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Description

This invention relates to a performance monitor apparatus. It relates particularly to such an apparatus which is suitable for assisting a minehunting operation at sea.

In a minehunting operation, the overall success of the operation depends at least partly upon the accuracy of the mission planning stage. This stage precedes the actual minehunting operation and it provides what are some essential operational parameters, these being the search track spacing, the search track width and the working speed of the vessel carrying the minehunting equipment. At the present time, the data that forms an input to the mission planning algorithms is obtained by a subjective assessment. As a result, the minehunting performance can frequently fall short of what should be possible with the systems available.

The present invention was devised to provide a performance monitor apparatus which would be more effective in operation and which would be able to adapt itself to the continuously variable sea conditions which occur whilst it is in use.

According to the invention, there is provided a performance monitor apparatus for a minehunting operation, the apparatus comprising probe means for gathering environmental data indicative of the variation of the velocity of sound and water temperature with depth relevant to minehunting performance, first data storage means for minehunting performance prediction algorithms, second data storage means for system/ship/mine target parameters, and performance prediction means capable of providing an output signal relevant to expected minehunting performance.

Preferably, the environmental data gathering means comprises a probe capable of being suspended at different depths in the water environment. A probe suspension means may comprise a cable which is carried on a jib assembly such that it may be unwound from a cable drum.

The cable drum may be driven by a motor which is arranged for remote control operation. The apparatus may include a computer arranged to control data movements for the monitoring operation.

By way of example, a particular embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a general view of the performance monitor apparatus showing the portion mounted on the ship deck and an electronics unit,

Figure 2 is a block diagram showing the main units of the system, and,

Figure 3 is a similar diagram showing an apparatus operator interface and the other interfaces involved.

As depicted in Figure 1, the performance monitor apparatus has a deck portion 1 which is intended to be mounted on the upper deck of a minehunting vessel and an operations room portion 2 which has an associated electronics unit and is located below the deck.

The deck portion 1 comprises a platform 3 which supports a jib 4 assembly. The platform 3 is located on the ship's deck close to the side rails. The jib 4 as depicted is in an in-board position but it is capable of being moved through 180° to an alternative out-board position where it is able to suspend a probe over the side of the ship and lower the probe to the required depth in the water alongside.

The jib supports a cable 6 which can be fed out from a cable drum 7 and which carries a probe 8 for making the sea measurements. The cable drum 7 is driven by a motor 9 and there is also a manual retrieval handle 11 which could be used by hand to rotate the drum in the event of a motor failure.

Control data for operating the deck portion 1 is fed along a connector 12 from the operations room portion 2. The same connector 12 serves to return velocity of sound and other data from the probe and from the deck portion 1 to the room portion 2.

The operations room portion 2 includes a plotter 13 and computer 14 which form part of an electronics unit 15. A host sonar unit 27 also supplies information to the electronics unit 15.

Figure 2 shows the main system units. From a power distribution cabinet 16, a three-phase electrical power supply is delivered to the winch, jib and probe assembly 17. The assembly 17 delivers velocity of sound depth and water temperature data 18 to a velocity of sound interface 19. The interface 19 supplies probe power 21 to the assembly 17 and control and monitoring data 22 are also transferred between these units.

The velocity of sound interface 19 delivers its velocity of sound, depth and temperature data 23 to the computer 14. Control data 24 is also transferred between the interface 19 and the computer 14.

The velocity of sound interface 19 forms part of the apparatus electronics unit 15 and this unit also includes a host sonar interface 26. This interface receives raw sonar return data from the host sonar unit 27 which is part of the marine equipment of the minesweeping vessel. The host sonar interface 26 thus provides background data 28 which is fed to the computer 14.

The computer 14 is thus enabled to provide set-up, graphical and alphanumeric data 29 which is delivered to the performance monitor plotter 13 of the operations room portion 2.

Figure 3 shows the arrangement of the apparatus operator interface and the other interfaces.

The ship's electrical power supply is delivered from the cabinet 16 to the winch motor, jib and probe assembly 10. A winch operator 31 is also required to stand by the deck portion 1 in case any manual overide of the electrical controls should become necessary. The interface 19 provides an electrical power supply 32 to the probe 8 and this returns the required velocity of sound, depth and temperature data 23 to the interface 19. The data 23 is then delivered to the performance monitor apparatus program software 33.

Sensors (not shown) on the winch and jib similarly provide feedback data 34 as to their positions and state of operation. Winch control instructions 36 are provided by the program software 33 to control operation of the winch and jib.

The software 33 forms part of the computer 14. The software also receives an input from the host sonar unit 27 through the host sonar interface 26.

A screen display line 37 from the software 33 is provided and signals on this are applied to the monitor apparatus plotter 13 in order to produce hard copies 38 for the use of an apparatus operator 39 of the monitor apparatus.

The apparatus operator 39 is also able to receive visual data and prompts 41 from a visual display screen 42 which receives results 43 from the software 33. The screen 42 further indicates requests 44 for inputs from the software 33. By using a keyboard 46 the apparatus operator 39 may make responses back to the software 33.

The software 33 also exchanges information on environmental conditions and the velocity of sound profile with diskettes in a diskette drive unit 47. The apparatus operator 39 is able to interchange diskettes in the drive unit 47 as may be necessary.

In operation of the performance monitor apparatus, to perform the Search and Classification predictions and make operational requirements, the computer requires Background Data as an input to its calculations. The Background Data can be produced in either of two ways:

a. The apparatus operator 39 can insert values for the prevailing environmental conditions, (that is, water depth, velocity of sound and temperature versus depth, rainfall, wind speed and sea bottom type) into the computer, using the software 33, and the computer will then calculate and generate 'synthetic' background data. The environmental conditions data can be either typed in, or read in from data previously recorded on the diskettes.

b. The sonar returns received by the host sonar unit 27 produce background data. During operation, this background data is continuously available to the system; hence it is referred to as "real time" sonar background data.

The Real Time Sonar Background data is produced from the host sonar, and passed to the computer by the interface 26 fitted in the electronics unit 14.

In general, the raw sonar data is processed by the interface 26 to produce a Reverberation Gain Control level representing the intensity level of Background Data.

The Background Data must be accompanied by an indication of the Range Scale and the number of data samples taken so that the position of each data sample in each sonar return can be ascertained by the software. When Background Data is requested by the computer, the software 33 checks the apparatus operator's inserted value of Range Scale against the Range Scale received from the host sonar and it alerts the operator if these differ as this would cause an error in the computations.

In the interface 26, the Range Scale is derived from the interval between Transmit Trigger pulses, which occur at the start of each transmission cycle. The number of data samples is obtained by counting sampling clock pulses. The Range Scale and number of samples (Range Count) are sent to the computer along with the Background Data.

The probe 8 is suspended over the side of the ship by the dedicated winch and jib assembly. The jib is rotated to its outboard deployment position by the winch operator 31 and then the winch is operated by the program software, through the velocity of sound interface 19, at relevant stages in the program sequence, that is when the apparatus operator 39 requests a measured velocity of sound profile.

The probe is lowered to the depth selected by the apparatus operator 39, during which time its transducers attain a steady operating temperature. As the probe is raised, it measures the velocity of sound and the temperature of the water plus its own depth at regular intervals of time.

The probe 8 contains three transducers, which measure velocity of sound, depth and temperature respectively.

a, The velocity of sound is measured by a sound velocity transponder, comprising a transducer and reflector, separated by three supports. The transponder utilises a "sing-around" method in measuring the time taken by a short pulse to travel through the water from the piezoelectric transducer to the reflector and back to the transducer. The arrival of each pulse at the transducer is used to electronically generate the transmission of another pulse to give a repetitive signal, the frequency of which is a function ot the velocity of sound.

b. The depth of the unit is measured by means of a thin foil, strain gauge bridge transducer.

c. Temperature measurement is by means of a thermocouple probe.

The transducers interface with power supply and measuring circuits contained within the electronics housing which produce signals, the frequencies of which are proportional to the measured values. The three signals (velocity of sound, depth and temperature) are passed to the in-board circuits through three twisted-pair cores of the electro-mechanical sea cable 6; a fourth twisted-pair core is used to carry power down the cable to the probe.

The sea cable 6 is wound round the drum 7 of the winch to which it is mechanically secured. Electrical connections are made through concentric slip rings, centred on the rotational axis of the drum 7, to the Winch Contactor cable interface terminals. From the Winch Contactor Module, the velocity of sound, depth and temperature data is passed to the velocity of sound interface 19 housed in the electronics unit in the operations room portion 2.

On the interface 19, the velocity of sound, depth and temperature data are converted to 16-bit digital values proportional to the received frequencies. A series of 16-bit values, representing measurements of velocity of sound, depth and temperature at regular intervals, are thus sent to the computer for use by the program software 33.

The winch and jib assembly, shown in Figure 1, is situated on the main deck where it is used to swing the probe 8 to its athwartships deployment position, support and guide the sea cable 6 and haul and veer the cable to raise and lower the probe through the sea. The assembly also provides a securing mechanism so that the jib and probe can be safely stowed when not in use.

The motive power to rotate the cable drum 7 is provided by the three-phase, bi-directional motor 9 which drives the drum via a 60:1 gearbox and a slip clutch.

The slip clutch has its fixed side connected to the gearbox and its slipping side connected to the drum. The clutch slips if the probe 8 or cable 6 becomes snagged when the winch is hauling the cable, or when the ship is moving, in order to prevent damage to the equipment or the ship; it also slips if the probe is nested in a bellmouth holder of the jib and the winch is hauling the cable in manual mode using the manual retrieval handle 11.

Before the computer sends control signals to the winch to operate it, it must be satisfied that the winch and jib are in the correct operational state. This state is signalled to the computer by various sensors (not shown) located on the winch and jib assembly 10. The winch and jib sensors are also used to detect fault conditions during operation.

The sensors are positioned to detect the following states:

a. **Jib Position**

Two microswitches are located on the jib upright support to detect that the jib is or is not locked and that it is either in its athwartships deployment position or its in-board stowed position.

b. **End of Cable**

A microswitch is positioned on the cable drum 7 to detect when there is less than 3.5 metres of sea cable wound onto the drum.

c. **Clutch Slip**

A microswitch is activated by the slip clutch on the cable drum 7 when slipping takes place.

d. **Overheat**

Two overheat sensitive resistors are embedded in electrical windings of the winch motor 9 to detect when the winding temperature rises above 165 ° C.

e. **Emergency Stop**

When a manually latched Emergency Stop push-button switch on the assembly 10 is depressed, the winch contactors are disabled and the motor 9 stopped. An additional pair of contacts on the switch are used to detect this situation.

A switch is located on the manual retrieval handle 11 to detect when the handle is depressed, that is, when it is engaged on the gearbox shaft. This switch is wired in series with the Emergency Stop push-button switch to stop the motor 9 directly and to provide a sensor feedback signal.

A microswitch is also activated when a Local Control Switch on the assembly 10 is enabled by the removal of a padlock.

The sensor feedback signals are sent through a Winch Contactor module (on the assembly 10) to the interface 19 in the operations room portion 2 where they are used for control purposes.

The winch is operated by sending Forward, Reverse or Stop signals to the winch contactors in the Winch Contactor module. The Forward Signal activates the Forward Contactor to veer the cable and the Reverse Signal activates the Reverse Contactor to haul the cable; the Stop Signal disables both contactors.

The motor control signals are generated by various sources as described below:

a. The Interface 19, located in the electronics unit, contains logic circuits which receive Sensor Feedback Data from the winch and jib assembly

10, detailing the operational state of the winch and jib, and generate control data to operate the winch. For example, if the Motor Overheated sensor signal is received, the interface 19 inhibits the Forward and Reverse signals. This function operates independently of the computer, although the Sensor Feedback signals are passed to the computer for monitoring purposes.

b. The computer generates Forward and Reverse signals when, through the software 33, the operator causes the probe to be raised or lowered. If the Sensor Feedback signals indicate an undesirable operational state, the computer inhibits the Forward and Reverse signals and informs the operator of the problem by displaying a message on the screen 42.

c. The Local Control Switch, located on the assembly 10, is a box containing a switch with three positions: VEER, HAUL and OFF (centre position). This unit generates Forward and Reverse signals which override all other control signals.

d. In addition to providing Sensor Feedback signals, the Emergency Stop push-button switch and the manual retrieval handle switches generate STOP signals which act directly on the winch contacter to disengage them and halt the motor.

Located within the Winch Contactor module is a small, high intensity, audible alarm which is sounded under the following conditions:

a. For a short duration prior to the computer starting the winch motor running, to warn the winch operator 31 to stand clear. This alarm signal is generated by the computer.

b. To alert the winch operator 31 to an erroneous operating condition, as indicated by the winch and jib sensors. This alarm signal is generated by the interface 19 logic circuits.

In use of the apparatus of the invention, it has been found that the mission planning output can be accurate and fully representative of the prevailing environment, the expected mine targets and the minehunting system which is available. This leads to greater efficiency and speed in the hunting operation. The stored data is intended to be used before a mission to predict the performance of the host sonar, and/or post-mission, by comparison, to enable the success of the mission to be assessed.

The foregoing description of an embodiment of the invention has been given by way of example only and a number of modifications may be made without departing from the scope of the invention as defined in the appended claims. For instance, it is not essential that the data storage function for the apparatus should be carried out by the use of diskettes, in a different embodiment the data storage could be effected by magnetic tapes or hard disks.

Claims

1. A performance monitor apparatus for a minehunting operation, characterised by probe means (17) for gathering environmental data indicative of the variation of the velocity of sound and water temperature with depth relevant to mine hunting performance, first data storage means (14) for minehunting performance prediction algorithms and second data storage means for system/ship/mine target parameters, and performance prediction means (13) capable of providing an output signal relevant to expected minehunting performance.

2. Apparatus as claimed in claim 1, in which the environmental data gathering means comprises a probe capable of being suspended at different depths in the water environment.

3. Apparatus as claimed in claim 2, in which the probe suspension means comprises a cable which is carried on a jib assembly such that it may be unwound from a cable drum.

4. Apparatus as claimed in claim 3, in which the said cable drum is driven by a motor which is arranged for remote control operation.

5. Apparatus as claimed in any one of claims 1 to 4, including a computer arranged to control data movements for the monitoring operation.

Patentansprüche

1. Ablaufüberwachungs-Vorrichtung für einen Minensuchvorgang, gekennzeichnet durch Sondenmittel (17) zum Sammeln von für die Änderung der Schallgeschwindigkeit und Wassertemperatur mit der Tiefe bezeichnenden Umgebungsdaten, die für die Minensuch-Ablauf relevant sind, erstes Datenspeichermittel (14) für Algorithmen zur Voraussage des Minensuch-Ablaufs und zweites Datenspeichermittel für System/Schiff/Minen-Zielparameter, und Ablauf-Voraussagemittel (13), das zur Schaffung eines für den erwarteten Minensuch-Ablauf relevanten Ausgangssignals fähig ist.

2. Vorrichtung nach Anspruch 1, bei dem das Umgebungsdaten-Sammelmittel eine Sonde umfaßt, die in verschiedenen Tiefen in der Wasserumgebung schwebend gehalten werden kann.

3. Vorrichtung nach Anspruch 2, bei der das die Sonde schwebend haltende Mittel ein Kabel umfaßt, das an einer Auslegeranordnung so gehalten ist, daß es von einer Kabelrolle abgewickelt werden kann.

4. Vorrichtung nach Anspruch 3, bei der die Kabelrolle durch einen für Fernbedienung eingerichteten Motor angetrieben ist.

5. Vorrichtung nach einem der Ansprüche 1 bis 4 mit einem zur Steuerung der Datenbewegungen für den Überwachungsbetrieb eingerichteten Computer.

Revendications

1. Appareil de contrôle de performances pour opérations de recherche de mines, caractérisé par un moyen du type sonde (17) destiné à recueillir des données extérieures, indicatives de la variation de la vitesse du son et de la température de l'eau en fonction de la profondeur, qui se rapportent aux performances de recherche de mines, un premier moyen de mémorisation de données (14) destiné à des algorithmes de prédiction des performances de l'opération de recherche de mines, un deuxième moyen de mémorisation de données destiné à des paramètres recherches système/navire/mine, et un moyen de prédiction de performances (13) qui est en mesure de produire un signal de sortie concernant les performances des opérations de recherche de mines.

2. Appareil selon la revendication 1, dans lequel le moyen de recueil de données extérieures comprend une sonde qui est susceptible d'être suspendue à des profondeurs différentes dans le milieu sous-marin.

3. Appareil selon la revendication 2, dans lequel le moyen de suspension de sonde comprend un câble qui est porté par un ensemble en potence, de façon qu'il puisse être déroulé d'un tambour de câble.

4. Appareil selon la revendication 3, dans lequel ledit tambour de câble est entraîné par un moteur qui est conçu pour fonctionner par télécommande.

5. Appareil selon l'une quelconque des revendications 1 à 4, comportant un ordinateur conçu pour commander des transferts de données associés aux opérations de contrôle.

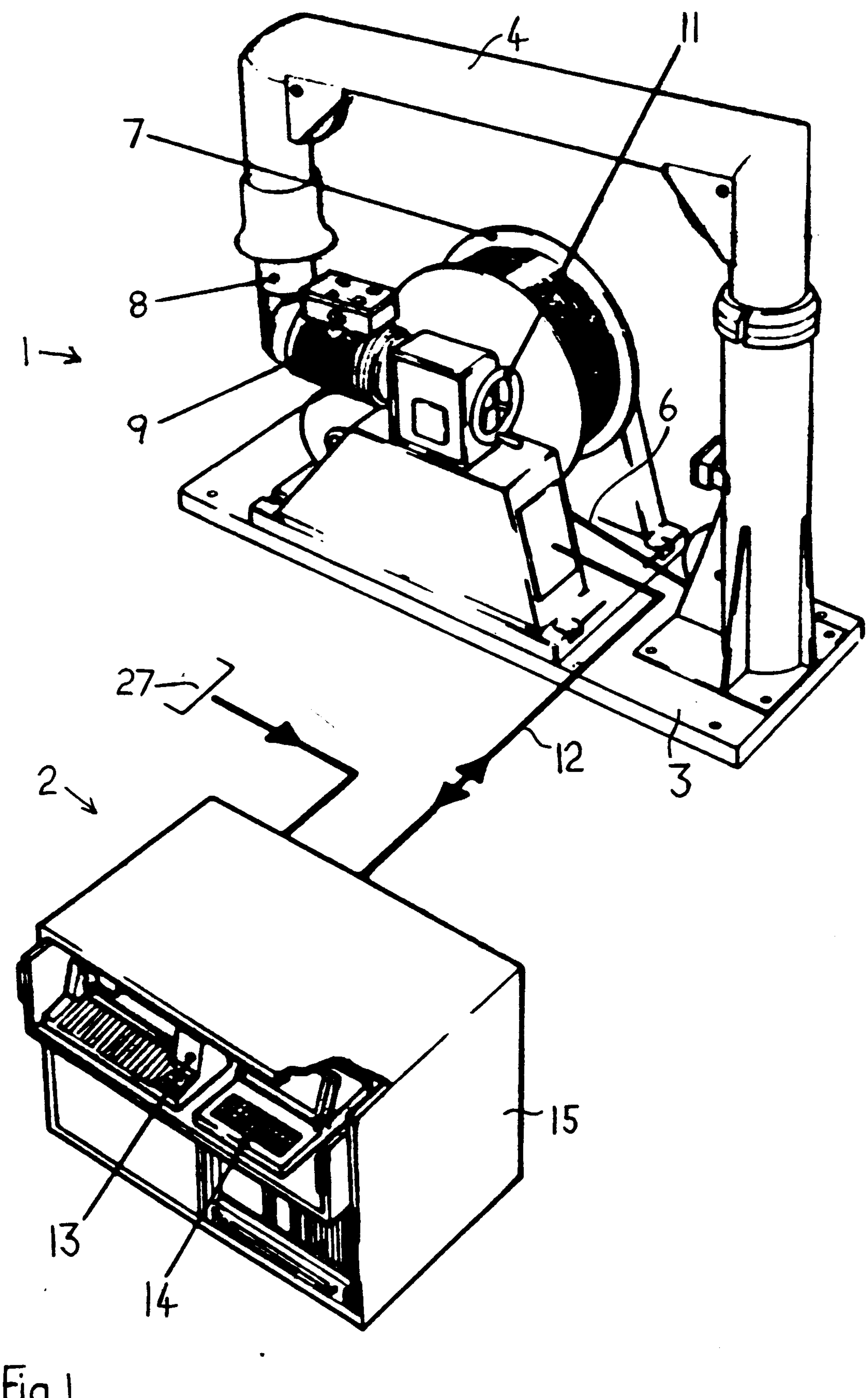

Fig.1

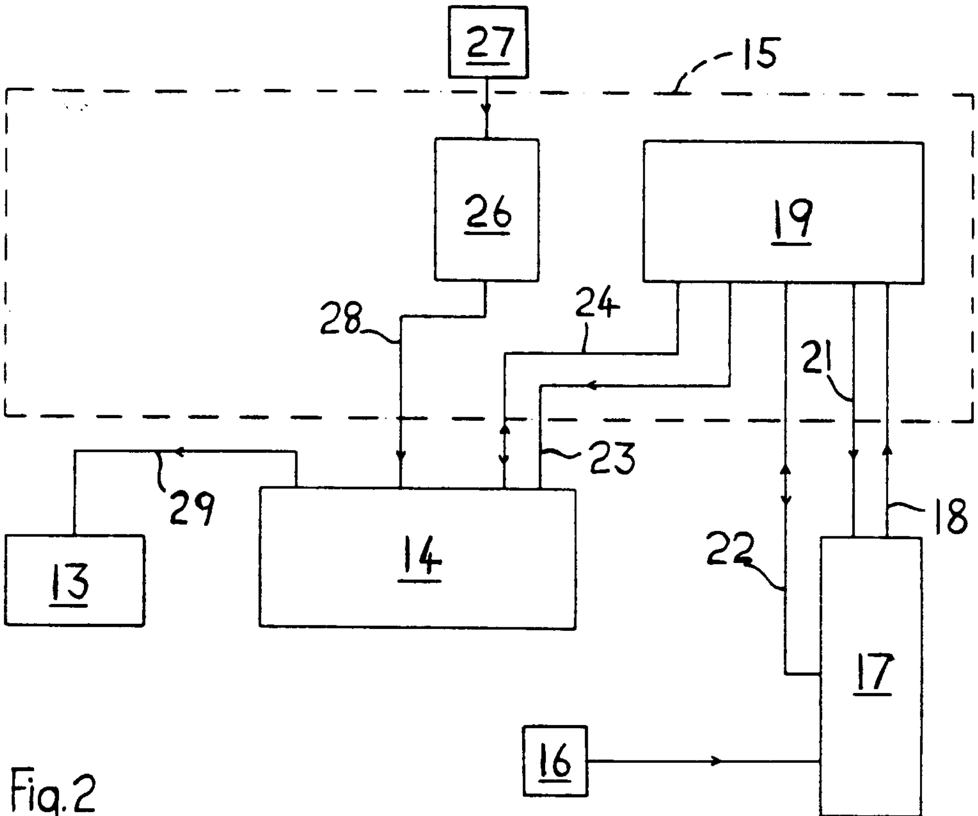
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Fig.2

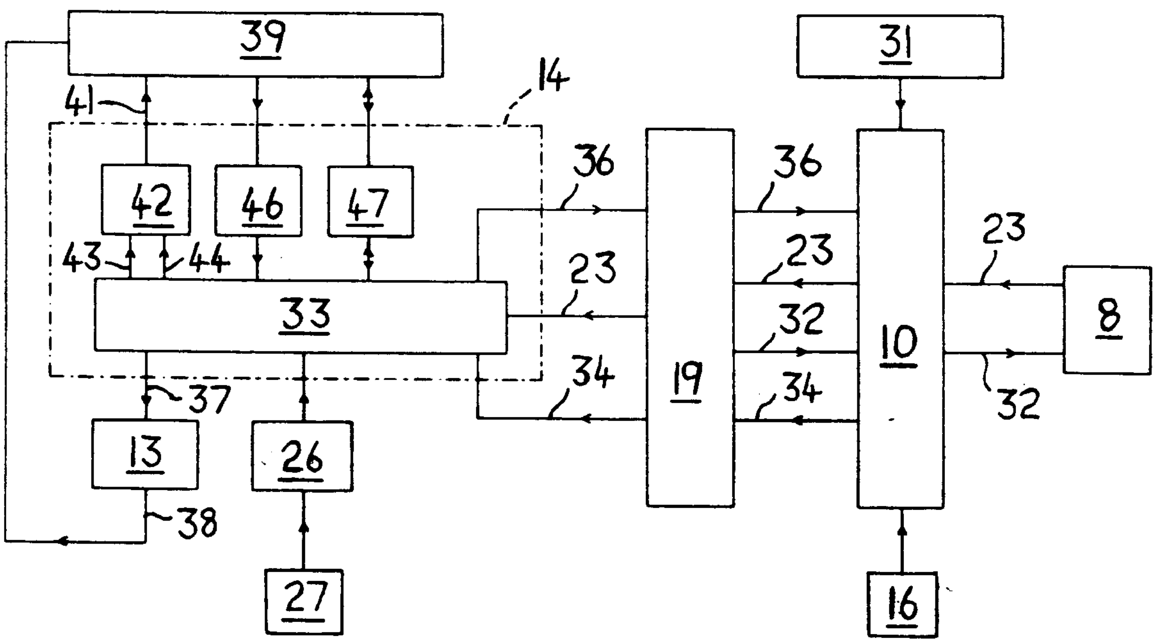
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Fig.3