

# LOAN DOCUMENT

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| DTIC ACCESSION NUMBER                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <div style="border: 1px solid black; width: 100px; height: 80px; margin: 0 auto;"></div> <p>LEVEL</p>                                                                                         | <p>PHOTOGRAPH THIS SHEET</p>                | <div style="border: 1px solid black; width: 100px; height: 80px; margin: 0 auto; display: flex; align-items: center; justify-content: center;"> <span style="font-size: 2em;">①</span> </div> <p>INVENTORY</p> |      |      |      |      |             |  |               |  |  |  |  |  |  |  |    |  |               |  |                    |  |              |                             |     |  |                                                                                                                   |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p><u>NRL-MR-11</u></p> <p>DOCUMENT IDENTIFICATION</p> <p><u>20 May 52</u></p>                                                                                                                |                                             |                                                                                                                                                                                                                |      |      |      |      |             |  |               |  |  |  |  |  |  |  |    |  |               |  |                    |  |              |                             |     |  |                                                                                                                   |  |
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| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center;">ACCESSION FOR</td> </tr> <tr> <td style="width: 50%;">NTIS</td> <td style="width: 50%;">GRAM</td> </tr> <tr> <td>DTIC</td> <td>TRAC</td> </tr> <tr> <td>UNANNOUNCED</td> <td></td> </tr> <tr> <td>JUSTIFICATION</td> <td></td> </tr> <tr> <td colspan="2" style="height: 20px;"></td> </tr> <tr> <td colspan="2" style="height: 20px;"></td> </tr> <tr> <td colspan="2" style="height: 20px;"></td> </tr> <tr> <td colspan="2">BY</td> </tr> <tr> <td colspan="2">DISTRIBUTION/</td> </tr> <tr> <td colspan="2">AVAILABILITY CODES</td> </tr> <tr> <td style="width: 50%;">DISTRIBUTION</td> <td style="width: 50%;">AVAILABILITY AND/OR SPECIAL</td> </tr> <tr> <td style="height: 80px; vertical-align: middle; text-align: center;">A-1</td> <td></td> </tr> </table> |                                                                                                                                                                                               | ACCESSION FOR                               |                                                                                                                                                                                                                | NTIS | GRAM | DTIC | TRAC | UNANNOUNCED |  | JUSTIFICATION |  |  |  |  |  |  |  | BY |  | DISTRIBUTION/ |  | AVAILABILITY CODES |  | DISTRIBUTION | AVAILABILITY AND/OR SPECIAL | A-1 |  | <div style="border: 1px solid black; width: 200px; height: 150px; margin: 0 auto;"></div> <p>DATE ACCESSIONED</p> |  |
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| JUSTIFICATION                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                               |                                             |                                                                                                                                                                                                                |      |      |      |      |             |  |               |  |  |  |  |  |  |  |    |  |               |  |                    |  |              |                             |     |  |                                                                                                                   |  |
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| AVAILABILITY CODES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                               |                                             |                                                                                                                                                                                                                |      |      |      |      |             |  |               |  |  |  |  |  |  |  |    |  |               |  |                    |  |              |                             |     |  |                                                                                                                   |  |
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| A-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                               |                                             |                                                                                                                                                                                                                |      |      |      |      |             |  |               |  |  |  |  |  |  |  |    |  |               |  |                    |  |              |                             |     |  |                                                                                                                   |  |
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| <p>PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                               |                                             |                                                                                                                                                                                                                |      |      |      |      |             |  |               |  |  |  |  |  |  |  |    |  |               |  |                    |  |              |                             |     |  |                                                                                                                   |  |

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# NRL MEMORANDUM REPORT No. 11

A TWO HELICOPTER ATTACK SONAR SYSTEM  
(Proposal)

R.H. Mathes

SOUND DIVISION

20 May 1952



NAVAL RESEARCH LABORATORY, WASHINGTON, D.C.

DECLASSIFIED: By authority of  
OPNAVINST 5510.114, 27 Apr 88  
Cite Authority Date  
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7103/119

DATE: 31 October 1996

FROM: Burton G. Hurdle (Code 7103)

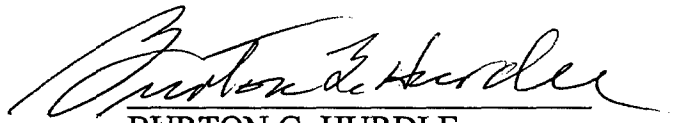
SUBJECT: REVIEW OF REF. (a) FOR DECLASSIFICATION

TO: Code 1221.1

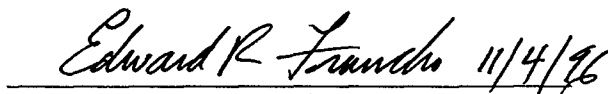
VIA: Code 7100

REF: (a) NRL Confidential Report #11 by R.H. Mathes, 20 May 1952 (U)

1. Reference (a) is a proposal for an ASW operational attack method employing two helicopters. One of the helicopters has a sonar system utilizing the Sector Scan Indicator (SSI) with the second helicopter deploying an acoustic transponder and attack ordnance. The report includes the operational method, the electronics required and a series of operational experiments.
2. The technology and equipment utilized in reference (a) have been superseded several times.
3. Based on the above, it is recommended that reference (a) be declassified with no restrictions.

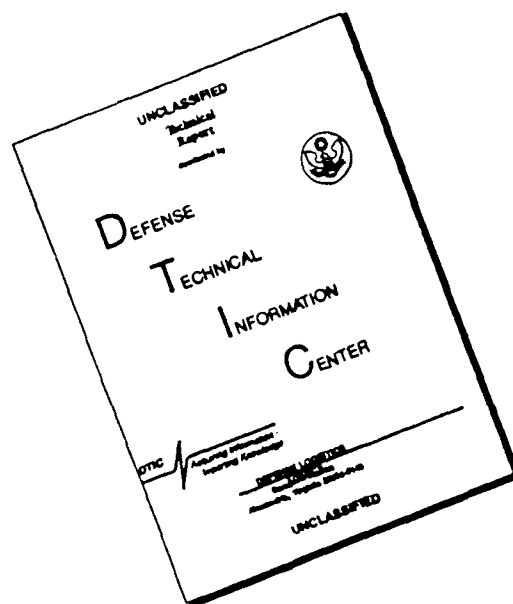
  
BURTON G. HURDLE  
Acoustics Division

CONCUR:

  
EDWARD R. FRANCHI  
Superintendent  
Acoustics Division

11/4/96  
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A TWO HELICOPTER ATTACK SONAR SYSTEM  
(Proposal)

by

R. H. MATHES

May 20, 1952

Airborne Sonar Branch  
Sound Division  
Naval Research Laboratory  
Washington 25, D. C.

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ABSTRACT

This report proposes a Attack Helicopter Sonar System in which one helicopter carrying a precision sonar set vectors another helicopter carrying a sonar transponder and ordnance to the target. The advantages of such a system are outlined, and the basis for the system set forth.

## AUTHORIZATION

NRL Problem No. 40S07-13

## PROBLEM STATUS

Continuing

  
  
[REDACTED] - [REDACTED]

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## A TWO HELICOPTER ATTACK SONAR SYSTEM

Most of the work done so far with helicopter sonar has been directed towards obtaining long detection ranges and evolving search and screening tactics. Extensive information is now available on these subjects, and the associated problems. There has been little work done to develop systems primarily for classification, precision tracking and attack. However, present systems are designed to place the helicopter within range to launch homing weapons.

The system proposed here divides the classification and tracking functions and the attack function between two separate vehicles. This method has several potential advantages. These are:

- (1) The weight of the sonar and the weapons system is divided between two vehicles thereby reducing the load per vehicle.
- (2) The screening vehicles are relieved of the weapon, which is not needed for the screening, detection and classification phases. The attack phase represents a very small fraction of the total time on station in any realistic screening and attack situation. This weapon weight saving may be converted into time on station. A single weapon carrying vehicle can back up the screen, or be held in readiness.
- (3) This system uses a sonar carrying helicopter to vector the weapon carrying helicopter to the target. This is a simpler problem than having the sonar carrying helicopter vector itself to the target.

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- [REDACTED]
- (4) If the weapon carrying helicopter can be vectored directly over the target, simple contact or influence type ordnance can be used. A great saving in weapon cost would be realized, and probably more than one weapon could be carried, thereby permitting attack and reattack.
  - (5) The vectoring is accomplished by sonar and a standard voice radio link, and does not require any radar or position keeping equipment.

As mentioned before, this system is divided into two parts. The first part consists of a sonar set capable of producing unusually precise target information. The central feature is an SSI sonar display which gives a true picture of the target in range and bearing, and its relation to the weapon carrier. The second part is a small towed transponder which gives the location of the weapon carrier with respect to the target on the sonar display.

Figure 1 is a photograph of the type of SSI display to be used in the sonar set. It represents a single ping on a row of bridge piers. The range and bearing to each pier may be determined, as well as the angle the row of piers presents to the sound beam. In this case this angle (aspect angle), is measured by the cursor to be 25 degrees. By a similar method, the angle, or with the aid of a compass, the course to steer from a transponder echo to a submarine echo may be determined. This type of display has the additional advantage that target aspect, or heading, may be seen under certain conditions. In this case, the target appears as an elongated trace on the scope and the angle is measured as with the bridge piers. Wake or doppler will tell which way the target is headed.

██████████ - ██████████

Figures 2 through 4 explain the attack philosophy. A fathometer device is used as part of the transponder for precision location over the target.

Figure 5 is a block diagram and schematic of the control console for the sonar set. The display is the upper section of the wedge shaped scan shown in Figure 1, instead of the PPI shown in Figures 2 to 4. This display is easier to build, and is more practical for aircraft installation. A full sweep is made regardless of range in order to maintain the largest picture area for the greatest accuracy. By controlling the ping rate, the target can be made to appear on the double cross line, and the range read from a dial or counter. The bearing is read from a dial when the target is centered, or an appropriate correction can be read from the display and added to the transducer bearing. The vector bearing knob controls the cursor, and may be used to obtain the course from the attacking helicopter to the target, or to obtain target aspect. By setting the vector range knob equal to the number of lines between the transponder echo and the target echo, an approximation of the range from the transponder to the target may also be obtained.

All the techniques involved in this system are known. The problem of producing a system reduces to integrating the electronics, display, and a precise training system together in a light weight form for airborne use, and undergoing a series of field tests to see under what conditions a weapon carrier may be placed in a position for direct attack on a submarine target.

[REDACTED]

PRELIMINARY DESIGN SPECIFICATIONS

Frequency - 15 KC (Alternate 28 KC)

Power - 500 Watts

Pulse Lengths - 2 ms to 200 ms

Beam Width (Display) - 30°

Training - Power with M.T.B.

Hoist - Folding Boom, Hydraulic Hoist

Display - Aural, SSI, Doppler

Transponder - 15 KC (or 28) Omni-Directional

Fathometer - 50 KC, Chart Recorder

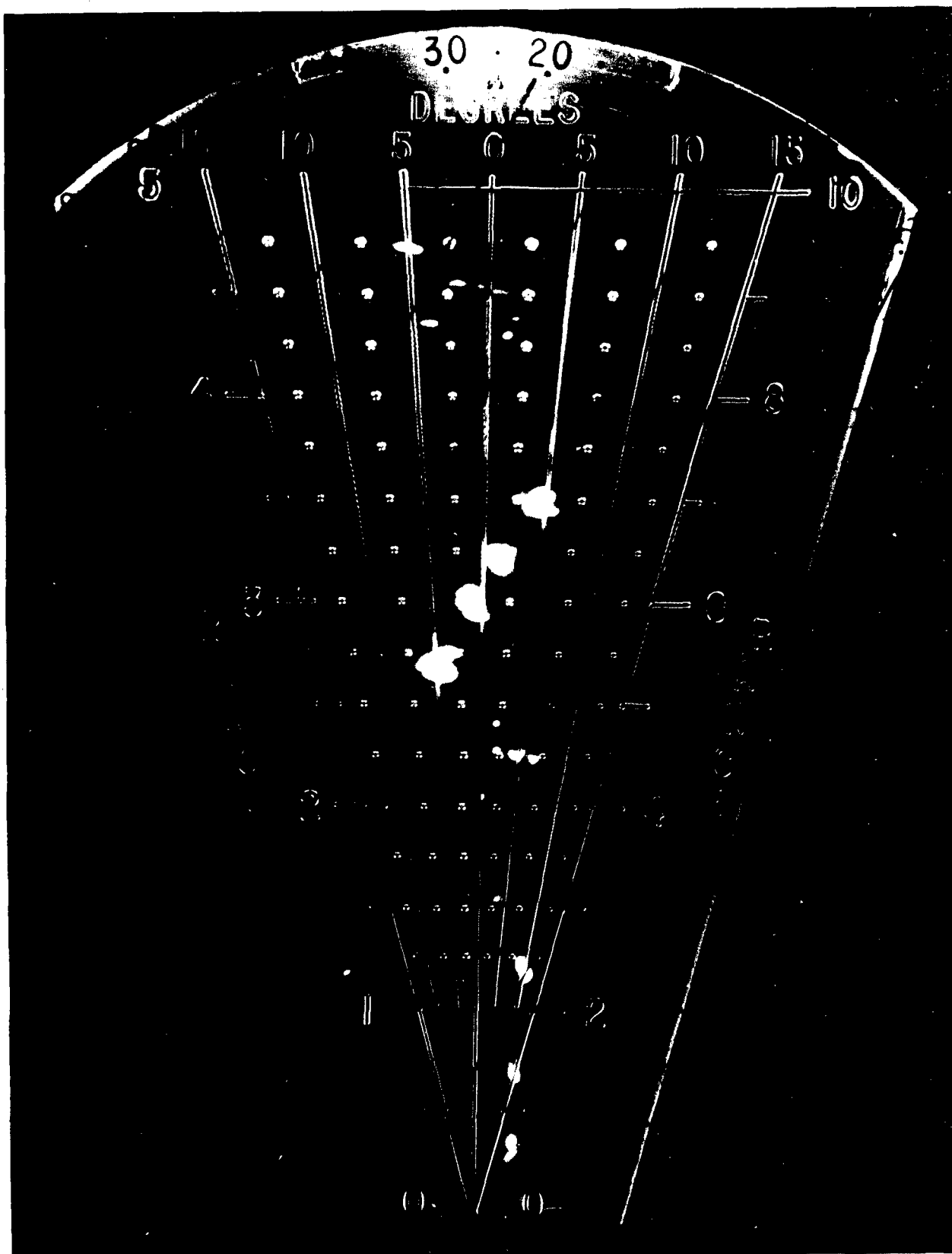


Fig. 1

# TWO SHIP HELICOPTER ATTACK SYSTEM

VEHICLE REQUIREMENTS: TWO HRP TYPE HELICOPTERS WITH RADIO

COMMUNICATIONS:

- #1 CARRIES ATTACK SONAR SYSTEM
- #2 CARRIES WEAPON AND TRANSPONDER

ASSUMPTIONS: INITIAL DETECTION MADE BY:

1. SIGHT FROM AIRCRAFT
2. RADAR
3. LONG RANGE SONAR
4. HELICOPTER SCREEN

I. HELICOPTER #1 ESTABLISHES CONTACT.

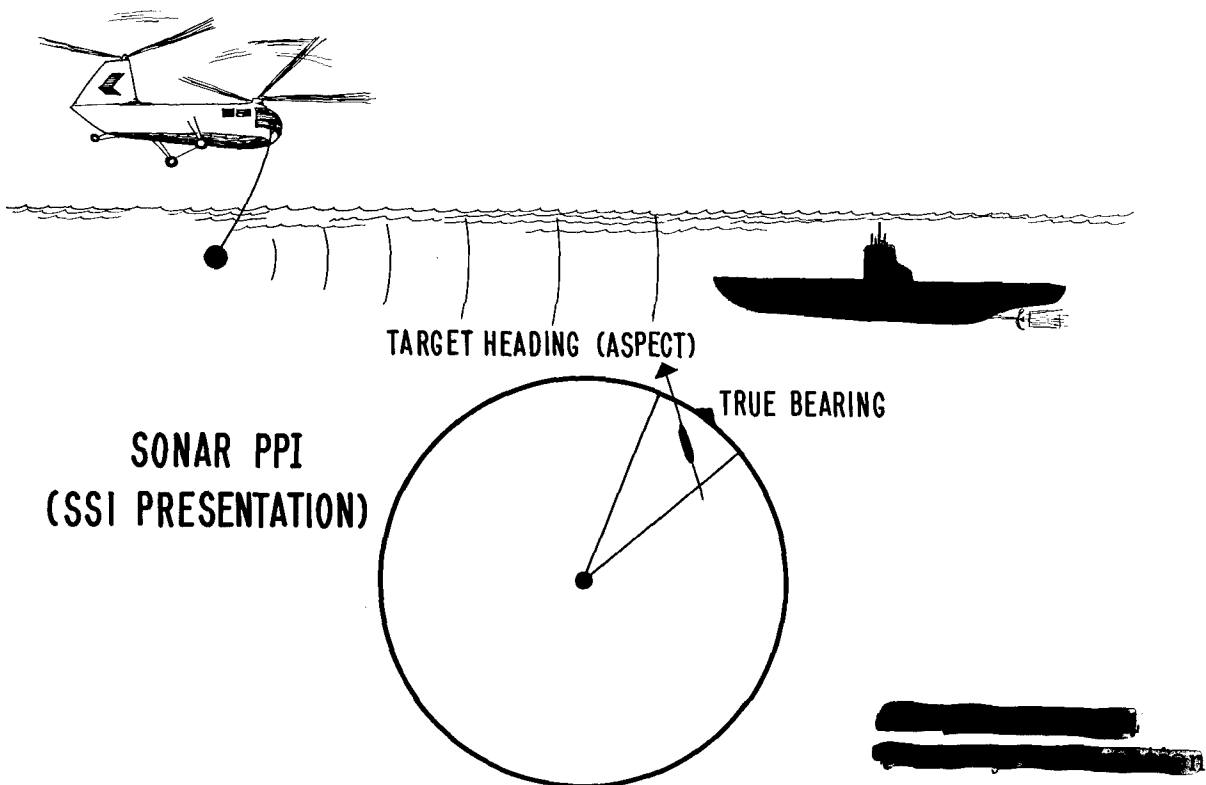
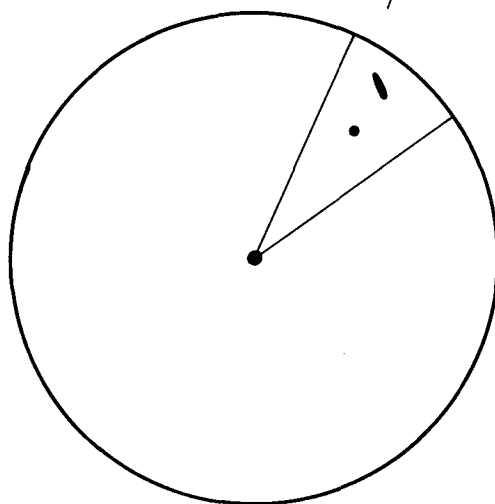
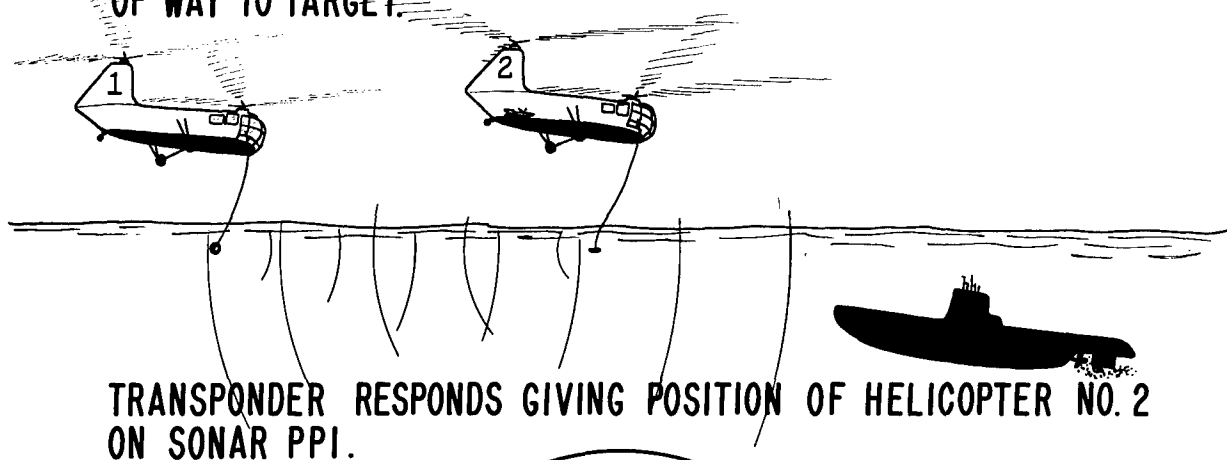


Figure 2

**II** HELICOPTER NO.2 IS VOICE VECTORED IN ON THE TRUE SONAR BEARING OVER HELICOPTER NO.1 & LOWERS TRANSPONDER ABOUT TWO-THIRDS OF WAY TO TARGET.



**III** HELICOPTER NO.2 IS VOICE VECTORED OVER TARGET BY HELICOPTER NO.1 FROM THE SONAR PLOT.

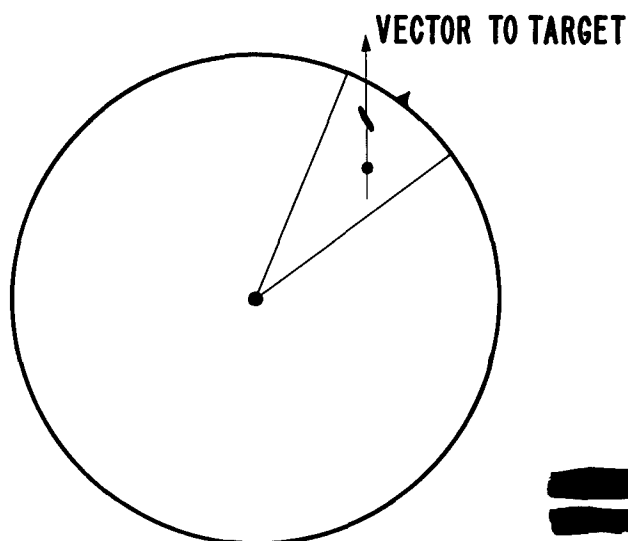
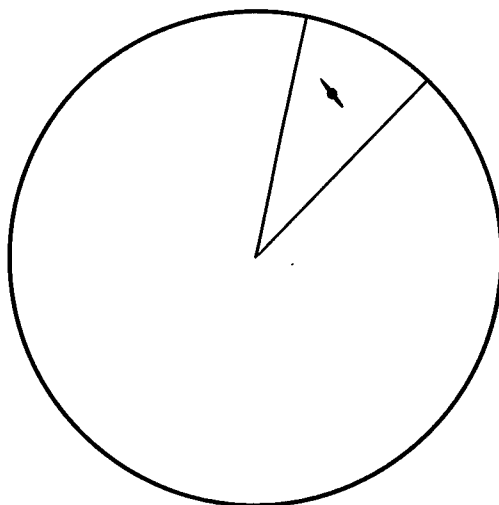
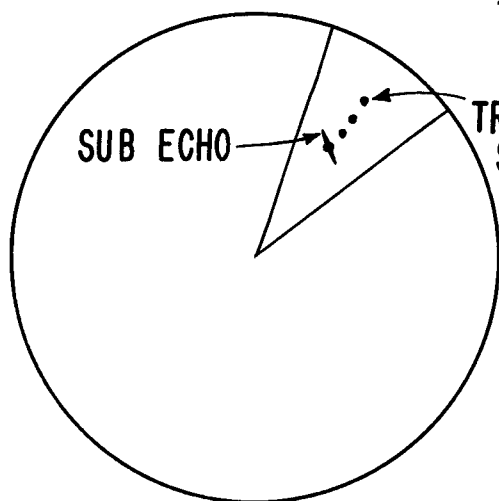
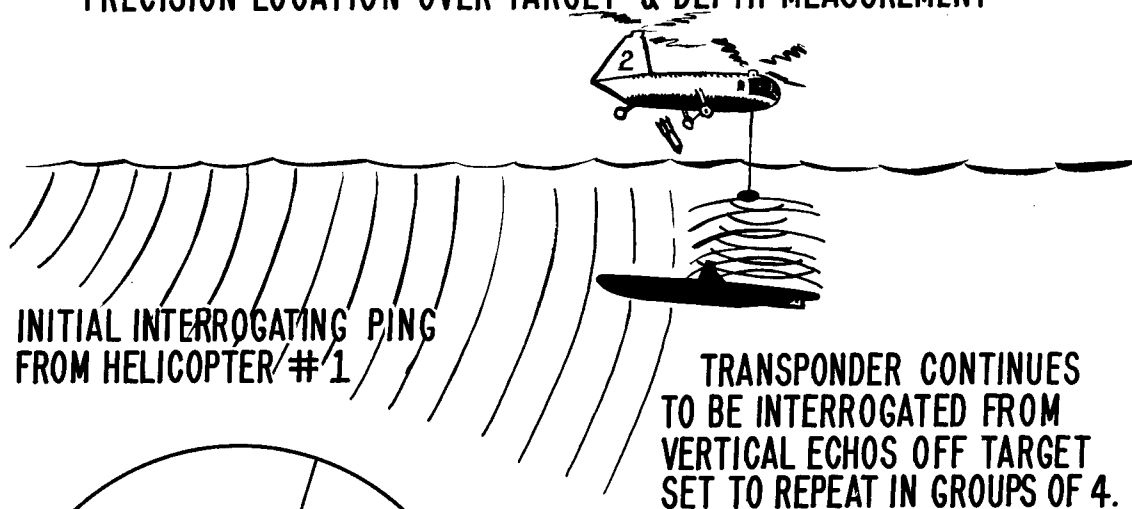


Figure 3

**IV TRANSPONDER REPLY AND TARGET ECHO MERGE WHEN  
HELICOPTER #2 IS OVER TARGET. DROP ORDNANCE.**



**V POSSIBLE USE OF TRANSPONDER AS FATHOMETER FOR  
PRECISION LOCATION OVER TARGET & DEPTH MEASUREMENT**



TRANSPONDER  
SIGNALS

DEPTH  
DETERMINED  
BY TIME  
INTERVAL  
OF VERTICAL  
ECHOS

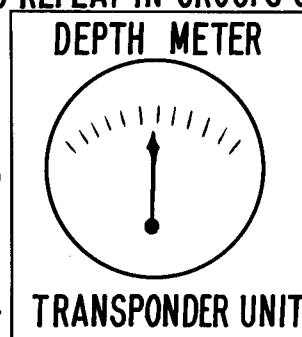


Figure 4

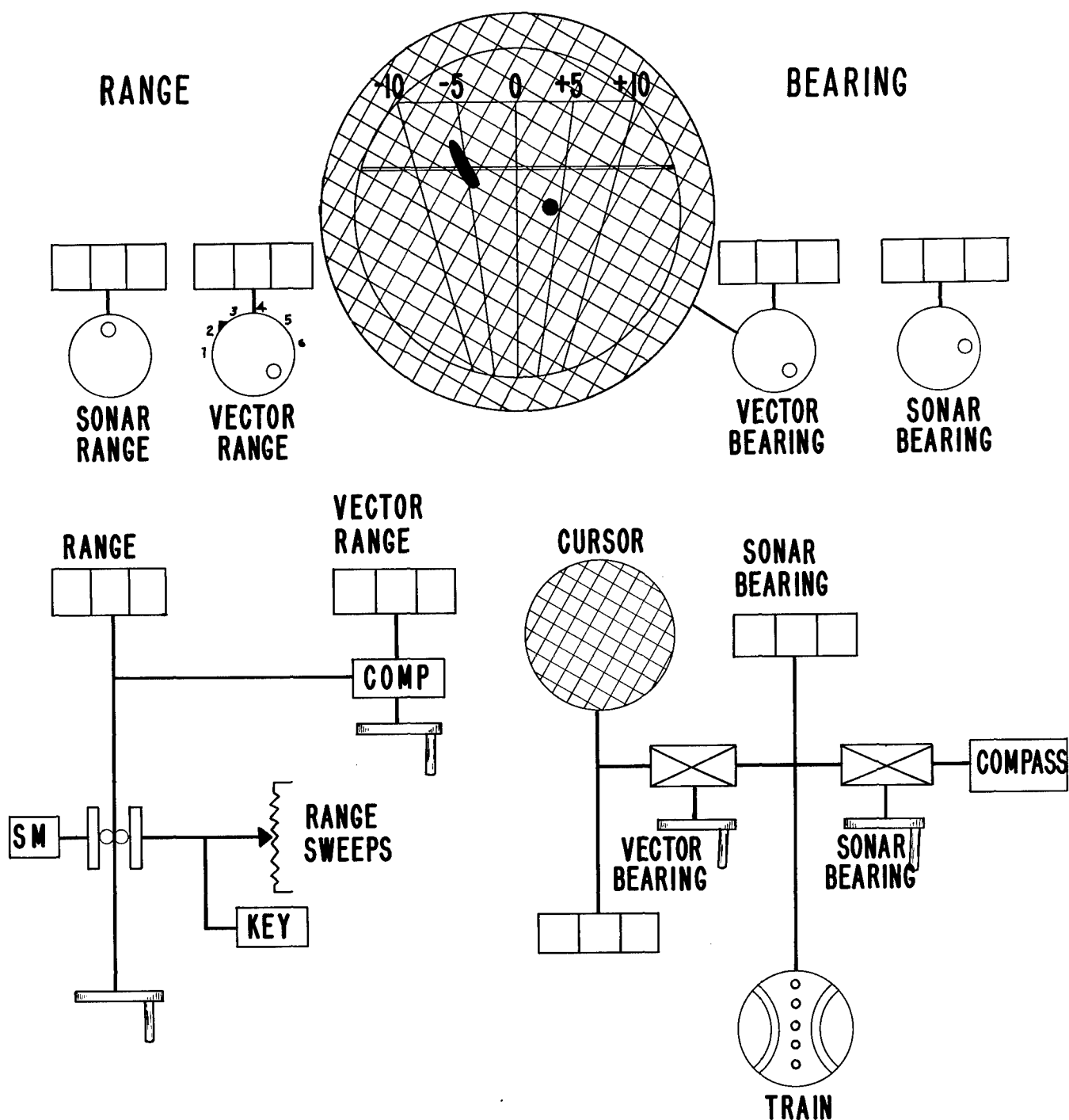


Figure 5