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INTRODUCTION TO CHAPTER FOUR - ANTISUBMARINE WARFARE:

The detection of enemy submarines is one of the Navy's major problems today. There are many types of equipment in use that aid in the detection and tracking of submarines. As an aviation electronics technician, you will need to understand the principles used in these equipments. Once again, every effort is made to discuss as many different platforms and equipments as possible.

SONAR PRINCIPLES

Learning Objective: Identify factors that affect the behavior of a sound beam in water.

The word sonar is derived from the initial letters of **S**ound, **N**avigation, and **R**anging. The word sonar is used to describe equipment that transmits and receives sound energy propagated through water.

Airborne sonar equipment is commonly called "dipping sonar," and is used aboard various helicopters. Sonobuoys, also a form of sonar, will be discussed later in this chapter.

The operating principles of sonar are similar to that of radar, except sound waves are used instead of radio frequency waves. When the sound wave strikes an object, some of the energy reflects back to the source from which it came. Since the speed of the sound wave and the time it takes to travel out and back are known, range can be determined. By knowing the direction from which the sound echo is reflected, the operator can determine the bearing information.

The type of sonar equipment that depends primarily on a transmitted sound wave and the reception of an echo to determine range and bearing

of a target is known as echo-ranging or active sonar equipment. Another type of sonar equipment is referred to as listening or passive sonar. This type of sonar uses the target as the sound source. Although most sonar equipment can be used in either mode of operation, surface ships and aircraft generally use the active mode, and submarines use the passive mode. In echo-ranging sonar equipment, the source of the sound wave is a transducer. The sonar transducer is a watertight unit that is used to convert electrical energy into acoustical energy and acoustical energy back into electrical energy. The transducer acts like a loudspeaker in an office intercom system, alternately converting electrical energy into mechanical energy and mechanical energy into electrical energy. The transducer acts like an underwater loudspeaker during transmission and an underwater microphone during reception. The sound waves produced by a sonar transducer are represented by the circular lines shown in figure 4-1. Refer to this figure as you read the following text.

When the diaphragm of the transducer moves outward, it moves the water next to the diaphragm. This produces a high-pressure area or compression in the water. When the diaphragm of the transducer moves inward, the water next to the diaphragm moves inward. Thus, a low-pressure or rarefaction is produced in the water. As long as the diaphragm is vibrating, alternate compressions and rarefactions travel outward from the transducer in the water. The distance between two successive rarefactions or two successive compressions is the wavelength of the sound wave. The frequency (in hertz) of the sound wave is the number of wavelengths that occur every second.

FACTORS AFFECTING THE SOUND BEAM

The particular sound waves of interest to the sonar operator are the waves that leave the sonar transducer in the form of a beam and go out into the water in search of a submarine. If the sound beam finds a target, it will return in the form of an echo. The use of sonar equipment depends on the presence and the recognition of an echo from a target. Detection of the echo depends on the quality and relative strength (loudness) of the echo compared to the strength and character of other sounds, since they tend to mask or cover it.

The sonar operator should know what factors can weaken the sound beam as it travels through water, what fa

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