Commercial Fishing Trials of a Twin-Rig Trawling System Using a Two-Warp Arrangement MFV Cygnus Star

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SEA FISH INDUSTRY AUTHORITY
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SUMMARY

This report describes the follow-up work resulting from initial gear handling trials of a twin-trawl system using a two-warp arrangement.

The system was evaluated in a situation as near to a normal commercial fishing exercise as was possible. The exercise took place in the Nephrops fishery on the North West coast of Scotland using the M.F.V. "Cygnus Star" which spends most of its fishing time involved in this fishery.

Apart from evaluating the handling of the two-warp system itself, the opportunity was taken to examine the performance of two nets rigged with rockhopper ground gears for use on hard ground. As far as we were aware, the twin-rig system had not previously been tried using rockhopper gear.

The main aim of the exercise was to assess the commercial viability of operating such a system.

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1 INTRODUCTION

The increased interest in multi-rig trawl systems, encouraged Seafish to examine the possibilities of developing a twin-rig trawl system utilising a standard stern trawler's existing two warp bottom trawling arrangement.

Following initial gear handling trials onboard the North Shields registered stern trawler "Laura Eve" (SN54) in March 1987*, a second set of trials was organised in order to evaluate the system in a commercial fishing situation on the North West Coast of Scotland in the Nephrops fishery. The vessel selected for the fishing trials was the M.F.V. "Cygnus Star" (B293) based at Kyleakin on the Isle of Skye.

The same basic twin-trawl system that was tested aboard the "Laura Eve", was used aboard the "Cygnus Star". However, a number of changes and adjustments were made as a result of lessons learnt, and experience gained during the initial handling trials.

* Internal Report No. 1310 refers.

2 OBJECTIVES

The initial handling trials onboard the M.F.V. "Laura Eve" showed that the two-warp system could quite easily be handled without any major difficulties. The main objective of the second set of trials was to put the system to the test of a commercial fishing exercise.

For obvious reasons, the initial testing of the system was carried out on fine ground. For the commercial evaluation of the twin-rig, it was decided to modify the rig to allow the capability of exploiting harder ground. The skipper of the "Cygnus Star" expressed a great deal of interest in this idea as he spends a significant percentage of his fishing time exploiting areas of harder ground for the better quality large prawns.

The two "clean ground" nets used in the first trials were replaced by two modified 520 dual purpose nets, rigged with rockhopper ground gear. To our knowledge this was the first time that a twin-trawl system had been tried using rockhopper trawls on hard ground. The second objective was thus to evaluate the rockhopper rig in a twin-trawl situation. This included finding out about the problems involved in using a twin-rig on hard "snaggy" ground.

Other objectives included:-

- Evaluating the handling performance of the vessel in a towing situation with respect to towing two nets as opposed to one - to examine the limitations on manoeuvrability during towing (if any).

- To highlight any modifications to the system that would improve handling of the rig during a full commercial fishing exercise. Particular attention being paid to speeding-up the hauling and shooting operations.

- To highlight any constructional modifications to the deck-layout that may be of value in vessels taking up this method of fishing.

- To establish the optimum rigging of the gear with regard to catching efficiency and if possible make comparisons with single net operations on similar grounds at similar times.

3 DETAILS OF THE CHARTER VESSEL

M.F.V. "Cygnus Star" (B293).

Cygnus - 44 G.R.P. Stern Trawler with forward wheelhouse, fitted with a net drum sited at the stern of the vessel.
(See photograph, Appendix III).

Skipper/Owner	-	Hamish Philp, Kyleakin, Isle of Skye.
Crew	-	Skipper and 2 deckhands
Vessel - Length	-	39 feet
- G.R.T.	-	31 (11.9m)
- Main Engine	-	Gardiner 127 H.P.
Wheelhouse Equipment	-	Shipmate RS4000 Receiver RS2000 Plotter
	-	American Pioneer Sidescope/Fishscope
	-	Simrad Skipper Colour Sounder CS116
	-	Furuno FR 803 D (36m) Daylight Viewing Radar
	-	V.H.F. Radio Equipment Sailor RT 144B
	-	CETREC 9000 Autopilot

4 FISHING GEAR AND OPERATION

In order to fish the harder areas of ground proposed, two new nets rigged with rockhopper ground gear were required to replace the clean ground nets previously used in twin-rig trials.

Following consultations between Seafish, the charter skipper and a net manufacturer, Mr J Sinclair from Buckie; two modified 520 x 70mm dual purpose trawls were constructed.

The nets were based on a design similar to the nets that Skipper Philp had previously been using in his single net operations.

To enable two nets of this size to be towed by the "Cygnus Star", it was necessary to reduce the drag at the net in some way. This was achieved by 'cutting back' the wing sections. This modification had two main benefits - firstly it reduced the netting area and hence drag, and secondly by removing a lot of netting in the lower wing it reduced the probability of wing damage which is commonly encountered on the harder ground tows.

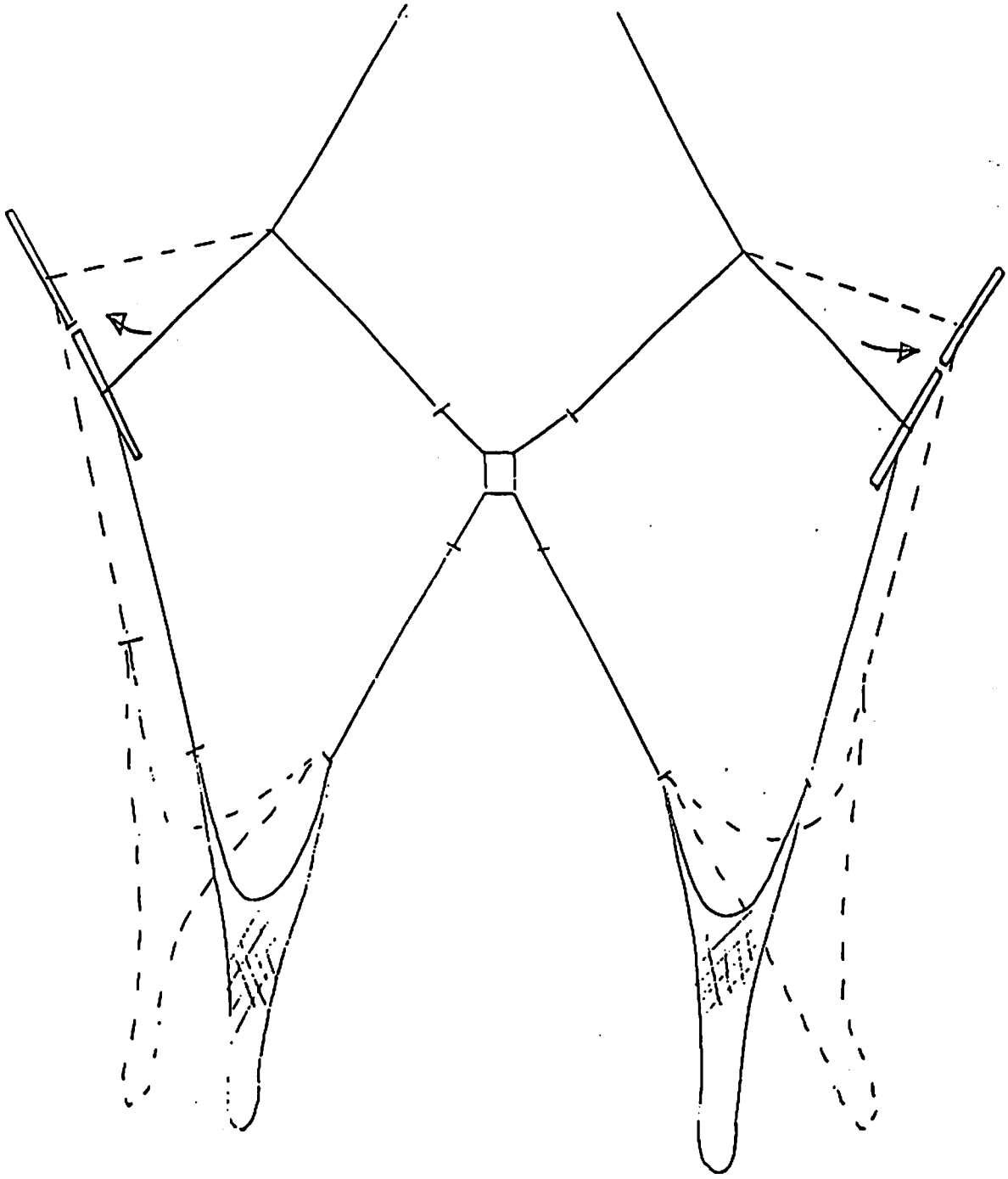
In order to be able to get over the harder ground the ground gear was constructed with a rockhopper rig. The basic dimensions of the nets were:- 33 feet on the headline, rigged with 7 x 8in floats. Fishing lines were 33½ feet having 1½ feet of slack over the rockhopper section only. The rockhopper section consisted of 12 feet x 12in rubber discs at approximately 12in spacings. The rubbers were mounted on 3/8in mild steel chain. The rockhopper discs made-up the bosum section of the ground gear. The rest of the ground gear consisted of 10 feet of 3in rubber discs on 3/8in chain running out to the lower wing-ends, with a further 6 feet 6in of 3in discs, again on 3/8in chain, making an overall ground gear of 45 ft.

A more detailed description of the nets is given in Figure 8 along with details of the ground gear arrangements (Figure 9).

The warp extension wires or bridles used for this exercise were 30 fathoms x 12mm steel wire, compatible with the vessel's existing warps. These were connected to the main warps by two swivels to ensure that turns were prevented from running up the warp extensions. The warp extensions were connected to 20 fathom split bridles with 2in rubber discs on the lower legs (on 14mm S.W.R.) by 3/8in mild steel short link chain independant legs. The rubbered lower legs were selected to reduce wear and damage suffered as a consequence of towing on the harder ground. It was also envisaged that the 2in discs would be of sufficient size to allow the gear to be towed across softer, muddy areas of ground, without too much risk of "digging-in". However, during the course of the exercise, some problems were experienced on the soft patches of ground. The gear tended to "dig-in" and on a number of occasions the nets were "mudded-up". This term is used to describe the nets when they become clogged with mud and bottom debris as a result of the gear digging too much. This problem was overcome to a certain extent by removing the 20 fathom split bridles and attaching the nets straight to the backstrops at the back of the doors. This rig was later improved by the use of short, 4 fathom splits.

Details of the rigs used are described in the Figures 1-6. A full description of the wire rig and details of clipping-up arrangements are contained in Internal Report No. 1310 which describes the initial handling trials of this gear.

In order to keep both nets in line and towing square, it was necessary to place an extension in the end of the outside warp bridles to counteract the shortfall created by the geometry of the gear.



The diagram (above) shows, in an exaggerated form, why the extension is required in the outer warp bridle. As the spread at the doors is increased, the result is that the rig is pulled 'out of square', with the nets being towed unevenly.

The rig under test was fitted with 6ft extension wires at the ends of the warp bridles. This was found to be sufficient to keep the nets level. The amount of extension required varies with the design of the rig and can only really be determined by practical experience resulting from trial and error. If the extension is insufficient then the result is that the inner wings of the trawls become slack, resulting in the build up of meshed fish and debris in that area. If too great an extension is added then the opposite applies - the problems occur on the outer wings of the trawl. Severe wing damage may result if this problem is not corrected.

Since the rig would have to be capable of being operated on hard, 'snaggy' ground, it was decided that the purpose-built sledge weight used in the initial handling trials, would be unsuitable for this work. It was felt that the design of the sledge would not enable it to get over rough ground without snagging and 'coming fast'. To overcome this problem, a new central weight was selected.

A solid rubber 18in 'bumper' bobbin was used. The bobbin was mounted on a heavy steel spindle allowing it to rotate as it moved across the ground. The idea being that the bobbin would bounce over sea-bed obstructions. This bobbin was to be replaced later by a 21in steel bobbin partially filled with concrete, for situations where a greater amount of weight was required. More details of the bobbin and the rigging arrangement are shown in the Figures 2-6.

A full description of hauling and shooting procedures has been given in Internal Report No. 1310. It is not considered necessary to duplicate it again in this report. The deck layout and handling arrangements for both the "Laura Eve" and the "Cygnus Star" were almost identical. The only major difference being that the net drum on the "Cygnus Star" was hydraulically powered which was an improvement over the system employed on the "Laura Eve".

The rigging diagrams included in this report, if examined in conjunction with the hauling and shooting descriptions given in Internal Report 1310, should adequately explain the handling procedures involved for any vessel rigged for standard stern trawling operation with the aid of a net drum.

5 TRIALS PROGRAMME AND NARRATIVE

As far as was possible, these trials were to be conducted as a normal commercial fishing exercise. Obviously, when working with new ideas and relatively unfamiliar gear, a certain degree of experimenting has to be involved. The aim was to maximise the fishing time, but at the same time establish the optimum rigging and handling arrangements for the twin-trawl system.

The vessels normal pattern of operation was to leave its home base of Kyleakin on the Isle of Skye for periods of up to 10 days, taking advantage of favourable tidal conditions.

The vessel would work daily or 48 hourly into any port in the vicinity of the grounds being worked. Skipper Philp would move about the North-West Coast depending on where the best reports of prawn catches were. He does not restrict himself to any particular fishing areas.

All fishing gear and equipment was transported to Gairloch on the North-West Coast of Scotland to await the arrival of the "Cygnus Star" which had been operating in that area.

The equipment arrived in Gairloch on Monday 21st September 1987 as the "Cygnus Star" returned from her days fishing. The fishing gear was rigged and put onboard the "Cygnus Star" on the morning of the 22nd. Despite very poor weather conditions the gear was shot in Gairloch on the afternoon of the same day. Once all the gear had been checked and all was in order, the vessel steamed to Skye in order to find more sheltered fishing areas away from the South Westerly gales. The vessel sheltered in Portree overnight on Wednesday 23rd September.

Fishing operations got underway on the morning of 24th September. Poor weather conditions were again encountered with strong West to North-Westerly winds. The vessel started fishing at the bottom end of Portree Sound moving North into Raasay Sound.

Details of the daily fishing operations are given in the fishing logs in Appendix I of this report.

The first tow on the first day of operation was carried out on clean ground using the purpose built sledge as the central weight. It was felt that a clean ground tow would be advisable while skipper and crew familiarised themselves with the handling of the system. No problems were encountered during the first tow. Both nets were taking even catches. Catch rates were low for both the charter vessel and other vessels operating in the same area.

The skipper was anxious to try the system on some harder ground where he was expecting better catches. The sledge was replaced by the rubber 'bumper' bobbin for the second tow. On hauling, it was evident that the rubber bobbin had not been rotating about the spindle. The problem was traced to ill-fitting 'V' shackles in the spindle ends. However, this problem did not seem to adversely affect the performance of the bobbin. It appeared that it was now behaving as a 'hopper', rather than rolling over the ground. It was envisaged that the spindle would eventually free itself with wear and so no alterations were made.

Towing two nets in a twin-rig situation gives the advantage of being able to make adjustments to one net while leaving the other as a control standard. The results of such alterations can be seen in comparison with the unaltered control. In this way the efficiency of the rig can be optimised much more quickly than with a single net operation. Any alterations to the nets or gear can be seen to have either beneficial or adverse affects by monitoring and comparing the catches in the two nets. This method was employed during the course of the trials. Alterations were made to the starboard side net leaving the port side as standard. Once beneficial rigging alterations had been established, both nets were altered in the same way.

On the second day of the trials the vessel was operating in Loch Kishorn on some of the harder ground tows. Initially, manoeuvering with the double rig had been treated with a great deal of caution as it was thought that the rig would be susceptible to fouling.

Shooting the twin-rig arrangement did not prove to be any problem. The steel 'V' doors appeared to perform as well as in the normal single net operation, with no apparent detrimental affects from the central sledge weight.

Turning during towing was initially carried out as a gradual process involving small alterations of course, allowing the gear to settle before continuing the turn. This proved to be a time consuming operation. Since during any turning manoeuvre the gear does not fish, then this was all unacceptable lost fishing time.

To overcome this problem it was decided to test the twin-rig system under the same handling conditions as applied to the skippers single net operation. Very tight turns were performed using a slight increase in engine revs. During all towing operations, both with a single net and with the twin-rig arrangements, the gear was towed from towing chains attached to the centre of the 'A' frame gantry. This arrangement allows for greater manoeuvrability.

Only on one occasion were any problems encountered. During the course of a very tight turn to avoid a seabed obstruction, the starboard trawl door dropped over the inside warp extension to the central sledge. This problem was overcome simply by turning the vessel very sharply in the opposite direction to the initial turn. In this way the fouled gear was cleared.

The susceptability of the twin-rig gear to 'foul-ups' during manoeuvres that was initially envisaged was soon dispelled as the skipper found that he could handle the rig as easily as a single trawl system.

The starboard net was adjusted by slacking out approximately 9in per side on the headline to allow slightly more strain to be taken off the ground gear. This was to help the net on the harder ground. No noticeable difference was observed in the catch rates and both nets were fishing evenly. During the second tow of the second day the starboard wing of the starboard side net was damaged and was temporarily laced-up. Further damage occured on the final tow with the belly sheet of the port side net being badly damaged. The vessel steamed into the Kyle of Lochalsh on the night of the 25th to land the days catch and to carry out repairs and alterations to the gear. The nets were put ashore and stretched out on the quayside and repaired. Alterations were made to the starboard side net. This entailed stripping the ground gear off the net and re-rigging it by tying the hopper rubbers onto the net by way of a dummy fishing line arrangement (see Fig 9 showing details of the hopper rigs used.) This method is one which Skipper Philp had found successful with his single net. The lower wings of the nets were both cut-away from the ground gear and just remained attached at the bunt-end. This was to try and reduce netting damage if the wing areas snagged hard ground. Additional weight, in the form of chain, was also added to the bosum section of the ground gear on the starboard net only.

Day three of the trials resulted in heavy damage to the starboard net as a result of 'coming-fast' on an unidentified obstruction on the sea-bed. The headline parted in mid-section and both the top-sheet and port wing were severely damaged. Once again the gear had to be put ashore at the Kyle in order to repair the damage.

Up to this point in time catch rates, although lower than average, were better than those of the majority of vessels working similar grounds using single nets. On a number of occasions when fishing alongside vessels of similar horsepower, the twin-trawl system was producing catch rates of 60% more, and on occasions was even doubling other vessels.

During the course of the fishing operations problems were encountered with the winch barrels due to the extra loading of wire with the addition of the 30 fathom warp bridles. (In effect an extra 60 fathoms per side of wire was added to the winch barrels). This over-capacity was causing the warps to catch on the guiding-on gear. This was overcome by removing 50 fathoms of warp from each side. After the trials were completed the skipper reduced the diameter of the warp bridles to further ease the problem.

The "Cygnus Star" sailed from the Kyle of Lochalsh on Sunday evening after awaiting favourable weather. It was decided to steam to grounds around the Isle of Rhum. The skipper had persuaded the M.F.V. "Stella Maris" to accompany the "Cygnus Star" in order that some comparative fishing could be carried out.

Fishing commenced in Canna Sound. This is an area of softer ground, mainly mud. This gave the opportunity of assessing the performance of the hopper rig on soft mud. It allowed us to establish also if the 'bumper' bobbin could be worked on this type of ground.

In order to ensure that the gear was 'taking the bottom' to the required degree, the footrope on the starboard net was dropped back to allow it to 'dig-in' more. This alteration had the expected effect, too much so in fact. It resulted in the starboard net 'mudding-up', whereas the port net was relatively clean. This situation was corrected by reducing the extension in the footrope.

It was also decided to remove the 20 fathom rubbered legs as these were digging-in to the soft mud and causing problems. This gave the opportunity of trying an alternative rig. The nets were then attached directly to the backstrops with no bridle or sweep lengths involved.

It was found that the twin-rig in this form could be handled even easier than the previous rig. Hauling and shooting times were reduced. The skipper found that he could turn the vessel through 180^{o} inside 3/10 of a mile with no adverse effects on the gear.

The alterations to the gear had the desired effect. By the end of the day the skipper was confident that the 'mudding-up' problems had been overcome.

Prior to the rubbered legs being removed from the rig, the vessel had been towing the twin-trawls at approximately 50 revs. above the normal towing revs. for the vessels single net. Once the legs had been removed it was found that the reduced drag allowed the gear to be towed at the same revs. as the single net.

During the fishing operations on the 29th September, it was noticed that the catch from the port net was less than the starboard net. This was put down to the rigging differences between the two nets, mainly the weight difference in the bosum of the two rigs.

The netting in the lower sheet in the area just behind the bosum of the ground gear was clean. The mud and weed etc., that is normally apparent in this area of the gear was not showing in the port net, but was clearly visible in the starboard net. To try and remedy this, more weight was added to the fishing line in this section of the port net. It now meant that the only rigging difference between the two nets was that the starboard net was attached directly to the hoppers and not onto a traveller chain.

The first tow after this alteration still resulted in uneven catches in the two nets. Again the port-side net was catching noticably less than the starboard side. This difference was then associated with the alternative rig in the ground gear of the starboard net. Before making the same alteration to the port-side net, it was decided to adjust the rig in such a way as to have a similar result as changing the hopper arrangement. This was done by slacking out the traveller chain, allowing the fishing line to drop back behind the ground gear. This seemed to produce catches that were more evenly matched between the two nets. On completion of the days work the catch was landed in Mallaig.

On the following day despite freshening weather conditions the indications were that the "Cygnus Star" was producing over 60% improvements in catch rates compared to similar vessels working single net rigs on the same grounds. The weather deteriorated rapidly later that day forcing the vessels in the area to seek shelter. The "Cygnus Star" and a number of other vessels found a lee anchorage for the night in Kilmory Bay on the North side of Rhum.

The following day was to be the last day of the trials. The "Cygnus Star" moved off the clean ground tows onto harder ground in order to try and find some better quality prawns. Unfortunately, the vessels working the deeper water tows had better results. No comparisons were possible on the final day as the "Cygnus Star" was the only vessel working the hard ground. The tows in shoal water could possibly have been affected by the brighter light conditions experienced that day. Three tows were carried out for the days work and the catch was again landed in Mallaig.

On completion of the trials the vessel returned to the Kyle of Lochalsh for its turn-around period. The skipper was pleased with the results and indications obtained from the trials and expressed a wish to carry on operating the system. The "Cygnus Star" returned to sea on the 4th October to carry on fishing with the twin-trawl system.

6 OBSERVATIONS AND DISCUSSION

Considering the relatively short period of time that the twin-rig system was under test, a more than satisfactory level of success was achieved with the gear. From a catch rate point of view, the skipper was happy with the results of this commercial exercise. In the initial stages of the trials, the main point of concern was the extended time required for hauling and shooting. However, the majority of this extra time incurred during handling the gear could be put down to unfamiliarity with the operation. In fact, hauling and shooting times were greatly reduced by the end of the trial period. It is envisaged that as experience is gained with the system, skipper and crew will highlight further handling improvements, and handling times will be further reduced. In a full commercial situation further developments will usually be highlighted by the skipper as a natural progression with the continuation of the operation.

These trials have highlighted the flexibility of this system in the sense that it is not necessarily restricted to clean ground fisheries. The charter skipper's increasing interest in fishing areas of hard ground for better quality Nephrops can be further pursued using the twin-rig system. The skipper has expressed concern about the decreasing levels of catches being experience on the traditional softer, muddy prawn grounds.

The introduction of the modified ground gear into the rig allowed harder grounds to be exploited but at the same time, this exercise showed that the rockhopper rig would also perform satisfactorily on softer ground tows. This facility removed the requirement for a changeover of ground gear types when changing from soft to hard ground or vice-versa. The rig was seen to be best suited to mixed areas of hard and soft ground, or soft areas interspaced with patches of hard ground. These types of areas are more often than not, avoided by vessels working single clean ground nets. Skipper Philp has experienced very favourable catches from this type of ground.

These areas of hard and soft ground tend to produce a larger size of prawn. The skipper believes that the main reason being that these areas are relatively untouched by trawlers at present.

Danish fishermen have gained considerable experience and expertise of multi-rig trawling systems over the last few years. From this it has become apparent that in the applications under consideration in the work carried out by Seafish, that the two-warp arrangement of this trawling system can be improved upon by using the three-warp arrangement. However, the two-warp arrangement has the advantage that it can be adopted by most conventional stern trawlers without the requirement of specialised winches capable of handling the extra warp required.

The Danish Industry has seen a large increase in the number of new vessels being built specifically for multi-rig trawling. The popularity of this method spreading to the U.K., and it is expected that there will be increasing interest in the building and/or conversion of vessels for this type of operation. In the short term the two-warp arrangement of the system allows fishermen to try multi-rig trawling without incurring the considerable (and often prohibitive) expense of winch conversion.

Skipper Philp has continued to work with the two-warp arrangement and is at present considering the possibilities of winch conversion/replacement or even the building of a purpose built multi-rig vessel. In pursuance of this interest, Skipper Philp has visited Denmark to observe at first-hand, the Danish multi-rig systems.

During the course of the trials a number of points to note became apparent with respect to modifications to the vessels existing single trawl gear handling arrangements to make them more compatable with the twin-rig system.

It must be ensured that the winch barrel capacity is sufficient to carry the additional wire required for the split warp extensions. If any vessel undertaking this method of trawling does not have the facility of a net drum, then this point is of more importance as any sweep lengths employed in the rig would invariably have to be carried on the main winch barrels.

Since the normal single trawl arrangement of one set of wires and links etc. per side is replaced by two sets per side with the twin-rig system, then it must be ensured that all towing blocks and other 'running gear' is capable of taking the extra wires and chains etc. If the blocks are of insufficient size to take the extra gear then the problem of chains, shackles, swivels etc. jamming in the blocks becomes a major problem.

With regard to the net drum onboard the "Cygnus Star", it was decided that the hauling and shooting procedure could be speeded-up by the addition of a vertical plate that would split the drum into two sections. This would enable each net to be separated as it was hauled onto the drum. This would reduce the probability of the nets fouling during hauling and shooting, hence speeding up the operation. The use of removable vertical poles sited in the transom rail to separate the sweeps as they are hauled onto the net drum is also recommended as an aid to speeding-up the hauling operation. (See photographs in Appendix III).

7 CONCLUSIONS

Multi-rig trawling systems have been developed and established as very effective trawling methods in numerous forms. It is fair to say that the twin-trawl, two-warp arrangement under examination during the Seafish trials programme has shown itself to be another successful application of this method of fishing.

The system can be employed successfully in the Nephrops fishery with the added advantage of not being restricted to one particular type of ground. The trials showed that the system is flexible enough to allow the use of different ground gears.

It had previously been thought that the nature of the system would restrict the manoeuvrability of the vessel during towing. No such problems were encountered during the trials programme. Skipper Philp commented that he could find no more problems in handling the vessel during towing when compared with his single net operation.

The twin-trawl, two-warp arrangement can be adopted by most conventionally designed stern trawlers with the minimum of alteration/modification to the existing gear handling arrangements. The system can be worked smoothly without putting any significant additional work load onto skipper or crew (apart from any additional work incurred due to the increased catches!)

APPENDIX I - FISHING LOGS

M. F. V. "CYGNUS STAR"

TWIN-TRAWL FISHING TRIALS

(SEPTEMBER / OCTOBER 1987)

M. F. V. CYGNUS STAR - FISHING LOG

DATE	HAUL	TIME SHOT	TIME HAUL	TOW TIME	POSITION SHOOTING	POSITION HAULING	TOW SPEED	DEPTH FTHMS.	WARP FTHMS.	WEATHER	SEA STATE	CATCH	COMMENTS
24/9	1.	0800	1130	3·5 HRS	LAT 57·32 N LONG. 06·06 W	57 29·7 06 05·7 W	2·2 K. 1100 RPM	50 F.	125	W→NW 6–7.	6.	APPROX. 10 BASKETS of BULK–SMALL PRAWNS – SMALL GROUND FISH MAINLY FLAT SORTED: 5ST TOTAL 2ST TAILS 3ST LIVE. OTHER VESSELS REJECTING APPROX 5ST. BUT FILLING EVERYTHING.	CLEAN GROUND TOW TO START. INTENTION TO MOVE ONTO HADDOCK TOWS ONCE CREW FAMILIARISED WITH GEAR AND HANDLING. SOD TO BE REPLACED BY BOBBIN FOR HARDER GROUND TOWS. POOR WEATHER – TOWING WITH OTHER VESSELS FOR CATCH COMPARISONS. EVEN BULK IN BOTH NETS. STBD NET 'MUDDED-UP' MORE THAN PORT NET. NETS TAKING BOTTOM O.K. NOTE: 4ST. TAILS TO 1 BSKT. 3ST. LIVE " "
	2.	1300	1700	4 HRS	LAT 57·30 LON 06·04		2–2·5K. 1100 RPM	50. ↓ 60	200	NW 6–7.	6–7.	30 BSKTS OF BULK – MOSTLY SMALL HADDOCKS. SORTED APPROX 95ST TOTAL EVEN BULK BOTH NETS. 2½ BOXES HADDOCKS SAVED.	STEAMED TO KYLE TO LAND.

M. F. V. CYGNUS STAR – FISHING LOG

DATE	HAUL	TIME SHOT	TIME HAUL	TOW TIME HRS.	POSITION SHOOTING	POSITION HAULING	TOW SPEED	DEPTH FTHMS.	WARP FTHMS	WEATHER	SEA STATE	CATCH	COMMENTS
25/9	1.	0745	1015	2·5	57 17·45 05 49·13 LOCH KISHORN.	57 20·73 05 43·51	2·4 K. 1120 REVS	60 ↓ 40	180 125	NW 2-3 (IN LOCH)	2.	5-6 BSKTS. BULK IN BOTH NETS.	LOCH KISHORN – HARDEE GROUND TOWS. ADJUSTMENT TO STBD. NET: SLACKED-OUT 9" PER SIDE ON H/LINE – HARD GROUND! EVALUATING PERFORMANCE OF GEAR-HANDLING DURING TIGHT TURNS. NO PROBLEMS. TOWING INTO SHOAL WATER.
	2.	1130	1400	2·5	57 18·85 05 45·05	57 18·37 05 46·33	2·4 K. 1120 REVS.	44.	125.	NLY 4-5.	3.	MEDIUM TO LARGE PRAWNS V. LITTLE FISH 11ST. + TAILS SORTED.	OUTFISHING OTHER VESSELS. BOTH NETS FISHING EVENLY. STBD. WING OF STBD. NET DAMAGED – LACED-UP. ALTERATION TO STBD. NET – NO NOTICEABLE DIFFERENCE IN PERFORMANCE AS YET.
	3.	1530	1800	2·5.	57 17·57 05 48·33	57 20·4 05 42·7	2–2·5 K 1125 REVS	60.	125	NLY. 4–5 ↓ 5–6.		STBD. NET 5 BSKTS BULK PORT NET APPROX. 3. UNEVEN CATCH DUE TO DAMAGE? 4ST. SIZED MED./LGE. PRAWNS.	PORT NET : BOTTOM SHEET OUT. STEAMED INTO KYLE – PUT GEAR ON QUAYSIDE AND REPAIRED DAMAGE. STRIPPED HOPPERS OFF STBD. NET ONLY – HOPPERS RETIED DIRECT TO F/LINE / PREVENTER ROPE. WINGS OUT AWAY FROM GROUND GEAR. EXT. IN H/LINE REMOVED AND REPLACED IN F/LINE (STBD. NET) TO CHECK EFFECT. EXTRA WEIGHT ADDED TO F/LINE. – PORT SIDE NET LEFT UNALTERED FOR COMPARISON / CONTROL.

M. F. V. CYGNUS STAR – FISHING LOG

DATE	HAUL	TIME SHOT	TIME HAUL	TOW TIME	POSITION SHOOTING	POSITION HAULING	TOW SPEED	DEPTH FTHMS.	WARP FTHMS	WEATHER	SEA STATE	CATCH	COMMENTS
26/9.	1.	0930	1230	3·0	57 17·2 05 49·2 LOCH CARRON & LOCH KISHORN.	57 20·7 05 42·53	2·2	60	125	N'LY. 4–5 (IN LOCH)	4	6 BSKTS. BULK EACH SIDE. MEDIUM PRAWNS. BOTTOM DEGRIS.	CHAIN ON F/LINE OVER HOPPER SECTION ON STBD. NET.
	2.	1330	1500	1·5	57 19·38 05 44·7	57 18·0 05 45·4	2-2-5	50 ↓ 60		N'LY 4–5.	4–5.	BLANK!	CAME FAST! – PACTED H/LINE ON STBD. NET. TOP SHEET & WING DAMAGE. CHOPPED-OFF 50 FTHM. WARP TO MAKE SPOOLING BETTER ON MAIN WINCH. DOORS WELL POLISHED. STEAMED INTO KYLE AND REPAIRED GEAR. NEW H/LINE.

FISHING LOG - "CYGNUS STAR"

COMMENTS MADE ON 27/9/87

To date insufficient fishing time carried out to fairly establish effectiveness of gear. Very poor weather conditions have restricted fishing time. Scarcity of prawns has meant no comparisons of bulk catches can be made. Lost fishing time due to gear damage has also hampered results.

Gear has shown that it is capable of being handled similarly to single net as regards turning and manoeuvering - no major problems encountered. So far gear has been towed on fine and medium/hard ground with reasonable ease and with minimal damage - skipper has remarked that nets have not taken the ground as well as his single net hopper gear. Major damage on 26/9/87 caused by an unknown sea-bed obstruction.

Alterations to the starboard net while leaving the port net unaltered have as yet made very little difference to catch rates. On all occasions (excepting damage), nets have fished equally, although no real quantities of bulk have been encountered.

On 25/9/87 when vessel was able to carry out the only uninterupted full days work (3 tows) to date, results were promising. Catches were double of other vessels fishing the same grounds, again quantities were small and some real conclusions can be drawn.

It is hoped that the next four/five days, if uninterupted by weather etc, will result in better indications of effectiveness of gear. Hopefully some comparative fishing can be carried out.

Sailed late afternoon for grounds around Isle of Rhum.

M. F. V. CYGNUS STAR - FISHING LOG

DATE	HAUL	TIME SHOT	TIME HAUL	TOW TIME	POSITION SHOOTING	POSITION HAULING	TOW SPEED	DEPTH FTHM.	WARP FTHM.	WEATHER	SEA STATE	CATCH	COMMENTS
28/9	1.	0830	1045	2¼	57 02·3 06 32·4	56 59·2 06 36·8	2 K.	45	155	S.W 2-3	2-3.	TWO FULL LIFTS OF BULK - MUD IN STBD NET - DRANK MORE THAN PORTSIDE. SMALL PRAWNS.	FISHING IN AREA AROUND ISLE OF RHUM - CANNA SOUND. FISHING WITH M.F.V. 'STELLA MARIS' (SKIPPER MICHAEL McNEIL.). OTHER VESSELS REPORTING SIMILAR CATCHES WITH WEED/KELP PROBLEMS. INTENTION TO REMOVE EXTENTION FROM P/LINE STBD. NET.
	2.	1345	1630	2¾	57 04·9 06 24·5	57 05·4 06 21·0	2·5 K.	65 ↓ 70 80 ↓ 100.	175 SHORTENED TO 125 IN 40 FATHOMS OUT AGAIN TO 200	SW 4-5	4.	3 BOXES LIVE 2ST. TAILS	STBD. SIDE MUDDED-UP MUDDING CAUSED GEAR TO CLOSE UP - REDUCED CATCH RATE.
	3. 1ST. TOW WITH ALTERED RIGGING. NO SWEEPS.	1815	1945	1½	'CANNA TOW'		2·5	50	125	SW. 4.	4	3 BOXES OF LIVE. 3ST. TAILS.	REMOVED 20 FTHM. SPREADERS TO REDUCE DIGGING-IN AND HENCE MUDDING-UP. TURNING WITH GEAR DOWN 180° TURN INSIDE ⅓ MILE - NO PROBLEMS! CLEAN PRAWNS BOTH NETS. SMALLER BULK FOR LAST TOW FAILING LIGHT IN SHALLER WATER. OVERNIGHT CANNA HARBOUR.

M. F. V. CYGNUS STAR - FISHING LOG

DATE	HAUL	TIME SHOT	TIME HAUL	TOW TIME	POSITION SHOOTING	POSITION HAULING	TOW SPEED	DEPTH	WARP	WEATHER	SEA STATE	CATCH	COMMENTS
29/9.	1.	0730	1030	3HRS.	57 03.9 06 23.7	57 04.9 06 22.6	2.5 k ↓ 3.0 AT T.MES. 1100 REVS.	40 ↓ 60 FROM 90 UPTO 50 DEEPER TOW DUE TO BRIGHT DAYLIGHT.	100 175	VARIABLE 2-3	SW SWELL SLIGHT.	STBD NET 11 BSKTS. BULK- CLEAN APART PORT 8 BSKTS 6 ST. THIS 4 BSKTS LIVE.	BREAKING DAYLIGHT SHALLOW WATER TOW. PORTSIDE NET DOWN ON STBD. CHAIN ON F/LINE MAY BE CAUSING DIFFERENCE (STBD NET.) AREA OF BOTTOM SHEET JUST AFT OF HOPPERS IS CLEAN-NOT SHOWING ANY SIGNS OF BOTTOM CONTACT. STBD. NET SHOWING GOOD CONTACT. CHAIN ADDED AS IN STBD. NET. BOTH NETS SAME RIG APART FROM HOPPER ARRANGEMENT. STELLA MAKES SIMILAR TOW HAD. 11 BSKTS. BULK.
	2.	1145	1245	1.	57 04.6 06 24.3 CANNA SOUND.	HAULED SHORT PORT NET DUG IN WHEN TURNING.	REVS. AT 1100. NORMAL TOWING REVS. FOR SINGLE NET.	75.	175	SLY 2-3. BRIGHT SUNNY PERIODS.	3 INCREASING 4.	SHORT HAUL 5 BSKTS BULK STBD. 3-4 BSKTS IN PORT. + ALOT OF MUD. 4 ST. + 1 BSKT OF LIVE.	
	3.	1345	1645	4.	57 05.8 06 22.9	57 04.8 06 21.4		175 SHORTENED TO 125 FOR SHOAL WATER.		BACKING SE'LY FORECAST. GALES 7-8 SLY.		STBD. NET MORE BULK THAN PORT. STBD. NET HAS DIFFERENT HOPPER RIG?	STBD. NET TAKING MORE THAN SINGLE NET OF STELLA MARIS ON NUMBER OF OCCASIONS. ONCE BOTH NETS ARE FISHING EQUALLY CAN EXPECT TO DOUBLE OTHER VESSELS OF SIMILAR ENGINE SIZE !! LANDED MALLAIG.

M. F. V. CYGNUS STAR – FISHING LOG

DATE	HAUL	TIME SHOT	TIME HAUL	TOW TIME HRS.	POSITION SHOOTING	POSITION HAULING	TOW SPEED	DEPTH	WARP	WEATHER	SEA STATE	CATCH	COMMENTS
30/9.	1.	0915	1145	2½	57 04·0 06 22·57 SAME AREA AS 29/9 BUT ON INSIDE TRACK 'HOPPER TOW'.	57 04·4 06 23·67	2-2·5K 1100 REVS.	40 ↓ 30	100 ↓ 75	SLY 4 INSIDE. 5-6 OUTSIDE FORECAST SLY 7-8	4 ↓ 5-6.	PORT AND STBD. MORE EVENLY MATCHED. PORT NET FISHING BETTER AFTER ADJUSTMENTS. 17 BSKTS BULK. CLEAN SMALL TO MEDIUM PRAWNS.	REPORT FROM 'STELLA MARIS' FOR 1ST. TOW WE MAY HAVE DOUBLED HIS CATCH. SLACKED OUT TRAWLER CHAIN ON PORT NET – ALLOWING F/LINE TO DROP BACK.
	2.	1230	1615	3¾	57 04·4 06 22·8	57 04·1 06 21·7	2·2 1 2·5 K.	54 ↓ 40.	125 ↓ 75	FRESHENED SLY 5-6	5-6	SIMILAR BULK TO 1ST. HAUL. 6ST. THIS 5 BRTS. LIVE	EVEN BAGS, LESS BULK FAILING LIGHT.
	3.	1655	1855	2.	57 04·3 06 21·49	57 03·3 06 24·6	2.2 K ↓ 2·5 K.	40	75	FRESHENED 6-7 MOD. SWELL INCREASING SEVERE GALE 9.	8.	10ST. LIVE. 2ST. THIS	½ HR. INTO DARK – ON LAST TOW. DODGING ALONG WEST & NORTH SIDES OF RHUM LOOKING FOR LEE ANCHORAGE. WEATHER DETERIORATING RAPIDLY. ANCHORED KILMORY BAY – N. SIDE OF ISLAND WITH 'STELLA MARIS'.

M. F. V. CYGNUS STAR - FISHING LOG

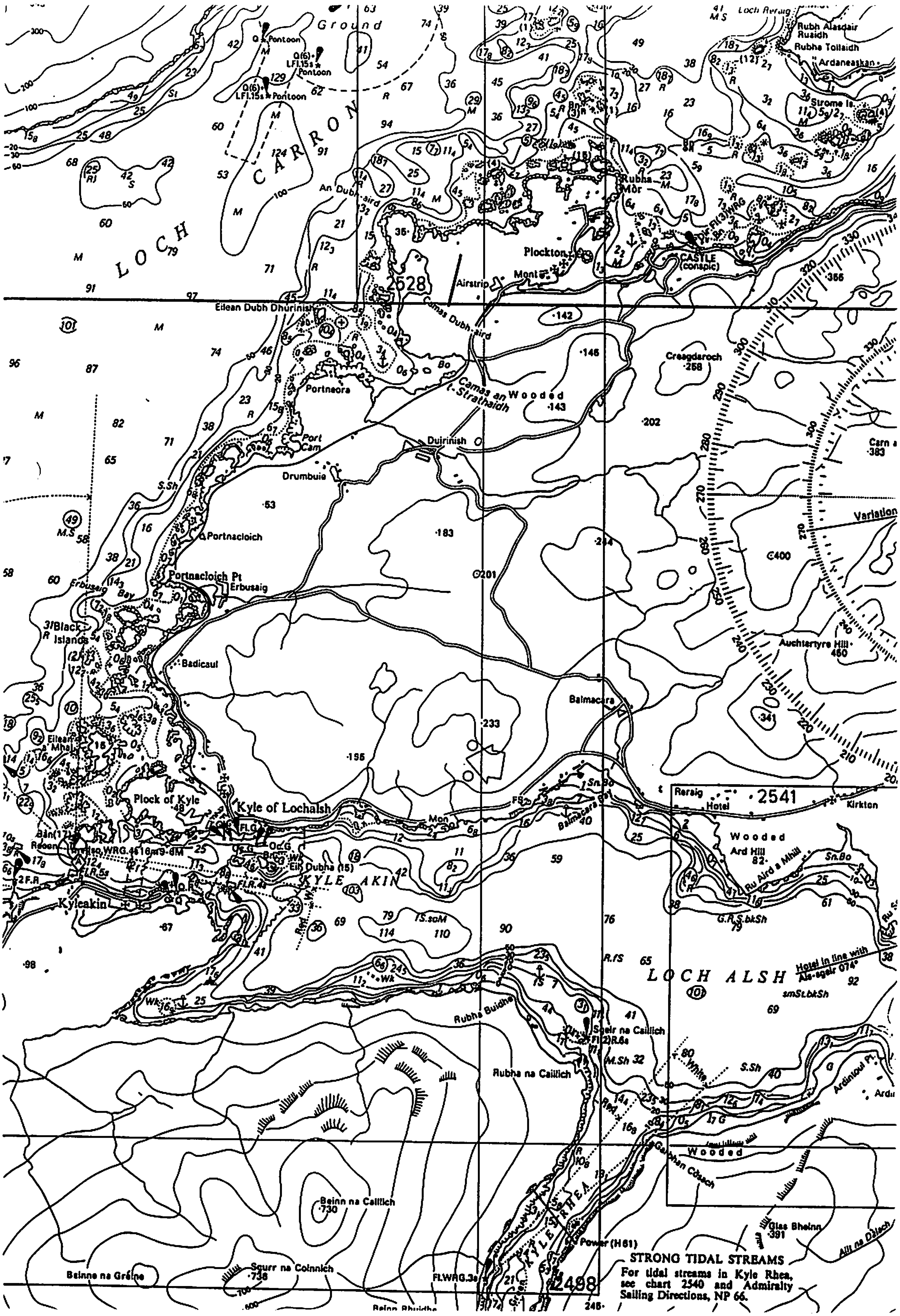
DATE	HAUL	TIME SHOT	TIME HAUL	TOW TIME HRS.	POSITION SHOOTING	POSITION HAULING	TOW SPEED	DEPTH FTHMS.	WARP FTHMS.	WEATHER	SEA STATE	CATCH	COMMENTS
1/10.	1.	0745	1200	4¼	57 03·65 06 22·47 CANNA SOUND SAME AREA AS 30/9/57. 'HOPPER TOWS'.	57 04·5 06 22·0	2-2·5K 1100 REVS.	40 1 30		SLY 3-4 FINED AWAY. THROUGH NIGHT LIGHT TO MODERATE SWELL	3.	SMALL TO MEDIUM PRAWNS. V. LITTLE BOTTOM DEBRIS. 14 ST. LIVE 6 ST. TAILS.	POOR NET STILL DOWN ON STBD. NET BY SMALL AMOUNT. FISHING WITH 'STELLA MAKI' POOR SHOT FOR 1ST. TOW. 1 BSKT. BULK FROM INSIDE TOW. 'STELLA MAKI' TOWED OFF INTO DEEPER WATER FOR 2ND. SHOT. BETTER RESULTS IN 60-80 FTHMS. (LIGHT DAYLIGHT AFFECTING SHOAL WATER TOWS).
	2.	1245	1630	4¼	57 04·1 06 22·18 TOWING TIGHT INSIDE AT CANNA. SHOT STEAMED OFF FOR LAST SHOT— CANNA SOUND.	57 04·6 06 19·2E	2-2·5K 1100 R.	50	100 ↓ 75	SE. BACKING ELY 3-4 BRIGHT PERIODS. FINE WEATHER	MODERATE SWELL CALM INSIDE SOUND.	APPROX. ½ BULK OF PREVIOUS TOW. 5 ST. LIVE 1½ ST. TAILS	STEAMED OFF TO JOIN 'STELLA MAKI' ON DEEPER WATER TOWS FOR LAST SHOT OF THE DAY.
	3.	1720	1850	1½	57 05·9 06 21·4	57 ::5·. 06 20·08	1120 REVS.	82 1 90	125	CALM HAZY SUNSHINE LIGHT FAILING.	SLIGHT SE'LY SWELL	EVEN BULK BOTH NETS SMALL PRAWNS.	STEAMED MALLAIG. LANDED. (2200) STEAMED KYLE 0320 FRI LANDED KYLE 0530 END OF TRIALS. SKIPPER TO CONTINUE WITH RC

Section of Admiralty Chart No. 2209

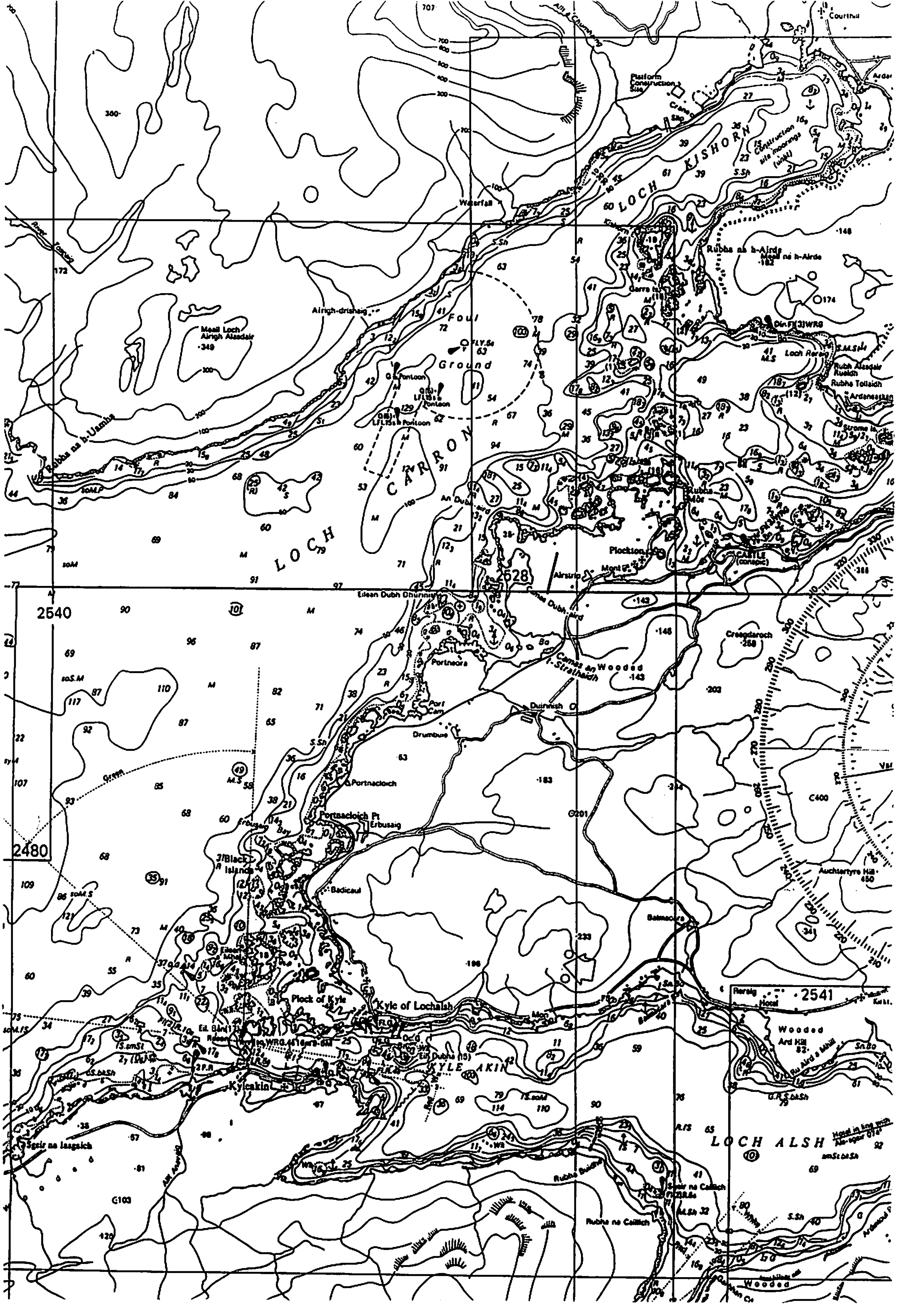
Scotland - West Coast Inner Sound

Showing some of the areas where the trials were carried out.

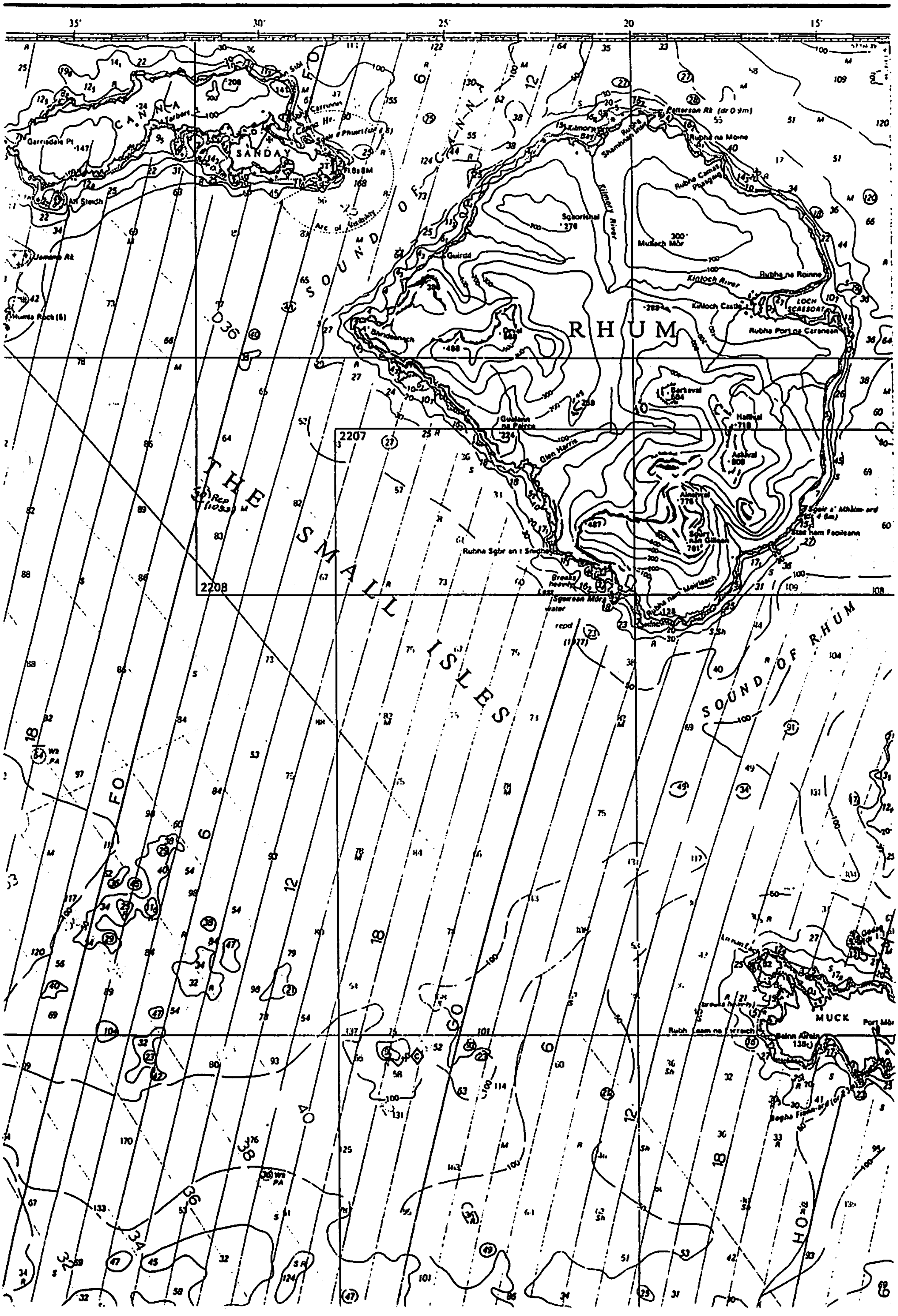
(Refer to Fishing Logs)



LOCH CARRON
Ground
Pontoon
Plockton
CASTLE (conspic)
Airstrip
Rubha Mòr
Strome Is.
Ardaneaskan
Rubha Tollaidh
Rubh Alasdair Ruaidh
Loch Reraig
An Dubh-aird
Eilean Dubh Dhurinish
Camas Dubh-aird
Portnacra
Camas an t-Strathaidh
Wooded
Duirinish
Port Cam
Drumbuie
Creagdaroch
Carn a
Variation
Portnacloich
Portnacloich Pt
Erbusaig Bay
Erbusaig
Black Islands
Badicaul
Auchtertyre Hill
Balmacara
Eilean Mhal
Plock of Kyle
Kyle of Lochalsh
Balmacara Bay
Reraig
Hotel
2541
Kirkton
Ard Hill
Ru Aird a Mhill
Eil. Dubha
KYLE AKIN
Kyleakin
LOCH ALSH
Hotel in line with Ala-sgeir 074°
Rubha Buidhe
Sgeir na Caillich
Rubha na Caillich
Ardintoul Pt.
Wooded
Garbhan Cosach
Glas Bheinn
Allt na Dalach
Beinn na Caillich
KYLE RHEA
Sgurr na Coinnich
Beinne na Grèine
Beinn Bhuidhe
2528
2498
STRONG TIDAL STREAMS
For tidal streams in Kyle Rhea, see chart 2540 and Admiralty Sailing Directions, NP 66.



Platform Construction Site
LOCH KISHORN
Construction site moorings
Waterfall
Rubha na h-Airde
Airigh-drisheig
Meall Loch Airigh Alasdair
Foul Ground
Loch Reraig
Rubha Alasdair Ruaidh
Rubha Toilaidh
Ardaneaskan
Rubha na h-Uamha
LOCH CARRON
An Dubh-aird
Plockton
CASTLE (conspic)
Airstrip
2528
2540
Eilean Dubh Dhurnish
Camas Dubh-aird
Creagdarach
Camas an t-Strathaich
Wooded
Portnacro
Port Cam
Duirinish
Drumbuie
Portnacloich
Portnacloich Pt
Erbusaig
Erbusaig Bay
Black Islands
2480
Badicaul
Auchtertyre Hill
Balmacara
Eilean Mhal
Plock of Kyle
Kyle of Lochalsh
Reraig
Hotel
2541
Ard Hill
KYLE AKIN
Kyleakin
Sgeir na Iasgaich
LOCH ALSH
Rubha Baidhe
Sgeir na Cailliche
Rubha na Cailliche


RHUM
CANNA
SANDAY
MUCK
THE SMALL ISLES
SOUND OF CANNA
SOUND OF RHUM
LOCH SCRESORT
Kinloch Castle
Kinloch River
Kilmory River
Glen Harris
Garrisdale Pt
Canna Hr.
Arc of Visibility
Rubha na Roinne
Rubha Port na Caranean
Rubha na Moine
Rubha Camas Phasgaig
Patterson Rk
Mullach Mòr
Sgorr nan Gillean
Askival
Hallival
Ainshval
Barkeval
Guirdil
Bloodstone Hill
Gualann na Pairce
Rubha Sgòr an t Snidhe
Sgeir a' Mhaim-ard
Stac nam Faoileann
Sgeirean Mòra
Breaks heavily
Less water
Port Mòr
Rubh Leam na Laraich
2207
2208

A P P E N D I X I I

FIGURES DESCRIBING THE TWIN-RIG ARRANGEMENTS

AND GEAR USED DURING THE FISHING TRIALS

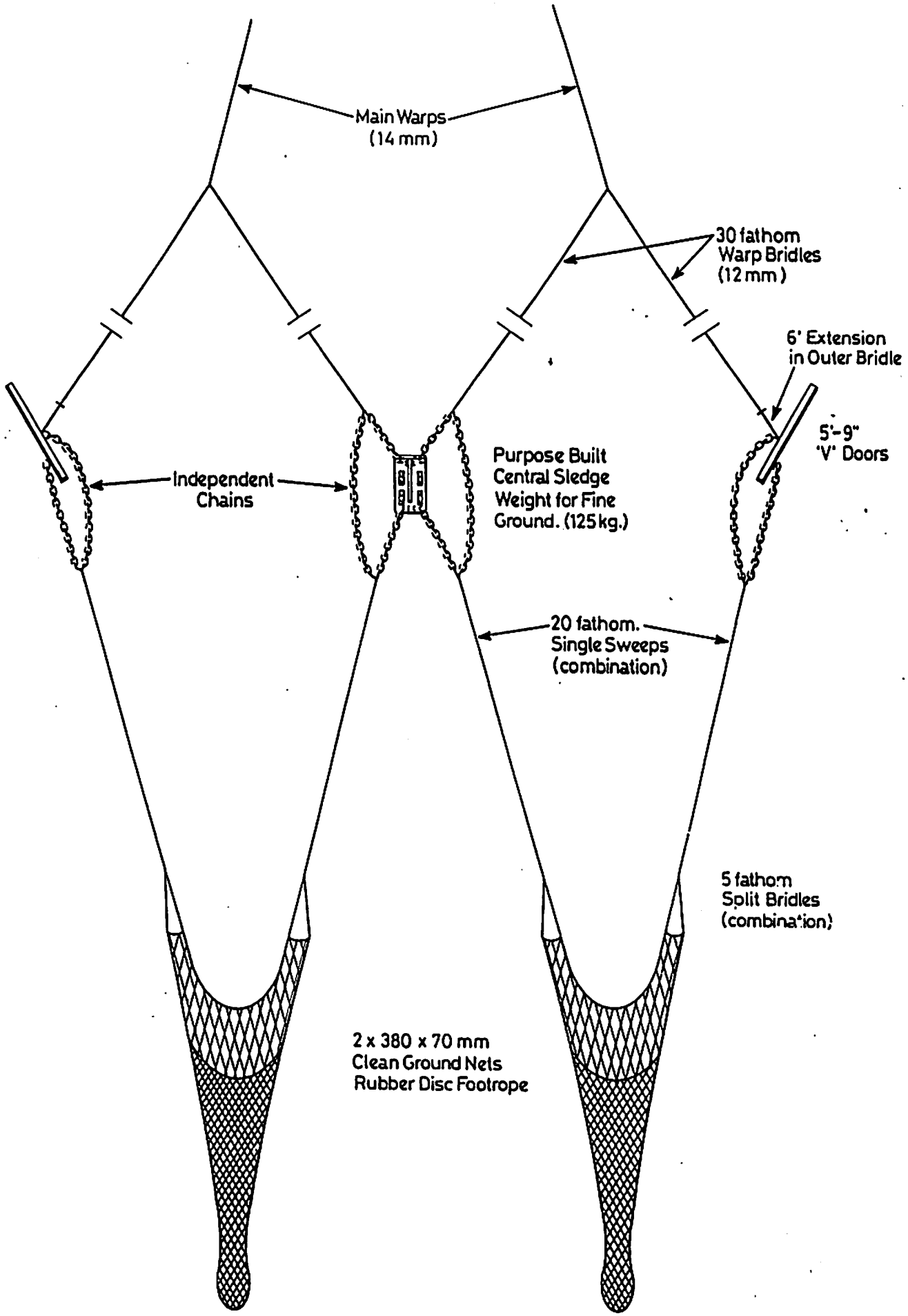


FIG. 1 Twin Rig Arrangement Using Fine Ground

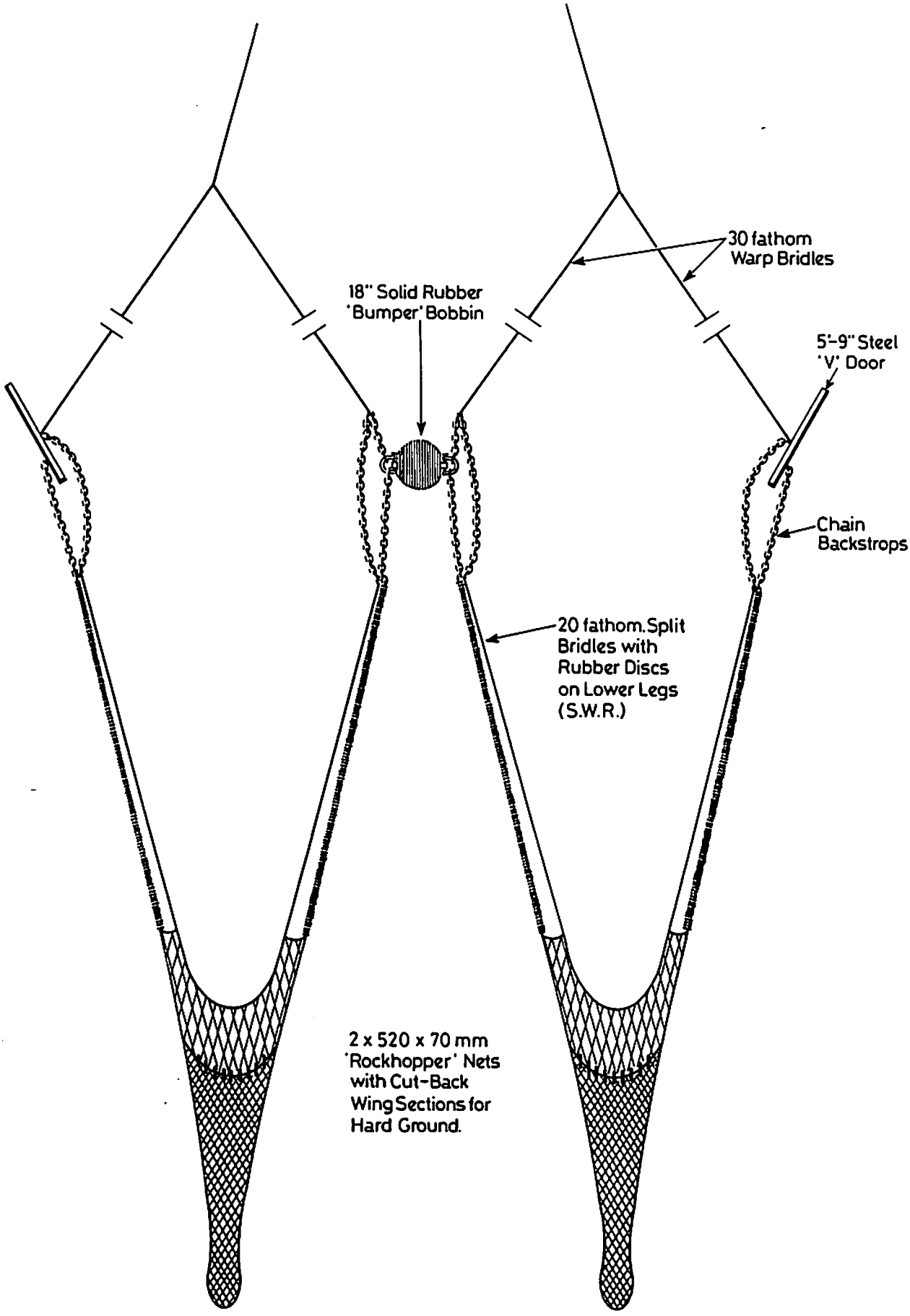


FIG. 2. Twin-Rig Arrangement Used on Hard Ground

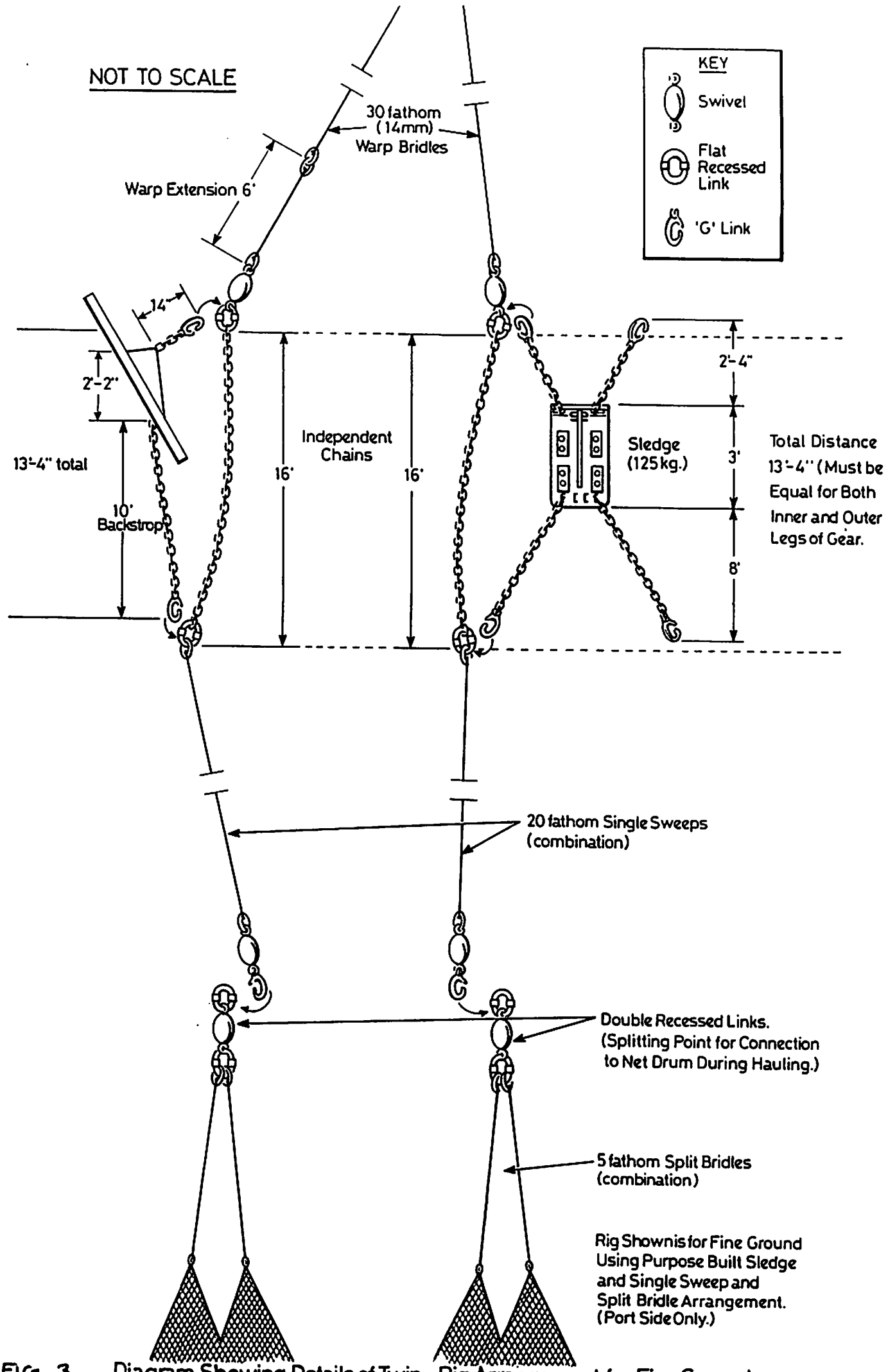


FIG. 3. Diagram Showing Details of Twin-Rig Arrangement for Fine Ground

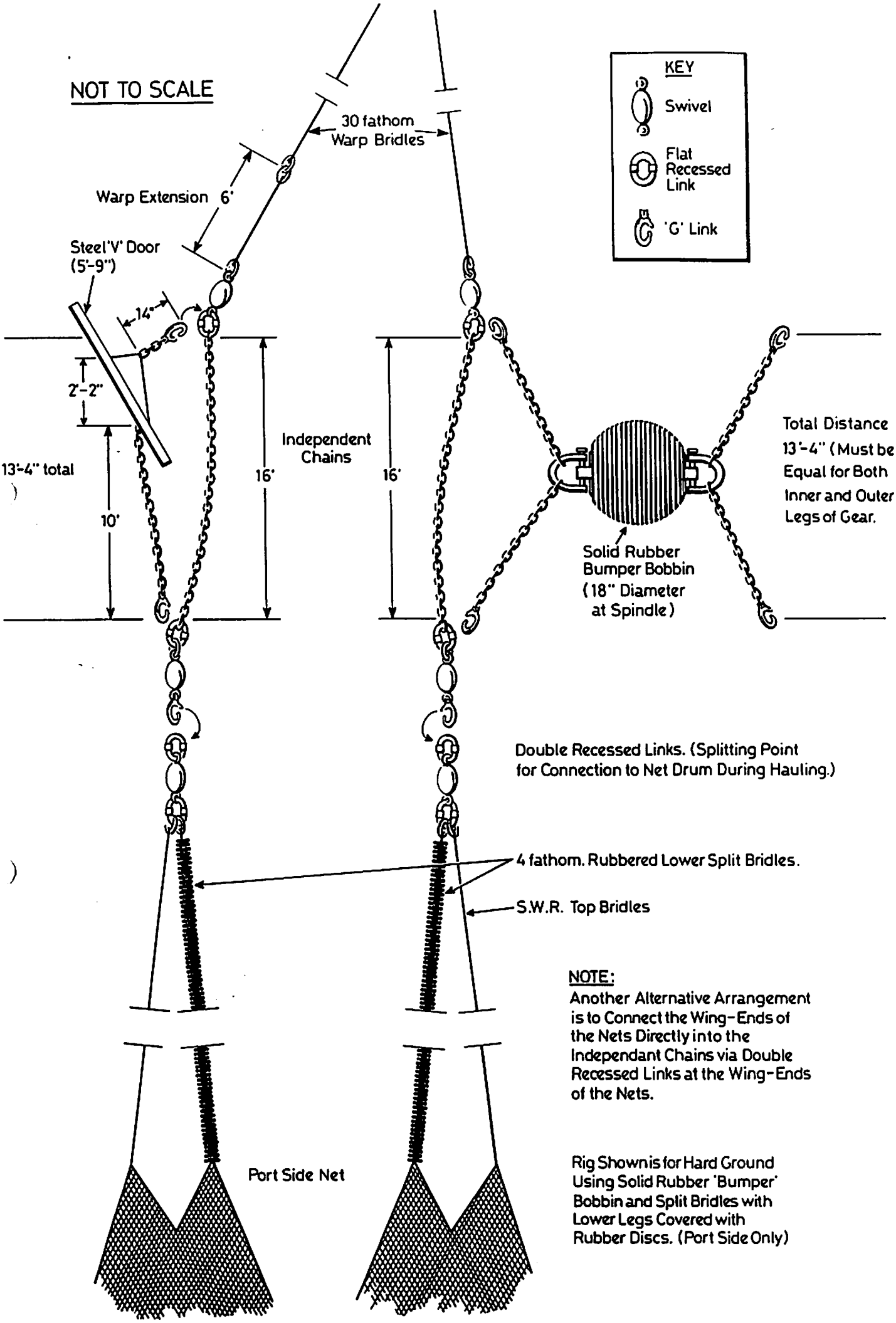


FIG. 4. Diagram Showing Details of Twin-Rig Arrangement for Hard Ground

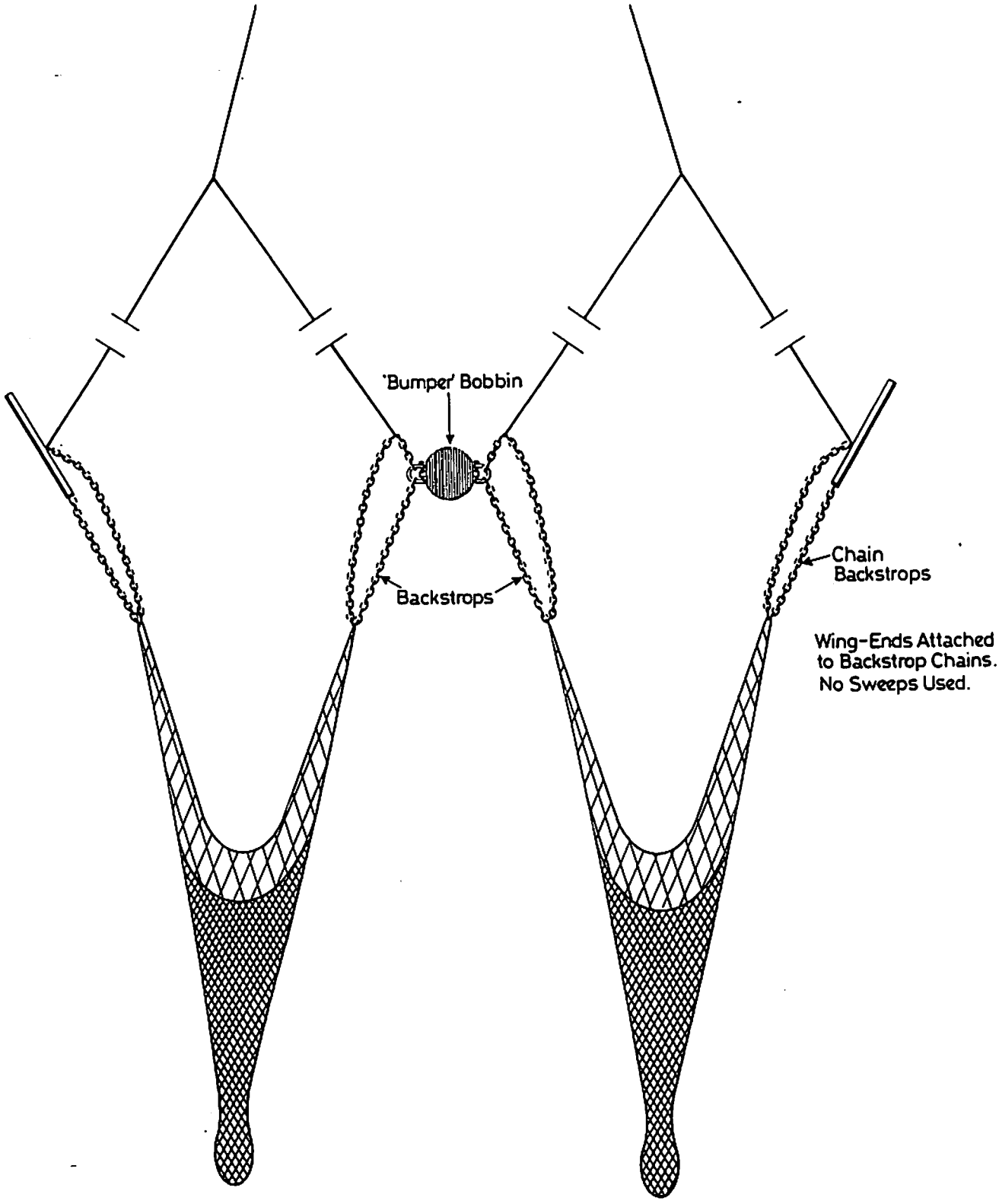


FIG. 5. Twin-Rig Arrangement with Nets Attached Straight to Trawl Doors.
i.e. No Sweeps Used.

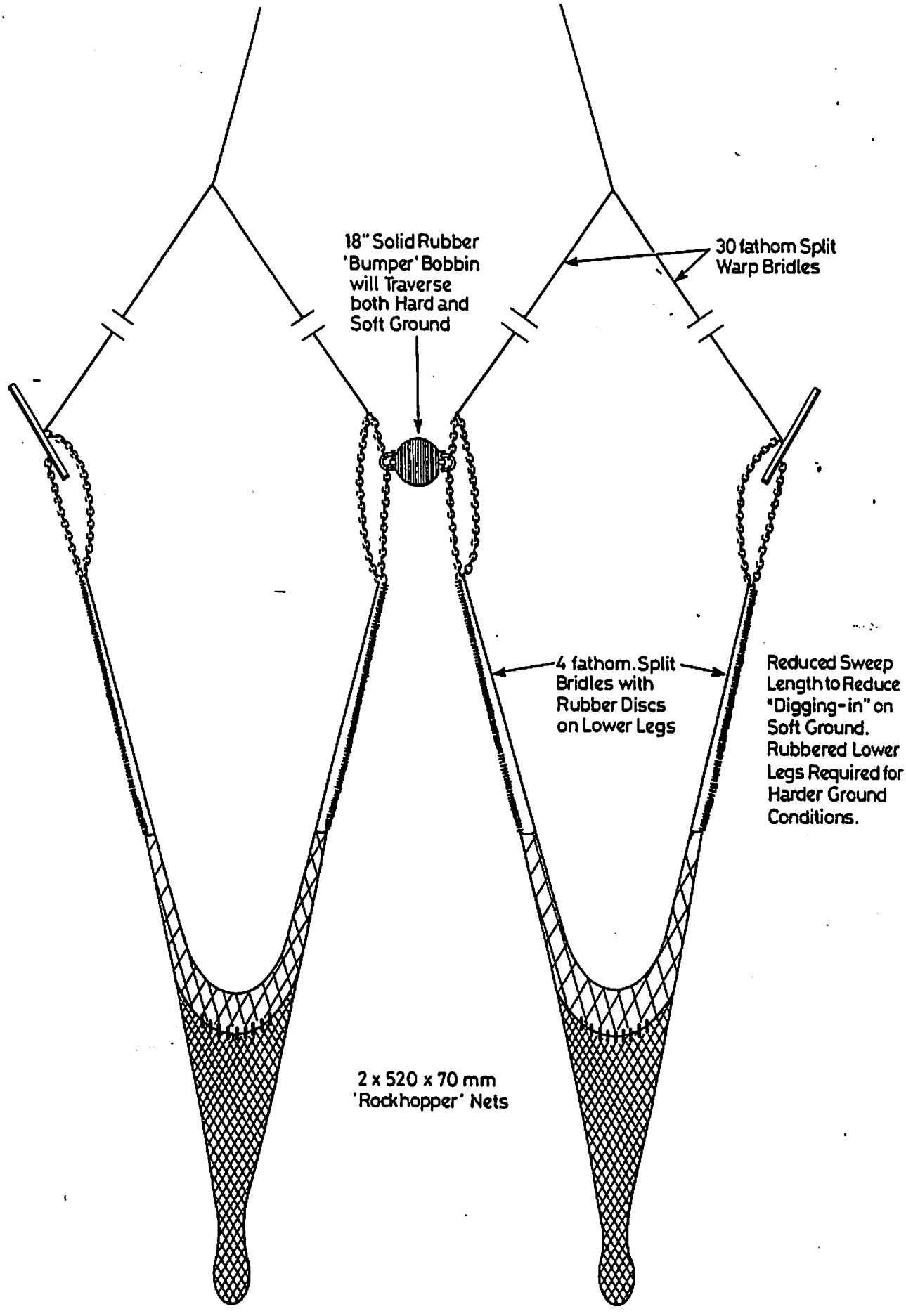
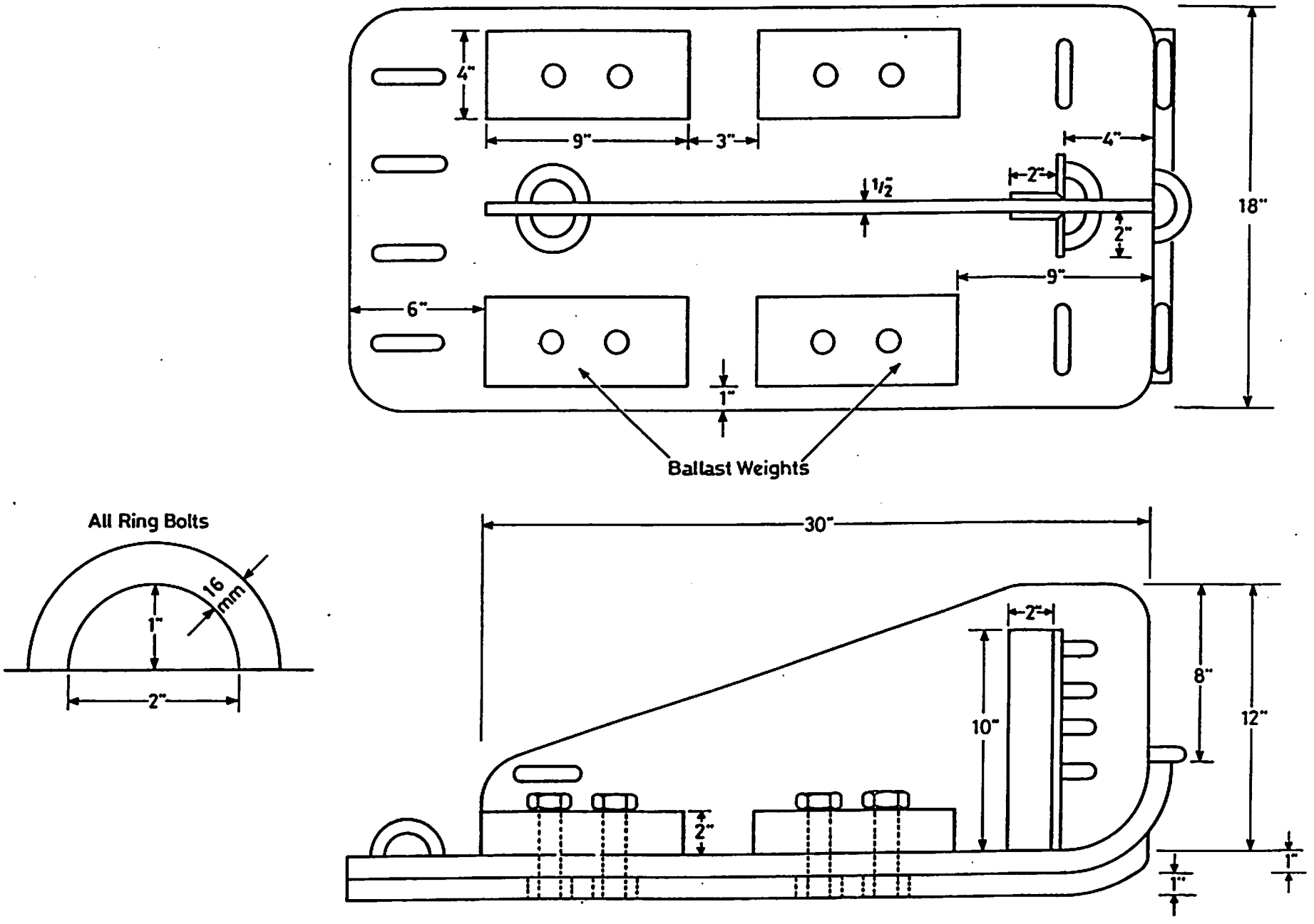
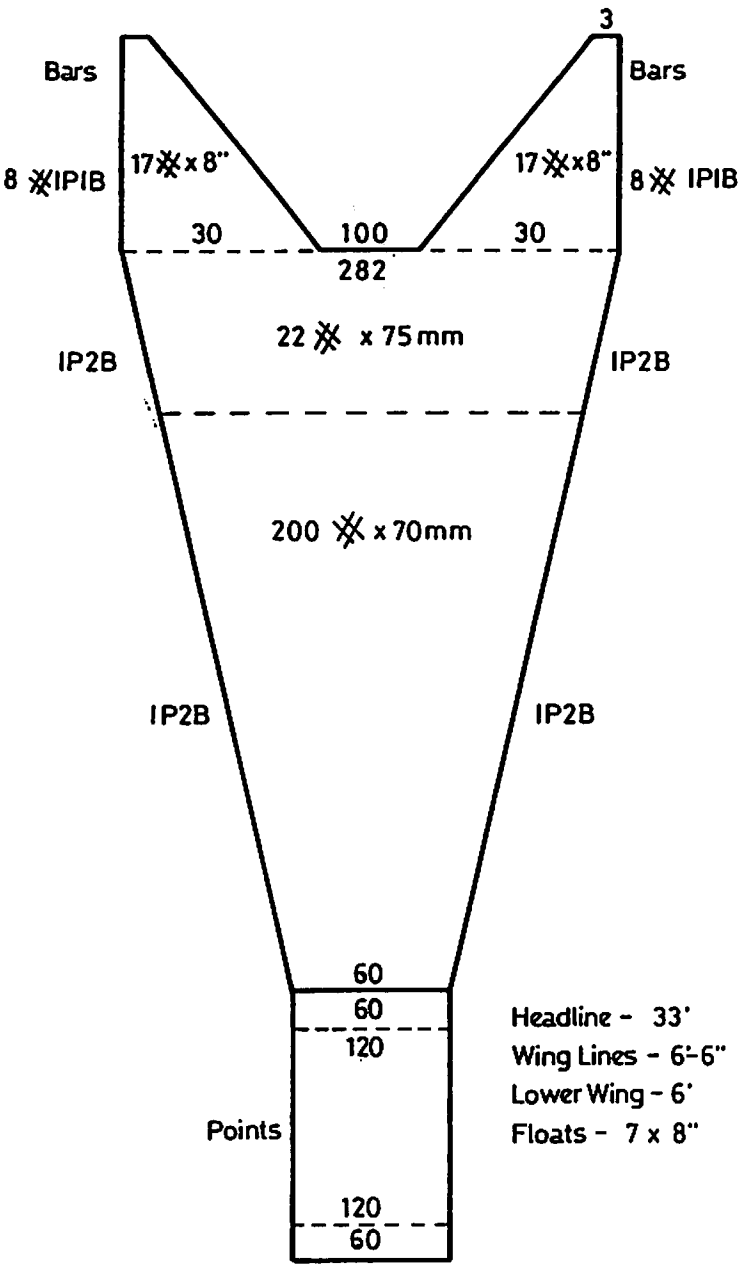


FIG. 6. Alternative Twin-Rig Arrangement used for both Fine and Hard Ground

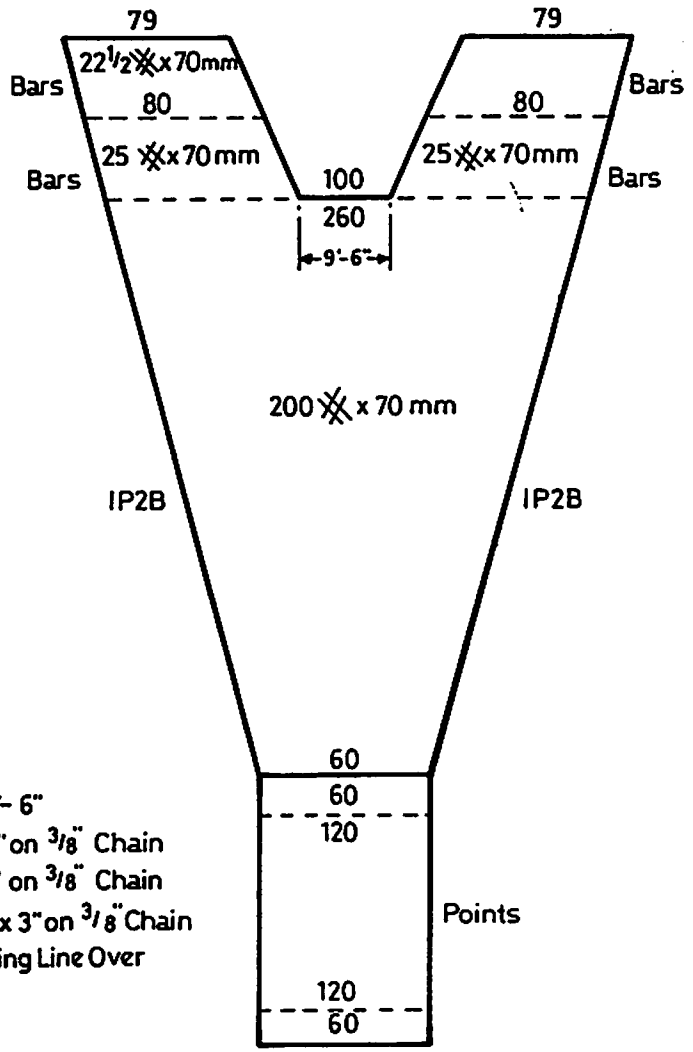


Details of Central Sledge

Fig. 7.



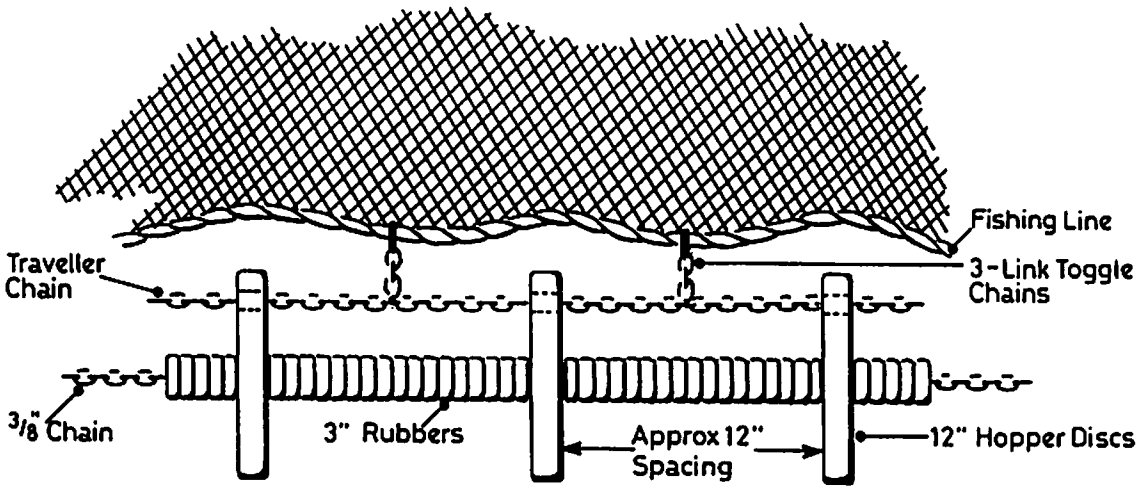
Headline - 33'
Wing Lines - 6'-6"
Lower Wing - 6'
Floats - 7 x 8"



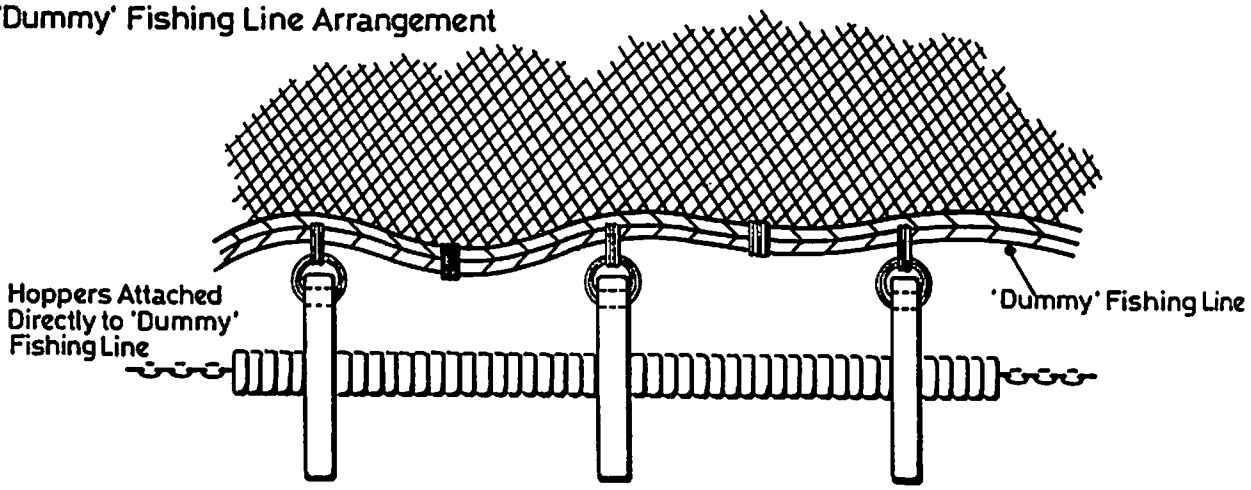
Fishing Line - 33'- 6"
Hoppers - 12'x12" on 3/8" Chain
Legs - 10' x 3" on 3/8" Chain
Extensions - 6'-6" x 3" on 3/8" Chain
1'-6" Slack in Fishing Line Over Hoppers Only.

520 x 70mm Dual-Purpose Net - M.F.V. "Cygnus Star". Fig 8

1. Traveller Chain Arrangement



2. 'Dummy' Fishing Line Arrangement



Ground Gear Arrangement from Bosum out to Wing-Ends.

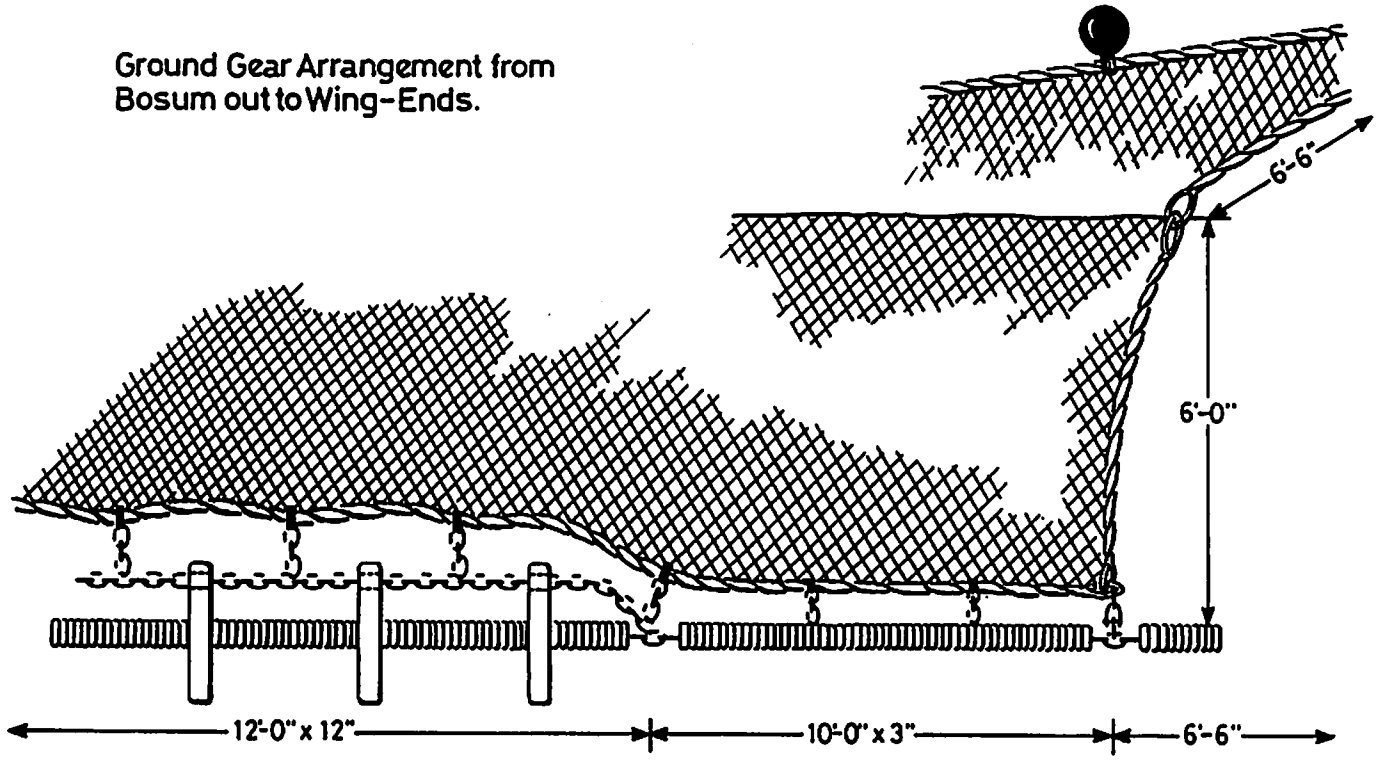
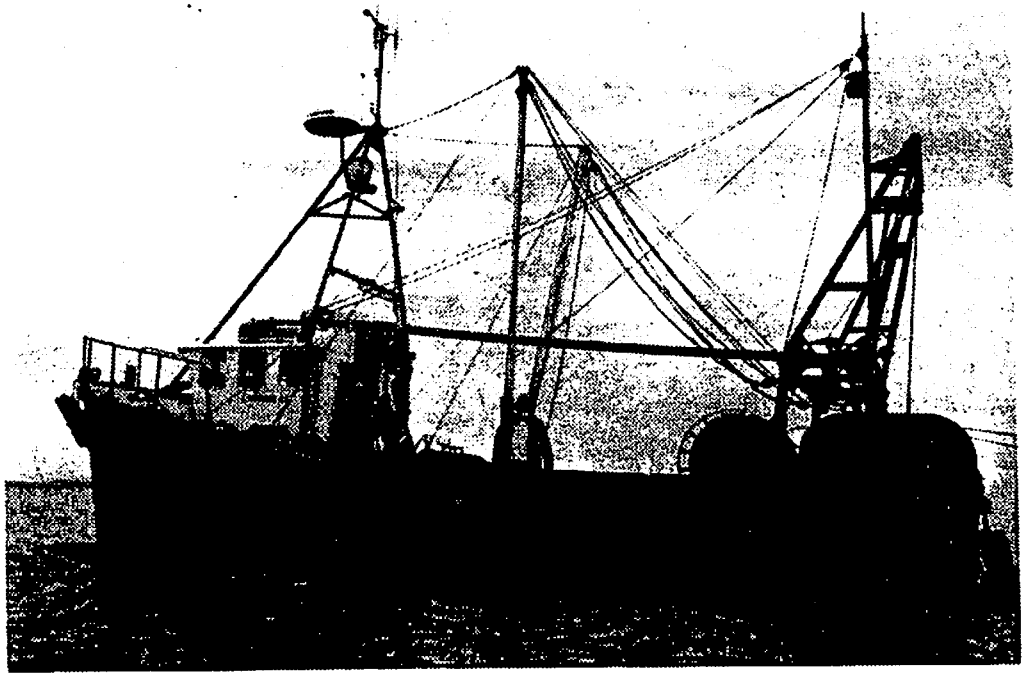


Diagram Showing Details of Hopper Rigs Used During Trials (Bosum Section) Fig.9

A P P E N D I X I I I

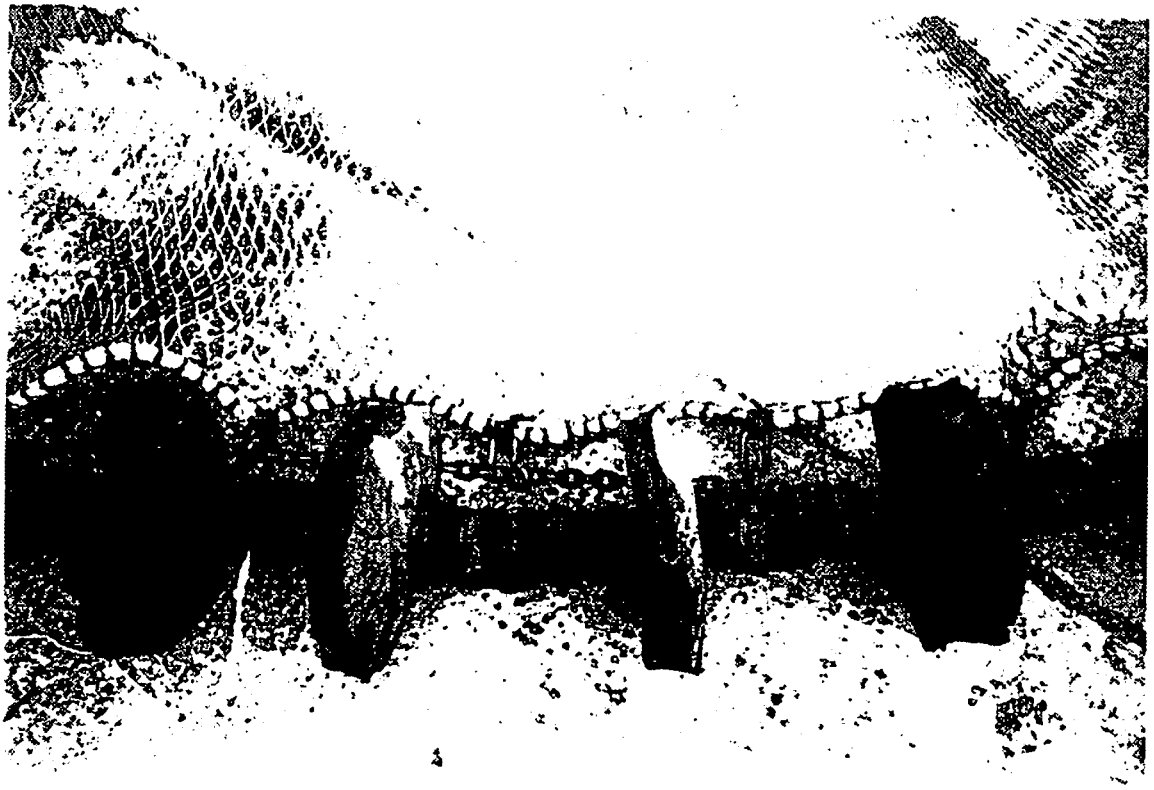
PHOTOGRAPHS TAKEN DURING THE TRIALS ONBOARD THE MFV "CYGNUS STAR"

1. PHOTOGRAPH SHOWING MFV 'CYGNUS STAR'.

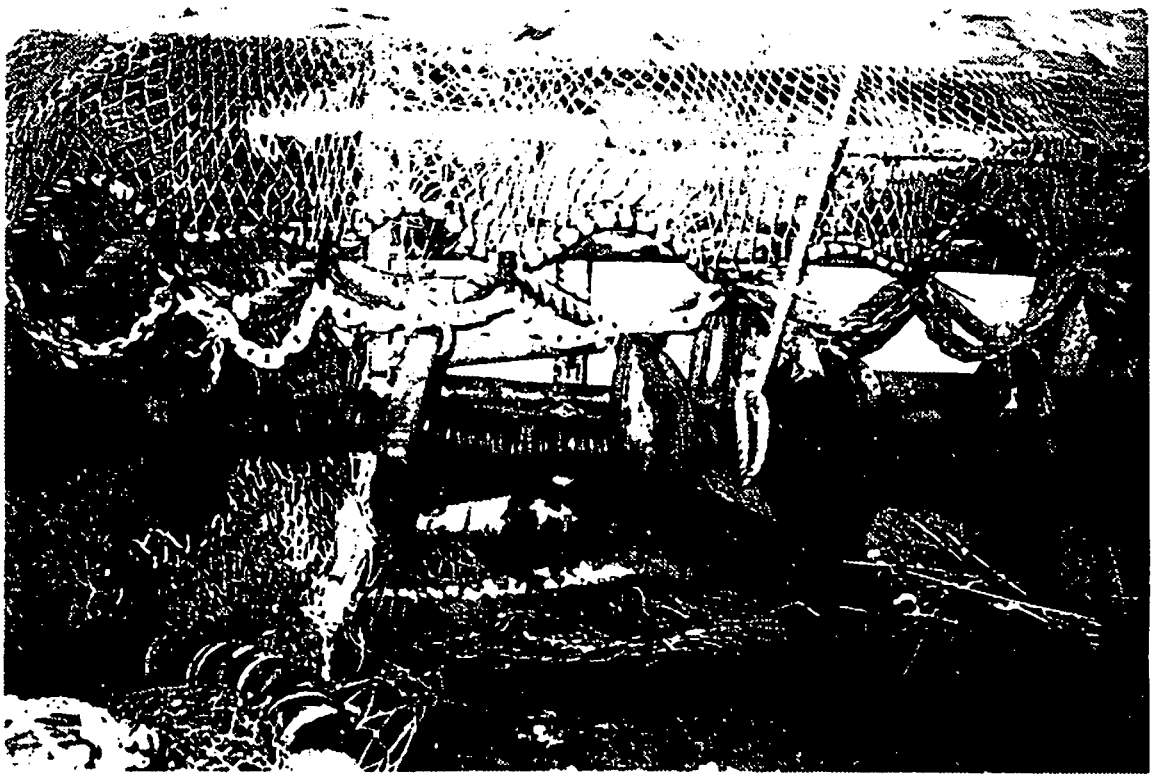


2. PHOTOGRAPH SHOWING THE 'CUT-AWAY' WING-END ARRANGEMENT USED IN THE NETS USED FOR THE TWIN-RIG TRIALS.

3. PHOTOGRAPH SHOWING THE 'ROCKHOPPER' RIG ARRANGEMENT USED ON THE TWIN-TRAWLS.

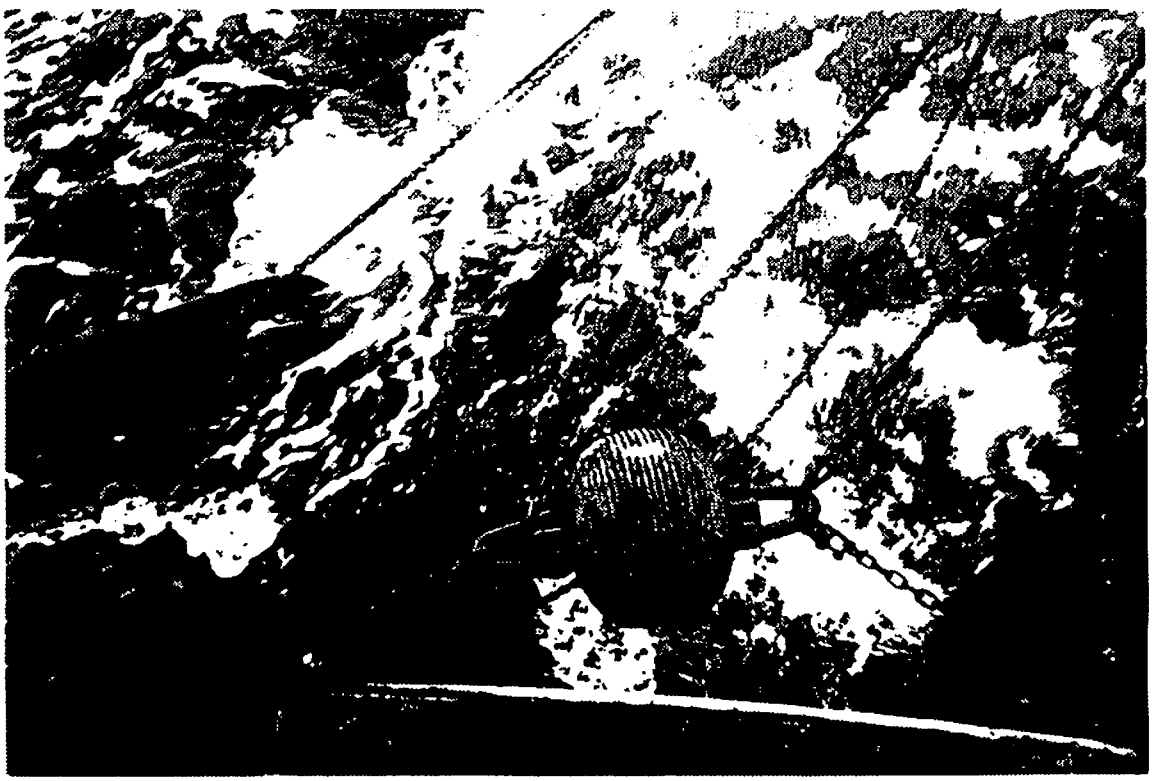


4. PHOTOGRAPH SHOWING THE MODIFIED 'ROCKHOPPER' RIG ARRANGEMENT USING A 'DUMMY' FISHING LINE.



5. PHOTOGRAPH SHOWING THE PURPOSE BUILT CENTRAL SLEDGE WEIGHT USED FOR FINE GROUND FISHING.

6. PHOTOGRAPH SHOWING THE SOLID RUBBER 'BUMPER BOBBIN' USED FOR HARD GROUND FISHING.



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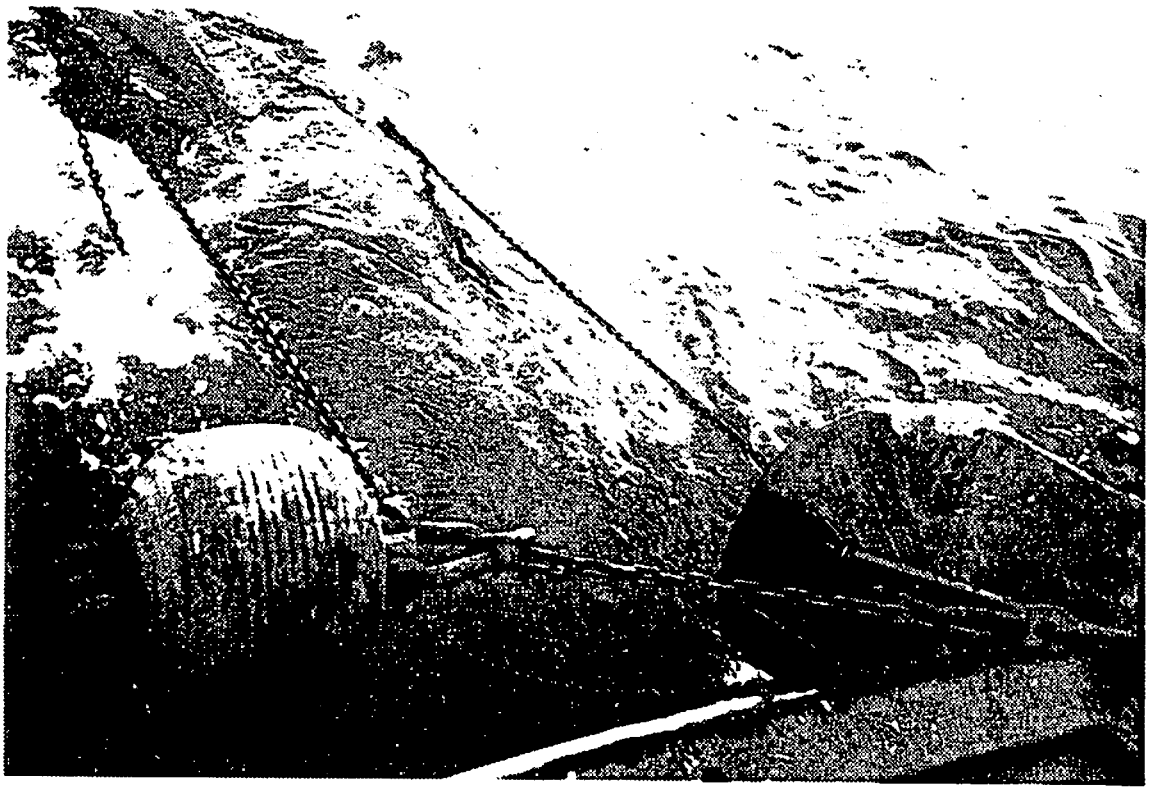
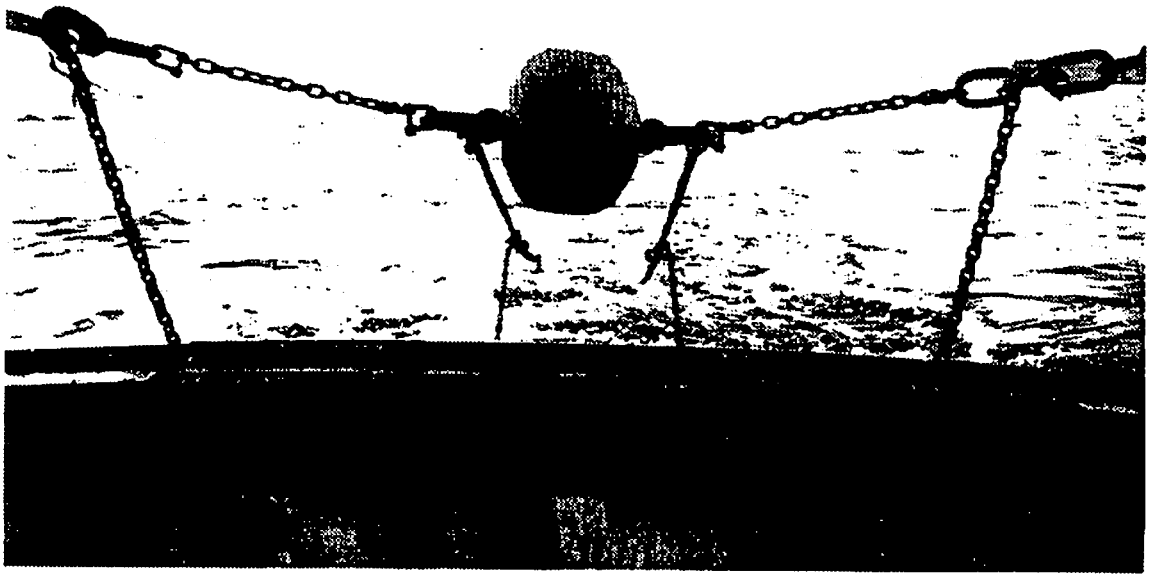
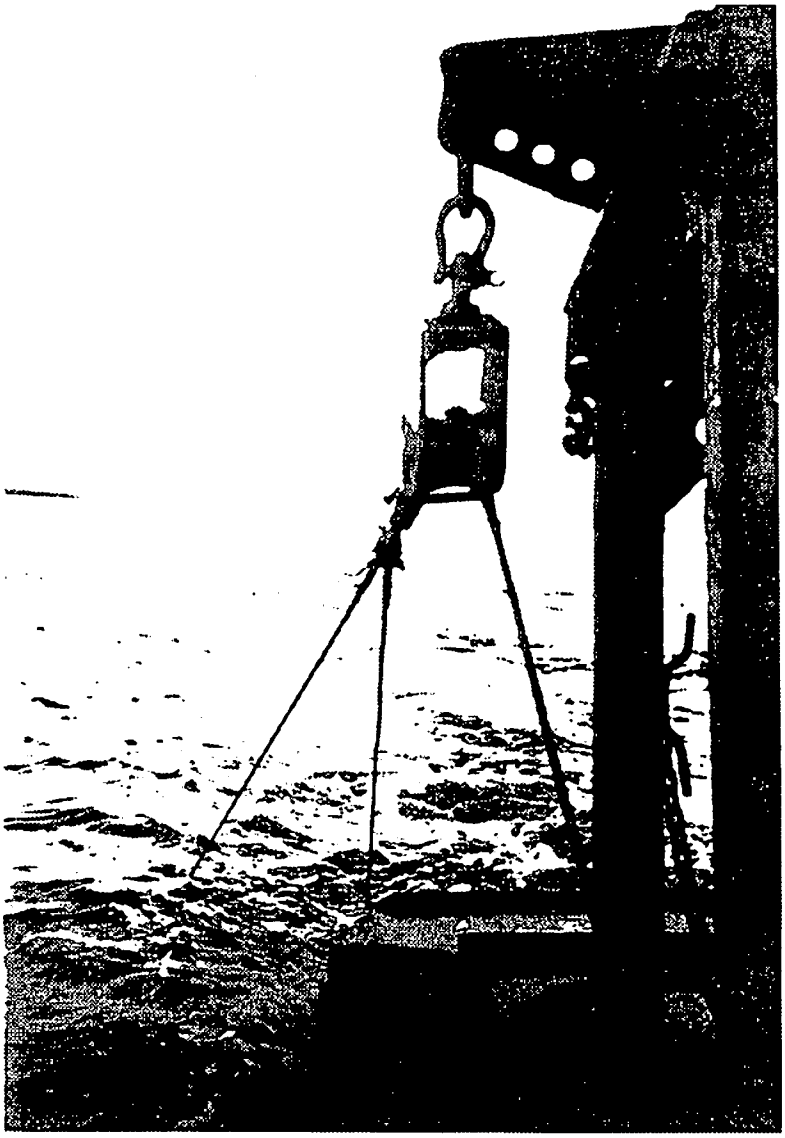


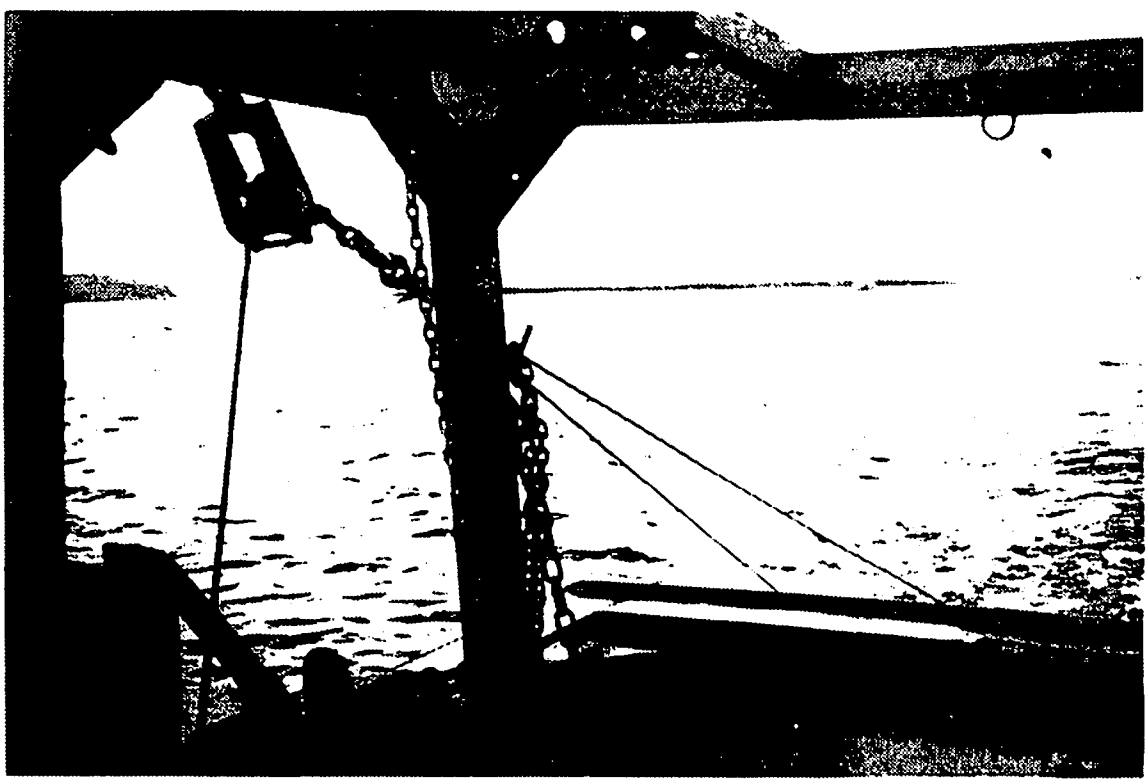
PHOTOGRAPHS SHOWING THE ARRANGEMENT OF CENTRAL WEIGHT (IN THIS CASE USING THE 'BUMPER BOBBIN') WITH RESPECT TO THE POSITION OF THE TRAWL DOORS.

8.

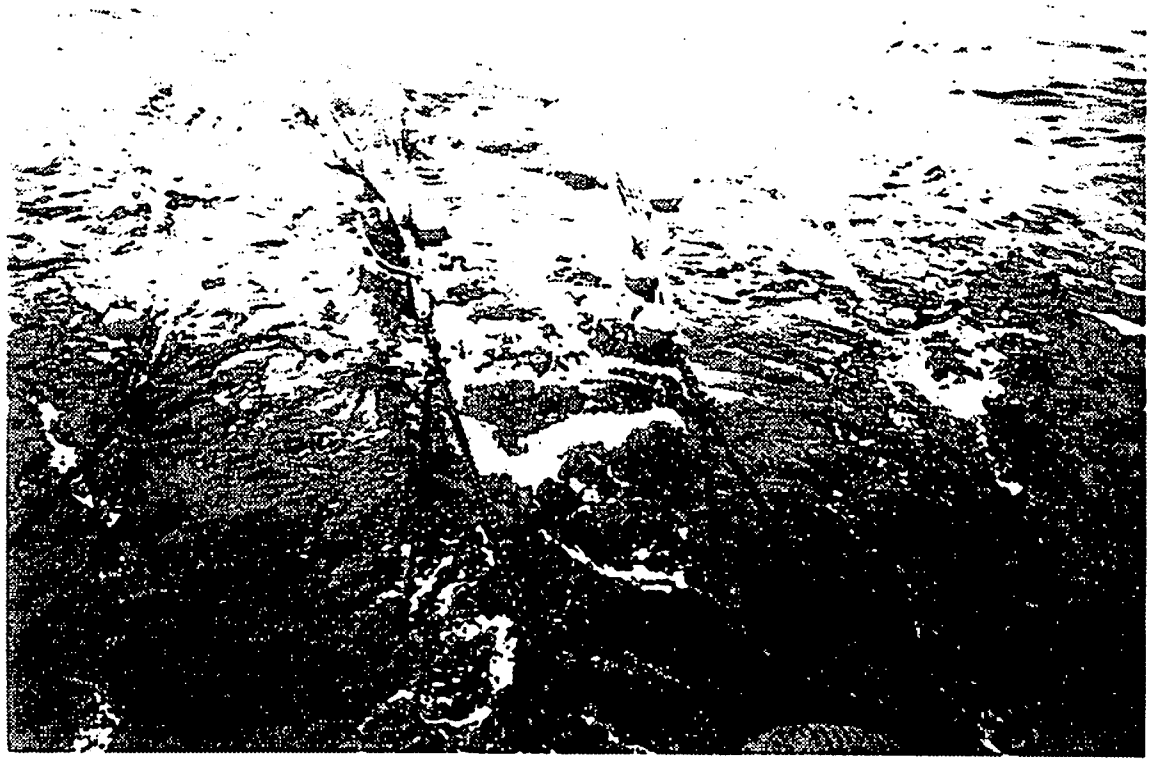




PHOTOGRAPHS SHOWING THE SPLIT WARP-END EXTENSIONS GOING TO TRAWL DOOR AND CENTRAL WEIGHT.



11. PHOTOGRAPH SHOWING TWIN-NETS DURING HAULING OPERATION. NOTE:- NO SWEEP LENGTHS ARE BEING USED.



12. PHOTOGRAPH SHOWING WING-ENDS OF BOTH TRAWLS CONNECTED INTO THE INHAULERS ON THE NET DRUM JUST PRIOR TO BEING TAKEN ONTO THE DRUM.