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C.M. 1973/B:3
Gear and Behaviour Committee

REPORT OF THE WORKING GROUP ON RESEARCH AND ENGINEERING ASPECTS OF FISHING GEAR, VESSEL AND EQUIPMENT

Rapporteur : J.G. de Wit
Netherlands Institute for Fishery Investigations,
Ymuiden - The Netherlands

1. Meeting time and place : 3, 4 and 5 May, 1973 - Ymuiden-The Netherlands

2. Terms of reference : At the 60th Statutory Meeting (Copenhague, 1972) it was decided that this working group shall consider especially high-opening bottom trawls, one-boat and pair trawling techniques, engineering aspects of multi-purpose vessels, instrumentations and electric fishing.

3. Participants :

Belgium

G. Van den Broucke — Rijksstation voor Zeevisserij - Ostende 8400
G. Cleeren — Rijksstation voor Zeevisserij - Ostende 8400

Canada

P.J.G. Carrothers — Fisheries Res. Board, St. Andrews, N.B.

France

M. Le Men — Institut des Pêches Maritimes - Nantes
M. Portier — Institut des Pêches Maritimes - Boulogne/Mer

Germany

R. Steinberg — Institut für Fangtechnik - Hamburg 50
K. Lange — Institut für Fangtechnik - Hamburg 50
G. Freytag — Institut für Fangtechnik - Hamburg 50

Iceland

A.H. Agústsson — Fisheries Association of Iceland - Reykjavik
E. Ragnarsson — Fisheries Association of Iceland - Reykjavik

The Netherlands

H.C. Besançon — Netherlands Institute for Fishery Investigations-Ymuiden
G.P. Boonstra — Netherlands Institute for Fishery Investigations-Ymuiden
S.J. de Groot — Netherlands Institute for Fishery Investigations-Ymuiden
I.K. Koldewijn — Netherlands Institute for Fishery Investigations-Ymuiden
P. Korbee — Netherlands Institute for Fishery Investigations-Ymuiden
J.G. de Wit (Convenor and Chairman) — Netherlands Institute for Fishery Investigations-Ymuiden

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*) General Secretary, ICES, Charlottenlund Slot, 2920 Charlottenlund, Denmark.

Norway

K. Olsen	Fisheries Directorate, Marine Research Institute 5011 Bergen.

Portugal

David B. Gil	Instituto de Technicas de Pesca - Lisbon

United Kingdom

M. Hatfield	White Fish Authority - Hull
D.N. MacLennan	Marine Laboratoty - Aberdeen
P.A.M. Stewart	Marine Laboratory - Aberdeen
A.R. Margetts	Fisheries Laboratory - Lowestoft

U.S.S.R.

A.I. Treschev	All-Union Research Institute of Marine Fisheries Oceanography (VNIRO) - Moscow
E.A. Karpenko	All-Union Research Institute of Marine Fisheries Oceanography (VNIRO) - Moscow
V.P. Simbirov	All-Union Research Institute of Marine Fisheries Oceanography (VNIRO) - Moscow

F.A.O.

J. Schärfe	Fishing Gear and Methods Branch Fishery Industries Division - F.A.O. Rome

4. Agenda

The Working Group adopted the agenda as proposed by the Chairman.

3 May, 1973

1. High-opening bottom trawls
2. One-boat midwater trawls
3. Two-boat midwater trawls

4 May, 1973

4. Electrical fishing
5. Instrumentation for gear research
6. Engineering aspects of multi-purpose fishing vessels

5 May, 1973

7. The engineering principles of "Fishing Unit Measures" by A.I. Treschev
8. Recommendations

5. High-opening bottom trawls (agenda item 1)

5.1. The general aim of this development is to catch some of the demersal fish just off the bottom, which the conventional bottom trawls just fail to catch.

Further requirements:
- the bottom contact has to be at least as good as that of a conventional bottom trawl;
- no arrangements or gadgets which complicate the manual or mechanical (net drum) handling of the gear.

The Working Group noted that Canada, France, Germany, The Netherlands and the United Kingdom were involved in the development of high-opening bottom trawls and that this development did not always follow the same lines of thinking.

5.2. The countries involved reported as follows on this subject.

5.2.1. J. Carrothers (Canada) said that W.W. Johnson is developing a high-opening bottom trawl of the same configuration as the Diamond Midwatertrawl.

5.2.2. M. Portier (France) reported that the first attempt to increase the vertical height of the trawlopening was the development of a two-panel trawl for the coastal fishery (150-500 hp, 110-368 kW) five years ago. C. Nedelec reported on this subject to the FAO Congress on Fish Finding and Aimed Trawling, Reykjavik, 1970. Inshore fishing vessels have used this type of trawl with good results for fishing different species of round fish in the Southern North Sea during recent years (fig. 1a). The rigging is generally: with three bridles and legs.

From this prototype a bigger trawl (fig. 2a) has been developed for vessels 1500-2000 hp (1100-1470 kW).
Headline 41.50 m and ground-rope 55 m, rigged with legs and often with a kite opening height 8-8.5 m, with good bottom contact of the ground-rope, catching mainly coalfish, cod and whiting.

This year a new type of a four-panel semi-pelagic herring trawl has been tank tested and tested at sea by the research vessel Pelagia - 600 hp, 440 kW April, 1973. It was rigged a) as a midwater trawl (2 long bridles and hydro-dynamic doors) or b) with forks and rectangular bottom doors. In the sea test it had a vertical opening of 8-9 m with the ground-rope at the bottom. The warp pull was 1.8 tons in each warp for hydro-dynamic doors and 2.2 tons in each warp for rectangular bottom doors (speed for both types of doors: 4 kn).

The new type of hydro-dynamic door is based on the Süberkrüb-principle but has an aspect ratio of 1 : 1 and a specially shaped shoe to avoid damage when the door strikes the bottom. The net was of 400 mm mesh length of the square. No floats or kites were used.
Testing on board a commercial trawler will take place about the middle of 1973.

5.2.3. Dr. R. Steinberg (Germany) said that his institute has been working on high-opening bottom trawls in close cooperation with commercial fisheries and several netmakers for about 2 years. But the research work could not be carried out as intensively as desired because the research vessel has been available for only a few trips. Moreover, the institute did not get the necessary funds for the arrangement of model-tests which, in his opinion, would have been of advantage.

During the experiments with high opening trawls several types of these trawls have been tested:

1. Two-panel net with enlarged upper panel;
2. Trawls with larger upper and lower panels and smaller side panels of different shape;
3. A combination of the two types mentioned above, i.e. a net with relatively small lower panel but enlarged upper panel and small side panels;
4. Two-panel net with extended square and
5. A so-called "Fécamp"-net trawl which is well known from the French fisheries.

If, when assessing a net, one considers not only the opening height and width, but also the handling, the possibilities for easy and quick repairing, the price and the possibility of its use on rough ground, then the first mentioned type of trawl seems to be the most useful for small trawlers as well as for deep sea trawlers.
With 61 m groundrope length (fig. 2b) this net has an opening height of about 10-11 m and an opening width of about 20 m, when using a propeller thrust of 14-15 tons.

The same type constructed for use on smaller trawlers of about 250-300 hp (184-220 kW) (fig. 1b) has a vertical opening of 8-10 m and horizontal opening between the upper wing tips of about 25-28 m (for 8 m) and 23-25 m (for 10 m). These opening heights, however, will be obtained only, when using 2 kites of 1 m2 each. It has been found, that it is of advantage to use the 2 kites fixed at the ends of the wings rather than one 2 m2 kite in the middle of the head-line. The trawl type in question can be handled relatively easily, its price is the lowest of all, and its repair is not too difficult. The rigging of the 61 m groundrope high-opening trawl is shown in figure 3b.

The trawl types with small side panels (fig. 4a and 4b) are of a too complex construction and, therefore, more expensive and difficult to repair. Besides, experiments have shown that the opening height is influenced only a little by these side panels.

The trawl with the extended square (fig. 5) has two main disadvantages. Firstly the square has a high sheering effect causing the vertical net opening to reach 12 m but its horizontal opening to be decreased to only 16.5 m. Secondly, this net is more difficult to handle during hauling, especially on stern trawlers with a short working deck; on such a vessel the square already covers the whole working deck when the belly has reached just the lower part of the ramp.

The "Fécamp" trawl seems to be unsuitable for fisheries on rough ground and is relatively expensive.

During the experiments with high-opening bottom trawls the influences on the shape of the net mouth of the length of the bridles as well as the influence of the kites and of the size of the otterboards has also been tested.

Unfortunately, possibilities for carrying out comparative fishing between high-opening and normal bottom trawls have been very poor so far. Therefore, it is not yet known whether the high-opening trawl, developed in Germany, has a better catching performance than the usual trawls.

It is intended to continue the experiments with high-opening trawls as soon as possible. But this will not be before the first half of 1974, because there is no research vessel available earlier for this purpose. Perhaps it may be possible to start model-tests in the course of 1973.

5.2.4. Besançon (Netherlands) reported that the development in The Netherlands has been governed by the requirement to obtain a trawl with a higher vertical opening without kites connected to false headlines. It was decided to choose a four-panel trawl with kites, directly connected to the wings and the square. This trawl is for vessels of 1600-2000 hp (1175-1470 kW) (fig. 2c). With good bottom contact of the ground-rope at a speed of 4.5 kn a vertical net opening of 10 m was obtained. Handling this gear, both shooting and hauling, was much easier than for the conventional trawl with kites and headlines. This resulted in a gain in fishing time and improved safety of the men handling the gear.

Prelimenary catch results are promising.

The trawl was rigged with flat rectangular otterboards 3.20 x 1.35 m. Weighing about 200 kg in air. Chain (125 kg) was attached to the groundrope. Upper and lower bridles were each 100 m wire; a 30 cm bobbin was connected to the lower bridle; each bridle was connected to a 3.6 m door strop. One kite of 70 x 50 cm was attached to each upper wing corner and one kite of 100 x 80 cm to the centre of the headrope. (fig. 3c).

5.2.5. Hatfield (U.K.) reported on the development of two-panel trawls promoted by the Industrial Development Unit (Hull) of the White Fish Authority (annex 1) and a new four-panel trawl (the "White Sea" gear) has been developed by the Marine Laboratory, Aberdeen. Recently a comparative fishing experiment was carried out from the research vessel "Scotia" in which the fishing performance of these two and four panel gears were compared against a traditional bottom trawl, and the four-panel gear gave the best catching rate. At the same time engineering performance measurements were made. The four-panel net had a larger horizontal spread (32.1 m against 24.4 m), but a smaller headline height (3.75 m against 4.7 m) compared with the large two-panel net. Both gears had about the same drag, 5.4 tons at 4 knots towing speed.

5.3.1. From the development reports it became clear that the increase of the vertical opening of the trawl mouth is seen as a function of:

- length of wires (bridles);
- mesh length and hanging in the square;
- kites to provide an uplift of the headrope.

The last two items roused a good deal of discussion.

5.3.2. Steinberg noted that for mesh lengths in the square of more than 200 mm the vertical opening of the trawl decreased and the horizontal opening increased. Therefore, in Germany the optimum mesh length of a high-opening bottom trawl has been settled at 200 mm. Treschev said that in USSR 200 mm and 100 mm have been accepted. Portier noted that in France 200 mm has been accepted, but this figure will possibly rise to 400 mm in future. Besançon said, no difficulties are encountered in The Netherlands with a mesh length of 400 mm. According to MecLennan the largest mesh length used in the U.K. is 300 mm, but for two-panel trawls the mesh length of the square is still 140 mm.

5.3.3. Kites as possible means to increase the height of the headrope revealed two lines of thinking. Participants from Germany and The Netherlands were in favour of kites. Participants from most other countries had objections to the use of kites. Steinberg opposed to the view that kites are a big nuisance compared with the advantage they have. He gave measurements of the headrope height of a 61 m groundrope high-opening bottom trawl as 4.6 m without kites, 8.7 m with 1 kite of 1 m2 and 10.0 m with 2 kites of 1 m2 each. The kites were connected to the middle of the headrope and not to the wingtips as is done in The Netherlands. No false headlines were used for the kites.

The objections to kites in general can be summarized as, firstly, they are not failproof because they tend to turn around, and, secondly, extra attachments like kites are unpopular because of their adverse effect on the trend to reduce labour.

Margetts pointed out that kites and false headlines have a second effect in the fishery for herring. They also send down the herring into the path of the net.
Troublesome kites and false headlines are necessary if the headline height is 4 m only. If the headrope height is 10-12 m there is a fair chance that the headline will send the herring down.

For very deep trawling it has been pointed out that kites are a better means of providing headline lift than are floats.

Kites are no obstacle of any importance to the using of a net drum. Very often the kites are connected to the net by means of snaphooks so that they can be removed before the net is wound on the drum.

5.3.4. Freytag has observed that the bottom contact of a 83 m (250 ft) groundrope high-opening bottom trawl was very good on a level bottom, but on the slope, the catches only equalled those of a 60 m(180 ft) groundrope trawl with wedges. He questionned whether the tendency to greater vertical openings should lead to trawls which can only be used on a level bottom.

Measurements by other investigators confirmed that very large trawls often do not behave in a steady fashion. They have a tendency to lift off the seabed. Even if the trawl is not completely off the bottom, fish can escape under the groundrope.

This is not only a problem of fishing on a slope. Weights of 6-8 tons are often necessary to bring the net down. It will be necessary to consider the rigging system to prevent this. It has been noted that this problem is not confined to the high-opening bottom trawls, It has also been observed in the sprat fisheries on a minor scale. With the groundrope not too tight on the bottom, to prevent damage, the crucial part of the groundrope has often been found off the bottom. Sector-scanner observations on a slightly undulating bottom have shown a trawl missing flat fish that go underneath the groundrope.

This subject has a great deal to do with Treschev's measurement of fishing effort.

5.3.5. A discussion on the relationship between model testing of trawls and full scale sea trials pointed out that model testing might reduce the time needed for sea trials. When a trawl has been tested in the model tank a period of time of one week for sea trials is sufficient to get the trawl operating well from an engineering point of view.
To establish the catching performance takes much more time.
It is often very difficult to find the correct vessel for the comparative fishing of two different trawls.

6. One-boat midwater trawls (agenda item 2).

6.1. Progress in different countries:

6.1.1. Carrothers (Canada) reported that the midwater trawl exclusively used in Canada is the Diamond Midwatertrawl. Many vessels use this trawl as an alternative to the bottom trawl.

6.1.2. MacLennan (U.K.) introduced his paper "Engineering performance data on single boat pelagic gears for vessel powers between 200 and 2000 hp".

This paper will b e presented to the next meeting of the Gear and Behaviour Committee.

6.1.3. Besançon (Netherlands) said that in The Netherlands a midwater trawl has been used successfully to carry a "Isaäcs-Kidd" trawl during a research trip to collect eel-larvae. A short paper will be submitted to the 1973-Gear and Behaviour Committee-Meeting. (See paper C.M. 1973/B:5).

6.1.4. The main recent development in France has, according to Portier, been the adoption of a mesh length of 800 mm in the fore net and the consequent increase in the net-size. Trawlers of 1100-1200 hp (810-880 kW) were successful in fishing for herring and mackerel during 1971-1972 with a midwater trawl of a circumference of 600 meshes with a mesh length of 400 mm. They have been even more successful during 1972-1973 with this type of trawl but having a circumference of 350 meshes with a mesh length of 800 mm (see fig. 6). Trawlers of 1800-2000 hp (1325-1470 kW) have used pelagic trawls of 500 meshes of 800 mm mesh length when the area, the depth and the weather conditions allowed.

6.1.5. The maximum mesh lengths, which have been successfully used in midwater trawls were reported to be:

Belgium	-	80 cm
Canada	-	60 cm
France	-	80 cm
Germany	-	80 cm
The Netherlands	-	120 cm
Norway	-	56 cm (sometimes)
Scotland	-	100 cm
USSR	-	80 cm

6.2. Discussion:

6.2.1. A further feature of the present development of midwater trawls is the general trend to simplify the net construction by reducing the number of different mesh lengths and by reducing the number of different cutting rates.

6.2.2. Regarding fish reaction to the net, it has been noticed that fish react to discontinuities and that changes in mesh length and in tapering rate cause changes in filtration of the water through the webbing (which cause discontinuities in watervelocity and water-pressure).

Proceeding from the net mouth to the cod-end, as the cross-section decreases so the water-velocity tends to increase. Small-meshed sections, however, tend to reduce the water velocity. Consequently, a pressure peak will occur at the intersection of a big-meshed section and a small-meshed section. Such pressure peaks might be detectable by fish. In this connection it is very important to ensure that the codend can get rid of the water easily.

6.2.3. In some countries experiments are going on with spinning rotors connected to the headline to raise the trawl quickly to avoid an obstruction on the sea-bed or to bring the net to the level of the fish shoal. For the same purpose others are considering such rotors to alter the angle of tilt of the Süberkrüb door.

7. Two boat midwater trawls (agenda item 3)

7.1. Hatfield reported on the work, the WFA is doing for the Herring Industry Board, to develop tables giving the depths of the net on the basis of vessel's speed, warp length and bridle length.

The general feeling of the meeting was that there are sufficient cheap and efficient netzsondes available which can be used for two boat midwater trawling and that netzsondes are to be prefered to fishing tables. Such tables are liable to incorrectness due to environmental conditions.

Steinberg underlined this conclusion with the information that earlier results in the Skagerrak herring fishery for long periods of fishing showed that the catch rate for two boat trawling without a netzsonde was 2 1/2 ton/hr and with a netzsonde 4 tons/hr. Hatfield agreed and said tables were intended for operators who do not fit a sounder and winch, either because of the expenditure involved, or because of lack of electrical power.

8. Electrical fishing (agenda item 4)

1. Progress Reports.

8.1.1. Stewart (U.K.) reported that work has been done on Nephrops norvegicus, which live in burrows in the sea-bed and come out for very short times of the day only. This behaviour limits the capture. Any means of making them leave their burrows is a big advantage. After experiments in aquaria it became clear that, as a general rule, it is necessary to define what the behaviour of the animals is in the open sea. The reactions to electrical stimuli of not only Nephrops but also of flatfishes and roundfish, mainly cod, have been studied. Fish exposed to electric fields appear to become exhausted rather quickly. Exposure to electric stimuli for 15 seconds results in the same exhaustion as 15-20 minutes of fast swimming in front of the trawl.

Underwater behaviour experiments using divers is very effective for obtaining accurate data. An experimental beamtrawl with double codend has been developed. The electrode array is cable-fed from a pulse generator on board the vessel.

8.1.2. Le Men reported on the electrical fishing system studied in France. This system utilizes light, an electrical field and a pump. Fishes, attracted by lights, group in a way which has been studied and which is now known. When the electrical field is established, fishes are obliged to swim towards the positive electrode. This positive electrode is the nozzle of a pump. Fish responses to light have been studied in past years. The exact configuration of the electrical field between the electrodes has been measured. This year fish behaviour in an electrical field has been studied in different experimental tanks. Fishes utilized were principally bass and mullets.

8.1.3. Boonstra reported on the present situation in The Netherlands. During 1972/73 he got earlier results of the electric shrimp fishery confirmed. When two beamtrawls were each equipped with an electrode array and current supplied to them alternately, the electrified trawl caught 2.4 times as many shrimps as did the non-electrified trawl. Due to the present difficulties of The Netherlands' shrimp fleet, the first priority for electrical fishing now is shrimp fishing. The second priority is flatfish.

The original pulse generator of the capacitor discharge system had a pulse frequency of 5-10 Hz and a pulse interruption time of 0.2 ms. Trials on a commercial shrimp trawler showed that the pulse was so heavily distorted due to a severe resistance-drop in the cable (0.7 to 1.8 Ohm) between the pulse generator on board and the electrodes at the net that no results were obtained. For the newly developed pulse generator the headline or beam-mounted type has been chosen. Power supply will be 42 V AC by cable from the ship allowing shorter cables from the pulse generator to the electrodes thus providing the latter with correct pulses. Experiments start in summer 1973.

8.1.4. Freytag reported on the progress of the electrified eel trawl for lakes in Western Germany.

8.2.1. Stewart introduced his paper "The selection of electrode materials for electrical fishing". This paper will be submitted to the 1973-Meeting of the Gear and Behaviour Committee in its final form.

8.2.2. Van den Broucke presented his paper "First Results of electro-fishing experiments". As regards flatfish, a selective fishery and a simplification of the fishing gear were aimed at by substituting heavy tickler chains by light electrodes. In the shrimpfishery the aim was to develop an extension from traditional night-time fishery to a day-time fishery and also to increase the selectivity. The experiments gave promising results for catching shrimps and soles, and also for the selectivity of soles. Research will go on to study adjustments of the pulse generator, electrode distance and different environmental conditions. A further aim will be to develop a compact instrument to be fixed to the headline or the beam of a trawl without a cable connection to the ship.

8.3. Discussion

8.3.1. The general feeling of the Working Group was that the pulse generator should be brought as close as possible to the electrodes to avoid pulse-distortion.

8.3.2. The expected application in commercial fisheries differs from country to country. In some countries there is a reluctance to adopt the new techniques of electrical fishing, in other countries fishermen are pressing research institutes for quick results.

8.3.3. Comparative electrical fishing experiments can best be performed by rigging electrode arrays both in the non-electrified and in the electrified trawl to avoid the mechanical effects of electrodes to the fish or shrimps.

8.3.4. The reactions of fish and shellfish to electric stimuli in aquaria differ from those in the open sea. The completely involuntary reactions like taxis and narcosis (as used in the French experiments) could be studied satisfactorily in tanks and aquaria. The character of the voluntary reactions under natural conditions differs from that in tanks.

8.3.5. The meeting realized that many data on fish and shellfish reactions to electrical fishing already exist. However, these data have to be sorted out to disclose the gaps in our knowledge. After these gaps have been filled it can be decided how to go on to produce technical specifications for electrical fishing systems.

The participants working in the field of electrical fishing were invited to catalogue and to pool their knowledge for this purpose.

9. <u>Instrumentation for gear research (agenda item 5)</u>

9.1. MacLennan described the work done to improve the instruments for measuring the horizontal and vertical net mouth opening. When using the well known echo-sounding type of measuring system one needs a very fast recorder in order to obtain a high accuracy. The high pen speed leads to mechanical troubles. He developed a system in which the signal does not go to a recorder but to a counter which counts the pulses. A digital to analog convertor feeds the recorder. The electronics do the fast moving and a fast moving pen can be avoided. Although this way of recording is expected to be cheaper and more accurate a number of problems have to be solved. The system has been used successfully on a midwater trawl. On bottom trawls too much noise disturbed the measurements, the amount of disturbance depending on the spot where the transducers were mounted and on the type of bottom. The instrument does not discriminate between noise of the trawl and pulses of the transponder. Work on this system goes on.

9.2. Carrothers said that in his opinion the stylus-type of recording echo-sounder of the type described by MacLennan (section 9.1.) is not suitable for underwater instrumentation. The type of echo-sounder that produces a voltage or current analogue of distance and interfaces directly with the recorder is far simpler and more satisfactory. Also, trawl noise has never interfered with his trawl-dimension measurements.

9.3. Margetts said that the sector scanning sonar, which enables measurement of the overall dimensions of trawls in seconds, is being built now in a compact solid state. The price comes into a range that others might be able to afford. The exact price is not yet known.

9.4. Besançon explained a device to measure the watercurrent in and outside the gear to study the current-pattern.

9.5. Olsen reported on the codend filling indicator, especially for capelin and blue whiting fisheries. It is based on the principal that the load in meshbars is measured at the entrance of the codend. A signal is transmitted to the bridge when this load surpasses a marked level.

9.6. Freytag reported that attention in Germany was directed mainly to the development of multi netzsonde systems with electro-mechanic switching systems using the netzsonde cable for different purposes.

9.7. Hatfield explained that the work of the WFA on gear instrumentation is directed mainly to use on board commercial trawlers to catch more fish. He informed the meeting of recent modifications of the warp tension meter (constant angle principle) which is now being used on board some 70-80 large British stern trawlers.

9.8. MacLennan proposed an Instrumentation Index to the meeting. He thought information on who is making which kind of gear instrumentation is very much required. The meeting noted that (a) it would be very difficult to draw the dividing line between what was to be included and what omitted, (b) it would be very time-consuming to make the index and to keep it up to date, (c) it would be necessary to go into details to make it useful, (d) advertisements of firms producing this type of equipment, and parts to make it, has very much improved during recent years, and (e) a scheme for an instrumentation Index was introduced four years ago by Mr. W. Dickson of FAO and it failed. The meeting did not support MacLennan's proposal.

10. Engineering aspects of multi purpose fishing vessels (agenda item 6)

10.1. Hatfield stated that most of the nearshore fishing vessels of the United Kingdom are multi-purpose. The British stern trawlers are dual-purpose and fit for demersal and pelagic fishing. The deck arrangement, as developed by the WFA, of a 22 m multi-purpose inshore vessel is given in fig. 7a. This vessel is fit for Scottish seining, demersal trawling and pelagic pair trawling. For Scottish seining the stacks of ropes are no longer stored on deck. A rope tank has been arranged to contain these long seine ropes. The arrangements for trawling are indicated in the drawing on starboard side. Those for seining are indicated on port side. One of the trawl warps runs on the port side and the other one on starboard. The seine ropes are taken together either on port or on starboard, depending on wind and weather conditions and on the judgment of the skipper. The seine is handled by a power block suspended from a boom. The trawls, either demersal or pelagic, are taken on the net drum. After the end of a seineshoot the trawl can be shot away immediately, and vice versa.
It is expected that this type of multi-purpose vessel will be able to make between 4 and 6 seine-hauls and about six bottom trawlhauls per day. The combination winch is equipped with tension rollers for hauling the seine ropes. The net drum delivers a pull of 2 tons at the smallest core at 20 revs/min. This type of multi-purpose vessel has a crew of six. It is hoped that this can be reduced to four men in future. In fig. 7b the deck-machinery layout of a 66 m distant water stern trawler of 11.7 m breadth has been drawn. Port side represents demersal trawling and starboard pelagic trawling.
The winch is a split winch. Each part has a pull of 12 tons at 76 m/s. at the outer layers in the condition "high torque - low speed". These winches are also designed for the condition "high speed - low torque".
The two inner barrels of each part are the gilson barrels. The outer ones take the first pull and the inner ones take the second.
The net drum always contains a pelagic trawl. The net drum has a torque of 3300 kgm at 20 revs/min.

10.2. Conversions from single-purpose to multi-purpose vessels.

Olsen informed the meeting that Norwegian purse seiners of 500-2000 hp are being converted now to vessels that can use the purse seine and the pelagic trawl. For this purpose the purse seine is no longer stowed on the poopdeck but one deck lower (the main deck). On the poopdeck there is a net drum containing the pelagic trawl. No major changes take place when operating the purse seine. When hauling the pelagic trawl, it is partly wound up by the net drum. The tunnel and codend remain in the water until the fish are pumped on board the ship. The suction hose is put into the trawl through the webbing and the fish is brought to the suction hose by lifting the codend by means of the power block. The main species being caught are capelin and blue whiting for the fishmeal industry. In many cases new winches have to be installed.

De Wit mentioned that the conversion of side trawlers to dual-purpose trawlers in The Netherlands, reported in the 1972-Meeting of this Working Group has made good progress. So far ten side trawlers of about 1200 hp each have been converted so that they can now use the bottom trawl over the side or the pelagic trawl over the stern.

11. <u>The engineering principles of "Fishing Unit Measures" as proposed by Dr. A.I. Treschev (agenda item 7).</u>

11.1. The paper C.M. 1971/B:9 - Fishing Unit Measures by Dr. A.I. Treschev was distributed to the participants. Treschev explained his method in the following way.

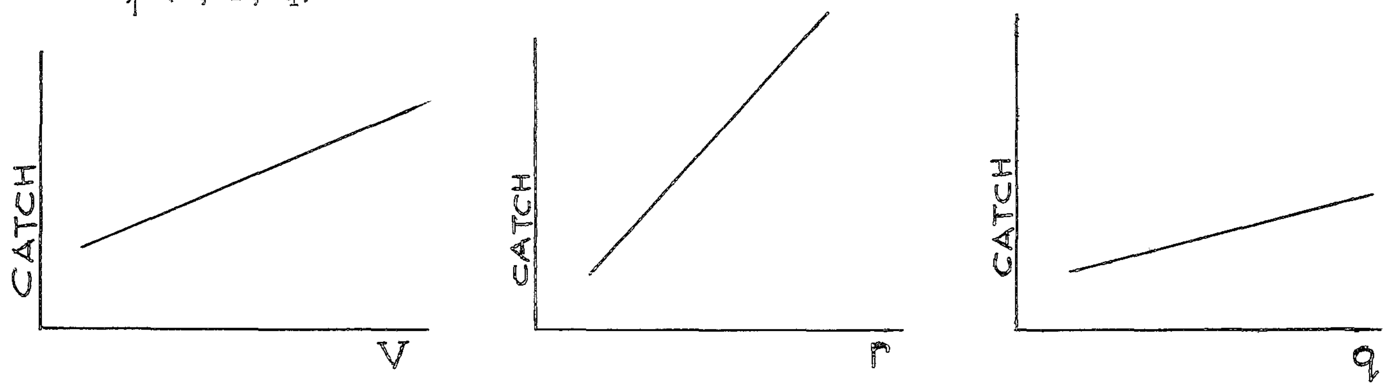
Fishing effectiveness (E) depends upon three factors:

1) Swept volume (V); characterises the degree of area covered which is fished

2) Degree of fish finding (r)

3) Catching ability of fishing gear (q)

$E = f_1 (V, r, q)$



<u>Swept volume</u> shows how these factors should be considered. V - depends on the mouth-area of the gear (S), speed (v) and fishing time (t).
In other words:

$$V = f_2 (S, v, t)$$

V depends also on a number of ship's factors:

$$V = f_3 (hp, \frac{B}{L}\lambda, K_w)$$

hp = horse power of engine

$\frac{B}{L}\lambda = \alpha$ = hydrodynamic data

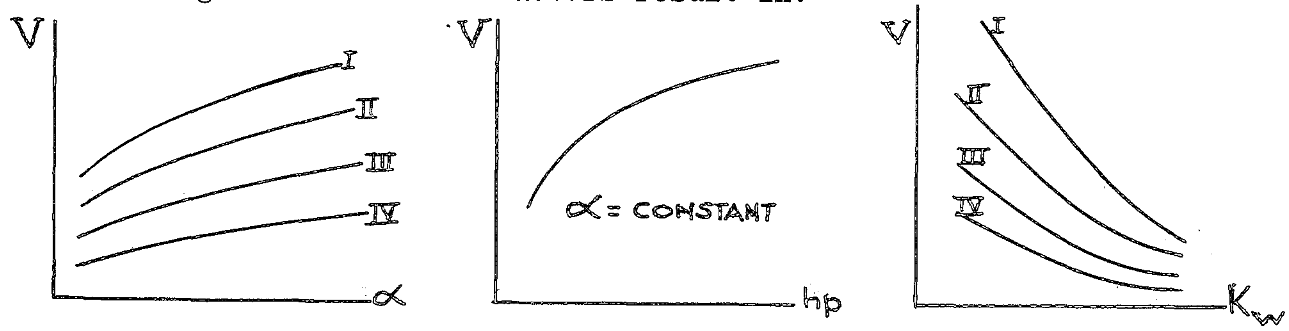
B = breadth

L = overall length of vessel

λ = coefficient depending on the form of the vessel, the propeller and the fishing gear

K_w = coefficient which characterises the influence of the weather. It can be the Beaufort scale of the sea state.

Investigations of these factors result in:



When we have established these diagrams we know the influence of all these parameters on the fishing efficiency.

Degree of fish findings

$$r = \frac{N_v}{N_{fa}}$$

N_v = the number of fishes discovered in the fishing area (fish in swept volume)

N_{fa} = total number of fishes in the area during fishing time.

Catching ability of fishing gear

$$q = \frac{N_c}{N_v}$$

N_c = number of fish in the catch

N_v = number of fish in swept volume

As we can see in this analysis Gross Tonnage has not been used because it has no direct influence on the fishing efficiency. Sometimes we find a relation between Gross Tonnage and catches. It only means that in such cases Gross Tonnage is proportional to hp and speed of vessels.

This brief analysis shows how many components should be included in the determination of fishing efficiency and why we cannot take only the time on the fishing grounds, hp, Gross Tonnage, a standard gear, and so on.

Swept volume is much more representative because it includes all real influencing factors, and it can be determined in a very simple way.

11.2. Driftnet and set nets

Although Treschev's introduction is related to trawling the working group started to discuss the application of the Swept Volume Method to driftnets and set nets.

Consideration has been given to the fishing technology and fish behavioural aspects of a drift of 1000 m to obtain the swept volume of driftnets (see C.M. 1971/B:9) under various conditions of tide and wind and to taking the area of a driftnet times a drift of 1000 m and taking a cylinder for a set net (height of the cylinder = height of set net and diameter of the cylinder = length of set net).

Treschev explained that he developed the formulae for the fishing unit from an analysis of catches. For driftnets he took catch-data from the Azov Sea, Caspian Sea and the Norwegian coastal fisheries. He found that the catches of a driftnet and of a set net, both of the same length and height, show the same relation as the volume of 1000 m drift of the driftnet and the cylinder of the set net.

Nevertheless, doubt remained on the following points:

- do driftnets and bottom-set nets catch the same species, so that a comparison can be made?
- is it permitted to take just the catches instead of going to the absolute swept volume?
- does a bottom-set net of twice the length of another one catch four times as much fish?
- are the catch-data, and the fishing units derived from them, of the regions considered also valid for other regions?

11.3. Trawling

The explanation, as given in 11.1., showed that for trawling the relationship

$V = f_3 (hp, \frac{B}{L}\lambda, K_w)$

was a further extension of the swept volume method as presented in paper C.M. 1971/B:9.

No reference has been made to the evaluation of the coefficient λ, which depends on the vessel's form, the propeller and the fishing gear.

The relationship between $V = f_2 (S, v, t)$ and $V = f_3 (hp, \frac{B}{L}\lambda, K_w)$ has not been clarified.

The fish behaviour has not been taken into account by Treschev. This aspect however, was found to be of great importance. The whole trawl-mouth is not equally effective. Treschev held the opinion that catch-differences, due to different constructions of trawls, even if they have the same S, have to do with catching ability (q) only. This factor should be considered separately.

He also held the opinion that the skipper-effect belongs to the "degree of fish finding" (r) and not to the "swept volume".

11.4. Hooks and lines

In some countries the snoods (or "gangings" in C.M. 1971/B:9) are four times as long as those in Treschev's paper, giving a swept volume that is 64 times as big. Treschev informed the meeting on the research, done to obtain the correct snood length. If the snoods are longer or shorter, the catch will decrease. For the snood length used in his paper, the catch results correlate very well with the sphere, the radius of which equals the snood length.

The meeting noted that the catch results cannot be extrapolated for shorter or longer snood lengths. It was also noted that the sphere represents a volume of attraction. It was found to be difficult to change from the principle of swept volume, in which a movement is introduced, to a principle not based on movement but on attraction and behaviour.

11.5. The chairman concluded from the discussion:

- there are still many doubts on the universal validity of the Swept Volume Method, as the discussion on driftnets and set nets has shown;
- different principles are applied to different types of fishing gears in order to obtain one universal system of fishing effort measurement;
- for the time-being there are big differences in the fishing gears and fishing methods of the countries represented in this meeting; these differences also make it difficult to reach unanimous agreement on the proposed method in a short time;
- nevertheless, the endeavours to arrive at an internationally acceptable and technically sound system have to be continued.

12. Recommendations (agenda item 8)

1. There are indications from trawl engineering measurements and from observations of catches that the catching efficiency, especially of high-opening bottom trawls, is sometimes reduced by loss of fish beneath the groundrope. Little is known about this aspect of trawling and the group recommends that member countries be urged to investigate the action of trawl groundropes and the reactions of particular species of fish to groundropes, both on and just off the bottom.

2. Information is needed about the effects of changes in mesh sizes between adjacent parts of trawl nets on their fishing efficiency. The group recommends that member countries be asked to include this subject in research programmes.

3. The promise shown by work on electrical fishing which was noted in last year's report has again been confirmed, but the existence of gaps in essential knowledge was recognised. The Working Group recommends that member countries of ICES once more be encouraged to pursue electrical fishing investigations with co-ordination of their programmes.

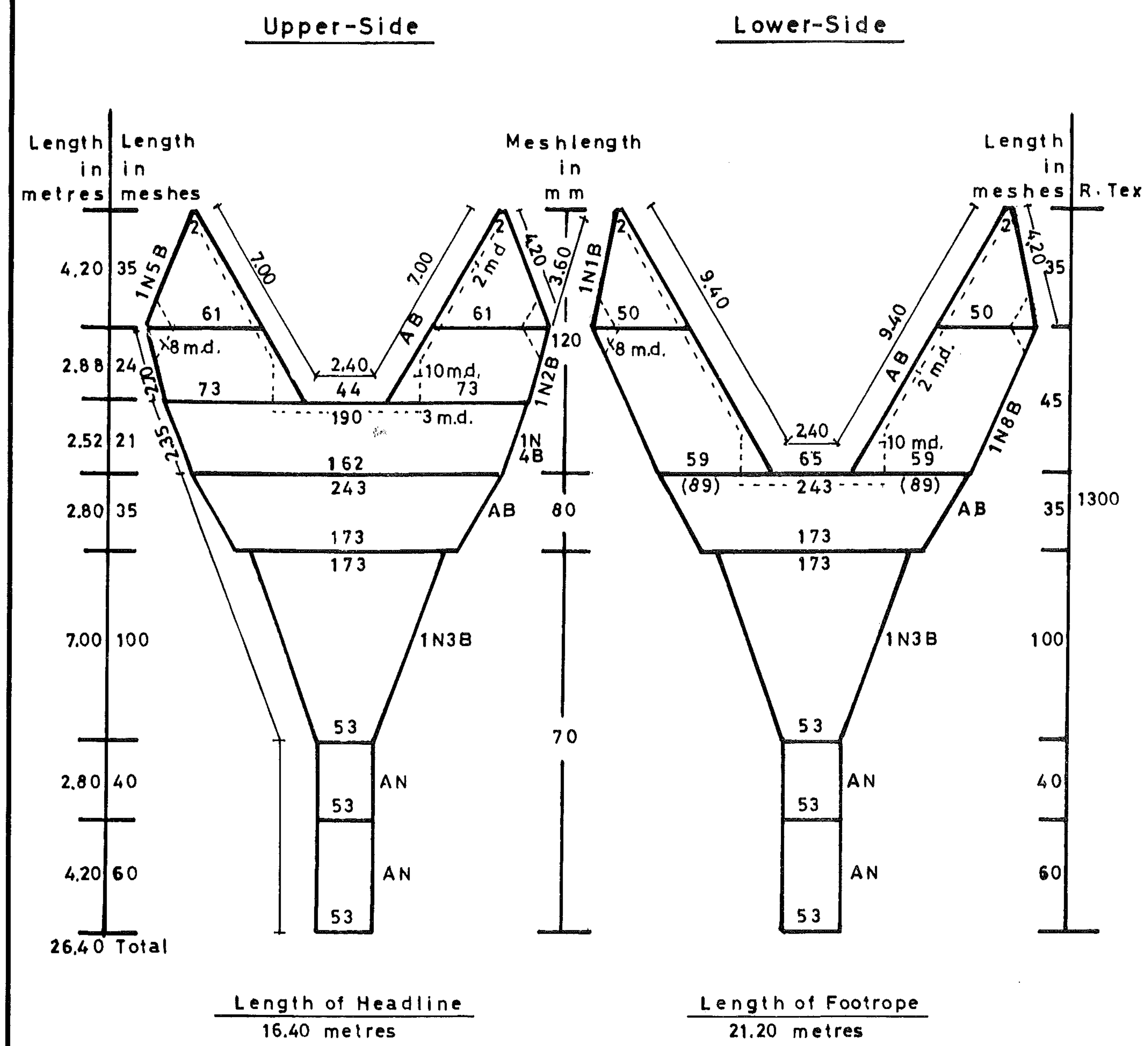
4. The Working Group recommends that it shall meet again in Boulogne, on 24, 25 and 26 April 1974 to discuss further developments in fishing gear, fishing vessels and their fishing auxiliaries, instrumentation, electric fishing, and, if possible, in the fishing effort measurements.

13. List of working papers

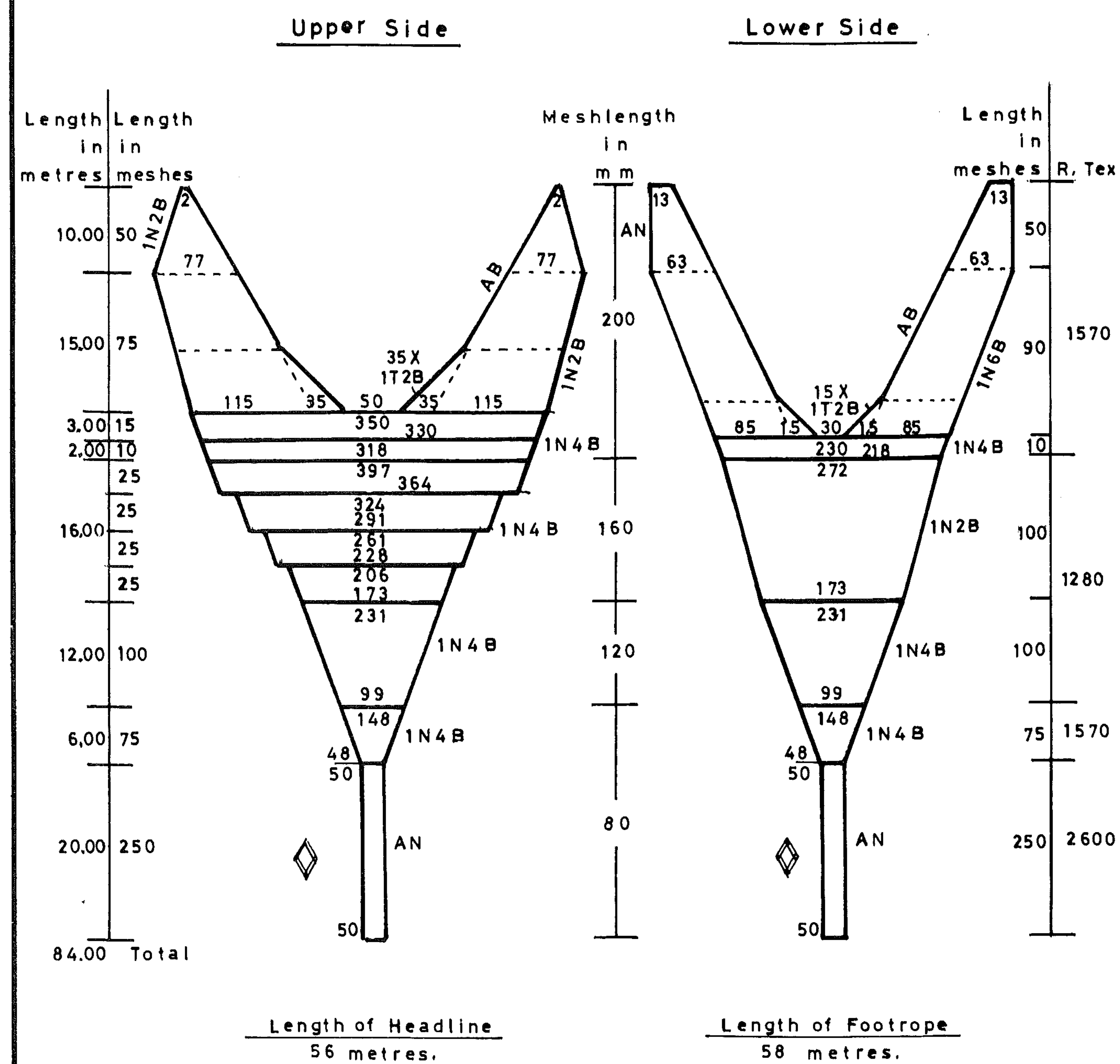
P.A.M. Stewart	- The selection of electrode materials for electrical fishing (will be submitted to the Gear and Behaviour Committee in a final form).
G. Van den Broucke	- First results of electro-fishing experiments.
Dr. A.I. Treschev	- Engineering aspects of Swept Volume Method, definition parameters of fishery. (incorporated in this report, item 11.1.).
D.N. MacLennan	- Engineering performance data on single boat pelagic gears for vessel powers between 200 and 2000 hp (will be submitted to the Gear and Behaviour Committee in a final form).
White Fish Authority Industr. Dev. Unit	- Notes on the development of an enlarged two panel demersal trawl. (see annex 1 of this report).

IJmuiden, August 1973
J.G. de Wit.

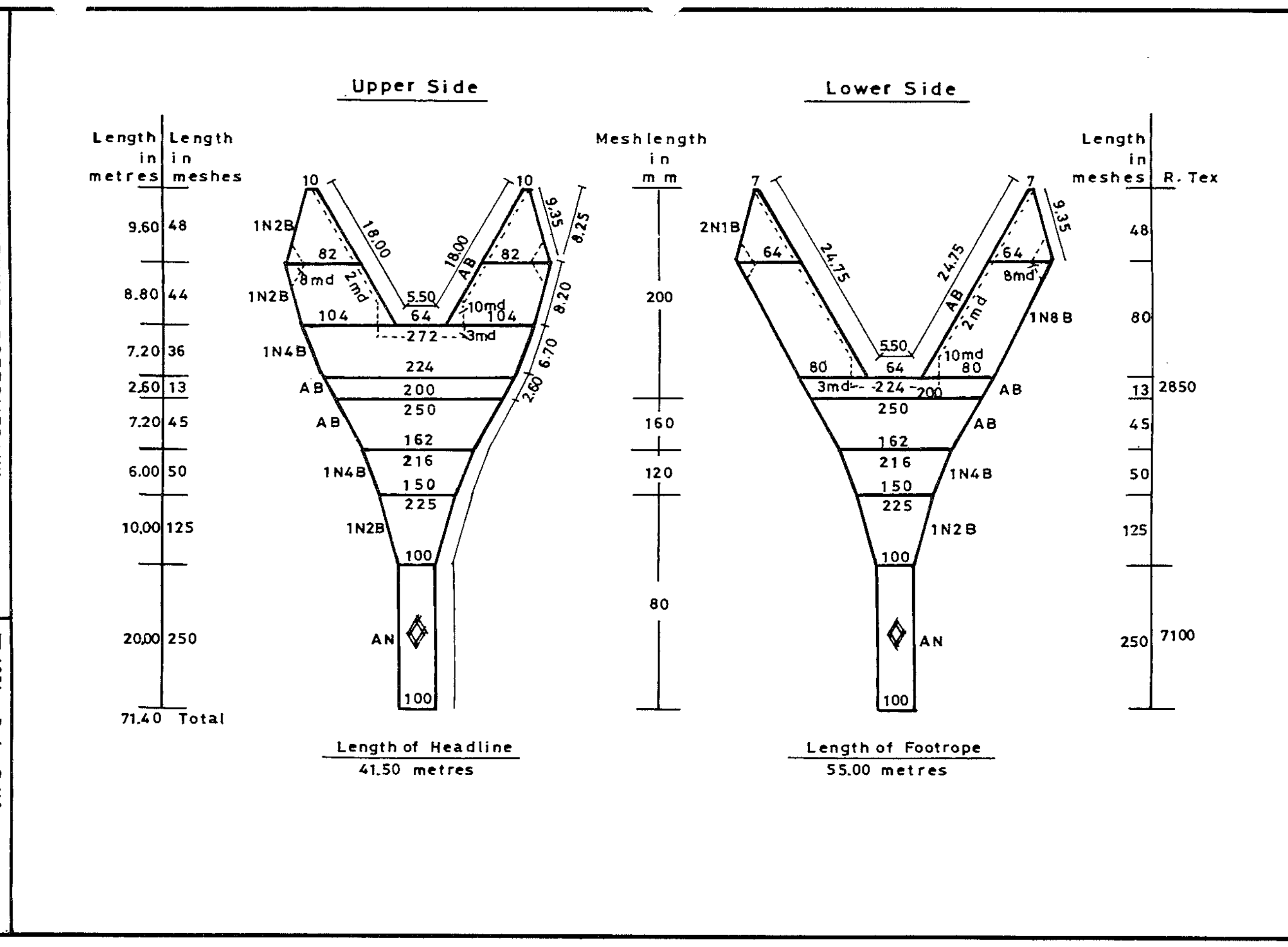
W/MV



HIGH OPENING BOTTOMTRAWL		Réf 57F V - 1968
For Trawlers of 150-200 hp.		ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM. 3-5 MAY 1973
Designed by: Institut des Pêches Maritimes	Scale: 1:200	
Boulogne-sur-Mer.	Fig: 1[a]	



HIGH OPENING BOTTOMTRAWL		ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM. 3-5 MAY 1973.
For about 300 hp. with enlarged upper panel.		
[redacted]: Institut für Fangtechnik.	Scale: 1:600	
Hamburg	Fig: 1[b]	



HIGH OPENING BOTTOMTRAWL

For Trawlers of 1200-1400 hp

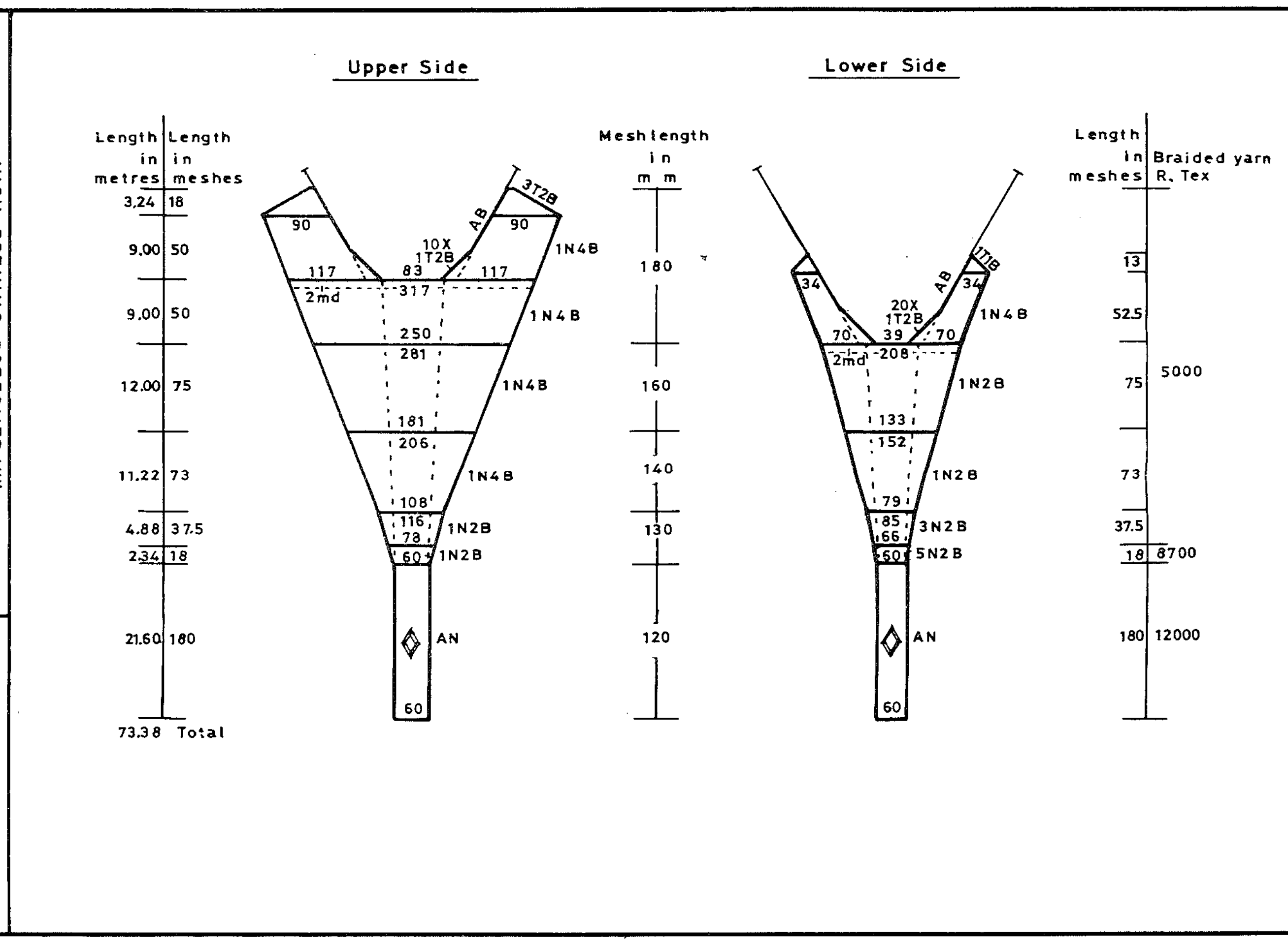
Designed by: Institut des Pêches Maritimes. Boulogne-sur-mer.

Scale: 1:600

Fig: 2a

IV 1971 Ref: F 118

ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM. 3-5 MAY 1973



HIGH OPENING BOTTOMTRAWL

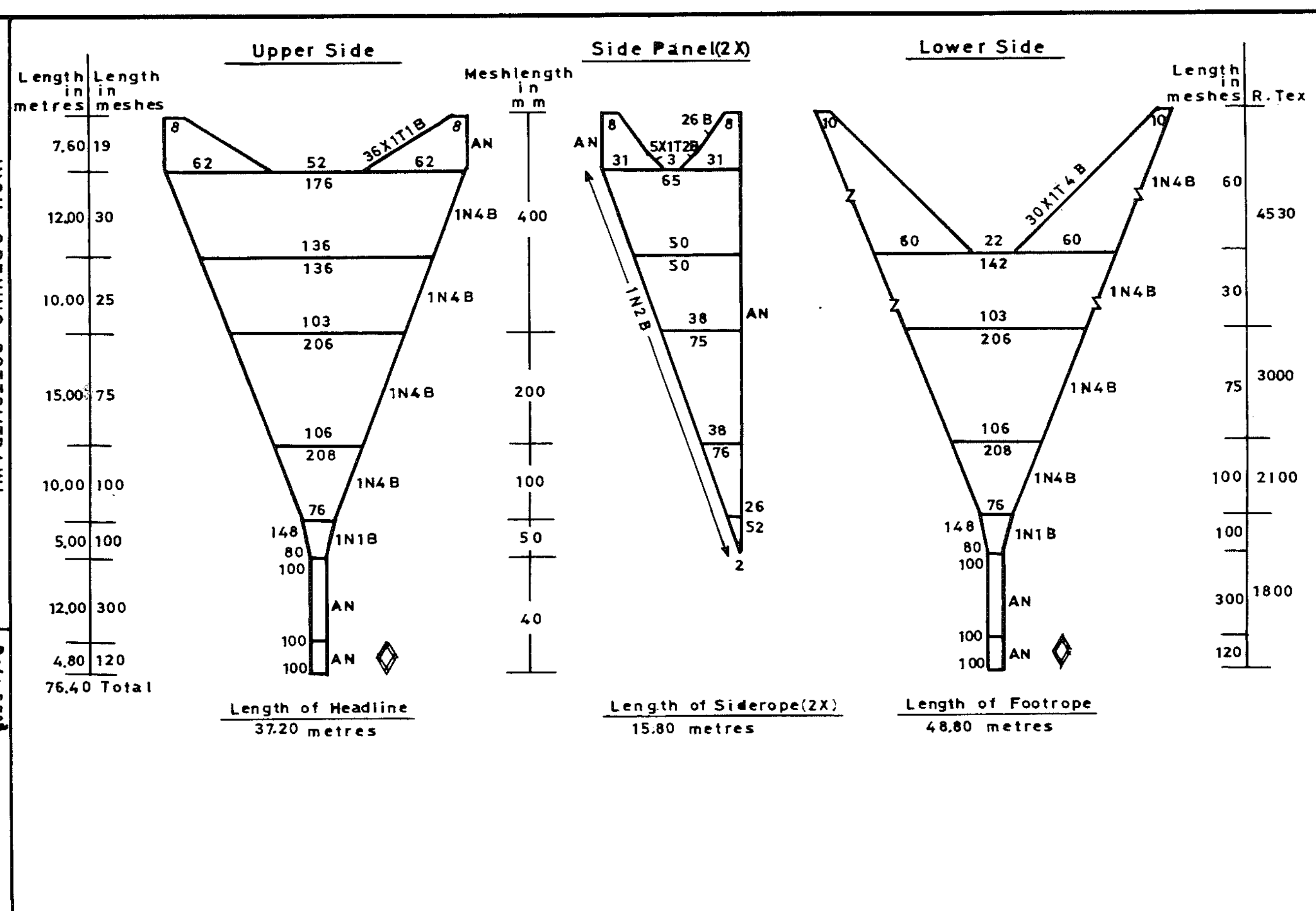
61 metres Footrope, with enlarged upper panel

[redacted] Institut für Fangtechnik. Hamburg

Scale: 1:600

Fig: 2b

ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM. 3-5 MAY 1973.



HIGH OPENING BOTTOMTRAWL

For Trawlers of 1600-2000.

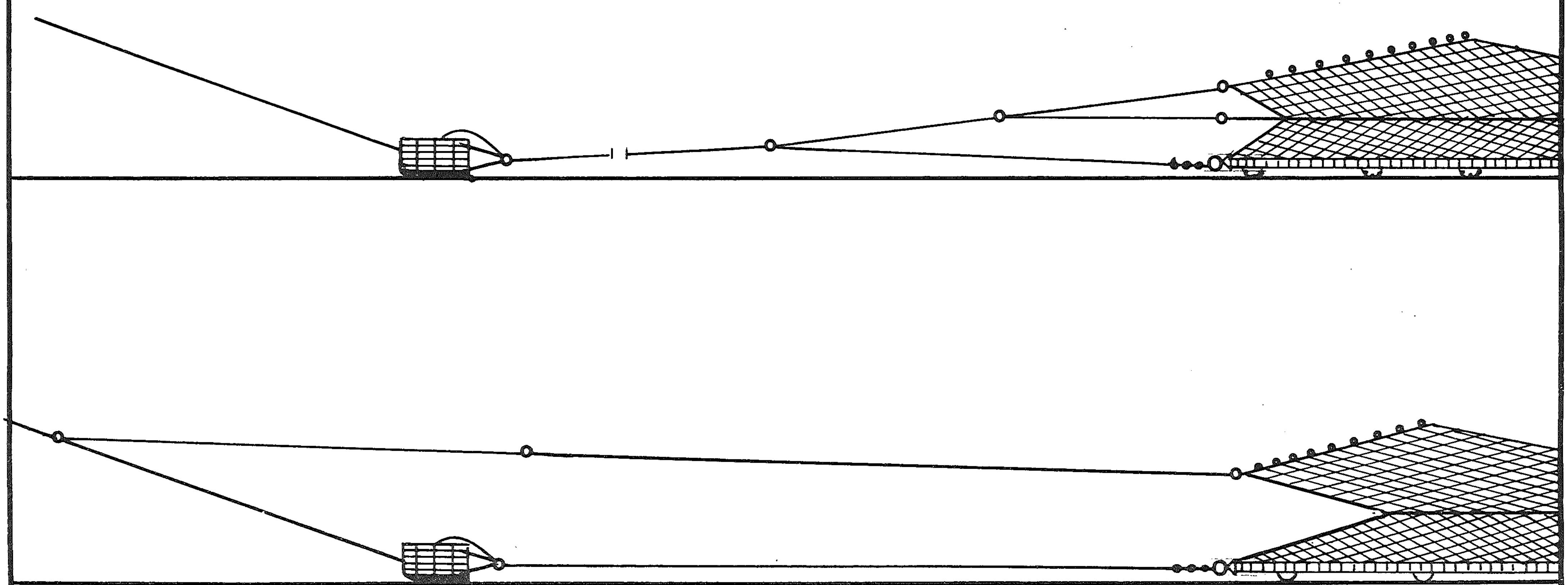
Designed by: R.I.V.O IJmuiden

Scale: 1:600

Fig: 2c

Ref: 573a

ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM. 3-5 MAY 1973.

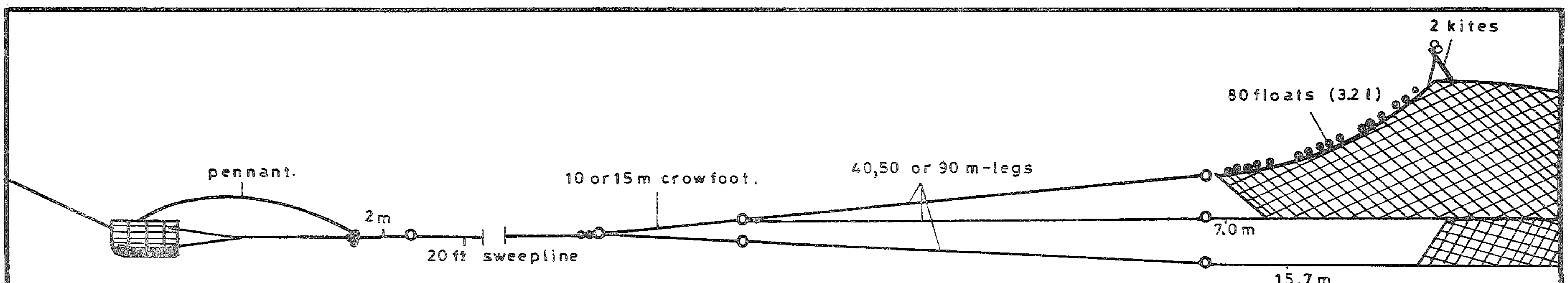


ENGINEERING WORKING GROUP
OF THE ICES GEAR AND
BEHAVIOUR COMM.
3-5 MAY 1973.

Rigging of High Opening Bottomtrawl.

Designed by:
Institut des Pêches Maritimes.
Boulogne-sur-Mer.

Fig: 3[a]



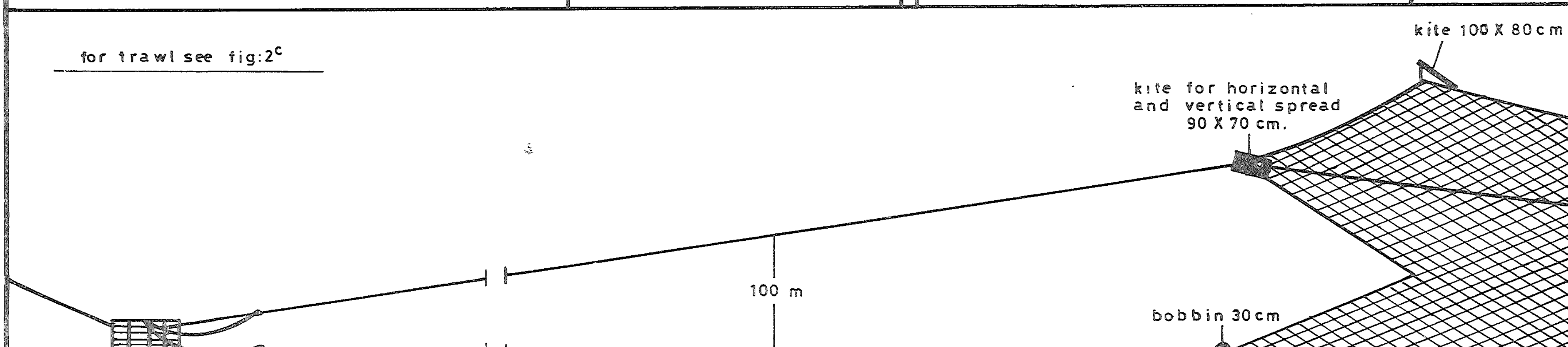
ENGINEERING WORKING GROUP
OF THE ICES GEAR AND
BEHAVIOUR COMM.
3-5 MAY 1973.

Rigging of High Opening Bottomtrawl.

~~Designed by:~~
Institut für Fangtechnik.
Hamburg.

Fig: 3[b]

for trawl see fig:2[c]



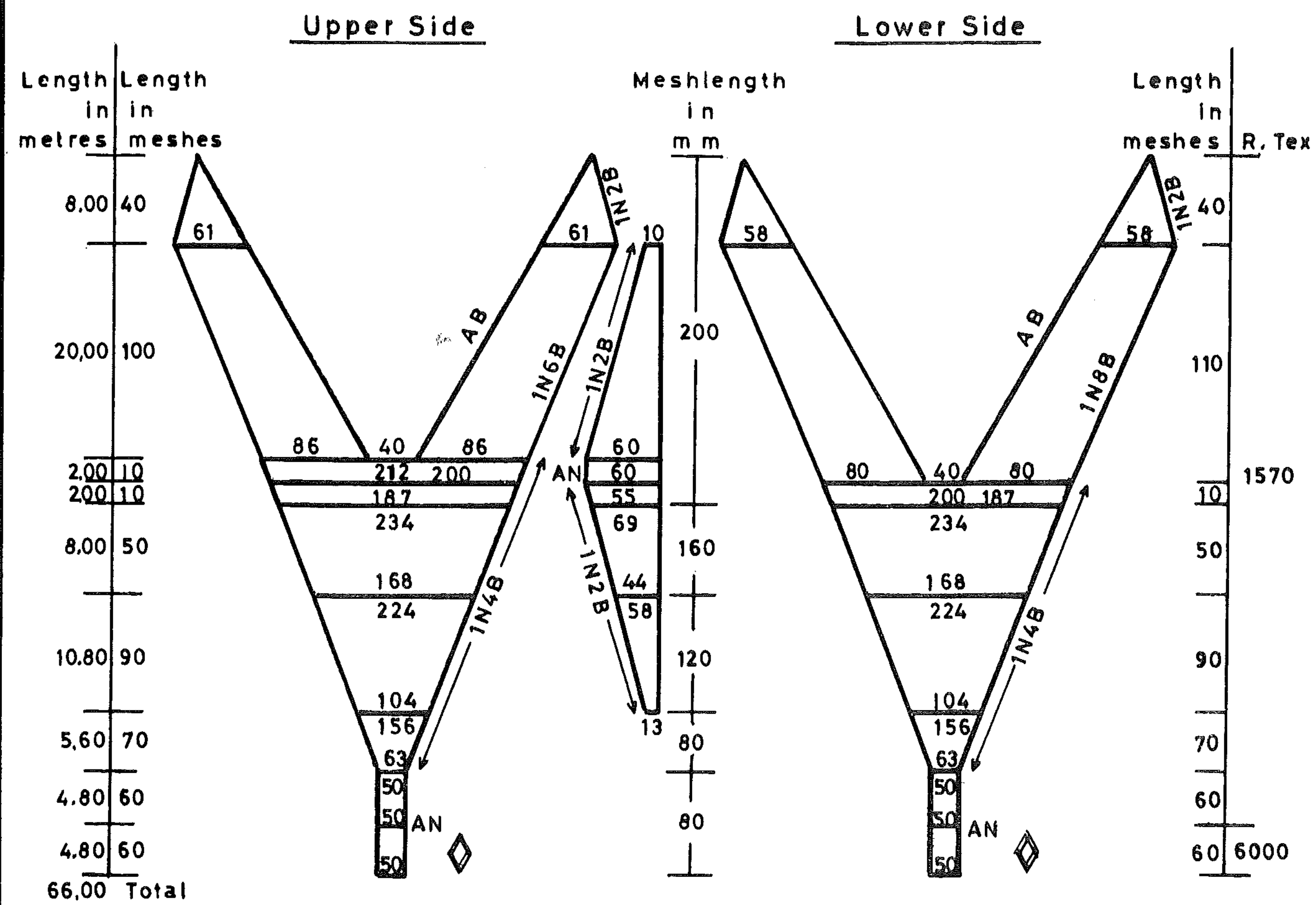
Ref: 585

ENGINEERING WORKING GROUP
OF THE ICES GEAR AND
BEHAVIOUR COMM.
3-5 MAY 1973.

Rigging of High Opening Bottomtrawl.

Designed by:
R.I.V.O. IJmuiden.

Fig: 3[c]



Bottomtrawl for Cod.

(520 meshes of 200 mm) for 250 - 400 hp.

[redacted] Institut für Fangtechnik.

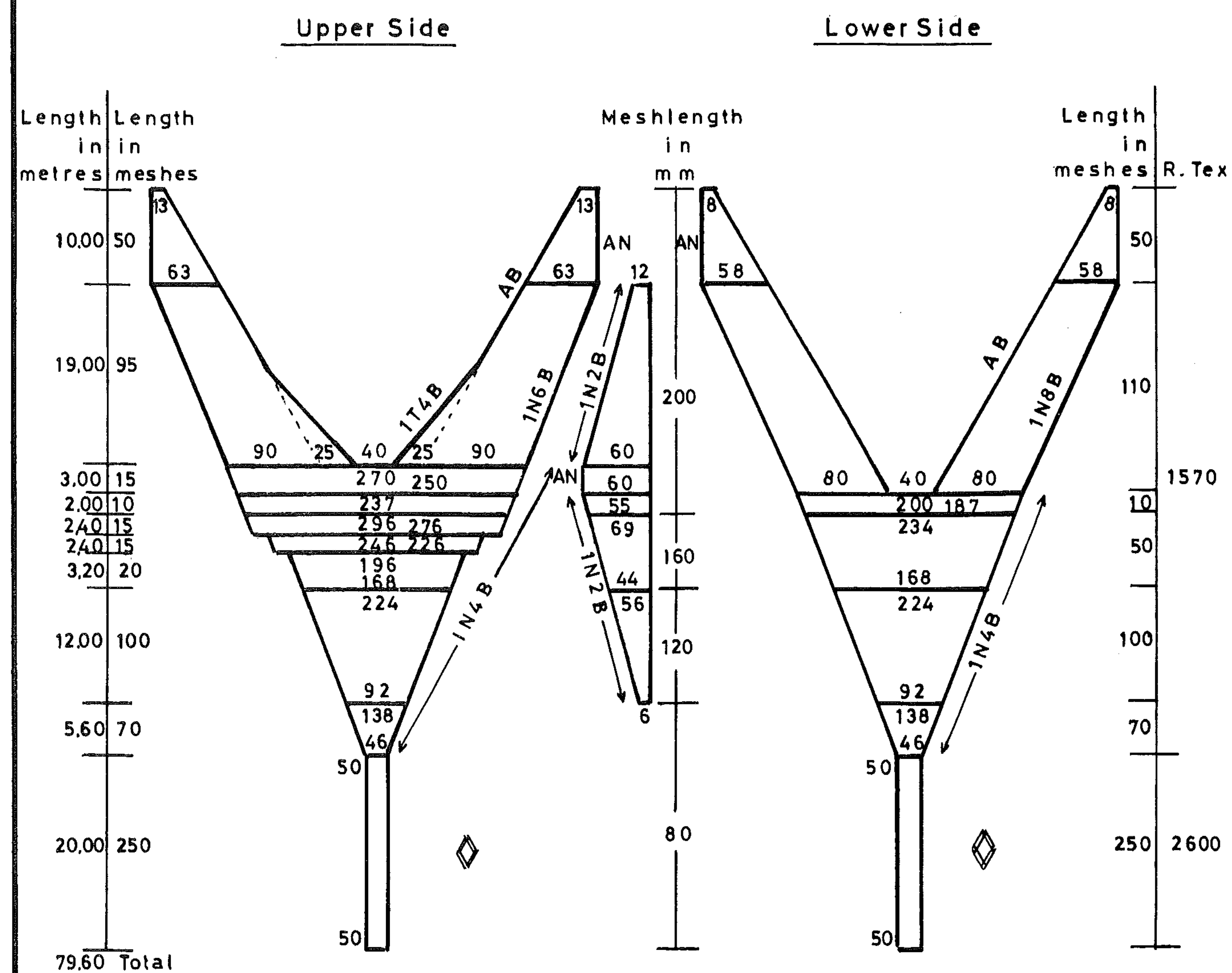
Hamburg.

Scale: 1:600

Fig: 4[a]

ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM.

3-5 MAY 1973



HIGH OPENING BOTTOMTRAWL

For about 250-300 hp. whih enlarged upper panel and smal side panels.

[redacted] Institut für Fangtechnik.

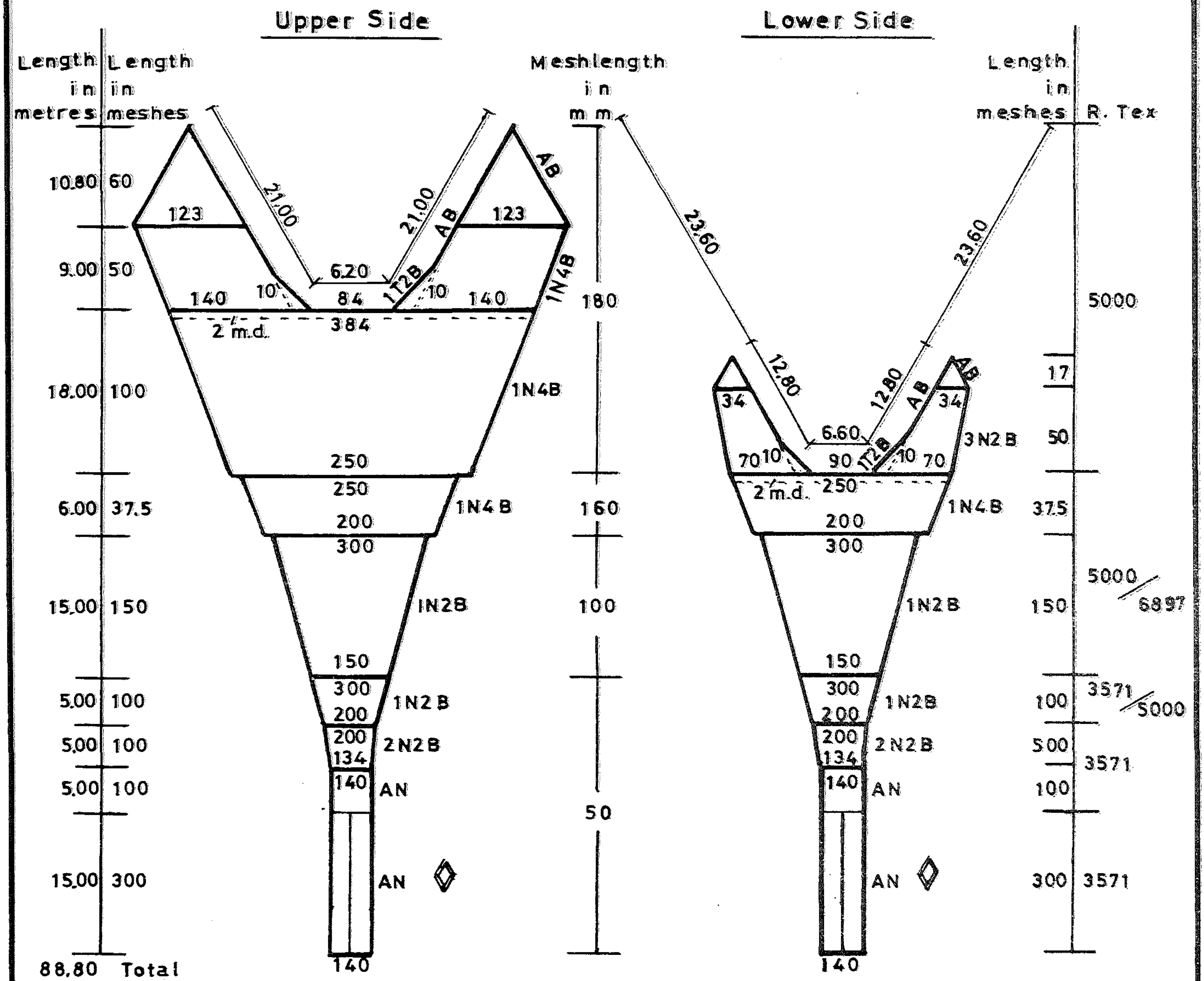
Hamburg

Scale : 1 600

Fig: 4[b]

ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM.

3-5 MAY 1973.



Bottomtrawl

48.20 X 79.40. With extended square.

[redacted] Institut für Fangtechnik.

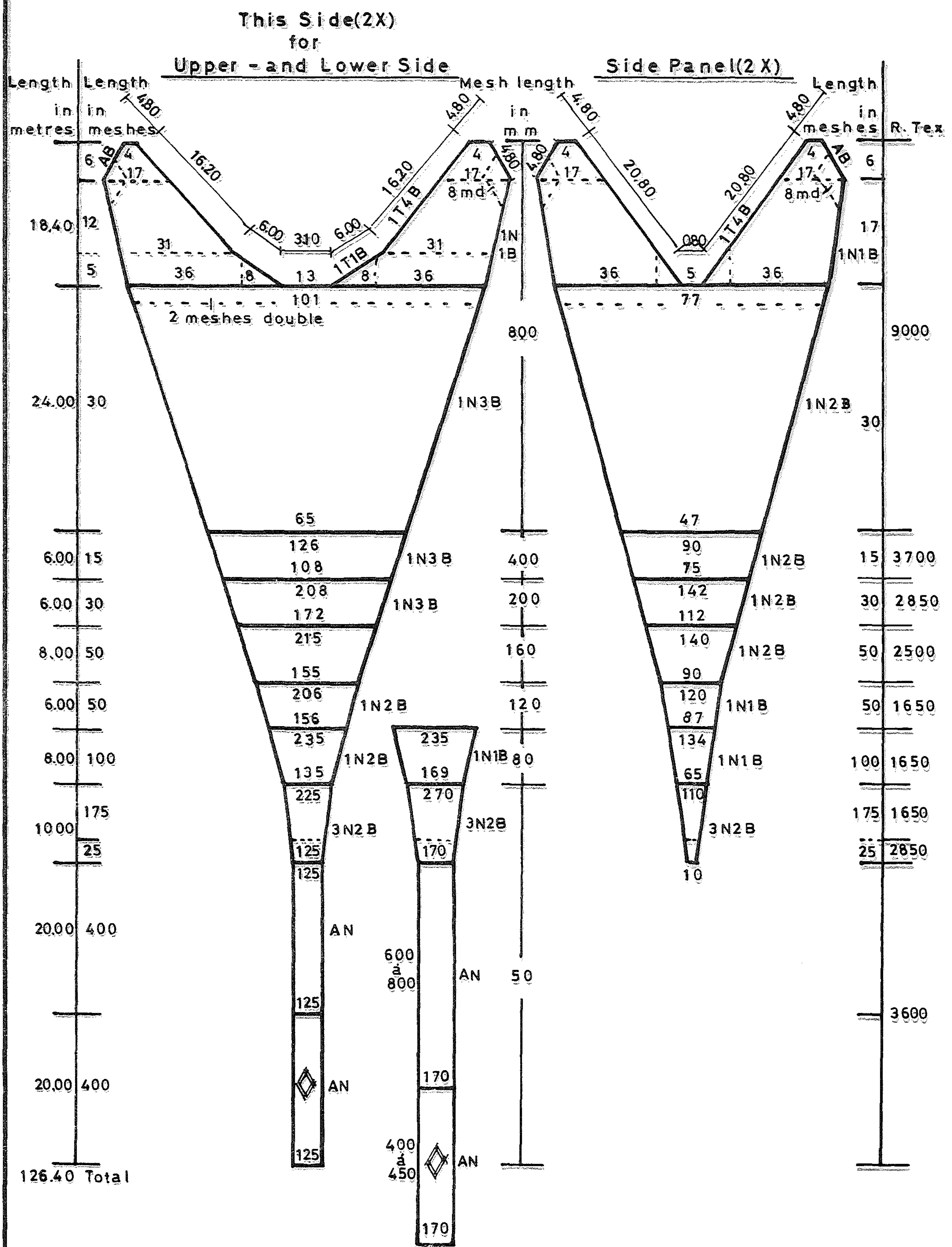
Hamburg.

Scale: 1: 600

Fig: 5

ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM.

3-5 MAY 1973.



Length of Headline and Footrope
57.10 metres.
47.50 „ of which in the Net

Length of Siderope
52.00 metres.
42.40 „ of which in the Net

MIDWATERTRAWL 57.10 X 52.00 (356 meshes of 800 m m)	Ref: P 105 ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM. 3-5 MAY 1973
Designed by: INST. DES PÊCHES MARIT. BOULOGNE S. MER	Scale: 1:600 Fig: 6

Fig: 7a

MULTI PURPOSE INSHORE VESSEL (22m)

DECK-MACHINERY LAYOUT

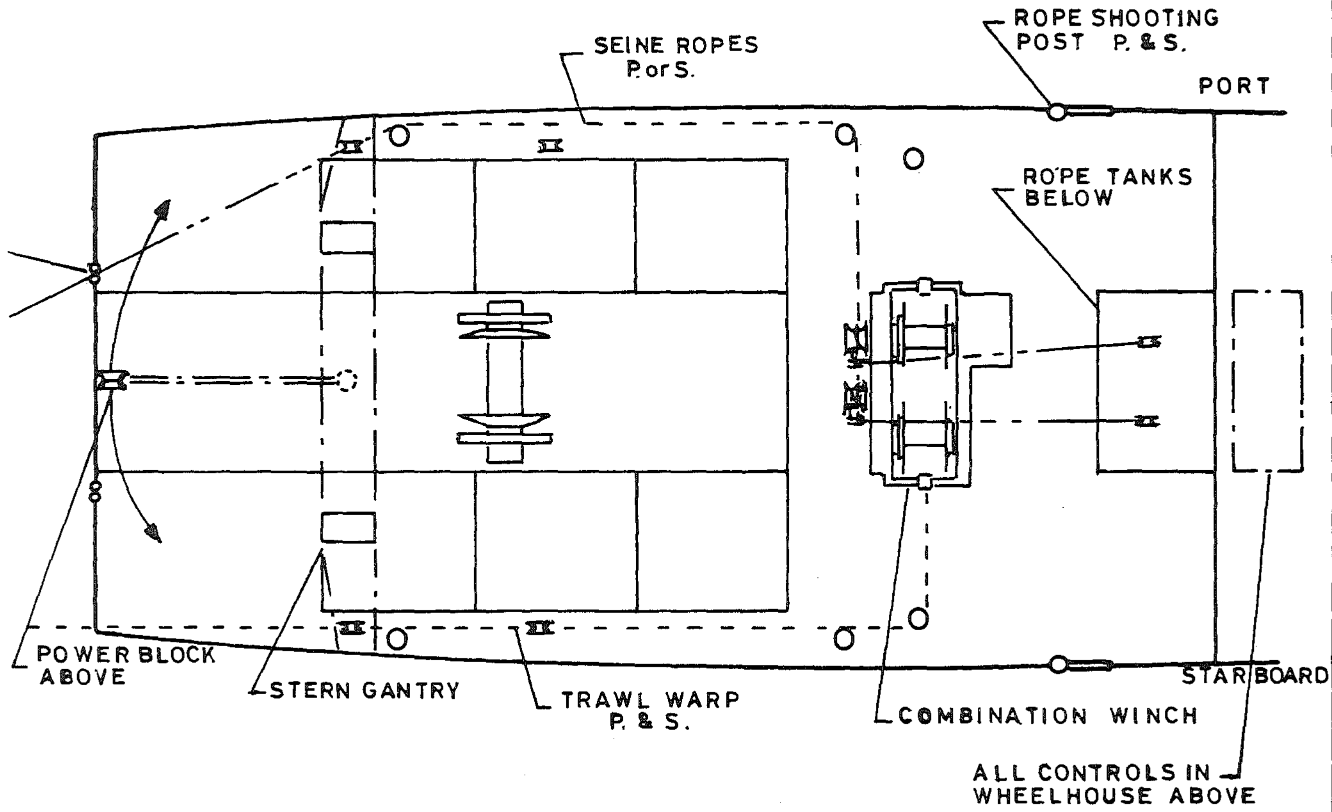
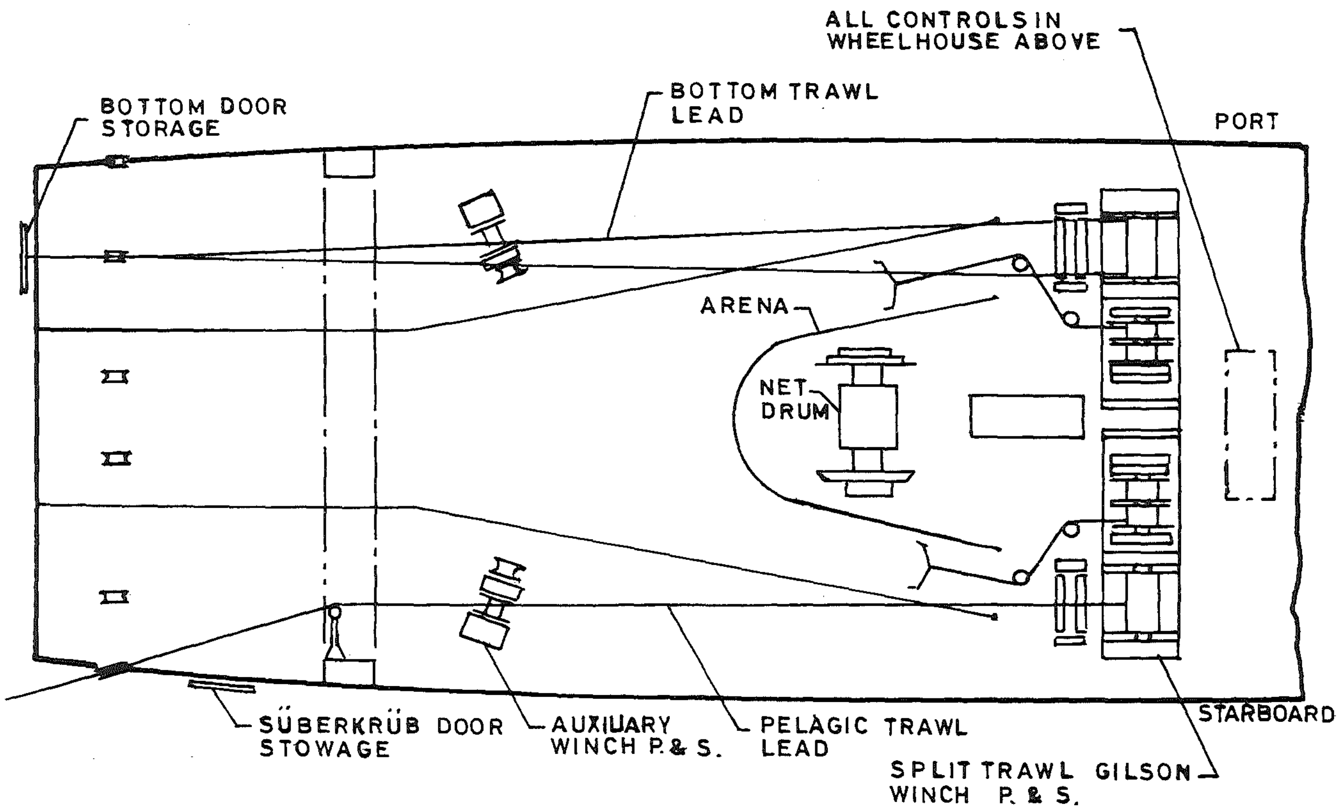


Fig: 7b

DUAL PURPOSE DISTANT WATER VESSEL (66m)

DECK-MACHINERY LAYOUT



ENGINEERING WORKING GROUP OF THE ICES GEAR AND BEHAVIOUR COMM.

3-5 MAY 1973.

WHITE FISH AUTHORITY

Industrial Development Unit

Field Report No. 053 1st May 1973.

NOTES ON THE DEVELOPMENT OF AN ENLARGED TWO PANEL DEMERSAL TRAWL

1. Introduction

With the new generation of British stern trawlers having engine powers as high as 2600 kW (3500 hp) installed for towing large pelagic trawls, it was felt by the Authority that a demersal trawl should be developed which was closer matched to these powers that the demersal trawls used at present. It was decided that the best way to achieve this would be to enlarge a trawl already being worked by the industry. The trawl which formed the basis of the enlarged trawl was the 29.3 m Stella which is a development of the standard 23.8 m Granton.

2. Development of the Enlarged Trawl

2.1 The first stage in the development of the trawl was simply to lengthen the upper and lower wings of the Stella trawl (Figure 1 and 2). This increased the headline from 29.3m to 36.7m.

2.2. Instrumented trials were carried out aboard F.R.V. Scotia in conjunction with Marine Laboratory Aberdeen. Preliminary results of the performance of the trawl compared with that achieved with the Stella are given in Table I and II.

2.3. During the trials the modified trawl was worked with 3.8m x 2.03m rectangular doors (fig. 4) and the double bridle rig shown in fig. 6. The Stella trawl was worked with the same bridle rig but standard rectangular doors of 3.3m x 1.5m. (fig. 5).

2.4. On completion of the instrumented trial, it was decided to increase the number of meshes in the square from 280 to 300 and lengthen the fishing lines from 6.4m to 6.7m as shown in fig. 3 in order to give more headline height.

7. First Commercial Evaluation

Since the last modification described, the enlarged trawl has been taken on its first commercial voyage on MT C.S. Forester, a stern trawler owned by Newington Trawlers of Hull. No trawl gear instrumentation was used. The voyage took place in April 1973. The trawl was shot away for a total of 25 tows, in rotation with the vessels own Stella and Granton year.

The catch rate was comparable to that of the vessel's own gear, ranging from 2700-4000 kg per haul in the first 12 hauls to 500-1000 kg in poor fishing later, and with a maximum haul of 7200 kg towards the end of the voyage.

The trawl proved no more difficult to handle than a standard Granton or Stella except that on that particular ship, which has a working deck only 13 m long, it was necessary to take two extra pulls on the net when hauling compared with a standard Stella. On vessels with normal sized working decks this will not be so.

The only conclusion which can be drawn from this single voyage is that the enlarged trawl is capable of catching fish, is not especially vulnerable to damage and can be handled adequately by the crew.

It is now being transferred to a larger Hull vessel for long-term evaluation.

TABLE I.

Engineering Performance of 36.4m Trawl and 29.3m Stella Trawl

36.4m Trawl

Ship's Speeds (Kts)	Headline Ht. (metres)	Total Warp Tension (Tons)	Power Reqd. (kW)	Total Net Drag (Tons)
3.0	5.6	7.5	335	3.50
3.5	5.2	9.0	450	4.25
4.0	4.9	10.5	600	4.75
4.5	4.4	12.5	710	5.25

29.3m Stella Trawl

3.0	3.1	7.0	300	2.25
3.5	2.3	8.0	335	3.00
4.0	1.8	9.5	522	3.25
4.5	1.5	10.5	600	3.75
5.0	1.2	12.0	710	4.00

TABLE II.

	Ships Speed (kts)	Headline Ht. (metres)	Door Spread (metres)	Wing End Spread (metres)
36.4m Trawl	4.0	4.9	104	24.9
29.4m Stella Trawl	4.0	1.8	99	19.8

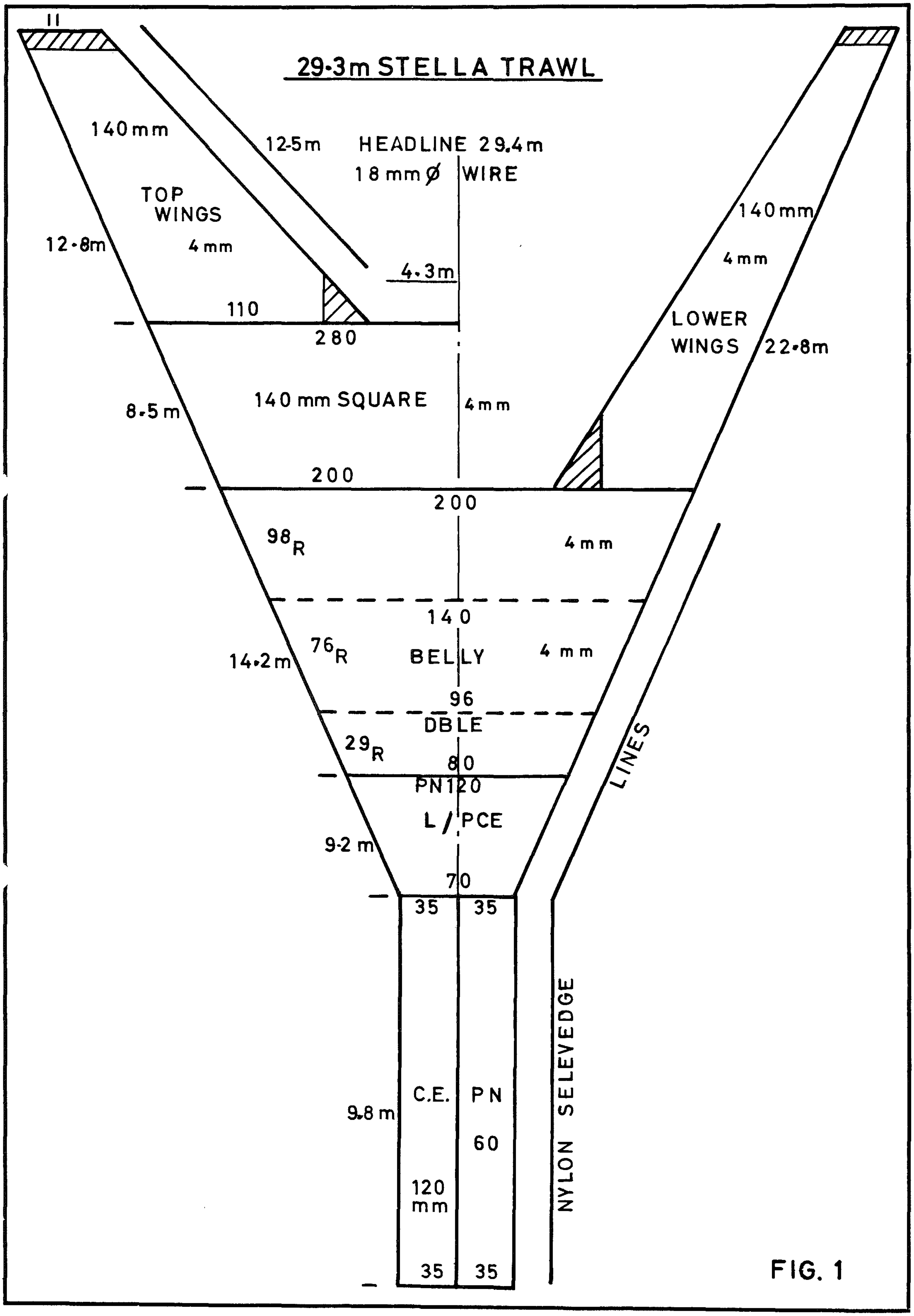
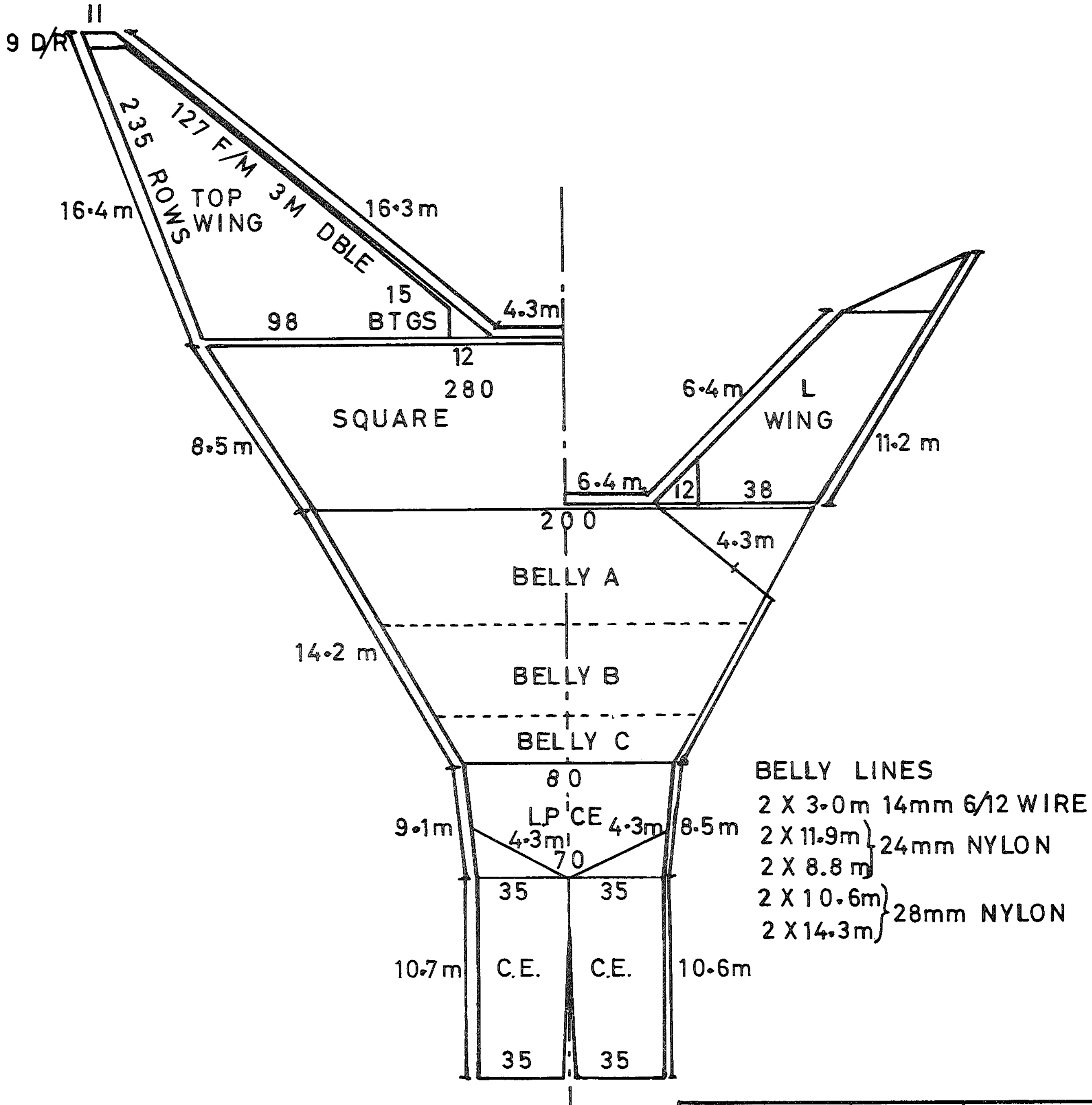

29·3m STELLA TRAWL
11
140mm
12·5m
HEADLINE 29.4m
18 mm Ø WIRE
TOP WINGS
12·8m
4 mm
4·3m
110
280
140mm
4 mm
LOWER WINGS
22·8m
8·5 m
140 mm SQUARE
4 mm
200
200
98R
4 mm
140
14·2m
76R
BELLY
4 mm
96
DBLE
29R
80
PN120
LINES
L / PCE
9·2 m
70
35
35
9·8 m
C.E.
PN
60
120 mm
NYLON SELEVEDGE
35
35

FIG. 1

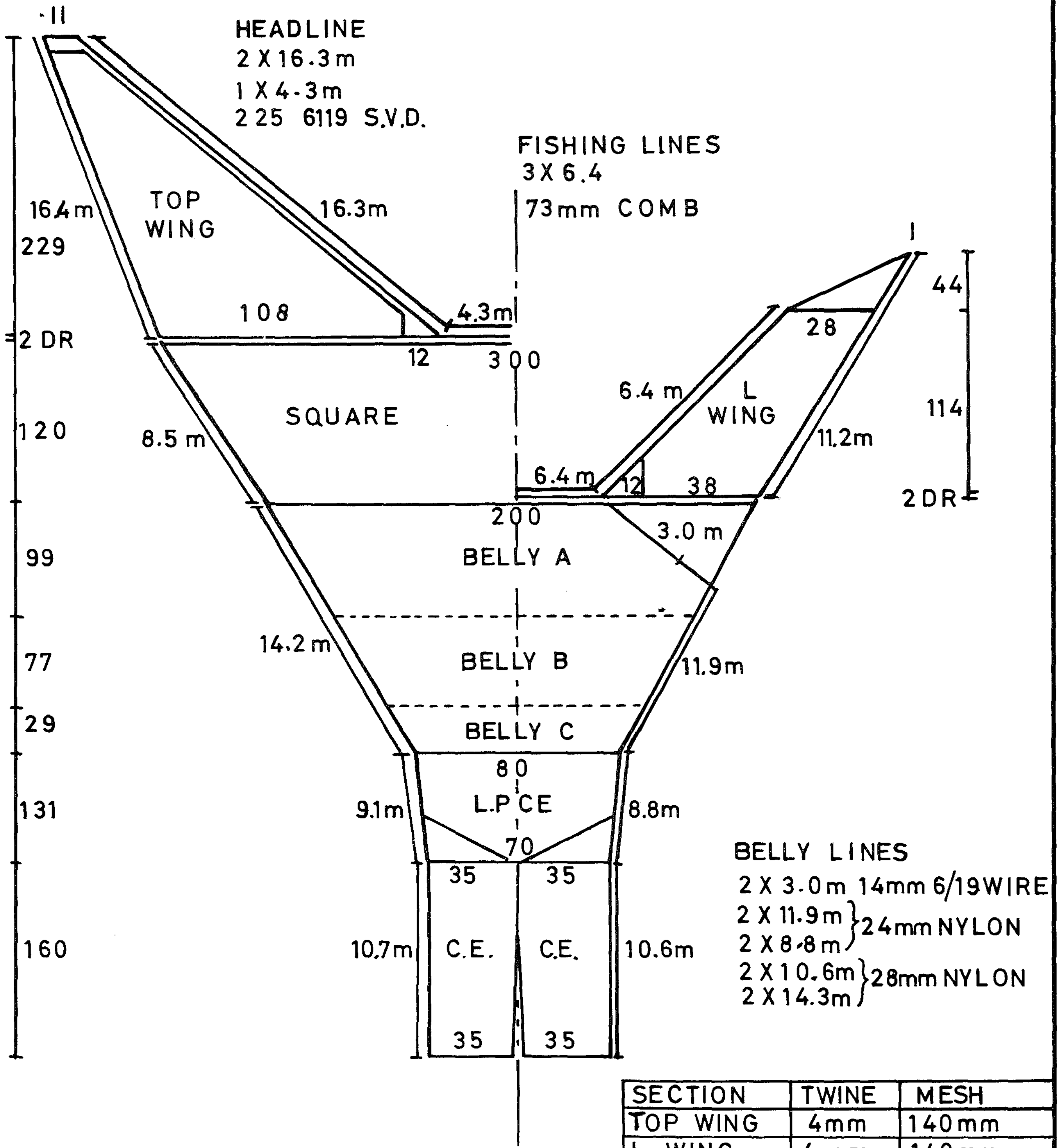
ENLARGED TWO PANEL DEMERSAL TRAWL MARK I



SECTION	TWINE	MESH
TOP WING	4mm	140mm
L WING	4 mm	140 mm
SOUARE	4mm	140mm
BELLY A	4mm	140mm
BELLY B	4 mm	140mm
BELLY C	4 mm	134 mm
L.PCE	PN100	140mmD
CODEND	PN 60	140mmD

FIG. 2

ENLARGED TWO PANEL DEMERSAL TRAWL MARK II



SECTION	TWINE	MESH
TOP WING	4mm	140mm
L WING	4mm	140mm
SQUARE	4mm	140mm
BELLY A	4mm	140mm
BELLY B	4mm	140mm
BELLY C	4mm	134mm
L.PCE	PN 100	142mmD
COD END	PN 60	136mmD

FIG. 3

3.8m X 2.03m RECTANGULAR TRAWL BOARD
WEIGHT IN AIR WITH BRACKETS = 1745 KGF

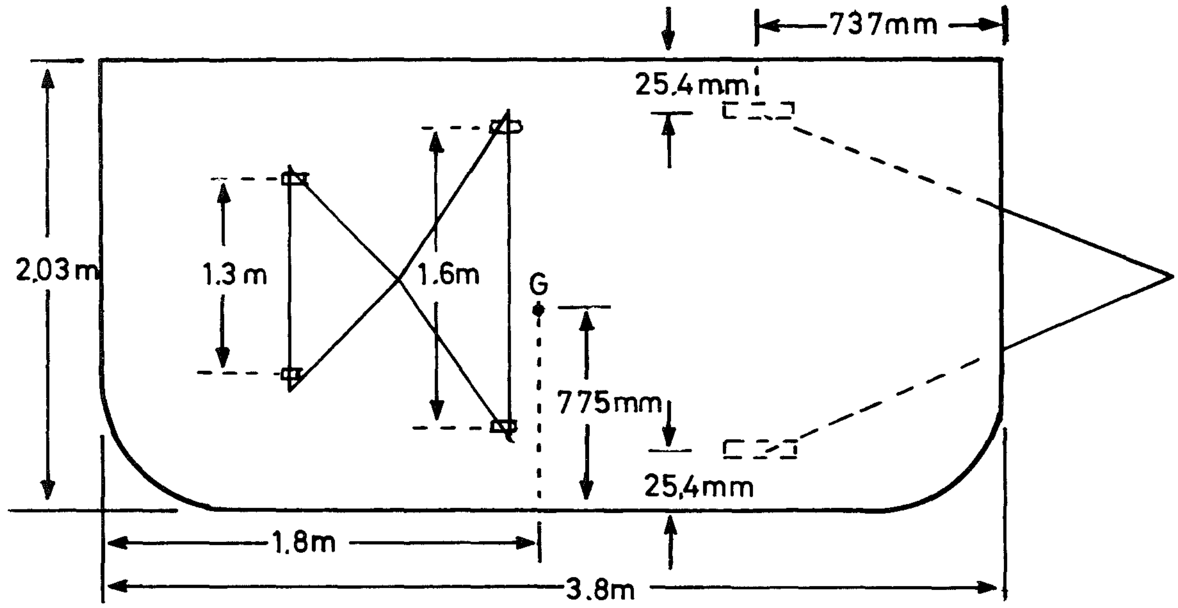


FIG.4

3.3m X 1.5m RECTANGULAR TRAWL BOARD
WEIGHT IN AIR WITH BRACKETS = 909 KGF

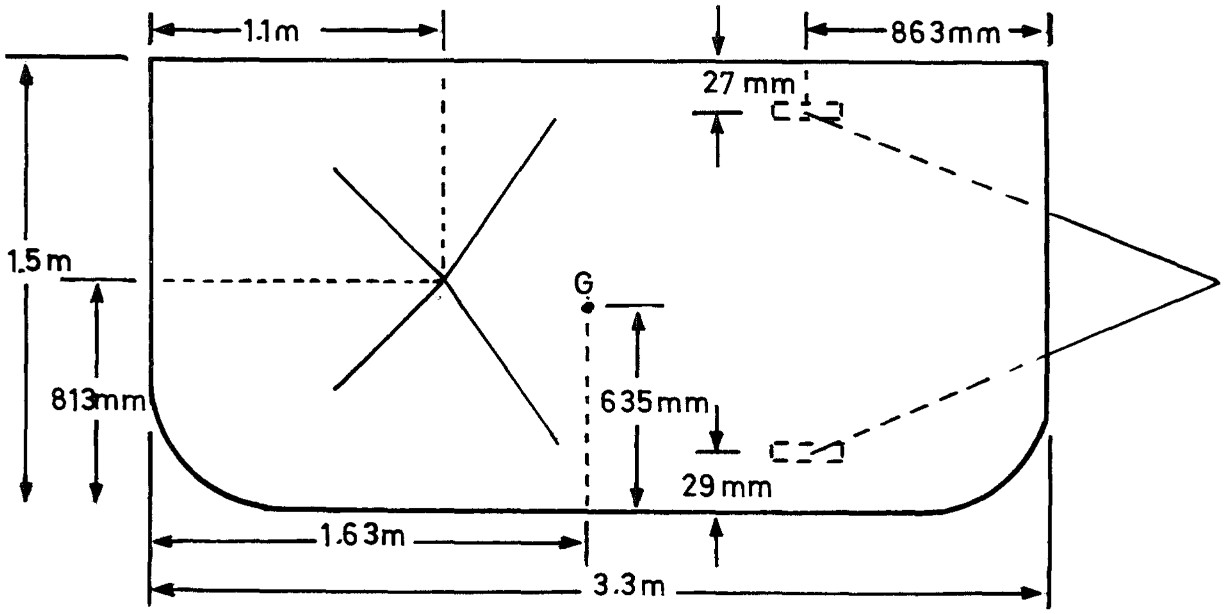


FIG. 5

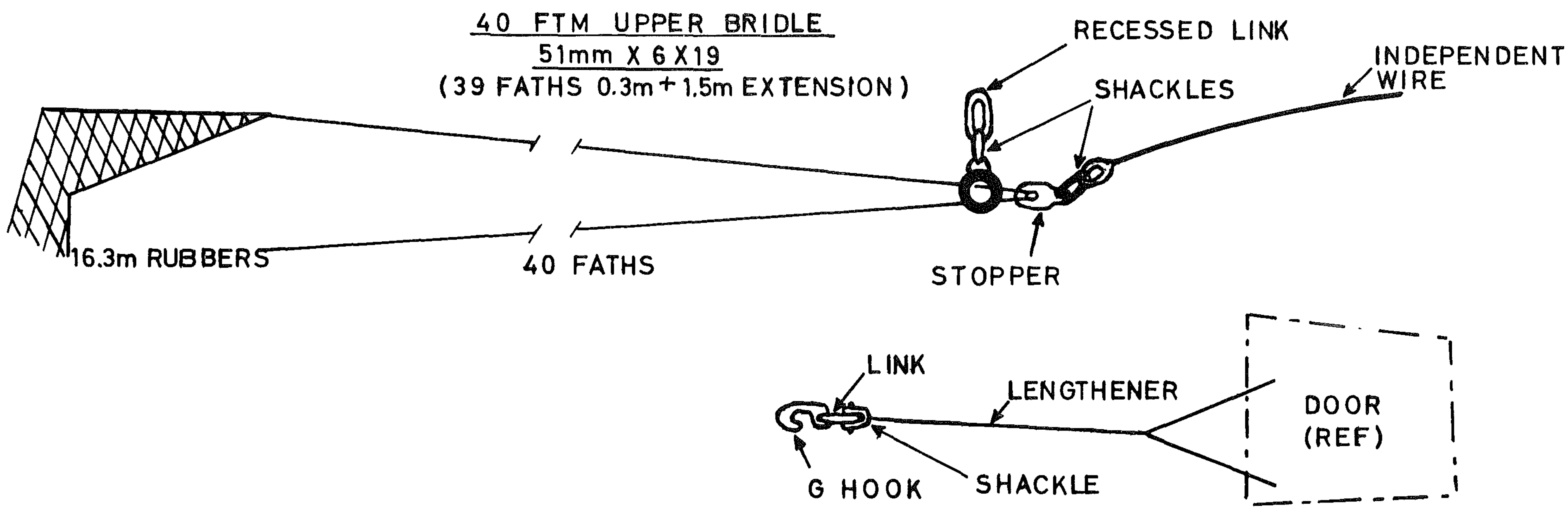

40 FTM UPPER BRIDLE
51mm X 6 X19
(39 FATHS 0.3m + 1.5m EXTENSION)
RECESSED LINK
SHACKLES
INDEPENDENT WIRE
16.3m RUBBERS
40 FATHS
STOPPER
LINK
LENGTHENER
DOOR (REF)
G HOOK
SHACKLE

FIG. 6