SEA FISH INDUSTRY AUTHORITY
Industrial Development Unit

INSTRUMENTATION TRIALS OF A HARD GROUND ROCKHOPPER TRAWL

Internal Report No. 1234
MAFF Ref. IBA 16

April 1985
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INDEX

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SUMARY

The rockhopper trawl has been introduced to enable trawlers to tow demersal trawls over grounds hitherto unavailable to them due to the hard rocky nature of the seabed.

It was discovered that by preventing the bobbins from rolling, and by fastening down the fishing line so that the lower sheets of netting are reasonably rigid, that it was possible to tow a set of fishing gear over some of these hard patches of ground without too much damage being done to the nets.

It is not established at this time who first started trawling using this novel idea but it is something that has been taken up by most of the trawling fleets around the UK and Scandinavian countries, and is hugely successful.

The trawl which is described in this report is basically a large standard two seam net with part of the top wing and the whole of the lower wing taken out, the net is mounted onto a rockhopper bobbin rig in the bosom and bunt sections.

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1. INTRODUCTION

This work was done under MAFF Commission Ref. IBA 16. Because of the continuing interest being shown by fishermen for demonstrations of different types of rockhopper bobbin rigs in the flume tank, the decision was taken to do full scale sea trials for comparative results on warp loads, wingend spreads, headline heights and vessel speeds. These results are used as a basis for the setting up of scaled model trials prior to them being used in the tank for demonstration purposes and gear technology courses.

Because there are so many different horsepowered vessels using the bobbin rig, it was decided to model the net and gear of the vessels that are currently the most successful financially. The vessels in question were the MAUREEN JUNE, CLARKWOOD and several of the Grampian boats, all with horsepowers between 1000-1700 hp. Although this class of larger type vessels are in a minority the net being used by them and by some of the smaller vessels is of a similar design and geometry and results are therefore relevant to the net that was used for the sea trials and therefore the 1:15 Flume Tank scale model is believed to be originally designed by Jim Robertson Nets Limited, North Shields. With continued use and the modifications done by each skipper to suit his own needs, most of these nets are significantly different to the original designs.

The net used by Skipper Stuart Thompson of the CLARKWOOD appeared to be the nearest one still similar to the original design; this was the net and bobbin gear used.

2. PREPARATORY VISIT TO ABERDEEN

Prior to the 24 hour charter of the vessel CLARKWOOD and prior to the scaling and building of a 1:15 scale model net and bobbin rig, Ben Ashcroft, Master Fisherman of the SFIA, arranged to meet Don Fishing Company management discuss the intended work of the Authority and to seek permission to board their vessels to measure the nets and bobbin gears currently being used.

Discussions were held with Skippers T. Taylor of the MAUREEN JUNE and S. Thompson of the CLARKWOOD, also a representative of the Enterprise Ships Stores. Enterprise Ships Stores are a subsidiary company of the Wood Group and are the local ships chandlers who repair and supply the rockhopper net and bobbins.

The discussions were primarily to find out what modifications or alterations had been done to individual nets. This information was a little difficult to obtain as both Skippers were reluctant to give information on their particular likes and dislikes. This, it might be said, was purely from a competitive fishing point of view, and the required information was obtained and with further cooperation from the ships stores who gave information on weights of bobbins, otter board sizes, wire sizes and weights, etc. all relevant information was obtained.

Based on the information obtained, the recommendation was made that the opportunity be taken to model the gear and follow at a later date with a 24 hour charter to do full scale instrumentation sea trials.

3. OBJECTIVES

a) To log warp loads, wingend spreads, headline heights and door spreads relative to different speeds and main engine revolutions for eventual comparison with model test data.

b) To keep a comprehensive log indicating gear used and rigging details.

c) To make a comprehensive plot of area towed using Decca Navigator Coordinates and radar observed land marks and distances.

d) To carry out a short trial to assess the merits of different engine speed and propeller pitch combinations for towing efficiency.

4. NARRATIVE AND OBSERVATIONS

4.1 Trials Programme

The charter was for a continuous 24 hour period commencing when the vessel left Aberdeen and terminating upon arrival back in Aberdeen.

To assess the effectiveness of the rockhopper bobbin rig and get as much information as possible within the time allowed, it was proposed at the outset of the trial to tow continuously and only heave back to the doors for turning. This was possible as the area fished provided good towing ground and damage to the trawl was expected to be non existent.

4.2 Voyage

The CLARKWOOD sailed from Aberdeen at 0930 hours 31 January 1985. During the steaming time to the shooting position the net and gear was made ready.

Altogether 8 hours 25 minutes was spent actually towing the gear on the seabed.

The vessel docked in Aberdeen at 0715 hours 1 February 1985, and the SFIA electronic equipment including winches and winch cradles were unloaded onto the quay.

4.3 The Fishing and Trial Area

The trial area chosen was from a position 4 miles South of Buchan Ness, towing in a Southerly direction upto 7 miles from Buchan Ness, turning round either to port or starboard and back to the Northward keeping approximately 4 miles off the mainland.

There were two good reasons why this area was chosen. For fourteen days prior to the planned trial day, continuous easterly gales had been forecast, but on the 31 January, westerly winds were forecast, consequently, the trial could take place in comparatively calm water which is essential for collecting information from electronic instruments that are connected to the trawl.

The other good reason was that the area is noted for good clean towing ground with no known obstructions therefore it was possible to keep towing for as long as necessary without having to haul the gear.

4.4 CLARKWOOD - Details of Vessel

Length O.A.	35.36m (116 ft)
Net Tonnage	145
Horsepower	1700
Main Engine	Mirrlees Blackstone
Navigation Equip.	Decca Arkass Auto Pilot
	Mk 21 Decca Navigator and Plotter
Echo sounder	Two Elac
Net Monitor	Elac
Radio Equipment	Two Sailor Multi Channel VHF
	ITT Single Side Band Radio
Built	Goole, 1976
Skipper	Stuart Thompson
Crew	Mate
	Bosun
	Chief Engineer
	2nd Engineer
	10 Deckhands
Trawl net	Rockhopper Trawl 530 x 6.25 inch mesh

Details of construction are shown in Figures 1, 2 and 3.

5. RESULTS

5.1 Towing Trials

The trials took place in water of nominally coastal depth and with a constant warp length short. The towing trials took place between 1740 hours on 31.1.85 and 0205 hours on 1.2.85 providing 18 separate records what are shown on Table 1. The results are plotted in Figs. 4, 5, 6, 7 and 8 which show, respectively

Door Spread against Towing Speed
Wing End Spread against Towing Speed
Headline Height against Towing Speed
Total Warp Load against Towing Speed
Fuel Consumption against Towing Speed

All trials at this time were carried out with the trawl winch automatic control system (Braatvaag 10-10) disconnected to allow recording of towing pull variations. The engine was run at constant speed with propeller pitch varied as necessary to provide the requisite towing speed.

5.2 Engine Speed Variation Trials

The vessel normally operates in a mode in which the main engine runs at constant speed and where propeller pitch is varied to meet the load requirements. Work on other vessels has shown that this arrangement is usually less fuel efficient than an operating mode in which pitch is held at maximum while engine speed is varied to suit the towing requirements. A test of this feature was carried out on the vessel during the trials as noted below:-

The vessel was run in normal mode and records of total warp load and vessel speed were noted. Engine speed was then reduced in a series of stages with propeller pitch being altered in each case to give the same towing pull as before. Unfortunately it was not possible to provide infinitely variable control on engine speed and the eventual choice was limited to full and 3 other set speeds. The lowest set

speed was too low for the required towing pull to be achieved. However, an estimate of fuel flow at a constant warp load has been made and is included in the trials results shown in Table 2.

Table 2

Variation of Fuel Consumption with Engine Speed and Propeller Pitch at Constant Output

Engine Speed Revs/Min	Propeller Pitch "%"	Fuel Flow L/hr	Ship Speed Knots	Total Warp Load Tonnes	Adjusted Fuel Flow
740 (max)	60	126.5	3.6	6.4	128.5
625	70	108.0	3.5	6.5	108.0
540	82.5	101.5	3.5	6.9	95.6
475	100 (max)	80.6	3.2	5.9	88.8

Notes: i) Row 1 represents the normal operating mode of the vessel

ii) The final column shows fuel flows "adjusted" to a common warp load of 6.5 tonnes

5.3 Normal Towing Activity

A short period of time was spent with the vessel operating in its normal mode with the automatic winch control in use. Under these circumstances the portable warp load meters could not be used and all comparisons must be made on the basis of equivalent towing speeds, wingend spreads or headline heights. The results are shown as the final block in Table 1.

5.4 Discussion of Results

The records of towing loads and speeds were specifically obtained for comparison with Tank trials and little can be made in the way of

significant comment on comparisons with other nets. However the total pull v. speed curve can be seen to be of a similar order to other trawls of similar (not necessarily equal) size and the impression is gained that on clean ground the Rockhopper variant of a trawl does not require higher towing powers than more traditional versions of the trawl. In fact there may be a saving in total fuel usage, associated with removal of the lower wing sections which had been removed in response to the skipper's comments about net damage in this area. This removal had not seemed to affect commercial catch rates. Though direct power measurements were not made it is possible to make reasonable estimates of power outputs by reference to fuel flow figures. The results show that normal towing power utilisation on the vessel is about 630 hp (470kW) whilst the maximum measured in the whole trials sequence was only about 770 hp (575 kW) or about 45% of total engine power. This would provide part of the explanation for the 30% variation in fuel consumption using the optimum propeller speed/pitch combination rather than the max speed/low pitch option normally used on the vessel (see Table 2).

It can be seen that, since the output power demand is very low it is necessary to reduce pitch to some 60% of full pitch to limit output to the necessary level. This setting is far removed from any optimum pitch defined by the designers. Were the demand nearer to the engine's rated power then more pitch could be applied and the "waste" in proportional terms would be less. The saving accruing from conversion of the vessel to operate in the optimum fuel efficiency role would amount to about £100 per fishing day though it must be remembered that it would require either operation of the auxiliary diesel set or provision of a variable input/constant output alternator drive to make this possible.

The final block of results show the slight financial penalty of the use of automatic winch control gear. It is difficult to be precise when the difference is small but use of this gear would seem to incur fuel usage to a cost of between £1 and £2 per hour during fishing. Operators must judge whether this extra expense is justified in terms of improved operating efficiency of the vessel, possible minor increase in hydraulic machinery repair costs (less than 1% typically) but with a significant saving in winch brake repair costs (perhaps as high as 80%).

CONCLUSIONS

6.1 The Rockhopper Trawl

Prior to the sea trials a 1:15 scale model net was made and tested in the Flume Tank at the Fisheries Training Centre at Hull.

It was found no modifications were necessary to the model or towing rig other than that already used by the fishermen to get optimum mouth opening and wingend spread.

To allow the net to achieve its optimum mouth opening the whole of the lower wing from bunt to wingend has been removed. In addition twenty five feet of top wingend netting has been removed at either end leaving the headline wire which remains as part of the overall length of the headline.

When the net is being towed, most of the weight is taken by a bolt-rope which is attached to the selvedge at either side of the net. This allows the top half of the trawl to lift and give improved headline opening. It is assumed that this plays a significant part in the effectiveness of this particular type of net on hard and rocky ground, by allowing the small amount of bobbin gear to become very light so that it will bounce high in the water when hitting an obstruction. It would follow that a considerable amount of time would elapse before the net settles back to the seabed and beacause of this very little damage is done to the netting. It should be noted that the net may be specified for vessels with lower horsepower than that used in the trials perhaps as low as 1000 hp.

5.2 Further Work

There are no immediate plans for carrying out further work on the full scale net and bobbin rig but on the conclusion of Flume Tank instrumentation modifications work that is being carried out, a Data Sheet will be produced based on model/full scale correlation.

The modifications to the wing ends of the net provide areas for fish escape when the model trawl is streamed in the Tank and this has caused comment from fishermen seeing it for the first time. However it should be remembered that catch rate during a voyage is related to the efficiency of the gear and the time the gear is actually being towed and that the improvement in the latter figure (by reduction in gear damage on hard ground) is a signficiant element in the success of this gear. However, there would seem to be an advantage in developing a "shepherding device" to replace the missing lower wing and restore any loss of efficiency.

APPENDIX I

GEAR TRIALS —— DATA SHEET

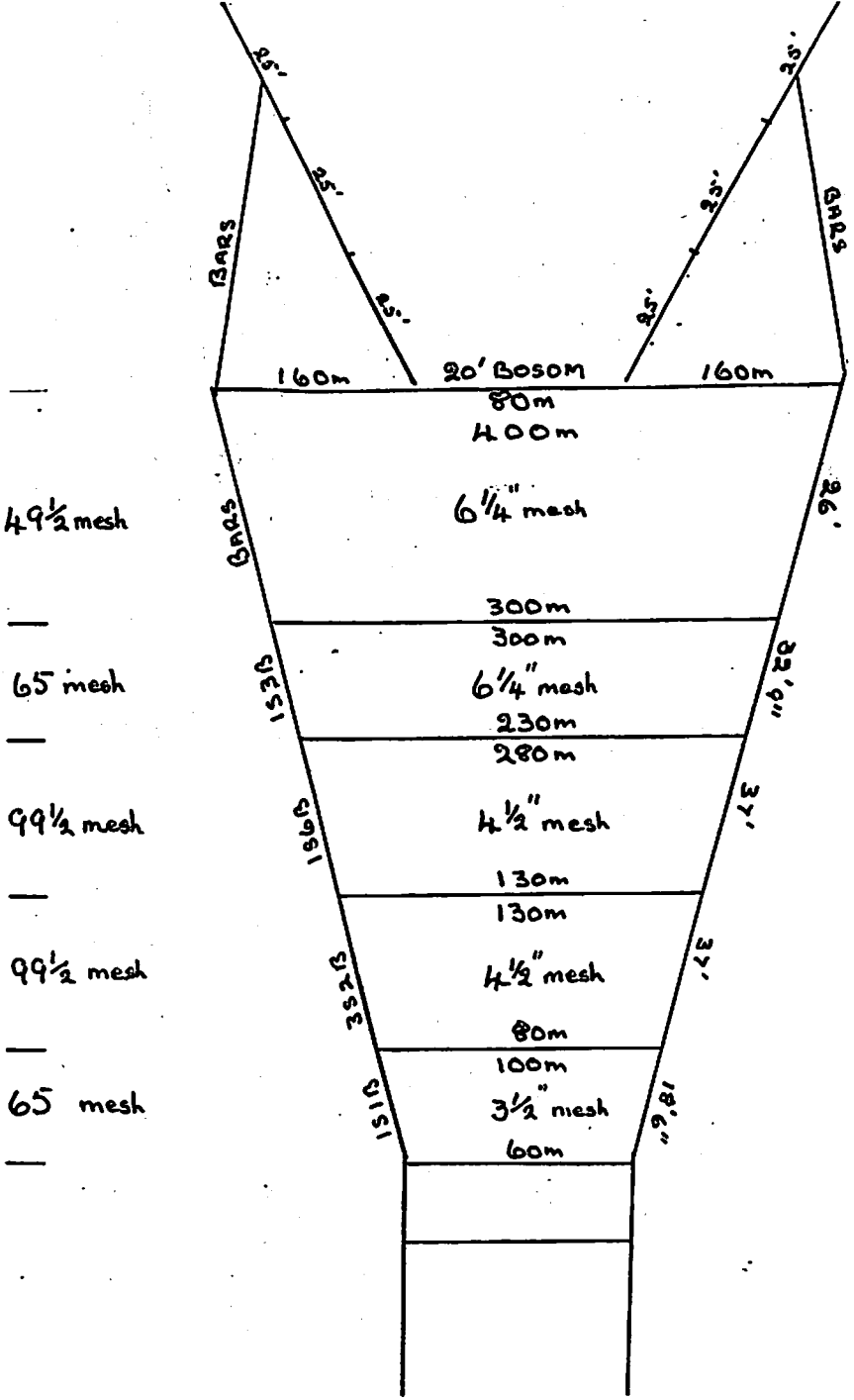
VESSEL CLARKWOOD. | RIG SPLIT BRIDLE DEMERSAL RIG | DATE 31-1-85 | HAUL 1

SHOOT	HAUL	WIND TIDE.	WARP AFT (FM)	DEPTH (FM)	RPM PITCH	SPEED	TENSIONS P	TENSIONS S	TENSIONS	FUEL FLOW LITRES HOUR		H/LINE HEIGHT (FT)	WING END SPREAD.	DOOR SPREAD	
1740	1840	WSTLY 6	150	35	750 60°	3·3	3·8	2·8	6·6	140	7	24	69	〃	Move gear back to doors - turned to Port - towing Sthly.
1900		WSTLY 4	〃	〃	〃	3·8	4·0	3·2	7·2	143	0	25	66	219	Electrical load put on Aux Generator.
1945		〃	〃	〃	〃	〃	4·1	3·2	7·3	128	0	26	62	216	All readings on net monitor 0-4.0
2015		〃	〃	〃	750 45°	2·95	2·5	2·4	4·9	101	0	29	56	198	Steering for North Sthly Should doors keep closing in
2030	2100	〃	〃	〃	〃	3·0	3·0	2·3	5·3	101	0	25	69	219	Heave gear back to doors turning. Load cells recalibrated to last test 4 zeros figures.
2120		〃	〃	〃	750 55°										Shot Sthly. Position 4 miles South of Rockall Bank.
2130		〃	〃	〃	〃	2·9	2·6	2·6	5·2	115	0	23	72	246	
2150		〃	〃	〃	〃	2·95	2·7	2·8	5·5	116	0	24	70	243	Ice indicating
2215		WSTLY 2-3	〃	〃	〃	3·0	2·5	2·6	5·1	116	0	26	66	234	
2230	2230	〃	〃	〃	〃	3·06	2·4	2·6	5·0	116	0	24	70	240	Hauling to Turn.
2250		〃	〃	〃	750 40°	2·45	2·3	1·5	3·8	95	5	29	158	134	Towing Nthly.
2310		〃	〃	〃	〃	2·55	2·2	1·6	3·8	95	3	31	147	126	
2330		〃	〃	〃	750 71°	4·0	3·5	3·5	7·0	143	0	23	66	228	
2350	2305	〃	〃	〃	〃	3·85	3·8	3·8	7·6	142	0	23	66	229	Heave Back to doors - turning. Shot back Sthly.

GEAR TRIALS DATA SHEET

VESSEL CLARKWOOD | RIG SPLIT BRIDLE DEMERSAL RIG | DATE 1-2-85 | HAUL

SHOOT	HAUL	WIND TIDE.	WARP AFT (FM)	DEPTH (FM)	RPM PITCH	SPEED	TENSIONS P	TENSIONS S	FUEL FLOW LITRES	FUEL FLOW / HOUR	H/LINE HEIGHT (FT)	WING END SPREAD.	DOOR SPREAD	
0015		WSTRLY 2-3	150	35	750 70°	4·0	3·7	3·6	152·	0	23	65	230	Towing Sthly.
0045		"	"	"	"	4·1	3·7	3·7	160·	0	23	65	227	Changed over to Main Engine power.
0105		"	"	"	"	4·2	3·7	3·7	161·	0	23	65	227	0107 hrs changed back to Aux power.
0120		"	"	"	"	4·1	3·5	3·6	153·	0	24	63	222	
0205	0205	"	"	"	"	3·55	3·2	3·2	126·	5				Hove back to doors for turning. Shot Nthly. finished with door spreads
				W. SIDDLE doing experiments with pitch and revs										
				relative to speed and warp loads.										
0245				finished with above experiments.										
0255		"	"	36	750 60°	3·47			135·	0	23	70		Towing on winch 10-10 gear. No warp loads or door spreads.
0300		"	"	"	"	3·5			134·	5	23	70		Towing Nthly.
0335		"	"	"	"	3·4			127·	8	24	66		
0350		"	"	"	"	3·3			128·	7	24	67		
0355	0355				Hauling - Steaming to Aberdeen -						Get gear off -		Charter	finished.



ROCKHOPPER TRAWL

530 × 6¼" MESH

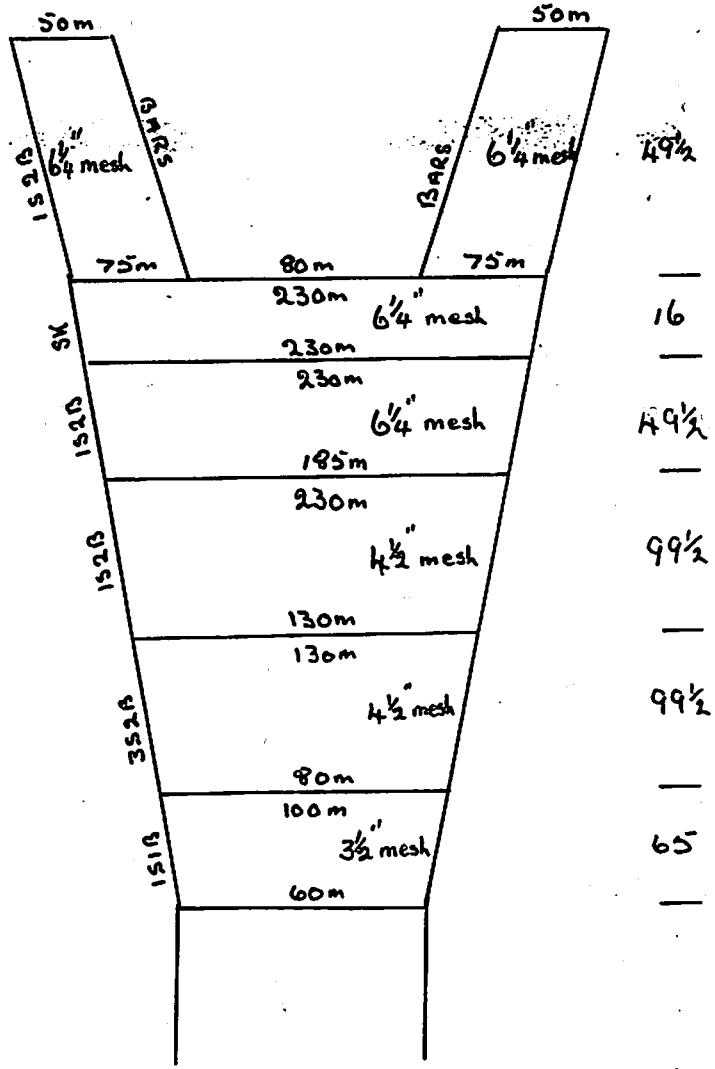


FIG 1

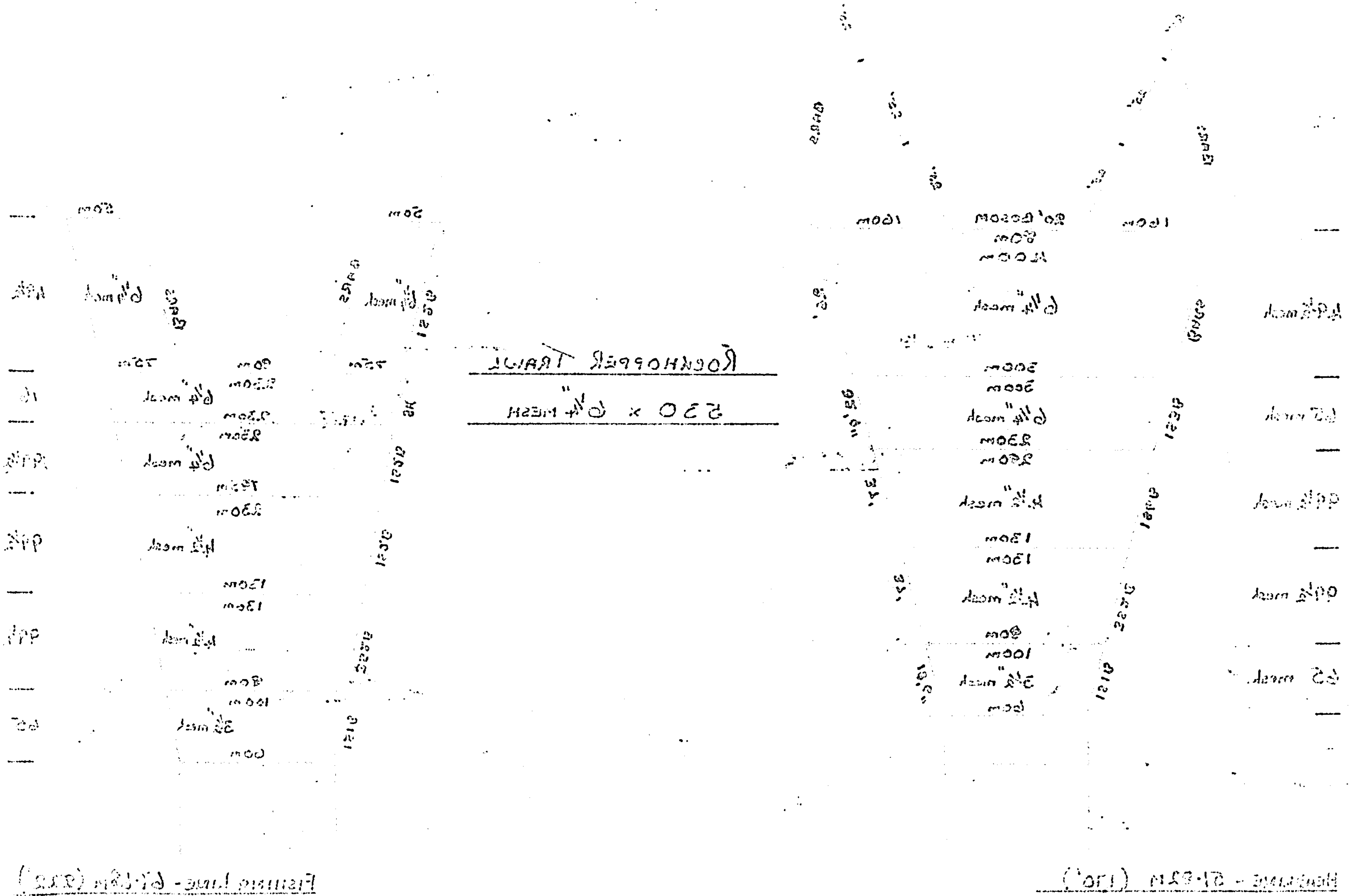
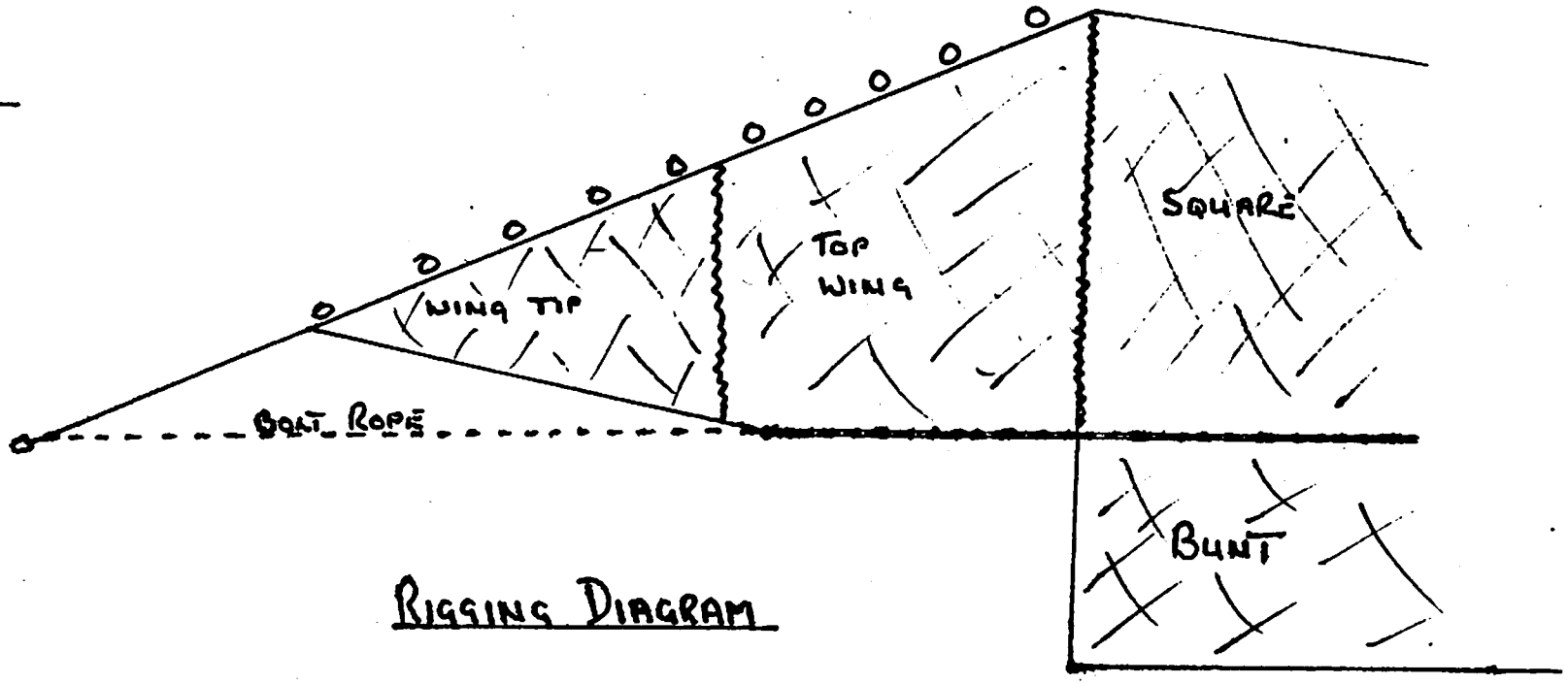

ROCKHOPPER TRAWL
530 x 6¼" MESH
Fishing Line - 61.6m (202')
Headline - 51.8m (170')

FIG. 1

33x11" FLOATS



RIGGING DIAGRAM

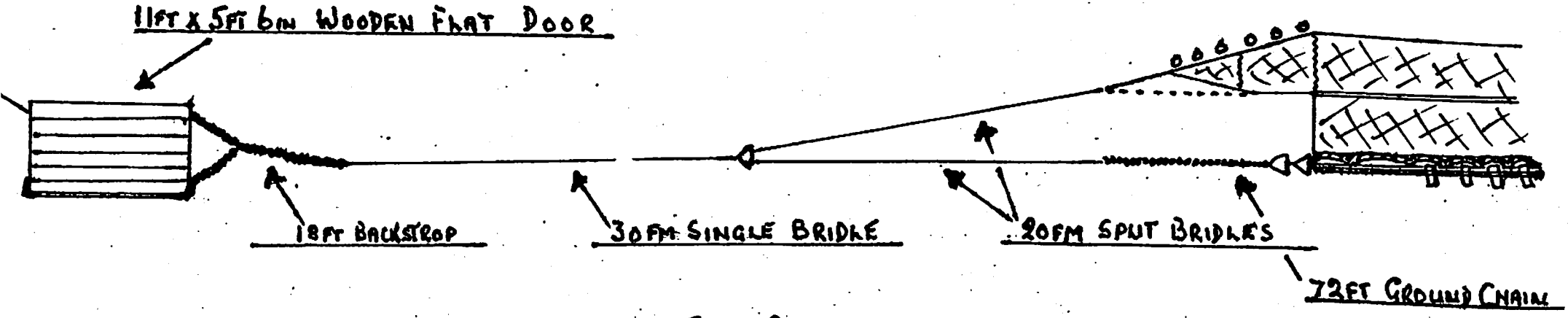
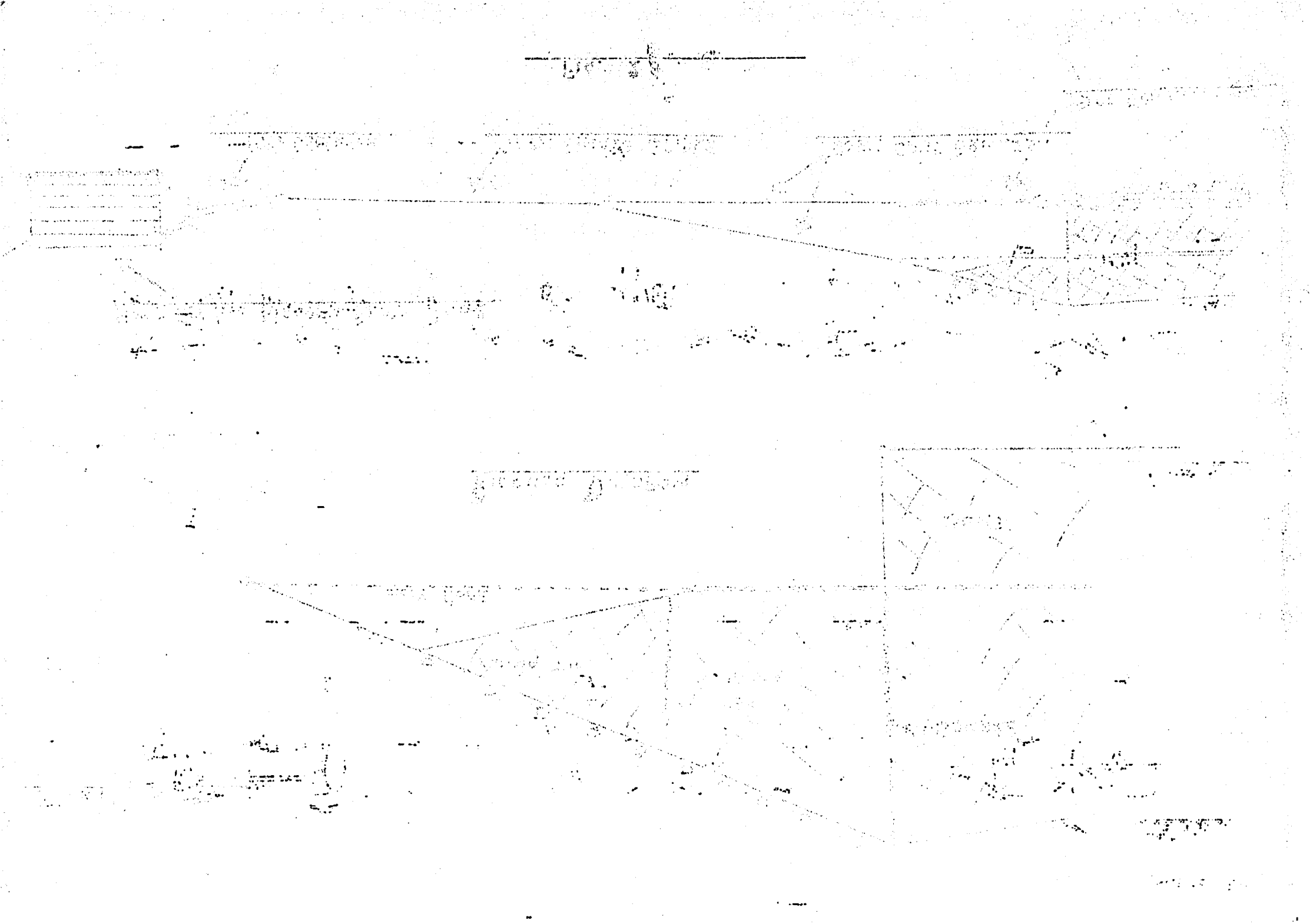


FIG. 2



ROCKHOPPER BOBBIN RIG

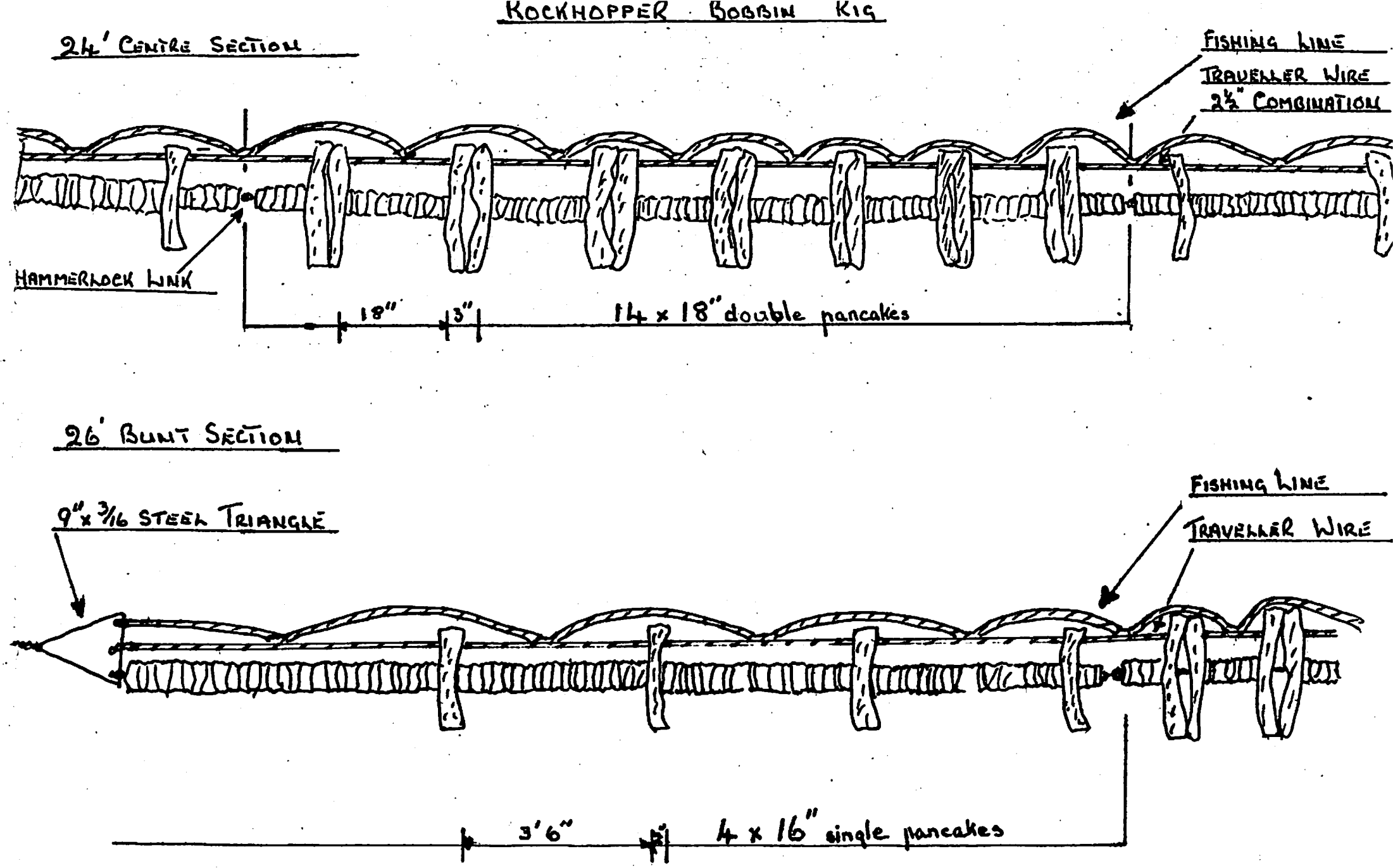
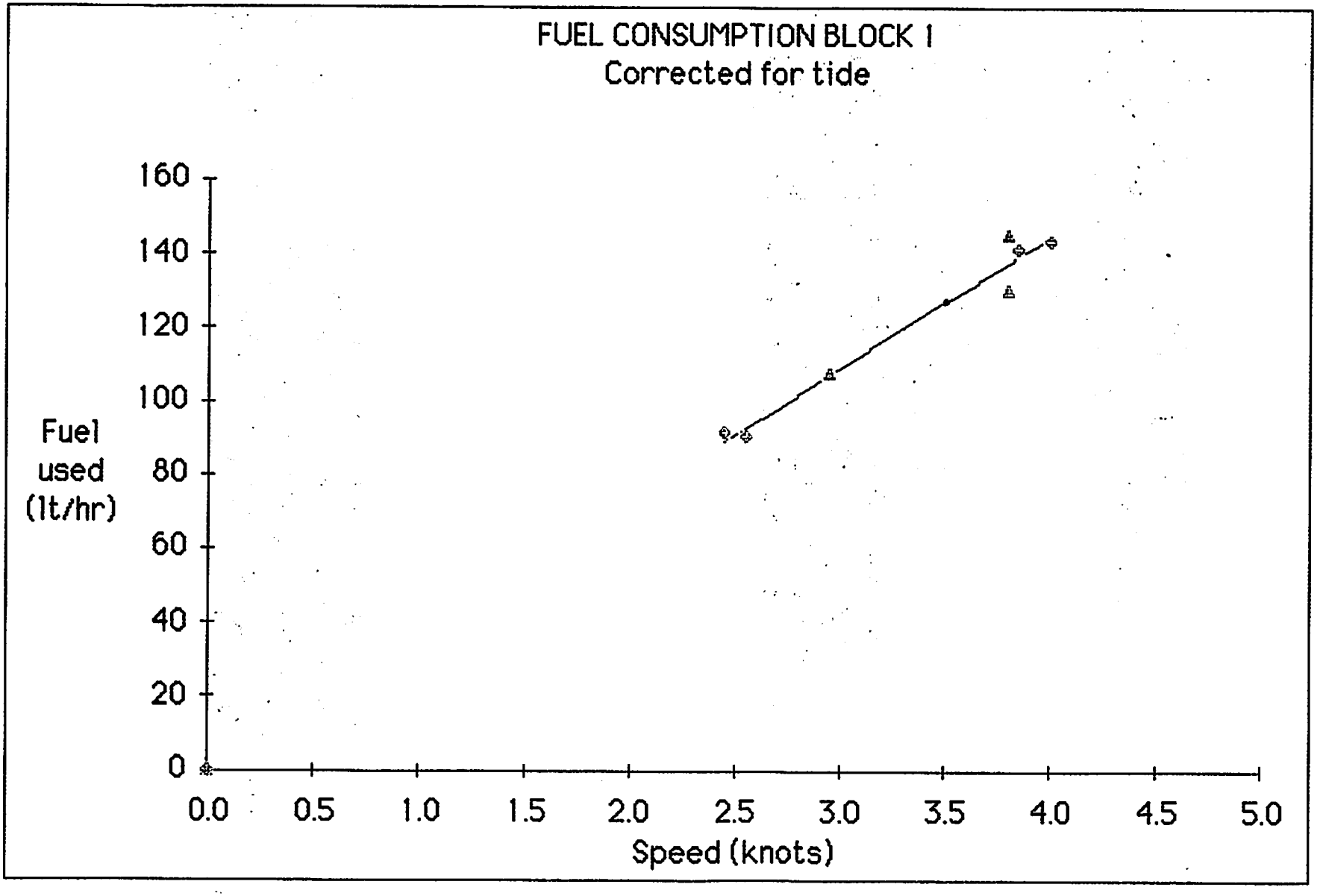
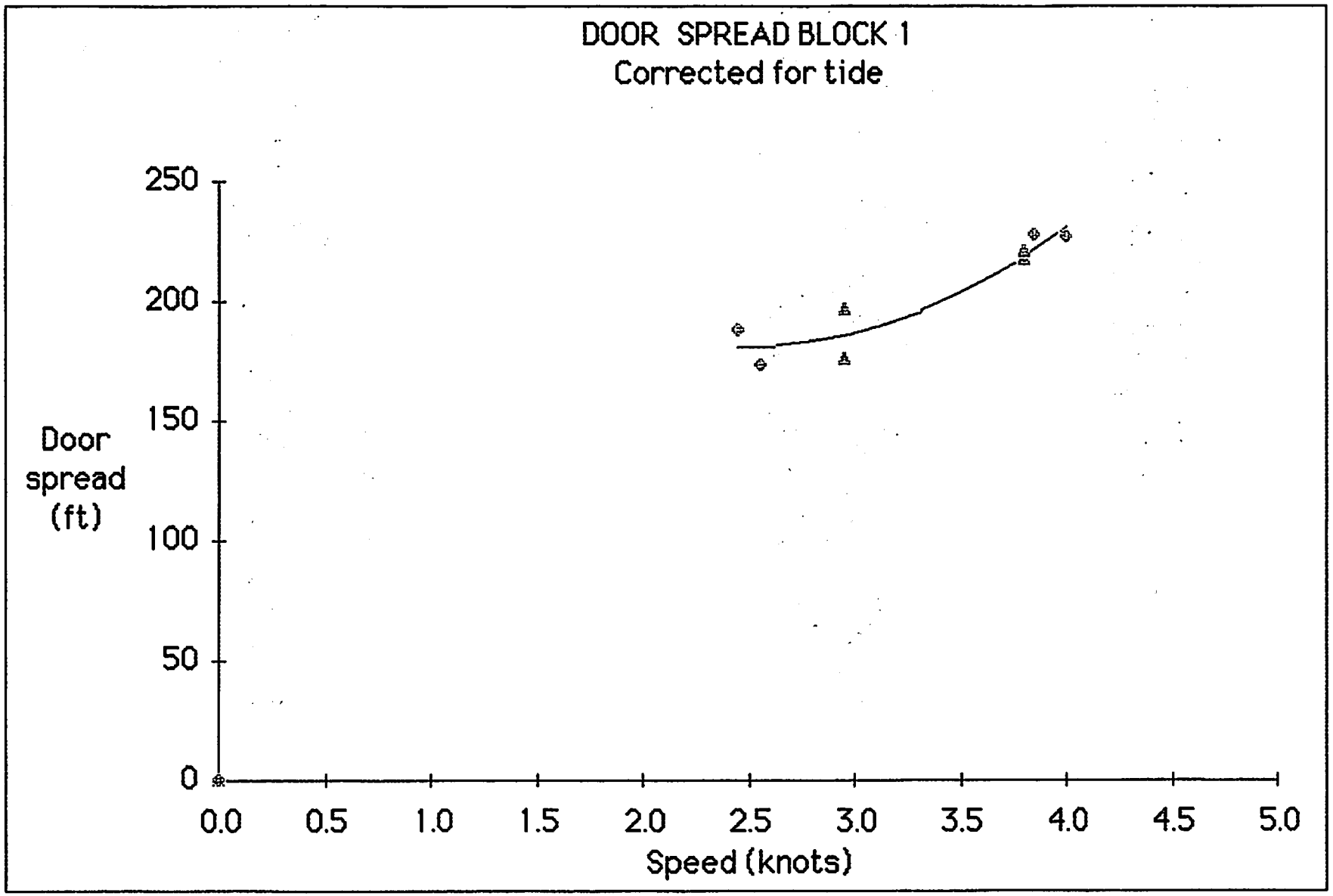


FIG 3

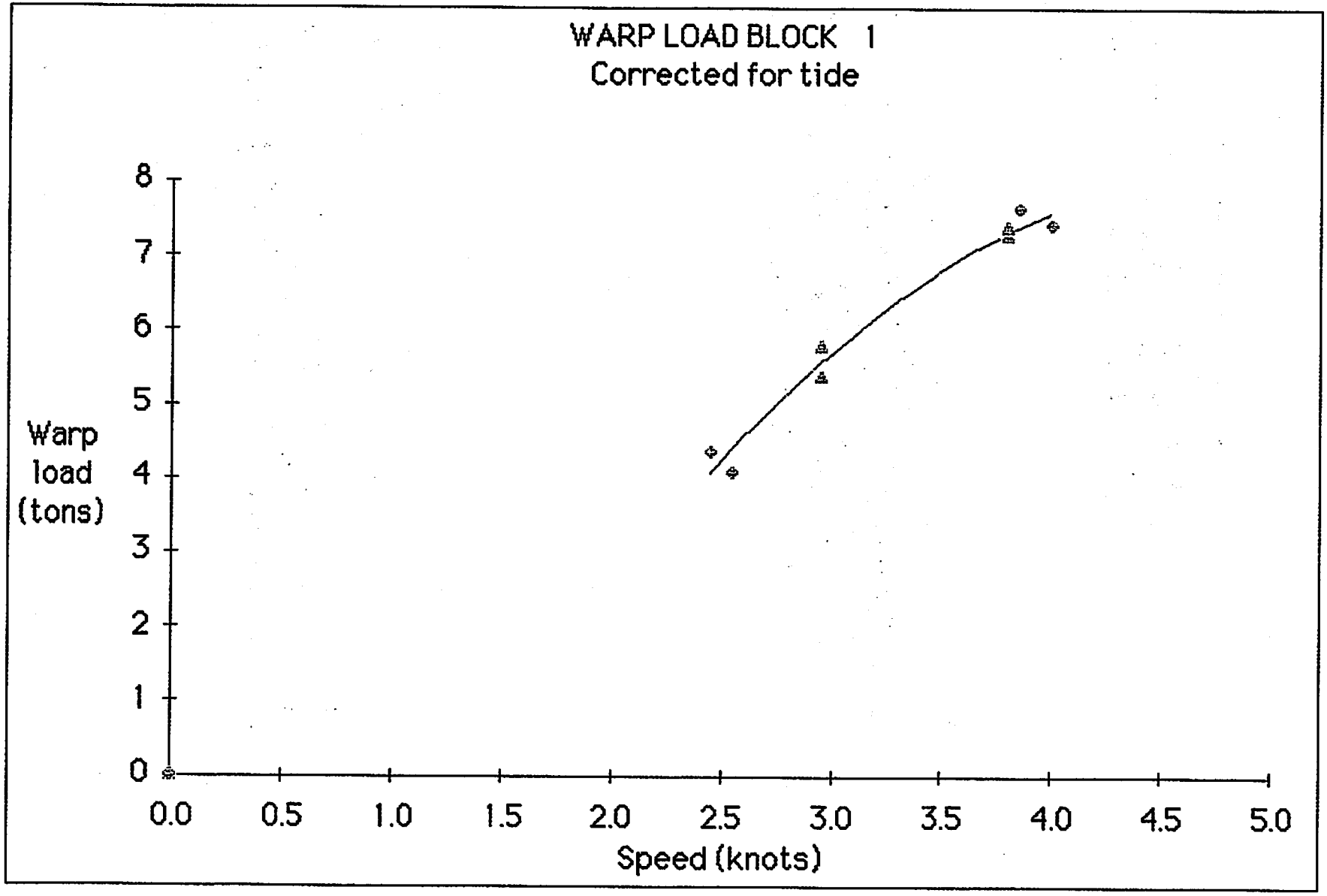
APPENDIX 2


FUEL CONSUMPTION BLOCK 1
Corrected for tide
Fuel used (lt/hr)
160
140
120
100
80
60
40
20
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Speed (knots)

APPENDIX 3


DOOR SPREAD BLOCK 1
Corrected for tide
Door spread (ft)
250
200
150
100
50
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Speed (knots)

APPENDIX 4


WARP LOAD BLOCK 1
Corrected for tide
Warp load (tons)
8
7
6
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Speed (knots)