ORION SERVICE DIGEST

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FRONT AND BACK COVERS Patrol Squadron One, home-ported at NAS Barbers Point, Hawaii, was the last fleet squadron to transition to the P-3 Orion. When the squadron traded their SP-2H Neptunes for P-3B's, it maintained its record of operating Lockheed aircraft since it was first commissioned nearly thirty years ago.

VP-1's history began on 15 February 1942 when it was commissioned at De Land, Florida as Bombing Squadron 128 (VB-128) and equipped with PV-1 Venturas. After initial training, the squadron flew ASW missions out of Floyd Bennett Field, N.Y., then in August 1943 deployed to Iceland where it was credited with sinking one German U-boat and damaging another. As World War II progressed, VP-128 changed bases several times, operating in both the

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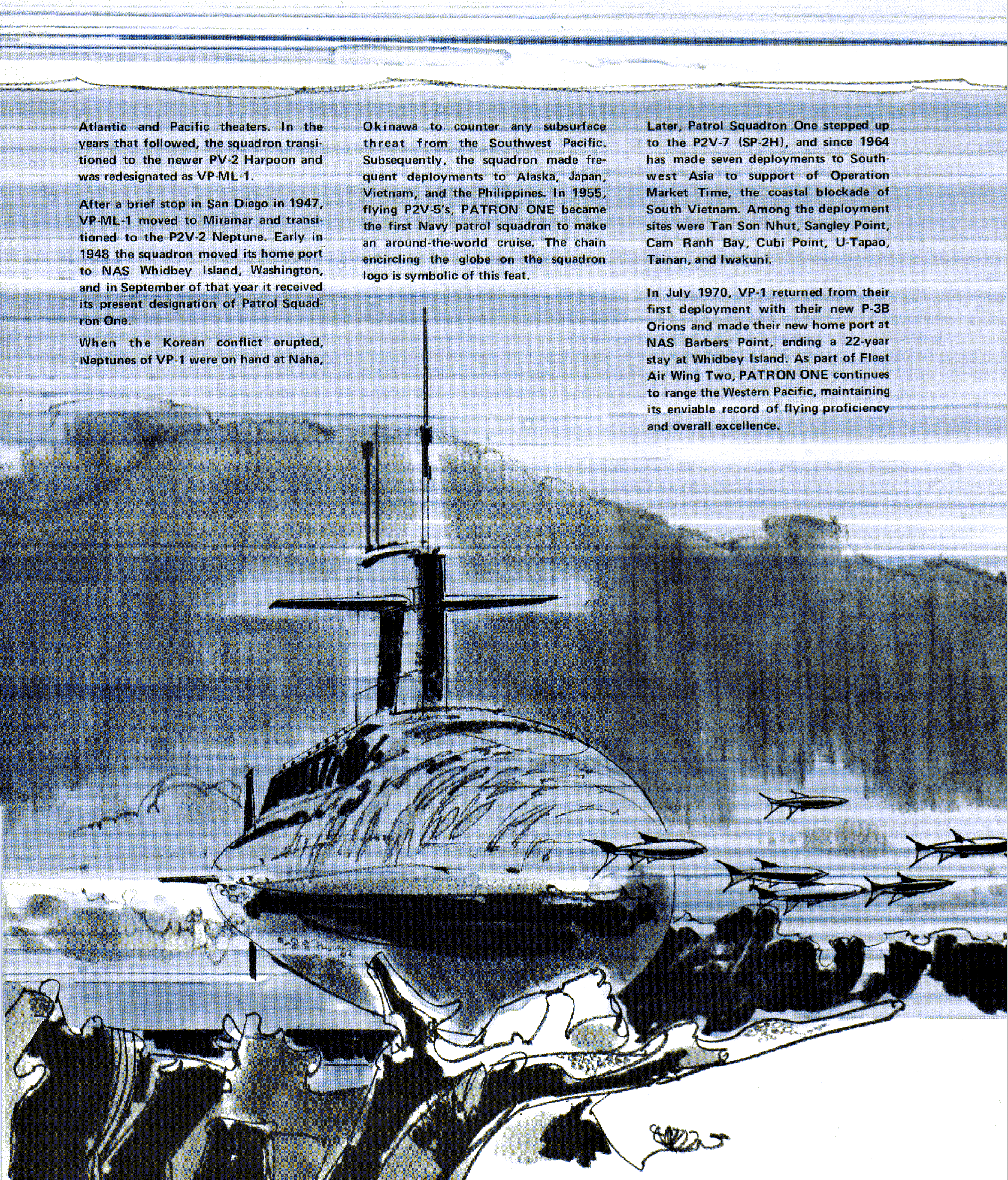
Atlantic and Pacific theaters. In the years that followed, the squadron transitioned to the newer PV-2 Harpoon and was redesignated as VP-ML-1.

After a brief stop in San Diego in 1947, VP-ML-1 moved to Miramar and transitioned to the P2V-2 Neptune. Early in 1948 the squadron moved its home port to NAS Whidbey Island, Washington, and in September of that year it received its present designation of Patrol Squadron One.

When the Korean conflict erupted, Neptunes of VP-1 were on hand at Naha, Okinawa to counter any subsurface threat from the Southwest Pacific. Subsequently, the squadron made frequent deployments to Alaska, Japan, Vietnam, and the Philippines. In 1955, flying P2V-5's, PATRON ONE became the first Navy patrol squadron to make an around-the-world cruise. The chain encircling the globe on the squadron logo is symbolic of this feat.

Later, Patrol Squadron One stepped up to the P2V-7 (SP-2H), and since 1964 has made seven deployments to Southwest Asia to support of Operation Market Time, the coastal blockade of South Vietnam. Among the deployment sites were Tan Son Nhut, Sangley Point, Cam Ranh Bay, Cubi Point, U-Tapao, Tainan, and Iwakuni.

In July 1970, VP-1 returned from their first deployment with their new P-3B Orions and made their new home port at NAS Barbers Point, ending a 22-year stay at Whidbey Island. As part of Fleet Air Wing Two, PATRON ONE continues to range the Western Pacific, maintaining its enviable record of flying proficiency and overall excellence.



MAGNETIC ANOMALY DETECTION AN / ASQ-81 MAD SYSTEM

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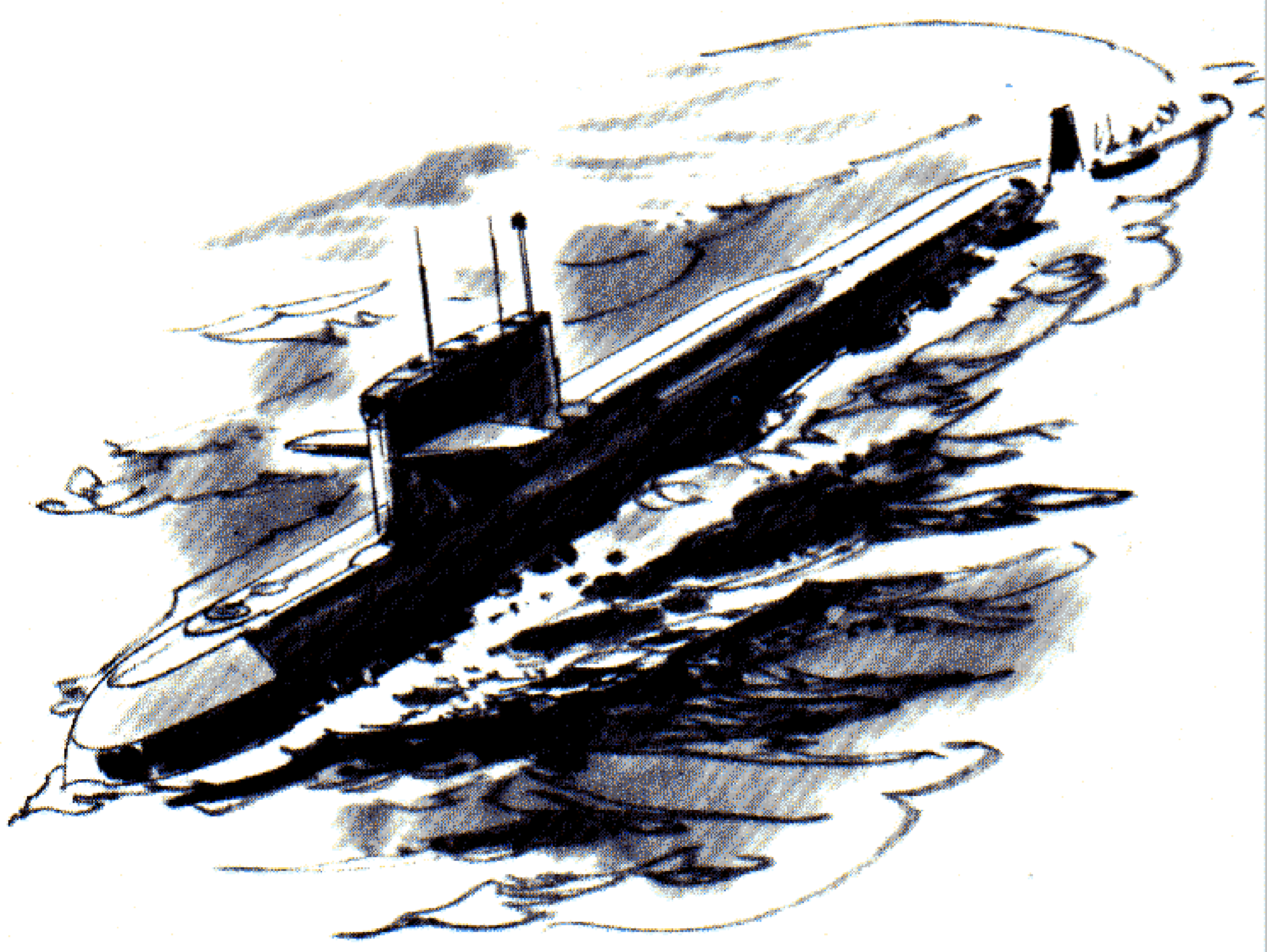
The problem of pinpointing the location of a submerged submarine from a low flying aircraft continues to be a critical area in the anti-submarine warfare field. One approach to a solution has been through the use of magnetic anomaly detection (MAD) equipment, which can detect the presence of a submarine by measuring the change in the earth's magnetic field caused by the ferromagnetic materials of the submarine.

While having a limited range compared with other detection systems, MAD has definite advantages over other systems at short ranges. Tactically, it is used both to classify and verify targets (whales and thermal layers can look like a target on some acoustic detection systems) and to pinpoint the target prior to attack. The MAD system consists basically of a very sensitive magnetometer and a paper strip recorder which continuously display the magnetometer output. When a MAD system is flown near a target, the change in the magnetic field is displayed as the recorder pen traces a characteristic pattern which can be recognized by the MAD operator.

A most important factor in MAD system performance is the degree to which the magnetic fields of the airplane can be suppressed by design, production control, and compensation techniques applied to the airframe and other equipments. Uncompensated aircraft magnetic fields can produce signals during maneuvers which limit the detection capability of the MAD system.

A great deal of research has resulted in significant improvements to MAD equipment since the first MAD set was introduced 30 years ago. The latest advances in the MAD field are incorporated in the AN/ASQ-81 system installed on the P-3C airplane. The acronym MAD originally stood for Magnetic *Airborne* Detection, and development of such a device began in both the United States and Great Britain in 1941. Both countries initially developed magnetic gradiometers which measured space rate-of-change of the magnetic gradient, but this research was terminated with the successful development of a saturable-core magnetometer which directly measured any anomalies in the earth's magnetic field.

MAD Mark I, consisting of a saturable-core magnetometer mounted on a gyroscope, was flight tested in 1941. However, the effect of gyroscopic precession created a high noise level during aircraft maneuvers, and this line of development was dropped in favor of magnetic stabilization of the magnetometer head.

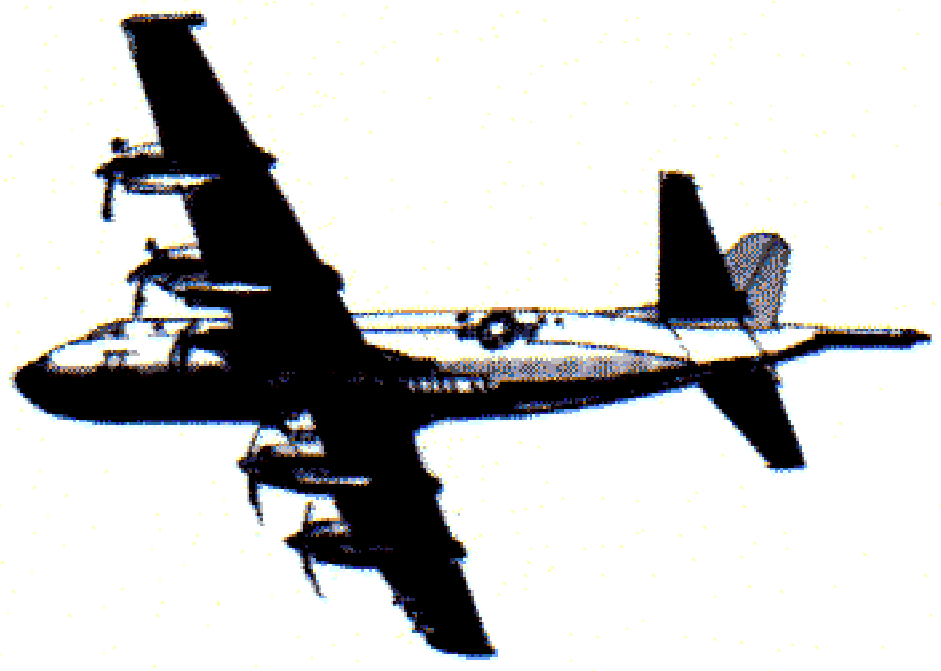


Although the original MAD research began before 1941, it wasn't until the advent of the PBY (equipped with ASQ-3 and -3A systems) that airborne MAD became an effective submarine deterrent. The first use of a MAD-equipped PBY was to detect U-boats entering the Mediterranean through the Strait of Gibraltar. Following World War II, essentially the same equipment was installed in early P2V aircraft and utilized to conduct combined magnetic survey and mineral deposit mapping flights over portions of North America.

The ASQ-8 appeared in time for use in the Korean conflict. The performance of the ASQ-8 MAD system installation on P2V aircraft was remarkable in its time, but the equipment was heavy (80 to 100 pounds), and the Neptune's magnetic fields were difficult to compensate for because the aircraft had not been designed as a MAD platform. The ASQ-8 utilized a flux-gate magnetometer, a type in which the sensor had to be kept in nearly perfect alignment with the earth's magnetic field at all times, regardless of the position of the aircraft. The high performance required of the magnetometer sensor, which was mounted on a stable platform, was difficult to maintain in the fleet.

The introduction of the P-3A Orion marked a significant improvement in MAD system performance due primarily to the improved magnetic characteristics of the aircraft. The P-3A was equipped with a redesigned flux-gate MAD system, the ASQ-10, which is only about one-third the weight of the ASQ-8, while the sensitivity and maintainability are about the same. The ASQ-10A succeeded the ASQ-10 in the early P-3C production aircraft, and has been succeeded in later P-3C aircraft by the ASQ-81 which uses a helium magnetometer.

The ASQ-81 incorporates a new approach to magnetic anomaly detection that utilizes an absorption cell filled with helium gas as the detecting device and deletes all moving parts from the detector assembly. Most important, however, from an operational standpoint, the signal-to-noise sensitivity is approximately 8 times that of the ASQ-10. This is due primarily to the absence of magnetic variations introduced by the stabilizing servos used in the older ASQ-10 system, which are not required by the ASQ-81 in a moving aircraft. Due to the inverse cube law of magnetics, as the distance increases from the magnet, the field strength falls off by a factor of the cube of the change in the distance. This sensitivity factor of eight doubles the detection range of the ASQ-81 ($\sqrt[3]{8} = 2$). The increased range and greater sensitivity help to restore some advantage to aircraft in their search for modern, deeply submerged submarines.

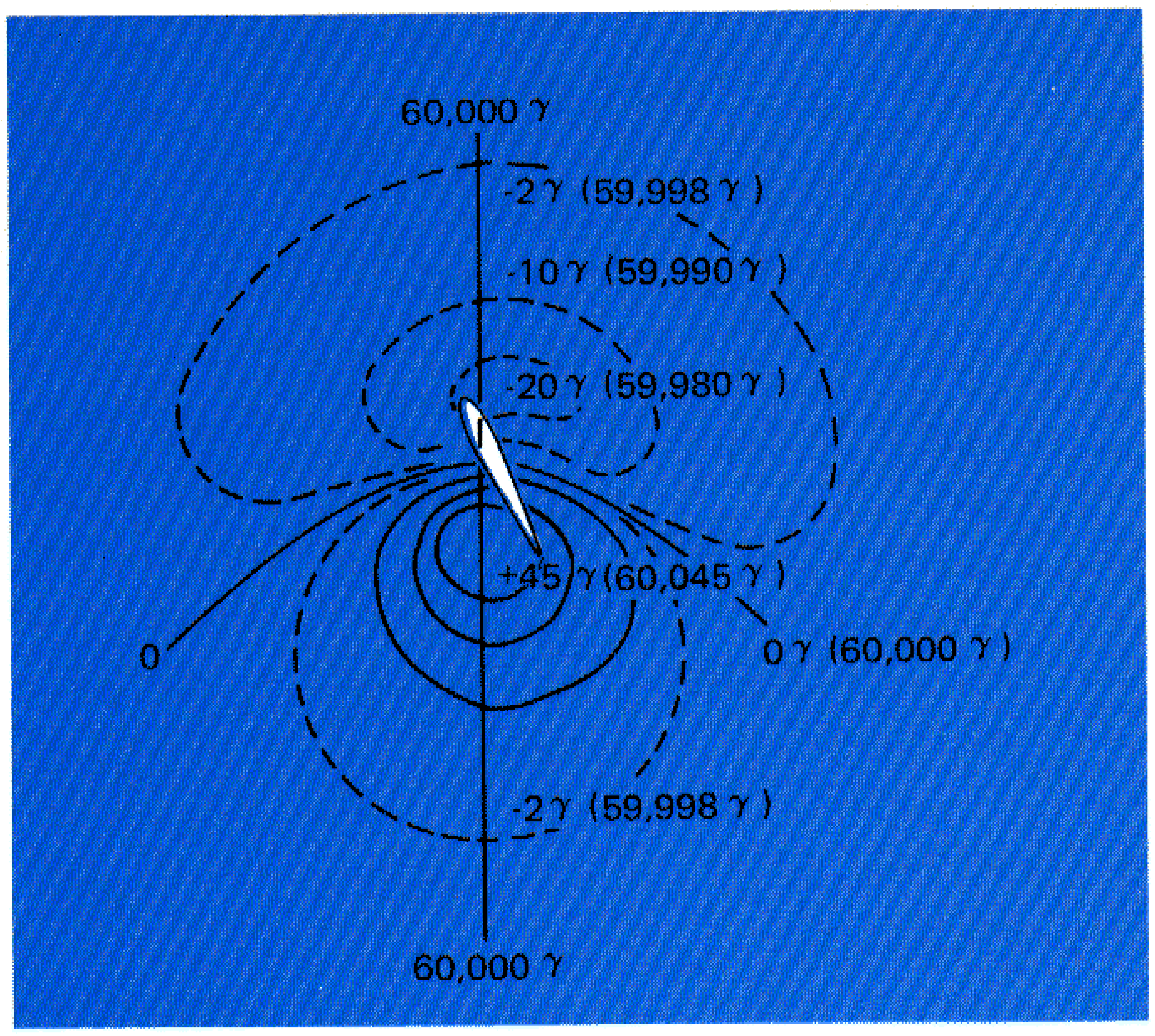


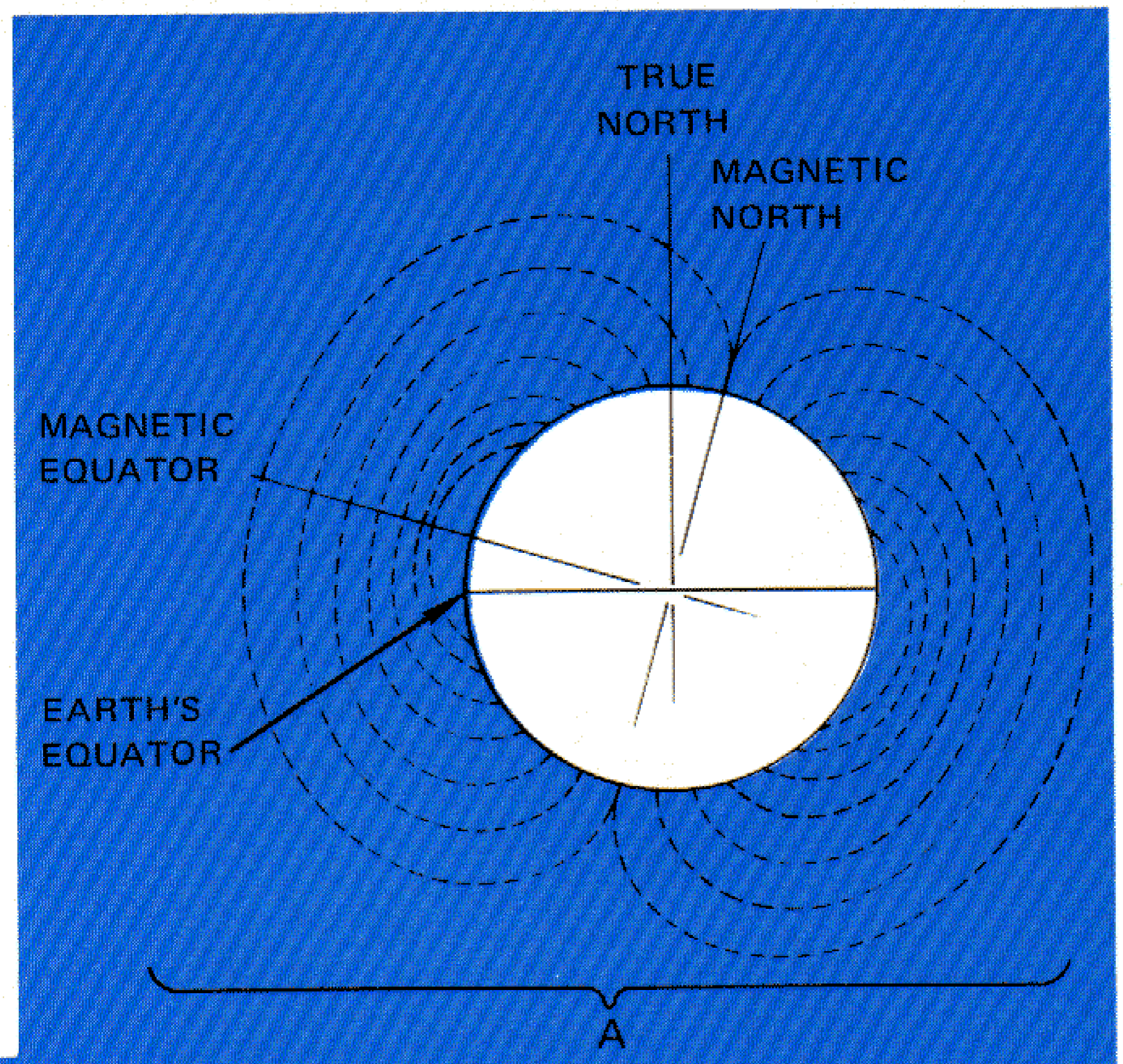
DESCRIPTION

Although the method of detection has changed, the magnetic disturbance in the earth's field produced by the submarine has not. To be an effective ASW device, the MAD equipment must still be sensitive enough to isolate a magnetic disturbance (anomaly) of less than 1γ (gamma) in an average earth's magnetic field strength of 50,000 gammas. The usual measure of magnetic field strength is the oersted (an oersted is equal to 100,000 gammas), but since a submarine disturbance is a very small part of an oersted, the gamma is used as a measure. An example of a small magnetic disturbance caused by a submarine is shown in Figure 1.

The anomaly depicted in Figure 2 is exaggerated to illustrate more clearly how a magnetic disturbance is generated. Part A of Figure 2 shows the angle at which the lines of magnetic force enter and leave the earth's surface. Part B represents the natural undisturbed magnetic field. In C and D the submarine has distorted the magnetic field so that

Figure 1. Sample Anomaly Disturbance





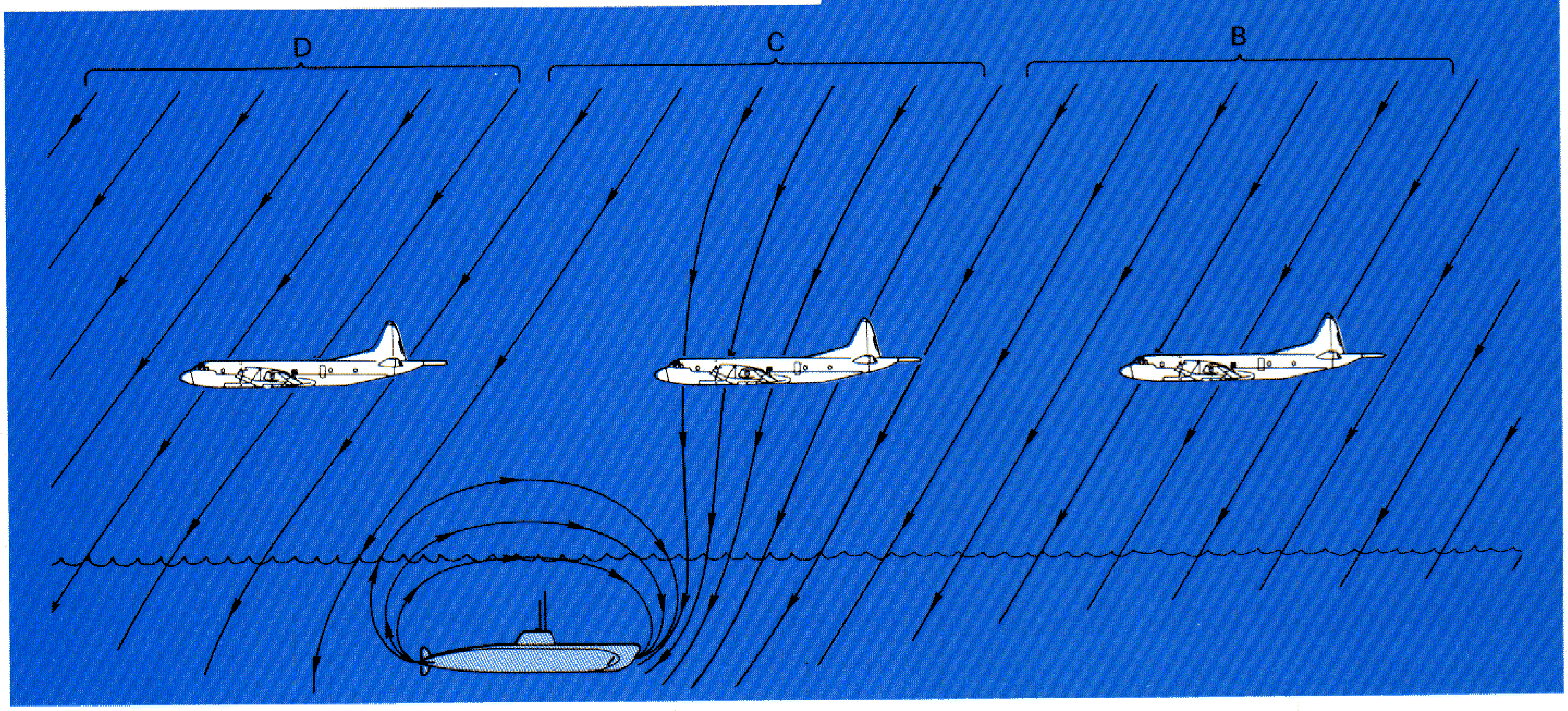
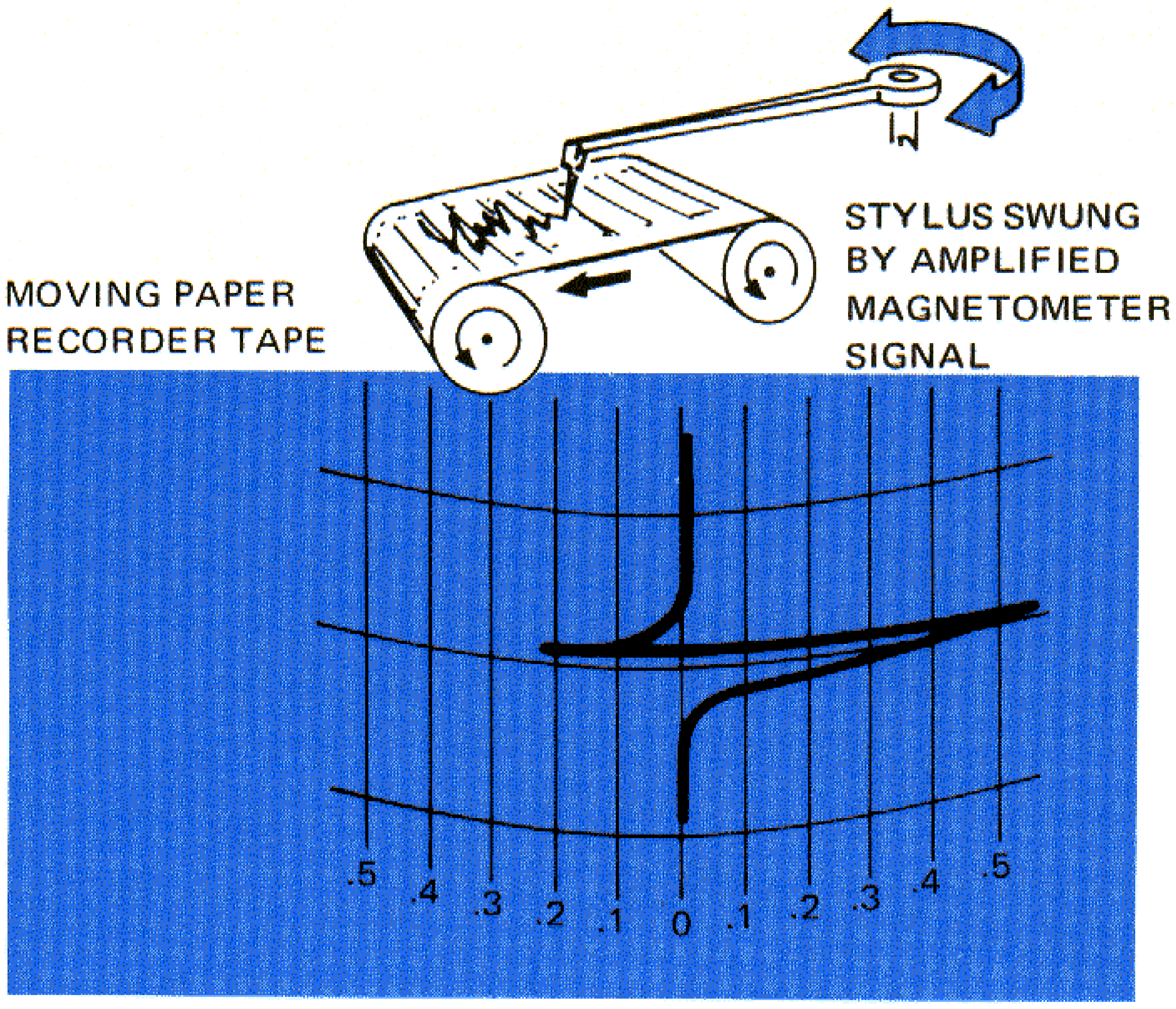


Figure 2. Simplified Comparison of Natural Field Density and Submarine Anomaly

it has increased at C and decreased at D. Figure 3 shows the end results of the aircraft flying over the anomaly using a MAD system.

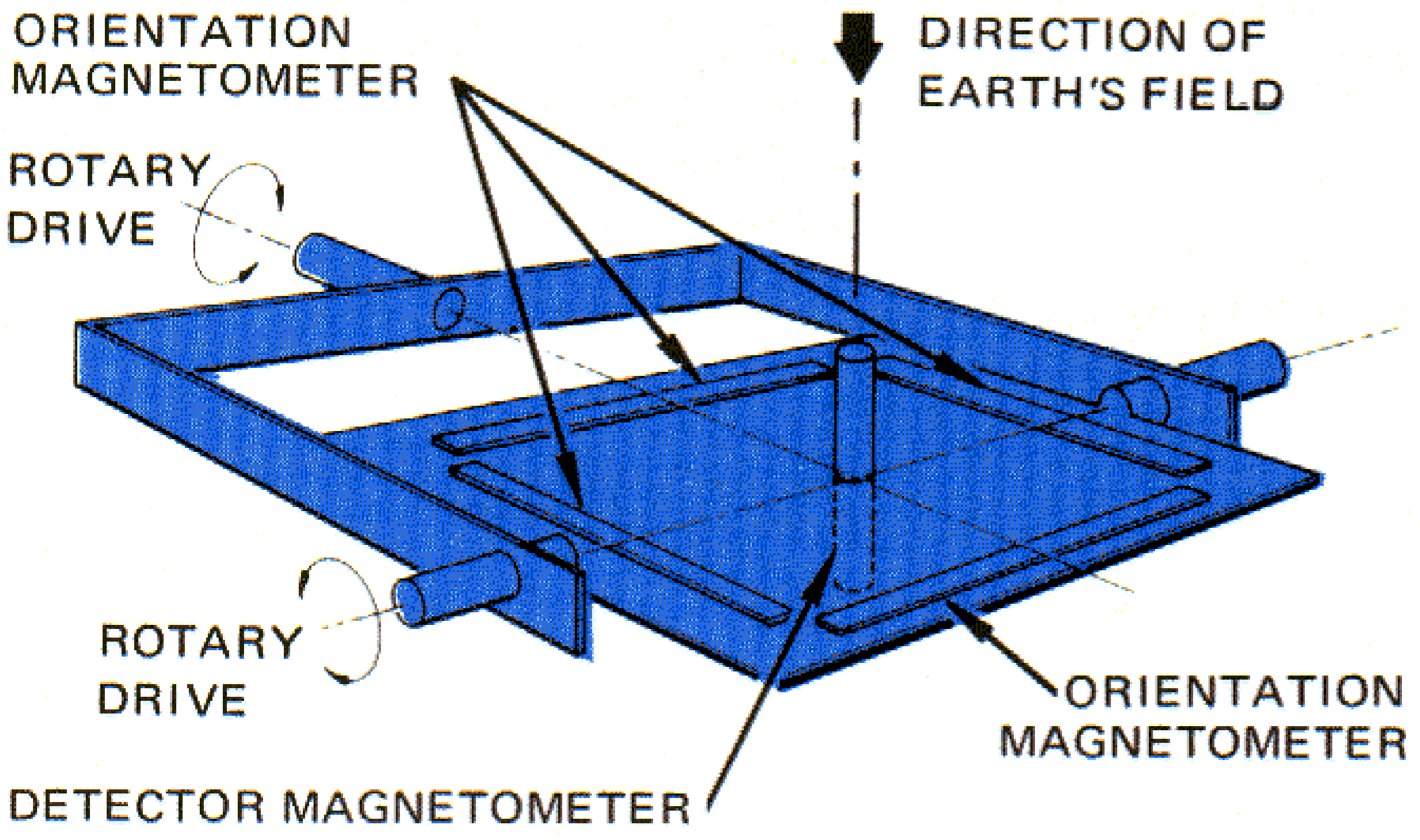
Figure 3. Recording of Aircraft Flying Over the Anomaly Using the MAD System



In addition to magnetic field changes caused by a submarine there are natural changes in the earth's field from point to point on the surface. The lines of force comprising the earth's magnetic field do not always run straight north and south (variation), nor is the angle with the horizontal constant over the earth's surface (dip angle). Furthermore, the intensity of the field varies, being greatest at the magnetic poles and least at the magnetic equator. Fortunately for the submarine hunter, the variation and the dip angle change gradually with respect to geographic position. Nevertheless, these changes must be compensated for to prevent their effects from producing false target signals. This compensation is achieved with bandpass filtering which removes slow rate-of-change signals due to the aircraft's transit over a small portion of the earth's surface, and passes faster rate-of-change signals caused by the local presence of a submarine.

AN/ASQ-10 SATURABLE CORE DETECTOR In the ASQ-10 system, the changes in the earth's field and orientation are monitored by the saturable core detector element (orientation magnetometers) shown in Figure 4. Orientation magnetometers are designed to sense null signals when positioned exactly at right angles to the earth's prevailing magnetic field. The null signals are used to control servo systems which constantly reposition the magnetometer support gimbals. It is necessary to reposition the support assembly each time the aircraft maneuvers or when it flies through natural earth magnetic field changes. Of course, the primary purpose for this orientation process is to hold the detector magnetometer (see Figure 4) directly in line (parallel) with the earth's magnetic field for minimum noise which produces maximum sensitivity.

Figure 4. ASQ-10 Detector Head



The detector magnetometer is excited by an ac signal which forces its core into magnetic saturation during each half cycle of excitation voltage. As long as the earth's magnetic field is undisturbed, the magnetometer output signal will resemble the waveform shown by the solid lines in Figure 5. The dotted line in Figure 5 indicates the output signal when an anomaly is detected. The saturation point is advanced during the negative half cycle and delayed during the positive half cycle of excitation. This shift in the saturation points occurs quite rapidly when an anomaly is present and is detected as a phase shift. The degree of phase shift is converted to a variable dc signal. Ideally then, all extraneous variations are filtered out of the variable dc leaving only the anomaly signal to drive the RO-32 recorder pen. Unfortunately, some of the extraneous variations are very nearly the same as the anomaly signal and tend to mask or distort

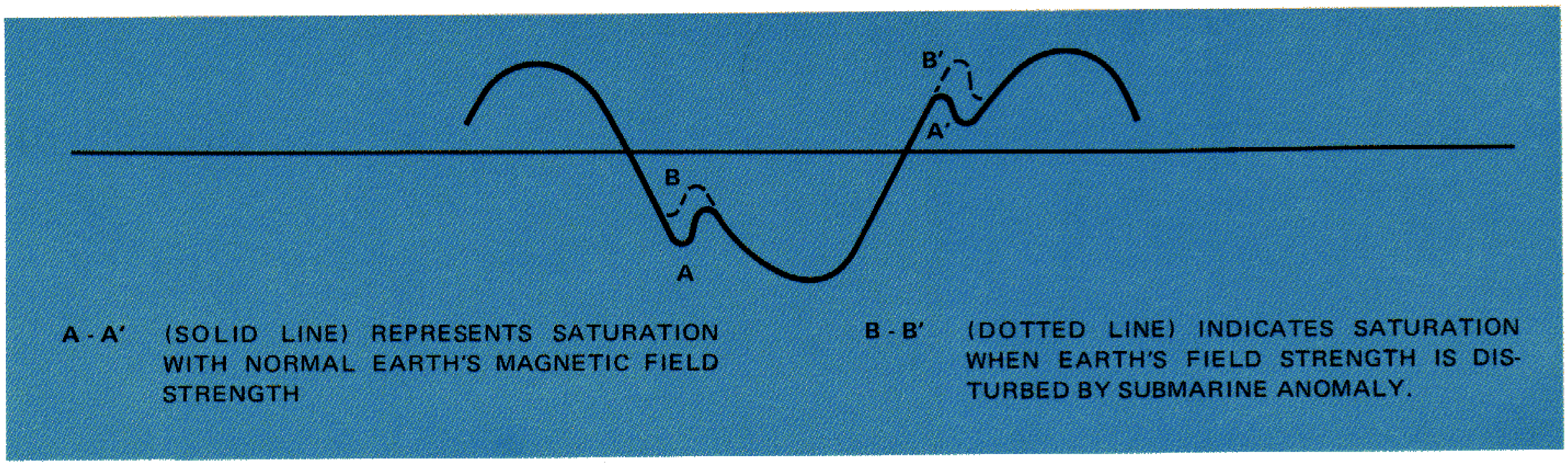


Figure 5. Shift in Magnetometer Saturation Point due to Submarine Anomaly

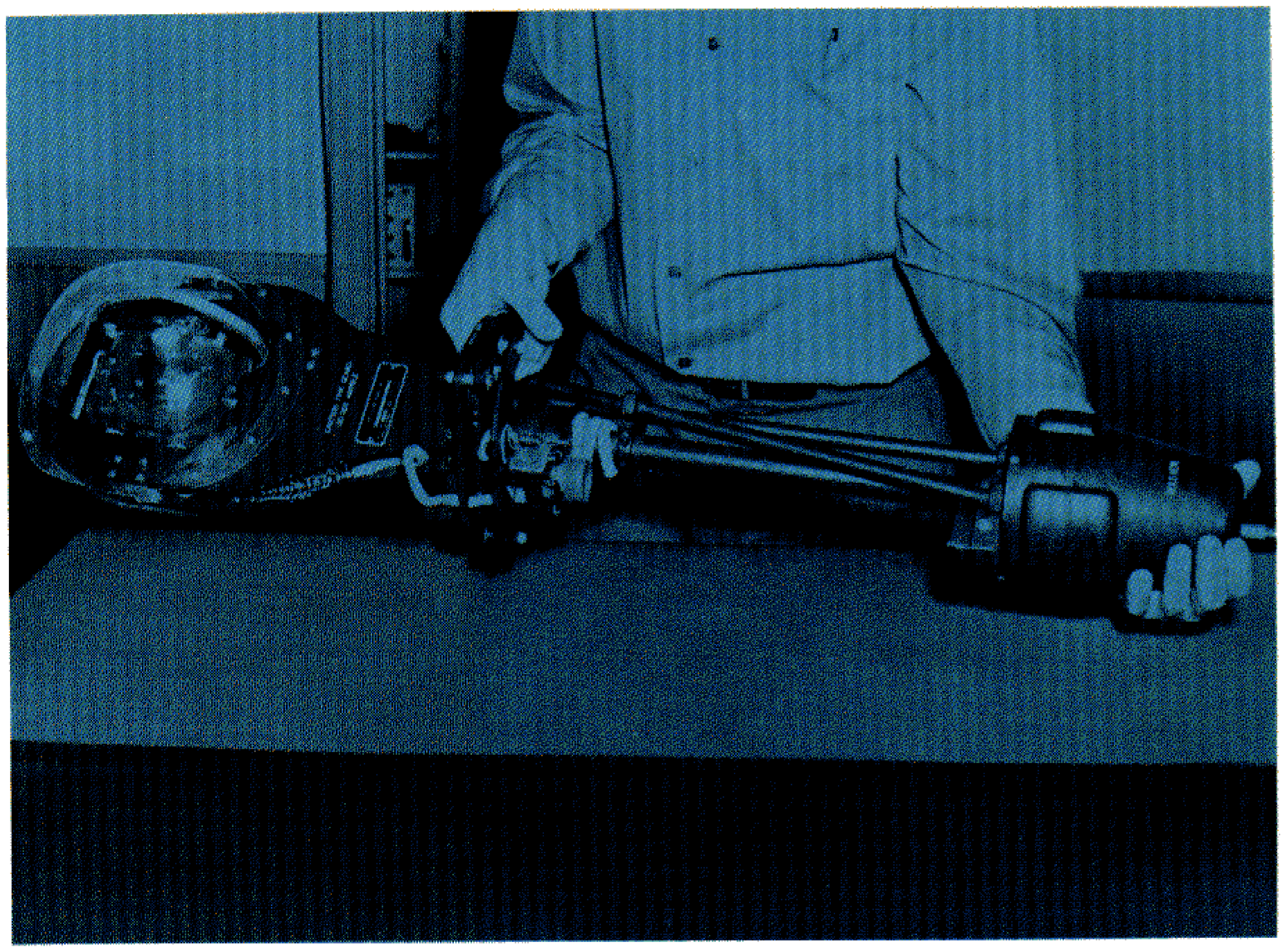
the recorder display. A majority of the unwanted signals are produced by random excursions of the orientation servo system. Figure 6 shows the mechanically complex ASQ-10 detector head.

AN/ASQ-81 MAGNETIC RESONANCE MAGNETOMETER

In contrast to the mechanically complex detection method used in the ASQ-10, the ASQ-81 has no moving parts. Magnetic anomaly detection is accomplished by utilizing the phenomenon of nuclear magnetic resonance discovered almost simultaneously by E. Purcell at Harvard and F. Bloch at Stanford.

This section will briefly describe nuclear resonance, followed by a brief discussion of *electron paramagnetic resonance* which is the nuclear resonance phenomenon seen in the metastable helium magnetometer used in the ASQ-81. Those readers whose interest in the ASQ-81 magnetometer is primarily functional may proceed to "Helium Magnetometer Operation." However, everyone is encouraged to read the entire section to obtain a better understanding of the why and how of system operation.

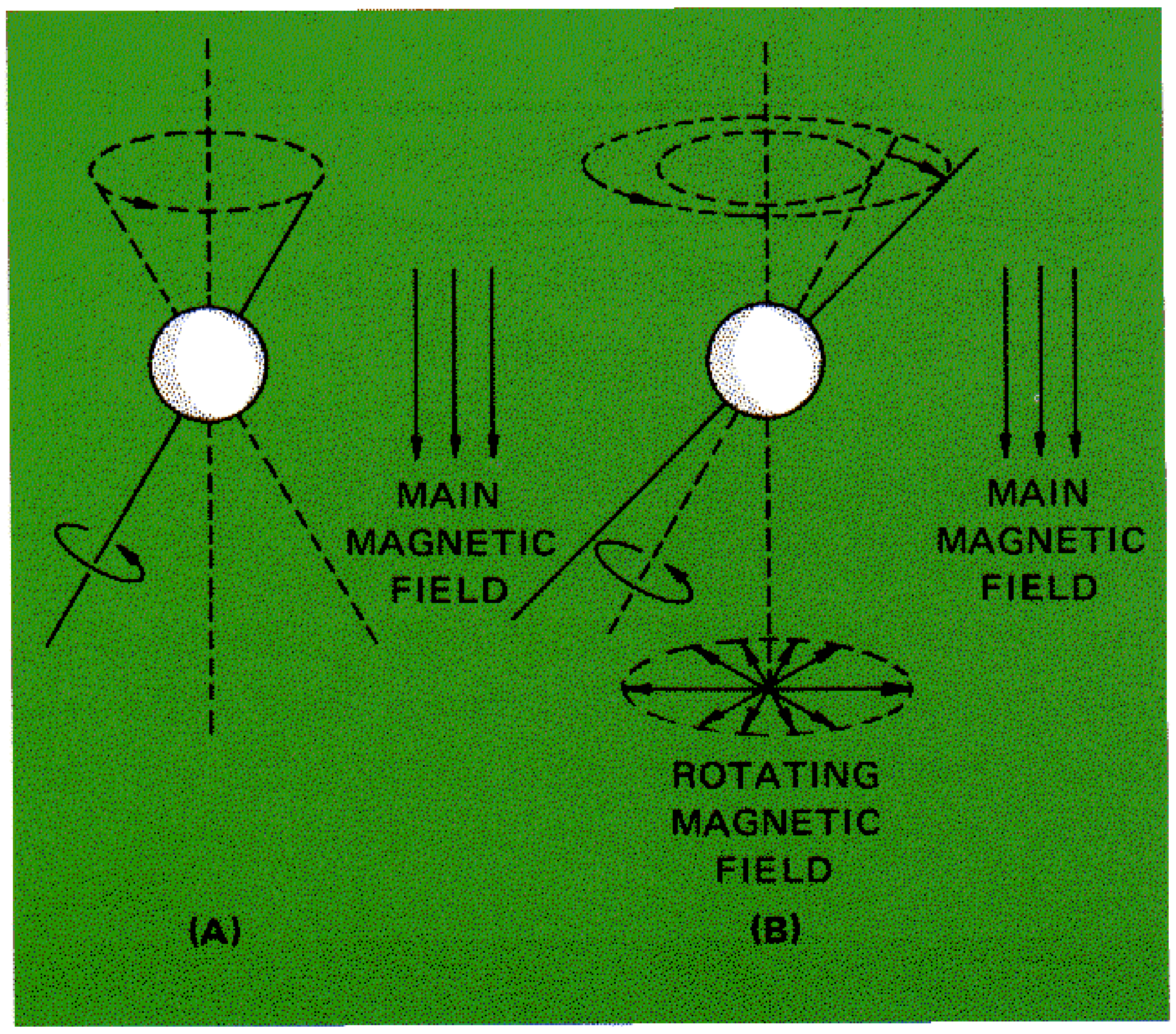
Figure 6. ASQ-10 MAD Detector Head



Magnetic Nuclear Resonance Nuclear resonance is based on the theory of atomic structure which states that the atom is considered to be a nucleus around which one or more electrons are orbiting. The nucleus has a positive charge because protons are part of it. The electrons have a negative charge that causes the atom to be neutral. The electrons and the nucleus have a spin and, because of the spin and the charge, a magnetic moment results. In the strict sense, nuclear resonance is a phenomenon of the nucleus shifting energy levels due to application of external forces. In the broad sense, it is any ascending energy level shift caused by external magnetic forces which force one type of spinning-charged particle or the other, or both, to flip, thus reorienting their magnetic poles.

The electron also is spinning about its own axis (much like the earth orbits around the sun once a year and spins about its axis once a day). This spin causes the electron to have a magnetic moment, much like a small magnet and to exhibit the characteristics of a tiny gyro. As is the case with a mechanical gyro, a force applied to the electron causes it to process, resulting in the wobble motion of the electron's spin axis, as shown in Figure 7A. Furthermore, the magnetic characteristics of an electron make it possible to substitute a magnetic field force *(earth's magnetic field)* for the mechanical force normally utilized to precess a conventional gyro. In addition to this, if a rotating radio frequency (r.f.) magnetic field is applied perpendicularly to the main magnetic field, the electron precesses further. This condition is depicted by the dash lines in Figure 7B as an increased wobble motion of the electron's spin axis.

Figure 7. Electron Precession



When the r.f. is adjusted until it reaches the natural frequency of the particular material in use (helium in this case), the deviation of the spin axis of the electrons tends to increase and paramagnetic resonance is achieved. *Electron paramagnetic resonance is resonance in which the electron is the only particle shifting energy states.* Resonance occurs when the angular velocity of the rotating magnetic field is approximately the natural spin axis wobble rate of helium electrons. This wobble rate is called the *Larmor frequency* or precession rate. As the electrons are caused to precess more by the external r.f. magnetic field, the amplitude of the precession becomes so great the electrons jump to a higher energy level, at which time light energy is absorbed by the helium. Light is used initially to increase the energy level of the electrons to a *metastable energy state,* an energy state which is a higher energy level with a much longer lasting duration than any other excited level. Helium is one of the elements or materials which can assume a metastable energy level.

The ASQ-81 uses electromagnetic radiation in the form of low frequency polarized light to periodically increase the energy level of the electrons and orient the magnetic moments of the atoms and their electrons on a plane in the direction of the light beam. This procedure is known as optical pumping. The pumping action of the light energy causes the electrons to jump from the ground energy level (E_0) two energy levels (E_2). Excited energy state 2 (E_2) has a very short life time without external excitation. Since the light is pumping, the electrons tend to fall back towards the stationary state (E_0), but must pass through energy state 1 (E_1). Due to certain rules of quantum mechanics involving conservation of energy, the electrons stay in E_1 100 to 1000 times longer than at any other excited energy level.

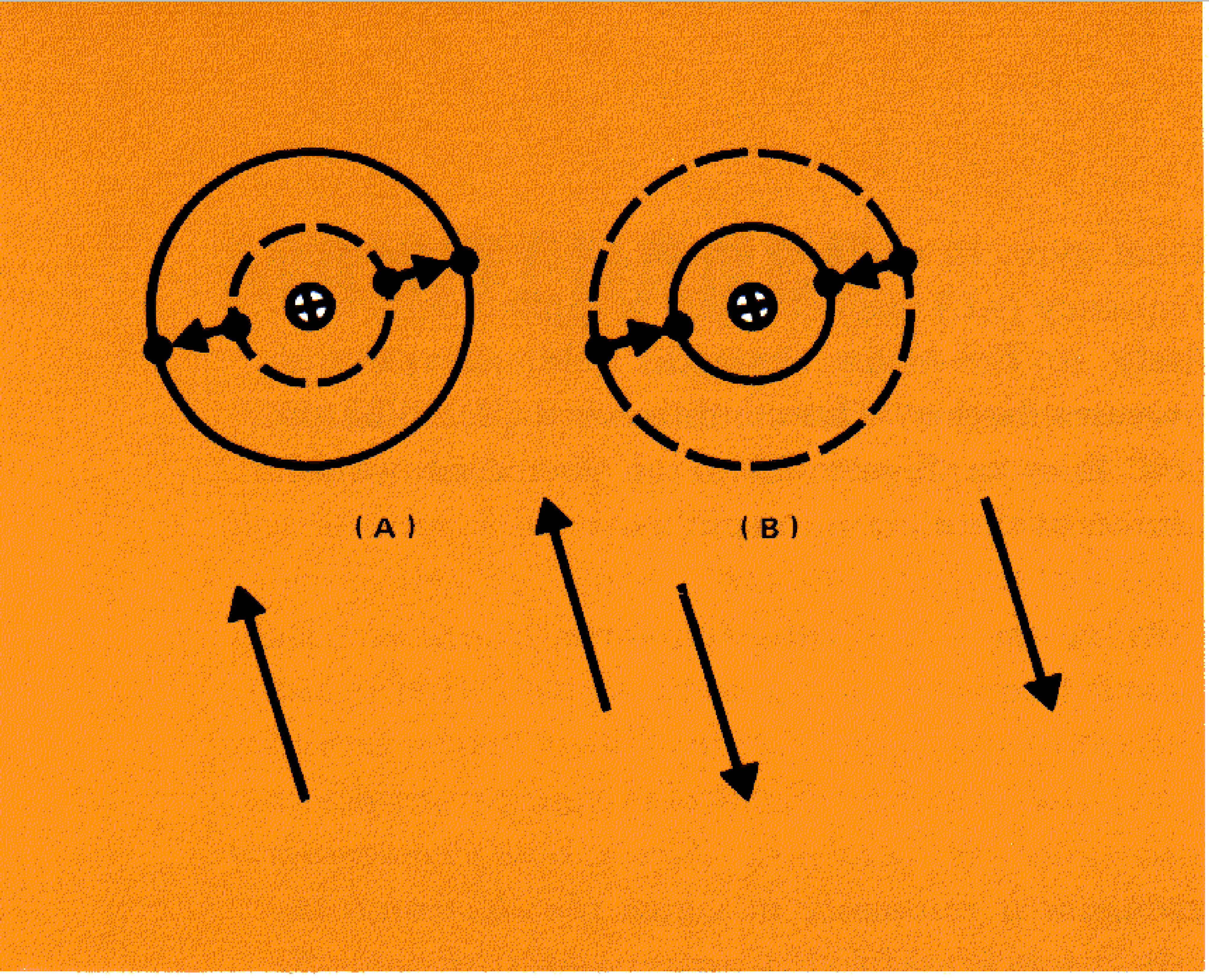


Figure 8. Helium Atom (A) Absorbing Energy and (B) Radiating Energy

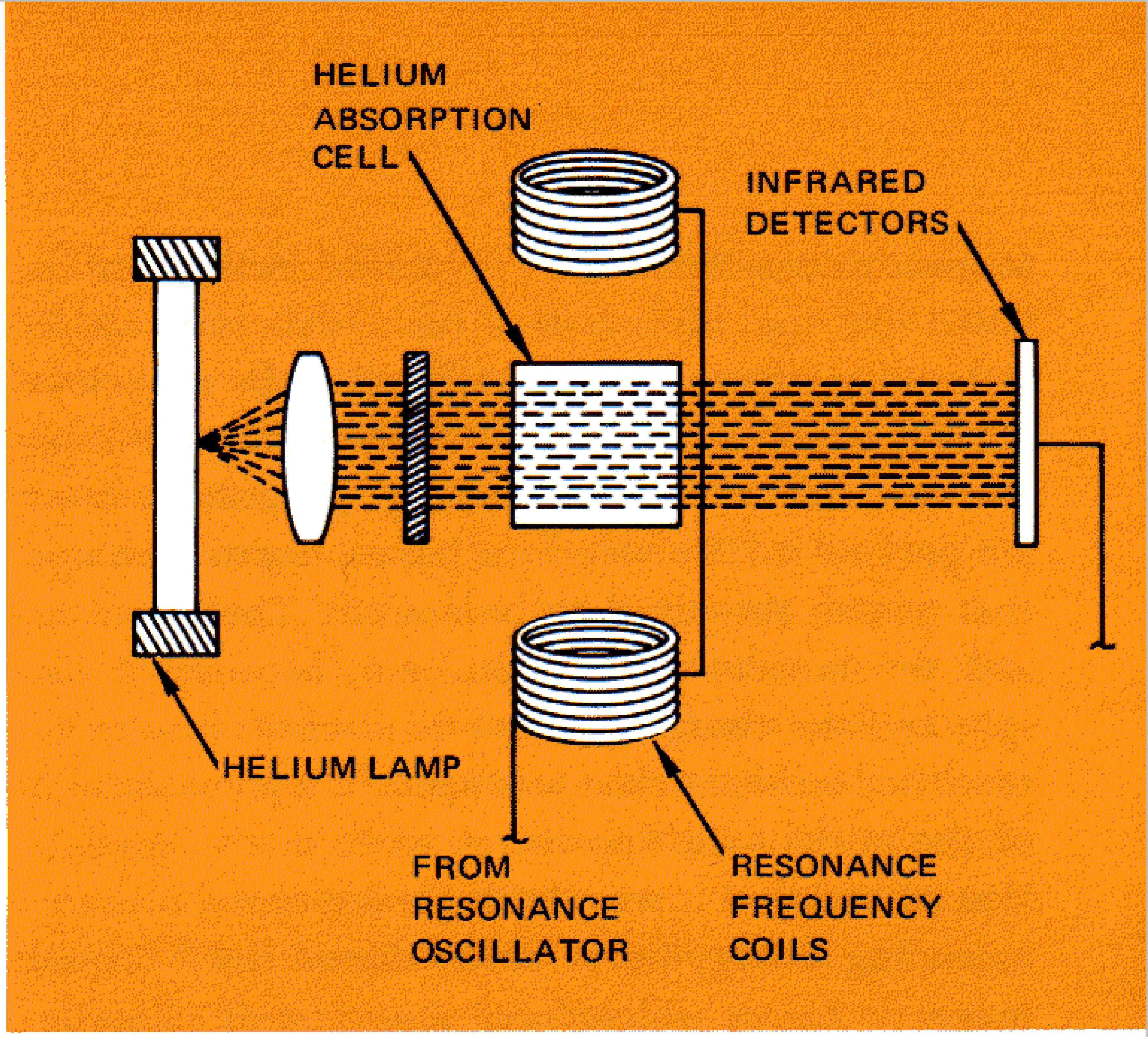


Figure 9. Essential Parts of Helium Magnetometer

It can readily be seen, as we continue to pump (periodically excite) the helium, the majority of electrons at any one time will congregate at the E_1 or metastable excited state. This is necessary because if resonance of unaligned ground state helium were attempted with an external rotating field, only a small percentage of the gas would change state and absorb light energy, thus making detection of resonance difficult. However, with the atomic system aligned and excited when resonance occurs, a great majority of the atoms change state and an easily-monitored amount of light is absorbed. We achieve a metastable state in the gas in order to have a relatively stable higher energy level in a much larger number of atoms. This produces a much greater change, statistically speaking, when resonance occurs and a second quantum energy level jump takes place.

As explained in detail later, optical energy is absorbed and released by the electron during these energy level transitions. It should be noted here that resonance can apparently be achieved only in certain solids and liquids with loosely knit atomic structures and in gases such as helium.

So far we have discussed the energy level change of the helium atom electrons by the use of an external magnetic field (supplied through coils) oriented 90° to the earth's field, rotating at the Larmor frequency of the electron which was determined by the earth's magnetic field strength. Because primary interest is in the changes in the earth's magnetic field, there must be a means for detecting and measuring these changes. Since the precession or Larmor frequency of electrons varies with magnetic field intensity at the rate of 28 Hz per gamma, monitoring the Larmor frequency changes is a convenient method for tracking magnetic field intensity.

However, a small change in the Larmor frequency of electrons is difficult to measure directly. It is more convenient and accurate to make an indirect measurement by monitoring the definite increase in light energy absorption that occurs at resonance. The atoms then give us some of this light energy as the Larmor frequency shifts away from the externally applied field's frequency and resonance is lost. Thus, variations in the earth's magnetic field strength are reflected by the changes in the quantity of light passing through the helium gas. Helium gas is contained in a transparent container called an absorption cell.

As shown in Figure 8A, energy is absorbed in forcing electrons to jump from one orbit to another orbit at a greater distance from the nucleus. Figure 8B depicts the atom giving up energy as the electrons move back to their original orbit.

When the oscillator supplying the coils (resonance oscillator) reaches the Larmor frequency, light is absorbed; when the resonance oscillator comes off the Larmor frequency, light is emitted. Thus the Larmor frequency (which represents the earth's magnetic field strength) can be tracked by knowing the resonant oscillator frequency when the absorption cell is absorbing energy.

As shown in Figure 9, the light energy source for the magnetic resonance magnetometer is a helium lamp. The infrared (IR) detector, which is a very sensitive and trouble-free device, is utilized to track the light energy level changes.

Helium Magnetometer Operation The necessary components for a magnetic resonance magnetometer are shown in Figure 9. The external energy source, the helium discharge lamp, applies light energy to the transparent helium-filled absorption cell. Light energy is absorbed or given up by the helium atoms as the cell goes in and out of resonance caused by slight changes in the earth's field. The IR detector, mounted on the other side of the absorption cell from the light source, picks up these energy level changes and produces an electrical output. The energy level is low when the cell is resonant, high when it is not resonant. The IR detector output signal can then be used to keep the resonance oscillator on or about the Larmor frequency of the helium in the cell, regardless of changes in the earth's magnetic field. A magnetic anomaly can then be detected when the resonance oscillator center frequency makes a typical swing within the bandpass relative to the flight envelope of the P-3 type aircraft.

If the resonance oscillator frequency were always maintained precisely at resonance, the IR output would simply be a very low dc level. This low dc level would be difficult to monitor and would not provide a phase change above and below resonance. For this reason the r.f. energy applied to the resonance coils is frequency modulated by 430 Hz. The resultant variation in the magnetic field forces the helium atoms in and out of resonance around the null and provides a phase reference signal to a phase detection circuit. Figure 10 depicts the phase reversal above and below resonance. Note also that at resonance, which is the normal operating point, the IR detector acts much like a full wave rectifier. As a result of this rectifying action the IR output at resonance is a pulsating 860-Hz signal. The detector also acts like a discriminator, in that the FM swing of the resonance oscillator is converted to an AM output when near the resonant frequency of the helium atoms in the absorption cell. This is true because its output goes positive with each increase in light energy given off by the absorption cell.

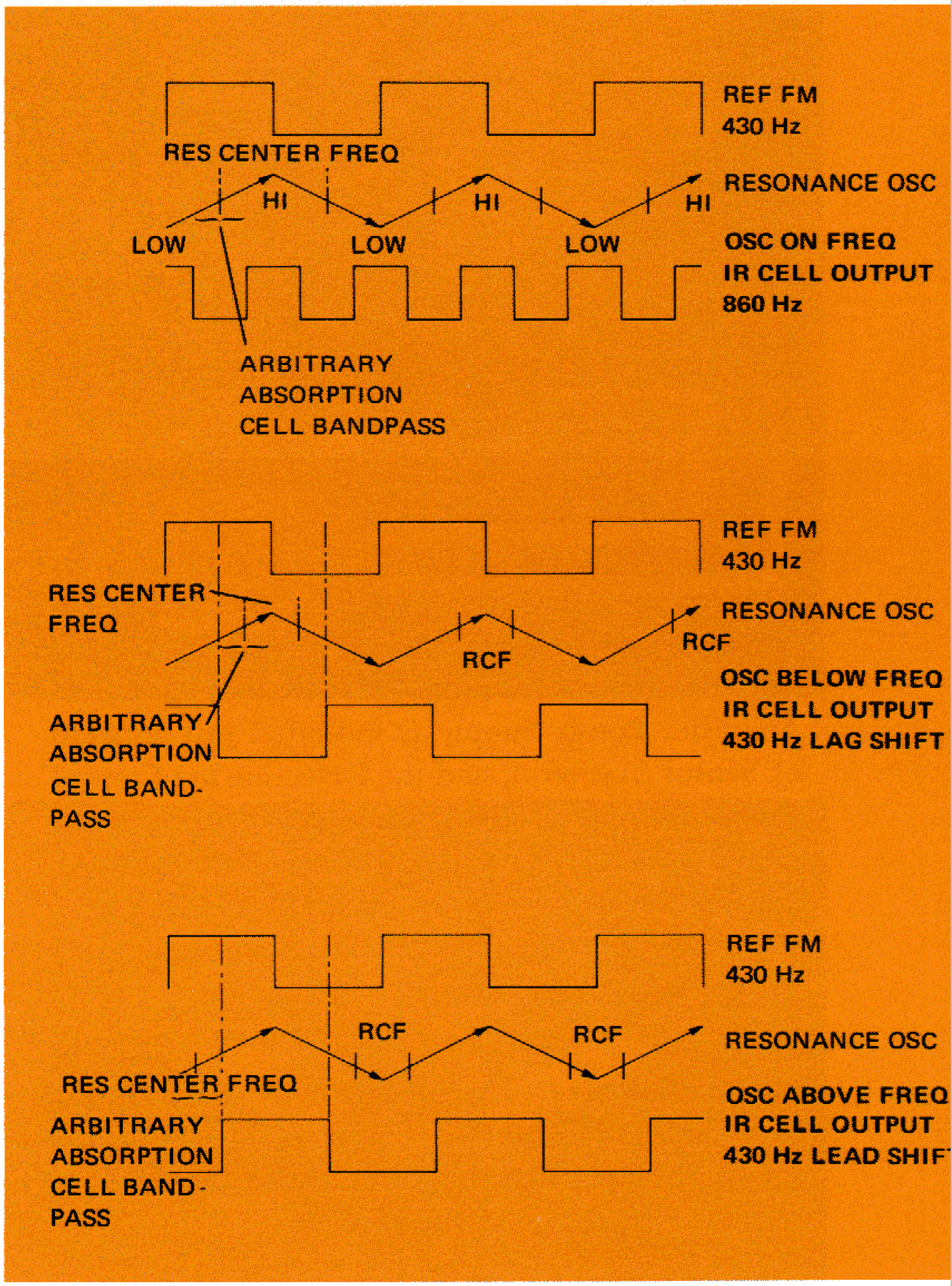


Figure 10. Resonance Waveforms from Detector

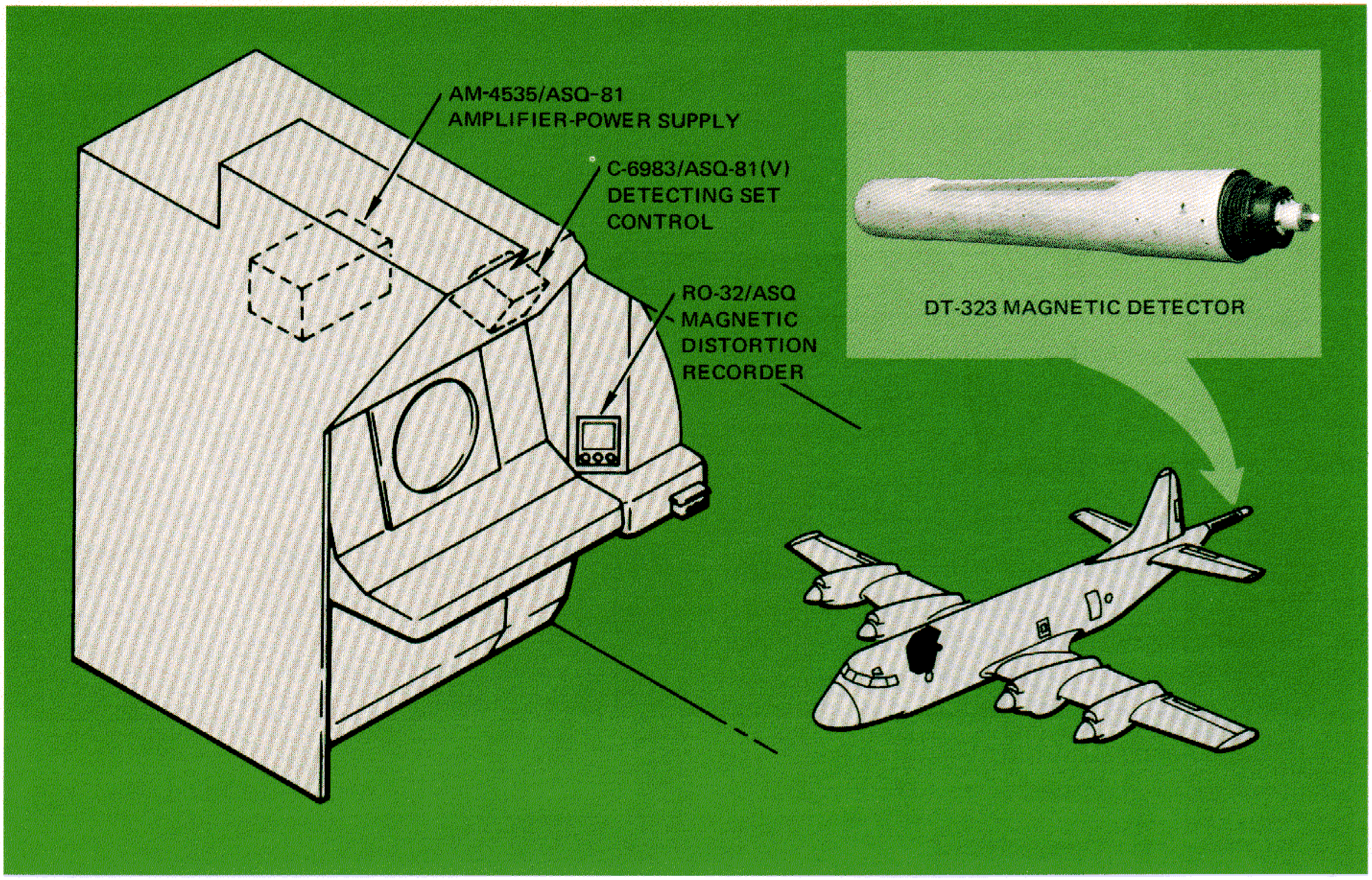


Figure 11. Location of AN/ASQ-81 MAD System Components

AN/ASQ-81 SYSTEM The AN/ASQ-81 system includes the Magnetic Detector, the Amplifier-Power Supply, and the Detecting Set Control. The Magnetic Detector is mounted in the tail boom, the Amplifier Power Supply is mounted just forward of Sensor Station 3, and the Detecting Set Control Unit is mounted on the Sensor Station 3 console. (See Figure 11.) The RO-32 Strip Chart Recorder remains the same as in the ASQ-10 system. Figure 12 shows the controls and indicators as they appear on the equipment.

Magnetic Detector The description given in the preceding paragraphs is for the basic sensing element. The actual arrangement of the ASQ-81 magnetometer is shown in Figure 13.

The detection element includes six separate helium absorption cells and six IR detectors, arranged in pairs, with the pairs oriented at 90° to each other. This configuration insures that one or more of the pairs is at least partially in line with the earth's field regardless of aircraft attitude or direction of flight. Since the signal from all three detector pairs is combined in the summing amplifier, the final output to the amplifier-power supply is not affected by aircraft maneuvers.

Two helium discharge lamps provide light energy to the three absorption cell pairs in the magnetic detector. The lamps are ignited by the 52-KHz 1500-V supply shown in Figure 14. After ignition the lamps are maintained in an ionized state by the 49.6-MHz output of the exciter-regulator.

In addition, the magnetic detector unit includes a pressure transducer and an altitude compensator circuit. The output of the pressure transducer varies the frequency of a 5.4-KHz oscillator in the altitude compensator at the rate of 1 Hz/Ft of altitude change. The total swing of the oscillator is 5.0

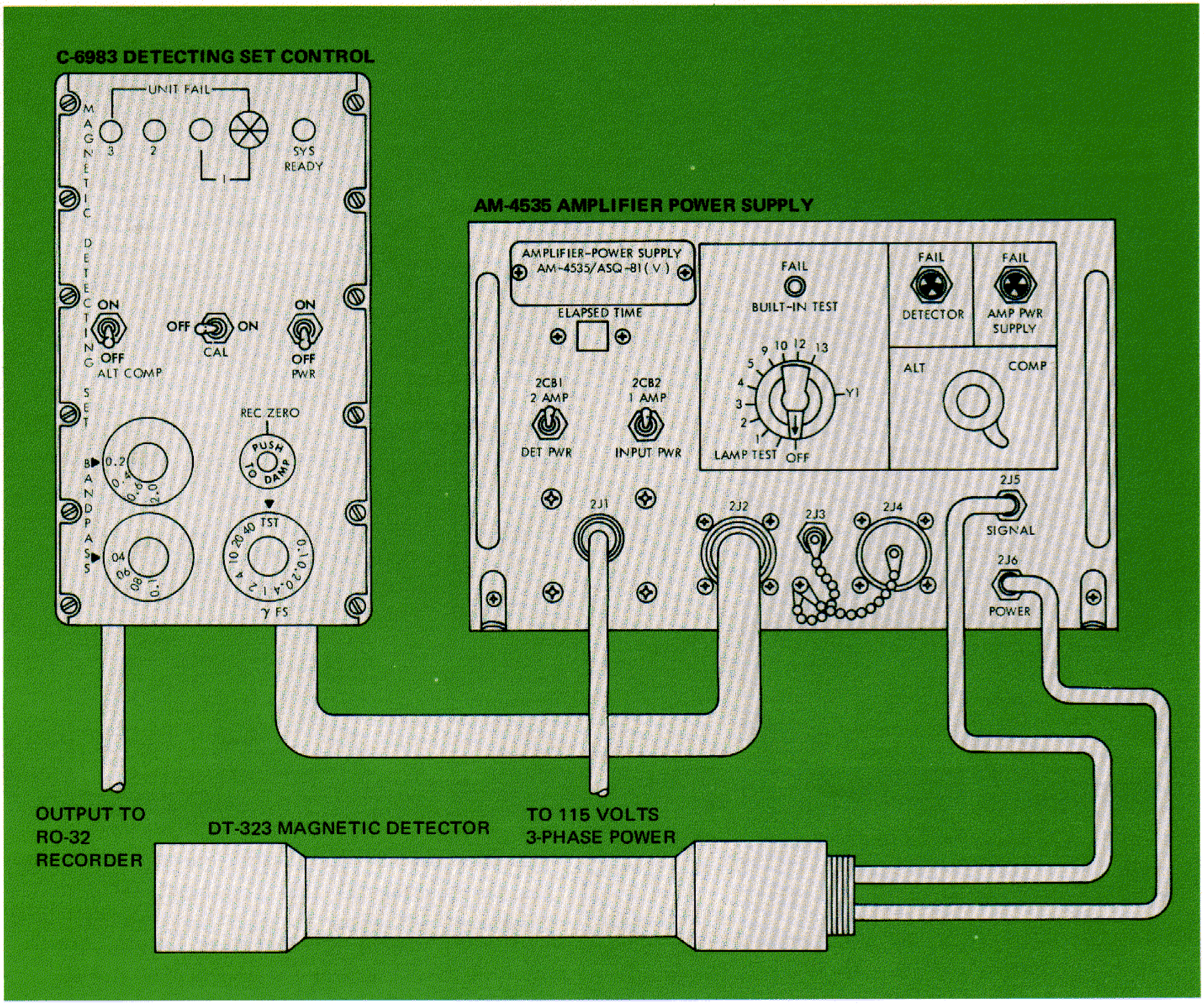


Figure 12. AN/ASQ-81 System Units

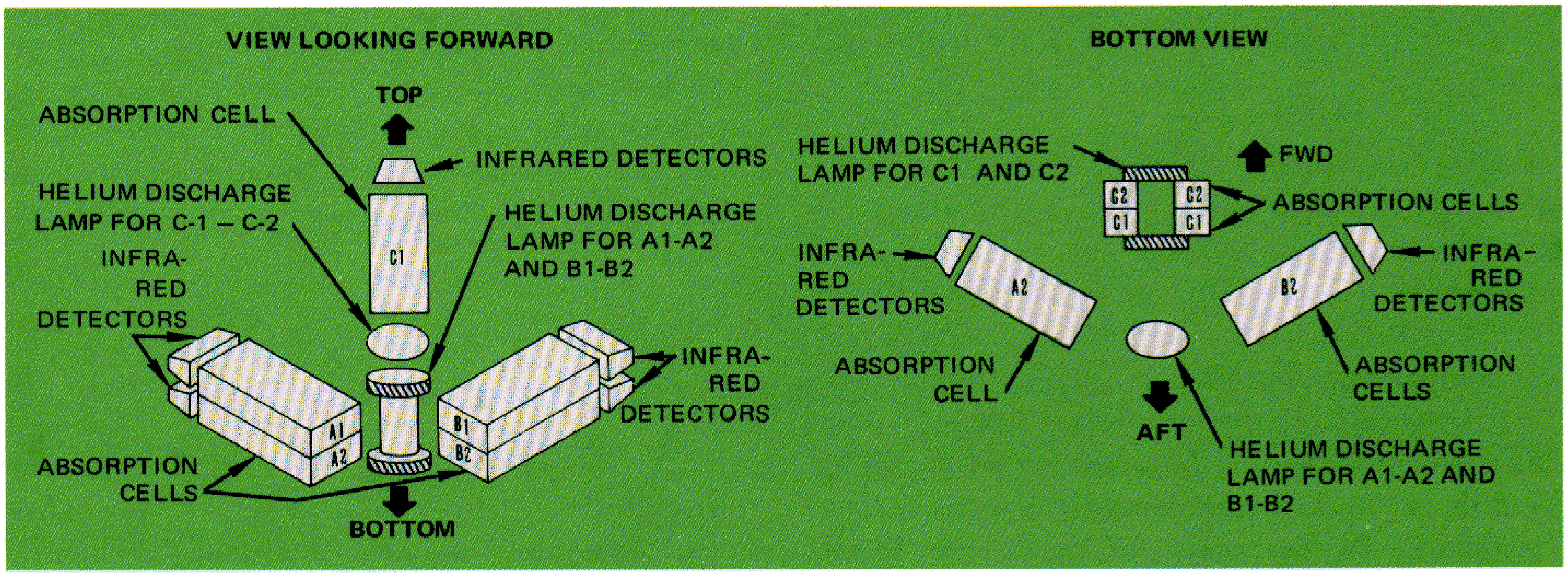


Figure 13. AN/ASQ-81 Magnetometer Axis Orientation

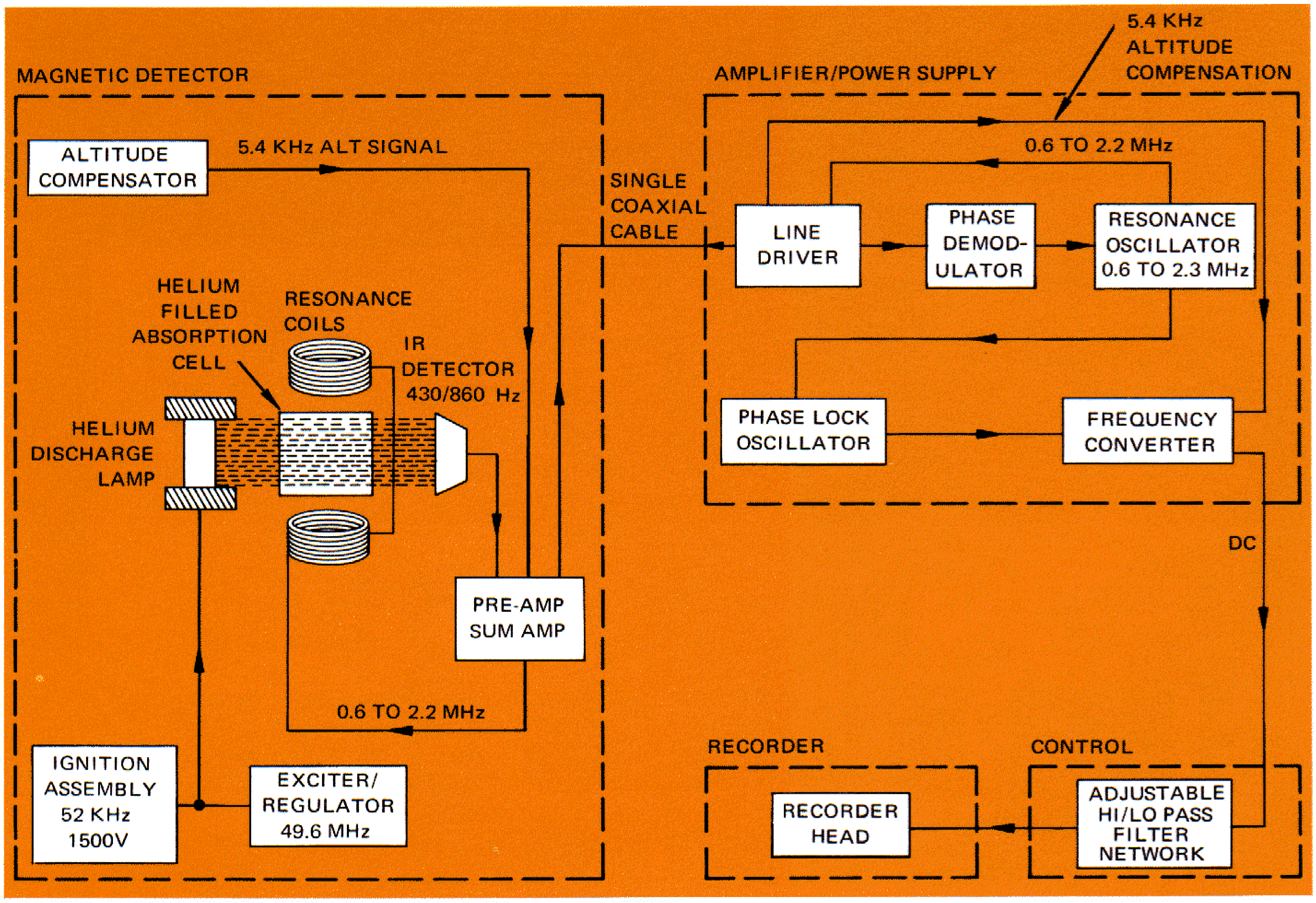


Figure 14. ASQ-81 Simplified Block Diagram

KHz to 5.8 KHz which can compensate for a maximum of ±400-ft rapid altitude variations. Additional circuitry in the amplifier-power supply converts the altitude-induced frequency change to a varying dc level. This dc level may, at the operator's discretion, be used to correct the final signal output.

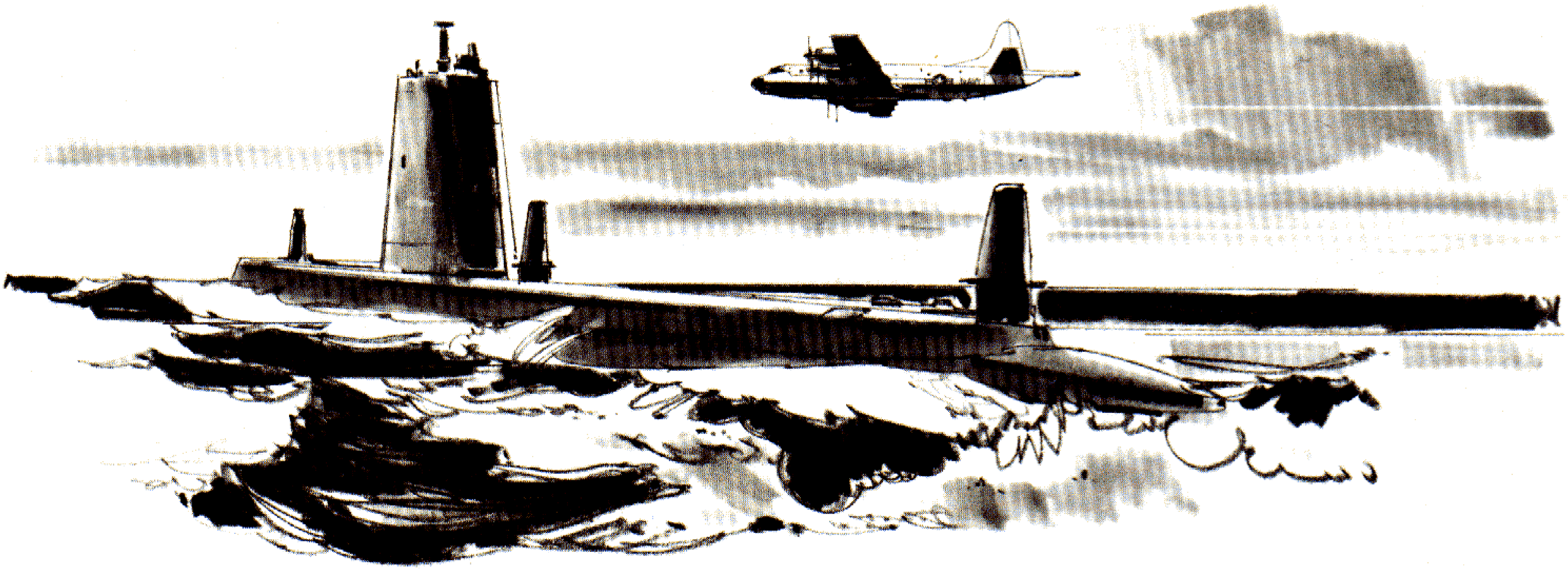
Amplifier-Power Supply A single coax cable carries all signals between the magnetic detector and the amplifier-power supply. The signals on the coax include the 5.4-KHz altitude signal, the 430/860 Hz IR signal, the 0.6 to 2.2 MHz resonance coil excitation, and the 52-KHz ignition signal. The 52-KHz ignition signal is monitored first by system BITE for its presence and, with the latest configuration, is checked approximately 5 minutes later (maximum warmup time) for its absence. If the signal is not present initially, the system timer stops and shows a detector head failure. Approximately 5 minutes later the absence of the signal is checked. The absence of the signal indicates that the intensity of both helium lamps was sufficient to cause the system to switch from ignition to the normal 49.6 MHz exciter signal. If this switchover did not occur, the system removes power to the detector head and illuminates the detector failure indicator. Bandpass filters at both ends of the coax route the frequencies to their respective circuits.

The IR detector error signal (anytime 430 Hz is present, this represents an error between the Larmor frequency and the resonance oscillator center frequency; 860 Hz indicates matched frequencies) is phase-detected in the phase demodulator to produce a variable positive or negative dc voltage. The variable dc is, in turn, used to change the resonance oscillator frequency. This closed loop action keeps the oscillator always at resonance as the earth's field strength changes or as an anomaly is detected. When neither 430 Hz nor 860 Hz is coming back from the magnetic detector, the system senses this and causes the resonance oscillator to sweep its entire range (0.6 MHz to 2.2 MHz). During the down sweep of the resonance oscillator, when 430/860 Hz is detected, the sweep is stopped and the loop is closed. The resonance oscillator output is routed to the resonance coils via the line driver and the preamplifier/summing amplifier. It is also applied to the phase lock oscillator assembly.

The purpose of the phase lock oscillator is to reproduce the resonance oscillator frequency, retain the magnetic anomaly, and eliminate the 430-Hz modulation signal. The oscillator is voltage controlled by a dc signal from the acquisition circuit until it locks on to the resonant frequency. After lock-on, the phase detector provides the control necessary for tracking the resonant frequency. This tracking is similar to the way the resonant oscillator tracks the Larmor frequency.

The frequency converter develops a variable dc signal proportional to the frequency shift of the phase lock oscillator. The frequency converter also generates a variable dc voltage proportional to the frequency shift of the 5.4-KHz altitude compensation signal input supplied by the magnetic detector unit. If the operator selects ALT COMP on the control unit, the two dc signals are combined by a summing network to compensate for magnetometer altitude change effects. Two driver amplifiers provide a primary output to the detecting set control unit and an auxiliary output for test purposes.

The primary output is passed through a series of high and low pass filters in the control unit. The filters remove all extraneous frequencies and noise from the variable dc except the anomaly signal. The filtered dc output drives the pen of the RO-32 Recorder to produce a permanent record of the submarine anomaly.



MAINTENANCE

Maintenance requirements for the AN/ASQ-81(V) system are based on a maintenance concept which calls for maximum support at the organizational level within a minimum amount of down time. To achieve this objective, stress was placed on extensive use of built-in test equipment (BITE), functional packaging, ready access to internal test points, and use of captive fasteners on assemblies and subassemblies which must be removed for maintenance.

Built-in-test equipment (BITE) provides automatic checkout, an indication of system failures, and identifies failures down to a replaceable component or module. Table 1 indicates the functions monitored with BITE and the mode in which they are monitored. Initial turn-on of the equipment during the automatic checkout starts a sequence of events that makes an end-to-end test of the equipment. Table 2 lists the complete timing sequence involved in automatic lock-on and self-test sequences. Lock-on occurs when the resonant oscillator stops searching and the system is ready to look for an anomaly.

The AN/ASQ-81(V) system contains four BITE cards: 2A6, 2A7, 2A8, and 2A11, which are located in the amplifier power supply unit. In addition to controlling the normal timing and automatic sequencing of the system, the BITE cards monitor various outputs of circuits by looking at signals called "bits". If a bit is missing during the period it is monitored, the BITE section shows the appropriate failure by lighting a lamp and setting an annunciator. The operator can readily identify a failure in the system by observing illumination of the unit fail indicator lamps on the detecting set control. Units are identified as follows:

Unit 1 - Detecting Set Control

Unit 2 - Amplifier Power Supply

Unit 3 - Detecting Head

The signals continuously monitored by BITE are: altitude compensator, resonance oscillator, 430-Hz reference, 860-Hz tuning fork oscillator, frequency converter phase detectors reference signal from the delay line, power supplies, and phase lock oscillator. Once locked-on, the BITE monitors the output from the automatic gain control (AGC) amplifier, ignition signal, phase sensitive detector,

TABLE 1. AN/ASQ-81(V) BIT DETECTORS

Continuous Monitor	Monitor During Lock-On	Monitor During Self-Test
Altitude Compensator Resonance Oscillator 430-Hz Reference 860-Hz Tuning Fork Oscillator Delay Line Power Supplies Phase Lock Oscillator	Automatic Gain Control (AGC) Amplifier Ignition Phase Sensitive Detector (PSD) Integrator Frequency Converter	MAD Filters Frequency Converter

TABLE 2. AN/ASQ-81(V) BITE SEQUENCE TIMING CHART

	TIME (T) (SECONDS)		
	START	STOP	EVENT
Normal Time Out	T_0	0.4	Clear timer and all registers
	4.2	4.6	Check ignition signal - stop timer if absent
	*75	---	Check ignition signal - remove power if present
	T_1	0.4	Clear timer and all registers (except ignition register)
	T_1		Start filter damping signal
	T_1	4.2	Drive resonance oscillator down
	4.2	10.0	Drive resonance oscillator up
	5.4	5.8	Check the three frequency converter bit detector outputs
	9.6	10.0	Check integrator and resonance oscillator high limits
	10.0	20.0	Drive integrator and resonance oscillator down for lock-on
	19.6	20.0	Check integrator and resonance oscillator low limits if not locked-on
	20.0	20.4	Check for possible detector/detector amplifier fail if not locked-on
	20.4	---	Recycle to second T_1 if not locked-on - Ready light blinks
		20.4	Stop filter damping if locked-on - Light Ready light
Extended Self-test Time out	**20.4	---	For self-test mode only, start 3.6 calibrate signal if locked-on
	**75	---	For self-test mode only, check signal circuit filter outputs

**ECP 0010 extends the allowable time to ≈5 minutes, and Ready Light blinks to indicate power is on.*

***Self-test only.*

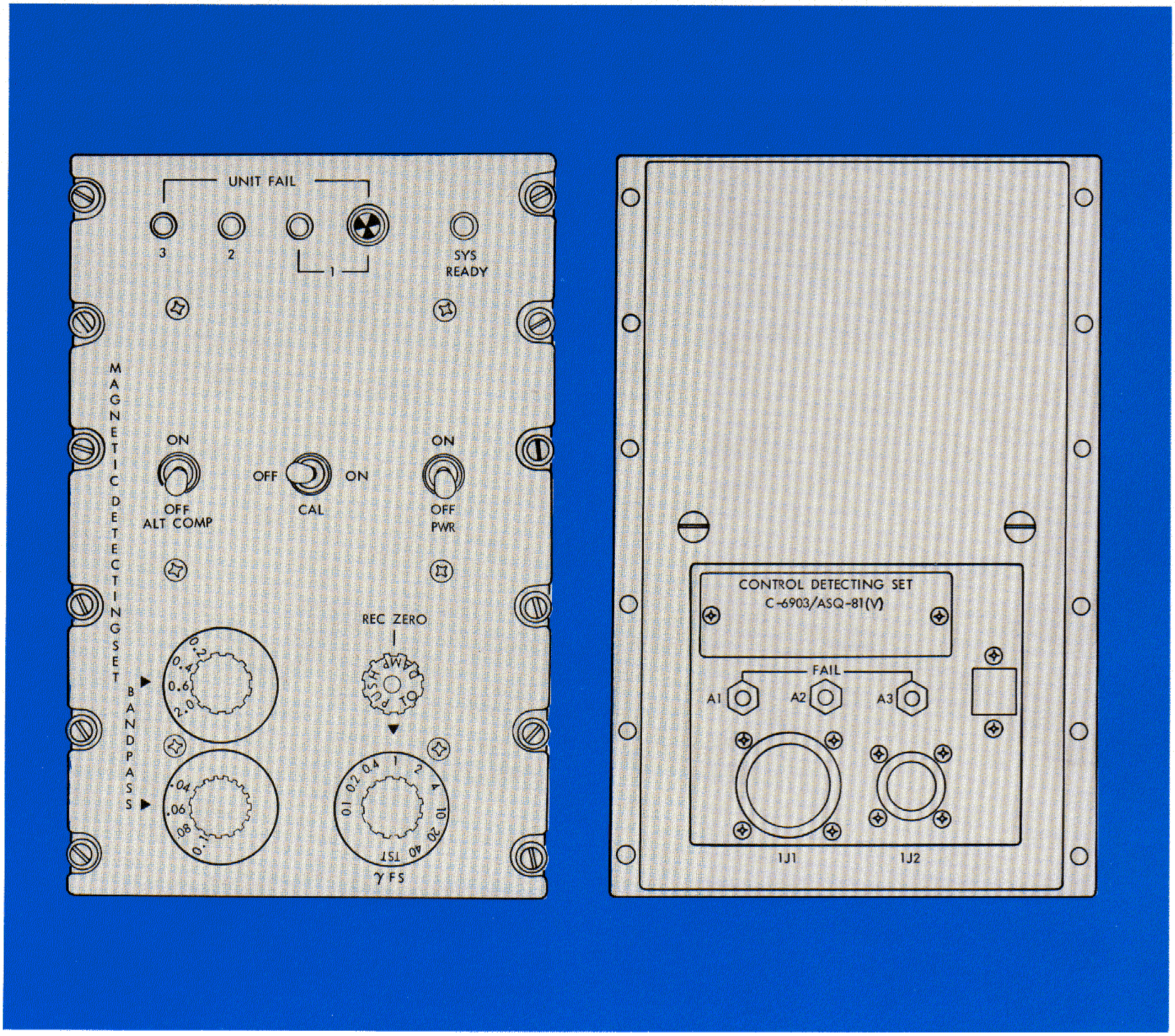
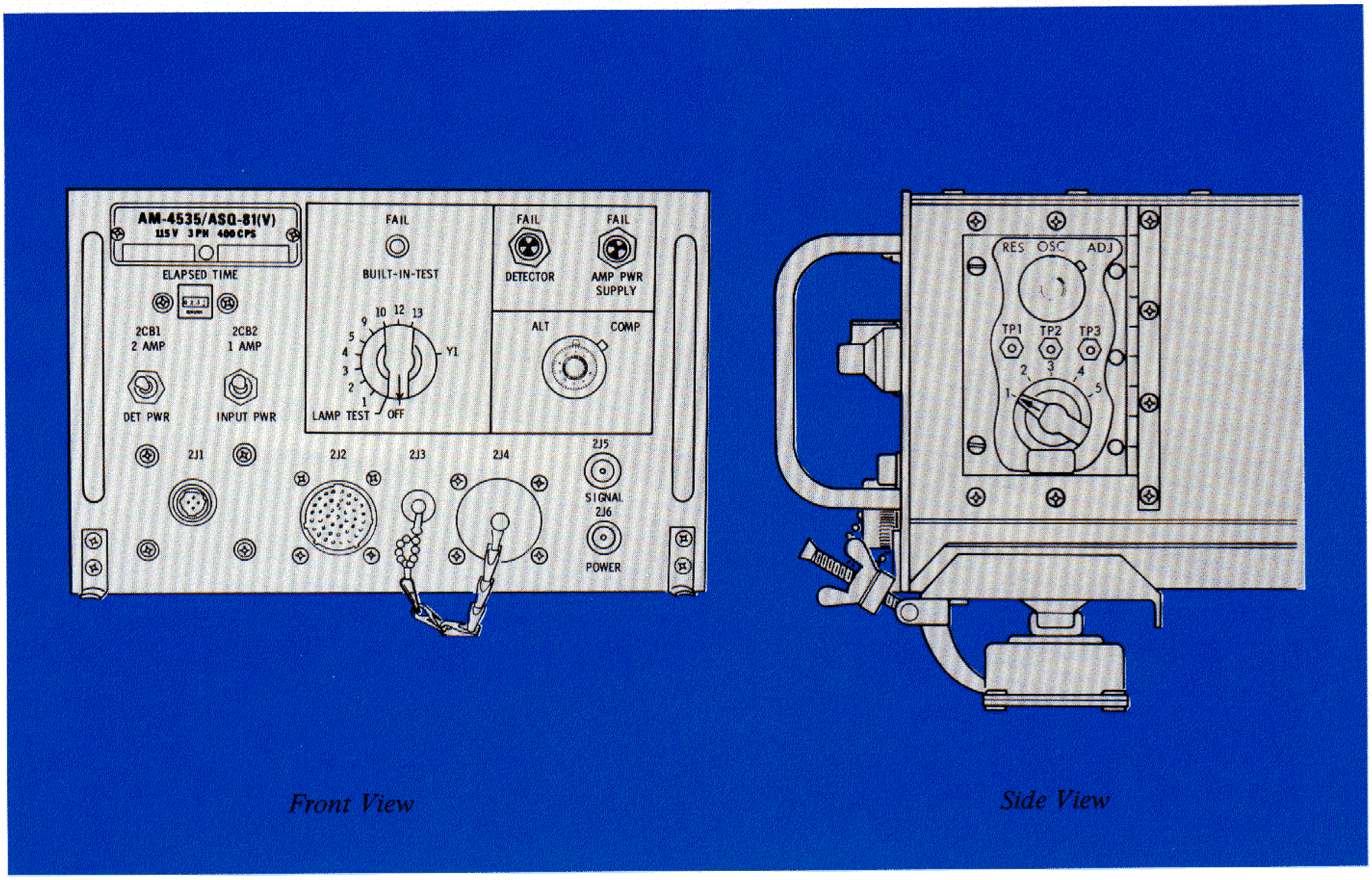


Figure 15. C-6983/ASQ-81(V) Magnetic Detecting Set Control Unit

integrator, and frequency converter. When the self-test mode is selected with the full-scale gamma switch, the three filter cards in the control unit are monitored. Lamps on the rear of the control unit (see Figure 15) indicate which filter card is defective; the lamp will extinguish when the problem is corrected. This is unlike the annunciators which lock-up and require power recycle to reset.

To further isolate troubles in the amplifier power supply (Figure 16), a BITE switch is provided that manually selects 14 built-in tests. A fail lamp above the BITE switch illuminates when a test has failed. By referring to the Maintenance Instructions Organizational Magnetic Anomaly Systems manual (NAVAIR 01-75PAC-2-8.5) and applying the particular failure indications, the faulty module can usually be found.

Further checks of the entire system can be made with the aid of a maintenance panel on the side of the amplifier power supply. During the two open loop positions, the resonance oscillator control is switched to "manual" by the 10-turn potentiometer located above the switch. During these modes, system noise level can be checked and



Front View

Side View

Figure 16. AM-4535/ASQ-81(V) Amplifier Power Supply

various test points can be checked for proper indications as defined in the maintenance manual mentioned previously. AGC can be bypassed to check full signal strength from the detector head. A dummy head position allows the system to lock-on to a synthesized signal produced in the amplifier power supply, thus eliminating the requirement for a signal from the detecting head. If the mode selector switch is in any position other than normal, the side door will not close.

If changing the module, indicated as failed, does not clear the trouble, suspect the BITE cards, as they are not checked by the system. Because the automatic lock-on sequence is under the control of the BITE card, the system cannot work normally with a defective BITE card. A bad BITE card can be detected by substituting BITE cards until the trouble is located.

Three test points (TP1, TP2, and TP3) and an auxiliary coaxial connector (aux coax) are available to monitor the system as follows: the TP1 is used to check for error signals from the head in AGC bypass and checks the AGC action during normal or dummy head; the TP2 is used to check for the output of the phase-sensitive demodulator to determine a plus or minus dc voltage; the TP3 is used to check the dc control voltage to the resonance oscillator, and the aux coax checks the systems for frequency, amplitude and waveform of the resonance oscillator during normal, dummy head, and open loop modes.

CONCLUSION

A general discussion of Magnetic Anomaly Detection has been presented in this issue. More detailed information covering specific areas of MAD will be given in a subsequent issue of the Digest.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OUR MEN ON THE SPOT

Frank Hampton, "Stumpy" Hollinger and Bob Keiser

Celebrate 35 Years With Lockheed

A vital part of Lockheed-California Company's Product Support team is the Field Service Representative, our "man on the spot" with you, the customer. Although we are proud of all of our Representatives, we are taking this occasion to recognize three in particular – Frank G. Hampton, Richard C. "Stumpy" Hollinger, and Robert M. Keiser – each of whom has served Lockheed for thirty-five years, most of which has been spent in the field.

All three men have worked their way up through the ranks, one starting at Lockheed as a frame builder while the other two began as apprentices. Despite the exacting demands placed upon them by the nature of being Field Service Representatives, each has raised a fine family, and Stumpy Hollinger and Bob Keiser are brothers-in-law. These same two gentlemen, we might add, are expert golfers and display trophies from service tournaments as proof. Frank Hampton favors bowling, is an avid armchair quarterback, and finds relaxation in woodworking.

Frank G. Hampton, Resident Service Manager at FAIRWINGSLANT, NAS Brunswick, Maine, began his career with Lockheed in September, 1937 as an apprentice. Like many service representatives in the aircraft industry, he learned the fundamentals of his future vocation in the factory working at such jobs as frame builder, general mechanic, experimental mechanic "A", and plumbing and hydraulics development mechanic. As he progressed, Frank held the positions of leadman, supervisor, group supervisor, and assistant foreman. With this background of many facets of aircraft manufacture and maintenance, Frank joined Lockheed's Product Support organization in November, 1949 and began his career as a Lockheed Field Service Representative.

In the twenty-three years since Frank joined Product Support, he has been a Service Representative to the U.S. Navy for P2V and subsequently for P-3 aircraft. He has accompanied squadrons during deployments, as well as serving at such bases as NATC Patuxent River, NAS Quonset Point, NAS Whidbey Island, and NAS Brunswick. Assignments have also taken him to NAS Alameda and NWTC Albuquerque. Since 1962, Frank has been designated a Resident Service Representative (Resident Service Manager), first at NATC Patuxent River and now at NAS Brunswick. The following excerpt from an unsolicited commendation is exemplary of Frank's performance. ". . . Mr. Hampton's technical assistance has been invaluable in solving many difficult maintenance problems. He has continually exhibited an outstanding degree of initiative and technical competence . . ."

Richard C. "Stumpy" Hollinger has been Lockheed's man on the move for SP-2 aircraft for the past twelve years. Since 1960 Stumpy has been operating out of NAS Glenview, Illinois as an Airframe Representative, assisting CNARESTRA operate and maintain their SP-2 Neptunes. From this central location, he has travelled the width and breadth of the United States, visiting one reserve unit after another to help ensure their operational readiness.

Stumpy started at Lockheed in July 1937 as a frame builder, then was a final assembler, flight line senior inspector, and group head before becoming a Field Service Representative in 1942. His first field assignment was with a P-38 mobile training detachment that toured the Zone of Interior. Following this duty, Stumpy was sent to North Africa and detached to the U.S.S.R. to support P-38 shuttle flights to that nation. In the years after World War II, he was a Service Representative for both the civil and military versions of the Constellation aircraft, then in 1948 became a Service Representative for the P2V Neptune and has been with this aircraft ever since. His assignments have taken him to Panama, Puerto Rico, Newfoundland, and Australia, as well as to numerous stateside Naval bases. Like Frank and Bob, Stumpy has been the subject of many letters of commendation from the squadrons with whom he has served.

Robert M. Keiser is one of our P-3 Airframe Representatives at FAIRWINGSLANT, NAS Brunswick, Maine. He began his career at Lockheed in April 1937, signing on as an apprentice, then learned the ropes during the next few years as a riveter, frame builder, skin fitter, field service mechanic "A", and flight line mechanic "A". Bob has been a leadman in several job categories, was a group leader, and has been a supervisor in the factory. Prepared with this broad knowledge of the disciplines of the aircraft industry, he became a Service Representative in August 1950, helping support the P2V Neptune at NAS Jacksonville.

For the next fourteen years, Bob continued to support the Neptune, accompanying Navy squadrons on deployment all over the world. Among the locations that his assignments took him were Port Lyautey, Morocco; Whidbey Island; Brunswick; Alameda; Key West; Keflavik, Iceland; North Island; and Rota, Spain. In 1964, while the Navy was in the midst of transitioning from SP-2's to P-3's, Bob also switched to the Orion, providing technical assistance at Patuxent River; Argentia, Newfoundland; Adak; Sangley Point, Republic of the Philippines; Norfolk; and again at Brunswick. Among the kudos earned by Bob is a letter from a squadron commander that reads in part, ". . . Such skill, determination, and devotion to duty are in the highest tradition of the naval service . . . ."

PATRON ONE

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