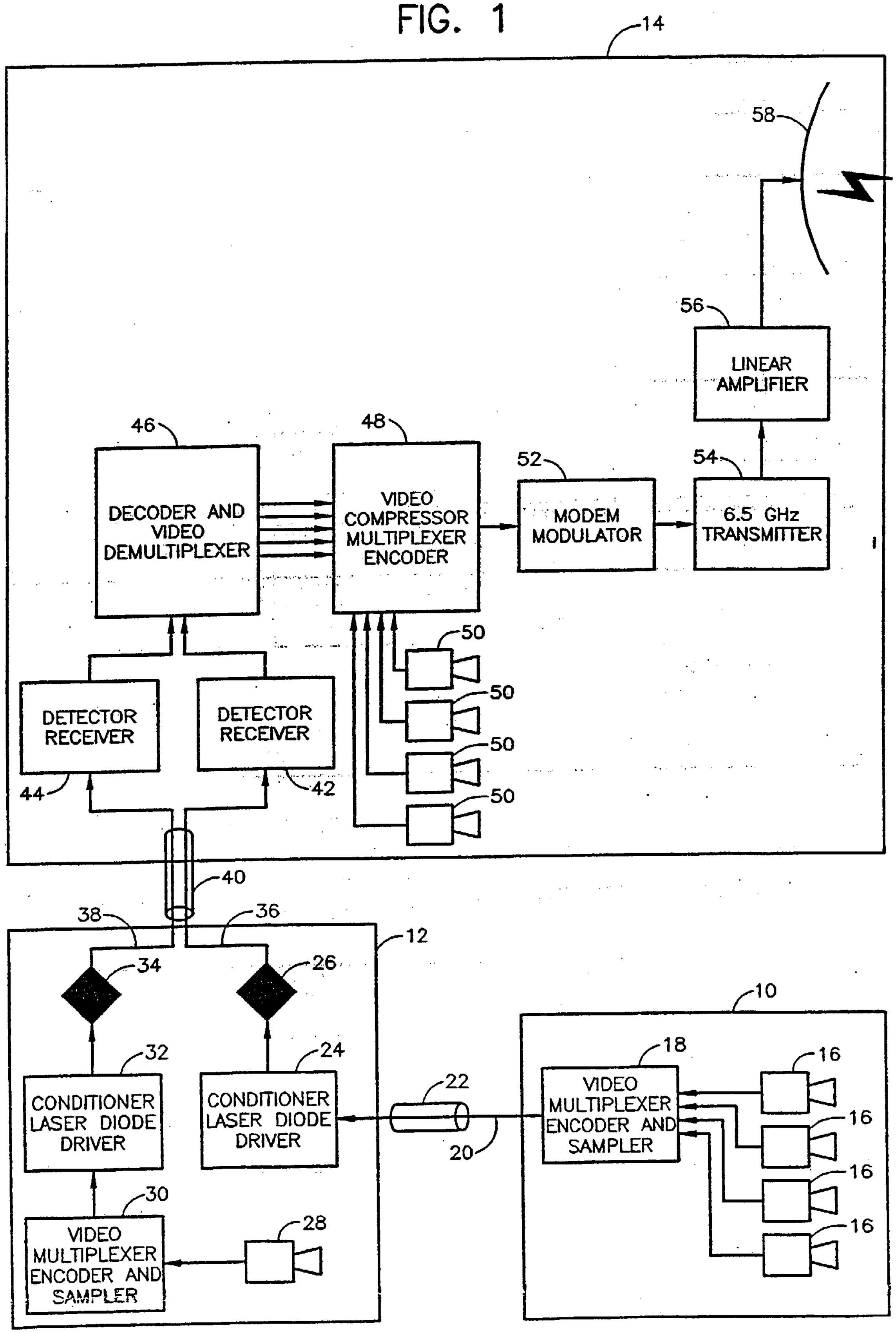
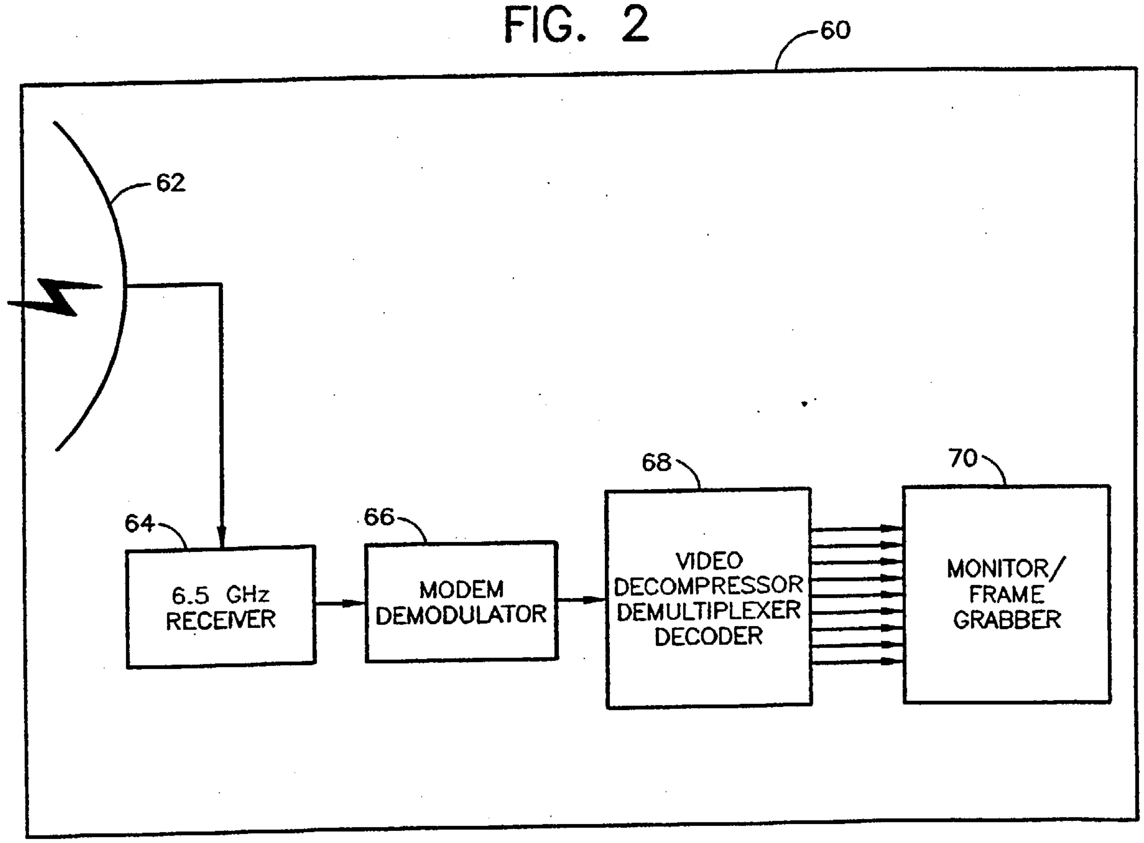

14
58
56
LINEAR AMPLIFIER
46
48
52
54
DECODER AND VIDEO DEMULTIPLEXER
VIDEO COMPRESSOR MULTIPLEXER ENCODER
MODEM MODULATOR
6.5 GHz TRANSMITTER
50
50
50
50
DETECTOR RECEIVER
DETECTOR RECEIVER
44
42
40
38
36
12
34
26
10
32
24
18
16
22
CONDITIONER LASER DIODE DRIVER
CONDITIONER LASER DIODE DRIVER
VIDEO MULTIPLEXER ENCODER AND SAMPLER
16
20
16
16
30
28
VIDEO MULTIPLEXER ENCODER AND SAMPLER

FIG. 2


60
62
64
6.5 GHz
RECEIVER
66
MODEM
DEMODULATOR
68
VIDEO
DECOMPRESSOR
DEMULTIPLEXER
DECODER
70
MONITOR/
FRAME
GRABBER

VIDEO TELEMETRY APPARATUS FOR REMOTELY OPERATED VEHICLES

This invention generally relates to video telemetry apparatus for remotely operated vehicles, such as that suitable for monitoring the operations of remotely operated vehicles under water.

The installation and maintenance of offshore structures such as fixed jackets, floating structures, undersea wellheads, and pipelines often requires the use of a remotely operated vehicle (ROV) or an autonomous underwater vehicle (AUV) due to the water depth and type of work to be performed. ROV work is typically done from a vessel or fixed platform with a direct wire connection to the ROV for video monitoring and control of operations. AUV work may be done using wireless transmissions to control the operation and monitor the operation by video. However, wireless video monitoring with the AUV is typically done at a narrow bandwith that limits the amount of video information that can be sent to the operator.

According to the invention there is provided a video telemetry apparatus for provision on a remotely operated vehicle controlled from a remote station where a drone vessel and tether management system are used with the remotely operated vehicle, the remotely operated vehicle and tether management system including a plurality of video cameras and means for producing a data stream from the camera signals, the video telemetry apparatus comprising:

means on the drone vessel for compressing, encoding, and multiplexing the multiple camera signals into a serial data stream;

means on the drone vessel for modulating a radio frequency signal with the compressed serial data stream;

means on the drone vessel for transmitting the signal; and

means on the remote station for receiving and viewing the transmitted signal.

In a preferred embodiment of the invention, a microwave transmitter is provided on the drone vessel and a microwave receiver is provided on the remote station (vessel or platform). The remotely operated vehicle is connected to and controlled by the drone vessel by an umbilical line that includes cables for power, control, and video signals between the drone vessel and remotely operated vehicle. Video cameras are provided on the drone vessel and the remotely operated vehicle. Signal conditioners and laser-modulated diodes are provided on the remotely operated vehicle to condition and transmit multiple video signals to the drone vessel through a single mode optical fiber in the umbilical line. A multiplexer produces a single output data stream for the optical cable. On the drone vessel, the signal is de-multiplexed, conditioned, encoded as necessary, and then transmitted via an antenna to a receiver on the operating vessel or platform. A receiver, demodulator, and decoder are provided on the controlling vessel or platform for viewing and/or capturing the video.

For a further understanding of the nature of the present invention, reference should be made to the following description, taken in conjunction with the accompanying drawings in which like parts are given like reference numerals, and wherein:

Fig. 1 is a schematic illustration of parts of a video telemetry apparatus according to an embodiment of the invention, on a drone vessel and a remotely operated vehicle; and

Fig. 2 is a schematic illustration of parts of the apparatus on a remote station.

Figs. 1 and 2 schematically illustrate a video telemetry system on a remotely operated vehicle 10, a tether management system 12, a drone vessel 14, and a remote station 60. Equipment used on the remotely operated vehicle 10 and the tether management system 12 are generally known but, for the sake of clarity, one type of video setup will be described.

The remotely operated vehicle 10 is provided with a plurality of cameras 16 and a video multiplexer, encoder, and sampler 18. The multiplexer produces a single serial output data stream at a high bit rate that is typically 100 Mbps when using digital sampling (50MHz when using analog). The cameras used may be of any suitable combination, such as two black and white cameras, a low-light-level camera, and a color camera. The signals are sent to the equipment on the tether management system 12 through a coaxial cable 20 that is contained within the tether line 22.

The tether management system 12 is provided with a first signal conditioner and laser diode drive 24, a first laser diode 26, a camera 28, a video multiplexer, encoder, and sampler 30, a second signal conditioner and laser diode driver 32, and a second laser diode 34. Coaxial cable 20 is connected between the video multiplexer and encoder 18 and the first signal conditioner and laser diode driver 24. Signals from the camera 28 on the tether management system 12 are sent to the video multiplexer and encoder 30 and then to the second signal conditioner and laser diode driver 32. The first and second laser diodes 26 and 34 respectively receive signals from their respective signal conditioners and laser diode drivers 24 and 32. The signal conditioners modulate the laser diodes 26 and 34, which transmit the video signals through single mode optical fiber cables 36 and 38 that are contained in an umbilical line 40. The video multiplexer/encoders also sample each video signal at a high bit rate.

The drone vessel 14 is provided with first and second detector/receivers 42 and 44 that respectively receive signals from the laser diodes 26 and 34. These signals are fed into a decoder and video demultiplexer 46. Separate signals representing the input from each camera 16 and 28 are fed to a video compressor multiplexer and encoder 48. Signals from one or more cameras 50 are also fed into the video compressor multiplexer and encoder 48. The video compressor multiplexer and encoder 48 performs the functions that include video signal compression, digital encoding of each video signal, and multiplexing the various video signals to create a serial data stream in DS3 format. The type of video compression used determines picture quality and affects the cost of the multiplexer units available. The standard DS3 format (also known as G.703) is a data stream at 44.736 Mbps. The DS3 data stream is sent to a modem modulator 52, which creates a 70 MHz radio frequency (rf) signal modulated by the DS3 digital data stream. The 70 MHz signal, commonly called an intermediate frequency (IF) signal is input to a microwave transmitter 54 where the IF modulates (or up converts the digital data stream to) the 6.5 GHz carrier frequency. A linear amplifier 56, if needed, is used to boost the output power up to the FCC license limit of 3150 watts. From the amplifier 56, the signal is sent to an antenna 58 for transmission to the remote station 60 seen in Fig. 2.

The remote station 60 is provided with a receiver antenna 62, a receiver 64, a modem demodulator 66, a video decompresser, demultiplexer, and decoder 68 and one or more monitors or frame grabbers 70 for viewing the video from the various cameras.

The antenna 58 on the drone vessel 14 is preferably a fixed omnidirectional antenna. A parabolic dish antenna may be used but it must be pointed at the remote station. Alternately, a fixed Yagi antenna may be used if the dynamic positioning system on the drone vessel 14 is capable of keeping the antenna continuously pointed at the receiver antenna 62 on the remote station 60. A Yagi antenna pattern typically exhibits an output beam angle of +/- fifteen degrees at a gain of 12 dB. An omnidirectional antenna transmits over three hundred sixty degrees at a typical gain of 2 dB, and a one foot diameter dish antenna exhibits an output beam angle of +/- 4.5 degrees at a gain of 22 dB.

Because many varying and differing embodiments may be made within the scope of the inventive concept herein taught and because many modifications may be made in the embodiment herein detailed in accordance with the descriptive requirement of the law, it is to be understood that the details herein are to be interpreted as illustrative and not in a limiting sense.

CLAIMS

1. A video telemetry apparatus for provision on a remotely operated vehicle controlled from a remote station where a drone vessel and tether management system are used with the remotely operated vehicle, the remotely operated vehicle and tether management system including a plurality of video cameras and means for producing a data stream from the camera signals, the video telemetry apparatus comprising:

means on the drone vessel for compressing, encoding, and multiplexing the multiple camera signals into a serial data stream;

means on the drone vessel for modulating a radio frequency signal with the compressed serial data stream;

means on the drone vessel for transmitting the signal; and

means on the remote station for receiving and viewing the transmitted signal.

2. A video telemetry apparatus according to claim 1, wherein said means for transmitting the signal comprises:

a transmitter;

an amplifier; and

an antenna.

3. A video telemetry apparatus according to claim 1 or claim 2, wherein said means on the remote station for receiving and viewing the transmitted signal comprises:

an antenna;

a receiver;

a modem demodulator;

a video decompressor, demultiplexer, and decoder; and

a monitor/frame grabber.

4. A video telemetry apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

The Patent Office

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Application No: GB 0115205.7
Claims searched: 1 - 4

Examiner: Matthew Males
Date of search: 14 December 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): H4F (FAAA, FAAX)

Int Cl (Ed.7):

Other: Online databases: WPI, EPODOC, JAPIO, INSPEC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	US 5103306	WEIMAN et al - whole document but see abstract; column 5, lines 10 - 68; Figures 1a & 2.	1, 2 at least
X	US 4855822	NARENDRA et al - whole document but see abstract; column 6, line 66 onward and Figures 1 and 2.	1, 2 at least
X	"Motion-based compression of underwater video imagery for the operations of unmanned submersible vehicles", Negahdaripour, S. and Khamene, A., Computer Vision and Image Understanding Vol. 79, No. 1, 162-183 (2000) - see whole document.		1 at least
X	"DSP hardware implementation of transform-based compression algorithm for AUV telemetry", Kocak, D.M. and Caimi, F.M., IEEE Oceanic Engineering Society (OCEANS '98), Vol. 3, 1624-1628 (1998) - see whole document.		1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		