International Working Group for Fishing Technology

REPORT

Of the 7th IF Meeting

Ostend, 2nd - 4th April 1963

FISHERIES RESEARCH STATION, OSTEND, BELGIUM

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RAPPORTEUR'S REPORT

of the 7th IF Meeting, Ostend, April 1968

INTRODUCTION.

On invitation of the Belgian Fisheries Research Station the annual meeting of the IF Group was held at Ostend from 2nd to 4th April 1968.

Dr. P. HOVART, director of the Fisheries Research Station welcomed the members of IF. He stressed the many important technical and scientific aspects of fisheries research which have been studied by the group, viz. the pelagic trawl, fishing gear research on model, as well as full scale research, research about instrumentation and equipment and, recently, studies on fish behaviour in relation to fishing techniques and tactics.

He felt that collaboration within the IF Group demonstrated to the full that important problems can be discussed by a small group of interested people.

He put forward some suggestions on the task of the group, its composition and its character.

All with all, he believed that the IF Group continues to demonstrate that as regards fisheries research, international collaboration is possible and that the necessity of collaboration needs not to be emphasized. Scientific research gains in efficiency and efficiency means accelerated progress.

He expressed the hope that this meeting will prove it once again.

Dr. G. KURC agreed to take the chair for the meeting and Mr. P. VANDROMME agreed to act as rapporteur.

The programme of the meeting was discussed and the following agenda was agreed to by the members :

Item 1 – Progress Reports.
Item 2 – Gear Research : model tests and commercial fishing trials.
Item 3 – Instrumentation and equipment.
Item 4 – Fish Behaviour : problems relating to gear.
Item 5 – Data processing.
Item 6 – Other Business.

The following members attended the meeting :

Dr. P. HOVART – Fisheries Research Station
Mr. R. POTTILLIUS Stadhuis, 4e verdieping,
Mr. A. VAN MIDDELEM Ostend, BELGIUM.

Mr. A.R. MARGETTS – Ministry of Agriculture, Fisheries and Food
Mr. J.P. BRIDGER Fisheries Laboratory, Lowestoft, ENGLAND.

Mr. P.D. CHAPLIN – White Fish Authority, Industrial Development Unit
St. Andrew's Dock
Hull – ENGLAND.

Dr. G. KURC – Institut Scientifique et Technique des Pêches Maritimes
59, Avenue Raymond-Poincaré
Paris (XVI), FRANCE.

Mr. C. NEDELEC – Centre de Recherches de l'Institut Scientifique et Technique des Pêches Maritimes
Quai Gambetta,
Boulogne-sur-mer, FRANCE.

Dr. J. SCHARFE – Institut für Fangtechnik
Palmaille, 9
2, Hamburg 56, GERMANY.

Mr. J.G. DEWIT - Fisheries Directorate - Technical Research
Mr. E.J. DE BOER Department
Mr. P. KORBEE Havenkade, 19
Mr. H.C. BESANCON IJmuiden, The NETHERLANDS.

Mr. D.N. MAC LENNAN - Department of Agriculture and Fisheries for Scotland, Marine Laboratory, P.O. Box nr. 101, Victoria Road - Torry Aberdeen, SCOTLAND.

Mr. W. DICKSON - Fishing Gear Section, F.A.O. Via delle Terme di Caracalla, Rome, ITALY.

AGENDA.

ITEM 1 - Progress Reports.

Progress Report from France.

REPORT ON RECENT IMPROVEMENTS IN THE TECHNOLOGY OF FISHING GEAR by C. NEDELEC

The object of the present report is to summarize the improvements obtained in 1967-68 in the particular field of fishing gear technology. It comprises three sections dealing with the following items :

- Evolution in fishing techniques
- Model tests
- Theoretical studies on the balance of fishing rigging under trawling conditions, and on the purse seine sinking rate.

1. Evolution in fishing techniques.

The outstanding events in the development of commercial fishing are the increasing use of pelagic trawls with Süberkrüb otter-boards in industrial fishing, and the use of a new type of bottom trawl having a high vertical opening in coastal fishery. Regarding the evolution of fishing vessels proper, the increasing number of stern trawlers equipped with more and more improved apparatus is worth emphasizing.

a) Development of pelagic trawls equipped with Süberkrüb otter-boards.

The now general use of netzsonde on trawlers specialized in mid-water herring fishing has opened the way to the use of purely pelagic trawls equipped with Süberkrüb-type otter-boards. In the case of trawlers from Boulogne, Fécamp or Gravelines, the trawls are either the large ones having four equal or unequal panels, with an opening perimeter of about 1,400 100 mm meshes operated with otter-boards of 5 to 6 sq m, or smaller trawls, as a rule with four equal panels, comprising about 1.000 80 mm meshes at the opening, with otter-boards of 4 to 5 sq m. This last type of trawl operated with 800 to 1.000 HP trawlers is made from thicker twine and seems to be suited more particularly for catching herring shoals of relatively dense concentration at not too great depths.

b) Use of a new type of bottom trawl with high vertical opening.

During the last two years small fishing crafts from Etaples (of 15 to 20 m in length and 250 to 350 HP) have been using a new type of high-opening bottom trawl. This trawl developed from the semi-pelagic trawl having two asymmetric panels is characterised by a more important square overhang, a body of rather short shape and stronger netting. Due to its relatively great height, this net seems to be particularly adapted for catching mainly white fish, whiting and cod. Its extremely short shape and its vertically free belly further permit the operation of this trawl on relatively hard and uneven bottoms.

c) Development of fishing vessels.

The use of the stern trawling method is becoming increasingly popular. Twelve large industrial trawlers of this type are now in operation at Boulogne. A similar trend is also observed in the small fishing crafts (four new vessels).

Regarding the detection and trawl control equipment, the number of vessels equipped with sonars and netzsondes has increased considerabl; thus, 28 sonars (i.e. approx. 50 % of the industrial fishing fleet) and a score of netzsondes have been recorded.

2. Model tests.

In this respect the construction at Boulogne, in 1967, of a testing tank especially designed for fishing gear models is worth mentioning. With this installation many experiments for fishermen, and tests having led to useful data and observations on the behaviour of various trawl types and otter-board types have been carried out under very satisfactory conditions.

a) Main characteristics of the testing tank.

The installation comprises a vertically arranged closed circuit tank in which the model is held stationary in a water stream produced by means of two coupled propellers driven from a 25 HP electric motor. The tank is 21 meter long and has a 2 m wide and 1,5 m high observation channel, equipped with glass panels along 4,5 m. The channel bottom consisting of an endless belt can travel at the same speed as the water stream, thus preventing the formation of swirls likely to interfere with the operation of the model at that level. The water stream speed is adjustable from 0 to 1 m/sec.

b) Models developed at the testing tank.

Models of various types of nets pertaining to different designs (white-fish bottom trawls, high opening or semi-pelagic trawls, pelagic trawls with conventional otter-boards or Süberkrüb otter-boards) have been made, the scale varying from 1/15 to 1/25 according to the similitude rules of Froude.

The reduction ratios may appear to be relatively small but if the fact is considered that the Cx values are practically constant at the Reynold numbers obtained for the various elements of the original and of the model, these scales may be considered as adequate. Besides, their values are rather moderate in comparison with the 1/100 to 1/500 reduction scales currently used for studying ship hulls or harbour constructions.

c) Other work contemplated.

In addition to the observations now being recorded in connexion with the hydrodynamic behaviour of the various sections of trawl riggings, measurements are made on models of otter-boards of different sizes and shapes with a view to ascertain the drag and lift variations as a function of the angle of attack and the angle of inclination. On the other hand, it will be endeavoured to determine the field of speeds of the water stream inside and ahead of the net opening ; it seems that modifications of this field are likely to influence the fish behaviour, especially under mid-water fishing conditions.

3. Miscellaneous studies.

a) Parameters acting on the fishing rigging under trawling conditions.

From many data recorded during actual fishing gear operation, various relationships have been determined in connexion with the surface area and weight of the otter-boards or the trawl twine area as a function of trawler b.h.p. and also of the type of trawl operated (bottom, mid-water or deep-water types). Thus, extremely convenient curves have been plotted which permit the determination beforehand, or the ascertainment of the main elements of the trawl gear for a given power available.

b) Purse seine sinking rate.

The influence of the hanging rate on the purse seine submersion rate has been determined from theoretical facts concerning the drag produced by the net during its immersion. However, two main types of purse seines, i.e. the Norwegian herring purse seine and the American tunny-fish purse seine, of which the hanging rate values constitute in this problem two extreme and opposite cases, may be considered as well adapted to the specific behaviour of the exploited fish species.

Dr. KURC informed the group that after extensive trials, the semi-pelagic trawl developed by the Sète Laboratory has recently been adopted by Spanish fishermen in the Malaga area.

He also reported on the progress made in the field of the fishing with light and in the field of the electrical fishery.

Progress Report from England.

PROGRESS REPORT ON FISHING GEAR EXPERIMENTS AT THE FISHERIES LABORATORY, LOWESTOFT by A.R. MARGETTS

Fishing.

Activity in the field of pelagic trawling was limited to underwater observations and photography of a half-scale net with rigging modifications, continuing in home waters the programme begun in Corsica in 1966.

R.V. CORELLA was temporarily fitted for purse-seining and shown to be capable of this method of fishing.

The particular series of bottom-trawl comparative fishing experiments referred to in earlier I.F. reports and involving the research vessels EXPLORER and ERNEST HOLT of the Aberdeen and Lowestoft laboratories respectively was concluded with one experiment in 1967. In this a standard Granton trawl was compared with a higher-headline trawl fitted with double 120 m bridles and curved otter boards. In Barents Sea winter darkness the Granton trawl caught more fish. In this experiment there were times when identical gears were fished simultaneously from both ships, and then their catches were very similar, indicating that there was no important ship/gear interaction with these ships and gears under the particular conditions.

Instrumentation.

Development work concentrated on the acoustic arch which, though primarily intended for use with bottom trawls, may also be useful with pelagic trawls. The arch is essentially a number of transducers in series arranged so that they face vertically downwards across the mouth of the trawl to allow that space to be acoustically scanned. If one arch is over the space between otter boards and another is on the headline, by counting the fish seen by each arch an estimate might be made of the efficiency of the trawl.

So far, only a prototype has been tested at sea. Results from this were encouraging, and construction of a number of identical units which can be linked together in series as required is now proceeding. Each unit contains two transducers, one transmitting and one receiving, and its own transmitter which is fired from a delay circuit. Delay is varied in each unit according to its position in the arch. In this way an arch, or the mouth of the trawl, can be covered in a time period limited by signal transit time in the medium - which could mean that a bottom trawl headline arch could be scanned something like ten times per second. The system utilizes 100 kHz transducers with a beam angle of 20°. Power supplies, trigger pulses, and received signals are carried by a cable between ship and trawl. A 48 cm wide Alden recorder is used ; the signal paths are displayed in sequence across the recorder paper and provision is made for the electronic processing of the signal for counting purposes.

First use of a "production model" of the acoustic arch will be in August 1968.

A ship-borne sector-scanning sonar is at present being fitted in R.V. CLIONE and is expected to be in use in July 1968. This apparatus will have a range of 400 m and scan a 30° sector at 10.000 times per second. The resolution of the beam is 0.3°. The stabilization within the ship will be to 0.5°.

Mr. CHAPLIN reported on the development of the net drum system in the United Kingdom, especially on the net drum installation on the trawler "Ross Daring".

Progress Report from Scotland.

Mr. MAC LENNAN reported that at the Marine Laboratory, Aberdeen, a computer based data logging system is being developed to further the understanding of trawl gear behaviour. This instrument will permit the analysis of the different parts of the net as well as the reactions and behaviour of the fish in and to the fishing gear.

A new side-trawler is under construction (delivery date August). This vessel will especially be used for general fishing gear studies.

Another new stern trawler (210 feet) will be built to replace the "Scotia" (1971).

Trawling gear tests (on half-scale model in tank and on full scale model) were carried out to study the rigging of the gear in view of the industrial fishery in the deeper waters of the Atlantic Ocean (i.e. Rockall and Porcupine areas).

Progress Report from the Netherlands.

Mr. DE WIT gave a short report on the improvement of the Dutch fishing fleet structure and of the equipment installed aboard the Dutch fishing vessels.

New fishing techniques are currently being introduced (e.g. winches)

The Dutch shrimp fishery is now changing its orientation. The principle of protecting the shrimps and the undersized fish by means of a selective trawl is gradually being abandoned in favour of an automatic sorting machine which has recently been developed. This machine permits the sifting of the shrimps and the fish and allows the smaller specimens to be returned alive to the sea.

Experiments have also been carried with pelagic trawls and herring seine nets. These experiments however were not as yet very successful.

The new research vessel "Trident" is shortly to be commissioned. The ship has a length of 61 m, is equipped with two motors (1200 and 600 hp), a pneumatic winch, a reversible propellor, etc.

Three laboratories will allow the simultaneous carrying out of diversified research.

Progress Report from Belgium.

Mr. VAN MIDDELEM reported on the Belgian activities. During the past year, the research has been mainly concentrated on shrimp beam trawling with nets fitted with a sieve. A conventional net on starboard was compared with seven different shrimp trawls on port equipped with a sieve. The tests have shown that only two nets can be retained for further research. It is intended to carry out further tests with these nets especially as regards their selectivity, the position of the sieve and the behaviour of the shrimps.

The shrimp nets with sieve allow an easier handling of the catch, the quality of the shrimps is better as the shrimps suffer less damage and the number of undersized fish is reduced to a minimum.

Further research will try to determine the characteristics of these nets.

In collaboration with the Netherlands a Furuno wireless net echosounder of Japanese construction was also tested in order to examine the technical possibilities of this instrument in relation to the plotting quality, the reliability, the synchronization, etc.

The wireless net echosounder attached to the headrope of the net emits acoustic impulses to the receiver which is towed under water behind the stern of the vessel. The receiver is electrically connected to the net recorder installed on board.

The experiments took place in the Silver Pit aboard the Dutch fisheries research vessel "Willem Beukelszoon".

The net used was a pelagic net composed of two equal parts with 160 mm meshes for the wings and 40 mm meshes for the cod end. Süberkrüb otter boards (approximately 1 m^2) were used.

The net echosounder indicated a netopening of $\pm$ 5.50 m ; headline, groundrope, fish concentrations and sea-bed were clearly plotted.

The operation of the wireless net echosounder and the stability of the synchronization in deeper water constitute points for further research.

A detailed report will be presented at the end of the meeting.

Progress Report from Norway.

Although Norway is not a member of the IF Group , an observer attended the meeting so that Norway may keep abreast of the research activities of the IF Group.

Mr. SUNDNESS reported on the Norwegian noise and acoustic studies now being carried out consecutive to the growing difficulties encountered by the Norwegian purse seiners to catch herring.

Progress Report from Germany.

Dr. SCHARPE reported on the important German work concerning the commercial midwater trawling for herring.

Pelagic nets with very large netopening (33 to 37 m) were very successful in the West-Atlantic herring fishery (Georges Bank and South New Jersey). During the period July-December, 13/14 trawlers made 26 trips and caught 26.000 tons of herring (on average 60 to 80 tons per vessel per day). All fish were filleted and deepfrozen and partly reshipped in St. Pierre-et Miquelon.

As regards the Atlanto-Scandic herring, the fishing conditions further deteriorated. Only poor fast reacting concentrations were encountered. Purse seining, drifting and midwater trawling failed.

"Outwitting the fish" with considerably larger gear seemed to be a solution to this problem. Bottom trawls with large netopenings (2.000 meshes in circumference of 20 cm (stretched), meshes at the net mouth stretched to 56 cm) gave satisfactory results.

Dr. SCHARFE insisted that the yield of the herring fishery with the pelagic trawl depends to a greater extent on the netopening than on the towing speed, which may be reduced to 1,8 - 2,2 knots even for the largest trawls.

Other activities during the past year included net model tests to study circular otter boards, the saving in towing resistance by means of increased mesh sizes, the calibration of speedometers, the improvement of measuring methods and equipment.

Further studies on the herring midwater trawling technique were carried out to improve the aiming efficiency, the horizontal aiming aft, etc.

To improve the catching efficiency larger nets at lower speeds have been tested ("outwitting").

Preliminary fishing trials on saithe were carried out with the new combined bottom and midwater trawl.

The building of a new research vessel is being planned to replace the "Anton Dohrn". The vessel will be a super stern trawler of 3.600/ 4.000 hp equipped with the best and newest acoustic equipment.

Progress Report from the FAO.

This report was presented by Mr. DICKSON. The main activity concerned the preparation of the FAO Conference on Fish Behaviour in relation to fishing techniques and tactics (Bergen).

Different trawls were also studied (Japanese trawls, the Granton trawl etc.).

ITEM 2 - Gear Research : Model tests and commercial fishing trials.

a) Model tests.

Mr. NEDELEC gave a description of the model testing tank recently installed at Boulogne-sur-Mer and in which he carried out tests on small scale models (1/25th and 1/50th) of bottom and semi-pelagic trawls.

Mr. DICKSON exposed the difficulties inherent to small scale models viz. the variation of certain factors as drag resistance and buoyancy.

Dr. SCHARFE also underlined the difficulties encountered during the study of very small scale models, especially as regards the rigging which cannot be exactly reproduced. He prefers larger models (scale 1/4th).

Mr. NEDELEC is of the opinion that if there are difficulties the tests are nevertheless practicable and allow the collection of acceptable data.

Dr. SCHARFE briefly outlined his trials with a small scale model (1/4th) of combination midwater and bottom trawl towed by a small cutter (14 m) at a speed of 2 knots (half the normal speed).

A film of this combination trawl in action taken by divers was projected.

b) Commercial Fishing Trials.

Dr. SCHARFE reported on the experiments aboard the "Walter Herwig" to improve the "Atlanto-Scandic" herring catches by using a large midwater trawl (2.000 meshes (20 cm stretched) in circumference, headline 80 m, wings and net mouth with 56 cm meshes (stretched), bridles of 200 à 250 m) and large Süberkrüb otter boards of 12,5 m^2. A multidirectional netzsonde was attached to the net and gave reliable indications on the different parts of the net and on the behaviour of the fish in front of and in the mouth of the net.

At a speed of 1.8 - 2.2. knots the vertical net opening was 33 to 37 m.

It seemed that if the net is large enough, it is advantageous to reduce the towing speed.

On average 46 tons of fish per hour were caught. Some hauls amounted to 80 tons. This constitutes a maximum weight a middle class stern trawler can handle.

Dr. SCHARFE presented a second report on a new type of combination semi-pelagic and bottom trawl with a large vertical net opening. When towed on the sea-bed this asymmetrical net has a vertical opening from 6 to 9 m according to the rigging used and in deep water, an opening of approximately 11 m can be obtained. The circumference of the net is 804 meshes of 18 cm (stretched).

The results for spawning herring were very satisfactory : on average the catches amounted to 4.5. tons per hour whereas the vessels using the classical gear only caught 1.3 tons per hour.

The rigging of the net consisted of 100 m bridles and Süberkrüb boards of 8 m^2.

These are only prelinminary results. It may be assumed that such a trawl, designed to work on hard bottoms with only the groundrope touching the bottom, could be used on the Newfoundland fishing grounds.

The contributions regarding the midwater trawling developments and the new combination midwater and bottom trawl presented by Dr. SCHARFE having already been published, the following bibliographic references can be given :

a) "Bessere Treffsicherheit für die Schwimmschleppnetz-Fischerei" Allgemeine Fischwirtschaftszeitung, 20. Jahrgang 1968, nr. 1-2, Seiten 35-38.

b) "Überlistungs"-Taktik mit verbesserter Treffsicherheit für die Schwimmschleppnetz-Fischerei auf atlanto-skandischen Hering". Informationen für die Fischwirtschaft, 14. Jahrgang 1967, Heft 6, Seiten 11-22.

c) "Fortsetzung der Fangversuche mit grösseren, groszmaschigen Heringsschwimmschleppnetzen auf atlanto-skandischen Hering mit den Trawlern "C. Kämpf" und "J. Homann" vom 13.-29.1. und 22.2.-10.3.1968". Informationen für die Fischwirtschaft, 15. Jahrgang 1968, Heft 2.

d) "Fischereiliche Erprobung eines neuartigen kombinierten Grund- und Schwimmschleppnetzes mit dem Trawler "Carl Kämpf" 25./26.2.68 Informationen für die Fischwirtschaft, 15. Jahrgang 1968,Heft 2.

ITEM 3 - Instrumentation and Equipment.

Mr. CHAPLIN informed the meeting on the development of the net drum system in the United Kingdom. The basic feature of this system is that the entire trawl, aft of the doors, is wound on to a single large drum as far as is necessary for the crew to take hold of the cod-end, lift it and empty it.

This system not only allows a saving in manpower to handle the trawl, but will reduce at the same time, the manual effort required and improve the safety of the operation. A copy of the paper presented by Mr. CHAPLIN is included in this report (Annex I).

Mr. MAC LENNAN presented the first part of his very technical report "Notes on Instrumentation Design relevant to the application of Computer Techniques to Gear Research". This paper is included in this report (Annex I).

The computer based data logging system now being developed was briefly described as was the instrumentation and associated hardware which will be used on-line to the computer in full scale gear trials. The measurements to be made are divided into two groups, those made on the ship and those relating to the underwater parts of the gear. The former group can be connected to the system in a conventional way. However, the large distance separating net and board instruments from the ship made it necessary to employ telemetry techniques for underwater measurements. A detailed description of the two telemeters links intended for operation from an otter board and the net respectively was given (see item 5).

Mr. DE BOER presented a film showing the automatic sorting machine (shrimp sieve) in operation. This apparatus allows the automatic sorting of the commercial shrimps, the larger flatfish and finally the smaller fish and the young shrimps which are returned mostly alive to the sea. The machine has been installed on some beam trawlers of 18 to 25 m (180 to 600 hp) carrying out either the shrimp or sole fishery.

A copy of this film called "Garnalenvisserij" (nr. B-60-5) can be obtained through the intermediary of the Embassy of the Netherlands.

Mr. DE BOER also showed a number of slides of the different types of winches currently in use on the Dutch beam trawlers carrying out the flat-fish fishery, especially the sole fishery. These winches are completely automatic and entirely controlled from the wheel-house : 85 hp, 2 separate drums, high resistance wires (30 tons) necessitated by the very heavy rigging (1,400 kg of chains). Already 460 trawlers take part in this fishery which is so remunerative that even certain larger trawlers of 32 m (1,200 hp) have been adapted for this fishery.

Mr. NEDELEC pointed out the danger of overfishing the populations and the possible destruction of the fishing grounds constantly ploughed up by the numerous and so heavily rigged trawls. This risk was however not evident to some IF-members in spite of the recent statistics which tend to show that 500 million immature soles are destroyed yearly by the shrimp trawlers in the Waddensea.

Dr. SCHARFE commented on his slides concerning the improvement in localizing fish concentrations during the pelagic fishery by means of a multinetzsonde. This instrument is fixed to the headline and sends impulses towards the surface, the bottom, ahead, horizontally and 15° horizontally. Transmitters are also fixed to the wing extremities and on the otter boards. The complete apparatus designed by Atlas-Werke and adapted by the Hamburg Laboratory allows an excellent plotting of the different parts of the trawl as well as the behaviour of the fish in the vicinity of the tow path. An incorporated current meter indicates the speed at which the trawl is advancing.

Mr. DICKSON presented a theoritical study on the course to steer for the trawl to intercept a fish school.

A diagram was elaborated showing the tow path of the net in relation to the direction of the ship ; a second diagram showed the points of interception between the detected fish school and the trawler in relation to the fishing speed, the speed of the vessel and time.

Mr. DICKSON pointed out that this problem needed to be studied further.

Dr. SCHARFE and Mr. CHAPLIN came across the same difficulties and tried to solve them in the same manner. A copy of the paper presented by Mr. DICKSON is included in this report (Annex I).

Mr. DICKSON renewed his request to the IF members to send him all information on underwater observation equipment so that he can complete the "FAO General Compendium on Instrumentation".

Mr. VAN MIDDELEM presented a short communication on the experiments carried out with the Japanese netzsonde in collaboration with The Netherlands. Some difficulties were encountered. The working of the instrument is influenced by ships fishing in the vicinity. Also ground-rope echoes and bottom echoes are too near each other. The technique has still to be improved. A paper on this subject is included in this report (Annex I).

Mr. DE WIT mentioned that this experiment has already once been used commercially in pair fishing. He pointed out that the aim of the experiments was not only for scientific purposes but also for use in the field.

Dr. SCHARFE was of the opinion that there are limitations to the system.

Mr. NEDELEC inquired about other systems of transmission.

Mr. DE BOER mentioned the experimental work on the "Laser" carried out by Philips. However, these studies may take several years.

ITEM 4 - Fish Behaviour : Problems relating to gear.

Mr. KURC briefly reported on the evolution of the research on light fishing in the Atlantic as well as on the behaviour of pelagic fish to artificial light and on the adaptation of the fishing techniques to this behaviour.

Experiments to catch sardines with electric light in the Atlantic were carried out. The traditional sardine fishery with ring nets and with baited cod eggs is rather expensive (in 6 months, the bait may cost from 20.000 to 50.000 Fr. fr. per ship), whereas the equipment needed for light fishing costs only about 10.000 Fr. fr.

The two fishing methods were compared and the light fishing catches were as good and even better than the bait fishing catches.

However, the light fishing method has not yet been adopted by the fishermen (only by 12 vessels so far).

Little is known as to why fish seem to be attracted to light and investigations were carried out in order to elucidate this problem.

The kinetic behaviour of young little fish in an illuminated field differs from the behaviour of adult fish. Young fish come nearer to the source of light but tire rapidly, adult fish react slower to the lamps and keep further off.

The nature and intensity of the light were also studied. Up to now only white light sources were used, blue-green light also offers possibilities. The light source ought not to be too bright (fish is attracted, but stay further off). A lower light intensity and a good diffusion attract the fish nearer to the light source. Four 500 W lamps seem to be sufficient.

The next step in the evolution of light fishing will be the combined use of light, fish pumps and electrical energy.

It is not easy to create an electric field in sea-water and in the pump fishery a large field is required. Fish outside the electric field are repulsed, whilst those inside it are attracted to the anode and pump (a rather limited area (50 cm) = area of narcosis - the fish within it stops swimming and is paralysed).

Dr. SCHARFE mentioned the Detlov (USSR) experimental pumping method.

Mr. MARGETTS and Mr. BRIDGER informed the group of their experiments with the Detlov pumping method. It was a complete failure. In their opinion this method had more scaring than attracting effects.

Mr. DICKSON proposed the building of a cage (1 m circumference) around the pump.

Mr. KURC also described briefly the preliminary promising experiments with a selective trawl destined to seperate Nephrops from young little fish, especially hake.

Dr. SHARFE spoke about the rake trawl to catch soles.

Mr. NEDELEC disagreed with too radical fishing methods. A rake ploughing the sea-bottom kills sand worms which constitute the food of flat-fish. This fishing method is prohibited in France.

ITEM 5 - Data processing.

Mr. MAC LENNAN briefly outlined the different systems (on line, off line) of data processing concerning the trawl and fish behaviour. These data are transmitted telemetrically to the ship and are then treated by a computer (see paper "Notes on Instrumentation Design relevant to the Application of Computer Techniques to Gear Research" included in this report) (Annex I).

ITEM 6 - Other Business.

- Mr. FOSTER having been prevented to assist at the meeting of the IF Group owing to a bereavement in his family, the President proposed to send him the following telegram "Gathered members of IF express sympathy to you , Bridget and family. Look forward your participation at next meeting", signed KURC, Chairman.

- A number of questions concerning the organization and the possible modifications to the Group having arisen during private discussions with different members, the chairman exposed the different problems and requested the members of the Group to discuss them and to state their opinion.

1. Some members think that the activities of the IF Group and those of the Gear and Behaviour Committee (ICES) overlap. Also, as the IF Group has no legal international status, certain members may have administrative difficulties to cover the costs inherent to the attendance of the meetings. The question may be put if it would not be useful to incorporate the IF Group as a specialized working group in the Gear and Behaviour Committee of ICES.

The general opinion was that the semi-official status of the IF Group permits the experts to exchange informally ideas and information and to enter into much greater technical details than would be possible in a large international organization.

Unanimously, it was decided to maintain the actual structure of the IF Group.

2. Some members may perhaps consider it desirable to enlarge the number of participating countries. It was decided to accept possible

new applicants but not to stimulate applications. Indeed, the countries actually represented are probably those carrying out most technological research, with the exception perhaps of certain Eastern European countries.

It was thought desirable that only really active members should participate in the meetings, its efficacity depending largely on a limited membership.

3. Originally the IF Group was only destined to study the problems related to the pelagic and semi-pelagic fishing. Gradually the studies encompassed all aspects of gear improvement, the technology of bottom trawls, instrumentation and even fish behaviour.

All IF members approved this evolution.

The President requested that the denomination "IF Group", should be more explicitely defined. It was agreed that this denomination would be maintained and in future should stand for "International Working Group for Fishing Technology".

- During the 6th session, a new programme for international collaboration similar to the one carried out aboard the "Ichthys" was mentioned. This question needs to be more accurately detailed. If an international programme is to lead to interesting results, it should be limited to one precise and carefully prepared subject.

In this connexion, the President made a personal suggestion as to the possibility of joint research on the technology of the shrimp fishery and the means of protecting the immature stocks.

The Netherlands as well as Belgium are interested in such a project and it was agreed that subsequently contacts will be made in view of the possible establishment of a joint programme.

- Mr. NEDELEC invited anyone wishing to study scale models to make use of the testing tank at Boulogne-sur-Mer.

- Mr. SUDNESS informed the members that the facilities of the Laboratory at Bergen are available to anyone (especially for study of machines and towing equipment).

- Mr. MARGETTS suggests that the members in future should add to their Progress Reports their programme for the coming year. This will certainly encourage spontaneous collaboration (Annex II).

This proposal was adopted and it was agreed that each member will send his programme to the Rapporteur, who will include it in the final Report.

- The participants who presented written or oral communications were requested to send the text or a summary to the Rapporteur (50 copies) by June 1st.

- Mr. MARGETTS kindly extended the invitation to hold the next IF Meeting at Lowestoft (March/April). The exact dates to be decided later.

The agenda being exhausted, Mr. VAN MIDDELEM on behalf of Dr. HOVART made the closing speech in which he expressed his pleasure to have been able to act as host to the IF Group at Ostend.

The Chairman on behalf of all members addressed his thanks to the Belgian Authorities, Dr. HOVART and his collaborators who have perfectly organized this meeting and for the kind hospitality extended to the IF members. He also commented on the successful work done during the course of this meeting.

P. VANDROMME.

ANNEX I

The Development of the Net Drum System in the United Kingdom

by

J.D. CHAPLIN

Net Drum System.

In almost every country in the world in which trawl fisheries are practised efforts are being made to reduce the man power required to handle the trawl on deck and to reduce, at the same time, the manual effort required and to improve the safety of the operation. This work is going ahead in parallel with the development of gutting machinery, since, for many types of trawling operation, any reduction in man power can only be effected if the labour content of the gutting process and of the gear handling are reduced simultaneously.

In Great Britain by far the most promising development in the mechanisation of gear handling is the net drum system. The basic feature of this system is that the entire trawl, aft of the doors, is wound on to a single large drum as far as is necessary for the crew to take hold of the cod end, lift it and empty it. For bottom trawls this means that the danleno bobbins, the wing end bobbins, the headrope floats and the bosom bobbins have all to be wound onto the drum together with the square and belly of the net. Such systems are not new and have been employed on a small scale on small stern fishing vessels, usually with light trawls fishing off the West Coast of Canada and the United States. In Great Britain the work is being extended to much larger vessels using heavy bottom trawls.

Net Drum Installation on ROSS DARING.

Following a prelinminary installation on a small inshore stern trawler the first full scale installation was designed and built for the ROSS DARING. This vessel is a 90 ft. all steel stern trawler built in 1963, primarily for North Sea fishing. The vessel is powered by a 6 cylinder diesel developing 650 b.h.p. and driving a c.p. propeller.

Prior to the fitting of the drum system the gear was handled, on this particular ship, by a fairly complex arrangement since she has been originally designed to operate with a reduced crew. Although the vessel hauled in the manner of a stern trawler the final operation, that of lifting the cod end aboard, took place over the starboard side.

The modified arrangement with the net drum system installed is shown in Figure 1, where it will be seen that the net drum is positioned about 13 1/2 ft. forward of the transom. A sketch of the net drum showing the principal dimensions appears in Figure 2.

The ship was originally equipped with hydraulic trawl winches. Since it was not necessary to operate the trawl winches at the same time as the net drum, no additional hydraulic power was required and the power to the net drum was supplied by providing a change-over valve between the pump and the trawl winch on the port side.

The trawl which is normally used by this ship is a Lowestoft nr. 2 trawl whose general dimensions are shown in Figure 3.

Handling Procedure on the ROSS DARING.

When hauling the doors are brought up to the after gantry in the normal manner. Two men then chain off the doors and detach the sweep wires in the usual way. These are coupled to short pieces of wire permanently attached to the outer section of the net winch. The net winch is then powered and hauls in the sweep wires, winding them on to the outer barrels. When they are almost fully wound on the winch is stopped, the gear is chained off and the sweep wires are pushed through a slot in the main flanges (see Figure 2). Hauling then continues on the drum to bring in first the danlenos, then the tow legs and then the wings, bobbins and headrope with its floats. At this stage the drum is stopped, usually with the bobbins on the deck. The same two crew members are then able to haul in the cod end using the permanently attached "poke" lines and the small winch shown in the centre of the working deck on Figure 1. This winch is also controlled from the wheelhouse. The cod end is lifted over the transom and the fish are emptied in the fish pounds on the port quarter. The whole operation from start to finish can be carried out by two men on the deck and one man, the skipper on this particular vessel, in the wheelhouse. Hauling and shooting the gear now takes 15 minutes instead of 25 minutes under the old arrangement.

Shooting the trawl is carried out in the reverse manner using a codend outhaul arrangement or yo-yo shown in Figure 1.

Net Mending.

It will be seen from the sketches that net mending space is provided between the net winch and the transom. This is adequate for most repairs. These repairs can be carried out by paying out the net until the damaged part is stretched out between the winch and the transom. Severe damage, large splits, etc., which require more space for repairing can be carried ou by passing the cod over to the forward side of the winch and taking the net off on this side using the reversing feature to simplify the operation. No damage is caused by the net being wound onto the drum with its bobbins and wires.

The system has now been in commercial service on this vessel for approximately a year. After the initial commissioning period no real difficulties have been experienced. The hydraulic power available is adequate except when the gear has been wound onto the drum in such a way that the bobbins ride on top of the danlenos. In these circumstances the net drum has occassionally stalled. This is very easy to remedy on the spot but as will be seen later, steps will be taken in future designs to eliminate this problem.

Net Drums for Distant Water Trawlers.

The success of the installation on the ROSS DARING has led to consideration of applying the same system to British Distant Water trawlers both side trawlers and the newer class of stern trawlers. Nearly all of these vessels use the small Granton trawl almost exclusively. The only problem encountered on the ROSS DARING which was of any significance was that mentioned earlier of the danlenos and the butterfly upsetting the neat winding on of the groundrope, headrope and net. For that reason it was decided to make a slight alteration in the design of the drum for installation on future vessels. This can be seen in Figure 4. For the future it is proposed that not only the sweep wires but also the danleno bobbin, its butterfly and the tow legs will be wound on to the outer barrel which has been enlarged to suit.

Installation on the ROSS KELVIN.

It was decided that the first trial installation of the new design for distant water trawlers would be carried out on a side trawler and the ROSS KELVIN was selected as the first vessel to be modified in this way. The general arrangement of the modification is shown in Figures 5 and 6. It will be seen that the net drum has been installed on a false deck fitted over the foredeck of the vessel. The warps are run to the gallows in the usual manner, passing under the false deck. The gear will be hauled through an opening in the bulwark which will be closed by a hydraulic gate when the vessel is not hauling or shooting the gear. The fish will be spilt on to the foredeck, on the port side for gutting and will be sent down the forward hatch and transported by conveyor, when required, to the after part of the fishroom.

Alternative method of Converting the Side Trawler.

An alternative which is suitable for some types of ship depending upon the nature of the accommodation existing at the after end is shown in Figures 7 and 8. In this type of conversion the after accommodation is removed and re-distributed elsewhere in the ship. A deck is constructed which, for all practical purposes, is identical to that on the ROSS DARING conversion discussed earlier in the paper.

One of the advantages of this scheme is that a side trawler is converted into a stern trawler. However, it would generally only be suitable for small vessels having limited superstructure.

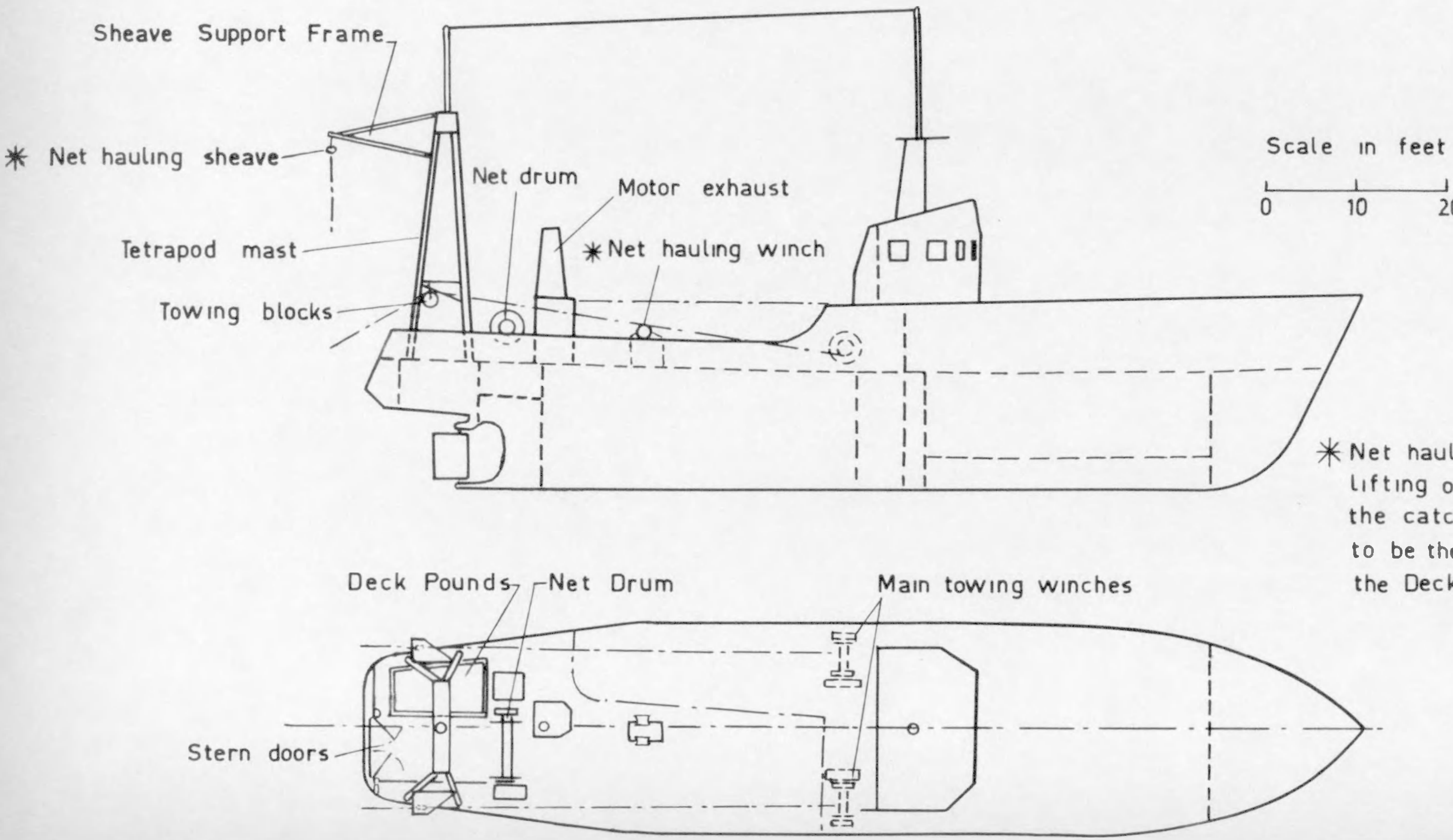
Net Drum Systems for Large Stern Trawlers.

On large stern trawlers the use of net drum systems can offer a most important additional advantage in that apart from a saving in man power they can be used to minimise the fishing time which is lost through damage occuring to the trawl. This is illustrated in Figure 9. It will be seen that two net drums of the general size and form illustrated in Figure 4, have been installed more or less side by side on the working deck of a 250 ft. stern freezer trawler. The warps have been taken over the drum by the use of an additional gantry and the only other major modification has been to widen the top of the ramp.

With an installation of this sort it will be possible to haul one trawl until the cod end is forward of the hatch leading down to the gutting pounds. It will then be possible to shoot the trawl on the second drum before spilling the cod end of the first and, of much greater economic significance, before mending the first trawl. The same pair of trawl doors is used for each trawl.

A detailed analysis has been carried out on the potential improvements which this system might be able to offer on typical stern freezer trawlers, fishing for demersal species. Several voyages have been studied and these show that between 7 % and 10 1/2 % of the available fishing time is lost through having to wait for the trawl to be mended. This could be eliminated by the use of the double net drum system.

99 ft. Overall length stern fishing trawler converted to net drum fishing.



✳ Net hauling refers to the lifting of the net holding the catch, out of the sea, to be then unloaded into the Deck Pounds

Figure 1

SKETCH OF NET DRUM FITTED TO ROSS DARING

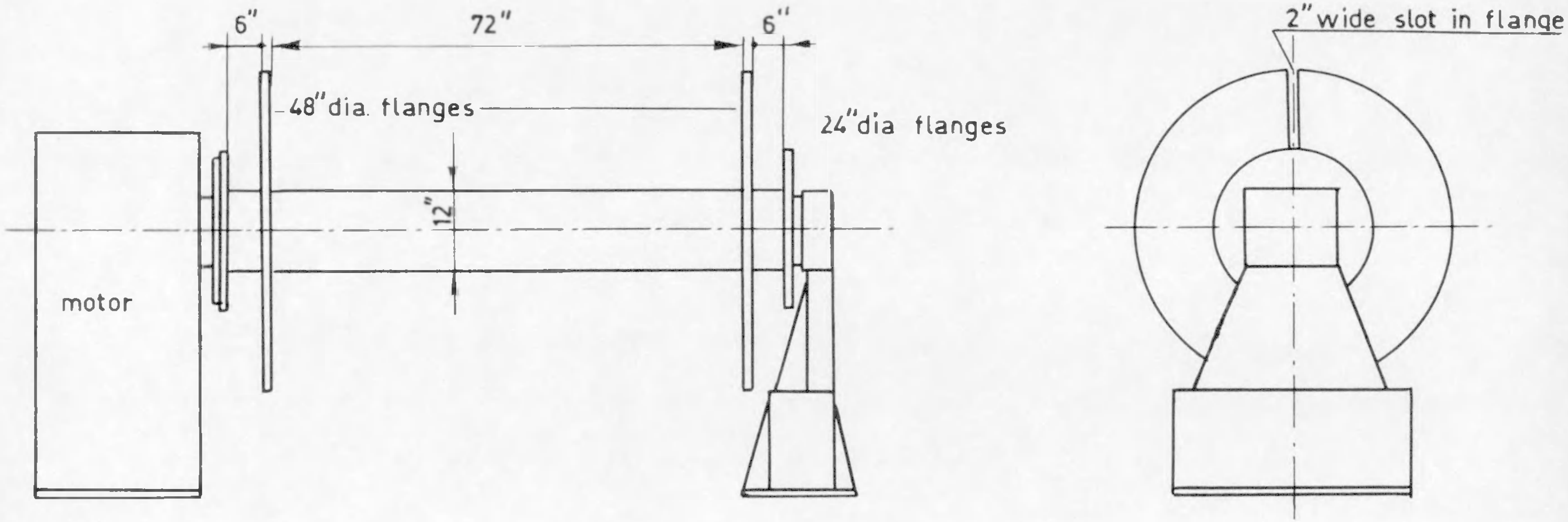


Figure 2

ROSS DARING TRAWL

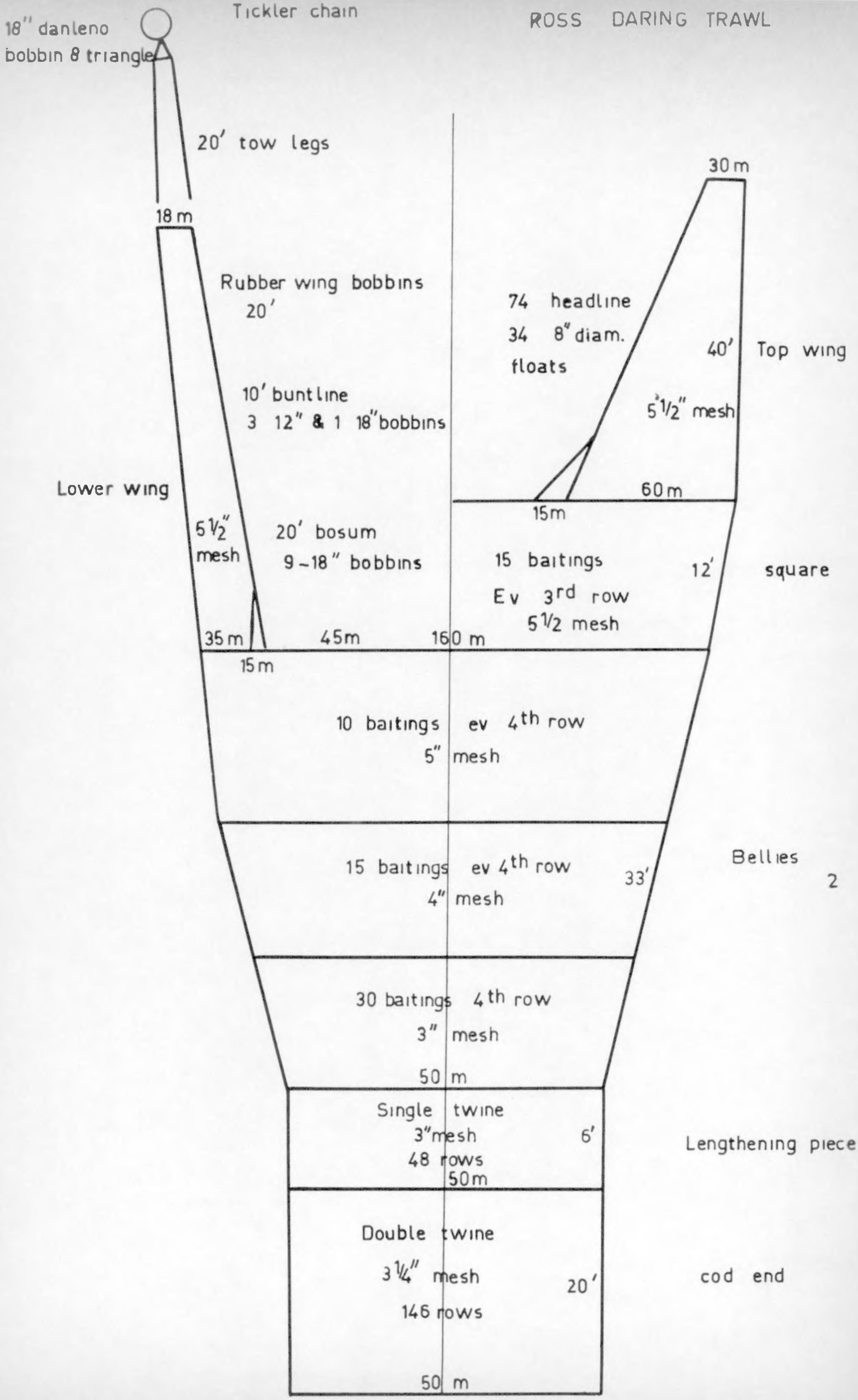
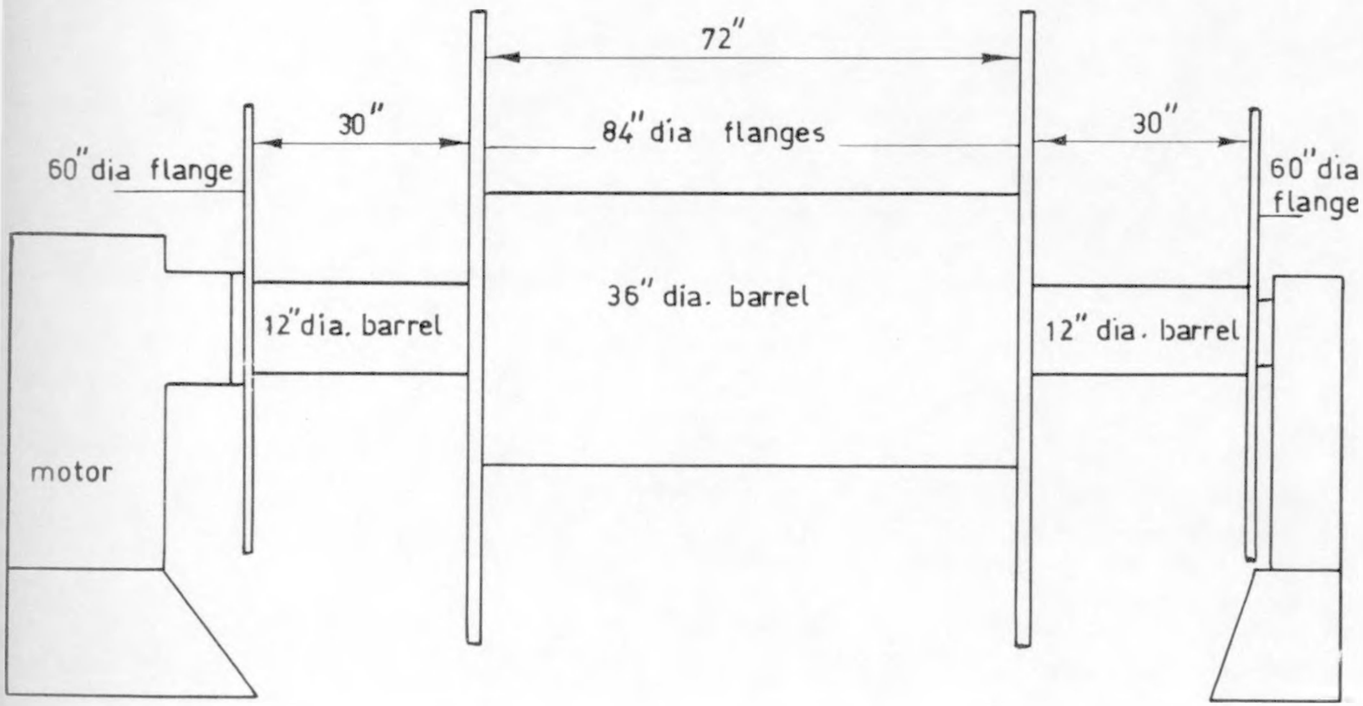
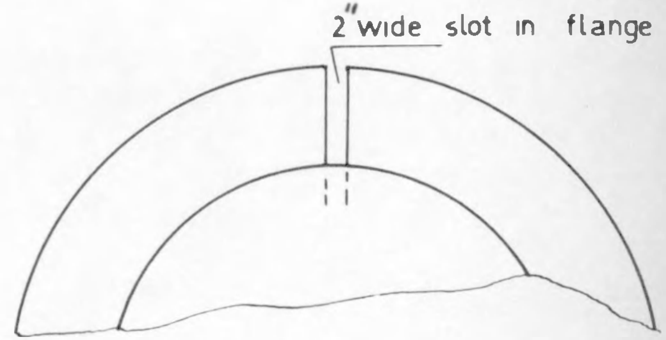


Figure 3

SKETCH OF NET DRUM FOR DISTANT WATER VESSELS





Maximum torque developed 30,000 LB/Ft
Ultimate load rating 60,000 at 6" above winch Ø ie 27,000 LB/Ft moment on base.
Maximum working load predictable = 9,000 LB at 7'-6" above winch Ø
ie 68,000 LB/Ft moment on base

Figure 4

175 ft. Overall length side fishing trawler
designed for conventional side fishing

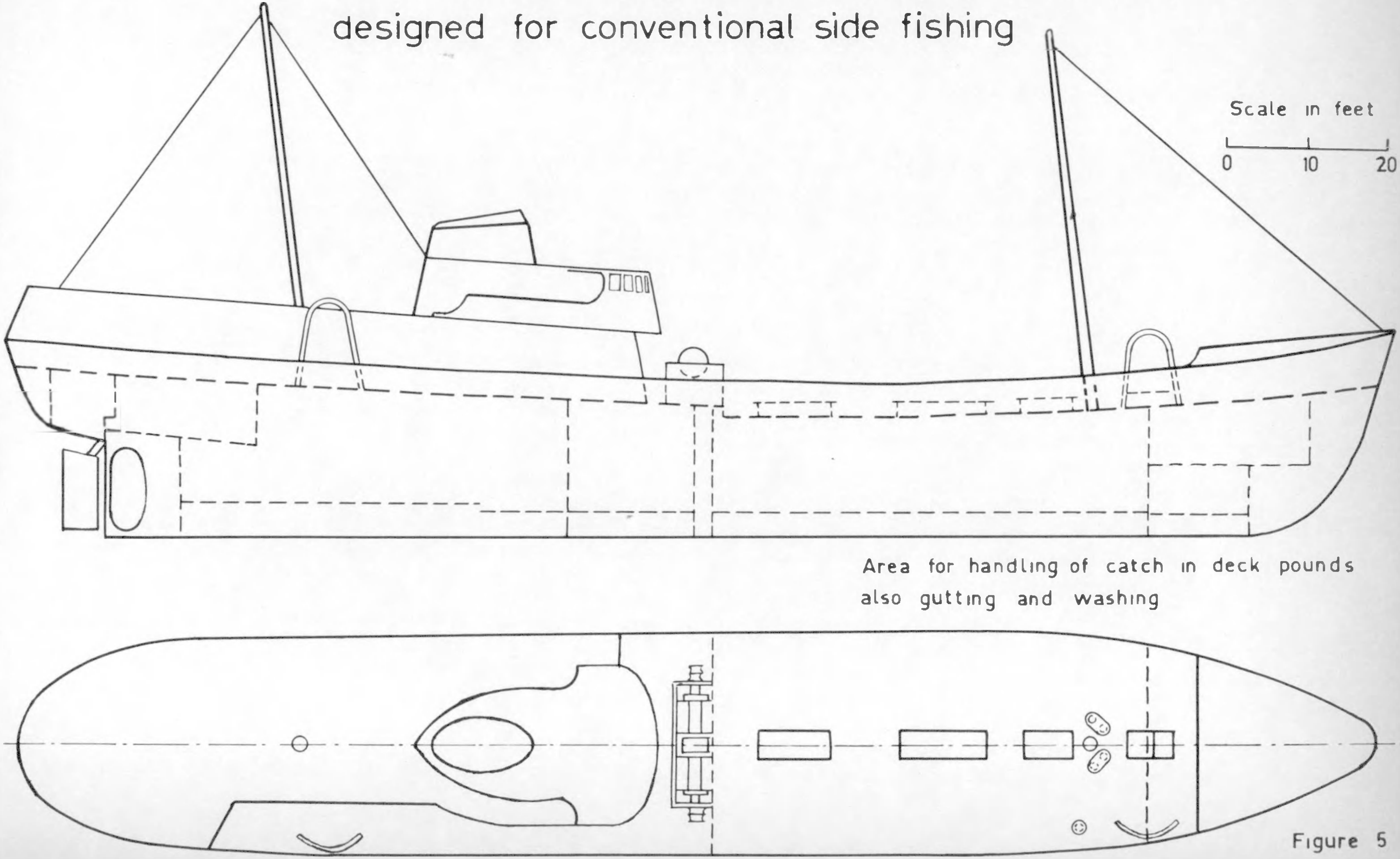


Figure 5

175 ft. Overall length side fishing trawler after conversion to net drum fishing

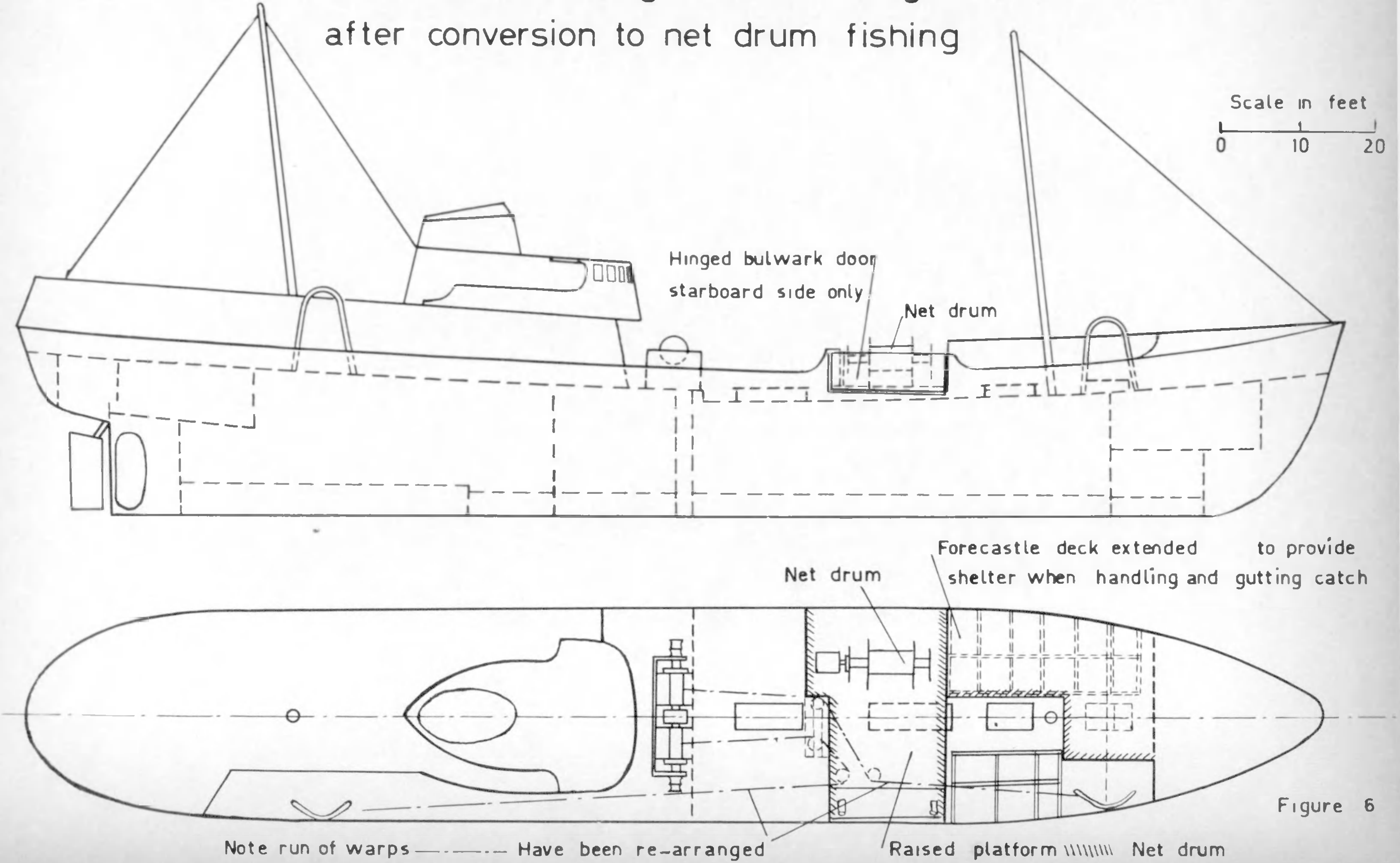


Figure 6

106 ft. Overall length side fishing trawler designed for conventional side fishing

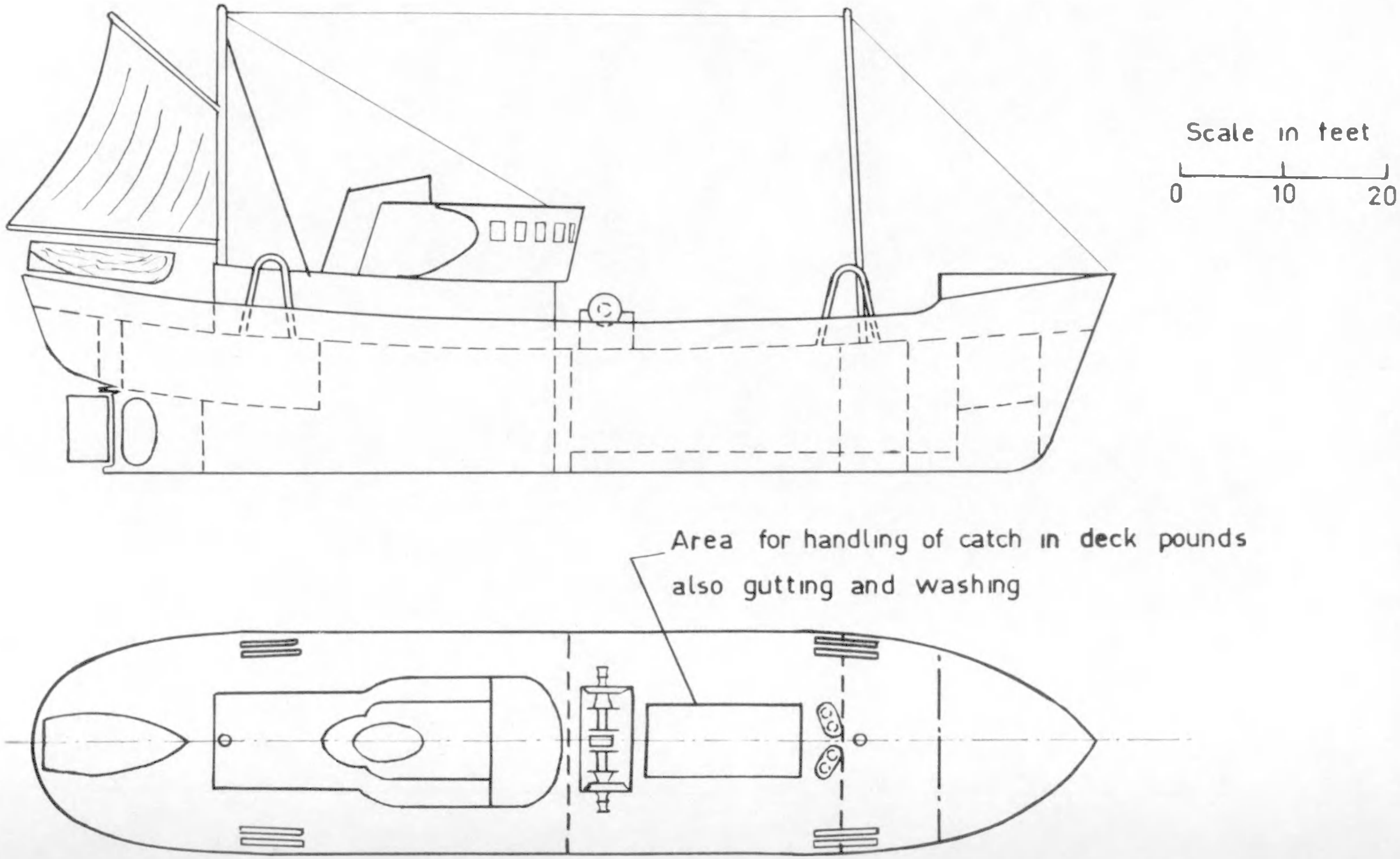


Figure 7

106 ft. Overall length side fishing trawler after conversion to stern operated net drum fishing

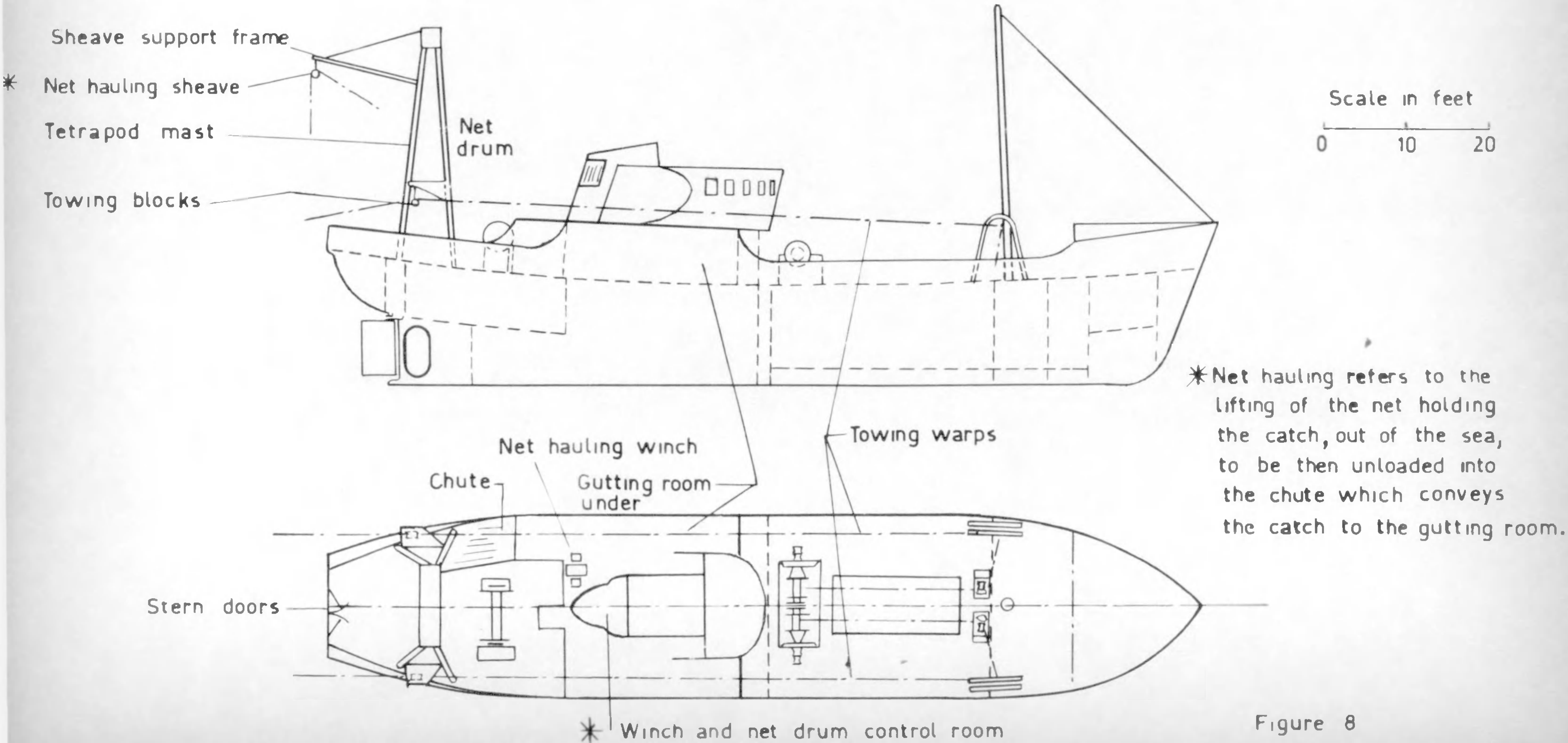


Figure 8

231 ft. Overall length stern fishing freezer trawler fitted for twin net drum fishing

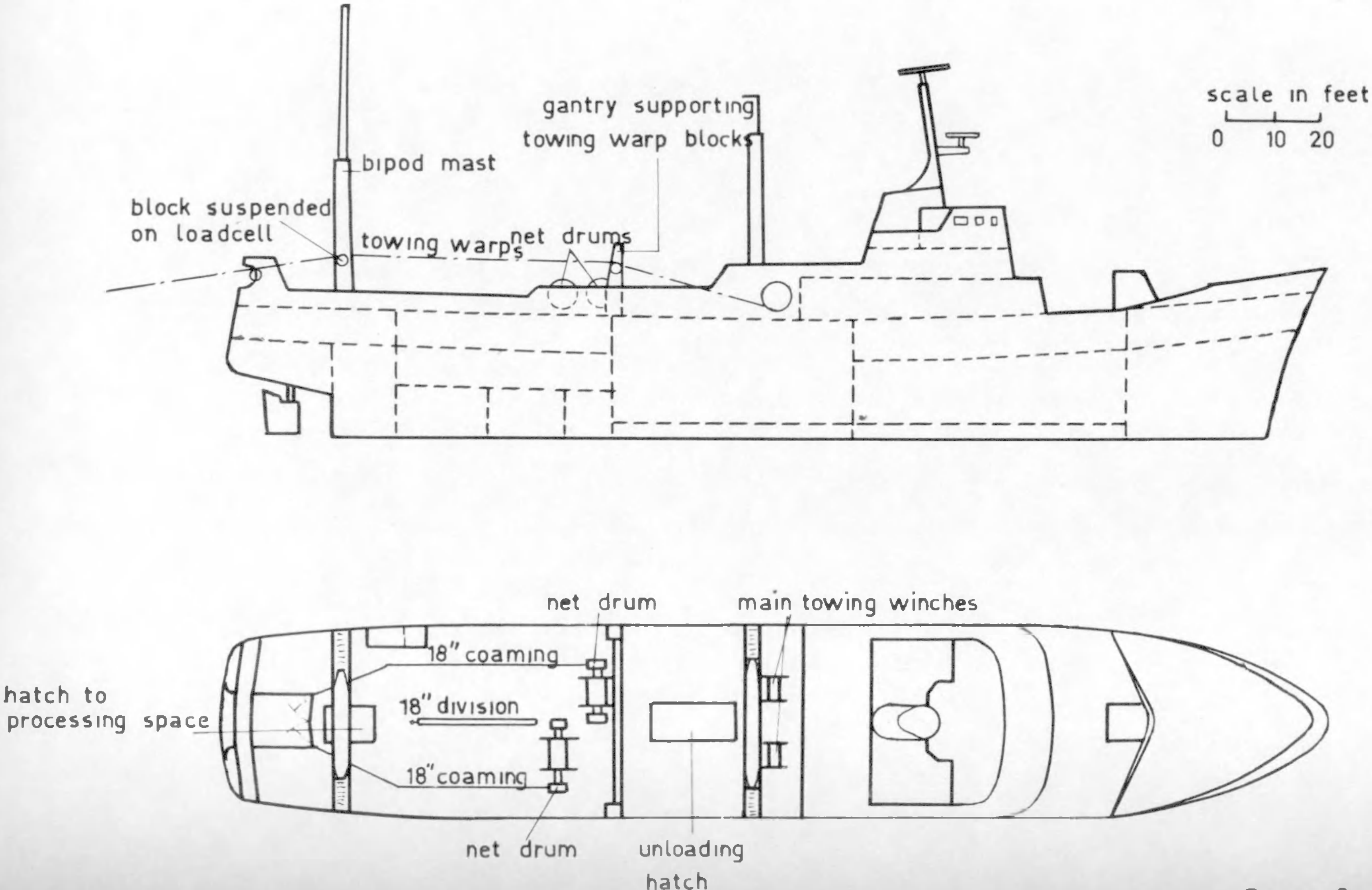


Figure 9

NOTES ON INSTRUMENTATION DESIGN RELEVANT TO THE APPLICATION OF COMPUTER TECHNIQUES TO GEAR RESEARCH

by

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Illustrations

Figure

Summary.

At the Marine Laboratory, Aberdeen, a computer based data logging system is being developed to further the understanding of trawl gear behaviour. This paper describes the instrumentation and associated hardware which will be used on-line to the computer in full scale gear trials. Measurements to be made can be divided into two groups, those made on the ship and those relating to the underwater parts of the gear. The former group can be connected to the system in a conventional way. However, the large distance separating net and board instruments from the ship makes it necessary to employ telemetry techniques for underwater measurements. Two telemeters links intended for operation from an otterboard and the net respectively are described in detail.

1. Introduction.

The experimental investigation of fishing gear performance presents special problems to the instrument designer, because he has to develop equipment to make measurements in a generally unfavourable environment. The problems are less severe at the surface of the sea, for example, ship performance tests, warp tension measurements etc., because the positions where the observations must be made are relatively accessible. However, when it comes to making measurements underwater - on the gear itself - the difficulties are indeed great and, in general, a remote underwater instrument will yield less information per test than a comparable instrument of similar complexity on the surface. The main reason for this lies in the way in which the respective measurements are made. At present, the underwater instruments used by the Gear Research Unit of the Marine Laboratory record the data as a trace on a paper chart, which cannot be examined until after the test, i.e. the haul, is complete. This technique is an example of <u>off-line</u> measurement, i.e. the data are not made available to the observer until some time after the measurement has been made. On the other hand, an instrument on the ship whose output is displayed to the observer is <u>on-line</u>, that is, the data can be examined at the same time as it is produced.

An important limitation on the performance of an off-line system arises from the inherent timing inaccuracy. Any measurement can be considered to be an average taken over a certain period of time, T ; thus the probable error in specifying the time to which the measurement refers is of the order of $\pm$ 1/2 T. Further, this means that two events separated in time by a smaller period than T cannot be compared in detail with one another, because one measurement may include a contribution from both events.

With the present off-line techniques available for gear research, T may be several minutes long, or even more. This means that transient or high frequency effects, such as gear pertubations or instabilities, cannot be studied in any detail.

Measurements which have been made with off-line instruments here led to a deeper understanding of the mechanics of gear behaviour, but they have also shown that much more could be learned if T were substantially reduced.

Obviously, the answer is to make all the measurements on-line. We then come up against the limit set by the capabilities of the human observer, who can only make a limited number of observations per unit time, and the resulting data rate is still unacceptably slow. Here, however, is where the power of digital computing techniques can be used to advantage. A data logging system which is controlled by a digital computer can record information at a rate which is orders of magnitude greater than is possible with "pencil and paper" techniques. Further, the data logging is more accurately and reliably carried out, as the computer will not bias its decisions in the way that a human observer may tend to do (albeit without conscious knowledge of the fact).

The computer is a very flexible tool ; as well as the basic process of recording data, calculations can be carried out using these same data - at the time it is logged, if required. For example, the data can be corrected by the application of calibration routines as the recording process goes on. This again shows how the computer can take over routine tasks, so releasing scientific effort for more intellectual pursuits.

The measuring instruments used must be good enough to make full use of the power of a computer based logging system. The characteristics required of such instruments, as described in the following paragraphs, are in general quite different from those pertinent to an off-line system.

2. The Basic Requirements and Methods of Gear and Environment Testing.

The object of the process of physical measurement, as applied to gear research, is to increase our knowledge of the engineering factors which have a bearing on trawl performance. Part of the problem, with the current state of the art, is to elucidate the interrelationships between various sets of parameters ; it has been shown by past work that a change in one feature of a gear gives rise to changes in many other parameters, often in a yet undefined manner. This means that the environment and physical behaviour of the gear must be comprehensively monitored. If there are gaps in the information available from a particular test, that is, certain parameters were not logged for one reason or another, the analyst may be severely hindered in his work on the results. For this reason it is true to say that one test with a complete set of results is more desirable than many tests for which only some results are available.

Having considered the main requirements for environment and gear measurements, the set of instruments outlined in Fig. 1 was chosen to be used with the computer installation on F.R.S. "Explorer". It should be emphasised that this is a basic set of instruments ; it is planned to extend and adapt it in the future. The system as a whole has been designed so that such an expansion can be easily carried out. This kind of flexibility is an inherent feature of computing techniques, and is one of their main attractions (1).

A fishing gear cannot be considered in isolation from the ship which is towing it, a fact which has been made abundantly clear by the knowledge gained from comparative fishing tests. A number of instruments are therefore used, as shown in Fig. 1, to measure ship performance and related parameters. These form the more conventional part of the data logging system because, being on or close to the ship, they are readily accessible. All shipboard instruments are cable connected in the normal way to the "central processor" and "interface" equipment. The central processor carries out all arithmetic, recording and controlling operations on the data. However, the computer itself can only understand data presented to it in conformity with its own special requirements, and this is almost always different from the form in which the data are produced by the instruments. It is therefore necessary to interpose an "interface" unit between the measuring instruments and the computer itself. All the interface does is to translate instrument output signals into the form understood by the computer, and vice versa if the computer is used to control the action of the instruments.

The situation is rather different for those instruments which will be attached to the underwater parts of the gear. The use of a separate electrical cable connecting these to the ship has several disadvantages which include difficulty in handling and possible interference with the rest of the gear. In the system under discussion (Fig. 1), independent cables of this type are not used. Instead, data transmission between the net and the ship is to be carried out over an acoustic telemeter link, while otterboard data is transmitted over an electrical telemeter link which makes use of a cable conductor internal to the towing warp. More will be said about these later, but a most important point to be borne in mind is that the bandwidth available on both telemeter systems only allows one channel of information to be transmitted at a time. In other words, one reading from one instrument is transmitted over the link, followed by another reading from the same or a different instrument, and so on. This technique is referred to as serial data transmission, as opposed to parallel data transmission in which the data from several instruments are transmitted simultaneously. Serial transmission is slower, but is less prone to errors than parallel techniques.

3. The Control and Operation of the Complete On-line System.

A block diagram of the computer based data logging system which is being developed for gear research on the F.R.S. "Explorer" is shown in Fig. 2. The arrows on the lines connecting the various blocks show the direction of information flow between the various parts of the system.

The basic elements of this system comprise :

a) the instruments, which are connected to

b) the interface, which is in turn connected to

c) the memory and arithmetic units, i.e. the central processor.

d) The operator, who communicates with the central processor using

e) the peripherals. These are simply input/output devices ; for input, a paper tape reader and an electric typewriter ; for output, a teleprinter (for typed messages), paper tape punches and a graph plotter.

Note that the operator is not in direct communication with the actual measuring instruments. Any control action (e.g. changes of reading rate) which the operator wishes to carry out with these is done indirectly via the central processor.

It is not in general possible to standardise the system so that all instrument outputs are identical in form. Correspondingly, more than one type of interface is normally required. Basically, instruments provide data which are in either <u>analogue</u> or <u>digital</u> form. An analogue quantity, in the present context, is an electrical voltage or current whose magnitude can take a continuously variable range of values. The magnitude of such a signal is the data which is wanted. For example, the warp declination meter gives an output which can be anywhere between 0 and 9 millivolts, corresponding to a declination angle which lies between 0 and 45 degrees. This instrument therefore gives an analogue output. On the other hand, a digital signal is (in this context) a voltage or a current which is coded in some way to represent a discreet <u>number</u>. In this case the magnitude of the voltage or current is of secondary importance, as it is the <u>number</u> which the signal represents which is required. For example, consider the engine RPM meter ; this instrument produces an electrical pulse each time the main shaft rotates through 4.5 degrees. The height of this pulse (height is of course an analogue quantity) does not depend on the RPM, and so is quite immaterial so long as it is sufficient for the pulse to be detected by the interface. What matters is the number of pulses which are produced in a given period of time, and this is digital information.

The digital computer, as would be expected from the name, operates entirely with pure numbers. The digital interface is therefore a relatively simple unit which switches the various digital signals going into it on to the one output line, as required, and also converts them to the precise digital code required by the computer. The analogue interface switches input signals in a similar manner, but in addition must convert them to the digital form demanded by the computer. The latter function, appropriately, is carried out by an "analogue to digital converter".

The third interface unit shown in Fig. 2, the "navigational interface", is in fact an extension to the digital interface, but is shown separately because it is a special purpose unit specifically intended to handle the Decca Navigator.

It will be seen from Fig. 2 that the information always flows from the instrument to the computer, never the other way around. In other words, the computer does not control, the operation of the individual instruments which therefore produce data in a manner quite independent of the working of the central processor or interface. To this extent the instruments and the computer work asynchronously. However, the computer can still control the operation of the whole system because it has control of the switches in the interface units through the connecting lines. In this way the computer can cause the connections to a particular instrument to be switched in so that data from that instrument (and only from that instrument) can be read into the computer memory. Henceforth this process will be referred to as "looking" at the particular instrument. The asynchronous technique has the advantage of being very flexible - it is relatively easy to change the mode of operation of the system - but it does require that instruments be looked at often enough not to miss significant data.

So much for communication between the instruments and the computer, But the human operator also has some communicating to do - with him rest the real control of the system. This function is carried out by the four blocks shown at the bottom of Fig. 2.

Before actual logging begins, the computer must be supplied with a set of instructions telling it precisely what to do. These instructions (other-wise known as the "program") are kept as a permanent record on a roll of paper tape. By running this tape through the paper tape reader the program is then read by the computer and stored in its memory. Then, and only then, can the computer be set to carry out its logging function. It does this by looking at individual instruments one at a time, stepping from one to another in a sequence which is predetermined by the program. This is not simply a matter of looking at each instrument once, cycling through the lot and starting again ; for various reasons some instruments have to be looked at more often than others, but this requirement is built into the initial program. Of course, the operator may wish to alter this sequence at any time during logging. He does this using the electric typewriter. The initial program read in included, as well as basic logging instructions, a set of instructions to allow the computer to look at the typewriter from time to time, and to interpret the operator's typescript. For example, suppose that initially the computer was set up to look at both the declination meter and the propeller thrust 4 times per second. The operator might type the equivalent of "from now on, do not look at propeller thrust at all and look at the declination meter 16 times per second". The computer would interpret this, and alter its internal logging instructions accordingly. Such a facility allows a very high degree of flexibility and ease in operation control of the system.

The timing of the logging sequence is determined by a crystal clock. The basic pulse frequency derived from the clock is divided down by the computer to give other time intervals necessary for sequence control. The longest time period required is 30 seconds, this being the fundamental logging period. The system repeats its actions in successive 30 second periods (unless the sequence is modified by the operator) - that is, it has a basic cycle which takes 30 seconds to complete.

During a fundamental logging cycle, the computer looks at each instrument a number of times, some, of course, more often than others. The central processor carries out some arithmetic on the resultant large quantity of data, to compress it into a more manageable amount. This essentially means that all the readings from one instrument in the 30 seconds are used to form the following quantities:

1. Mean value
2. Standard deviation
3. Maximum reading
4. Minimum reading
5. Number of readings

At the end of the 30 seconds, those five quantities are output as data on paper tape by a paper tape punch, to give a permanent record. Alternatively, uncompressed data can be output on the graph plotter for visual display, if the operator so desires.

The above is a greatly over simplified description of how the computer based data logging system will work in practice. In fact, the on-line computer can and will do much more than these basic operations. Other features which have been designed into the system include :

1. The application of calibration routines to instrument data.
2. The detection of erroneous instrument readings and the output of appropriate messages on the teleprinter.
3. The calculation of position and speed from navigational data.
4. The combination and correlation of the various readings to check on their validity.

However, as this paper is mainly concerned with the instruments and associated hardware, these need not concern us further here.

4. Shipboard Instruments.

4.1. General.

This heading covers all measuring equipment at the surface end of the gear, as well as that relating solely to ship performance.

It has already been stated that the gear cannot be considered in isolation from the towing vessel. A gear which operates satisfactorily from one ship may not do so from another for various reasons, the most important of which is, of course, ship power available. However, ship performance measurements in research are also useful for the more general reason that they complete the picture of the environmental conditions relating to the test results. In addition, it is always useful to be able to carry out correlations between sets of independent measurements, so that errors or failures which have occurred can be easily detected. Preferably, this correlation should be done at the time of the test so that there is a chance of rectifying the fault before further results are recorded, which may by later correlation be found to be invalid. So, for example, propeller thrust, RPM and wind measurement may be used, with a knowledge of ship hull characteristics, to give an independent estimate of water speed. The ability of the digital computer to carry out such correlation calculations, which may involve a large number of arithmetic operations in a relatively short time makes it possible to program a really comprehensive self check facility into a computer based data logger.

4.2. Ship's speed.

The measurement of water speed is of central importance to the whole procedure of analysing gear performance using instrument data. Quite apart from obvious engineering considerations, the catching power of a trawl is also speed dependent through various fish behavioural parameters, such as fish swimming speeds (2). In the past the usual technique for measuring water speed has been to use propeller operated instruments, such as the Chernikoef log. These suffer from the disadvantage that the propeller rotation speed, which is nominally proportional to water speed, is also affected by other factors such as mechanical alignment and growth of marine organisms on the propeller shaft. However, several other techniques can now be used for water speed measurement which do not require such vulnerable mechanical linkages. The instrumentation system which will be installed on "Explorer" includes a new speed log, developed by the National Institute of Oceanography, Godalming, which is of this type. The electromagnetic principle, which makes use of the conducting properties of sea water, is employed. A magnetic field is generated in the water by a coil in the body of a probe beneath the ship. A schematic of this arrangement is shown in Fig. 3. The log measures independently both forward and sideways components of ship's speed. This is a most useful feature, particularly where side trawling is concerned, as the assymetry of the towing point with respect to the centre line of a side trawler can lead to a significant "crabbing" movement, i.e. sideways velocity. The movement of sea water relative to the coil magnetic field causes electric currents to flow in the sea. These are detected as voltages picked up by probes AA' (for the forward velocity component) and BB' (for the sideways component). These voltages are proportional to the respective velocity components, and are transmitted to the analogue interface.

4.3. Wind parameters.

A record of wind speed, and also wind direction, is required as part of the general environmental information relating to a gear test. It is also useful for obtaining the towing capability of the ship in relation to a particular gear, as a function of weather conditions. This relationship can be deduced empirically, or theoretically through a knowledge of the wind drag characteristics of the ship's superstructure.

Wind speed is simply converted to an analogue signal by using a cup anemometer to drive a dynamo. Many commercially available anemometers incorporate such a system to drive a remote indicating meter, so it is not necessary to carry out special modification to the mechanical parts of the anemometer to render it suitable for connection to an on-line system.

The accuracy of the cup anemometer is not particularly good. The response time to changes in wind speed is long, and moreover is not the same for an increasing speed change as for a decreasing change (3). The reading is also affected by, among other things, the roll of the ship. It may be possible, however, to compensate for this by carrying out a special calibration routine in the computer using the information available on the ship's roll (see below, section 4.4.2.).

The wind direction, relative to ship centre line, is to be determined by coupling a wind vane to the shaft of a "sine/cosine" potentiometer. A conventional potentiometer is not used because it suffers from the disadvantage that the winding does not cover the full 360° of a revolution, so that the bearing cannot be accurately determined when the wind is in certain directions. The sine/cosine pot, however, gives two voltage outputs (one proportional to the sine of the wind direction angle, the other to the cosine) which do not suffer from any such discontinuities. By connecting these two outputs to the analogue interface the wind direction angle can be arrived at by dividing the two voltages and computing the arctangent of the result.

4.4. Other new developments.

4.4.1. Engine RPM.

At present engine RPM is determined by counting pulses which occur each time a contact linked to the main shaft closes. This contact closes once per revolution of the main shaft ; the resulting pulse rate is far too slow to give the enhanced measurement resolution which the computer installation is expected to make possible. To increase the pulse rate, a proximity detector will be positioned above an accessible 80-tooth gear wheel on the shaft. The detector will give one pulse each time a single tooth passes it, thus giving an 80-fold increase in pulse rate for a given RPM value. The line carrying these pulses is connected to the digital interface, for pulse detection and counting under computer control.

4.4.2. Block accelerations.

The towing block is a critical point, particularly on a side trawler, as all mechanical interactions between ship and gear must be effected by coupling through the block. This point was therfore chosen as the location for an instrument to measure angular motions, which are regrettably a fact of life on board a ship.

Three angles must of course be measured independently, namely, roll, pitch and yaw. This will be done using three strain gauge accelerometers mounted in the same frame. Thus three lines must be connected to the analogue interface, carrying voltages proportional to the respective accelerations. The instantaneous angles and angular velocities can then be obtained by integration within the computer.

4.5. Existing instruments adapted for the computer installation.

The reader will no doubt be familiar with the present generation of instruments which have been used by the Marine Laboratory for fishing gear research (4). Leaving aside underwater instruments for the present, the fact that all the equipment was designed to give an output suitable for paper chart recorders considerably eases the problem of adapting them for use with the computer installation. The analogue interface (Fig. 2) will accept signals in the range -20 millivolts to +20 millivolts. This covers the range of the chart recorders used at present, i.e. 0 to +12 millivolts. Thus the warp divergence and declination meters, deck warp tension cells and propeller thrust meter are already compatible in signal output range with the analogue interface. Some minor modifications will have to be made, however, to increase the accuracy obtainable from this equipment to suit the capabilities of the new system. These will include improved transducer power supply stabilisation and reduced signal source impedance.

Finally, a word about the echosounder. The output from this can conveniently be presented to the computer in digital form in the way illustrated by Fig. 4. A bistable output is only "flipped" between the times of sounder transmission and the reception of the return pulse from the sea bed. The computer can recognise the state of the bistable output, via the digital interface, and so can determine the transmit-receive interval by counting pulses from the crystal clock during this period. A relatively simple operation will then convert this time into the required depth. This basic system could give rise to problems should the level of pulse discrimination be such, that midwater echoes were sometimes mistaken for the sea bottom. Errors due to this effect can be considerably reduced by using an echo-sounder with a "bottom look" facility ; a sounder of this type is available on the "Explorer". A further elimination of errors can be effected by programming the computer to recognise spurious readings on a statistical basis.

5. Underwater Instruments.

5.1. General.

The problems relating to the interface between shipboard instruments and computer are fairly conventional, as the equipment is quite accessible. Quite a different situation holds for the instruments on the net or other underwater parts of the gear, which may be as much as half a mile from the observer on the ship, and furthermore under several hundred feet of water. This situation calls for the use of some kind of telemeter system which will transmit the information across such distances with a minimum of degradation. The simplest form of telemeter would employ an independent cable to carry electrical signals from gear to ship. However, a major aim in the development of the new system was to keep to a minimum the extra bits and pieces which have to be attached to a gear, to reduce the effect of the instrumentation on the behaviour of the gear. So, other media will be used for signal transmission as described in sections 5.2-5.3.

Signals are normally transmitted over a telemeter link in digital form. This is done to reduce the effect of interference to the signal from outside sources, which is usually a big problem in telemtery applications. This means, of course, that where instruments giving an analogue output are being used underwater, the ADC on the ship cannot be used ; instead, separate ADC's in the underwater telemeter control units convert these outputs before transmission across the link, following which the signal goes direct to the digital interface.

5.2. Net instruments.

A number of telemeter systems for the transmission of data from a fishing net to the towing ship have been described ; (5, 6, 9) indeed, equipment of this nature is available commercially. However, such equipments are almost exclusively concerned, at the present time, with single channel measurements. That is, the instrument only transmits information on one parameter of the gear, for example, the depth of the headline beneath the surface. Obviously, to get a more comprehensive coverage of the gear, information from a number of instruments must be transmitted across the link. Now the telemeter links described here are basically single channel, i.e. can only carry information from one instrument at a time, and this means that all the instruments must be selected in turn for connection to the transmitting circuitry, so that over a period of time data on more than one net parameter is received at the ship.

At the Marine Laboratory, Aberdeen, a single channel telemeter has been developed to measure the distance between the wing ends of a net (5). Work is now in progress, aimed at the extension of this system to handle up to 16 separate instruments on the net, and it is expected that a 16-channel instrument should be operational about the time when the computer equipment will be installed on the F.R.S. "Explorer".

Information will be transmitted from net to ship as acoustic signals in the water. The performance of an acoustic link is limited by the far from ideal acoustic transmission properties of sea water. In particular, the data transmission rate is limited by the existence of "multipath" effects, i.e. the results of multiple scattering of acoustic waves by particles in the water (7).

Experiments have been carried out on F.R.S. "Explorer" using the net telemeter transmit and receive units to determine the magnitude of this limitation. The results obtained show that in normal conditions, with suitably chosen acoustic transducer beamwidths, it should be possible to sustain a data transmission rate of one channel per second. To optimise the maximum transmission rate, the transducer beamwidths must be made as small as possible while still allowing easy transducer alignment. It further helps to differentiate between horizontal and vertical beamwidths, and the Aberdeen net telemeter employs two separate transducers in the transmitting unit to achieve this. Having done this, a single transducer in the receiver unit was found to be quite adequate.

The essentials of a single channel telemeter are shown in the bloc diagram of Fig. 5. A sequence controller generates a series of pulses at regular intervals. Each time one of these electrical pulses occurs, an acoustic pulse is transmitted from one of the transducers. A certain time after this event, the second transducer detects the acoustic disturbance, reconverts it to an electrical pulse which is amplified and fed back into the system. A timer is used to measure the time interval between transmit and receive pulses, which is simply done by gating an oscillator on with the first and off with the second. The resultant number of oscillations is fed to an encoder, which converts this digital distance information into another digital form better suited for transmitting across the acoustic link to the ship.

The extension to this basic system to incorporate more than one parameter is shown in Fig. 6. This time, as well as producing a series of pulses (each of which causes one measurement to be made) the sequence controller also generates a "channel select" signal which tells the rest of the system which measurement is going to be made when the next pulse occurs. Firstly, the channel select signal is used to set the multiplexer so that only those sensors relating to that particular channel are connected to the measurement circuitry when the next pulse occurs. Also, the encoder must have the channel select signal available, because each measurement which is transmitted to the surface is accompanied by further data which explicitly gives the appropriate channel number. In this way, there can be no ambiguity in deciding (on the ship) from which of the net instruments a particular measurement comes.

It will be seen from Fig. 6 that two kinds of parameter sensor are connected to the system. Firstly, there are those concerned with measuring distance, the operation of which has already been described above. Secondly, we have a quite different (but more general) type, which includes sensors to measure tensions, depth, temperature, etc. The common feature of the latter group is that these instruments can all be conveniently made to give a voltage analogue output from a transducer bridge circuit. Therefore, as far as the rest of the system is concerned, all such instruments appear identical. The most useful instrument in this group is the load cell, for measuring the strain in bridle and other wires. The following paragraphs will consider exlusively the connection of load cells to a multichannel telemeter system, but of course what is said there could equally apply to the connection of some other parameter sensor.

Two quite general points must be made before proceeding with a more detailed description.

a) In order to reduce the complexity of the control circuitry, all instruments connected to the system must produce as nearly as possible the same kind of signals. Now the system under discussion was conceived as a distance measuring device, using acoustic transducers. So, the addition of load cells to the system can be most efficiently carried out by arranging that the system gets data from the load cells in an equivalent form to that from distance sensors, i.e. as a pair of pulses separated in time by a period proportional to the parameter it is required to measure.

b) Good underwater connectors are very expensive, and their cost and size both rise rapidly with the number of pins on the connector. Therefore, the smaller the number of leads in the cable connecting the control circuitry with a load cell the better ; ideally this cable should have only two leads, one screen and one inner. This means of course that any power required by the instrument must be carried by the same leads as the data signal, but this does not give rise to any great difficulty.

A tension to be measured is converted to a proportional voltage from a bridge circuit by means of a pressure transducer hydraulically coupled to a piston under load. The bridge output voltage by itself satisfies neither of the above stated conditions : (a) for obvious reasons and (b) because 4 leads are required for a bridge circuit. The answer to this is to incorporate some additional circuitry in the load cell itself. Circuitry for this purpose has been developed, and is shown as a block diagram in Fig. 7. The operation of this circuit is as follows. Initially, the clamp is switched on, and holds the voltage across C1 at some fixed value, Vref. C1 is connected to one input of a comparator, the other input being connected to the output of a differential amplifier which is required to raise the (normally) low signal voltage obtainable from the bridge circuit to a suitably higher level, say V_o. Vref must be less than the smallest possible value of the amplifier output voltage. Now suppose that the sequence controller (Fig. 6) generates a pulse, and it requires information from this particular load cell, then the multiplexer is set to feed this pulse via C3 down the connecting cable to the lead cell, and so via C2 to the clock input of the binary, which then changes state. The binary output controls the clamp, which now switches off (i.e. the clamp output goes open circuit). Therefore, the current I is allowed to flow into C1, and as a result the voltage across C1, starting from Vref, increases linearly with time. This continues until a voltage level equal to V_o is reached. The comparator detects this condition, and triggers the pulse generator. This has two effects, (1) the binary is reset, causing the clamp to come on again, so returning the circuit to its initial condition, and (2) a pulse is sent back down the connecting cable, to the control circuitry, and is used via the multiplexer to stop the timer. Clearly, provided the voltage ramp across C1 was sufficiently linear, the time delay between the first and second pulses is proportional to V_o-Vref, which is linearly related to the quantity it is required to measure. So, by the use of this circuitry the same timer, encoder, etc. as would be used for distance measurement has been used to provide a digital measurement of a transducer analogue output.

The distance and tension sensors have not been made exactly equivalent, as there would be no point in using the HV pulse generator (Fig. 6) here. Indeed, the operation of the HV pulse generator while a load cell channel was being sampled could lead to undesirable interference effects, and so this unit is inhibited in these circumstances by a gate and a decoder. The latter detects the condition "load cell channel next" from the information supplied to it on the channel select line.

Based on "worst case" component tolerances, the measurement error (assuming a 5° C ambient temperature range) introduced by the load cell circuitry has been calculated to be somewhat less than 1 % of the full scale measurement. A typical error figure would be less than 0.5 %.

The circuit described above can, as was stated, handle the outputs from a variety of transducers. It is therefore proposed that a quantity of these circuits will be manufactured so that they can be used in any extensions to the fully developed system required at a later date. This will result in a very flexible system, as an additional instrument could be incorporated in the telemeter merely by selecting an appropriate transducer, wiring on a circuit card and connecting to the control unit using the standard cable and connectors.

5.3. Otterboard instruments.

It is not a practical proposition to connect instruments located on or near the otterboards into the net telemeter system, because of the distance separating the two parts of the gear. It is not only the distance itself which is the problem, but also the damage which could result through frequent ground contact if a cable were, say, attached to a bridle wire on a bottom trawl. Therefore, a quite separate telemeter link is required to service otterboard instruments.

A set of instruments, together with associated control and telemeter equipment, specifically intended for otterboard measurements has been developed by the Central Institute for Industrial Research, Oslo. It is proposed that this instrument set be used, in conjunction with the digital computer, to obtain detailed information on the behaviour of otterboards on gears worked from F.R.S. "Explorer". Details of the board instruments and control equipment have been described at previous I.F. meetings (8), and need not be repeated in this paper.

The control unit of the board telemeter selects in turn the instruments connected to the system, and digitises the instrument reading to finally produce a frequency division multiplexed output. In other words , data from each instrument (one at a time) is converted to a pulse train whose frequency is related to the quantity it is required to measure. The question now arises as to how these pulses will be transmitted from the board to a receiving terminal on the ship. Two means of doing this are available with the standard telemeter set ; these are an independent cable connection, or an acoustic link. The independent cable is of course an excellent medium for the transmission of electrical signals, but as already stated has serious engineering disadvantages, particularly when used on a bottom trawl. On the other hand an acoustic link would also be undesirable, as one has already been specified for the net telemeter system. Of course, both board and net instruments will be used on the same test, so data transmission over two independent acoustic links could lead to awkward interference problems.

Because of the difficulties associated with these methods of data transmission, some thought has been given to alternative techniques for sending data from an otterboard to the ship. In particular, the towing warp has been considered as a vehicle for carrying electrical signals. This could be done without modifying the external characteristics of the warp, by replacing part of the fibre core by an insulated conducting wire. In this way an electrical signal could be sent up the inner conducting wire, with the return path through the outer steel of the warp. But now the problem is how to get access to the inner conductor so that it can be connected to the pulse generator in the board control circuitry. It would be possible, of course, to take the insulated inner conductor out through the steel strands of the warp at a point close to the end of the warp. However, this would not be a satisfactory solution, as this end of the warp has to be attached to and detached from the board each haul. The conductor wire would therefore be very liable to get damaged during these operations, not to mention what would happen to it when it then gets wound on to the winch with the bridle wires lying on top of it. What is wanted then, is some means of injecting an electrical signal into the conductor cored warp without having to extract the conductor to make a physical connection to it. An experimental investigation of this technique recently carried out at Aberdeen has shown that it is indeed possible to do this.

Basically, the system used is that shown in Fig. 8. The inner conductor is shorted to the steel of the warp at a point close to the eye in the otterboard end of the warp. The conductor need not be taken out through the steel strands to do this. At the ship end, of course, there is no problem about separating the conductor from the steel as this end of the warp is permanently attached to the ship's winch barrel The shipboard termination could conveniently be done by attaching a two-pole socket to the winch barrel, one pole connected to the steel and the other to the inner conductor. Returning now to the underwater equipment, the pulse train output from the telemeter control unit on th otterboard is first amplified then used to drive a current transformer. The output leads from the transformer are clamped on to the steel of the warp so as to give a good electrical contact and yet be easily attached or detached. As the transformer has a large turns ratio, each time a pulse is produced by the board telemeter a large current flows for the duration of the pulse through the steel of the warp between the transformer lead clamps. The steel has a small but finite electrical resistance, and the net result is that a small voltage appears between the steel and the inner conductor while this current flows, provided the input impedance of the shipboard units connected to the warp is reasonably high. This small voltage is only present for the duration of a pulse from the telemeter control unit and so is itself a pulse, which can be amplified by the pulse amplifier on the ship producing in turn a pulse suitable for connection to the digital interface. Hence each pulse produced at the otterboard causes one pulse to occur at the digital interface, and so the frequency can be determined by pulse counting under computer control.

An experiment was carried out to test the feasibility of this technique, using a short piece of trawl warp, about 20 ft long, with a copper conductor inserted into it. The conductor was shorted to the steel at one point, and a transformer connected as in Fig. 8. The primary of the transformer was not connected to a pulse generator, but instead to a 50 Hz AC supply which was more convenient for the purposes of the test. The transformer secondary leads were clamped to the steel about 45 cm apart, and an oscilloscope was connected between the copper and the steel at the other end of the warp. A peak to peak signal of about 20 millivolts was observed on the scope. This is an encouraging result, bearing in mind that the particular transformer used limited the amount of current which could flow in the steel, and that this current could be considerably increased by improved transformer design. In addition, the skin effect in the warp steel is not negligible even at frequencies as low as 50 Hz. This means that the resistance of the steel to the current passing through it increases with the frequency of the current source, and correspondingly so does the voltage signal at the warp terminal. Thus a fast rise time pulse (which is what is to be used in practice) would lead to a much greater peak to peak signal than that from a 50 Hz driving waveform of the same amplitude.

Following this encouraging experiment, a theoretical investigation was made of a full scale (i.e. 600 fathom long) conductor cored warp. Attention was mainly concentrated on the transmission characteristics of the warp, regarding the latter as a co-axial cable. It was shown that the experimental results on the short length of warp could be extrapolated to predict that a 600 fathom length of conductor cored warp could be used to give a reasonable signal level at the ship ; that is, the signal attenuation in transmission up the warp is not serious.

The electrical characteristics of the warp transmission system therefore appear to be good enough for the purpose in hand. On the basis of this preparatory work, a pair of 600 fathom conductor cored warps has been ordered from a cable manufacturer and these are expected to be available for full scale tests on F.R.S. "Explorer" later this year.

There are still some open questions regarding the mechanical properties of this system. The inner conductor must be a low resistance material - in this case copper. Steel cannot be used because its high resistance would lead to considerable signal attenuation. Now it is well known that warps stretch when towing loads are applied to them ; the copper will also stretch, but as this metal has a low yield point it will in general return to a different final length than the steel of the warp. In fact, the copper would end up longer than the warp. Obviously, this situation must result in kinking, and eventual breakage of the copper conductor. However, it is hoped to overcome this effect in the conductor cored warp to be used on "Explorer" by specifying a braided conductor, comprising many individual strands, instead of a single copper wire. In this way, it is expected that the strain on the warp will not be transmitted to the copper as the braid can expand in length without stretching the individual copper wires. In view of the novelty of this application, however, these warps will have to be tested out in actual trawling conditions over a long period of time before it can be said with certainty that the mechanical design is satisfactory.

Should the conductor cored warp telemeter be proved in practice, it will provide a very neat way of transmitting data from an otterboard to the ship. It only allows one-way transmission, of course ; it cannot be used for sending control data from the ship to the board instrument set. However, the present design of the computer installation does not require this facility.

6. Conclusions.

This paper has discussed the design and development of instruments, and associated hardware, for use with a computer based data logging system for fishing gear research. The description given on the operation of the computer itself, and the interface, has been limited to those aspects directly relevant to the input and sequencing of instrument data.

Throughout the design of the complete system, considerable emphasis has been placed on obtaining a high degree of flexibility in the system. This is most important considering the research nature of the application, because in research the details of operation may need to be frequently changed. Consequently, many functions, such as pulse counting, which would be carried out by hardware in a conventional data logger are, in this system done by software. It is much easier to change the program in the computer than to alter the wiring of the electronic equipment.

The instrument whose connections to the computer have been discussed in this paper must be considered to be a basic set which will be used initially. As the system develops after installation, there will undoubtedly be many additions to the equipment connected on-line. These may well include :

a) a second Decca Navigator set, for interchain fixing

b) a warp length meter

c) warp vibration transducers

d) load cells incorporated in the gallows blocks

e) flow meters located on the net and/or otterboard

The computer based data logging system will be installed on the F.R.S. "Explorer" early in 1969. Once the system is fully commissioned and operational, it will be a powerful tool for obtaining information on the behaviour of a trawl gear in action. It will then be possible to investigate many problems in this field which cannot be resolved by present techniques.

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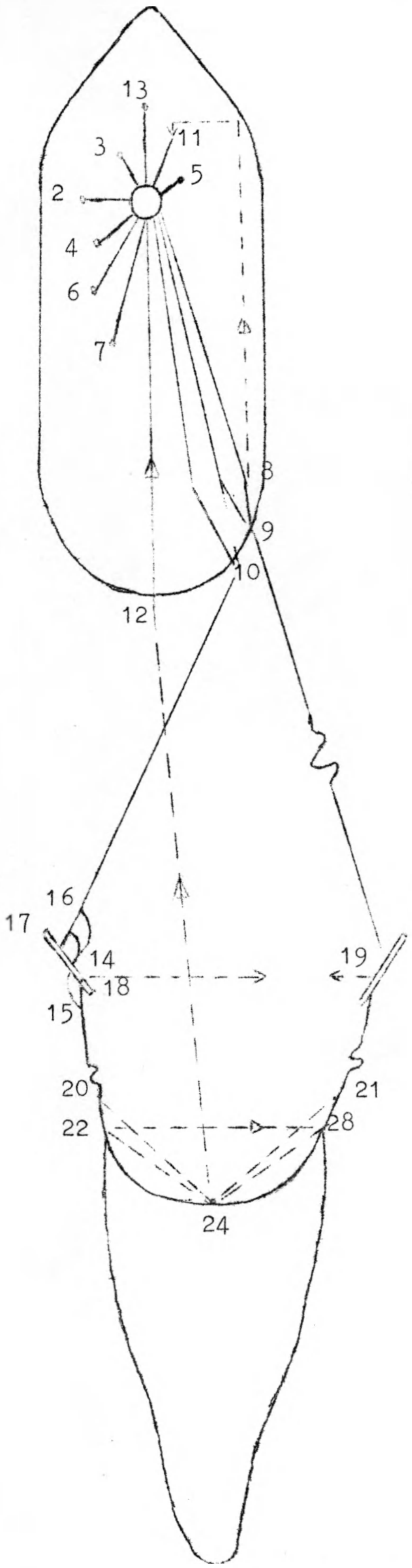


Key

1. Central processor and interface.
2. Electro-magnetic speed log.
3. Decca Navigator.
4. Echosounder.
5. Gyrocompass.
6. Engine RPM meter.
7. Propellor thrust meter.
8. Warp tension cells.
9. Block accelerometer.
10. Divergence/declination meter.
11. Terminal for otterboard data.
12. Terminal for net data.
13. Wind vane/anemometer.
14. Otterboard angle and depth sensors.
15. Sweep tension cell.
16. Transmitter for otterboard data.
17. Warp tension cell.
18. Board spread transmitter/receiver.
19. Board spread transponder.
20. After sweep tension cell.
21. Four sweep tension cell.
22. Netwidth transmitter.
23. Netwidth receiver.
24. Headline height sensor.

Δ Telemeter signal paths.

› Acoustic measurement pulses.

FIGURE 1. LOCATION OF INSTRUMENTS ON SHIP AND GEAR.

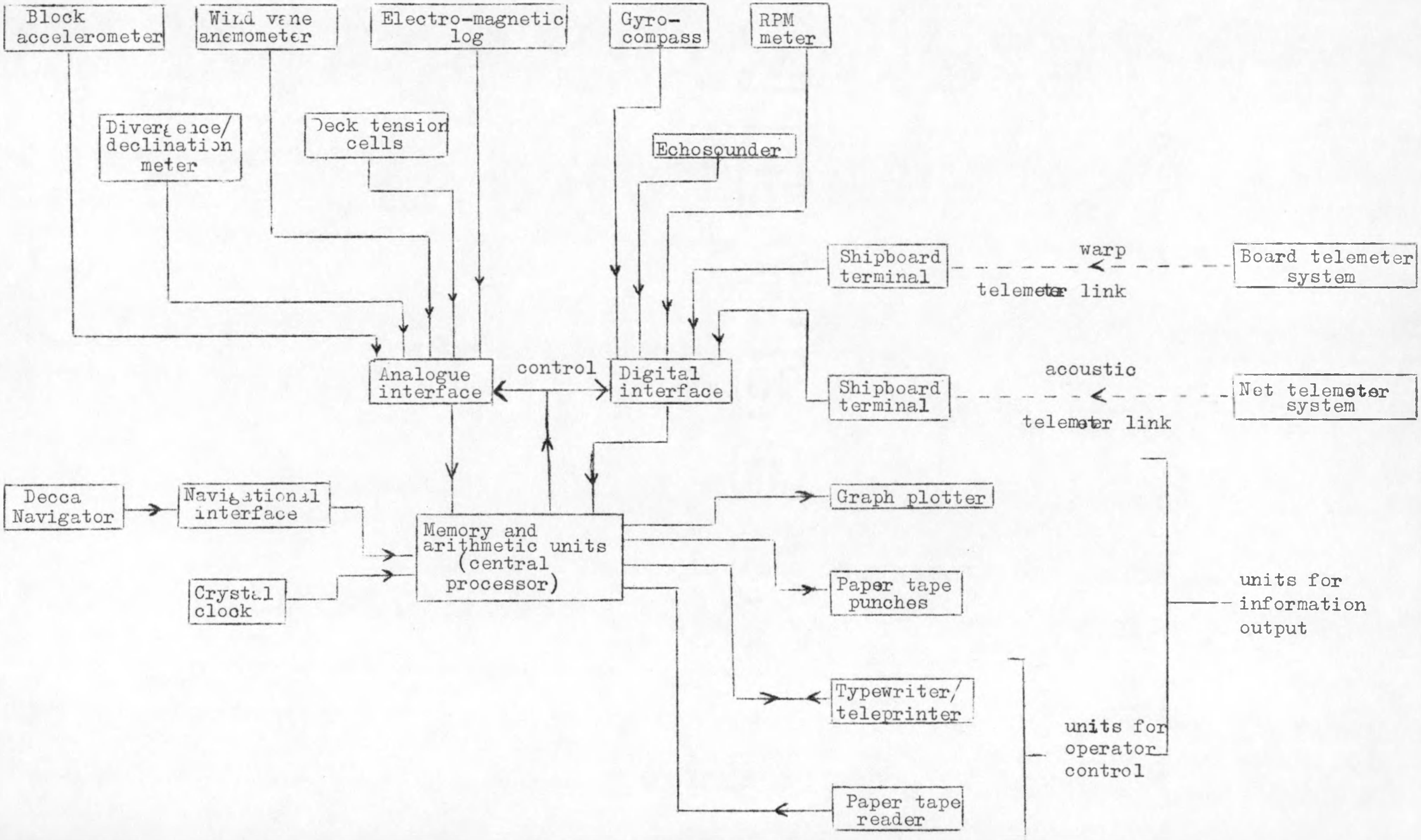
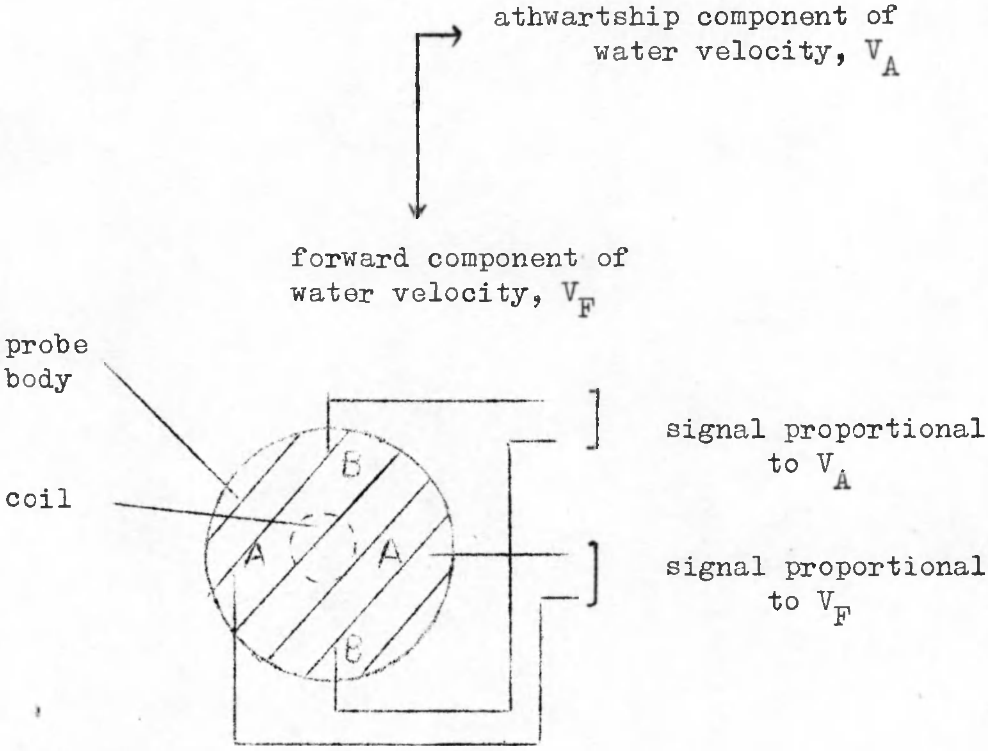


FIGURE 2 BLOCK DIAGRAM OF DATA LOGGING SYSTEM



<u>Figure 3</u> <u>Coil and sensing probe arrangement in a two component electro-magnetic log</u>

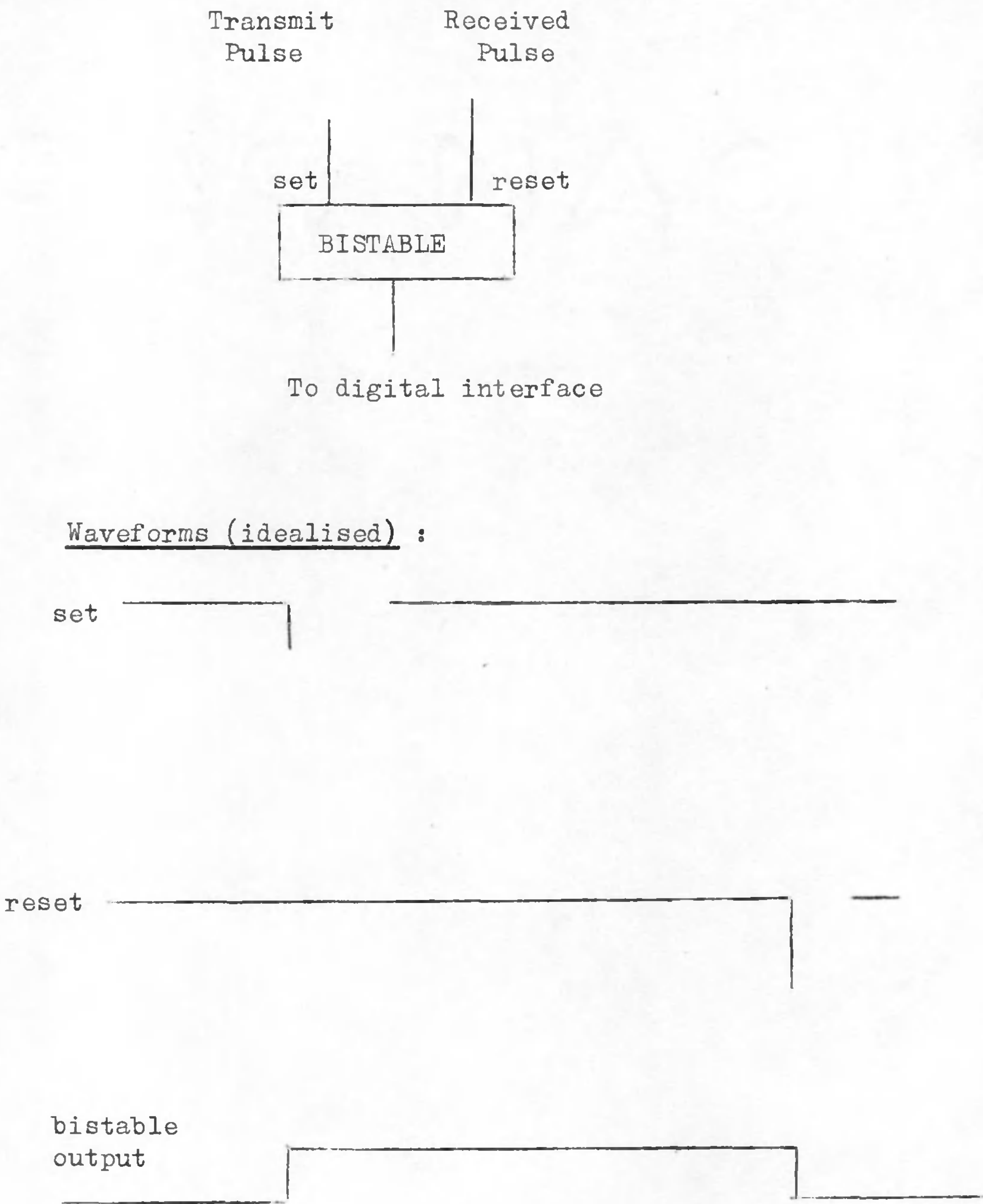


Figure 4 Providing a digital output from an echosounder

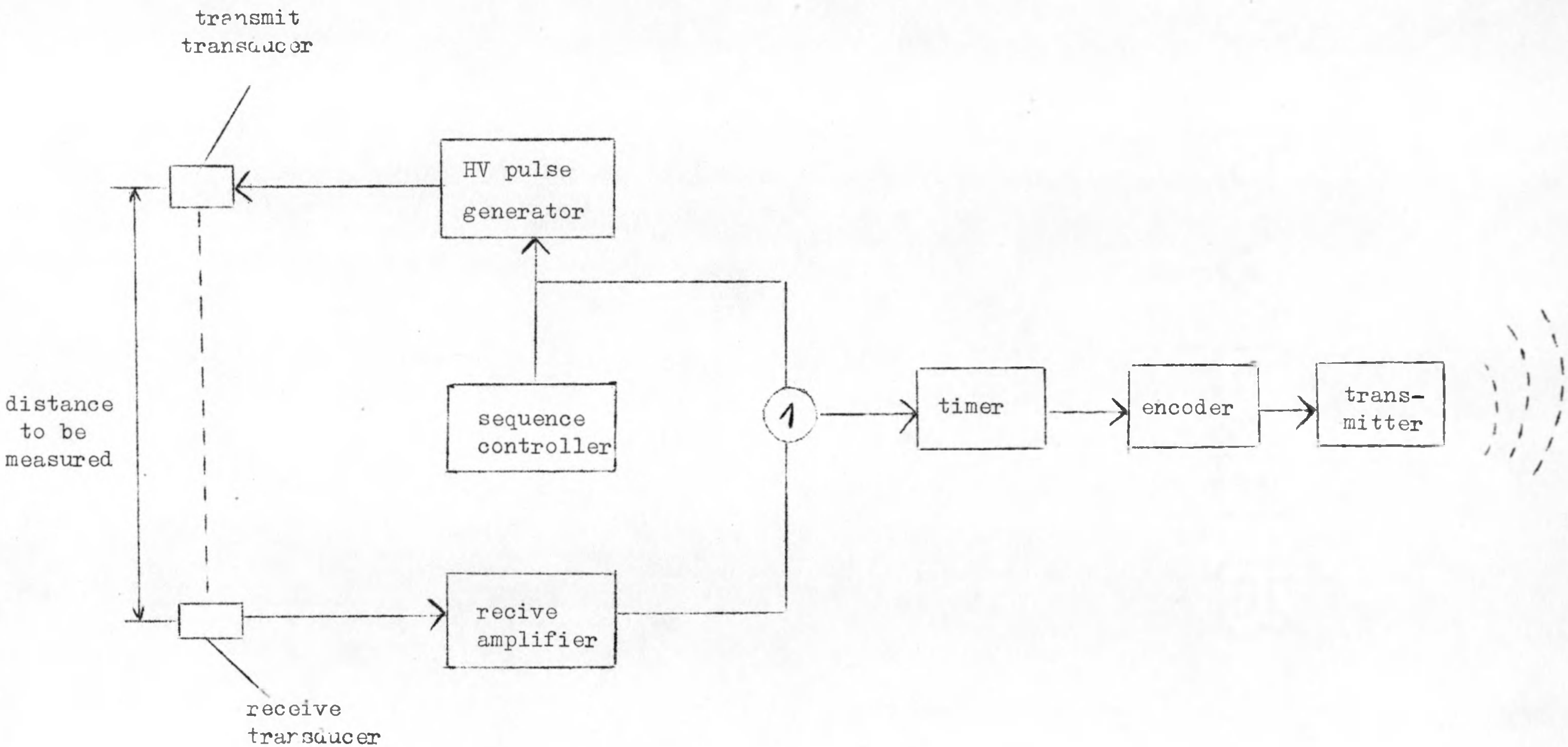
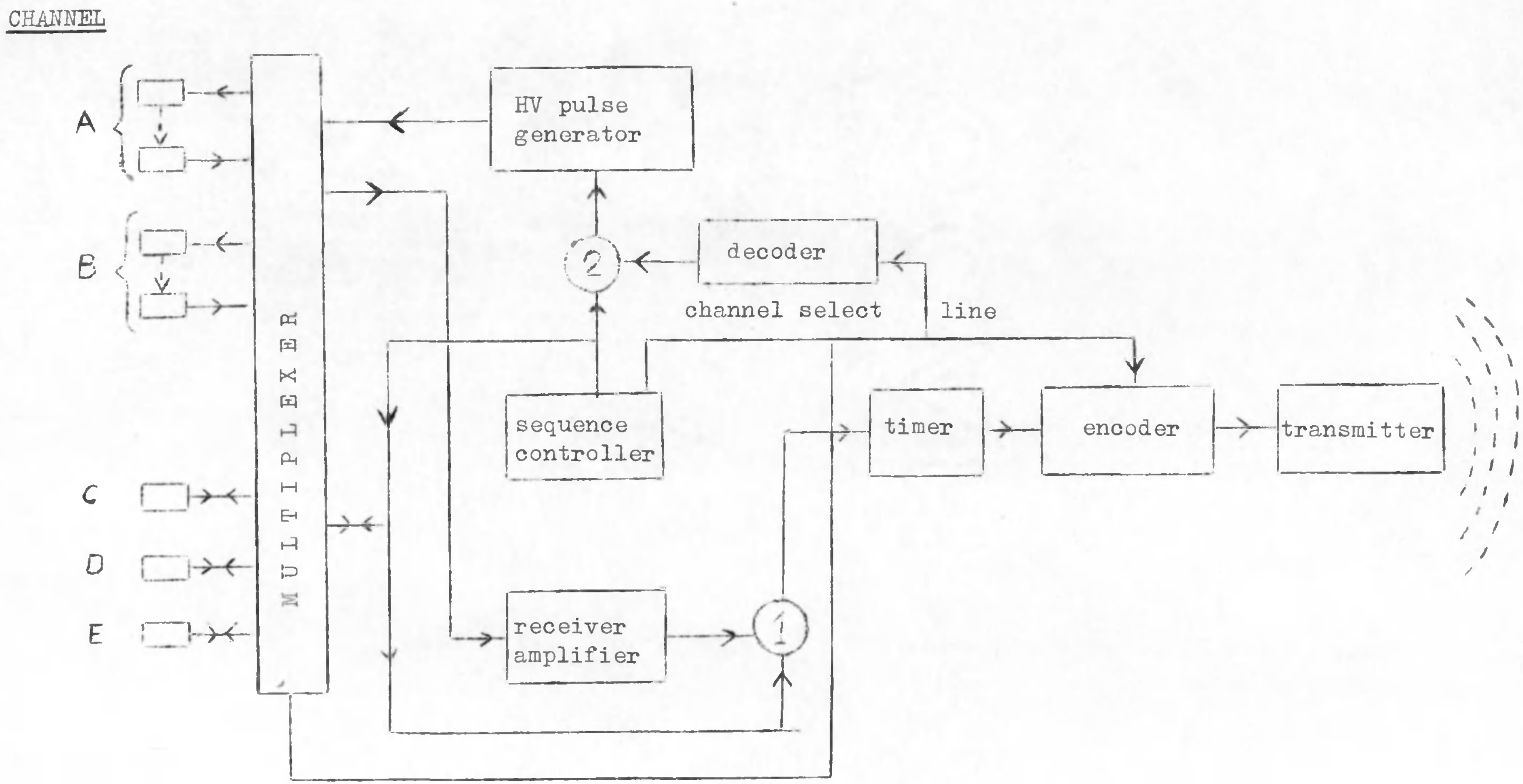


Figure 5 Block diagram of single channel telemeter



channels A and B : – each has 1 pair of acoustic transducers (transmit and receive) connected to the multiplexer.

channels C, D and E :– each has 1 load cell (or some other compatible instrument) connected to the multiplexer.

Figure 6 Block diagram of multichannel telemeter

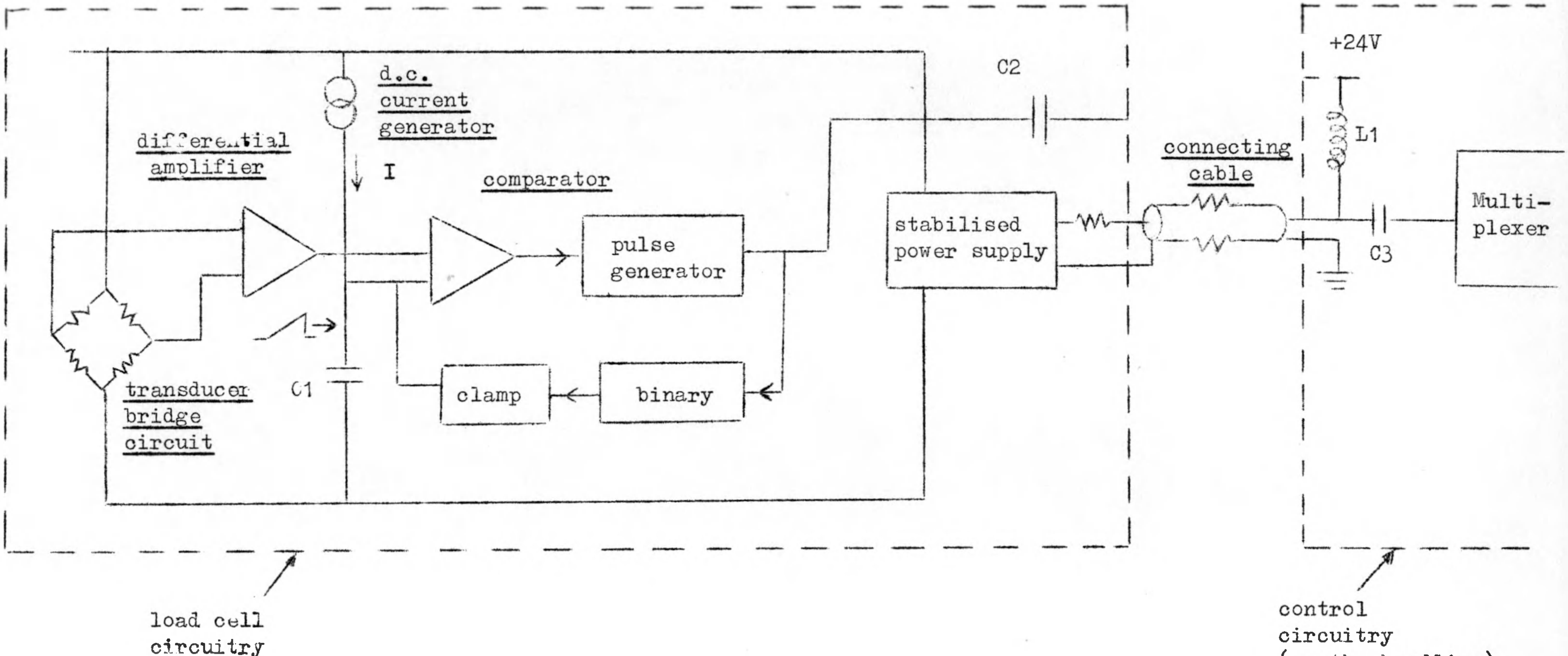


Figure 7   Block diagram of load cell circuitry

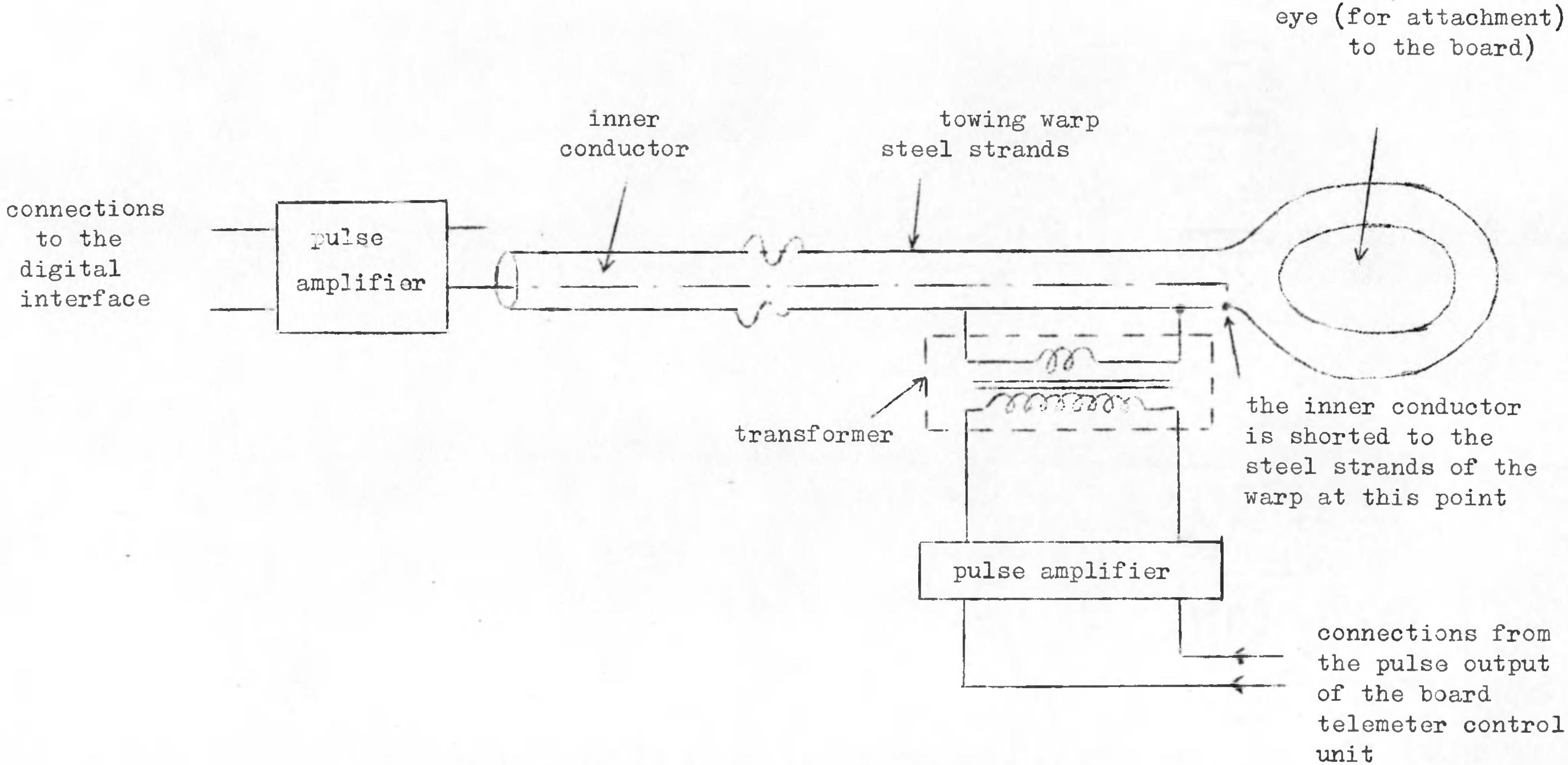


Figure 8 Diagram showing a technique for telemetering otterboard data via a towing warp

COURSE TO STEER FOR THE TRAWL TO INTERCEPT A FISH SCHOOL

by

W. DICKSON

From the reports received by those engaged in midwater trawling it would appear that any fish school picked up by the sonar at more than 20° off the ship's heading is rarely caught by the trawl net. The trawl at the far end of the towing warps must change direction more gradually than the ship can turn and so the trawl does not directly follow the path of the ship. Following a change in direction by the ship it would seem to be implicit that trawl leaves its original course tangentially thereafter following a curved path which eventually follows that of the trawler on its new course. Consequently, unless the fish school is located at a considerable range the vessel must under-steer to bring the path of the trawl through the fish school.

The trawl does not move on a circular arc but on a curve which approaches the new course of the trawler much more gradually as described by Karapuzov (1966). The situation is most clearly seen if the trawler is assumed to take a short right angled turn ; something it could hardly do in practice. This is shown in Fig. 1, the warps leaving the path of the trawl tangentially and the trawl always at the same distance from the ship. This ignores any curvature in the warp due to the different paths of net and trawler.

The theoretical curves followed by the trawl for given courses taken by the trawler are shown in Fig. 2, but this does not directly give the course on which the trawler should go to take the trawl through a given point. By setting off the range rings on Fig. 2 the following table can be drawn up :

Range	School bearing	Ship course	School bearing	Ship course	School bearing	Ship course	School bearing	Ship course
100 m	26°	10°	59°	20°	–	30°	–	40°
200	17°	"	35°	"	53.3/4°	"	74.1/2°	"
300	13.3/4°	"	20°	"	42.1/2°	"	57.1/2°	"
400	12.1/2°	"	24.3/4°	"	37.3/4°	"	50.1/2°	"
500	11.1/2°	"	23°	"	35°	"	47°	"
600	11°	"	22.1/4°	"	33.1/2°	"	44.3/4°	"
700	10.3/4°	"	21.1/2°	"	32.1/2°	"	43.1/4°	"
800	10.1/2°	"	21.1/4°	"	32°	"	42.1/2°	"
900			21°	"	31.1/2°	"	42°	"
1000			20.3/4°	"	31°	"	41.1/2°	"

For accuracy this table was drawn up from a larger scale drawing than FIG. 2 and FIG. 3 can be drawn up from it. Since FIG. 2 will hold good whether the units used be metres, fathoms or yards so long as both warp length and range are in the same units, it is possible to make FIG. 3 non-dimensional, that is instead of having several sheets of graphs for different warp lengths, one set of graphs expressed in terms of Target Range/Warps Length will suffice.

Moving school.

If the fish school is also moving, the solution of the course to steer becomes more complicated. There are four steps to an approximate solution.

1. Use sonar to determine the velocity of the fish school relative to the ship.

2. Determine the actual speed and direction in which the fish school is moving.

3. Determine the point of interception of trawl and fish school.

4. Determine ship course to take the trawl through this point of interception.

The first step is determined as in FIG. 4 and the second step follows as in FIG. 5, the ship's water velocity being known.

From the position of the fish school (Fo) at time t = o, arcs of circles can be set off predicting the school's position at say one minute time intervals, t = 1, 2, 3 etc. as in FIG. 6 and the direction of the school movement is layed off across this position range. Similarly from the position of the trawl (To) at time t = o, circles can be set off to give the trawl's position at one minute time intervals, t = 1, 2, 3 etc. The solution as determined in this manner is approximate only since the trawl moves from its position at t = o in a curve rather than a straight line but for small angles of turn from the original course the error is small. The points at which these sets of circles intersect, at time t = 1, 2, 3 etc., can be marked off and a curve (shown dashed) drawn through them. The position at which the swimming direction line of the fish school crosses this curve at F, gives the point of interception of trawl and fish school and the time at which it should take place (in this case at time t = 0 + 7.4 min.). It will be seen that there are other points of intersection of the two sets of circles, e.g. at 3, and 8, but somewhat dependant on the bearing and range of the target at time t = o, the chances of a physical interception should be better if the fish are moving in the same general direction as the ship and across its path, since a smaller angle of turn is needed.

When the range and bearing of the point of interception have been determined FIG. 3 can be used to determine the ship's course.

The solutions offered here are graphical throughout, which makes the understanding of the problems easier. It can be argued that there is insufficient time at sea to determine the course to steer in this manner although with drawing instruments ready it is not the work of very many minutes. More than one fishery research vessel will soon be equipped with a digital computer for which it should be possible to write a program that will give the course to steer very quickly.

REFERENCE

Karapuzov, A.I., Research on the curvilinear movement of a trawler and trawl. 1966 - Trudy, VNIRO, Moscow, Vol. 61 : 235-70.

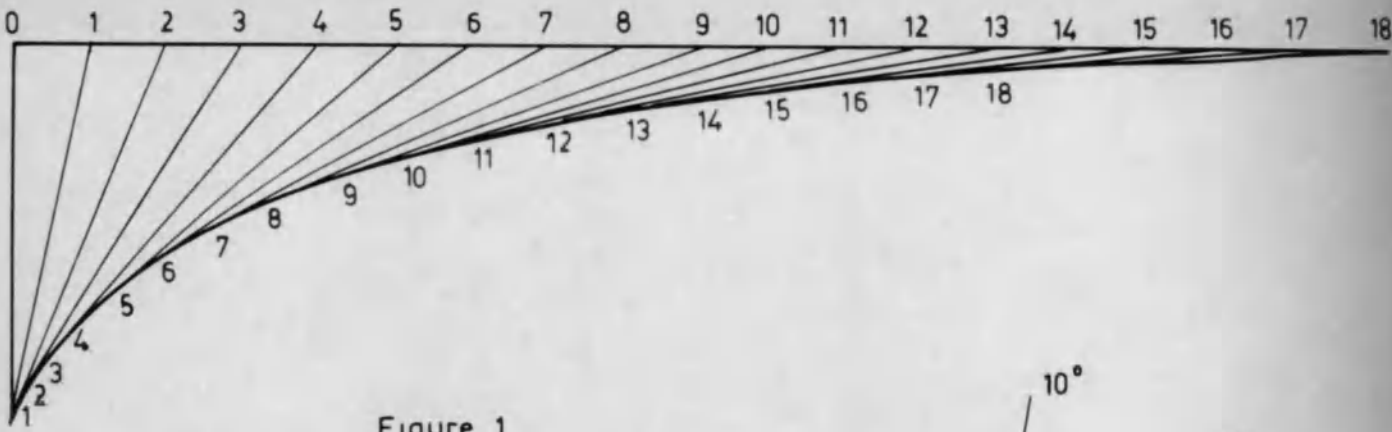


Figure 1

Path of trawl following a 90° turn by the towing vessel

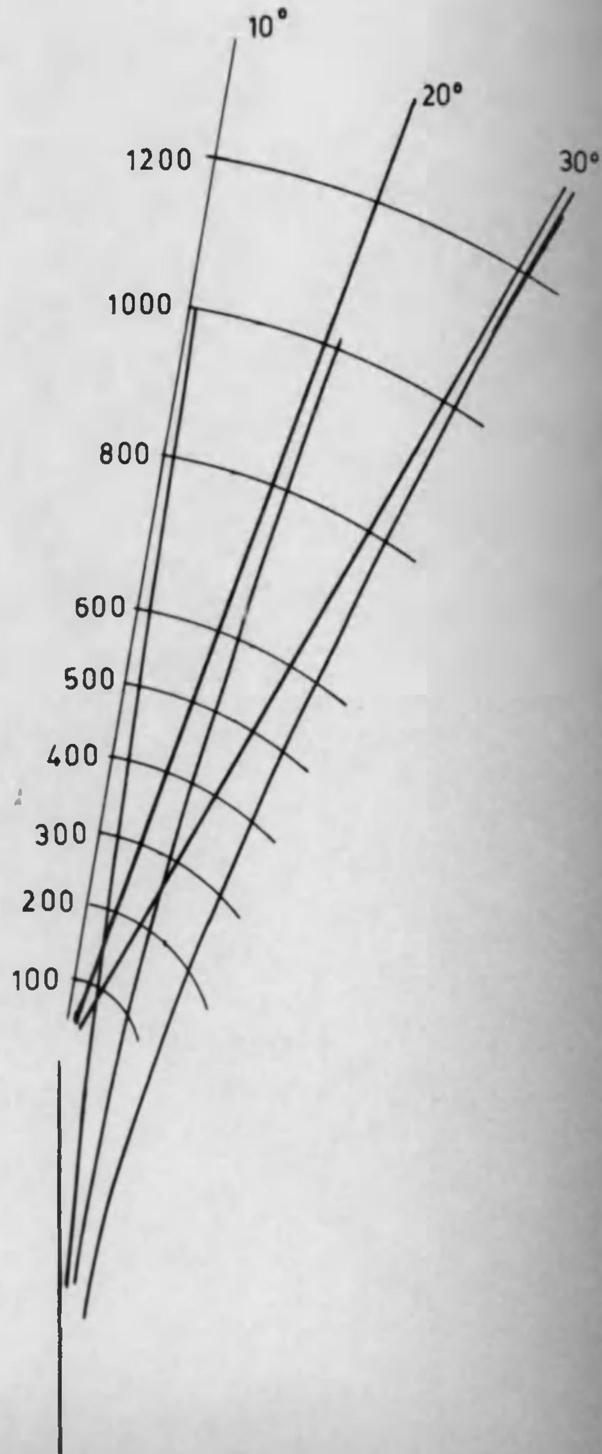
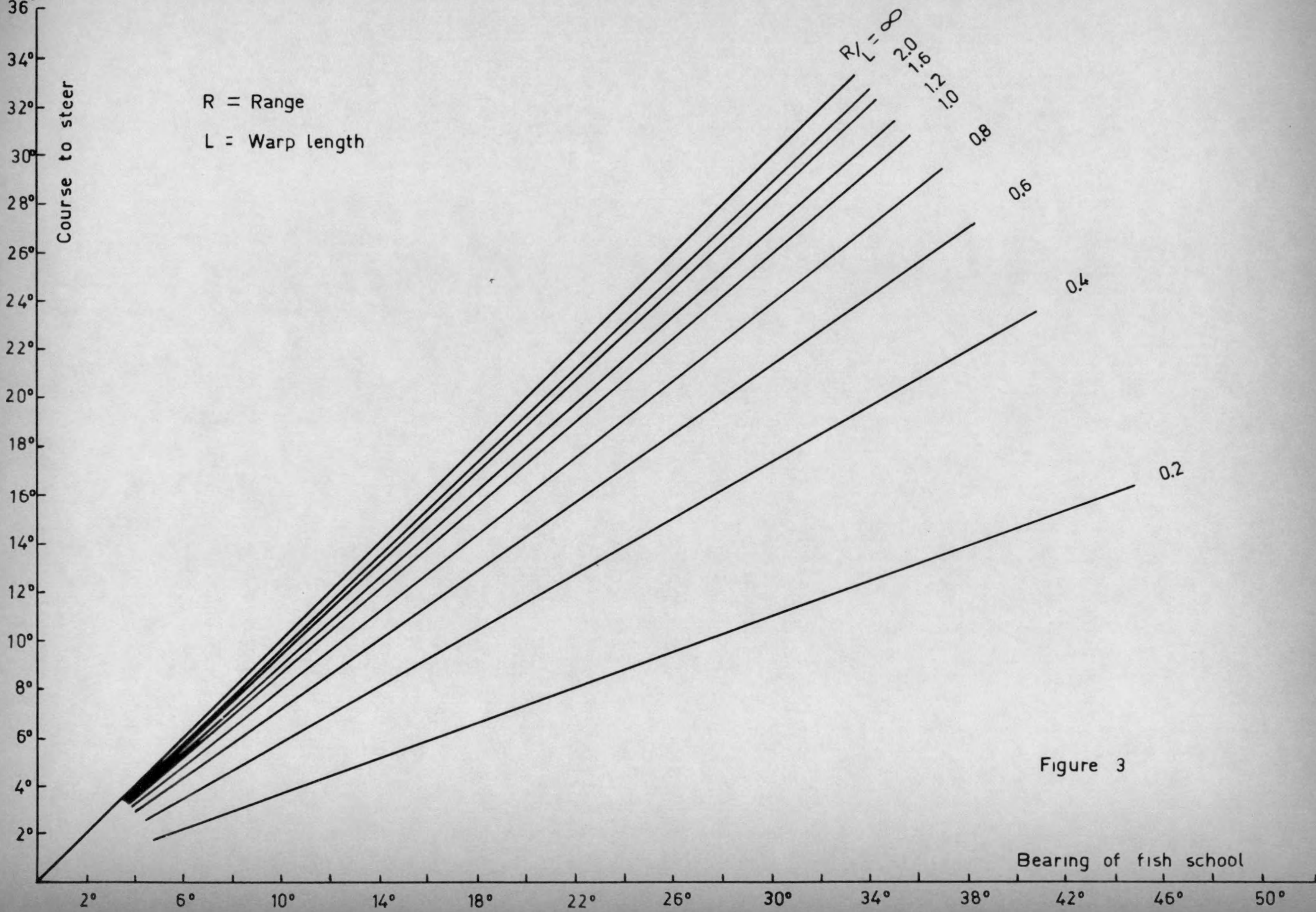


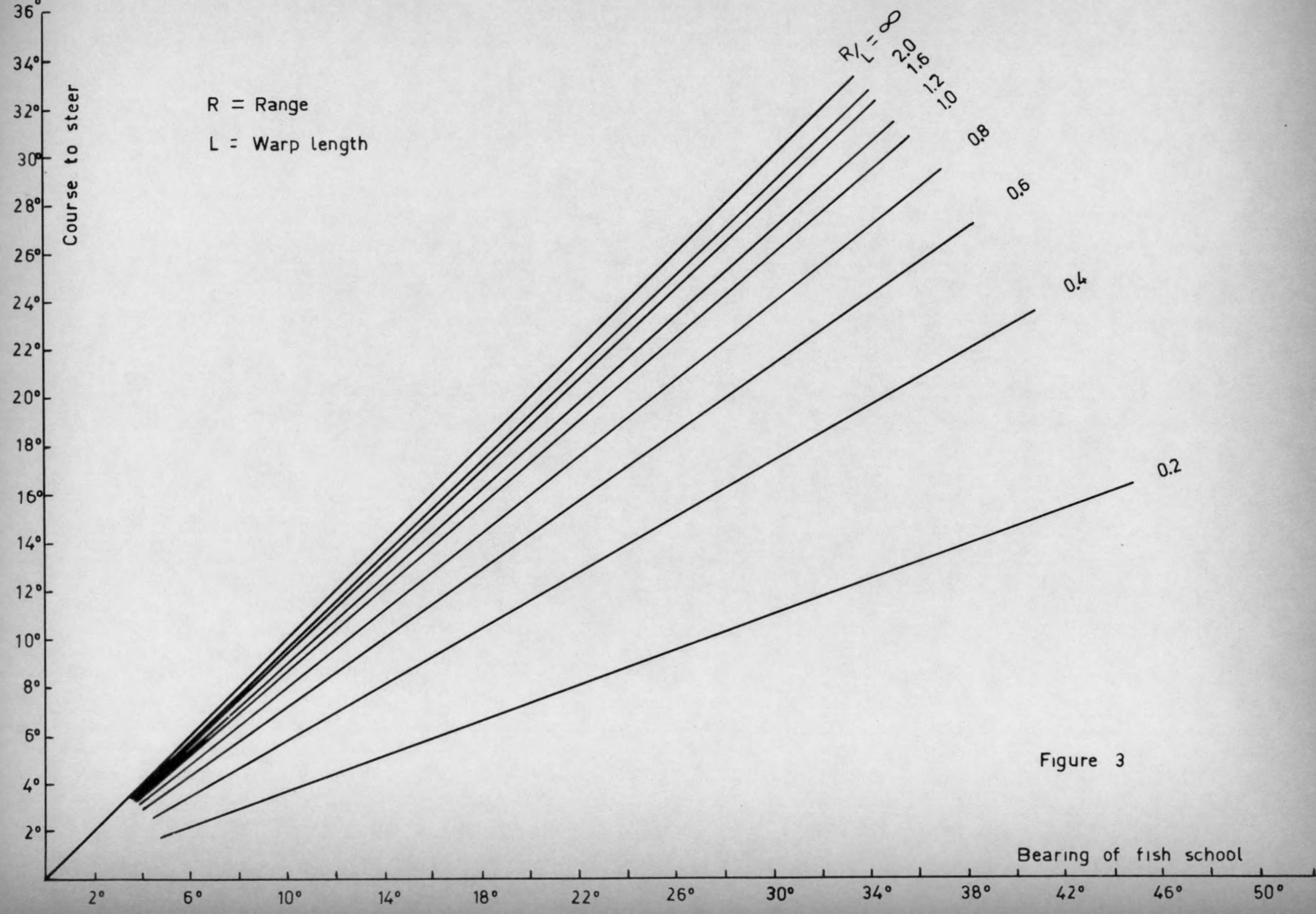
Figure 2

Path of trawl following 10° 20° and 30° turns by the towing vessel



R = Range
L = Warp length
Course to steer
Bearing of fish school
R/L = ∞
2.0
1.6
1.2
1.0
0.8
0.6
0.4
0.2
36°
34°
32°
30°
28°
26°
24°
22°
20°
18°
16°
14°
12°
10°
8°
6°
4°
2°
2°
6°
10°
14°
18°
22°
26°
30°
34°
38°
42°
46°
50°

Figure 3



R/L = ∞
2.0
1.6
1.2
1.0
0.8
0.6
0.4
0.2
R = Range
L = Warp length
Course to steer
Bearing of fish school
36°
34°
32°
30°
28°
26°
24°
22°
20°
18°
16°
14°
12°
10°
8°
6°
4°
2°
2°
6°
10°
14°
18°
22°
26°
30°
34°
38°
42°
46°
50°

Figure 3

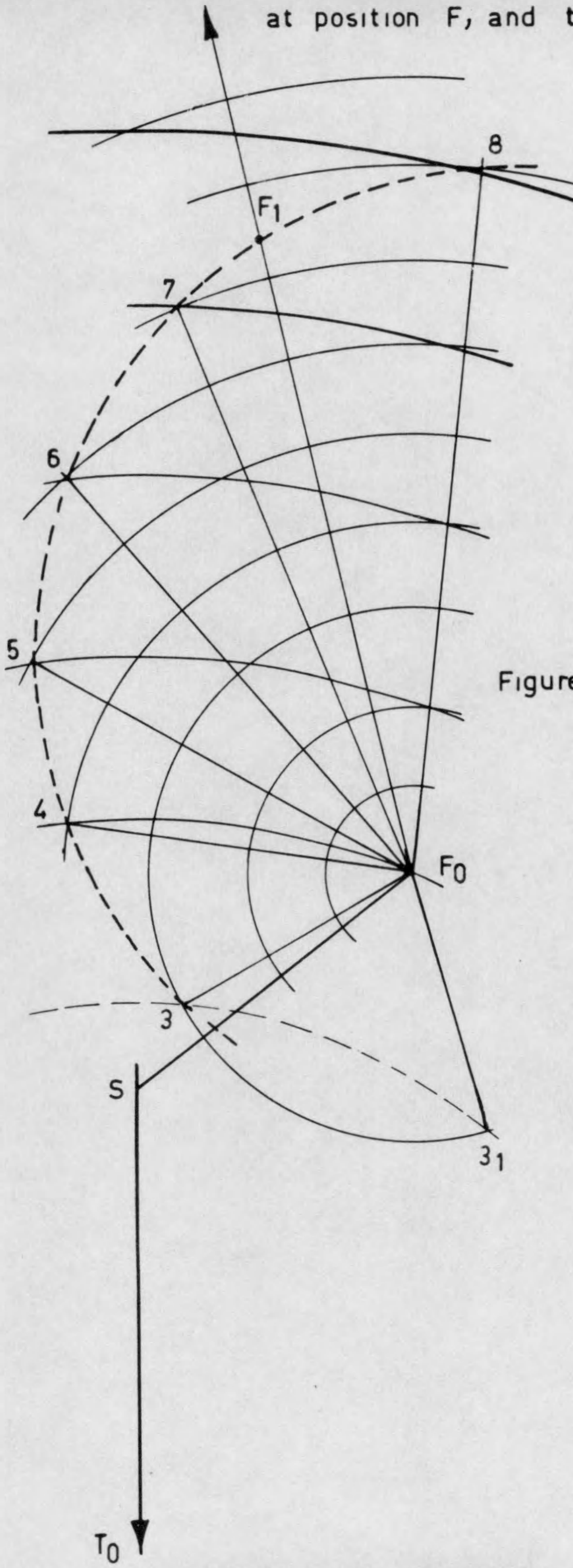


Figure 6

APPROXIMATE SOLUTION FOR A MOVING TARGET

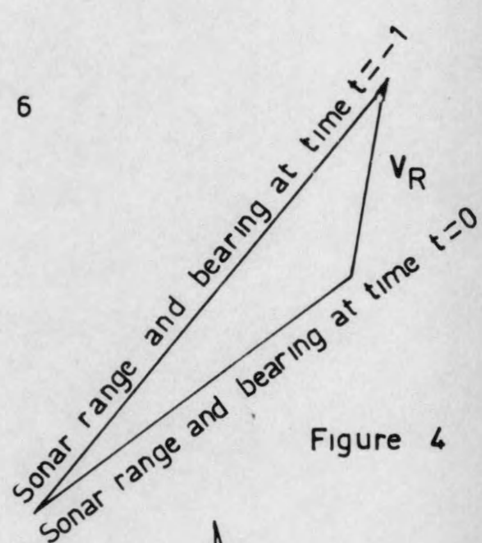
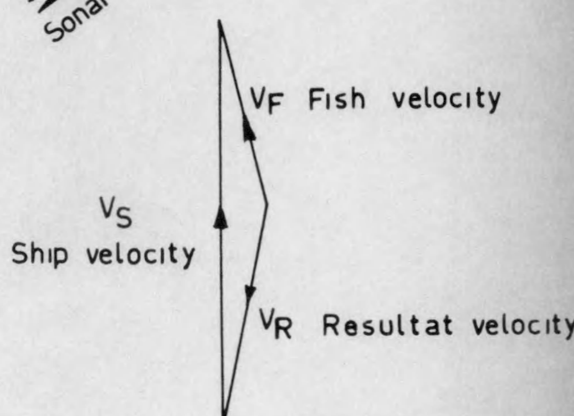


Figure 4



Triangle of velocities

Figure 5.

Experiments with a wireless net echosounder for the pelagic fishery.

by

A. VAN MIDDELEM.

Introduction.

The report describes the experiments, mentions their aim, analyses the observations and brings forward some conclusions.

In annex a technical description of the echoapparatus, the installation and the operation is attached.

§ 1. Object of the experiments.

The aim of the experiments was to test for the first time a wireless Furuno net echosounder of Japanese construction (1), in order to examine the technical possibilities of this cableless net echosounder in relation to the plotting qualities, the reliability and the general operation.

The use of net echosounders for fishery purposes started approximately during the years 1950. These net echosounders allowed the reproduction of the vertical opening of the net, the distance between the net and the sea bottom, the entering of the fish and other echo traces. The net echosounders were mounted on the headline of the net and were by means of an isolated electrical cable and an electrical winch connected to the electronical apparatus on the ship.

Over the years different cable types were experimented and as experience was gained, they were continually adapted and improved. However, there always remained the problems of cable isolation, loss caused by damage, the cost of the electrical winch, the operation of the winch, etc.

In order to eliminate these difficulties it was presumed that wireless echosounders would bring a solution.

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(1) Furuno Publication n° OM-1055a, 1967.

The wireless net echosounder, fitted on the headline of the net, emits, wireless acoustic impulses to the receiver, which is towed under water approximately 30 m behind the stern of the vessel and connected to the electronic apparatus aboard the fishing boat. Initially such net echosounders presented less possibilities than the cable net echosounders, as the netopening was not registered. Technical modifications have now made it possible to register the same data as cable net echosounders, viz. netopening, distance between net and sea bottom and the entering of the fish. These new possibilities justified the experiments.

§ 2. Circumstances of the experiments.

1. Vessel.

The experiments were carried out aboard a vessel with the following characteristics :

length : 35 m

width : 7,20 m

G T : 205

power : 240 H.P.

2. Fishing ground.

The experiments took place in the Silver Pit. The depth of the fishing ground was about 75 m, so that it was possible to vary the depth of the net.

The shaded surface of figure 1 indicates the fishin ground. The different hauls are given in figure 2 ; the numbers correspond with the hauls (see table II).

3. Fishing gear.

(a) Net (figure 3).

The trawl was a pelagic net composed of two equal panels, with the following characteristics : (see table I).

- the net was manufactured of polyamide yarn, with a R tex number varying between 640 and 1600,

- the headline and groundrope had the same length,

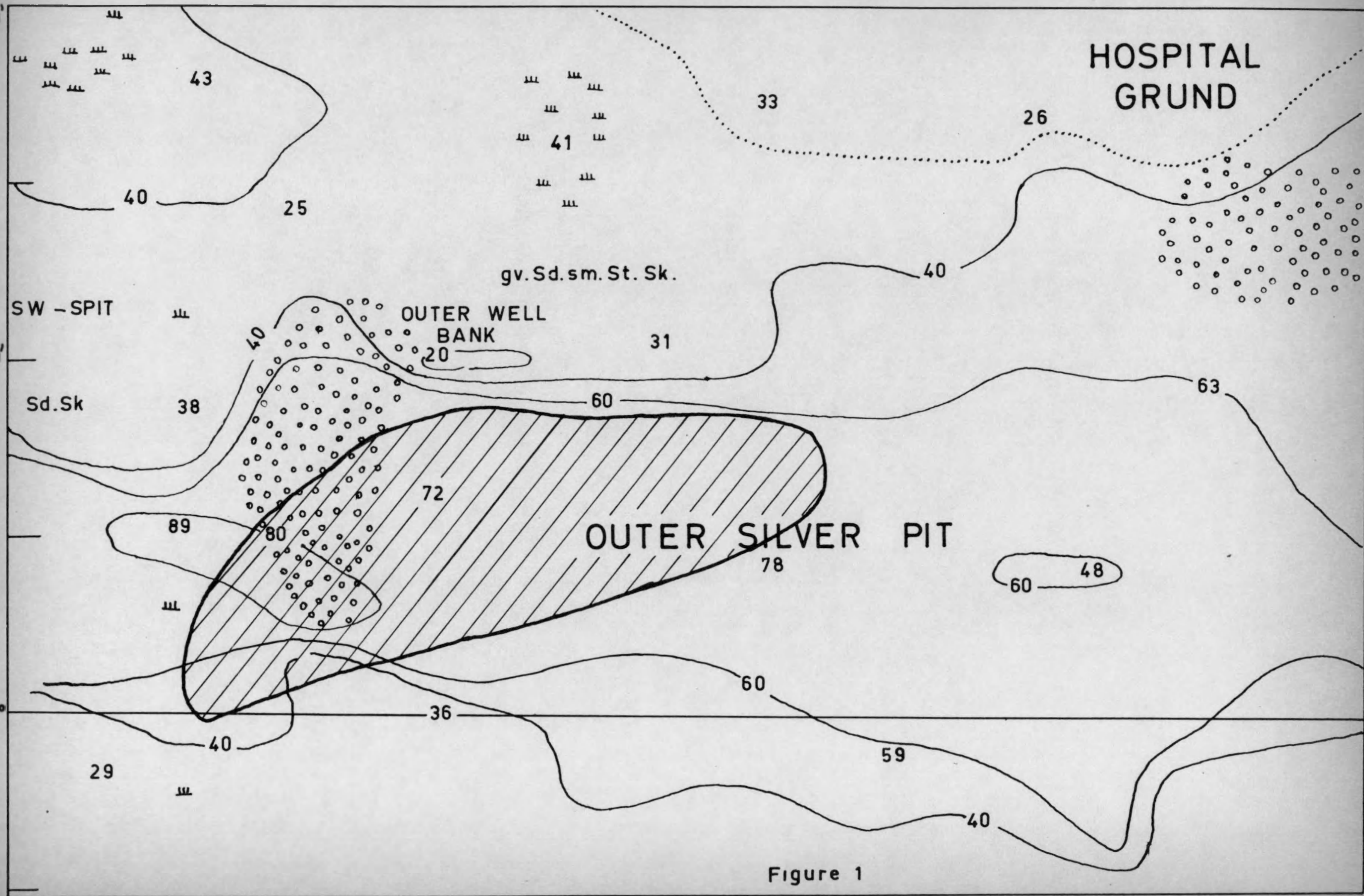
20'
10'
54°
HOSPITAL
GRUND
OUTER WELL
BANK
SW - SPIT
Sd.Sk
gv.Sd.sm.St.Sk.
OUTER SILVER PIT
43
40
25
41
33
26
40
31
20
63
60
38
72
89
80
78
60
48
60
36
40
59
40
29

Figure 1

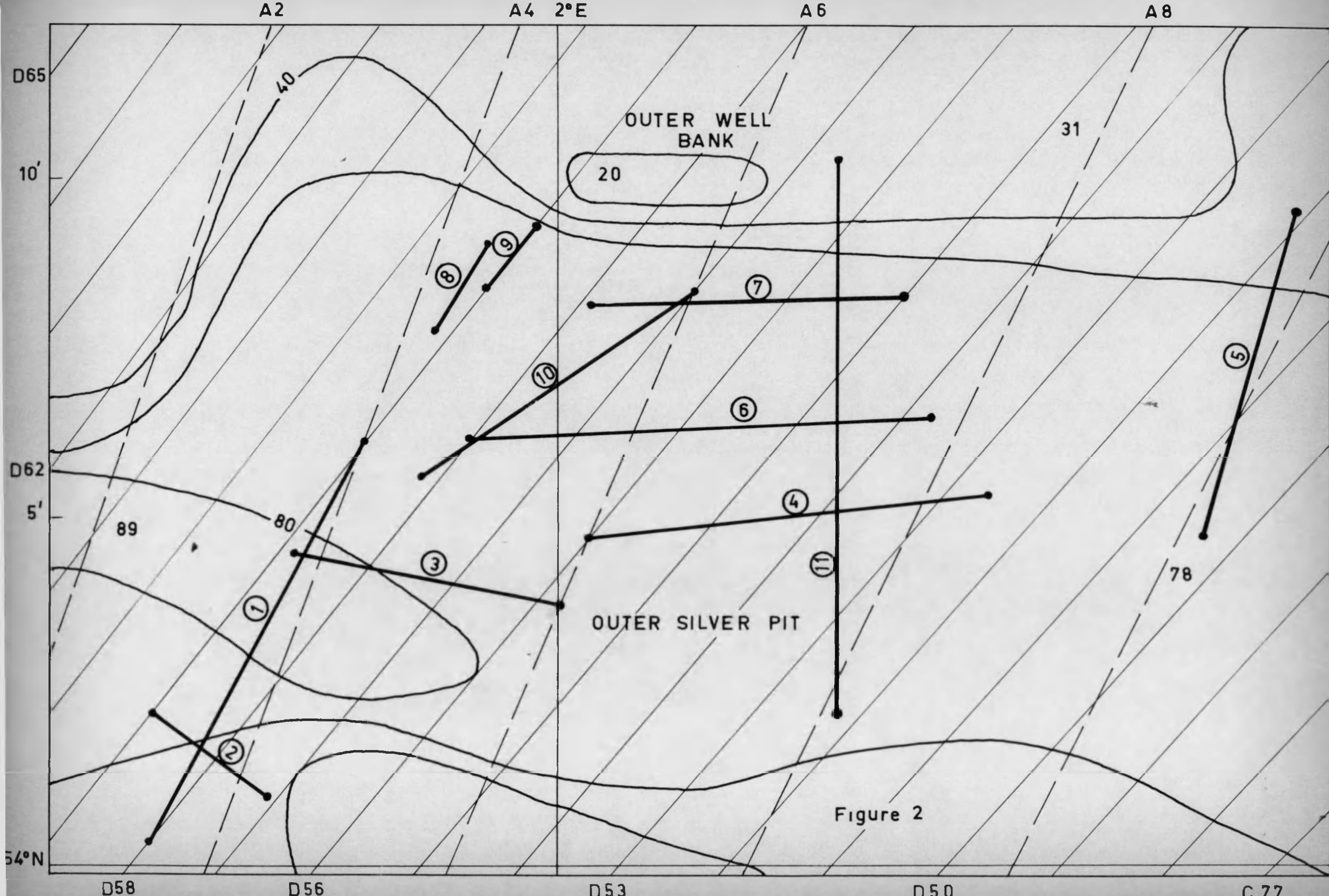
A2
A4
2°E
A6
A8
D65
10′
D62
5′
54°N
D58
D56
D53
D50
C 77
40
80
20
31
89
78
OUTER WELL
BANK
OUTER SILVER PIT
1
2
3
4
5
6
7
8
9
10
11

Figure 2

Table I - Characteristics of the pelagic trawl.

Part of net		A_1	A_2	B	C	D	E	F	G
Material		PA	PA	PA	PA	PA	PA	PA	PA
Colour		white	white	white	white	white	white	white	white
Length of mesh in mm		160	160	160	120	80	40	40	40
Breaking load in kg		60	60	60	50	50	35	35	80
R tex number		1150	1150	1150	950	950	640	640	1600
Length of headline in m		15,60	--	--	--	--	--	--	--
Length of groundrope in m		15,60	--	--	--	--	--	--	--
Number of meshes upper side		25	42	144	152	150	200	100	200
Number of meshes underside		42	50	114	100	100	100	50	200
Depth per part		35	5	30	52	75	300	150	400
Cutting rate	outside	1/2	1/2	1/2	1/2	1/3	1/6	1/6	0/1
	inside	1/1	2/1						
Taper ratio	outside	1N2B	1N2B	1N2B	1N2B	1N1B	5N2B	5N2B	N
	inside	1N1T	1T2B						

Pelagic trawl (2 equal panels)

Number of meshes	Length of mesh in m	Taper ratio	R...... tex
40	160	1/2	1150
30	160	1/2	1150
52	120	1/2	950
75	80	1/3	950
300	40	1/6	640
150	40	1/6	640
400	40	0/1	1600

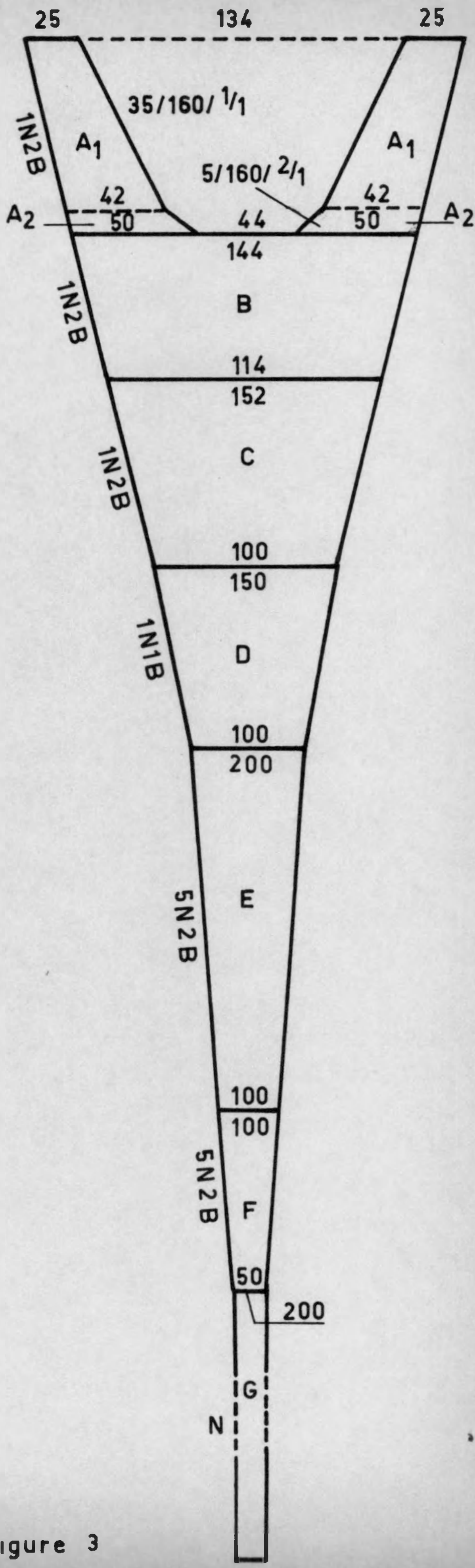

Figure 3

- the length of mesh amounted to 160 mm for the wings and to 40 mm for the codend,

- the wings of the belly were tapered outside according to the cutting rate 1N2B over a depth of 40 meshes and inside according to cutting rates 1T1N and 1T2B, respectively over a depth of 35 and 5 meshes,

- the belly and the baitings of the trawl were symmetrical,

- the net had six cutting rates : 1N2B, 1N1B, 5N2B, 1N1T, 1T2B and N,

- the part F of the net before the codend had a depth of 150 meshes,

- the codend had a length of mesh of 40 mm over a depth of 400 meshes,

(b) Boards (figure 4).

The boards used were Süberkrüb boards with a surface of ± 1 m2. These boards were entirely of iron construction. The convex side of the boards was provided with three welded sheets on which the legs were attached. The warp could be attached on one of the three openings of the middle segments of the concave side. The angle of attack of the Süberkrüb boards amounts to ± 20°, and to ± 37° for the otter boards.

Figure 5 gives a general view of the vessel with its equipment.

4. Weather conditions.

The trials were carried out under favourable weather conditions. During the trip to the fishing ground the wind force was 7 Beaufort and during the experiments and on the return journey between 2 to 4 Beaufort. The wind direction changed from W to S-SW (see table II).

Table II shows that the towing time and the length of the warps varied respectively between 15 min to 3.30 h and 140 to 365 metres.

The netopening amounted to ± 5,50 m and the towing speed varied between 2,75 and 3,5 knots.

SÜBERKRÜB BOARDS

Figure 4

FISHING VESSEL WITH EQUIPMENT

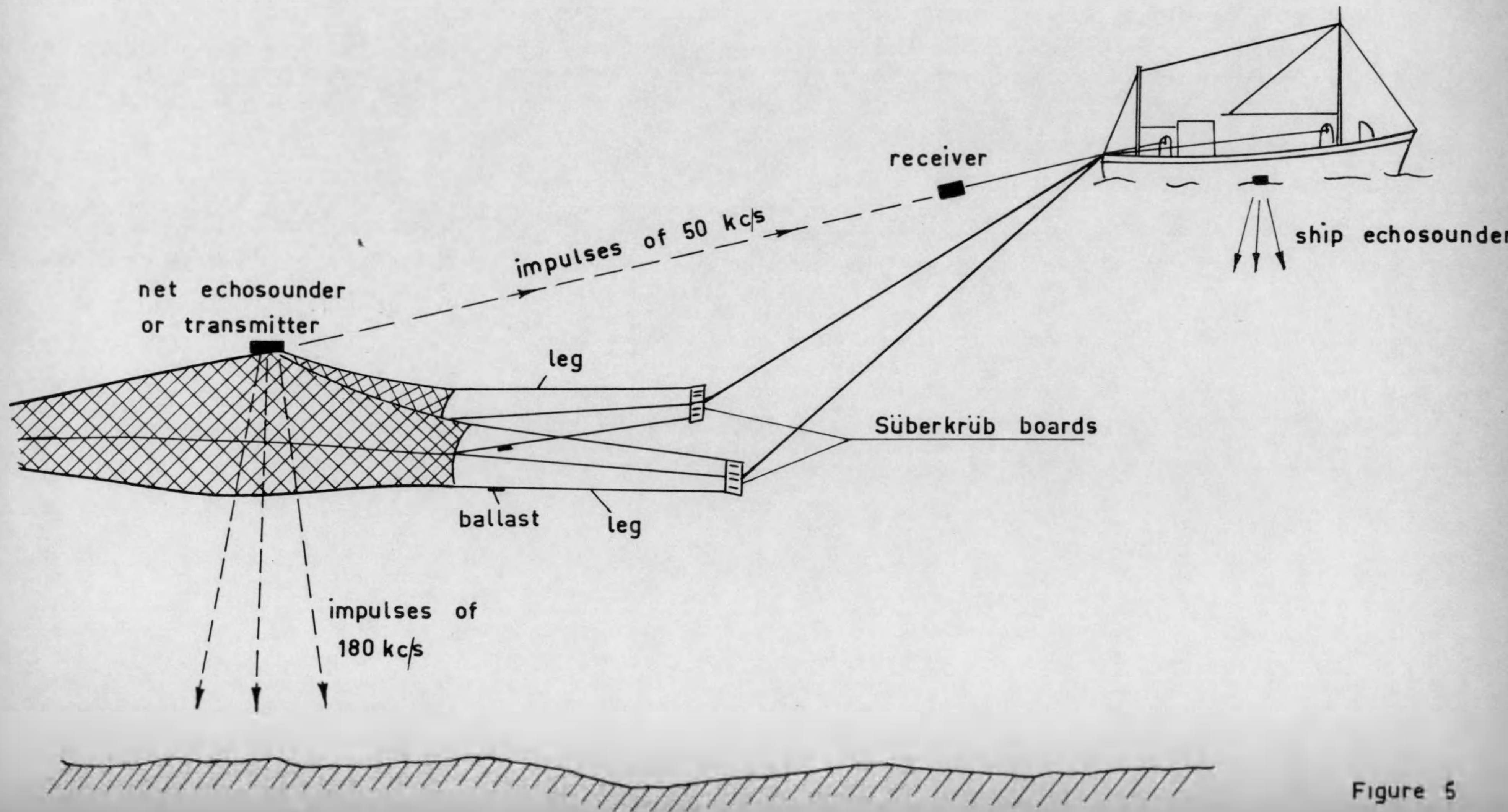

Figure 5

Table II - Circumstance of trials.

Haul			1	2	3	4	5	6	7	8	9	10	11
Position beginning haul	Red	Letter of zone	A	A	A	A	A	A	A	A	A	A	A
		Number of lane	3.40	3	3.80	6	9.85	4.70	8.50	4.20	4.45	4.45	6.55
	Purple	Letter of zone	D	D	D	D	D	D	D	D	D	D	D
		Number of lane	58	59	58.80	56	52.20	58	53.20	59.25	59	58.15	56.70
Position end haul	Red	Letter of zone	A	A	A	A	A	A	A	A	A	A	A
		Number of lane	4	4.25	6	8.50	10.15	7.80	7.10	4.35	4.60	6	8.10
	Purple	Letter of zone	D	D	D	D	D	D	D	D	D	D	D
		Number of lane	59	57.20	55.80	52.70	50.41	53.80	55	59.40	59	57	52.25
Duration of haul in h			3	1	2	2	1	2	2	1/2	1/4	1 1/2	3 1/2
Wind force in Beaufort			4	3	3	2	2	2to3	3	3	3	3	3
Wind direction			W	W	WSW	WSW	WSW	SSW	SSW	SSW	SSW	SSW	SSW
Course			NEbN	SE	EbS	E	SSW	EbS	E	NEbN	NE	ENE	S
Depth in meter			80	75	75	80	75	75	75	60	50	73	75
Length of warp in m			180	365	275	180	230	180	180	180	180	140	140
Rotation per min. of motor			200	210	200	210	220	210	220	210	210	210	205
Opening of net in m			6	--	--	5	5,5	5,5	5,5	5,5	5,5	5,5	5,5
Speed in knots			2,75	3,20	3	3,3	3,5	3	3	3	3	3	3

§ 3. Results.

During the trials different technical aspects have been studied, namely the recording or plotting of the indications, the reliability and the general operation procedure.

1. Recording or plotting of indications.

Figure 6 gives a net echogram of the wireless Furuno net echosounder recorded during the trials.

The transmission line corresponds to the headline of the net. The netopening (distance between headline - groundrope) is 5.5 m. Indications of fish are clearly plotted on the recording paper even the traces just above the sea-bottom. The distance from the headline to the sea-bed varies between 60 and 20 metres.

2. The reliability.

Under the reliability of the wireless echosounder can be cited (a) the synchronisation, (b) the phenomenon of interference, (c) the strongly reflected echoes and (d) the working life of the dry cells.

(a) Synchronisation.

Synchronisation has to be obtained between the r.p.m. of the motor (recorder) and the impulse rate of the net echosounder. The sychronisation forms an important part of the construction.

The sychronisation can be disturbed by noise. Noise caused by the propeller or vibrations may prevent the synchronisation between the synchronisation impulse and the reference impulse of the motor. A fallen out synchronisation results in unstable indications and causes fluctuations of the echotraces (see figure 7).

(b) Interference.

The phenomenon of interference occurs only when other vessels equipped with the same apparatus operate at the same time on the same fishing ground. Figure 8 gives an echogram disturbed by interference from another net recorder. The interference is the stronger as the other ship is nearer.

(c) Reflected false echoes.

The echoes emitted from the transmitter are reflected after touching an object and return as target echoes

NET ECHOGRAM

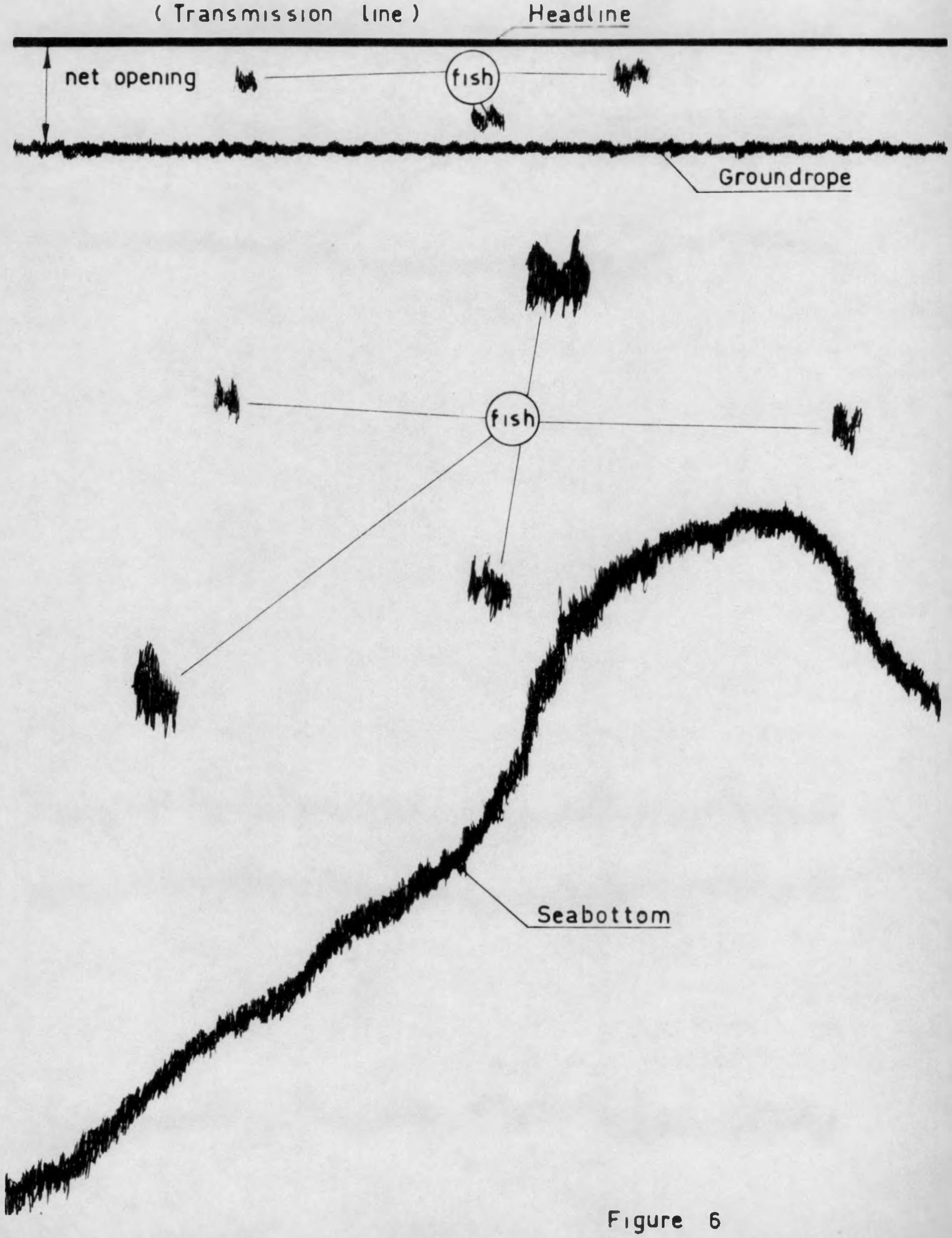

Figure 6

PHENOMENON OF INTERFERENCE

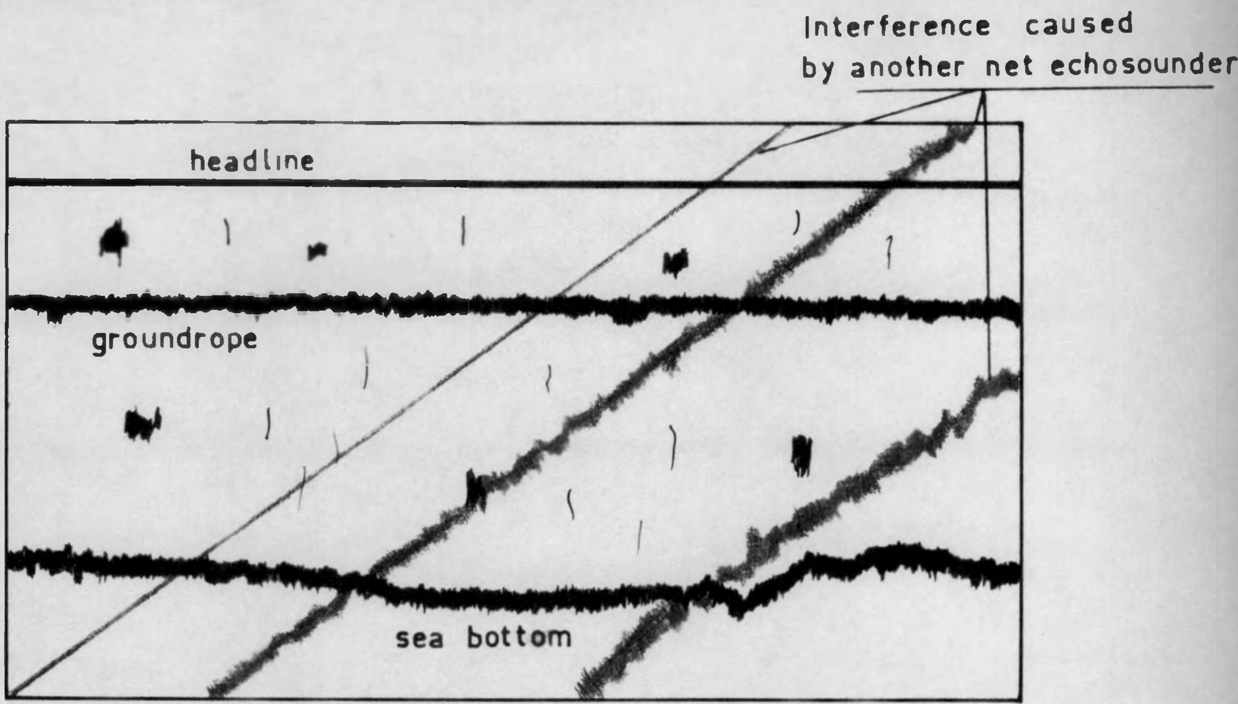

Figure 8

OUT OF SYNCHRONISATION

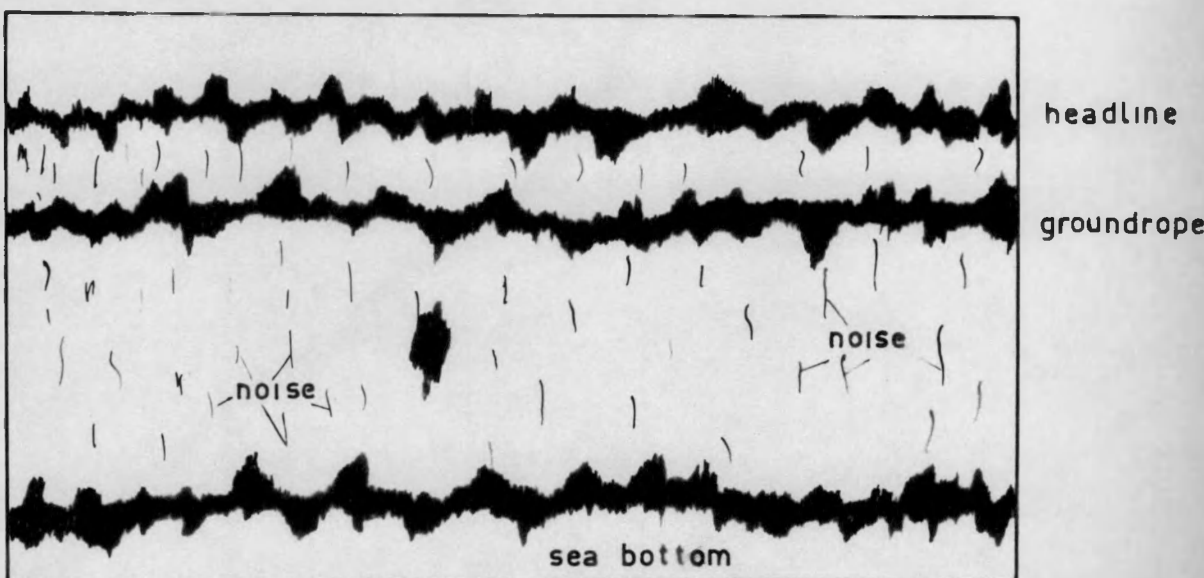

Figure 7

to the same transmitter. However the possibility exists that echoes are strongly reflected. These echoes appears on the echogram as strong or false echoes. Whereas the distance BC is shorter than CAB, these false echoes will be plotted at a higher level on the echogram than the direct echoes (figure 9).

(d) Dry cells or batteries.

The transmitter fitted on the headline of the net is fed by means of dry cells. The life of the dry cells lasts approximately 25 hours. During the experiments, the cells were changed after every three hauls, although, the echograms were still very clearly reproduced. The replacement of cells is done by dismantling the watertight cover of the transmitter.

3. Operations.

The operation of the echo installation is carried out by means of switches and potentiometers mounted on the front panel of the recorder. The recorder has only one depth scale, meaning that it is not possible to check on to another scale.

§ 4. Conclusion.

The trials aimed to test technically the posibilities of a wireless net echosounder ; the aspect "catch" was not taken into consideration.

The trials have shown that :

- the net echosounder (transmitter), the towed receiver and the recorder are easy to mount,

- the entering of the fish, the sea bottom and the net-opening are clearly plotted,

- the fish swimming just above the bottom is well registrered,

- practically no disturbance is caused by the propeller or by vibrations,

- changes in depth of the net are very well indicated on the recording paper,

- any synchronisation disturbance could easily be adjusted,

- the operation of the apparatus is very simple.

ABNORMAL RECORDINGS DUE TO STRONG REFLECTED ECHOES

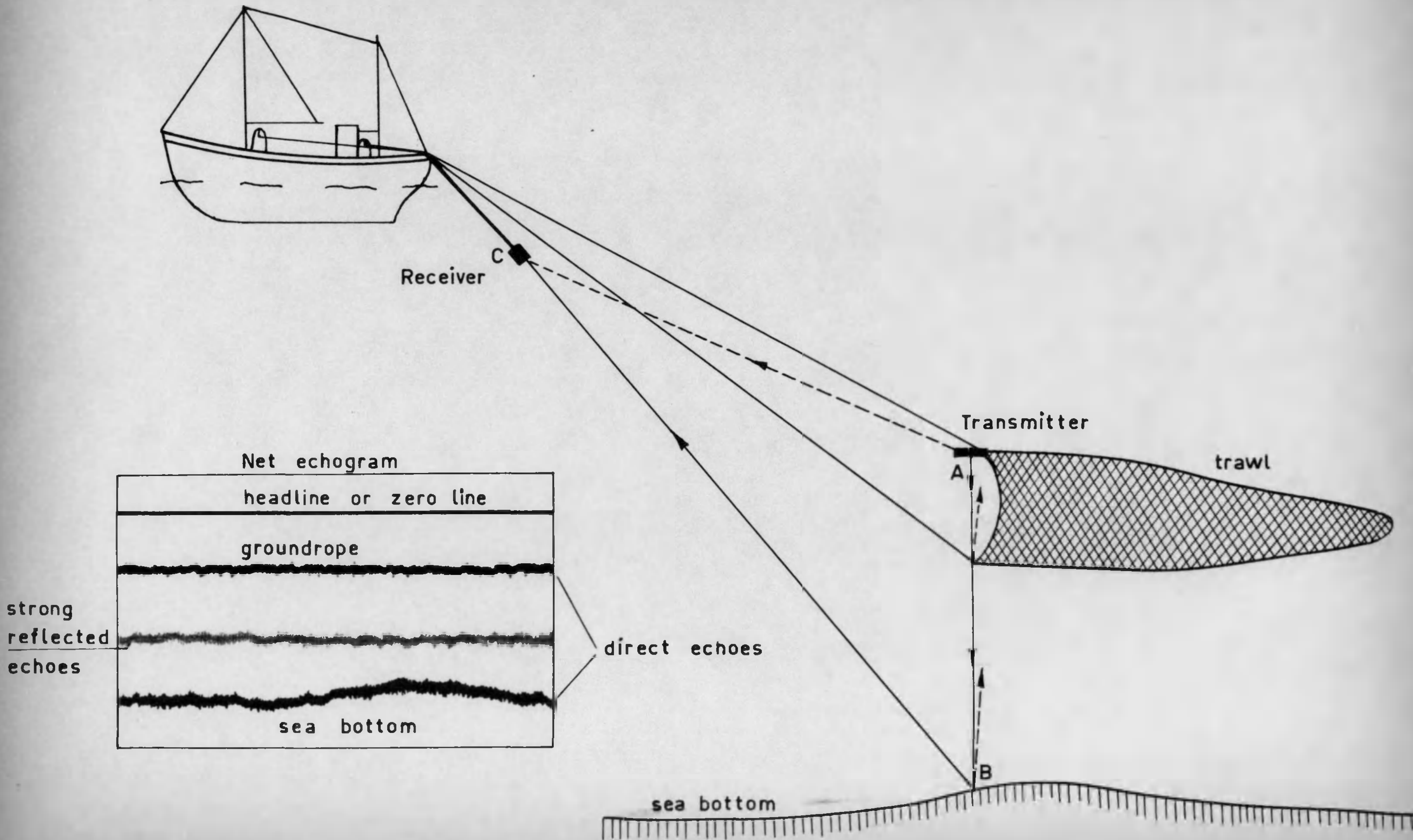

Figure 9

The operation of the net echosounder and the stability of the synchronisation in deeper waters form a further point of research. The same applies to the echo reproduction of fish schools in deeper water.

The unit presents promising prospects for the pelagic fishery. The behaviour of echo impulses over short distances should also be investigated.

ANNEX.

I. Description of the wireless net echosounder.

1. Generalities (figure 10).

The Furuno cableless net echosounder requires neither an electrical winch nor a cable connection between ship and net.

The transmitter, fitted on the headline of the net is composed of an emitter and a receiver. This unit is fed by means of dry batteries. It emits acoustic impulses of 180 kc/s under a beam angle of 12° towards the sea bottom. These impulses are reflected when touching an object (fish, wrecks, sea bottom etc.) and picked up by the same transmitter, which detects the impulses and sends them as acoustic transfer impulses of 50 kc/s under a beam angle of 42° to the towed receiver. The picked up acoustic echoes are converted in electrical energy and after being coupled to several amplifying stages plotted on the recording paper.

The net recorder echogram permits the observation of the opening of the net, the fish traces between net and sea bottom and the depth of the net.

The transmission range between transmitter and receiver amounts to approximately 2.000 m and the range between transmitter and sea bottom 200 m. The transmitter is constructed for a depth of maximum 1.200 metres.

Echo reproduction is ensured up to a speed of 8 knots.

The most important characteristics of the cableless net echosounder are given in table III.

2. Net echosounder (transmitter).

When the net echosounder (figure 11) is immersed in a depth of 10 meters, a built in depth switch is automatically closed. This excites a quartz - and frequency stabilised oscillator (figure 12). The oscillation frequency of 382,5 c/s is consecutively divided into 3 c/s by means of a seven stage frequency divider. The divided wave of 3 c/s is applied to the delay circuit composed of a multivibrator in order to reform the impulse and to produce an impulse of 1.8 msec. This impulse of 1.8 msec is fed to the 180 kc/s impulse generator. Via the

RECEIVER AND TRANSMITTER

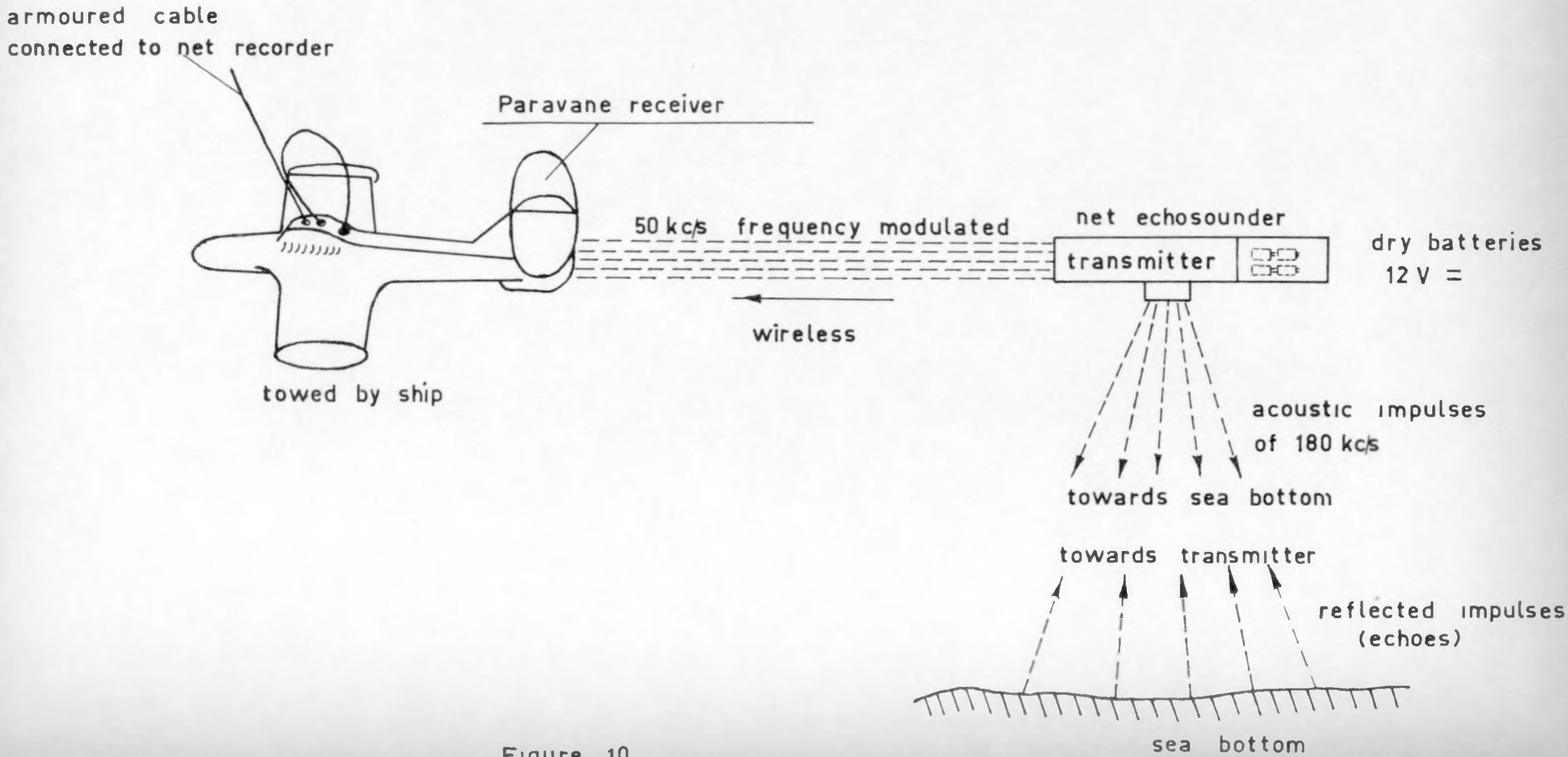

Figure 10

Table III - Characteristics of the wireless net echosounder.

1. Net echosounder	2. Receiver (ship net echosounder receiver)	3. Net recorder
- Power source : 12 V dry batteries - Sounding frequency : 180 kc/s under a beam of 12° - Transfer frequency : 50 kc/s under a beam of 42° and frequency modulated - Emitting range a) 200 m on 180 kc/s b) 2.000 m on 50 kc/s - Maxiumum depth of transmitter 1.200 m - Minimum sounding depth : 2 m	- Frequency : 50 kc/s under a beam of 42° - Receiving distance : 2.000 m - Type of receiver : a) paravane b) warp	- Power source : 24 V = - Type of paper : dry - Speed of paper : 1,9 mm/min 3,7 mm/min - Recording paper : width : ca 200 mm effective width : 170 mm length : 21 m

TRANSMITTER

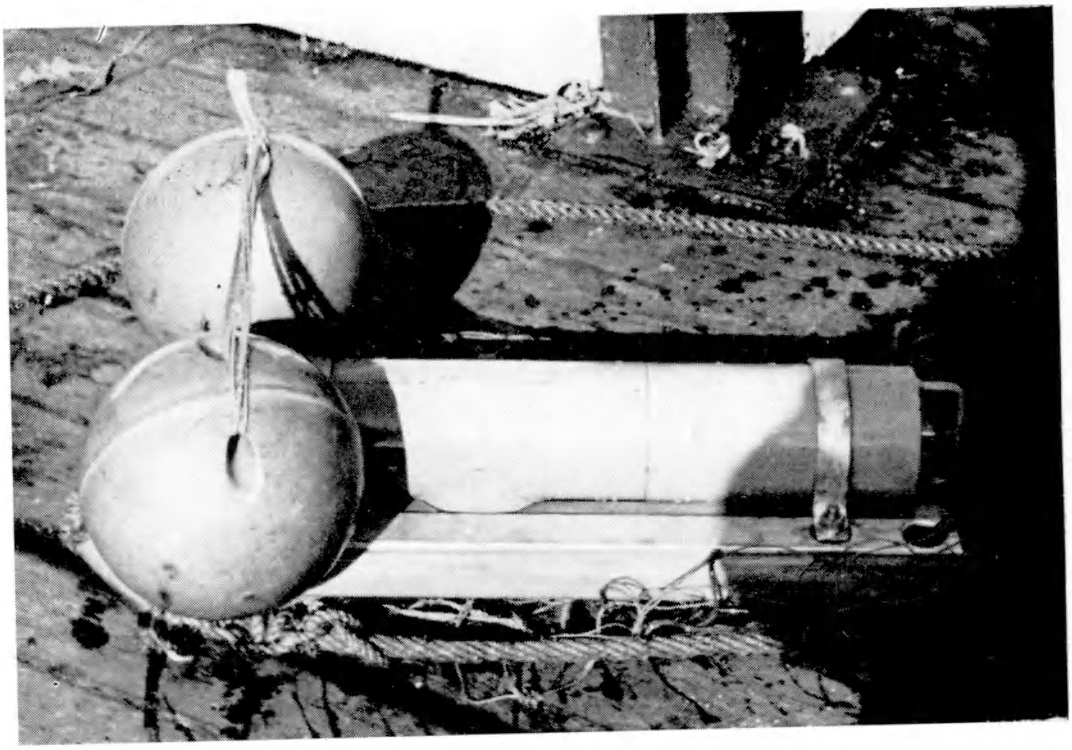

Figure 11

BLOCK SCHEMA OF THE NET ECHOSOUNDER

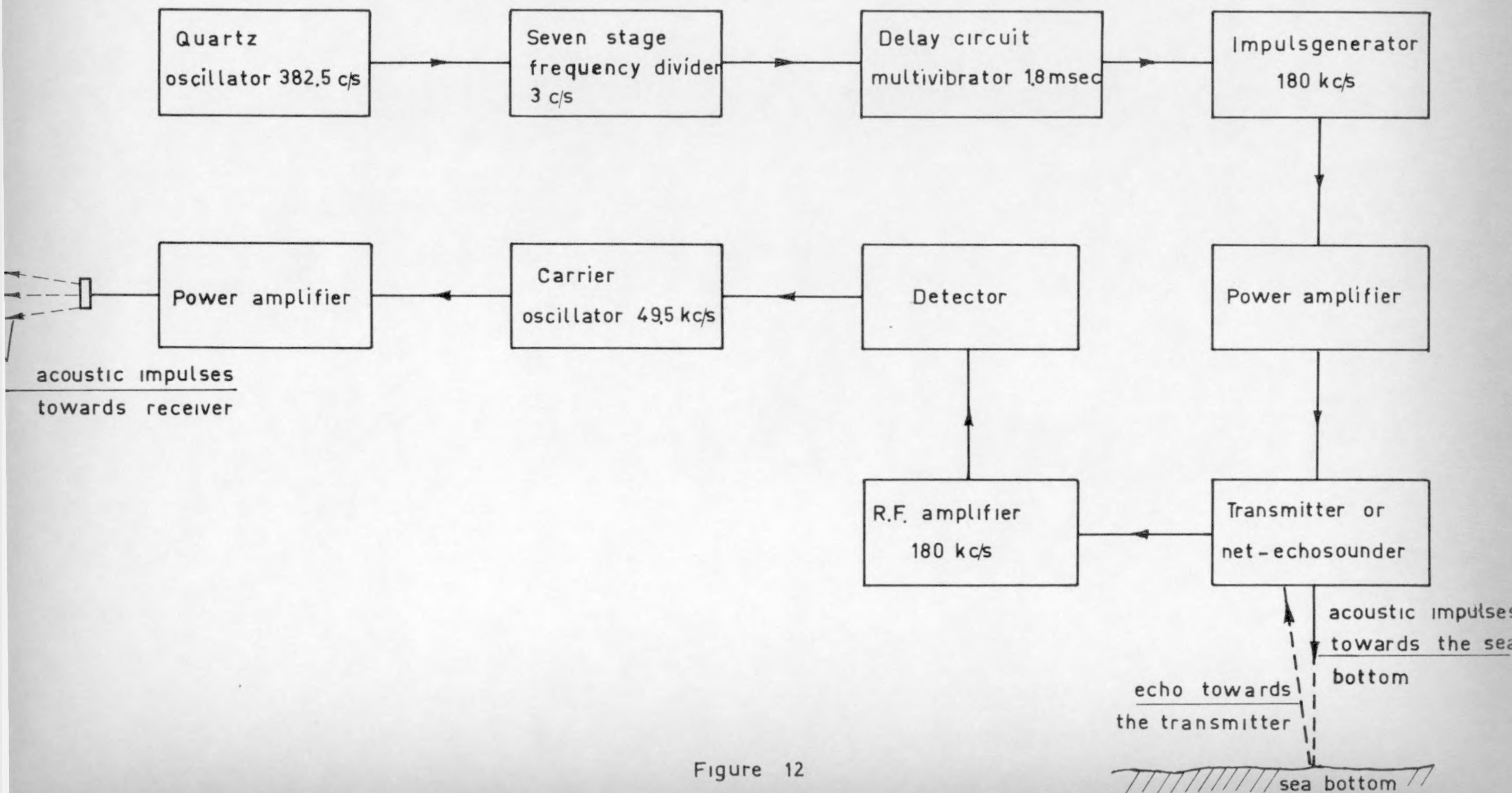

Figure 12

final power amplifier, the impulse is transmitted by the sounding transducer of the transmitter so that an acoustic impulse of 180 kc/s is emitted towards the sea bottom.

The impulse is reflected after touching an object and returns as a target echo to the same transducer. The returning target echo (usually very feeble) is successively led to the R.F. amplifier and the detector circuit. The detected target signal is fed to the 49,5 kc/s carrier oscillator which modulates the carrier frequency. This frequency modulated signal is applied to the transmitting transducer which converts this signal into an acoustic impulse which is in turn emitted towards the receiver unit.

3. Receiver unit of ship net echosounder receiver.

The receiver tuned on 49,5 kc/s picks up the target signal delivered from the transmitter. The receiver converts the acoustic signal into electrical energy.

The receiver is towed at a distance of approximately 30 m behind the stern in order not to be influenced by the noise of waves caused by the propeller.

There are two kinds of types of receivers.

a) Paravane type receiver (figure 13).

The paravane type receiver is put into the water by means of a boom. The receiver should be towed outside the turbulence and noise caused by the propeller.

b) Warp type receiver (figure 14).

The warp type receiver is more convenient for two-boat trawling. The receiver is mounted on a board with eye-bolts. The receiver slides along the warp into the water. Turbulence and noise from the propoller have to be avoided.

4. Recorder.

The target signal from the net echosounder is coupled to the recorder via the receiver (figuur 15). The feeble- and in frequency modultated signal is amplified in the wide band amplifier. The signal is successively fed to the limiter and the F.M. demodulator for detection.

The sychronisation impulse from the F.M. demodulator is used as a comparison impulse and the target signal is amplified in the power amplifier and plotted on the recording paper.

PARAVANE

Figure 13

WARP RECEIVER

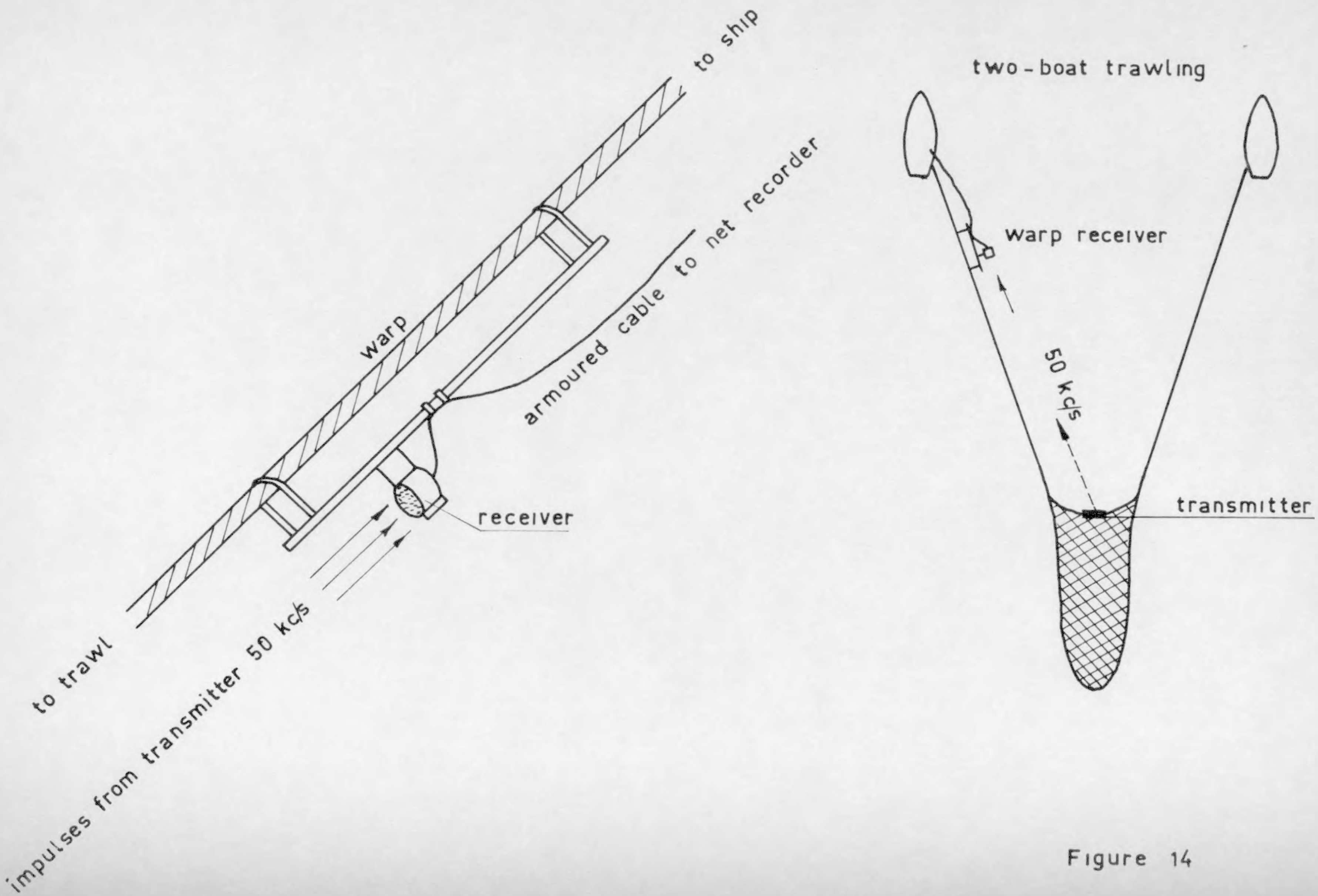

Figure 14

BLOCK SCHEMA OF NET RECORDER

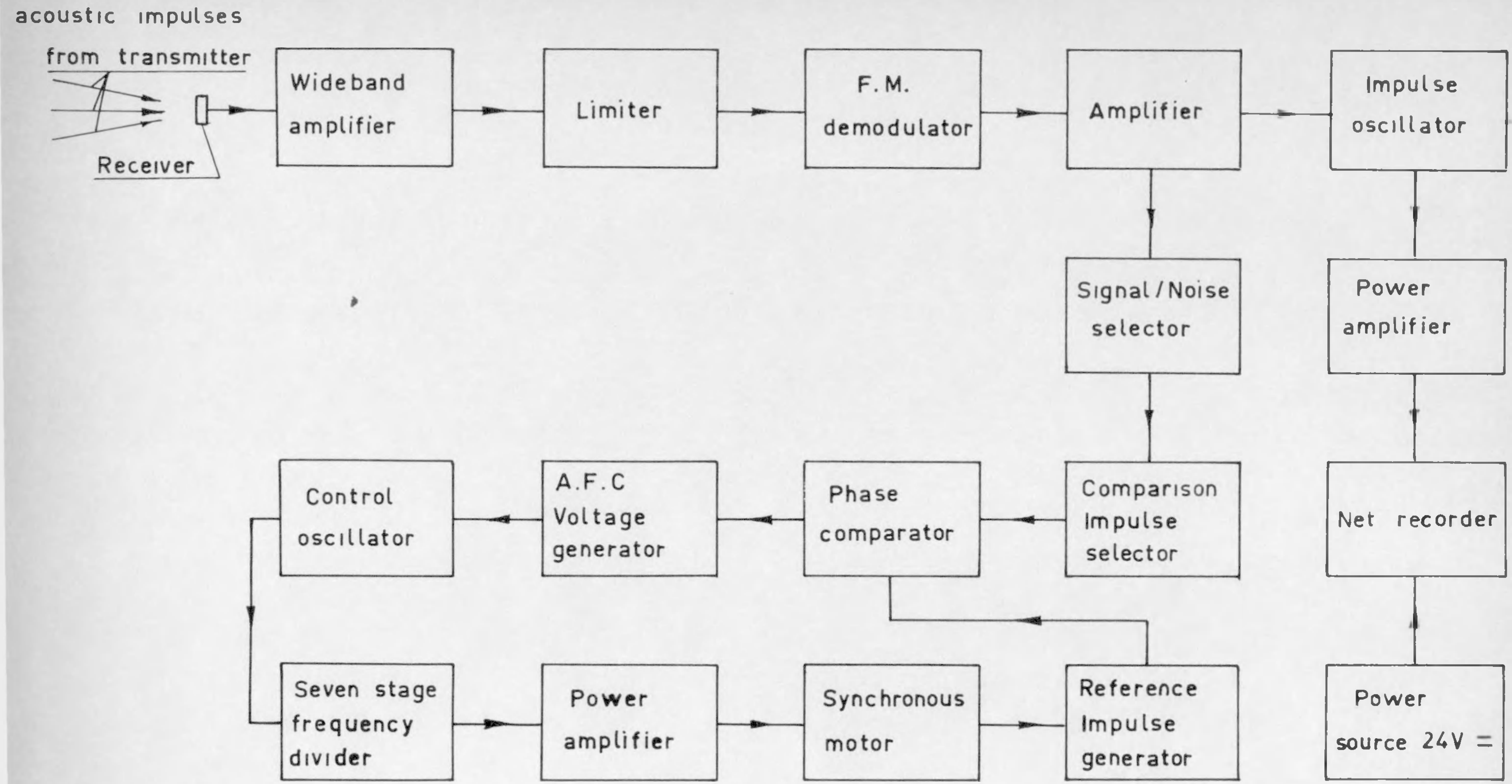

Figure 15

The comparison impulse passes to the signal/noise detector for rejection of noise components. The comparison impulse selector and the reference impulse generator apply simultaneously an impulse to the phase comparator. The reference impulse is generated in the reference impulse generator in order to ensure the sychronisation between the rotation of synchronous motor and the impulse repetition rate of the sounding impulse of 180 kc/s.

The control oscillator generates an oscillation wave, its frequency is divided through the seven stage frequency divider and fed to the synchronous motor via the amplifier. The oscillator frequency is controlled by an A.F.C. voltage.

The comparison impulse and the reference impulse are compared by the phase comparator. In unsychronised state a positive or negative voltage will be produced (A.F.C. voltage).

II. Installation and operation of the apparatus.

1. Recorder.

The recorder is fed by a direct voltage of 24 V.

The recorder has to be mounted in a dry, good ventilated and waterproof place. It may not be directly exposed to sea air, high temperatures and vibrations.

The recorder is provided with the following switches :

- Power source switch,
- Amplifier gain control,
- Detector gain control,
- Synchronisation adjuster,
- Automatic synchroniser,
- Transition switch,
- Zero line adjuster,
- Zero point adjuster,
- Paper speed changer.

2. Receiver.

The paravane type receiver is provided with ± 40 m armoured cable and towed behind the stern of the ship. A boom is required to put the receiver overboard. A small hand winch facilitates the shooting.

The warp type receiver is always provided with armoured cable. This type does not need a boom or derrick. A winch eventually facilitates the shooting manoeuvres.

In both cases care has to be taken to avoid the turbulence caused by the propeller.

3. Net echosounder.

The net echosounder or transmitter is mounted on a board with eye-bolts in order to attach it on the headline.

During the mounting attention has to be paid to the following points :

- the sounding transducer of 180 kc/s has to be directed towards the sea bottom,

- the transfer transducer of 50 kc/s must be directed towards the ship,

- the deformation of the headline can be avoided by means of floats.

The power source of the transmitter is composed of 8 dry cells or batteries of 1,5 V each corresponding to a voltage of 12 V. The batteries work from the moment that the transmitter is immersed in a depth of 10 m. The net echosounder requires a voltage comprised between 8 and 12 volts. When the voltage becomes lower than 8 volts the batteries have be replaced.

The replacement of the spent batteries is very simple.

ANNEX II

PROGRAMMES FOR 1968

F R A N C E

Laboratoire de Paris

Thème de recherche : Pêche de la sardine dans le golfe de Cascogne.

Connaissances acquises.

Ce programme s'inscrit dans le cadre des recherches sur la pêche des espèces pélagiques de la zone côtière.

Les études porteront sur le milieu, sur la biologie et l'écologie de l'espèce ainsi que sur la technologie de la pêche.

A. Etude du milieu.

Quatre campagnes saisonnières d'hydrologie des pêches seront effectuées dans le golfe de Gascogne. Elles porteront sur la température des eaux et le plancton.

B. Biologie et écologie.

Les concentrations et la dispersion des bancs de sardines seront observées en mer, à bord du "ROSELYS", en corrélation avec les conditions de milieu.

L'abondance des oeufs et larves de sardines ainsi que leur répartition seront étudiées par le laboratoire de plancton de Paris.

C. Technologie de la pêche.

1) Pêche à la lumière. Les travaux en cours depuis longtemps déjà, seront poursuivis en vue de l'amélioration des techniques d'attraction du poisson par la lumière artificielle.

On connaît bien, maintenant, le comportement des sardines sous une lumière d'une intensité donnée, produite au moyen de lampes à incandescence.

Des essais ont également été faits en 1967 au moyen de lampes à vapeur de mercure. Bien qu'ils aient été prometteurs, ces essais doivent être poursuivis.

On tentera aussi de se procurer des lampes fluorescentes, non encore expérimentées en France, mais que les pêcheurs japonais utilisent apparemment avec succès.

Au cours de chaque essai, des mesures de turbidité et de photométrie seront faites et les conditions hydrologiques et météorologiques seront observées.

2) Pêche à l'électricité. Au cours de l'année passée des connaissances théoriques ont pu être acquises sur le comportement des poissons dans un champ électrique, sur la forme et la durée des impulsions nécessaires pour provoquer la taxie anodique ainsi que sur la forme et les dimensions des électrodes. Les résultats théoriques devront permettre de construire dans un proche avenir un prototype de pêche.

Thème de recherche : mise au point d'un chalut sélectif à langoustine et merlu.

A. Connaissances acquises.

Le chalut imaginé est dérivé du dispositif de sélectivité du chalut à crevettes de M. DEVISMES. Ce dispositif est cependant inversé car l'on sait que les jeunes merlus et les langoustines sont souvent pêchés simultanément. Or, nos expériences ont montré que le merlu a tendance à nager vers la partie supérieure du chalut. Il faut donc utiliser ce type de comportement pour favoriser l'évasion des jeunes merlus vers une poche supérieure, tandis que les langoustines seront dirigées vers une poche inférieure.

B. Programme de travail.

Les premiers essais ont été exécutés durant la deuxième quinzaine de Mars. Il en a été brièvement rendu compte à Ostende. Des essais complémentaires seront repris dans le courant de l'année après modification du chalut.

Laboratoire de Boulogne-sur-Mer

Technologie des engins de pêche.

A. Connaissances acquises, problèmes posés, recherches envisagées.

L'installation d'un nouveau treuil plus puissant sur la Thalassa permettra de reprendre les essais de pêche pélagique dans de meilleures conditions. On projette également d'acquérir des appareils destinés à étudier l'équilibre du gréement en chalutage de fond.

Les premières observations sur maquettes réalisées dans le bassin de la Chambre de Commerce, au cours du 2ème semestre de 1967, ont fourni des données intéressantes sur le comportement de divers engins. Ces observations seront complétées en 1968 par des essais portant sur d'autres types de chaluts et de panneaux.

L'étude des variations de la traînée et de la poussée s'exerçant sur les panneaux en fonction de l'angle d'attaque sera entreprise ; elle comportera en particulier une comparaison au point de vue hydrodynamique des panneaux rectangulaires et des panneaux ovales.

B. Programme de travail.

- En mer :

Thalassa - Les essais de chalut pélagique et les mesures sur le train de pêche pourront être réalisés en tant qu'objectifs complémentaires de la campagne hareng (15 août - 15 octobre).

- Au laboratoire :

Les travaux sur maquettes seront poursuivis. D'autre part les données théoriques sur la filtration et la traînée des filets de pêche seront précisées.

C. Résultats escomptés.

Les essais de chalut pélagique sur la Thalassa ont principalement pour objet l'appréciation de la rentabilité de cette méthode de pêche dans les pêcheries de hareng de la Mer du Nord.

Les observations sur maquettes doivent fournir, sur le fonctionnement des engins de pêche, des données précises qui pourraient être vérifiées par des mesures en mer dans les conditions normales de pêche.

On peut rappeler ici le travail entrepris sur les méthodes de pêche régionales : des observations ont déjà été effectuées, en particulier par MAUCORPS (pêche du hareng au chalut-boeuf), PORTIER (pêche du maquereau au chalut semi-pélagique) et LAMOLET (chalutage de la crevette). Ces observations seront poursuivies et complétées dans le courant de 1968.

E N G L A N D

Programme of fishing gear investigations at the Fisheries Laboratory, Lowestoft

Fitting of ship-borne sector-scanning sonar on R.V. CLIONE.

The re-construction in the part of the ship below the fore-deck incorporating a tube from the fishing deck vertically down through the hull and opening to the sea has already been completed. The stabilization mechanism will be fitted and tested in June. The electronic apparatus will be installed in June-July and sea trials and operator training will be conducted through August and September.

The sector-scanning sonar will be used for fish behaviour studies in September.

Aimed fishing.

R.V. CLIONE and R.V. CORELLA will work together on aimed fishing with pelagic trawls in August-September. Both ships will use conventional sonar and 800 or 1200 mesh single-boat trawls. Underwater television and a multi-directional transducer apparatus will also be used. The main purposes will be to improve sonar-using techniques and to study the reactions of fish shoals to trawls and trawlers.

Purse-seining.

One short voyage of R.V. CORELLA in May will be devoted to practising purse-seining.

Bottom trawl investigations.

In October-November, R.V. CORELLA will use instrumented bottom trawls to study the effects of tickler chains. The underwater television and still cameras will also be used on the trawls.

In collaboration with the Marine Laboratory, Aberdeen the collected data from the past few years' series of distant-water bottom trawl comparative fishing experiments will be prepared for publication.

B E L G I U M

Fisheries Research Station

Study of shrimp nets with different taper ratios in function of the catch capacity and the drag.

Study of the behaviour of shrimp nets equipped with a sieve. Determination of their selectivity.

Current measurements in different parts of the shrimp trawl to obtain an insight into the repartition of the speeds.

Selectivity of a semi-pelagic trawl for cod end whiting.

Study of the security system for beam trawl fishing vessels.

G E R M A N Y

1. Continuation of testing and developing the new combination bottom and midwater trawl on herring and round fish under different fishing conditions, increase of the net size.

2. Testing of the meanwhile improved electrical fishing equipment in combination with bottom and midwater trawls.
   This project is conducted in close co-operation with the american firm SMITH RESEARCH & DEVELOPMENT COMP. (Dr. C. KREUTZER).
   Publication of results may to a certain extent be restricted.

3. Further improvement of midwater trawling in particular with regard to electronic and acoustic means for more accurate "aiming".