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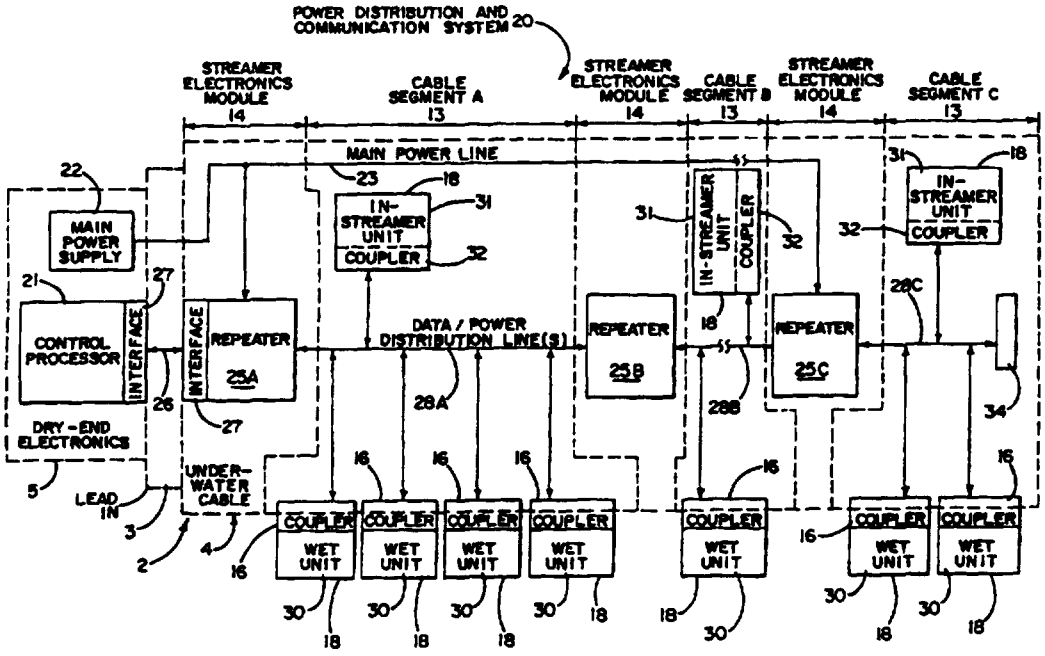

(57) Abstract

A system for communicating with and powering sensors and cable control and monitoring devices deployed at individual locations along an instrumented underwater cable used in offshore seismic prospecting or scientific, and/or military underwater cable or other applications. The system includes a unique underwater cable architecture, coupler design, and electrical device architecture to improve the reliability of the underwater cable and to allow the electrical devices to receive operational power from the underwater cable.

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ELECTRICAL POWER DISTRIBUTION AND COMMUNICATION SYSTEM FOR AN UNDERWATER CABLE

This application claims the benefit of U.S. Provisional Application No. 60/004,203, filed 9/22/95, which is incorporated herein by reference; U.S. Provisional Application No. 60/004,209, filed 9/22/95, which is incorporated herein by reference; U.S. Provisional Application No. 60/005,500, filed 9/22/95, which is incorporated herein by reference; U.S. Provisional Application No. 60/004,493, filed 9/22/95, which is incorporated herein by reference; and U.S. Provisional Application No. 60/004,494, filed 9/22/95, which is incorporated herein by reference.

Field of the Invention

The invention relates to underwater cable assemblies and, more particularly, to apparatuses for powering and communicating with and powering electrical devices, such as sensors and cable-control devices, deployed at spaced locations along an instrumented underwater cable, such as a towed seismic streamer cable used in offshore seismic prospecting or other applications.

Background of the Invention

Towed seismic streamer cable assemblies typically include a plurality of spaced electrical devices selectively disposed therealong. Where the electrical devices are connected around an exterior of the towed seismic streamer cable, they are commonly referred to as wet units. In many applications, the wet units are inductively coupled to data communication lines within the seismic streamer.

One or more of the seismic streamer cable assemblies may be towed by a survey vessel. The wet units communicate with dry-end electronics disposed, for example, on the survey vessel via one or more communication channels. Communication channels between the wet units and dry-end electronics conventionally include either a single-ended or twisted-pair data communication line inductively coupled to the wet units. Electromagnetic coupling may be utilized to allow communication with the wet units without breaching the exterior sheath of the towed seismic streamer cable.

Conventionally, each of the wet units receives operational power from a battery

disposed within the wet unit. The use of batteries as a primary power source in the plurality of spaced electrical devices may be required in practical applications because of low coupling coefficients between the underwater cable and the wet units. However, the use of batteries as the primary power source is frequently undesirable since the batteries may require replacement every few weeks or months. Replacing the batteries typically involves removing the wet units as the seismic cable is retrieved onto rolls on the survey vessel. The wet units are then individually serviced by opening the wet unit and replacing and/or recharging the existing batteries. This battery maintenance process may be highly inefficient and results in unwanted down time. Further, when lithium batteries are used, the cost of disposal and replacement of the batteries for a single vessel may exceed several hundred thousand dollars per year. Accordingly, conventional wet unit designs suffer from a number of problems.

A major problem associated with eliminating batteries from the wet unit devices is the low coupling coefficient between the wet units and the underwater cable. Although numerous attempts have been made to improve this coupling coefficient, these attempts have been less than satisfactory.

U.S. Patent No. 4,912,684 to John T. Fowler describes a communication system which transmits both power and data signals along a one- or two-wire transmission line running the length of the underwater cable. The power signals may be used to charge batteries in wet units such as cable-leveling birds attached along the cable. The power and data signals are inductively coupled between the transmission line and the wet units by means of coils connected to the transmission line at specific locations along the streamer and associated coils disposed within each bird. However, due to a number of technical difficulties, a seismic streamer cable assembly which transfers operational power from the underwater cable directly to the wet units or to the wet units and in-streamer devices has not yet proven commercially practical.

For example, conventional transmission lines are typically configured as continuous, unbroken transmission lines running the length of the streamer cable which has traditionally been about 6 km or less. Transmission line losses in transmission lines of underwater streamer cables having a length longer than 6 km exacerbate the problems associated with powering the spaced electrical devices directly from the underwater streamer cable. Furthermore, data and/or power transmitted to electrical devices at the aft end of an underwater streamer cable are often severely attenuated. This problem may be

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