



A towed body for echo integration in
shallow water.

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Abstract

A towed body for carrying an echosounder transducer is described. This towed body is mounted with a Simrad split-beam transducer and a small CTD sonde. The body is towed at speeds up to 12 knots from the front deck of the research vessel DANA and this system enables a stable position of the body at 2 meters depth below surface. The towed body is 10 meters away from the ship just in front of the bowwave.

Résumé

Un corps remorqué pour porter un transducteur échosondeur est décrit. Un Simrad transducteur faisceau fendu et une petite sonde CPT sont attachés sur le corps mentionné. Le corps est tiré avec une vitesse jusqu'à 12 nœuds du pont avant du navire de recherche DANA, un système permettant une position stable du corps à une profondeur de 2 mètres sous la surface. Le corps remorqué se trouve à 10 mètres du navire droit devant l'onde de l'avant.

Introduction

The Danish Institute for Fisheries and Marine Research has concentrated its hydroacoustical work towards surveying of the Skagerak, Kattegat and Baltic areas. The main target species is herring, and the central technique is hydroacoustical echointegration.

The western part of the Kattegat, the Western Baltic, and the Belt Sea (subdivision 22), and the Sound (subdivision 23) with average depths of 20 - 30 m are hardly accessible to hydroacoustical integration with the Danish research vessel Dana with its draft of more than 6 m and length o.a. of 78 m. Since the transducers on Dana are hull mounted, and ringing is noticeable for about 10 msec after the transmit pulse, actual integration cannot give reliable figures for approximately the upper 15 m of the water.

Furthermore Olsen et al (1982) documents avoidance reactions by fish in ranges 50-100 m away from a vessel in horizontal directions, adding to the dubiety of integration results obtained at close range.

Based on previous good experience with a towed body constructed to be used from small vessels in a mobile hydroacoustic system, Lassen and Lundgren (1984), the Danish Institute for Fisheries and Marine Research, decided to construct a towed body (an "echo-fish") for the Dana which should be able to go stably at a depth of 2-3 m below the surface. The towed body should run along the side of the ship in front of the bow wave.

The system was constructed in the spring of 1985 and put into operation in August - September 1985.

The towed body is mounted with a Simrad 38 kHz split beam transducer and a small CTD-sonde.

Towed body

The towed body is constructed from glassfiber reinforced plastic and is partly filled with polyurethane foam. The length is 2.10 m and the weight is about 200 kg. including transducer and CTD-sonde. In water the towed body has a slight positive buoyancy. (see fig. 1).

A hydrofoil fin is mounted at the fore of the towed body. This fin drags the towed body away from the research vessel, and at the same time it stabilizes the towed body to pitch by dragging the towed body down below the surface waves. Through tilting the fin and adjusting the wire length and the speed of the vessel, the towed body can be positioned at various depths (2 - 8 m) and distances away from the research vessel. The hydrofoil drags the towed body outwards to an angle of about 10°.

The towed body is stabilized to roll. This stability is achieved, because the centre of gravity and that of buoyancy are separated thus creating a restoring moment for the tilted hull.

Since the forces on the fin and drag through the wire and dependent on the speed through the water and the restoring moment to roll is not, the towed body is only stable up to 12-13 knots depending on sea state, wind force and direction and the course of the vessel relative to the waves.

To make the towed body running along the side of the ship in front of the bow wave, it is towed from a hydraulic crane on the front deck. With the crane arm stretched, the towing point is brought to a distance of 4 meters outside the shipside. (fig. 2). The crane is also used for handling the towed body to and from the deck.

The tow wire is a 15 mm diameter, 12 conductor, armed cable, Rochester Design C-310. Cross-section is shown in fig. 3. The cable is spooled onto a hydraulic winch with sliprings. The winch is mounted on the mainarm of the crane to avoid problems with twisting and bending the cable.

Acoustical system

The towed body is mounted with a Simrad 38 kHz split beam transducer, and the echo integration is performed with a 38 kHz Simrad EK400 echo sounder as transmitter which is connected to the transducer through a Simrad ES400 split beam system. An overview of the acoustic system of R/V DANA is given in figure 4.

Conductivity - Temperature - Depth Sonde.

The towed body carries a low precision (0.05°C , 0.05 mS) CTD sonde. (fig. 5). The thermometer is a Pt 100 sensor, the conductivity sensor is of electrode type and the depth transducer of membrane type with semiconductor sensor. The unit is self-contained with amplifiers, digitiser and microprocessor and needs only a 15 V DC supply current. The data from this sonde are transmitted through the armed cable as sequential ASCII characters on a low speed high current (100 mA) loop circuit to avoid disturbances from the transmit pulses. The data are converted to V24/RS232 levels in a receiving box.

Calibration

Calibration of the system was done using the copper sphere technique. The towed body was mounted on a triangular rig, (fig. 6) and the copper sphere was placed in the acoustical axis of the transducer at a distance of about 12 m.

Performance

The towed body system was used under the Swedish - Danish hydro-acoustical survey in the Kattegat, Skagerrak and the Western Baltic in August - September 1985.

The towed body was able to run stable in a depth of 2 - 2.5 m below the surface at speeds from knots up to 11 - 12 knots in a distance of 10 meters from the ship side, which gives 40 - 50 % longer integration track during the same survey period since the integration speed possible with the hull mounted transducer is only 8 knots.

Some unstability of the towed body was observed, when the waves were interfering with the bow wave, but the unstability disappeared, when the speed was lowered.

The ringing after the transmit pulse declined to 4 msec, which made it possible to start integration in a depth of 5 - 6 meters below surface.

Some measurements of the passive noise on the transducer is given in table 1.

Acknowledgement

Several people have been involved in the development of this system, specifically we thank mr. Leif Wagner Smitt of the Danish Maritime Laboratory for the design of the torpedo, mr. Markussen of Borgen-Markussen for the design and construction of the CTD-sonde and its communication system.

Reference

Olsen K., Loevik A., Angell J. and Pettersen F. (1982):
Observed fish reaction to a survey vessel with special reference to Herring, Cod and Capelin.
ICES/FAO Symposium on Hydroacoustic methods in fisheries research Bergen 1982, paper no. 48.

Lassen H. and Lundgren B. (1984):
A mobile hydroacoustical integrator.
ICES C.M. 1984/B:16.

SPEED	COURSE RELATIVE TO SEA	WAVE HEIGHT	NOISE V_p	WIND
KNOTS	DEGR.	m	mV	m/s
12.5	290	1-1.5	30	8
11.0	"	"	"	"
9.0	"	"	"	"
"	360	"	39	"
"	90	"	"	"
"	180	"	38	"
"	270	"	38	"
11.7	270	"	38	"
12.0	360	"	39	"
"	90	"	39	"
12.0	180	"	39	"
15.0	360	"	40	Towed Body
"	90	"	"	very unstabil

Table 1. Measurements of pasive noise on the transducher.

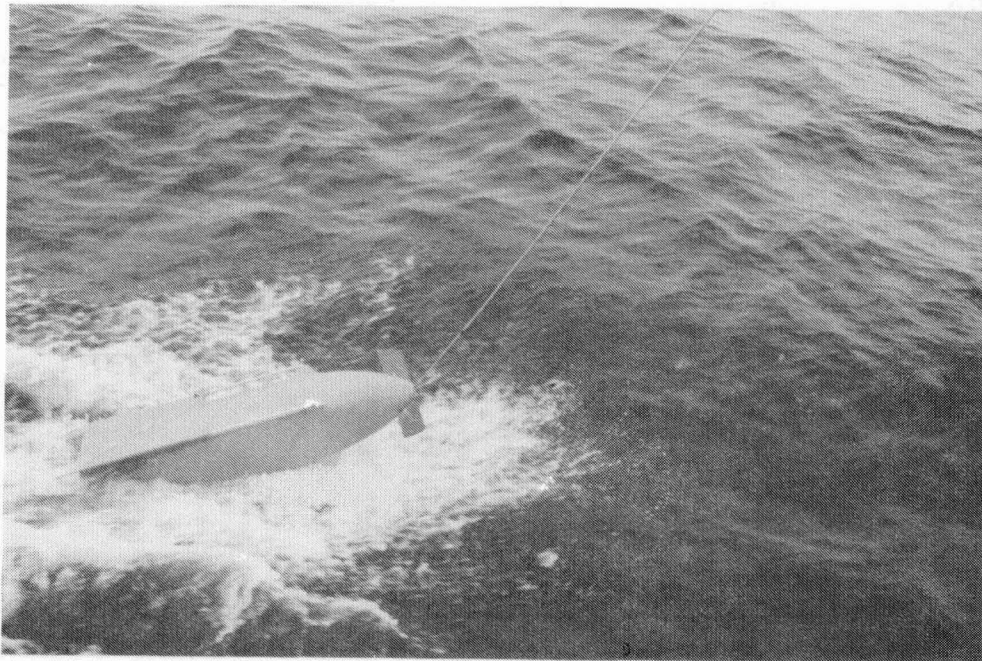
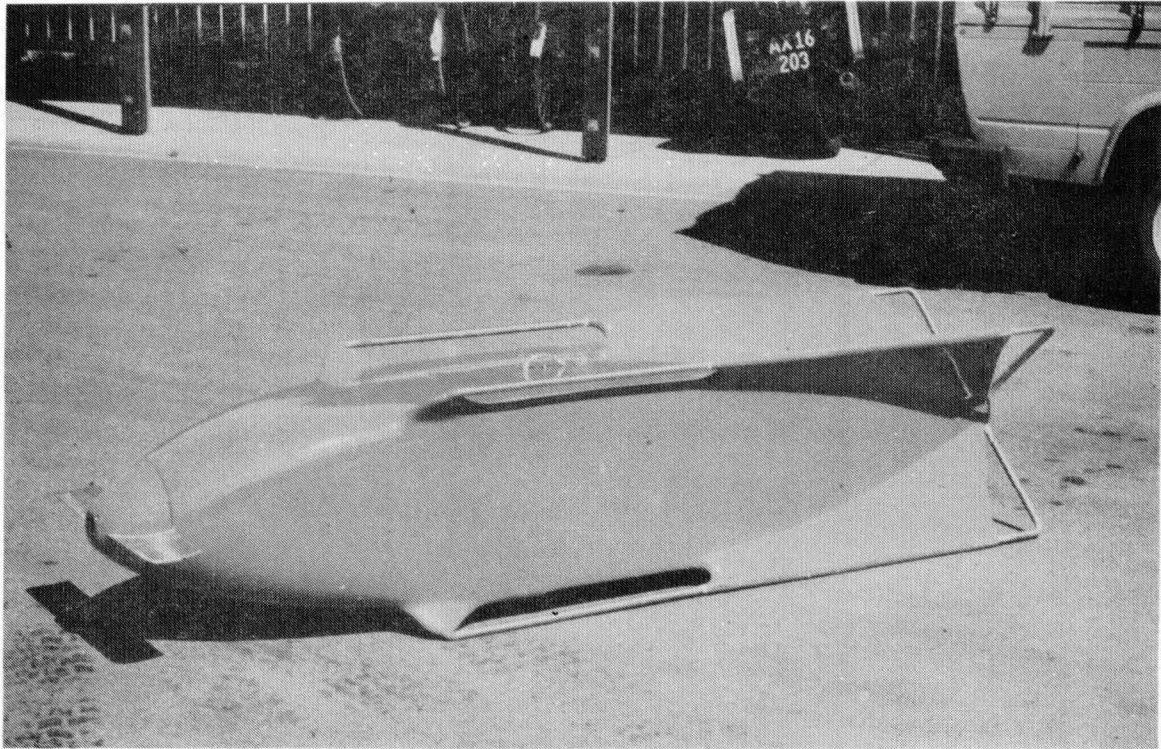


Fig. 1 Towed Body.

Support wire
Crane
Wire cable
Towed body

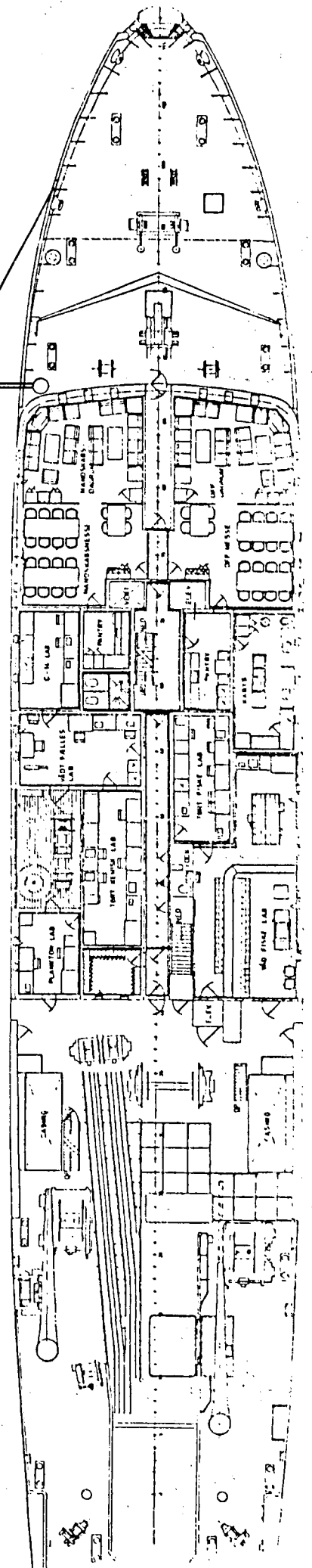


Fig. 2 Overwiev of the Towed Body System.

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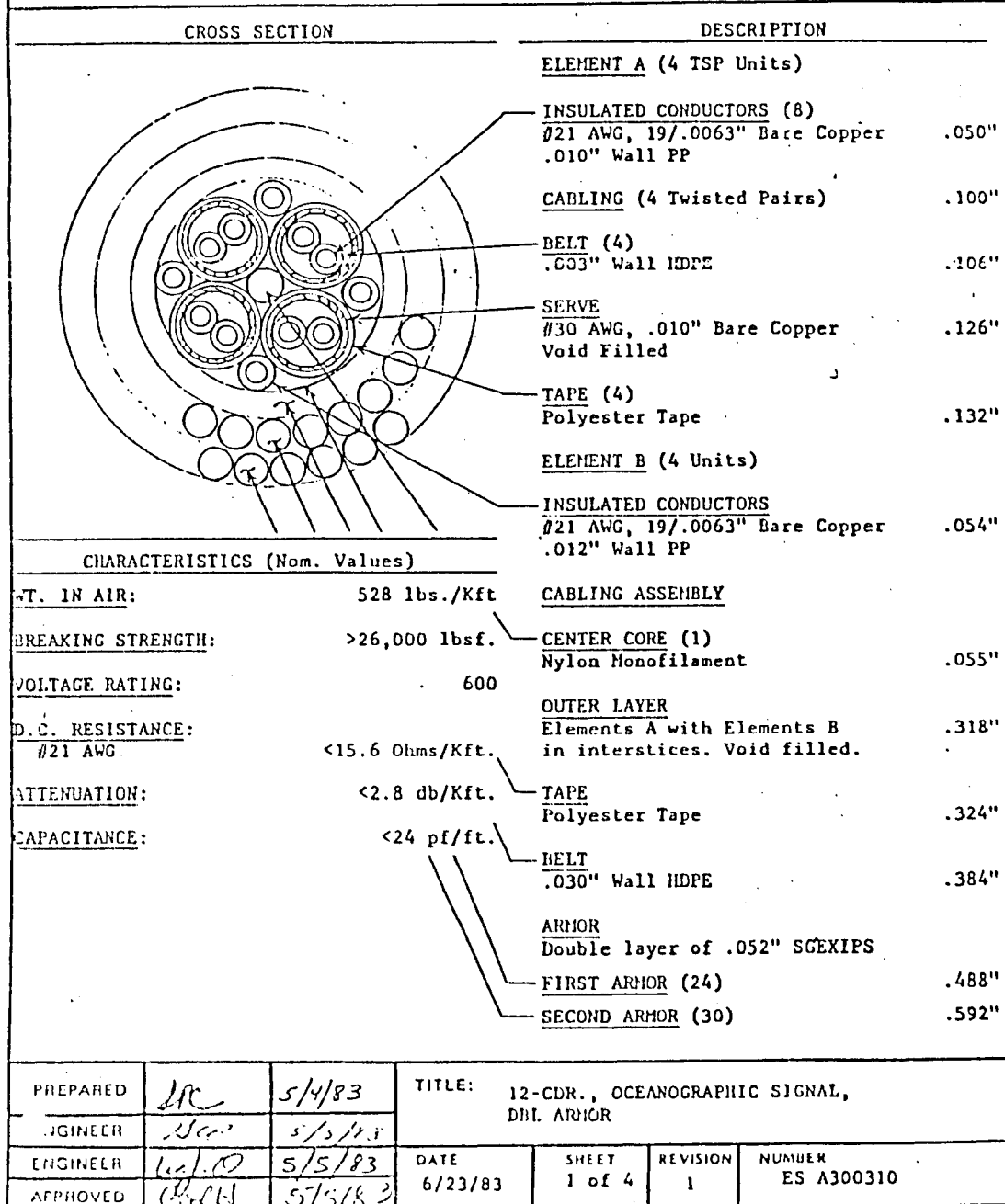


Fig. 3 Cross-section of Towing Cable.

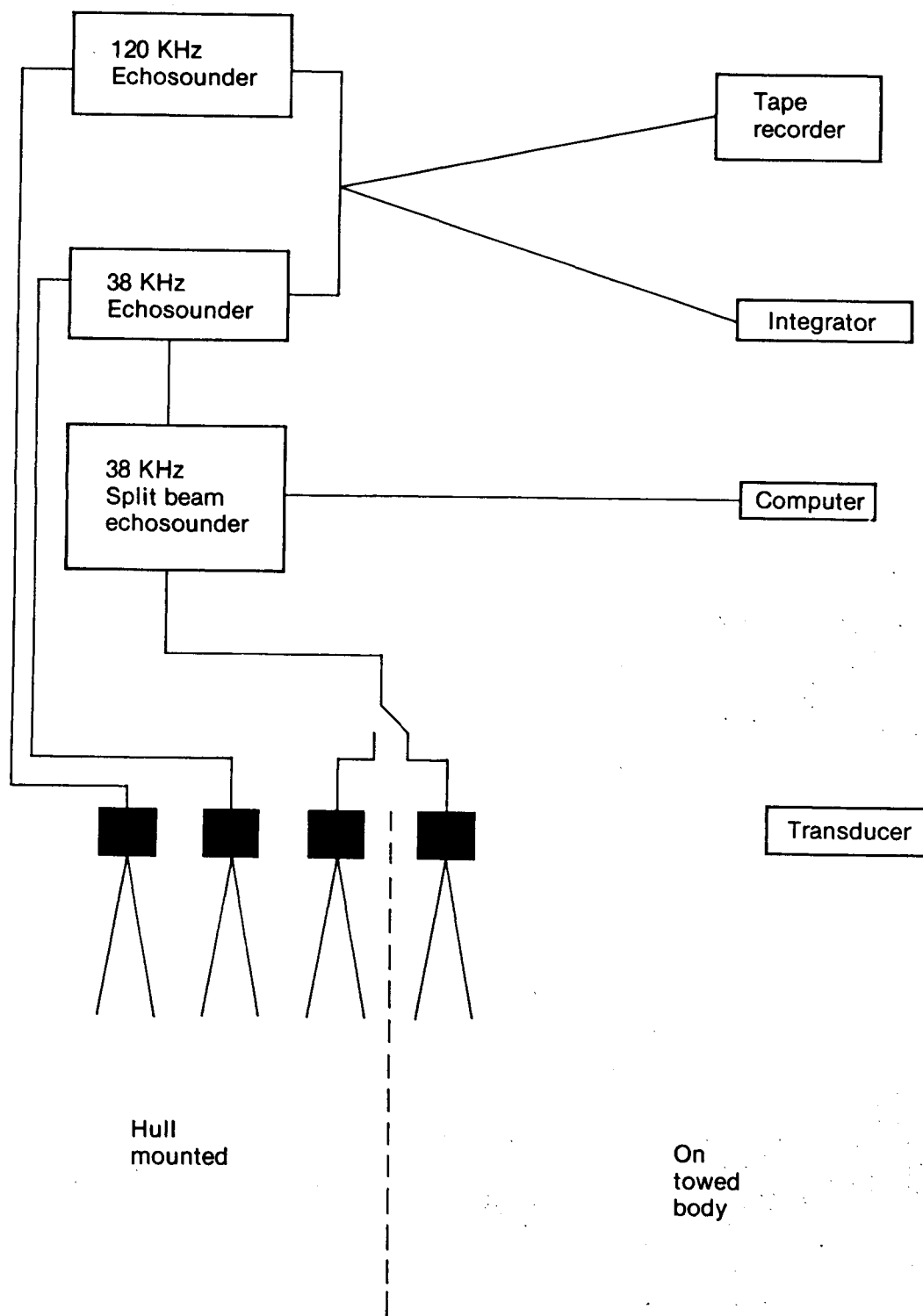


fig. 4 Overview of the hydroacoustic system of R/N DANA.

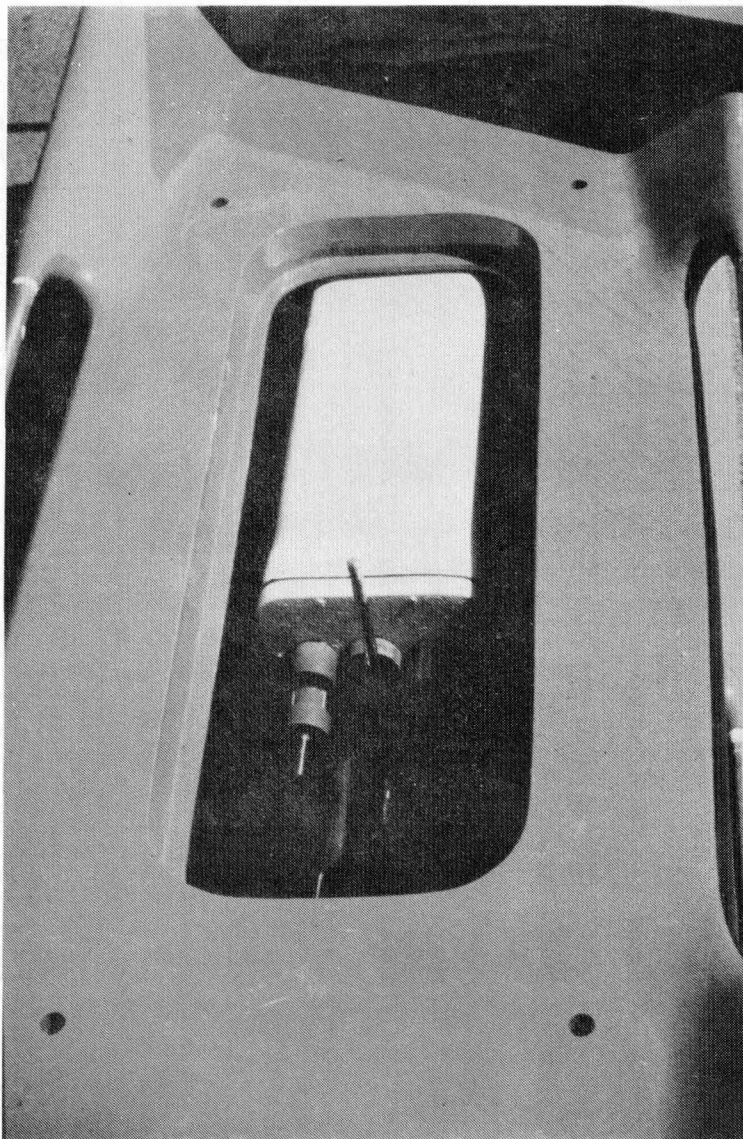


Fig. 5 CTD-sonde mounted in the Towed body.

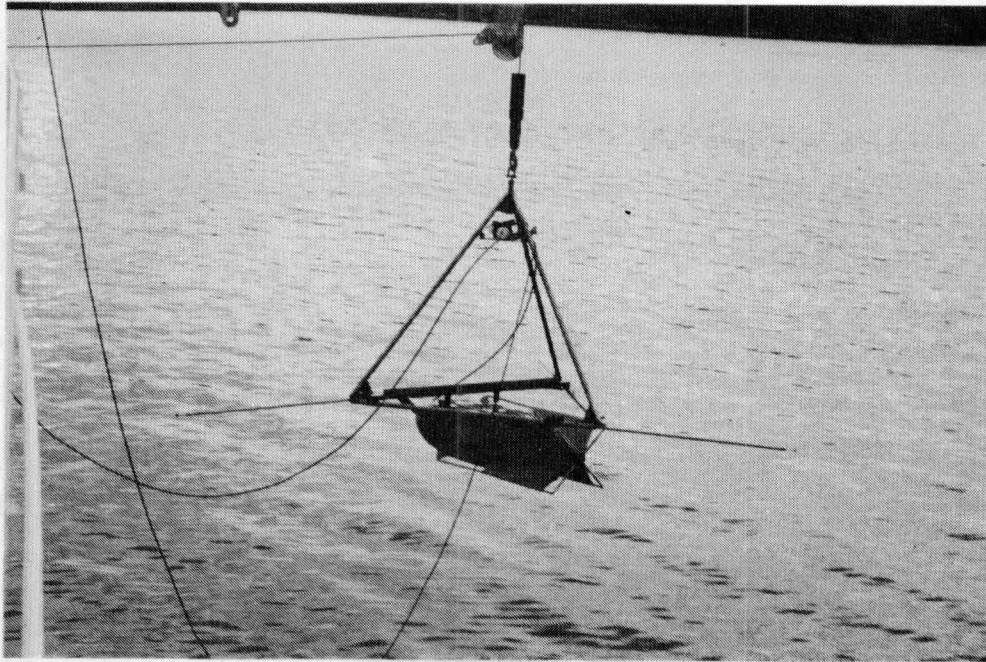


Fig. 6 Calibration Rig.