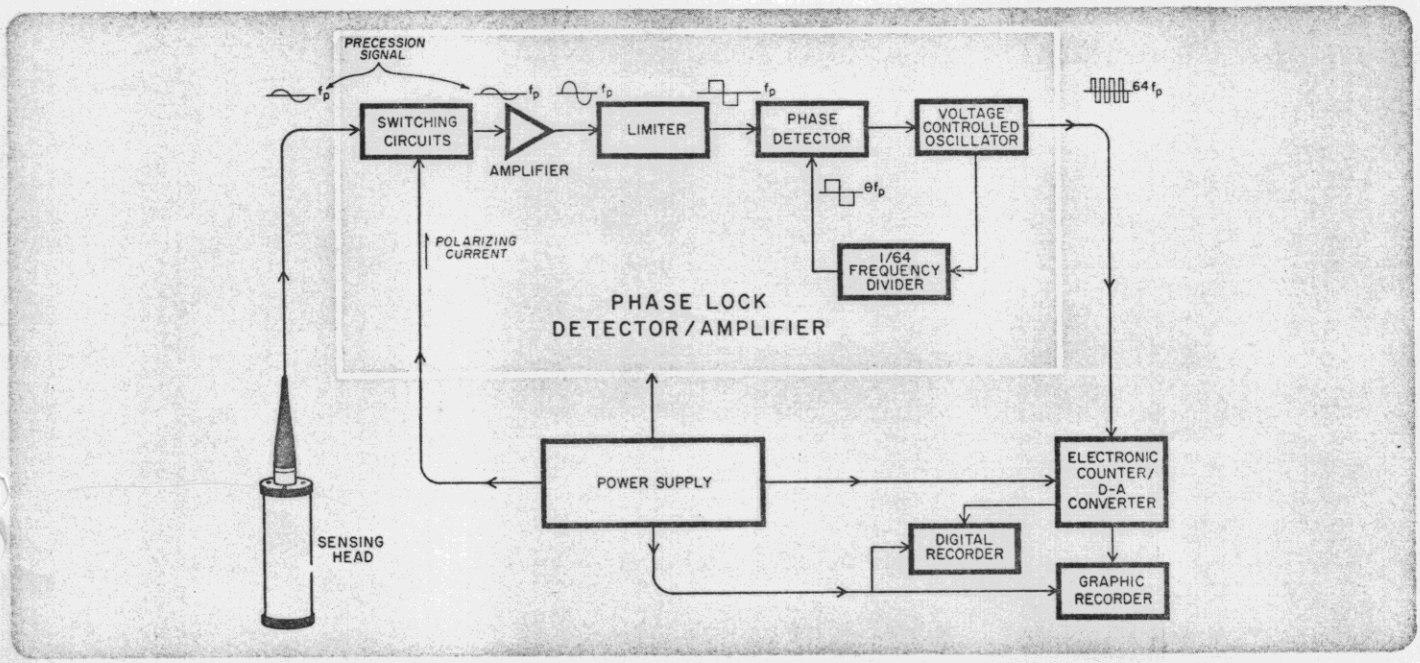

Figure 11: Block Diagram of V-4970.

is one of the most accurately measurable variables in electronics provides us with an extremely precise method of measuring magnetic fields, in our case, the earth's magnetic field.

Any hydrocarbon fluid is an excellent source of protons. In open atmosphere, protons in a fluid sample will be randomly oriented because the earth's field is too weak to cause alignment. How then are the protons made to precess about the earth's field? A strong magnetic field is applied, at an angle to the earth's field, to the fluid sample from an external coil surrounding it. This strong field polarizes the protons in one direction. The field is suddenly removed and the protons, trying to align themselves with the earth's field, precess around it and induce a voltage in the coil at the precession frequency. It is this signal that is used to measure the earth's magnetic field strength (see Figure 12).

The use of two polarizing coils mounted perpendicular to each other prevents the possibility of the polarizing field being in the same direction as the earth's field. Therefore, a signal will always be induced into one of the coils, and we have an instrument that is insensitive to changes in orientation—a marked advantage over other magnetometers.

After the sensing head has been polarized the induced signal is amplified and squared and enters the phase detector. The output of the phase detector directs the voltage controlled oscillator (see Figure 11). The VCO generates a signal approximately 64 times the precession frequency. A portion of this signal is fed back to the phase detector through a 1/64 frequency divider (bringing it down to almost f_p). The frequency difference between f_p and θf_p will generate a dc voltage to change the VCO frequency to exactly 64 f_p. If the 64 f_p signal is now counted for the correct gate period, the digital frequency counter will count exactly 23.4875 times f_p. The earth's magnetic field is thus read directly from the digital frequency counter. Using a digital-to-analog converter the output of the counter can be presented on a strip-chart recorder for a permanent record (see Figure 10).

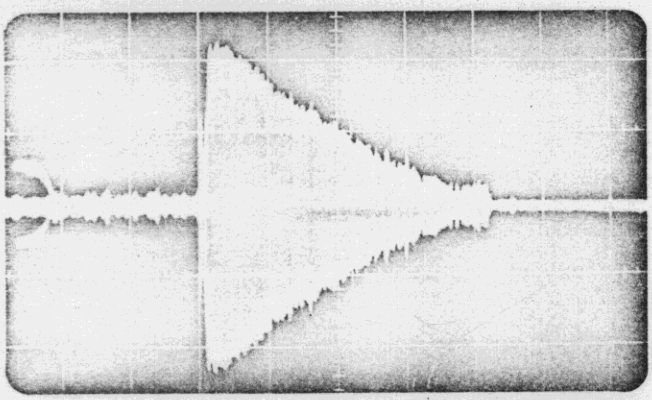

Figure 12: Proton precession signal as it is viewed on an oscilloscope.