Canadian Fully Powered Rope Reels for Scottish Seining

Jack Rycroft and David Tait

Fisheries Development Branch
Scotia-Fundy Region
Halifax, Nova Scotia B3J 2S7

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by

Jack Rycroft

Chief, Operations Division

Fisheries Development Branch

and

Captain David Tait

Scantec Ltd.

Department of Fisheries and Oceans
Scotia-Fundy Region
P.O. Box 550
Halifax, N.S.
B3J 2S7

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ABSTRACT

Rycroft, Jack and David Tait. Canadian Fully Powered Rope Reels for Scottish Seining. Can. Ind. Rep. Fish. Aquat. Sci. 147: iv and 19 p.

This report describes the development in Atlantic Canada of fully powered rope reels for Scottish seining. The Fisheries Development Branch, Department of Fisheries and Oceans, Halifax, was responsible for the project concept, engineering feasibility study and eventual arrangement with Dugas Equipment Ltd., Caraquet, New Brunswick, to construct the prototype reels. Included in the report is a description of initial fishing trials, subsequent modifications to the experimental equipment and eventual successful commercial fishing operations.

Fully powered rope reels are now in commercial production.

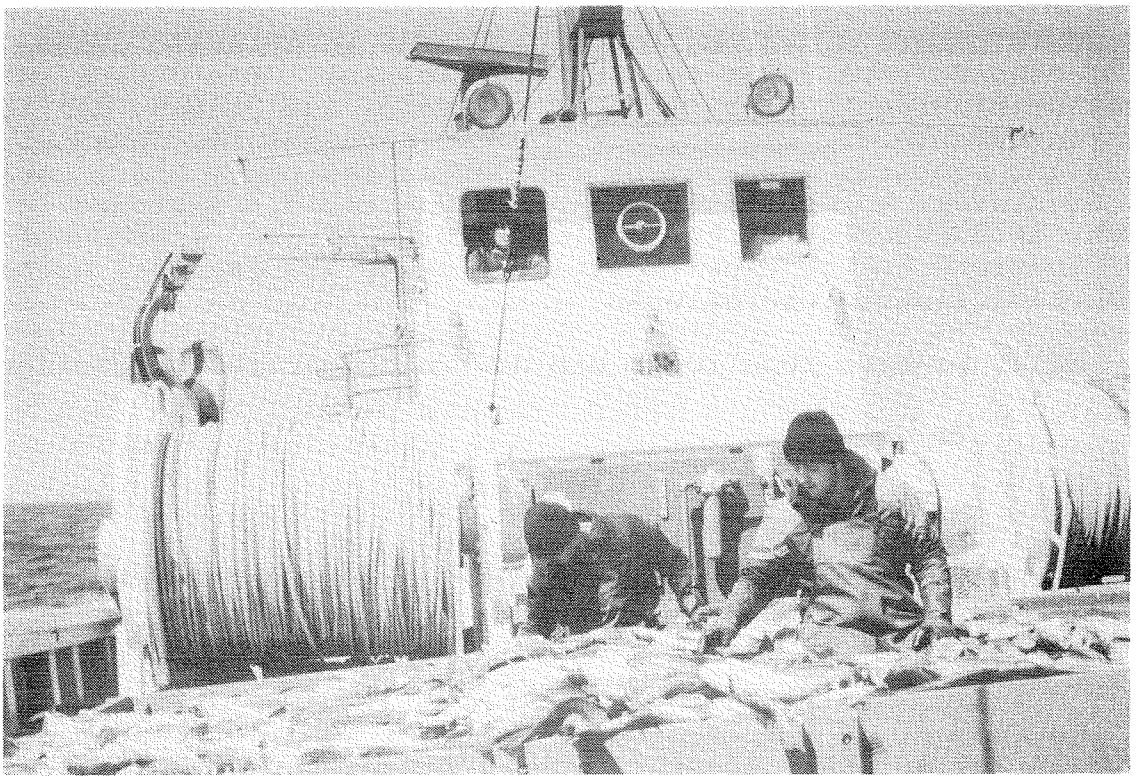
RESUME

Rycroft, Jack and David Tait. Canadian Fully Powered Rope Reels for Scottish Seining. Can. Ind. Rep. Fish. Aquat. Sci. 147: iv and 19 p.

Ce rapport décrit la mise au point de moulinets mécanisés destinés aux senneurs écossais dans l'Atlantique canadien. La Direction du développement des pêches du ministère des Pêches et des Océans à Halifax s'est chargée de la conception de ce projet, de l'étude de faisabilité en ingénierie et des accords éventuels avec la firme Dugas Equipment Ltd., Caraquet, (Nouveau-Brunswick) pour la construction du prototype du moulinet.

La description des essais de pêches initiaux, des modifications subséquentes apportées à l'équipement expérimental et des activités de pêche commerciale fructueuses possibles est incluse dans ce rapport.

Les moulinets mécanisés sont maintenant fabriqués de façon commerciale.



Scottish Seining on the Monique H with Canadian Fully Powered Rope Reels

1. INTRODUCTION

Since its inception in Denmark during the mid 1800s seine-net fishing has proven to be an extremely cost efficient fishing method which yields a high quality product.

Early seining methods employed in Denmark involved setting the gear and hauling from a fixed position held by an anchor. This operation, appropriately named "Danish Seining" or "Anchor Seining", was originally developed to catch flatfish.

Danish Seining was introduced to England and Scotland around 1920. The Scots changed the method by towing and heaving the gear simultaneously, thus eliminating the cumbersome anchor equipment. This method became known as "Scottish Seining" or "Fly Dragging" and has proved to be highly efficient in catching all demersal species.

Most European countries subsequently adopted this technique and today even some Danish vessels are constructed primarily to operate as "Scottish Seiners."

Danish and Scottish Seining techniques were introduced to Eastern Canada in the mid 1950s and 1960s respectively. The Scottish method prevailed and today Canada has a fleet of approximately one hundred Scottish Seiners, the majority of which operate from three ports in Northeast New Brunswick, Shippegan, Caraquet and Lameque.

Seine net fishing was for many years a labour intensive operation. However, over the years, as a result of innovative technology, being developed, particularly in the United Kingdom and Scandinavia, it has evolved from hauling with steam powered equipment to present day hydraulic winches for hauling and automatic rope reels for stowing the ropes. Rope reels have effectively transformed both Danish and Scottish Seining operations, mainly by reducing the workload and increasing crew safety. These hydraulic reels, however, are for the sole purpose of stowing and shooting the ropes. They are lightly constructed and are driven by low torque motors since the main seine winch is the prime hauler. Some vessels experiencing main winch failure have used the reels for gear retrieval providing the ropes were not under tension. The possibility of the reels becoming prime haulers was examined in the UK and Scandinavia, but too many problems were anticipated and the idea was discarded.

2. ROPE REEL DEVELOPMENT

Following the successful introduction of conventional self-tensioning rope reels to the Scottish seine fishery in Northeast New Brunswick, an attempt was made to haul seine ropes directly onto net drums. However, although meeting most of the torque requirements the units did not possess the necessary line speeds required during the shooting and hauling operations.

A meeting was convened by the Department of Fisheries and Oceans Fisheries Development Branch with representatives from the key sectors of industry to examine the feasibility of designing and manufacturing two rope reels capable of performing all functions related to the shooting and hauling of ropes during the fishing cycle. In fact these would be the first fully powered rope reels.

Representatives who attended the initial and subsequent meetings were from the Fisheries Development Branch, Scotia-Fundy Region; Dugas Equipment Ltd., Caraquet, N.B.; Caulderfield Hydraulics Ltd., Sheffield, England; and a Scottish Seine Captain David Tait under contract to the Development Branch.

Project objectives were discussed and defined as follows: to eliminate the seine winch as the prime hauler, and to combine all the structural and torque/speed parameters it provided with the versatility of conventional automatic rope reels, in a single unit.

The benefits to be derived from the project were projected to be:

- increased crew safety;
- increased deck space;
- reducing the power drain required to operate a conventional system;
- simpler hydraulic circuitry, reducing costs on installation by 10 to 15% over conventional systems;
- reduced rope wear; and,
- a smoother transition of speeds during the fishing cycle.

The decision was made to develop and test fully powered rope reels under commercial fishing conditions.

2.1 Technical Requirements

Discussions then centered on the engineering and hydraulic design criteria to be adopted. Hydraulic circuit drawings were designed to meet the following specifications:

- Line pull 8000 lbs. (3629 kg) bare drum.
  2000 lbs. (907 kg) full drum.
- Infinitely variable speed from 0 to 100 ft. per/min for the first 5 coils and speeds of 400 to 450 ft. thereafter. Speed factors to be achieved by two fixed displacement hydraulic pumps.

- Rope capacity to be 24 coils of 3" circ. seine rope.
- Hydrostatic regenerative braking during shooting of ropes with infinitely variable control by means of electrically modulated pressure control valves.
- Shooting speed of vessel 8 knots.
- Main hauling motors (radial piston) to have totally free wheel characteristics to be engaged during shooting.
- Infinitely variable speed control of each reel by means of electrically modulated 3 way pressure compensated flow control valves.
- Control panel with control levers giving positions Haul, Reverse, & Shoot complete with all necessary tachometers and pressure gauges.

Materials:

- 2 rope reels, capacity 24 coils (120 fath. each) of 3 ins. circ. rope.
- Stress factors to be in excess of the torque requirements contained in the hydraulic specification.
- Core diameter 16 ins. of heavy duty seamless tube with at least 1 ins. wall thickness.
- Flanges to be no less than 5/8 ins. high tensile steel suitably stiffened to prevent splaying.
- Guide gear to be chain driven on a double helical screw with upper & lower carrier bar supports, and to have adequate spacing between guide rollers to facilitate entry to split links.
- Frame to be fabricated with heavy box section and to be reinforced at motor housings.
- Strong wire mesh guards at each end of the reels for increased crew safety.
- Estimated weight of two empty reels without motors is 3500 lbs. (1580 kg).

2.2 Vessel Selection

Since this was a development of prototype reels which would be subjected to the full torque of fishing gear, structural strength and associated weight were designed far in excess of that required by conventional self tensioning reels. The vessel used to test the equipment had to be large enough to maintain stability factors associated with the prototype rope reels and have adequate deck space to accommodate such a system.

It was therefore decided to employ the "Monique H", an 86 ft. 6 in. side/stern dragger, operating from Caraquet, New Brunswick. The "Monique H" was on the slipway in Caraquet and easily accessible for the equipment installation, creating no costly lay-up time.

The vessel also had the available living quarters to accommodate the technologists and observers involved in the project, and had a current groundfish license.

There appeared a need to demonstrate the viability of converting vessels of this category from trawling and purse seining, especially on the basis of fuel consumption. With steadily increasing fuel prices, the owners of the "Monique H" were contemplating alternative fuel efficient fishing methods.

2.3 Gear Installation

Conversion of the "Monique H" from a stern trawler to Scottish Seiner began late March 1982. Trawl gear had to be removed to accommodate the rope reels and associated equipment.

Deck alterations were required to aid installation of new equipment. The ship's dory was removed from above the wheelhouse and relocated on the foredeck in order to facilitate structural alterations. The davit for launching the dory was also removed from the aft mast. The aft deckboard divisions were also rearranged.

Since Scottish Seining operations require constant monitoring by the Skipper, structural alterations were required to the interior and exterior of the wheelhouse. To permit unrestricted viewing of the after deck, the overhang on the aft end of the wheelhouse was reduced and an opening window was fitted. This also enabled the Skipper to hear advice from the crew when hauling. The interior of the wheelhouse was altered to accommodate a central fishing console containing all the controls required to operate the equipment and the vessel during fishing operations.

The installation of the new equipment caused some alteration in weight distribution to the vessel. The structural changes necessitated stability tests on the vessel as required by government regulations. These tests were performed by J.B. McGuire Associates of Pictou, N.S. All G.M.F.L. results on roll and inclining tests proved adequate for fishing operations to be performed by a vessel of this class.

2.4 Fishing Gear and Auxilary Equipment

Installation of a freestanding, articulated crane with a 28" Scottish Seine power block is the first of its kind in Northeast New Brunswick.

The power block has a single V-groove wide enough to accommodate two 8" floats simultaneously and was suspended from the crane boom. The power block has to be elevated

sufficiently to give the bridles and net a sufficient angle of wrap to provide grip for hauling, but it has to be lowered beneath bulwark height at the initial stages to insert the bridles. To eliminate twisting of the bridles and net during hauling, the block is lined up in the horizontal plane by the crane operator. By manipulating a control valve the crane and block can be raised, lowered, extended, retracted and slewed over a wide arc.

Removal of the trawl winch and attached warping heads required the installation of a small capstan for auxiliary deck duties such as heaving the bullrope to split the bag.

Roller guides, or fairleads were strategically sited to minimize rope wear during shooting and hauling. Three guides were placed on the stern bulwark, the centre guide was used mainly while towing. The two outer guides were used during shooting. Four wheelhouse roller guides were installed for shooting and hauling. Two rollers were positioned at the aft end of the wheelhouse to guide the ropes while being transferred from one reel to another for splicing, etc.

The province of New Brunswick Department of Fisheries supplied two modern seine nets. One was a 560 mesh box seine, and one a 600 mesh hi-lift seine. These were complete with spares and 20 fathom combination bridles. The two nets were designed and constructed by I.C. Trawls Ltd., Newfoundland. Twelve coils of rope (120 Faths. each) were spliced, and hove on each rope reel, and a further six coils were supplied as spares. All the ropes were of three inch circumference; hard lay with a lead core.

2.5 Operation Techniques

The Captain and crew had no previous experience in the technique of Scottish Seining, and the Department provided technical assistance to instruct them.

The gear is shot in the conventional manner with rope being led from the reel to the shooting roller on the vessel's stern. With the highflyer released, the vessel gathers way and the control on the port reel is engaged in the shooting position. The drag from the rope and highflyer is counteracted by hydrostatic braking. This prevents over-running of the reel which could cause motor damage and loose bights of rope.

Shooting at 8 knots, the first 9 coils form one side of a triangle with the next 3 coils forming half of the base. The net is let go at the centre, followed by rope from the starboard reel which is ready in the shooting mode, and a further 3 coils complete the base. The vessel then shoots the remaining 9 coils, and steams back to retrieve the highflyer. The nylon messenger rope attached to the port reel has been prepared for connecting to the side attached to the highflyer. When the shooting procedure has been completed the vessel steams slowly ahead at a predetermined speed. The rope reel controls are manipulated briefly until the desired line pressures and line speeds are registered. In the case of the "Monique H" engine RPMs is 575 with approx. 900 PSI on each reel. The line speed on each reel at the commencement of the tow is approx. 40 ft./min. This is steadily increased during the fishing cycle until the gear closes at approx. 120 ft./min. It is to be noted that the line speed throughout the fishing cycle is complemented by the increasing core diameter on the reels, adding approx. 5 ft./min. to the hauling speed for each layer of rope.

2.6 Sea Trials

Following the completion of installation, initial trials were conducted in the Bay of Chaleur in May of 1982.

On the first day the "Monique H" started to fish on suitable seining ground in 27 to 40 fathoms of water. Two sets were completed for a total catch of approximately 7000 lbs., the majority of which was cod. This was the first ever attempt by this Captain and crew at Scottish seining, and the first time Scottish seining had been conducted using fully powered rope reels.

The powered rope reels performed remarkably well as the results indicate; however, a few anomalies were detected in the hydraulic system. The reels appeared to be restricted from adequate free-wheeling in the reverse or shooting mode. This distorted the shooting pattern, created irregular, therefore inefficient sets and negated calculations essential for shooting the gear clear of hard ground and obstructions. When heaving in the fast mode the reels also failed to meet the speed contained in the specifications adding considerable time to the fishing period. After the trials the vessel proceeded to Caraquet for modifications to the system.

With adjustments and modifications completed it was decided to attempt a typical commercial trip alongside other Scottish Seiners on Scottish Seine grounds known as the Shediac Valley area, approximately thirty-five miles southeast of Miscou Light. This area was selected because of the close proximity to Caraquet, plus the availability of fish stocks and extensive areas of soft ground which would reduce the possibility of hooking up.

Commercial trips began in June and were usually five days in duration. Seven fishing

trips were completed by the end of July in which 187 sets were made in 34 actual fishing days. During this period close scrutiny was kept on the equipment for any indication of malfunctioning, and a slight splaying of the rope reel flanges was detected. These were subsequently reinforced and gave no further trouble.

The codend winch on the lifting derrick proved inadequate for other general duties and it was decided to install a small capstan. This was sited in a convenient location.

Line speeds, shooting and hauling were still below specifications and a meeting was convened by the Department between representatives from industry with a view to solving the problem.

The hydraulic pumps were driven by a power take off on the front of the main engine (Caterpillar 565 HP @ 1200 RPM). Pump ratios and line speeds were calculated theoretically and functioned perfectly in the slow mode or fishing cycle. The problem occurred only in the fast reverse shoot, and fast haul condition. This was manifested when speed requirements were critical, i.e. shooting, heaving up after the gear was closed, and especially when recovering the gear during a hookup. Fast line speed in the hydraulic circuit was to be achieved by boosting with the second hydraulic pump. This arrangement worked well, but to get the required oil delivery to the pumps, the main engine speed had to be increased. The vessel having a fixed pitch propeller, gathered too much way, and main engine RPMs had to be decreased to avoid gear damage. Subsequently line speed was reduced and a considerable loss of fishing time elapsed until mid reel, when the diameter compensated for the reel RPM and line speed improved.

Various options were considered to rectify the pump ratio:

(1) Replace the main hydraulic pumps with a high capacity unit which would increase the oil flow and allow up to 90% efficiency. This option would have to include replacement of hydraulic hose, fittings, and valves, to handle the increased flow. This alternative would result in a one month lay up.

(2) Install a Twin Disc Omega Gear or C.P. propeller. This option would have a lay up of six weeks.

(3) Replace the existing (100 HP) auxiliary engine with a GM G-71 (160 HP @ 1800 RPM). This would have the HP required and cover the RPM to give the necessary oil flow. This option was approved unanimously, and the existing pumps and hydraulic fittings would remain. There would be complete independence between the hydraulic drive and the main engine, thus allowing line speed to meet specifications. This arrangement would leave the main engine for propulsion only.

During the installation of the auxiliary engine, the guide gear was removed and overhauled, and final refinements were carried out on the complete installation.

The "Monique H" sailed at the end of August for the Shediac Valley area to test the effectiveness of the new system. It proved to be an unqualified success. System pressures, line speeds and line pull, were operating as per specification. Results of landings during the commercial sea trial period of 1982 were extremely positive.

2.7 Catch Statistics

Total catch landed by the "Monique H" from June 1982 through November was 931,849 lbs. (422,687 kg). A total of 450 sets were completed during 83 fishing days averaging over 5 sets per day. The maximum number of sets per day was 8, using 12 coils of rope per side.

In 1983, skipper and crew of the "Monique H", with only one short season of Scottish seining, landed 1,690,910 lbs. (767,000 kg) in 84 fishing days. A total of 555 sets were completed, averaging over 6 sets per day, and the maximum number of sets per day increased to 11.

These figures alone validate the operational efficiency of fully powered rope reels.

In any Scottish seining operation the skipper's knowledge of the fishing grounds, crew experience, and attitude are contributory factors to success. These were acquired in a short space of time.

Development Branch personnel carefully selected types of fishing gear, some of which had never been used in New Brunswick. These included modern ropes, and nets to match the vessel's HP. The skipper was taught alternative shooting patterns and was instructed on the critical towing and heaving speeds required when operating an efficient Scottish Seiner.

3. DISCUSSION AND CONCLUSIONS

As in most prototype equipment evaluations, some factors were considered to have a higher success ratio than others.

When alterations or refinements were found necessary, they were implemented immediately after discussion between the concerned parties.

The system has now been operational for two years on a commercial basis, and the vessel has completed over 1000 sets. There are still 60% of the original seine ropes in use.

Also from the prototype, knowledge is gained through the experience and transferred to future production models. In this case new structural design features were evaluated, resulting in future reels being lighter in construction.

The hydraulic system can also be streamlined, and by introducing alternative pumps, the reels can be made more versatile. This can only lead to a decrease in cost and an increase in productivity for fishermen who invest in Canadian fully powered rope reel systems.

Total cost of fully powered rope reels installed on a new vessel in 1983 is estimated at $60,000 in comparison to $75,000 for the traditional winch and rope reel system.

TABLE I: SPECIFICATIONS - MV MONIQUE H

1.	Length	86'6"
2.	Breadth	23'
3.	Depth	10'4"
4.	Gross tonnage	135 tons
5.	Register tonnage	62.72 tons
6.	Main engine	Cat. D379 565 HP - 1225 r.p.m.
7.	Reduction	3.95:1
8.	Screw	Bronze - 5 blades - 68.50
9.	Speed	10 knots
10.	Auxiliary engine	GM 6-71
11.	Electrical system	110 v. DC
12.	Load capacity	160,000 lb.
13.	Crew	5
14.	Fuel capacity	4,200 gal.

Electronic Equipment

1.	2 radars	1 Decca - D-202-24M; 1 Decca R-M-916 48M
2.	2 echo sounders	1 Simard EH2F; 1 Simard ES2D
3.	2 Loran C.	1 Epsco C-NAV-XL; 1 Epsco C-NAC-2
4.	1 plotter	C-1
5.	1 automatic pilot	Wood Freeman 500B
6.	1 VHF	Sailor
7.	1 sideband	Canadian Marconi
8.	1 compass	

TABLE II: WEIGHTS OF TRAWL EQUIPMENT REMOVED AND SEINE EQUIPMENT INSTALLED

Trawl Equipment Removed

ITEMS	APPROXIMATE WEIGHT
3 Trawl Gallows	600 lbs. ea.
3 Hanging Blocks	150 lbs. ea.
6 Deck Blocks	200 lbs. ea.
1 Trawl Winch	800 lbs.
800 Fathoms Trawl Wire ($\frac{3}{4}$ steel core)	4,300 lbs.
1 Net Drum	300 lbs.
1 Complete Trawl (spares)	1,200 lbs.
1 Stern Roller	300 lbs.
TOTAL WEIGHT	9,350 lbs.

Seine Equipment Installed

ITEMS	APPROXIMATE WEIGHT
2 Fully Powered Rope Reels	3,700 lbs. ea.
30 Coils 3" Circumference Seine Rope	6,330 lbs.
1 Jutland Gutting Machine	800 lbs.
1 Auxiliary Capstan	300 lbs.
2 Scottish Seine Nets	800 lbs. ea.
1 Anchor Windlass (wire)	1,750 lbs.
1 Hydraulic Tank (oil)	100 lbs.
4 Wheelhouse Guide Rollers	100 lbs. ea.
2 Rope Transfer rollers	50 lbs. ea.
2 Seine Railrollers	50 lbs. ea.
1 Articulated Crane	2,000 lbs.
1 X 28" Powerblock	300 lbs.
TOTAL WEIGHT	21,180 lbs.

TABLE III: COMMERCIAL FISHING RESULTS OF "MONIQUE H" DURING SEA TRIALS, 1982

June 6 - July 30

TRIP #	DURATION (DAYS)	# OF SETS COMPLETED	TOTAL CATCH (LBS.)
1	5	21	70,900
2	5	31	89,000
3	5	28	46,600
4	5	26	50,400
5	5	25	52,300
6	5	34	51,300
7	4	22	33,300

Total Catch - 393,800 lbs. 5.5 sets/day
2,106 lbs./set
11,582 lbs./day

Changeover to Auxillary G.M. 6-71 Engine

August 27 - November 22

8	1	6	22,000
9	4	21	26,900
10	1	5	5,500
11	4	23	31,100
12	5	26	66,950
13	6	36	55,000
14	5	28	54,500
15	6	34	67,000
16	2	9	13,000
17	4	20	55,000
18	4	20	59,300
19	1	5	6,500
20	6	30	75,300

Total Catch - 538,050 lbs. 5.4 sets/day
2,046 lbs./set
10,980 lbs./day

Total sets - 450
Fishing days - 83
422,687 kg - Total catch - 931,850 lbs.

1982
max. sets/day = 8

Until Oct. 11

Total sets - 555
Fishing days - 84
Total catch - 1,399,699 lbs.
6.6 sets/day

1983
max. sets/day = 11

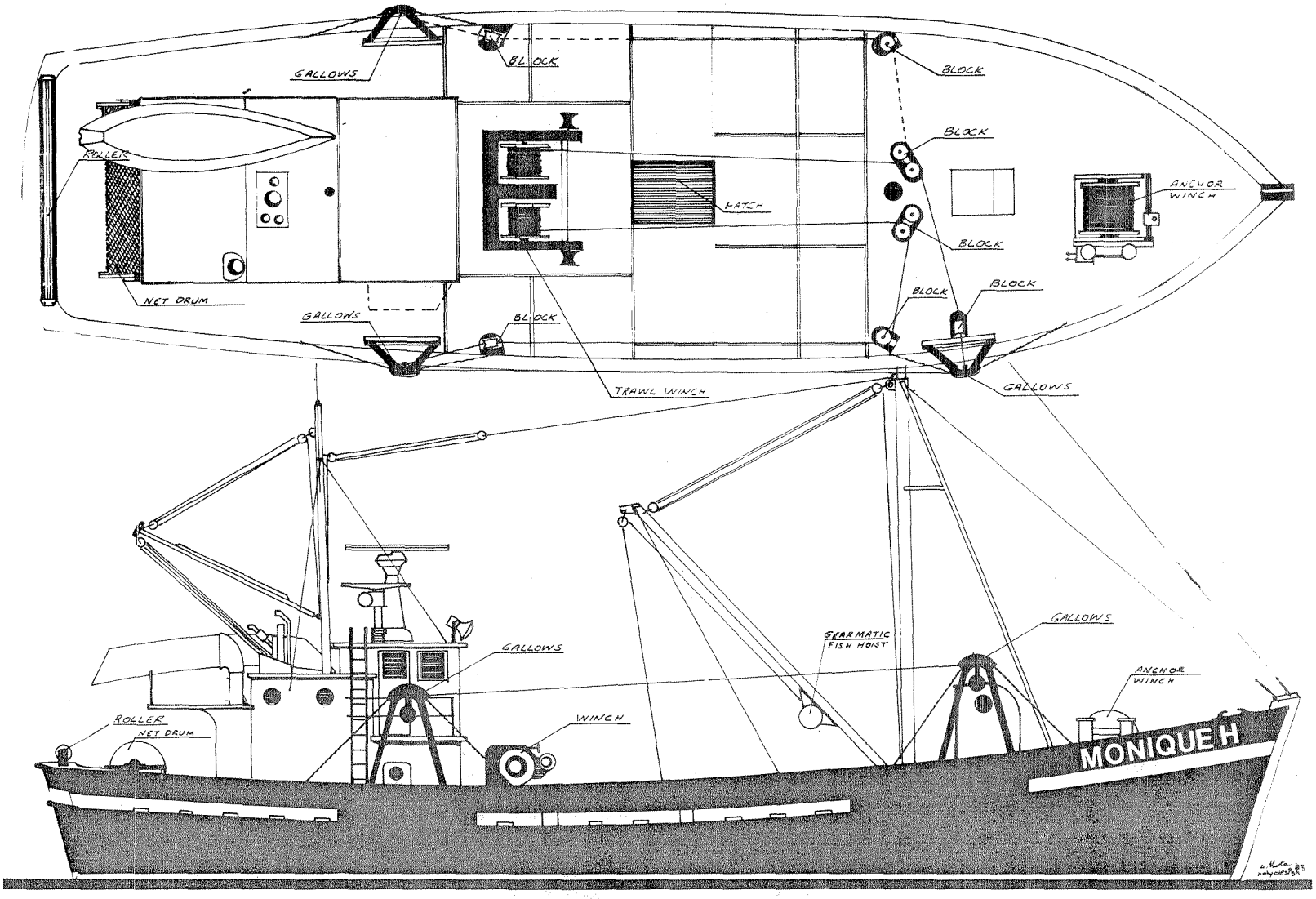


Figure I. Monique H before alterations –
Deck layout for side and stern trawling

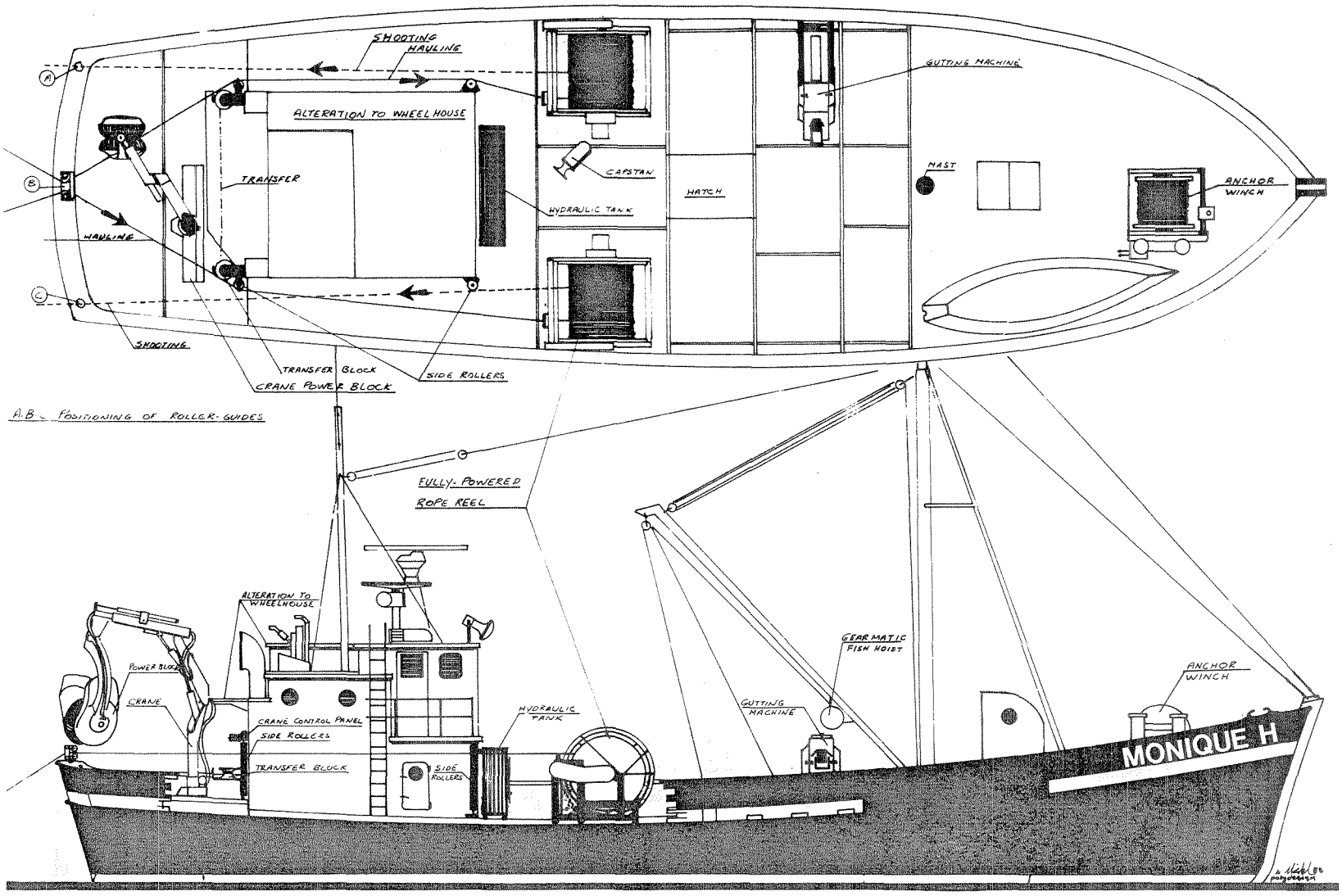


Figure 2. Monique H after alterations –
Deck layout for Scottish seining

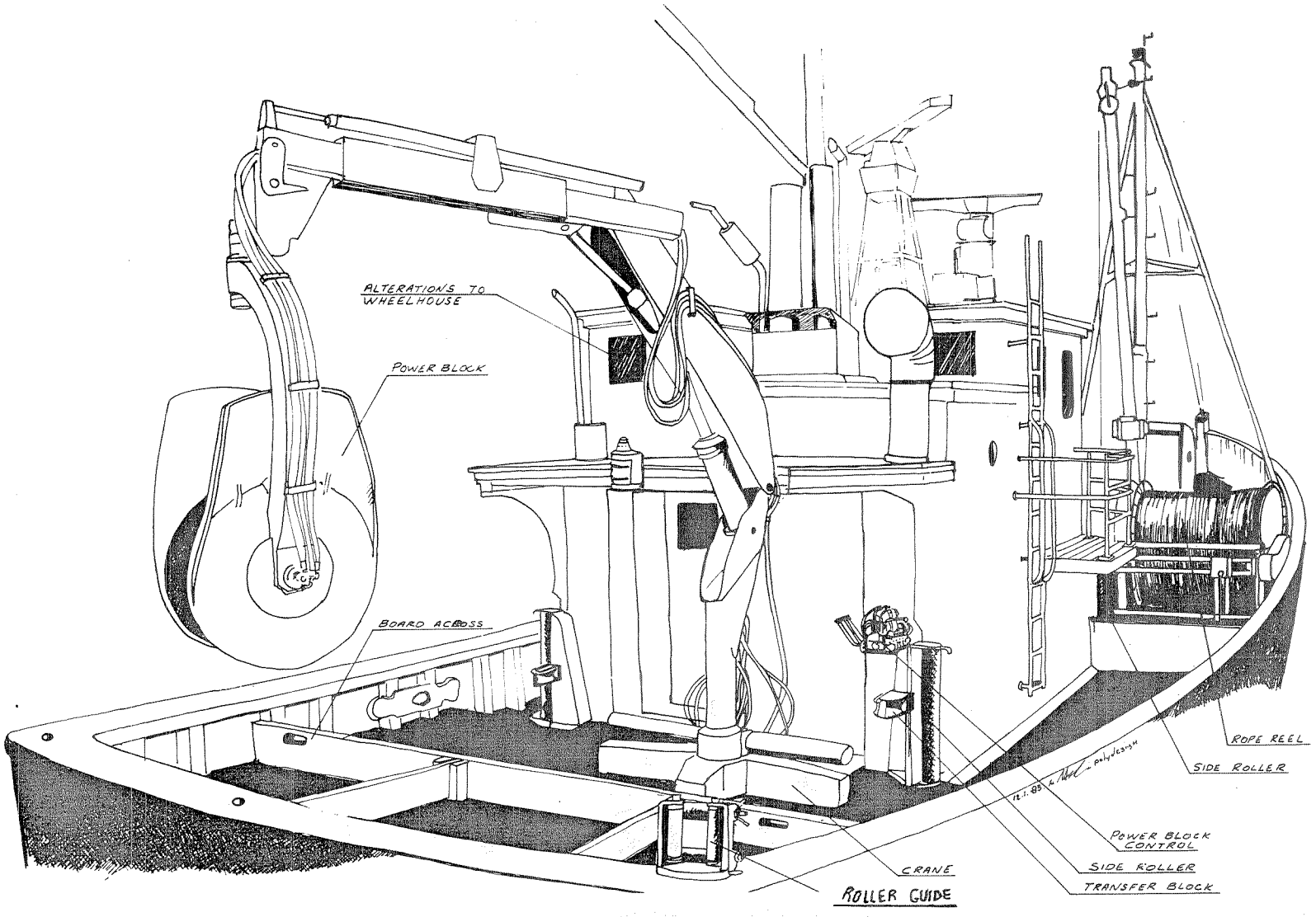


Figure 3. Deck layout for Scottish seining

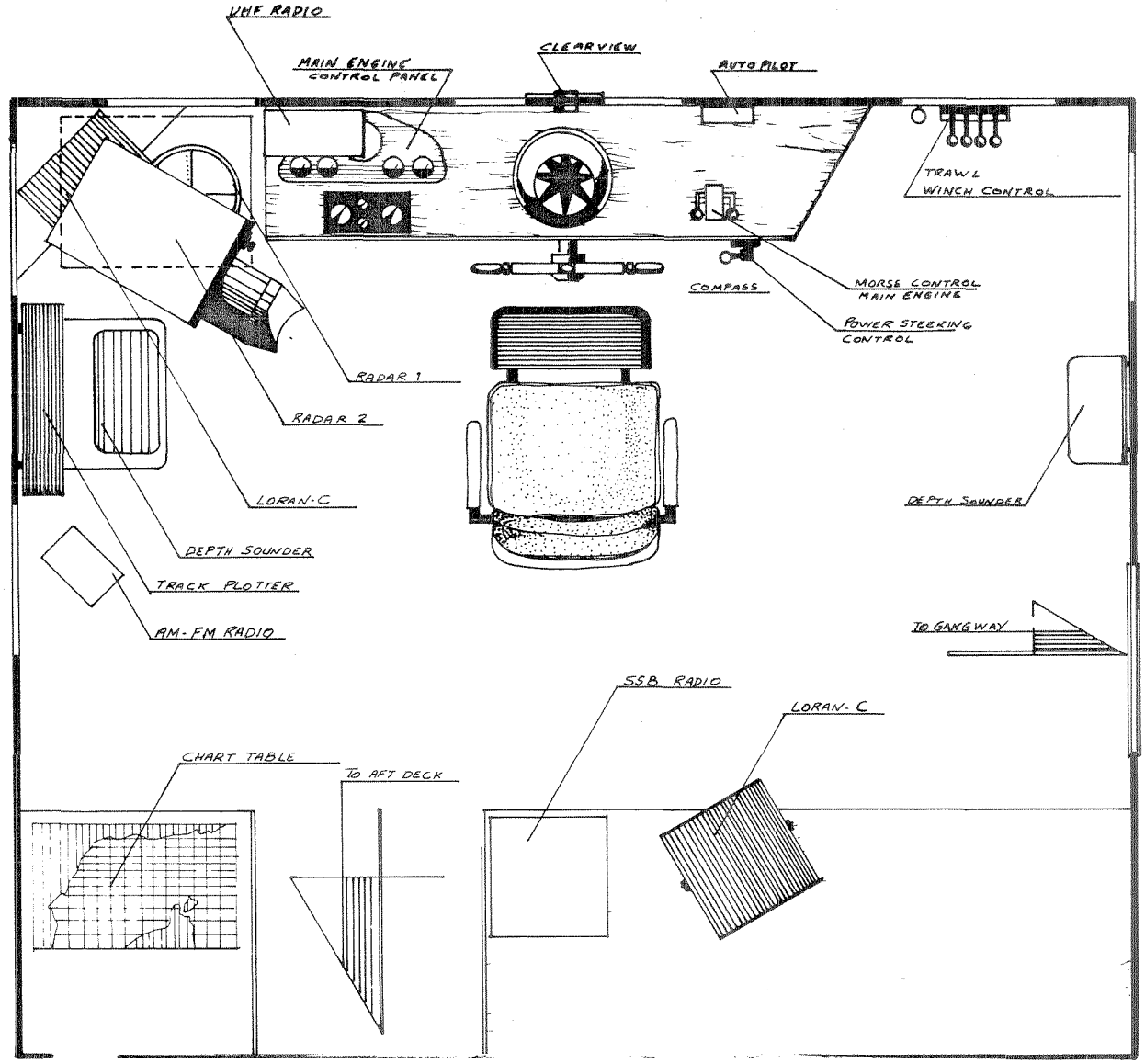


Figure 4. Wheelhouse before alterations

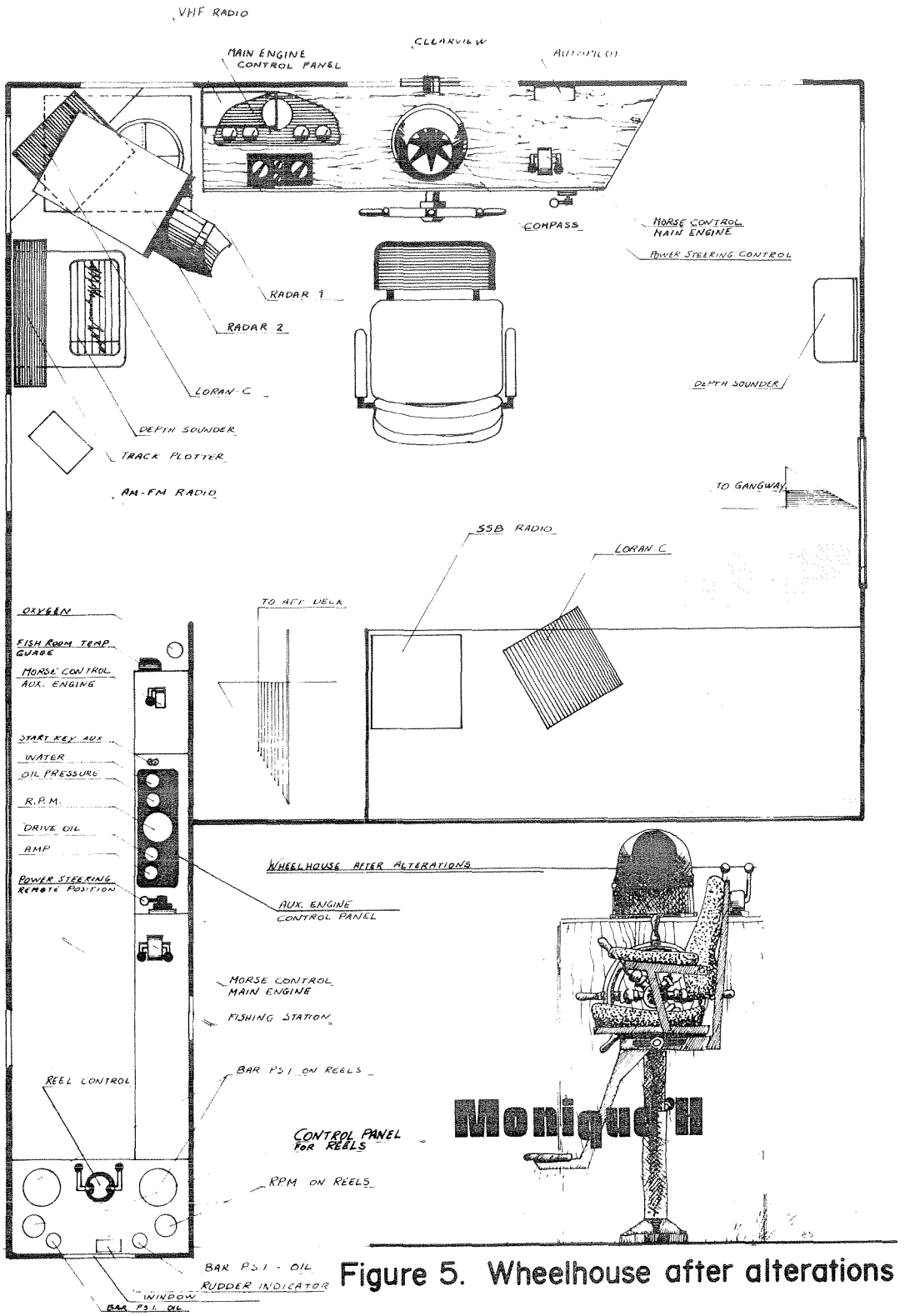


Figure 5. Wheelhouse after alterations

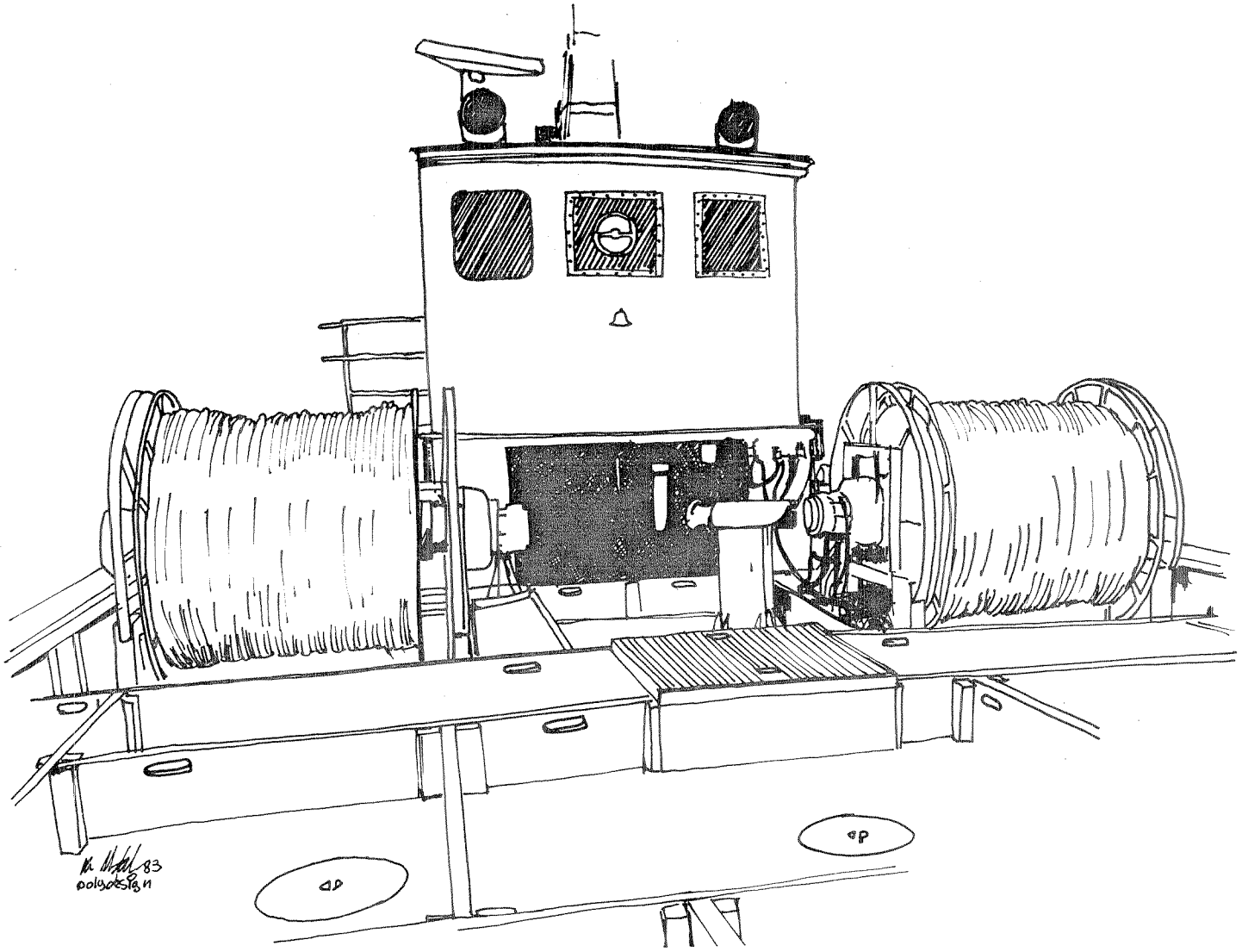


Figure 6. General view of installation

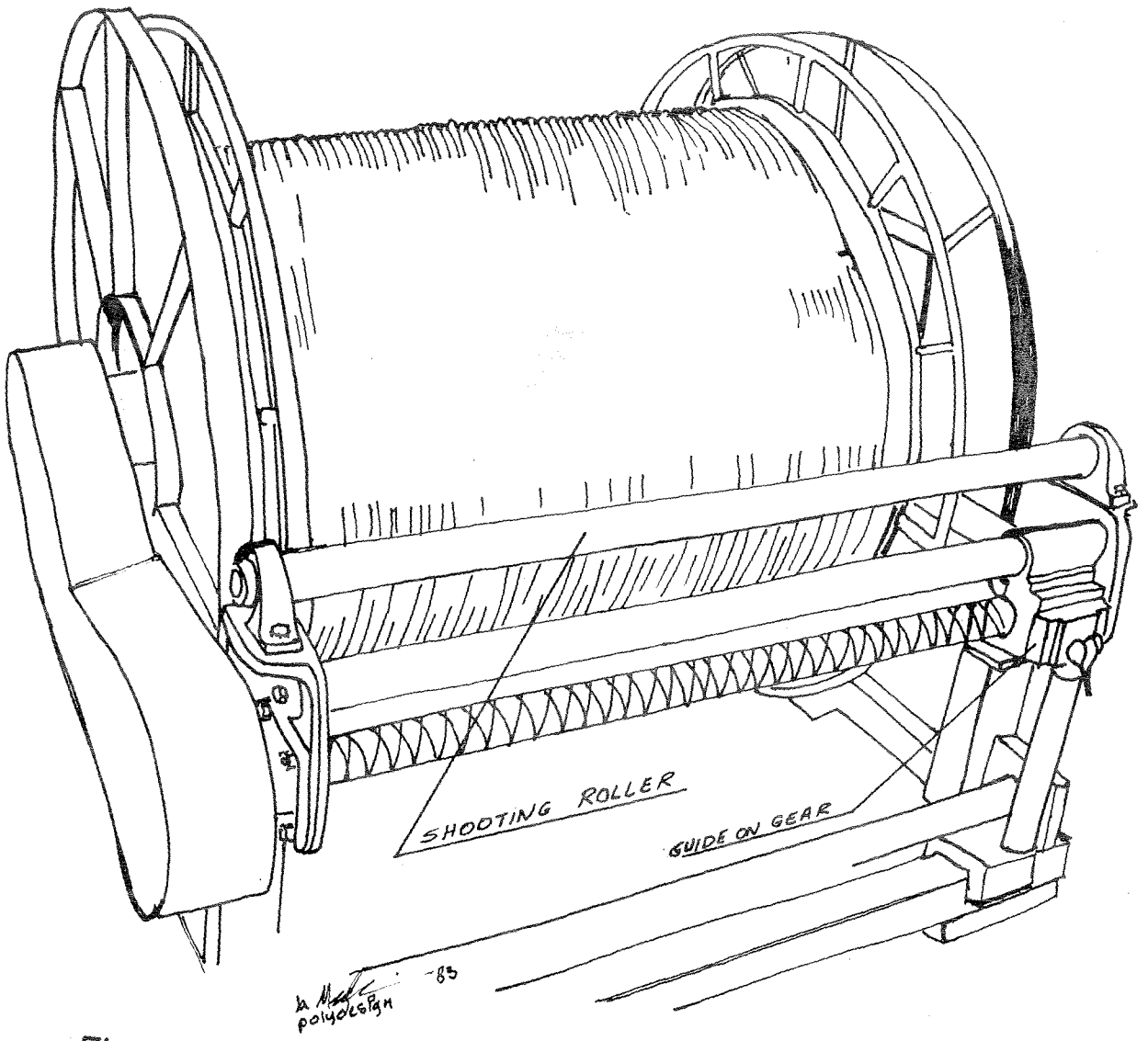


Figure 7. Detail of Canadian fully powered rope reels

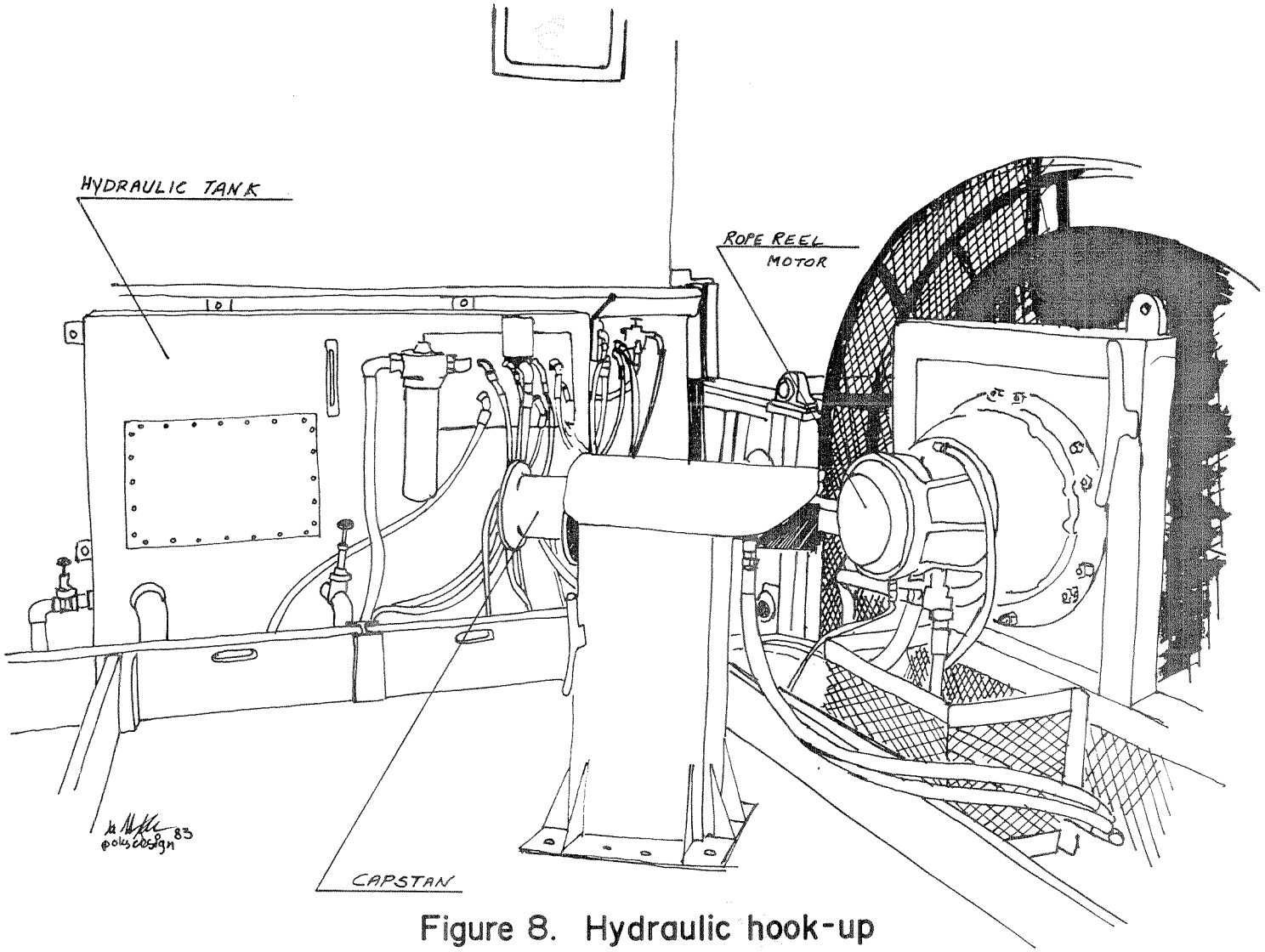


Figure 8. Hydraulic hook-up

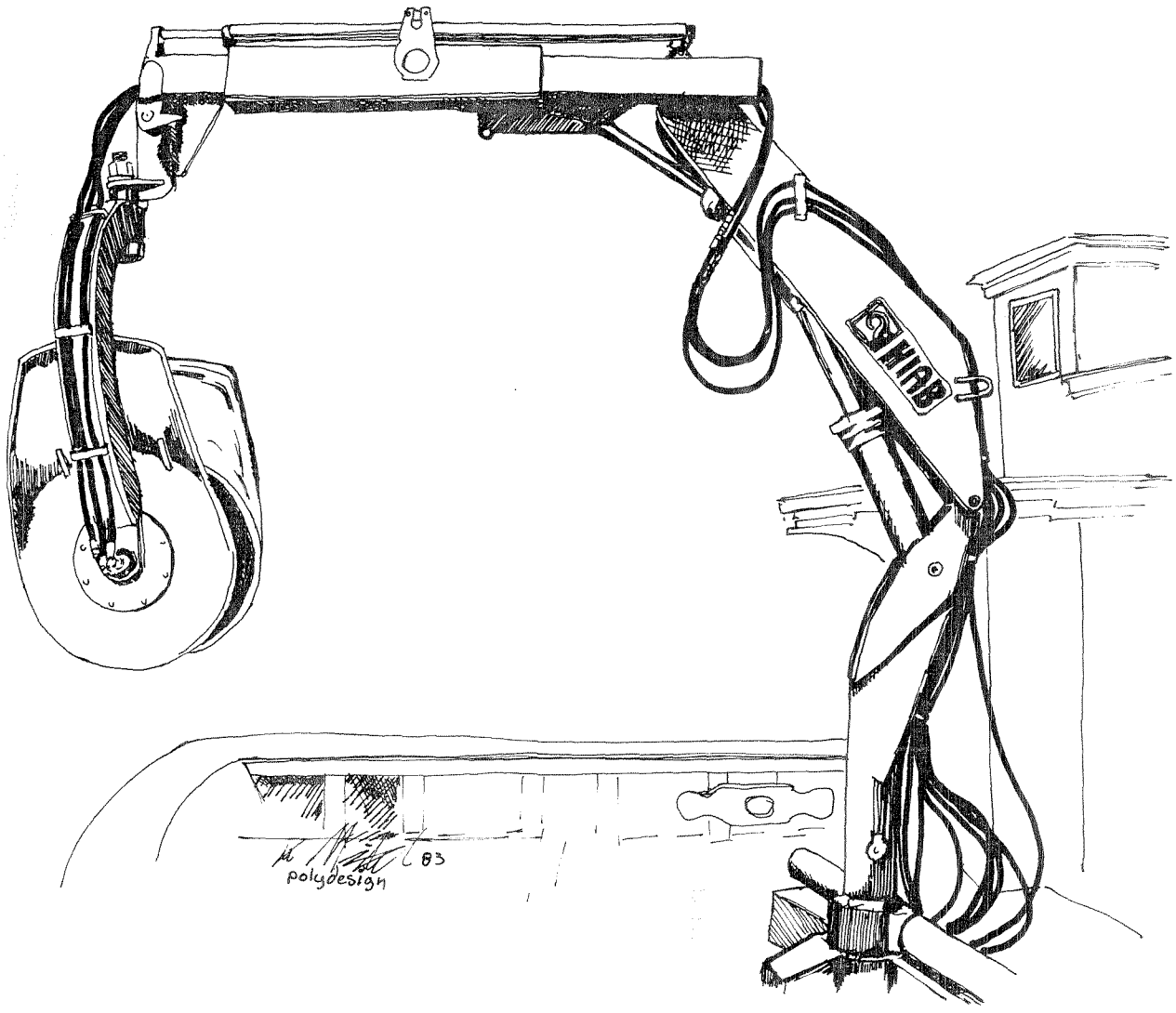


Figure 9. General view of crane and power block

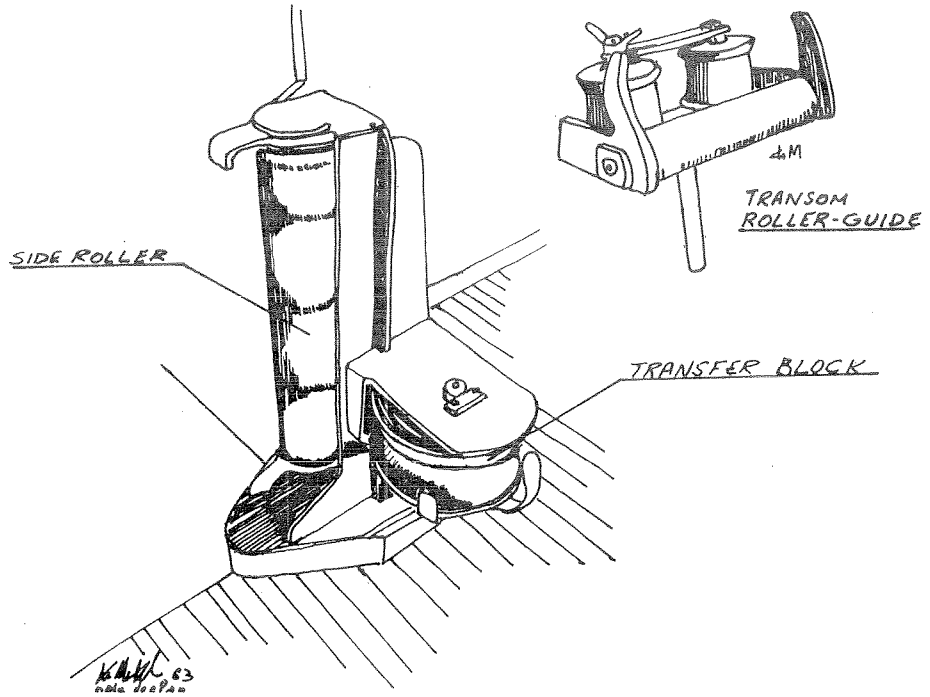


Figure 10. Starboard side roller and tranfer block

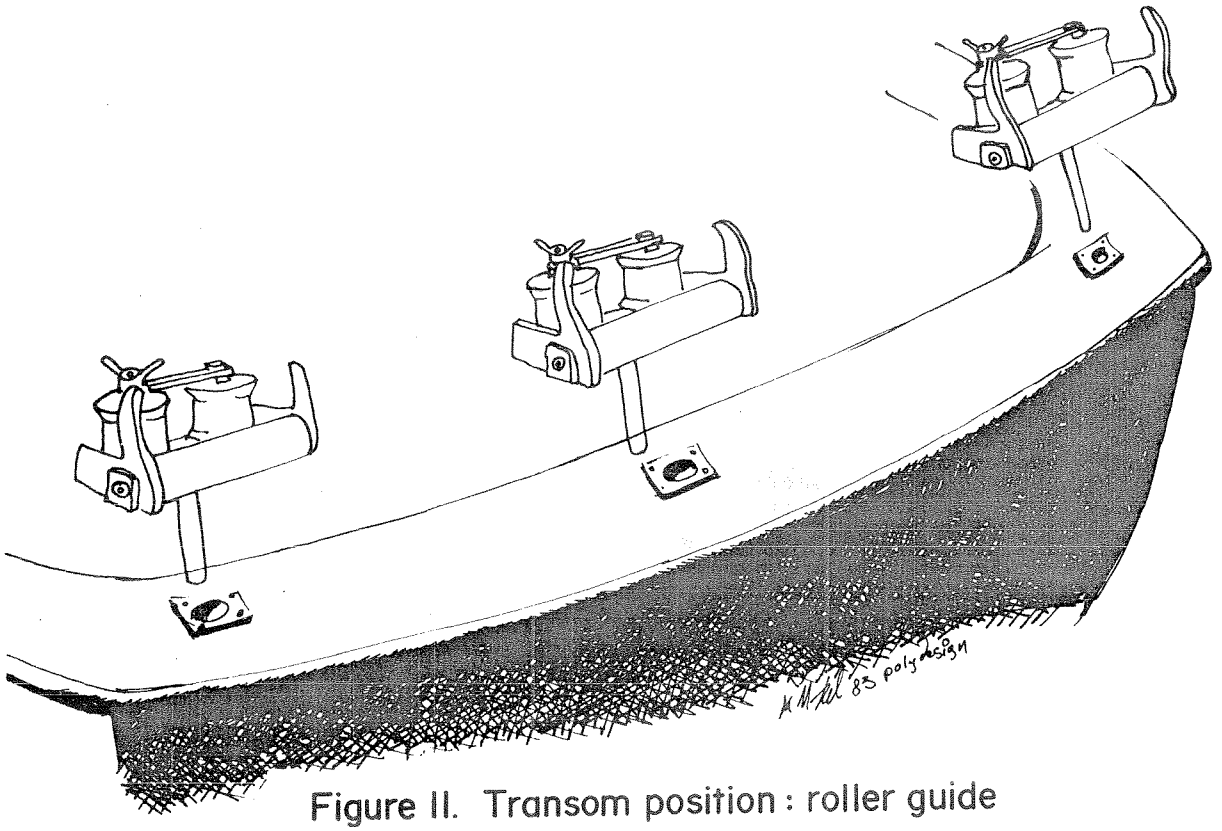


Figure 11. Transom position : roller guide