U.S. NAVY

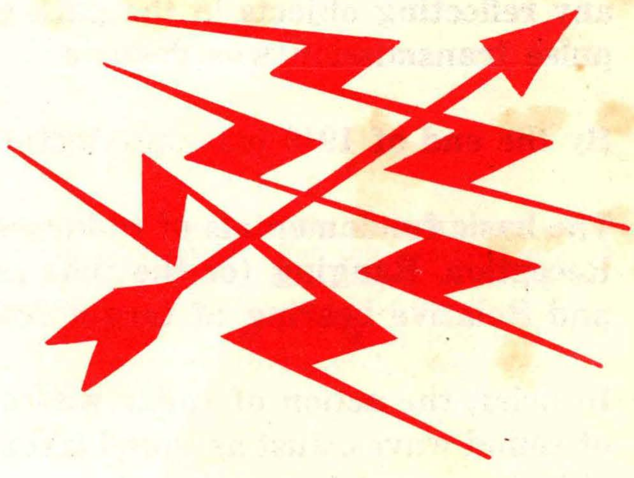
Radio

Aircraft

Detection

And

Ranging



MAINTAINED BY ELECTRONIC
TECHNICIAN MATES

How it started: RADAR

In 1922, in the course of some studies of high frequency radio transmission, Dr. Albert Taylor of the Naval Research Laboratory observed that a ship passing in the path of the radio waves reflected some energy back towards the transmitter, thus resulting in what might be called a "radio echo" from the object.

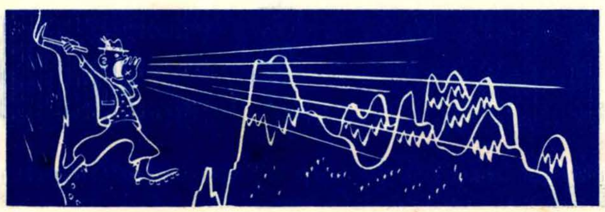
Between 1922 and 1930 further tests proved the military value of this principle for the detection of surface vessels which were hidden by smoke, fog, or darkness. Further experiments were conducted with carefully guarded secrecy.

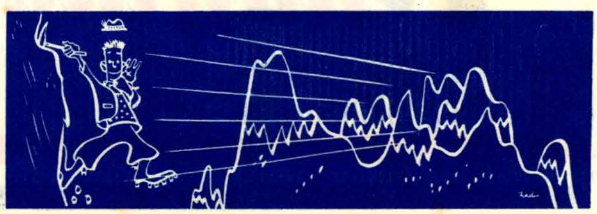
By 1936 the United States was working on the development of a radar warning system for coastal frontiers, using the principle of sending out a short burst, or "pulse" of radio transmission. Echoes would then be received from any reflecting objects in the path of the radio waves. Between 1936 and 1940 pulse transmission was developed further.

By the end of 1940 mass production of radar equipment was on its way.

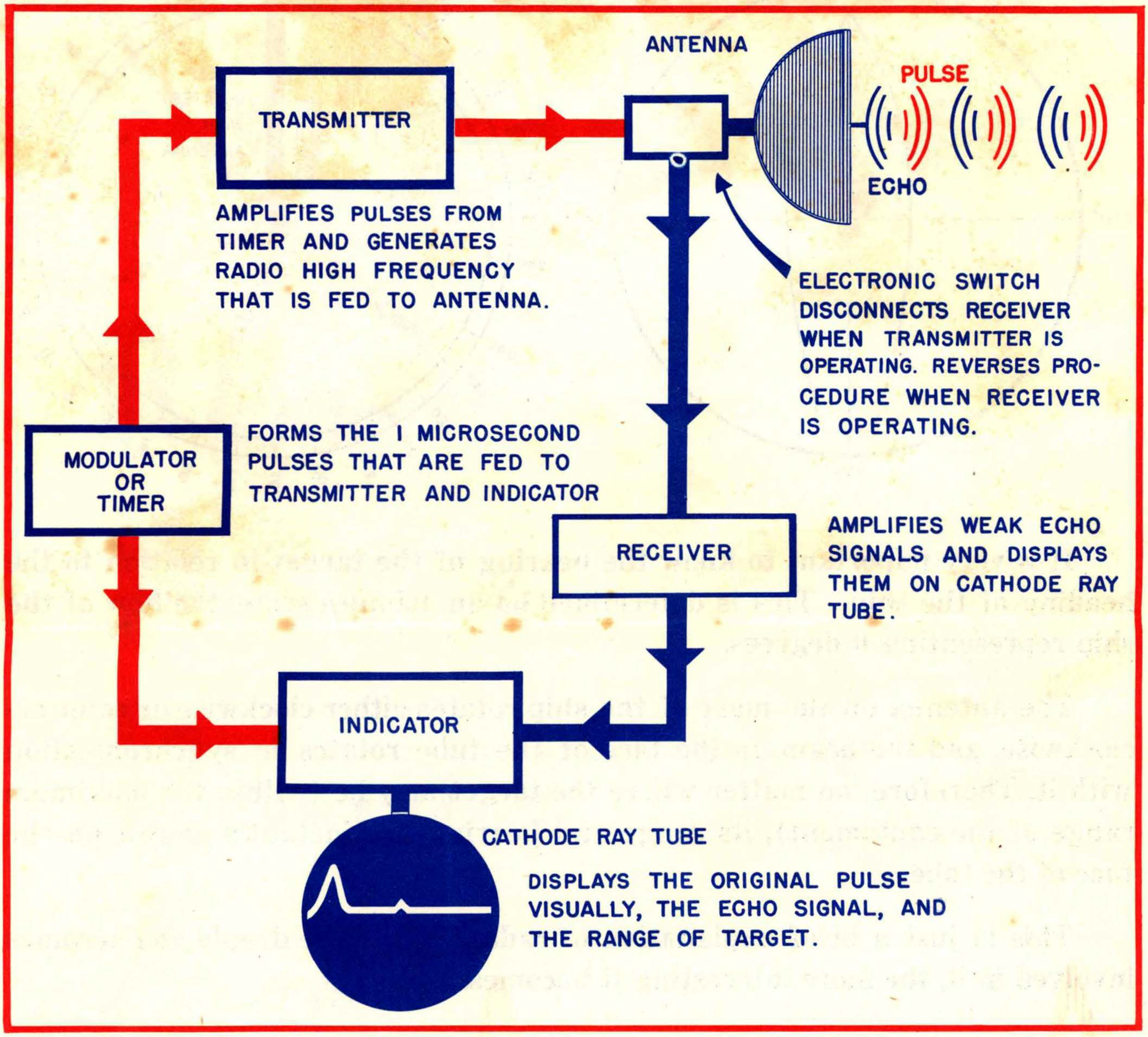
The basic fundamentals of radar consists of four phases, namely: Radiation, Reception, Ranging (or the time required to send out and receive a signal) and Relative bearing of target from ship.

In brief, the action of radar waves can be favorably compared to the action of sound waves. Just as sound is reflected in the form of an echo when it hits an object, so, too, is a radar signal reflected when it hits a target. (See illustration below.) In speed they differ: radar waves travel 186,000 miles per second; sound waves travel approximately 0.2 miles per second.





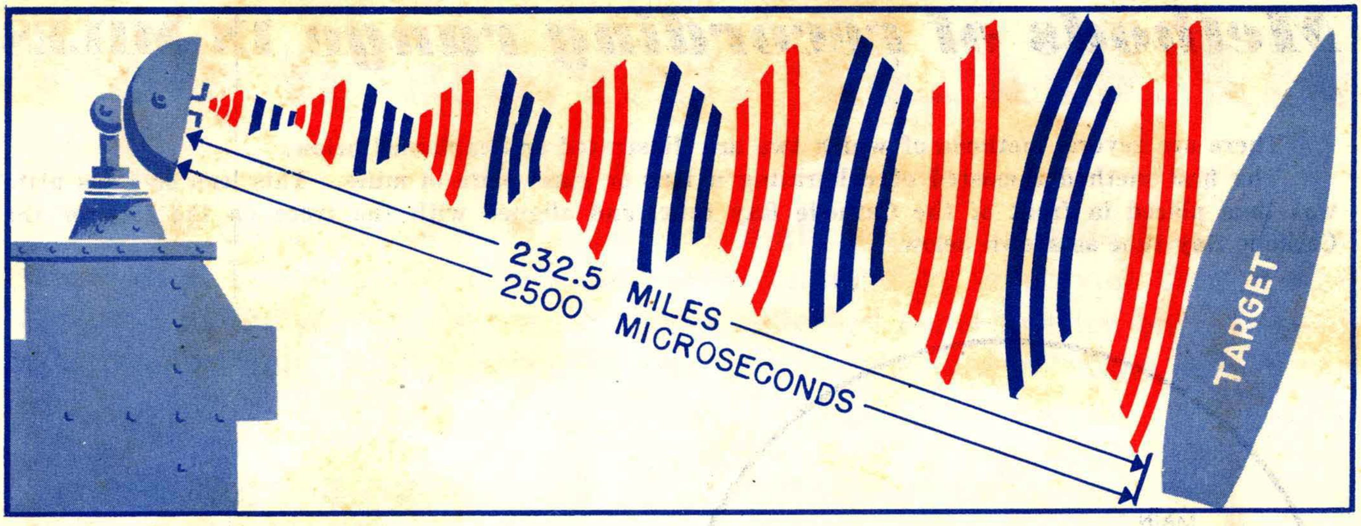
How it works . . .



Determining the range . . .

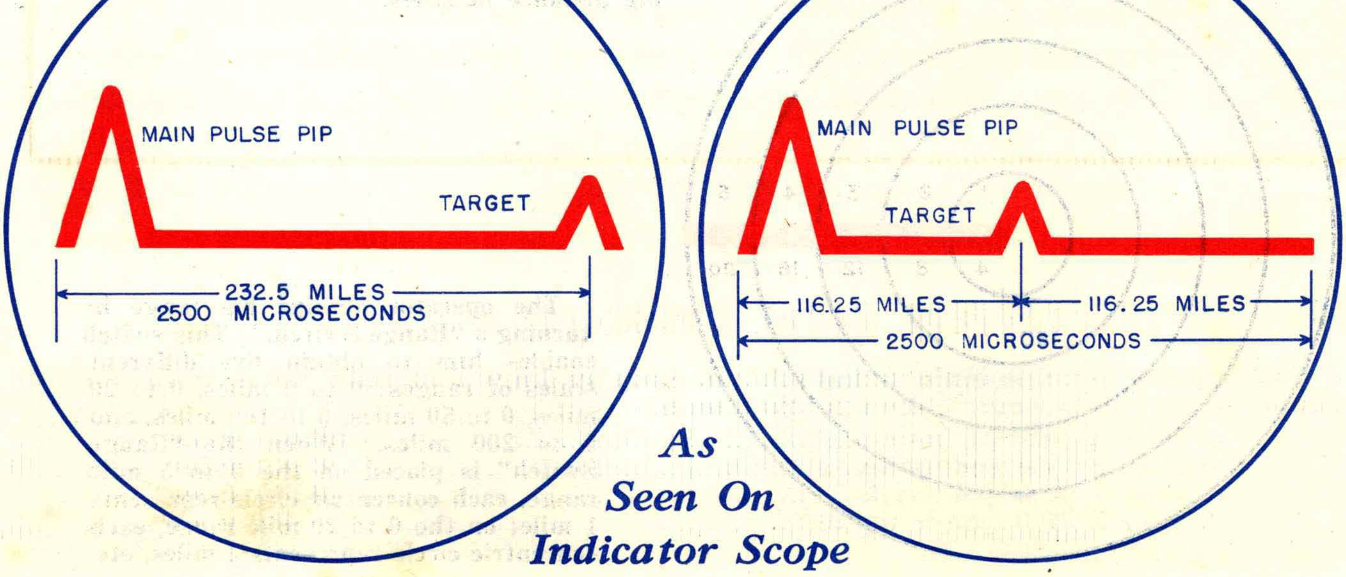
This is purely a simple mathematical solution. Since we know that radio waves travel 186,000 miles per second we can break it down in this manner.

A pulse in 1 second travels	**186,000 miles**
A pulse in ½ second travels	**93,000 miles**
A pulse in ¼ second travels	**46,500 miles**
A pulse in $\frac{2500}{1,000,000}$ seconds travels	**465 miles**



Range is defined as the time required for a radar wave to travel from the antenna to an object and return. Thus, if a radar wave in 2500 microseconds travels 465 miles, the distance of the target from the ship will be ½ of 465 or 232.5 miles.

The distance from the ship to the target is shown on the Cathode Ray tube by means of a beam that sweeps horizontally across the face of the tube. The movement of the beam across the face of the tube is simultaneous with the movement of the main pulse from the antenna to the target and back to the ship.

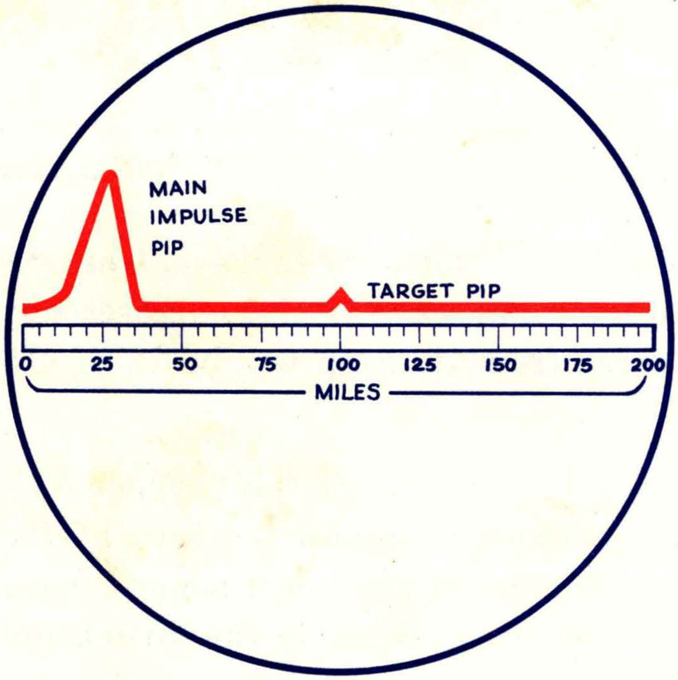


As Seen On Indicator Scope

Methods of recording range IN MILES

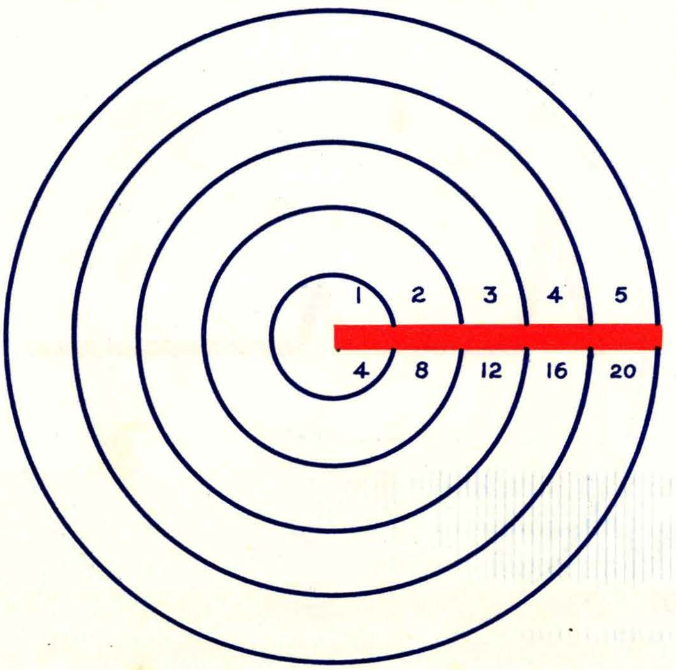
There are several methods of which two are illustrated and explained below.

The first method consisted of calibrating a lens or glass plate in miles. This lens or glass plate was then placed in front of the Cathode Ray tube, and aligned with the trace on the face of the Cathode Ray tube as shown below.



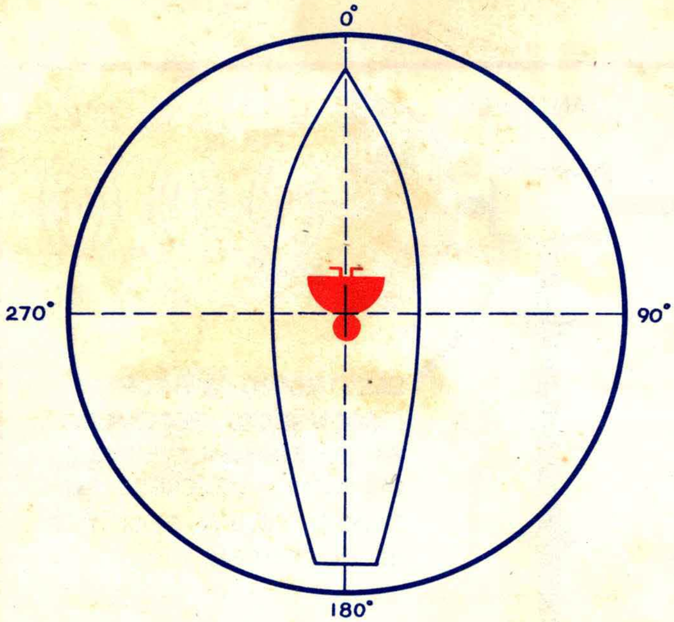
This shows the main pulse pip to be at 0 miles and the target pip to be at 100 miles from ship.

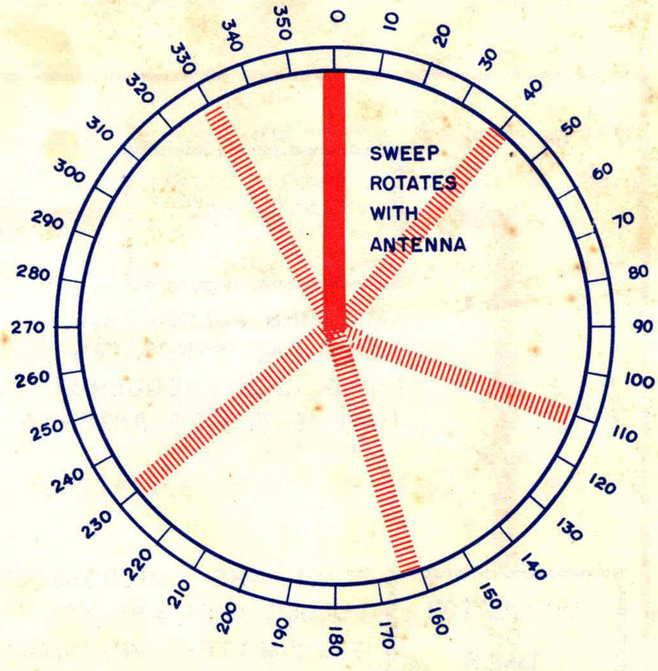
This earlier method was found to be not entirely accurate because it relied too heavily upon mechanical adjustment. For this reason the electronic system has been developed, in which the beam sweeps from the center of the face of the tube to the edge. The face of the tube is divided into five concentric circles, each circle representing distance in miles.



The operator obtains his range by turning a "Range Switch." This switch enables him to obtain five different scales of ranges: 0 to 5 miles, 0 to 20 miles, 0 to 50 miles, 0 to 100 miles, and 0 to 200 miles. When the "Range Switch" is placed on the 0 to 5 mile range, each concentric circle represents 1 mile; on the 0 to 20 mile range, each concentric circle represents 4 miles, etc.

Relative Bearing of Targets -





It is very important to know the bearing of the target in relation to the heading of the ship. This is determined on an azimuth scale, the bow of the ship representing 0 degrees.

The antenna on the mast of the ship rotates either clockwise or counter-clockwise, and the beam on the face of the tube rotates in synchronization with it. Therefore, no matter where the target may be (within the maximum range of the equipment), its range and bearing are instantly shown on the face of the tube.

This is just a brief explanation of radar. The more deeply one becomes involved in it, the more interesting it becomes.