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FIELD TESTS OF BRAINCON TYPES 120 V-FIN TOWED UNDERWATER VEHICL--ETC(U)
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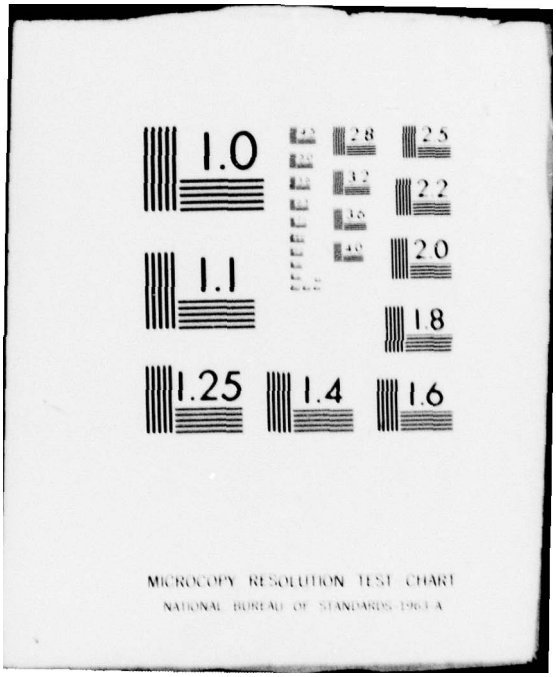
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NATIONAL BUREAU OF STANDARDS 1963 A

Hudson Laboratories
of
Columbia University
Dobbs Ferry, New York

Robert A. Frosch
Director

(9) Technical Memorandum No. 67

(6) FIELD TESTS OF BRAINCON TYPE 120 V-FIN TOWED UNDERWATER VEHICLE.

by

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and
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INTRODUCTION

Hudson Laboratories purchased one Type 120 V-Fin from the Braincon Corporation of Marion, Massachusetts, in July 1962. Type 120 V-Fin is a towed underwater vehicle designed to enclose an Edo UQN-1 sonar transducer with modified case. The V-Fin operates as a hydraulic depressor developing a negative lift proportional to speed increase so that depth of tow should remain essentially constant. The towed system was adapted for echo sounding to eliminate the quenching effect on the sonar transducer produced by turbulence generated at a ship's hull.

DESCRIPTION

The Type 120 V-Fin is 4 ft long with a 4-ft 9-in. wing span (Fig. 1). The shell is composed of fiberglas laminated with epoxy adhesive and weighs about 90 lb without sonar transducer. To fit a frame in the interior cavity of the V-Fin, the crystal bank from an Edo UQN-1 sonar transducer was mounted in a compact aluminum case. The case, 12 in. × 12 in. × 6 in., was made by Hudson Laboratories according to drawings from the Edo Corporation; weight is approximately 50 lb.

The V-Fin is towed with 50 ft of faired cable. The fairing is manufactured by the Braincon Corporation of synthetic rubber in 1-ft sections. Four axial holes are provided for electrical and strain cables; two 0.5 in. diameter; two about 0.3 in. diameter. Braincon has indicated that they can change the diameter of these holes for future orders. The fairing is installed by slipping it coaxially over the cable.

FIELD TESTS

The V-Fin underwent several tests by Hudson Laboratories:

1) T-boat tests: Noise measurement

2) USNS J. W. Gibbs tests:
   a) Installation
   b) Noise measurement
   c) Bathymetry

1) T-boat Tests

A series of noise measurements were made by Francis Preston and Roman Sadowy in which the towing position, depth, and speed of the V-Fin were varied (Table I). The R/V Manning, a 65-ft T-boat, was used for the tests in Long Island Sound during August. Sea state was near zero.

The noise measurements were taken on the jack output of an Edo Fathometer, which is the cathode of the output tube of the Edo receiving amplifier. Relative noise levels were obtained.

An 88-dB hydrophone was also mounted inside the V-Fin in order to obtain broadband noise measurement in a 5-kc to 15-kc frequency band. While the noise measurements taken on the Edo are all directly comparable, the broadband measurements had to be taken with two different systems because of equipment failure (Fig. 2).

It is concluded that in all towing positions, depths, and speeds tested the noise was no problem so far as normal echo sounding operation was concerned.

It made no difference whether a towline was attached to the V-Fin or not.

The noise was somewhat less when the V-Fin was towed abeam ship and somewhat more when the V-Fin was towed from the stern. No advantage was gained by using a float.

It must be emphasized that the results obtained apply only to the conditions on the T-boat. On a bigger ship on the high seas, the noise characteristics might be quite different.

An indication of vertical stability of the V-Fin was obtained from a surface reflection often visible on the Fathometer record. The recorded depth of the surface reflected arrival is the subsurface depth of the V-Fin. Fluctuations of the order of ±1.5 ft about a mean depth were determined for towing speeds up to 10 knots (Table II).

2) USNS J. W. Gibbs Tests

a) Installation

Installation of the V-Fin aboard the Gibbs was directed by Seymour Adler. Considering the results of the T-boat tests a tow point was chosen on the starboard side about one third of the distance from the bow to the stern (c. 100 ft). The V-Fin is towed on 50 ft of faired cable from a pad eye welded to the hull at the level of the main deck. A power winch is used to raise and lower the V-Fin from a boom on the boat deck. Ramon Rico and Ken Spalin handled the actual launching.

Separate electrical and strain cables were used for the initial installation. After one week of towing the electrical cable opened where the fairing abraded against the ship's hull at waterline. In the future, armored electrical cable will be used in addition to a strain cable. Braincon recommends American Steel and Wire Amerograph Cable, 0.375 in. o.d., with electrical characteristics equal to RG-58/U, in lengths up to 50 ft (breaking strength 11,000 lb; weight 237 lb/1000 ft). A cable with good flexibility characteristics will be tried for the next launching: Boston Insulated Wire and Cable Company, Type DSS-3, armor braid, 2-conductor, 16 gauge cable with 3000 lb breaking strength. According to Braincon, forces up to 3000 lb may be exerted by the

V-Fin in normal operation.

The V-Fin was towed at 6 knots with 65 ft of cable extending from the tow point (15 ft of unfaired cable to water line plus 50 ft of faired cable below water line). As observed over a one-week period, the V-Fin maintained a position 23 ± 4 ft behind the tow point. Sidewise motion of the V-Fin appeared negligible. The observations were made through the surface of the water from points directly above the V-Fin to minimize the effects of refraction.

Based on the above observations the cable angle was about 21 degrees from vertical, and the mean depth of the V-Fin was 47 ft (Fig. 3). The ± 4 ft variation observed in the position of the V-Fin was caused by a continuous forward-backward oscillation apparently equal to the length of the V-Fin. A depth fluctuation coupled to the oscillation is calculated to be ± 1.25 ft. This depth fluctuation is in agreement with that indicated from the surface reflection measurements presented in Table II.

An additional independent method was used to check the towing depth and vertical stability of the V-Fin. A switch has been installed in the Navigation Lab on the Gibbs so an operator can alternate between the hull mounted and V-Fin transducers. With the Gibbs underway at 6 knots a constant difference in bottom depth of 6 fathoms was read on the Precision Depth Recorder (PDR) between the hull mounted and V-Fin transducers (Fig. 4). The towing depth and vertical stability of the V-Fin determined within the accuracy of the PDR (1 fathom) brackets the values obtained from the surface reflection and observation.

A set of 20 degree ailerons was used on the V-Fin for all tests here reported. A set of 30 degree ailerons is provided by Braincon for stronger depression.

Pad eyes to tow the V-Fin from the USS Allegheny will be installed within the next several months.

b) Noise measurement

Noise measurements were taken on the jack output on the Edo Fathometer on the Gibbs in the course of bathymetric work at 6 knots, sea state 1 (Table III). This is a different Edo Fathometer from the one used on the T-boat. Since the gain was not obtained, the values are not comparable to the measurements taken on the T-boat. A gain calibration of the Gibbs' Edo would be needed to compare the two sets of measurements.

c) Bathymetry

A distinct improvement in the ratio of signal-to-noise and in acoustic coupling of the towed transducer over the hull mounted transducer on the Gibbs was noted. A comparative PDR record is shown (Fig. 4).

TABLE I

T-boat Noise Measurements

	Edo Noise Measurements				Hydrophone Noise Measurements	
Position	Length of faired cable below waterline	Speed KN	Edo relative noise level MV	Edo gain 2 = x370	Electronic system	RMS pressure bandwidth 5-15 kc μb (dyne/cm^2)
A	21	0	-	-	1	3
A	21	4.5	310	2	1	4
A	21	7.5	340	2	1	13
A	21	10	340	2	1	17
A	44	4.5	280	2	1	4
A	44	7.5	310	2	1	8
A	44	10	280	2	1	11
AD	45	4.5	275	2	-	-
AD	45	7.5	300	2	-	-
AD	45	10	300	2	-	-
B	23	0	-	-	2	6
B	23	4.5	400	2	2	8
B	23	7.5	400	2	2	11
B	23	10	400	2	2	20
B	46	4.5	400	2	2	7
B	46	7.5	400	2	2	12
B	46	10	400	2	2	28
C	46	4.5	320	2	-	-
C	46	7.5	320	2	-	-
C	46	4.5	320	2	-	-
C	46	7.5	320	2	-	-

TABLE II

Vertical Stability of V-Fin Measured from Surface Reflection

Ships speed KN	Mean depth of V-Fin ft	Fluctuation in depth ± ft
4.5	21.0	1.0
4.5	38.0	1.0
7.5	20.0	1.0
7.5	37.0	1.0
10	20.0	1.5
10	33.5	1.5

TABLE III

USNS J. W. Gibbs Noise Measurements

Edo Noise Measurements

Position	Depth ft	Speed KN	Edo relative noise level V	Edo gain
A	47	6	1	0
A	47	6	1	5
A	47	6	2	9
A	47	6	5	10

Key to Positions

A. Fish towed abeam ship
B. Fish towed directly from stern
C. Fish towed from stern using 8 ft float
   C1. Float 100 ft behind ship
   C2. Float 400 ft behind ship
D. Fish with additional towline

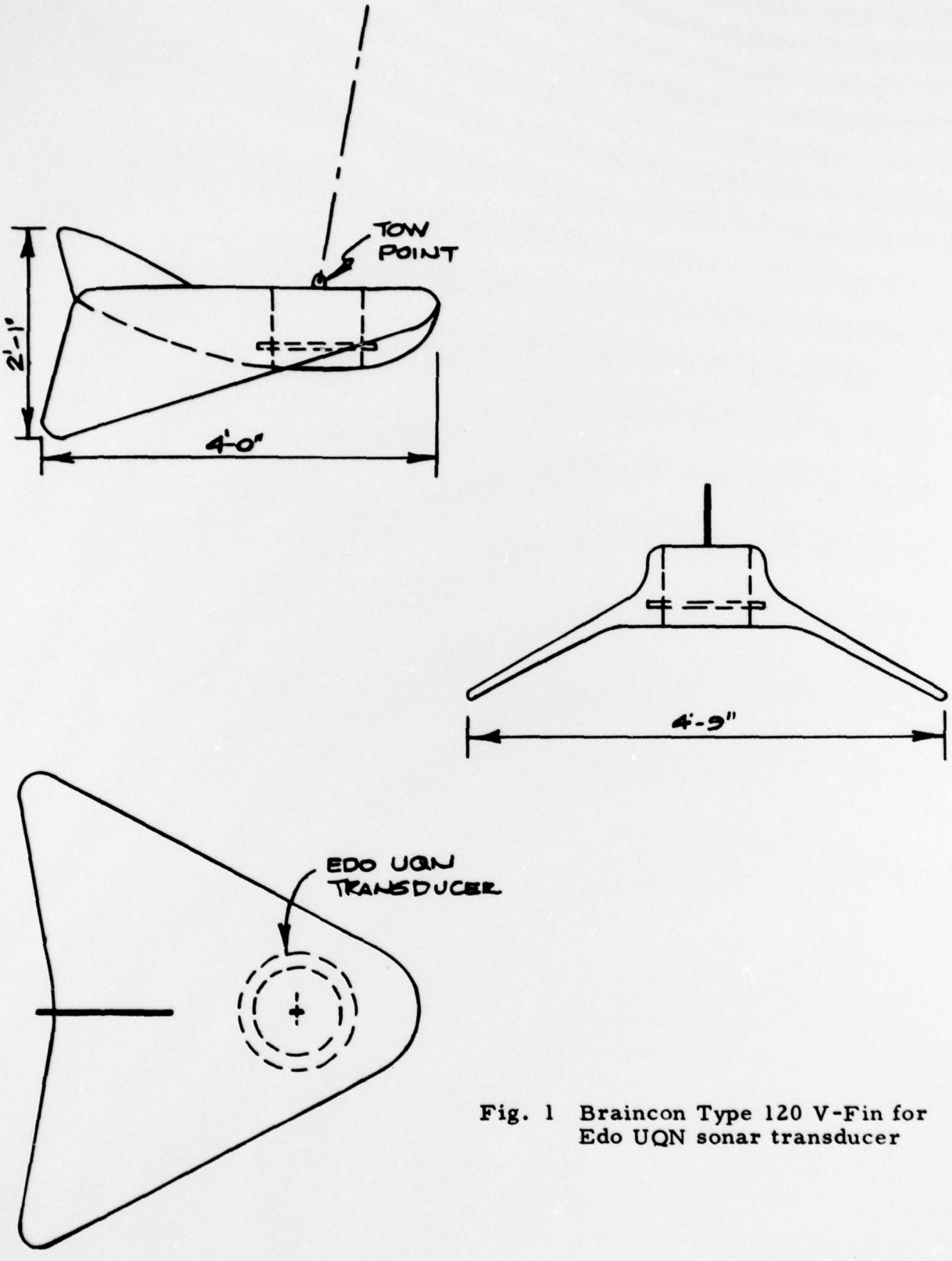
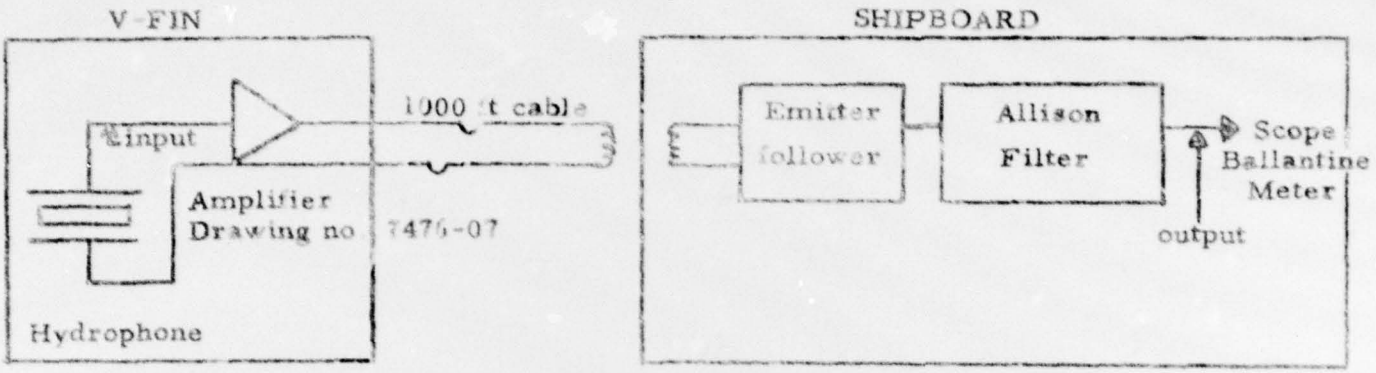


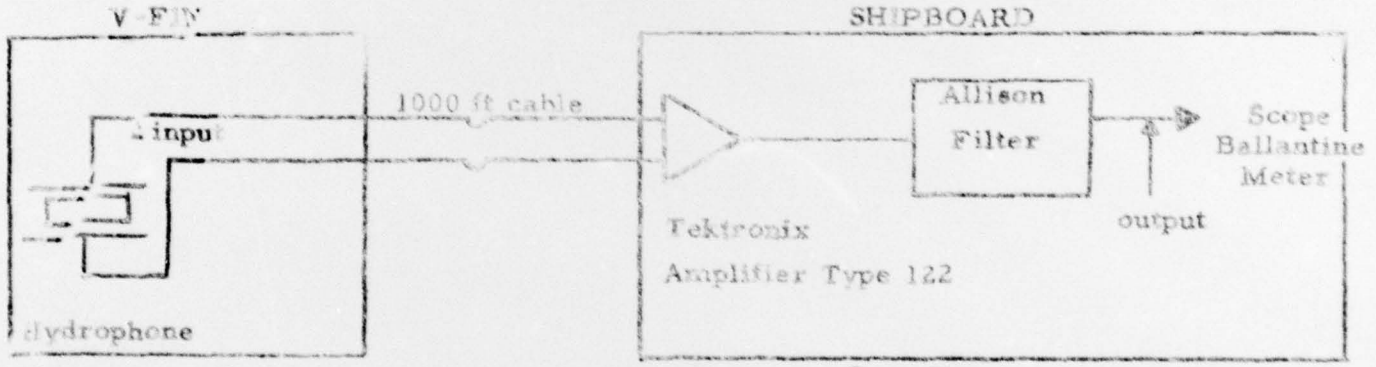
Fig. 1 Braincon Type 120 V-Fin for Edo UQN sonar transducer

Fig. 2



Overall gain ×150

System 1



Overall gain ×50
Tektronix gain ×100
6 dB loss in filter
Cable loss neglected
86 dB hydrophone

System 2

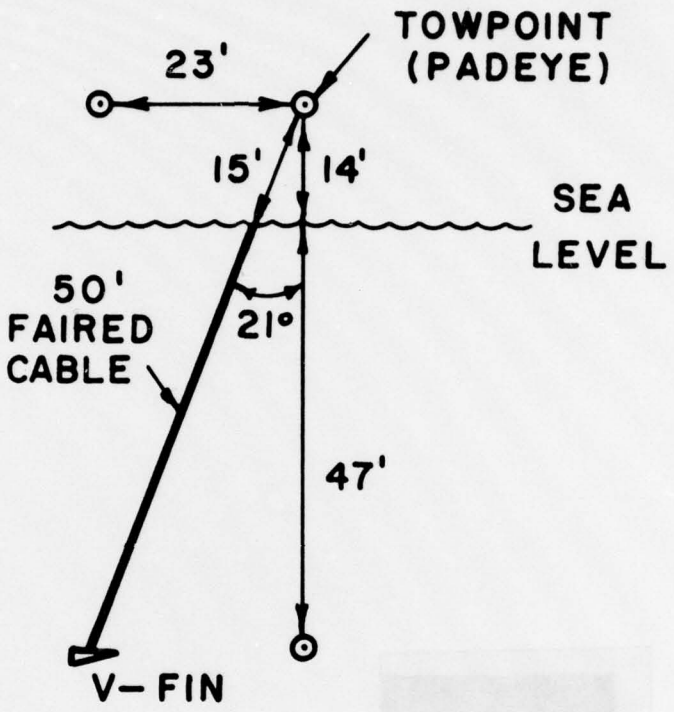


Fig. 3 Towing position of V-Fin.
USNS Gibbs underway at 6 Knots.

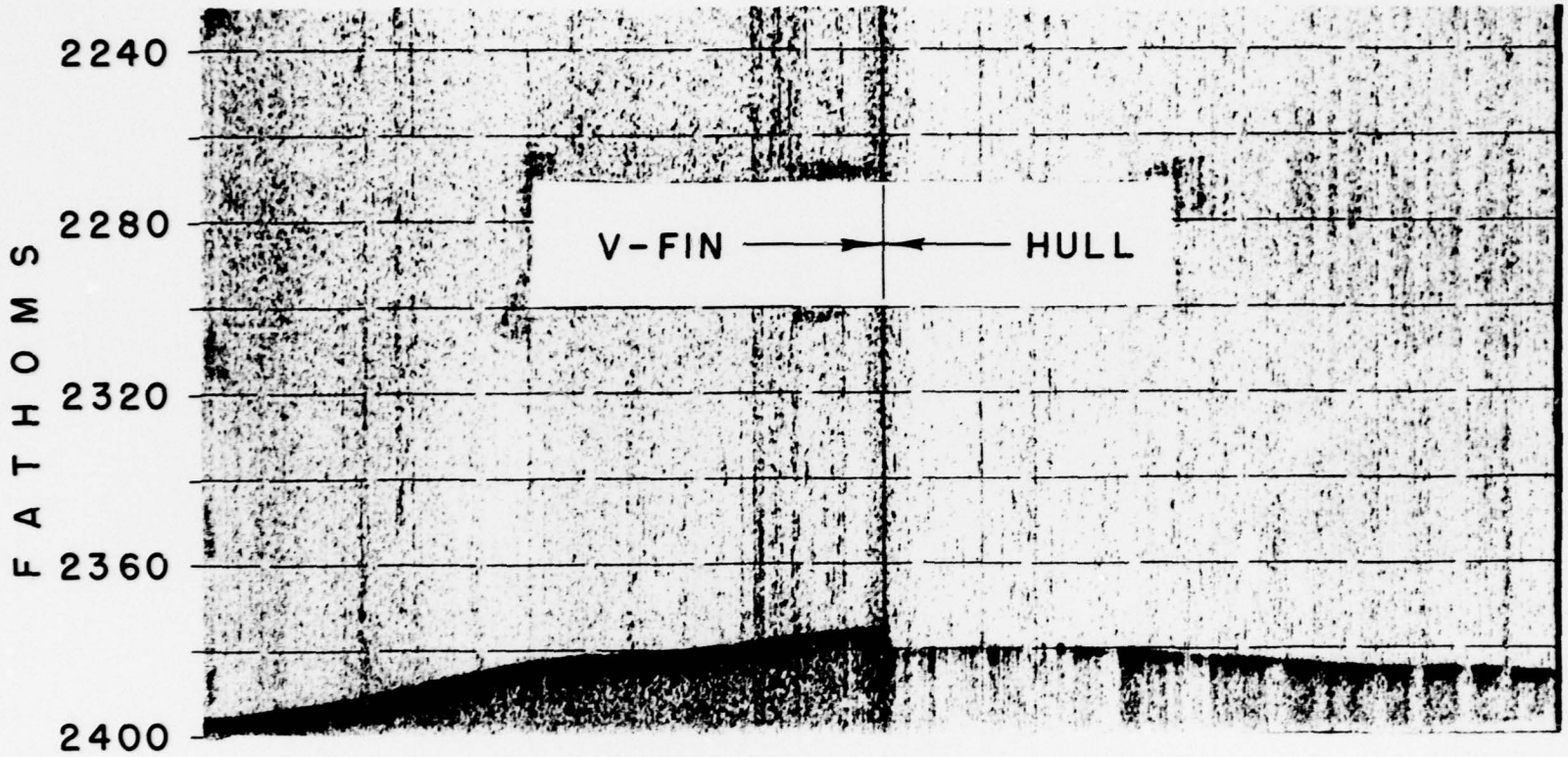


Fig. 4 PDR record made on the USNS J. W. Gibbs with hull mounted transducer and with transducer towed in V-Fin. Ship's speed: 6 knots. Course: 270°T. Wave direction: 220°T. Wave height: 3 - 4 ft.