sensor for the j^{th} wave period and E_j is proportional to the energy associated with the j^{th} wave period. These equations can then be inverted to obtain the E_j in terms of the R_i which is the data telemetered.

The inverted set of equations for an array with the gages located at the 95% response depths for periods of 4, 8, 12, 16 and 20 seconds are:

$$E_{20}=+0.393R_{39}-2.80R_{157}+12.39R_{352}-28.5R_{626}+18.56R_{978} \quad (4)$$

$$E_{16}=-1.000R_{39}+7.12R_{157}-29.8R_{352}+53.6R_{626}-30.0R_{978} \quad (5)$$

$$E_{12}=+1.46R_{39}-10.03R_{157}+28.12R_{352}-38.61R_{626}+19.20R_{978} \quad (6)$$

$$E_{8}=-2.67R_{39}+7.11R_{157}-12.19R_{352}+14.28R_{626}-6.79R_{978} \quad (7)$$

$$E_{4}=+1.84R_{39}-1.56R_{157}+2.26R_{352}-2.71R_{626}+1.35R_{978} \quad (8)$$

The subscripts on the E's indicate period; those on the R's indicate depth.

Since a short appendage to the buoy might be much more convenient in field operations than a long one, an array of gages located at the 10%-response depths is also considered. The inverted set of equations for the short array are:

$$E_{20}=+18{,}271.R_{4.9}-5{,}102.R_{19.8}+1{,}766R_{44.6}-405.9R_{79.4}+31.4R_{124} \quad (9)$$

$$E_{16}=-32{,}870.R_{4.9}+8{,}814.R_{19.8}-2{,}689.R_{44.6}+400.0R_{79.4}+37.4R_{124} \quad (10)$$

$$E_{12}=+14{,}474.R_{4.9}-3{,}783.R_{19.8}+1{,}064.R_{44.6}-111.5R_{79.4}+2{,}86R_{124} \quad (11)$$

$$E_{8}=-1.721.R_{4.9}+430.5R_{19.8}+109.2R_{44.6}+94.1R_{79.4}-2.86R_{124} \quad (12)$$

$$E_{4}=+43.3R_{4.9}-75.9R_{19.8}+15.7R_{44.6}-0.15R_{79.4}-3.06R_{124} \quad (13)$$

Obviously the coding system resolution required to use the short array would be greater than that required to use the long array.

Once the equations for 4, 8, 12, 16 and 20 second periods have been solved to obtain five estimates of the energy spectrum the location of any maximum might or might not be indicated. If a maximum is indicated, another set of equations for a more narrow range of periods can be determined and solved to locate the energy maximum in more detail.

FIG. 2 illustrates an operable pressure transducer. The transducer and variable resistance element are assembled in a water-tight housing and the electrical wire connections are brought out of the housing lid through a watertight seal. A movable arm **14** of a double resistance unit **15** with the arm normally positioned at the center of the resistor unit is connected to the pressure differential chamber **16** by a movable arm. A spring **17** within the pressure differential chamber operates against outside pressure to record the correct pressure. The pressure differential chamber is surrounded by oil in area **18**. A separate chamber in the bottom of the housing below the pressure differential chamber contains a diaphragm **19** with oil on the upper side **21** and opening **22** in the bottom of the housing which permits sea water to enter the area **23** below the diaphragm **19**. A slow leak valve **24** is positioned in the partition **25** between oil chambers **18** and **21** to permit oil to slowly pass from one chamber to the other depending on the pressure of the sea water. An over pressure valve **26** is also positioned between the two oil containing areas to relieve the pressure from the upper chamber.

Each of the pressure transducers **11** secured to the cable **12** attached to a weather buoy **10**, or any other appropriate buoy, are connected to an electrical calorimeter-telemetering system such as described in application Serial No. 300,948, filed August 8, 1963, which integrates and telemeters the signal to any suitable receiver-recorder. Such a system is illustrated by the schematic drawing in FIG. 3. As shown, a differential pressure transducer **11** is connected to the movable arm **14** of a double resistance unit **15** which arm is normally positioned at the center null position of the resistor unit. An electrical power source **27** is connected with one side going to the center tap **28** of the resistance unit to provide a null position, and the other side of the power source is connected to each end of the resistance unit. Any electrical outputs between the end taps and the movable arm **14** is directed to amplifier **29** of any suitable type. The output of the amplifier is then connected to a heater coil **31** that surrounds a heat conductive material such as a thermistor or a coil of temperature resistance wire **33** surrounds the heater coil to detect any change in the temperature of the copper bobbin. The temperature sensor element changes resistance in accordance with the heat of the copper bobbin and permits a corresponding current flow from an electrical power supply **34**. The current passing through the resistor is amplified by amplifier **35** which is connected with any suitable telemetering equipment **36** that sends out a signal through antenna **37**. The telemetered signal is received by any suitable receiving equipment which may be abroad an airplane, a ship, or land based. The telemetering equipment is programmed for sending signals over specific time intervals or it may be interrogated for sending out information at times other than at the timed intervals. The system could also be used for continuous signals. When operated intermittently, the system integrates the input power over an interval of time that is essentially limited by the thermal time constant of the device. When operated continuously, the device averages the input power over an interval of the time that is mathematically related to its thermal time constant.

It has been determined that a 30 gram copper bobbin in the center of a three inch cube of foam plastic has a thermal time constant of about 20 minutes and averages over a 20 minute period with very good accuracy.

In operation for intermittent signal transmission, a timer controls the power sources for the heater element and the heat sensor-transmitting unit. The power sources are turned on, the buoy floats on the water surface and follows the waves over the crest and into the troughs as the waves pass the buoy. The differential pressure transducer is normally centered along the resistance unit such that no voltage flows through the amplifier through the movable arm. As the buoy rises over the crest of the wave, the pressure on the transducer decreases moving the movable arm along the resistance portion to permit a voltage flow through amplifier **29** to amplify the voltage and thereby apply a higher voltage across the heater element. The less the pressure on the transducer due to the height of the wave the greater the heater element will heat the copper bobbin. Now, as the buoy rides over the crest and into the trough the buoy will go below the normal surface and pressure on the transducer will be greater than at normal such that the movable arm will go through zero and cross onto the other resistance position to permit a voltage flow such as described above when the buoy rode over the crest of the wave. Thus the heater element produces heat during the time the buoy is above and below normal. The resistance temperature wire coil detects the change in the temperature of the copper bobin and this change permits a current flow which is amplified and telemetered by the telemetering equipment. The output of the telemetering equipment is recorded and analyzed to determine the wave spectrum. Each pressure transducer secured to the cable will give its own separate output according to the pressure at the depth of the transducer. Thus by analyzing all of the output curves the period, height, length, etc., of the wave condition can be determined.

Obviously many modifications and variations of the