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OILFIELD
SEAMANSHIP

Volume 3

Anchor Handling

by
Michael Hancox

Re-ordering

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Front Cover Picture
H.E.R. Group provide all the necessary personnel and cable handling equipment to carry out a round the clock operation replacing the wire rope anchor lines on the Safe Holmia. Two teams work on separate vessels reeling off the old wires, removing and refitting the sockets to the new wires, and finally spooling them up onto the anchor winches.

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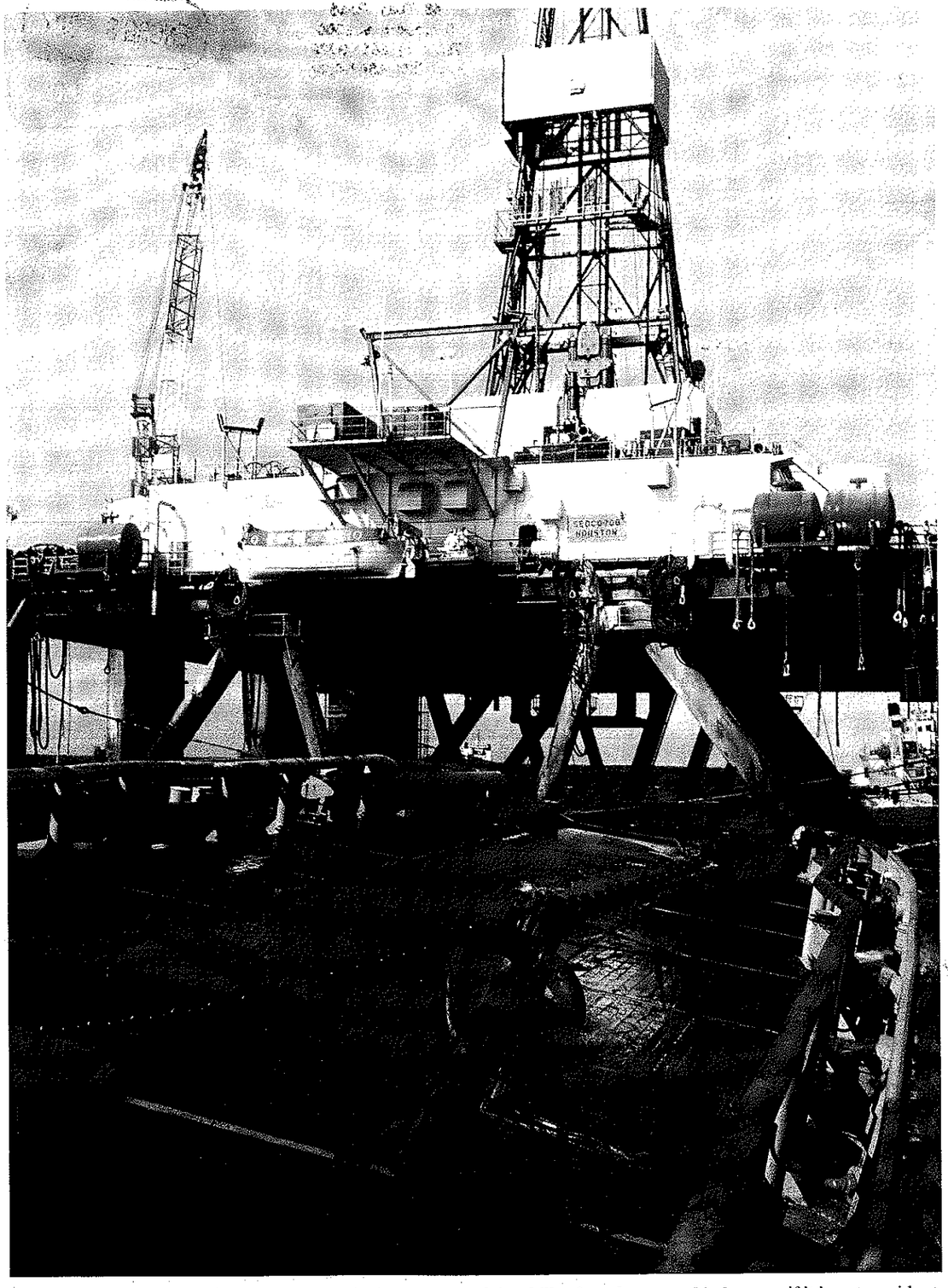

A far greater emphasis has to be placed on the importance of the **skills of good seamanship because** if it is not, accidents will continue to occur, many of them with fatal consequences, and those traditions we were so familiar with and rightly proud of will be a thing of the past. **Text books like this on oilfield seamanship augment** the skills which **are so important, they cannot replace them.**

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CONTENTS (cont'd)

PART 1. INTRODUCTION

The text below has been taken as an extract from,
A Summary of Marine Accidents by the Marine Accident Investigation Unit of the Department of Transport — UK

There have been many text books written on the subject of seamanship. Some of the older ones have gone out of print but remain classics in their own right, and a copy can be a much sought-after possession. Others are kept up-dated and new editions appear on the bookshelves and, then to add to the store of knowledge available, new authors appear on the scene and present the same subject in a different manner. These text books, whether old or new, will become part of the essential library of both trainee and experienced seamen.

Good reference books help the practitioner form a sound background knowledge of the subject, but in most cases it takes practical experience before a person can really be said to be proficient. Seamanship is no different in this respect. A person can acquire any amount of knowledge from books on the work of navigating, maintaining and operating a vessel, but the all important skill aspect **can only be acquired from hands-on practical experience.**

There are countless examples of what one would term good seamanship but this all important factor is absent, or at least not put into practice, in so many of today's accidents at sea. No doubt the experience is often at hand, but the skill necessary to carry out operations in the tradition of good seamanship is not, or is at least, not applied when it's needed most.

A far greater emphasis has to be placed on the importance of the **skills of good seamanship because** if it is not accidents will continue to occur, many of them with fatal consequences, and those traditions we were so familiar with and rightly proud of will be a thing of the past. **Text books on seamanship augment** the skills which **are so important, they cannot replace them.**

Chief Inspector of Marine Accidents
December 1992

PREAMBLE

Anchor handling is an activity which is exhilarating, boring, exhausting, terrifying and often professionally very satisfying. It can test boat handling skills to the limit and try a Master's patience beyond what the most phlegmatic of personalities should reasonably have to tolerate.

It is a cooperative venture where there may be several boats working together to deploy, retrieve or move a mooring spread and therefore attempting to "do your own thing" without taking into consideration the overall plan or the activities of the other tugs can upset or endanger someone elses work or crew.

When handling the anchors of a barge or drilling rig the boat is the servant of the vessel whose anchors it is working and as such cooperation willingness and professional skill will be assumed — failure in any of these characteristics can result in the boat being "run off", that is summarily dismissed.

In these operations heavy machinery is being frequently worked to the limits, breakdown must be expected and may happen at 'the most inopportune' moments; quick reactions, positive action and a display of initiative may go far to obviating the resulting problems.

All the elements for serious damage to the boat and crew exist in anchor handling work; close proximity manoeuvring, wires and chains under high tension and ship motion due to sea state. The utmost vigilance is necessary on the part of Master and crew members.

Short cuts, taking chances and allowing frustration (caused by fatigue or impatience) to lead to actions which are foolhardy usually don't pay off and may lead to serious injury to men or damage to the boat.

This book is aimed at the Masters, officers and crew of the offshore oilfield's anchor handling fleet, marine superintendants of companies involved in using these craft and at cadets and others including barge masters, barge engineers and barge movers who need a guidebook on the capabilities and techniques of oil industry anchor work.

The book covers the majority of common operations which might be encountered but it must be understood that the methods described are not the only means of achieving a particular aim. Seamanship applied to this kind of work has often to be modified or adapted to suit the requirements of a particular operation or available equipment. No work on this kind of subject can hope to overcome deficiencies in aptitude, i.e. the ability of a person to handle a vessel or its equipment. Good ship handlers have an inate sense of "feel" whether it be in the positioning of their vessel or operating the winch system. Technique may be learnt and acquired through practice but there are individuals who will never master the actual business of "boat handling" and this should be recognised by themselves and those who employ them.

It should not be thought that oilfield anchor handling work is a recent unique phenomenon. The operations are modifications of methods used and described as far back as 1650 — although the use of chain cable in navies after 1800 saw the introduction of handling methods similar to today's techniques (see footnote).

Sailors, dredging crews and those engaged in laying or retrieving heavy moorings use and have used techniques found in the offshore oil industry for many years and the evolution of the anchor handling tug reflects a progressive modification to suit particular circumstances.

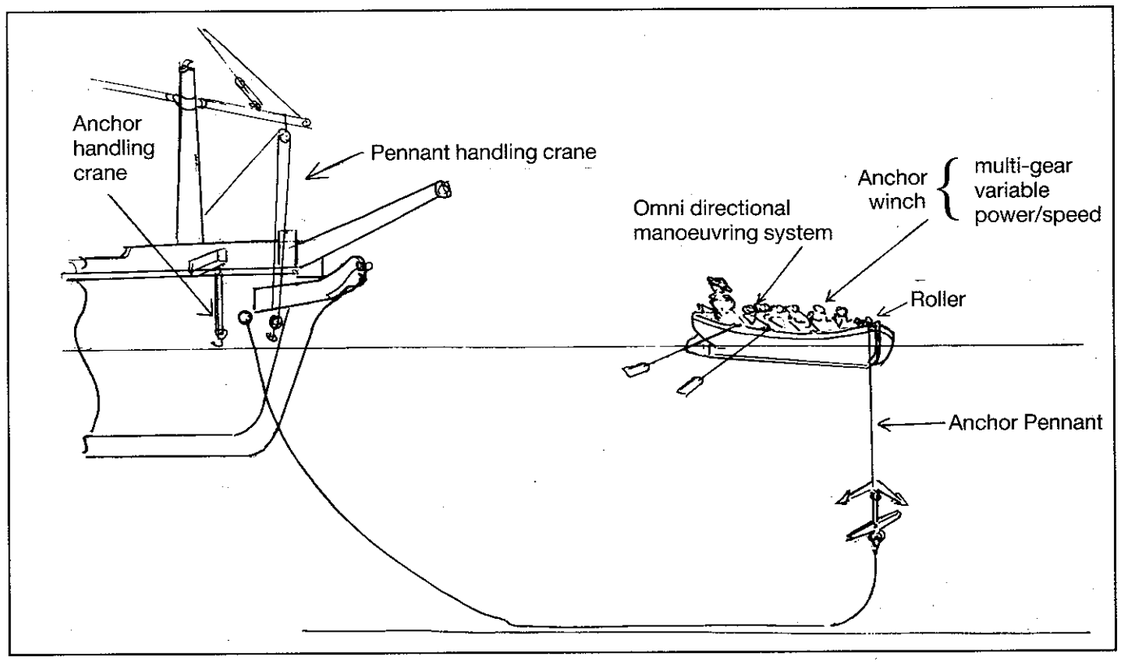
The book is written around mainly North European practice, which is often modified by local conditions and equipment. In any geographical area, methods develop which suit that locality and the author does not wish to imply that the methods described are the only appropriate ones.

The author is indebted to many individuals, barge engineers, tower foremen, as well as boat captains of several nationalities, barge movers and especially to those who have allowed me to "experiment" with methods, sometimes against their better judgements.

It is extremely important to allow the imagination "elbow room" when faced with a task which is somewhat out of the ordinary and this book aims only to show what is usual not what is possible.

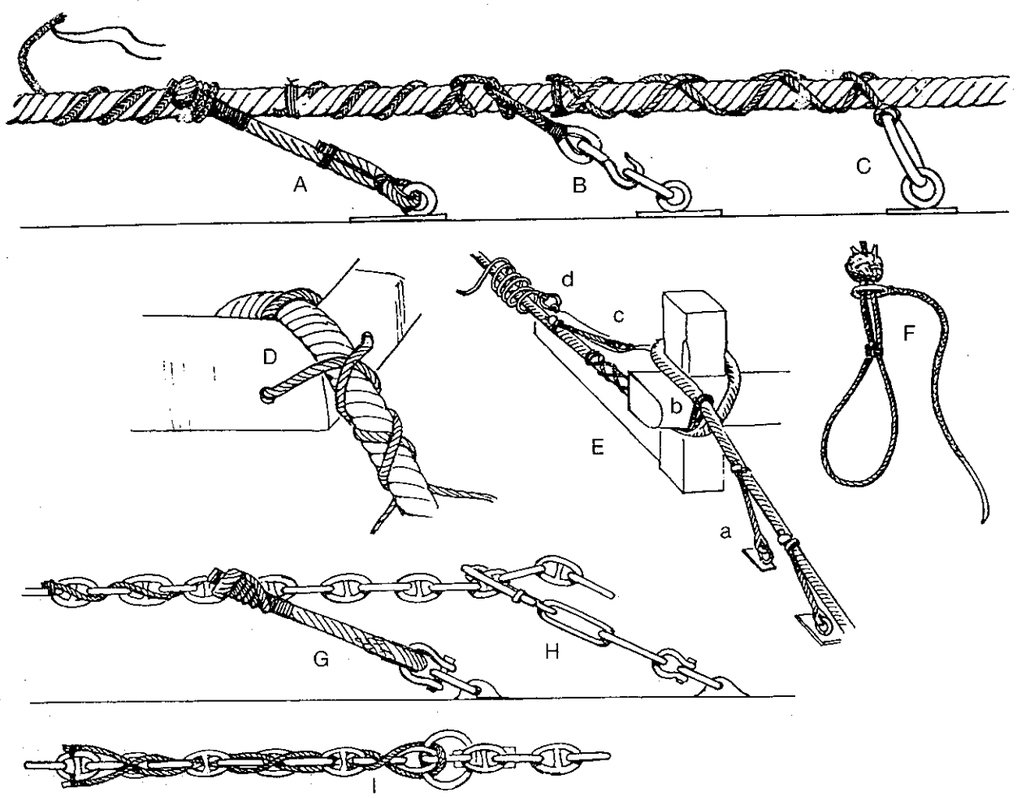
Masters of anchor handling tugs are urged to read Volume 5 of this Oilfield Seamanship Series, Barge Moving and Mooring in order to get the perspective of the operation from the barge's point of view.

Michael Hancox
February 1994

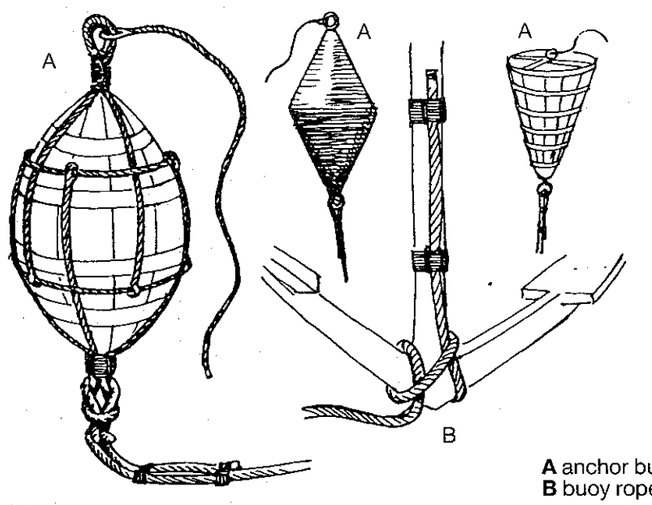


Anchor handling circa 1790 — most seamen would become proficient after only two floggings.

NB: Readers should consult Seamanship in the Age of Sail by John Harland — Conway Press 1984 ISBN No. 0 851771793.



A deck stopper; **B** small dog stopper; **C** two tailed ring stopper; **D** hatch stopper; **E** varieties of stoppers: **a** deck stopper; **b** dog stopper; **c** bitt stopper; **d** ring.



A anchor buoys
B buoy rope hitched

Stoppers and anchor buoys from a byegone age proving that nothing is ever really new in the anchor handling business.

CHARACTERISTICS OF ANCHOR HANDLING VESSELS

The following diagrams show the outlines of the three most common types of oilfield anchor handling and towing vessels. These are drawn to the same scale and should be contrasted with that of the modern ocean going salvage tug.

The table accompanying each diagram describes the application of each vessel type in its correct role and also mentions a list of the inappropriate uses to which the vessel may be put.

All vessel types develop through a process of specific area and job requirements mixed with historical tradition in shipbuilding characteristics.

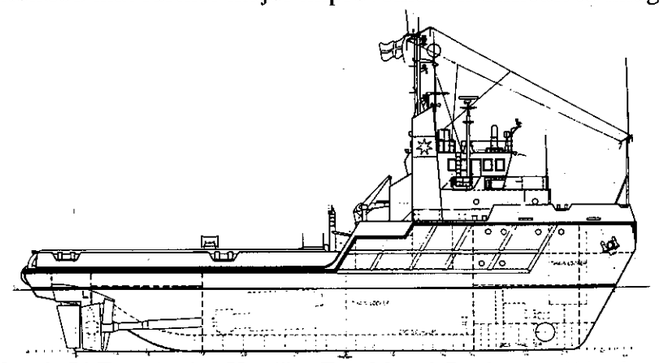
Ship designers and builders have great difficulty in adopting good ideas without modification and the results are often poor substitutes.

In the offshore oilfield the late 1970's and 1980's saw the evolution of standard designs both in anchor handling tugs and anchor handling tug supply ships and although these vessels have become increasingly more powerful with numerous add on roles such as fire fighting, oil pollution control and rescue capability, there seems to be a limit above which the type cannot evolve much further. The oil industry is particularly prone to the whims of "fashion", without much thought as to whether these ideas are really of use. For example the trend is to consider the "standard" offshore oil industry AHTS class vessel as being of about 10000 BHP and 120/130 tonne bollard pull — some owners/ operators have built vessels of 200 tonnes or more bollard pull which are impressive in their specification and power by any standard. However unless such a huge vessel is, in its anchor handling and towing roles, connected to anchor retrieval systems, towbridles and tow connections capable of withstanding the forces such a vessel can impose, its ability is somewhat limited and could be very dangerous. Asking the Master of a vessel of such size (displacement) and power to limit the use of his capability is often impractical because the kinetic energy of the vessel, moving in a seaway will impose on anchor pennants, mooring systems and tow gear, forces which may well part gear however careful he is.

It is significant that the Anchor Handling tug of Northern European design, as characterised by the Maersk "B" Class vessels or Boa "Pride" class have not seen much further development since being built in the early 1980's, apart from some larger vessels built for particular applications, notably Hereema's purpose built tugs as characterised by "Husky".

In the opinion of this auther the pure AHT such as Husky or Maersk Battler (illustrated) is such an excellent design for the application intended that further major improvement is difficult to imagine and in the foreseeable future, where barge anchors of even the largest crane vessels, such as Micoperi 7000, with 40 tonne anchors, is unlikely to be exceeded, no need exists to increase the power of either the vessel or the winch system.

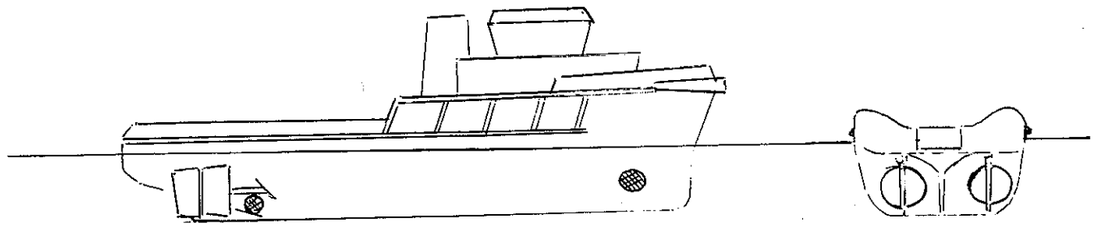
The above statement of course can be modified where a particular area of need may arise requiring a boat of slightly different design or specification.

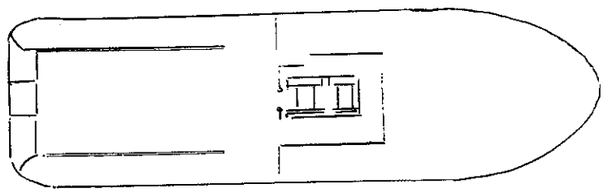


Maersk 'B'-Type Anchor Handling Tug, Maersk Battler, is said by the author to be such an excellent design for the application intended that it is hard to imagine any room for further improvement.

CHARACTERISTICS OF ANCHOR HANDLING VESSELS (cont'd)

Anchor Handling Tug (North European Design)





Length OA.	45.7m
Beam	13.0m
Depth	6.3m
Draft	4.7m
HP	9900
Bollard Pull	120 Tonnes
Tow Wire	1000m x 64mm
Thrusters	2 x 600 HP

Characteristics

1. Excellent seakeeping ability in heavy weather.
2. Highly manoeuvrable and able to work in rough seas.
3. Fast, powerful double drum winches capable of continuous use for long periods.
4. Relatively low freeboard on working deck making buoy catching and anchor handling easy.
5. Heavily fendered to enable the boat to go alongside barges and other vessels at sea and tow in alongside position.
6. Able to change from towing to anchor handling role without need for elaborate rigging of equipment.
7. Design of stern area allows vessel to work with pennants and chain well underneath stern.
8. Heavy bow fendering enables boat to **push** when required and **work in seaway alongside.**

Applications

1. Running and retrieval of barge and rig anchors especially suitable for lay barge and construction vessel work where high speed and rapid anchor running/retrieval required.
2. Agility and power allows boat to fish, grapple and work anchors in very confined spaces in rough water.

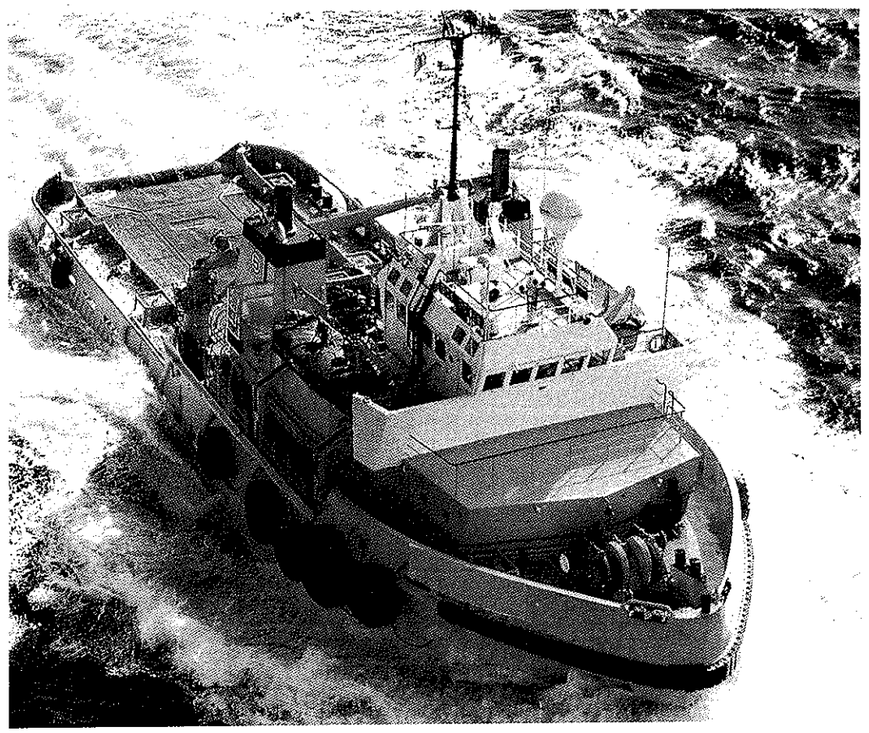
Applications (cont'd)

3. Particularly useful for towing and handling cargo barges at sea during pipelaying and construction operations where barges must be manoeuvred and handled close to and alongside.
4. Suitable for anchor handling in up to 800ft and in rough water conditions with strong currents and tidal streams.

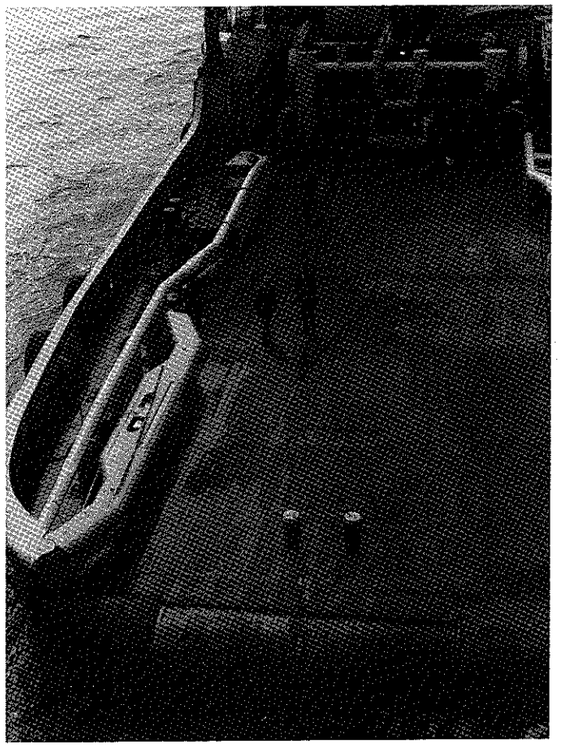
Limitations

1. Relatively small deck space means that there is limited space for carrying/stowing large anchors and buoys while working.
2. Stern area limitations may present difficulties when decking the **largest** of barge anchors.
3. May have limited chain locker space for carrying of large amounts of barge mooring chain.
4. When used as a 'live' anchor in heavy weather/strong currents these boats may be unable to apply expected power on the anchor line.
5. In deep water (1000ft) or in very sticky bottom conditions may not have sufficient power to deploy long lengths of heavy mooring chain.
6. Limited pennant storage reel space so may not be able to spool up very large amounts of heavy pennants.
7. Limited endurance for deep sea towage work (long duration).
8. Loses much effective pull when towing in heavy seas.

CHARACTERISTICS OF ANCHOR HANDLING VESSELS (cont'd)

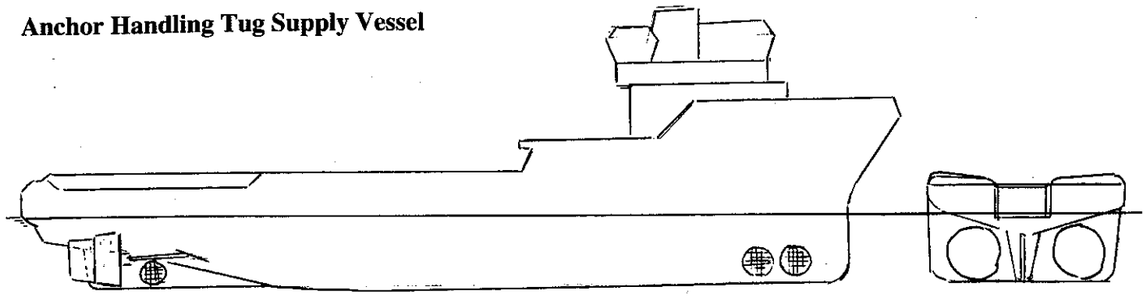


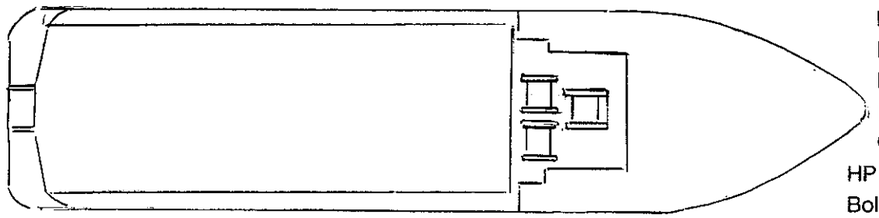
The 'Boa Pull', one of the Boa Pride class of 9,700 HP Anchor Handling Tugs (AHT's)



Stern view of a 12,000 HP AHT
Note: Shorter working deck by comparison with AHTS's, low bulwarks and crash rails and special stern roller gate, with line guides, which can be closed during towing operations. No towline stops are fitted — A heavy structure aft of the winch drums is all that is required.
Note also, rounded tug like quarters.

Anchor Handling Tug Supply Vessel





Length OA.	74m
Beam	16.4m
Depth	8.0m
Draft	5.7m
Deck Cargo Cap.	1300 tonnes
HP	13300
Bollard Pull	150 Tonnes
Tow Wire	1400m x 72mm
Thrusters	3 x 1000 HP

Characteristics

1. May have very high horsepower and bollard pull combined with large size and high volume deck cargo space.
2. Modern vessels have multiple thrusters and propellor systems giving excellent handling characteristics allowing them to work in very rough weather.
3. Powerful multi drum towing and anchor handling winches combined with power storage reels for anchor handling in deep water.
4. Large capacity chain lockers capable of holding considerable lengths of anchor chain.
5. Large deck space and stern area permits largest anchors, buoys and other equipment to be handled and stowed on deck while vessel continues to work anchors or tow.
6. Can carry large volumes of fuel and water.
7. Deck space may be utilised for variety of specialised purposes such as fitting power cable reels, cranes, 'A' frames, diving/ROV spreads etc.

Applications

1. General purpose oilfield work boat. Towing anchor handling cargo carrying both deck, dry bulk and liquid in the most hostile seas.
2. Ideal for specialised mooring and anchor handling work such as installation of SBM moorings, where large deck space and chain locker capacity needed.
3. They are well suited to perform anchor handling in extreme water depths using the heaviest of mooring equipment.

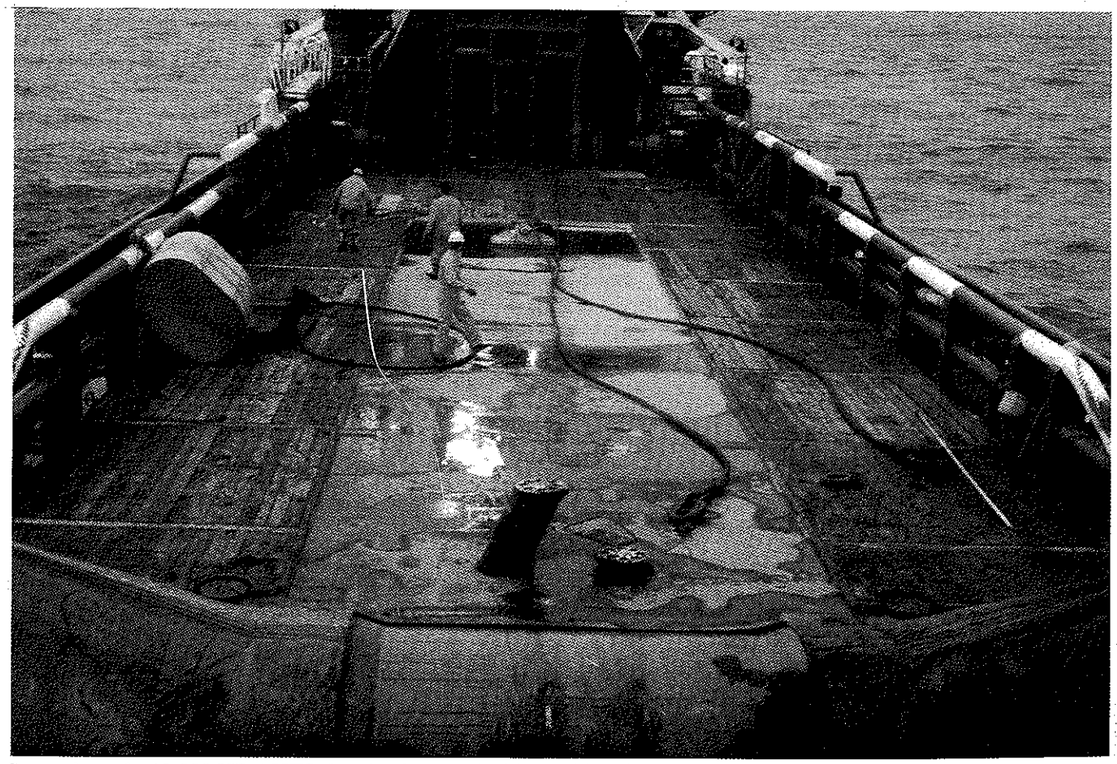
Applications (cont'd)

4. Increasingly used for transoceanic towing applications especially those units in excess of 130 tonne bollard pull due to their excellent endurance and good towing characteristics in moderate deep sea conditions.
5. Increasingly used for specialised towing/anchor work such as tow out and positioning of large gravity based platforms, TLP's and other similar structures.
6. Readily adaptable to salvage role for a variety of tasks.
7. Excellent for live anchor work for lay barge, construction barge applications.

Limitations

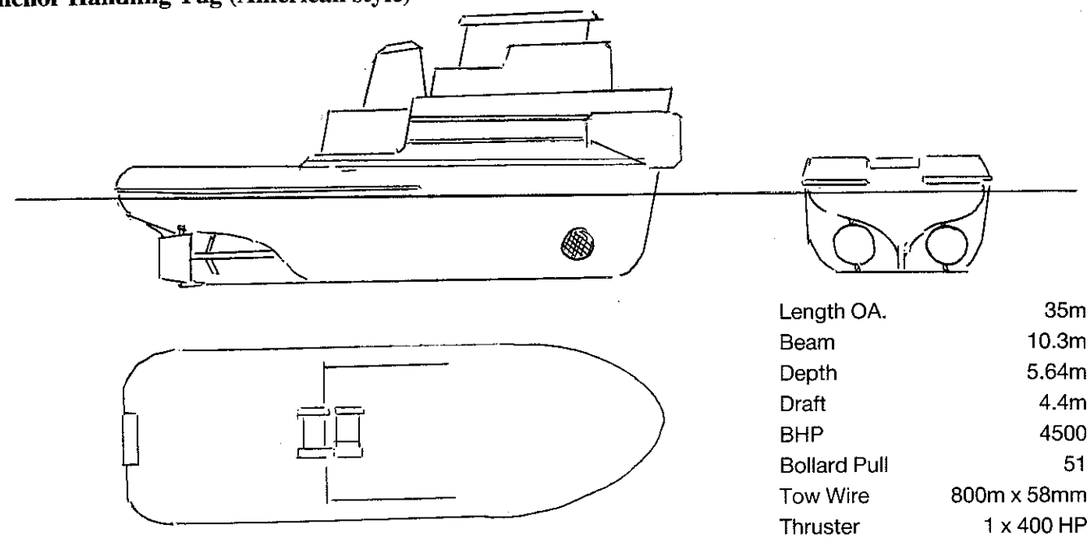
1. The largest vessels are relatively slow to manoeuvre and have winch systems where speed of operation is rather slow (compared with AHT's) for handling lay barge and construction barge anchors.
2. Usually unable to push as well as tow. Unsuitable for alongside towing (barge manoeuvring).
3. Usually too big and slow for handling cargo barges in confined spaces.
4. When used for general towing purposes, especially in largest versions great care must be exercised to ensure that bridles, towing points etc are sufficiently strong to match the tow gear and power of the boat.
5. In deep sea towing lose pulling power in rough seas due to relatively shallow draft and stern design.

Typical anchor handling tug supply vessel — (AHTS)



Stern view of a 12,000 HP AHTS showing long and wide working deck, high crash rails and bulwarks

Anchor Handling Tug (American style)



Length OA.	35m
Beam	10.3m
Depth	5.64m
Draft	4.4m
BHP	4500
Bollard Pull	51
Tow Wire	800m x 58mm
Thruster	1 x 400 HP

Characteristics

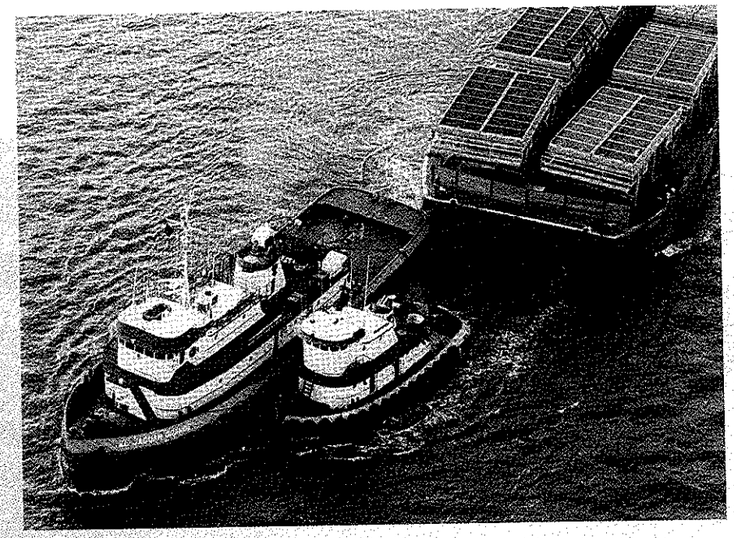
1. Relatively large beam to length ratio deep fore foot and aft body with low freeboard aft.
2. Powerfully engined and constructed heavily fendered at bow.
3. Usually fitted with fast operating double drum winch, one drum for towing, the other for anchor handling.
4. Very manoeuvrable, rapid response to helm and engines.
5. Towing/working deck small usually only about ⅓ length stern roller often quite small compared to European AHT class vessel.
6. Often features rather large and elaborate deck house structure.

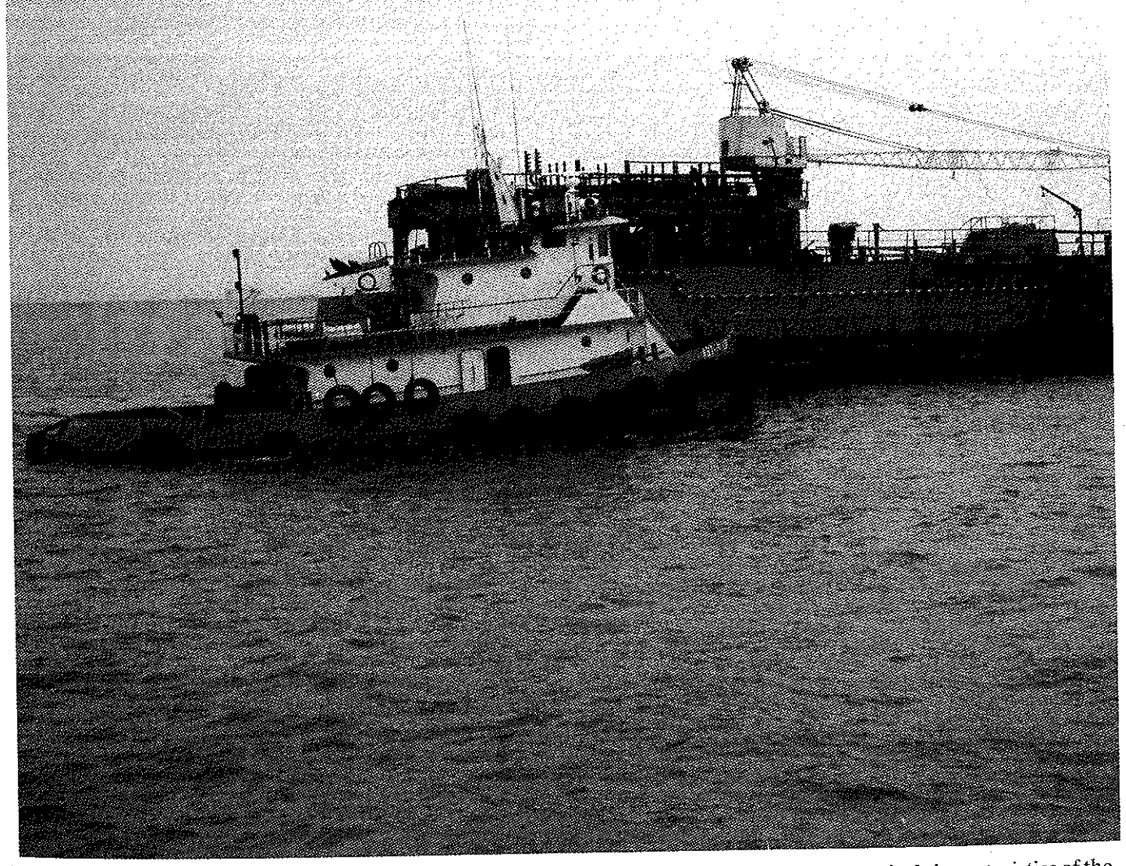
Applications

1. Very suitable for 'snatching' anchors on lay barges and construction barges in shallow to medium water depths.
2. Excellent characteristics for cargo barge towing and positioning work able to push, side tow and tow on line.
3. Very useful for handling towing and positioning operations for jack-up barges especially in confined spaces and in-field moves.
4. In larger versions have good deep sea towing characteristics and endurance, with very adequate sea keeping ability while towing.

Limitations

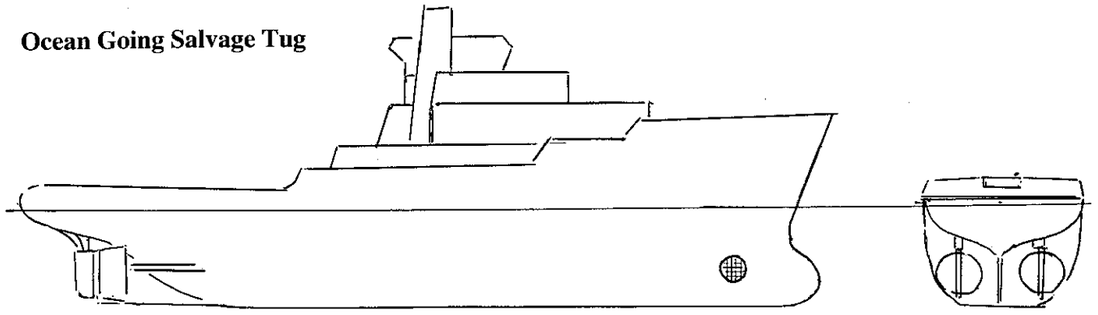
1. Low freeboard aft, and open towing deck make these boats **very** wet in even moderate sea conditions and are often dangerous to work in average North European weather.
2. Low freeboard, confined roller, stern area and small aft deck make handling large anchors on deck very difficult and dangerous in even moderate conditions.
3. Space, freeboard and winch power may limit ability to handle very heavy chain mooring systems. Limited drum space can prevent storage of large amounts of pennant wire.
4. Poor bow thruster performance can limit ability to work across strong currents.
5. Lack of deck space can be a serious problem when rigging complex mooring gear.
6. Often under powered for working anchors in water depths over 300 feet.

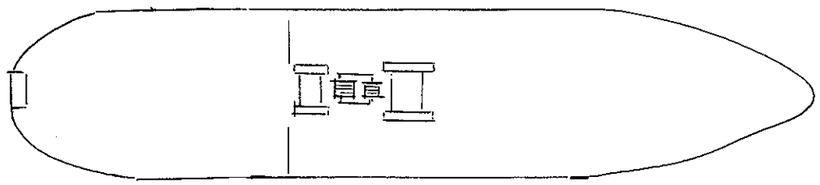




Main picture: A small version of the North American anchor handling tug but displaying the typical characteristics of the class, notably low freeboard aft, heavy fendering at bow and large deck house structure.
Inset picture (top): Large and small 'American style' AHT's work together.

Ocean Going Salvage Tug





Length OA.	68m
Beam	13.5m
Depth	6.8m
Draft	6.9m
Shaft Horse Power	10000 BHP
Bollard Pull	120 Tonnes
Tow Wire	1700m x 66mm
Thruster	1 x 1000 HP

Characteristics

1. High power/bollard pull combined with large displacement and hull shape designed for the roughest seas.
2. High free-running speed, moderate to good manoeuvring characteristics.
3. Towing winches of specific design for taking large amounts of towline and absorbing high forces.
4. Usually fitted with ample auxiliary winches, capstans, cranes, workboats, fire fighting and pollution equipment.
5. Would be expected to carry large volumes of rescue towing equipment, heavy rigging gear, diving equipment, anchors and tackle for salvage applications as well as portable pumps, generators and workshop facilities.
6. Relatively confined aft working deck and stern area designed for towing work and limited anchor handling over the stern.
7. Long endurance in terms of fuel and other consumables.

Applications

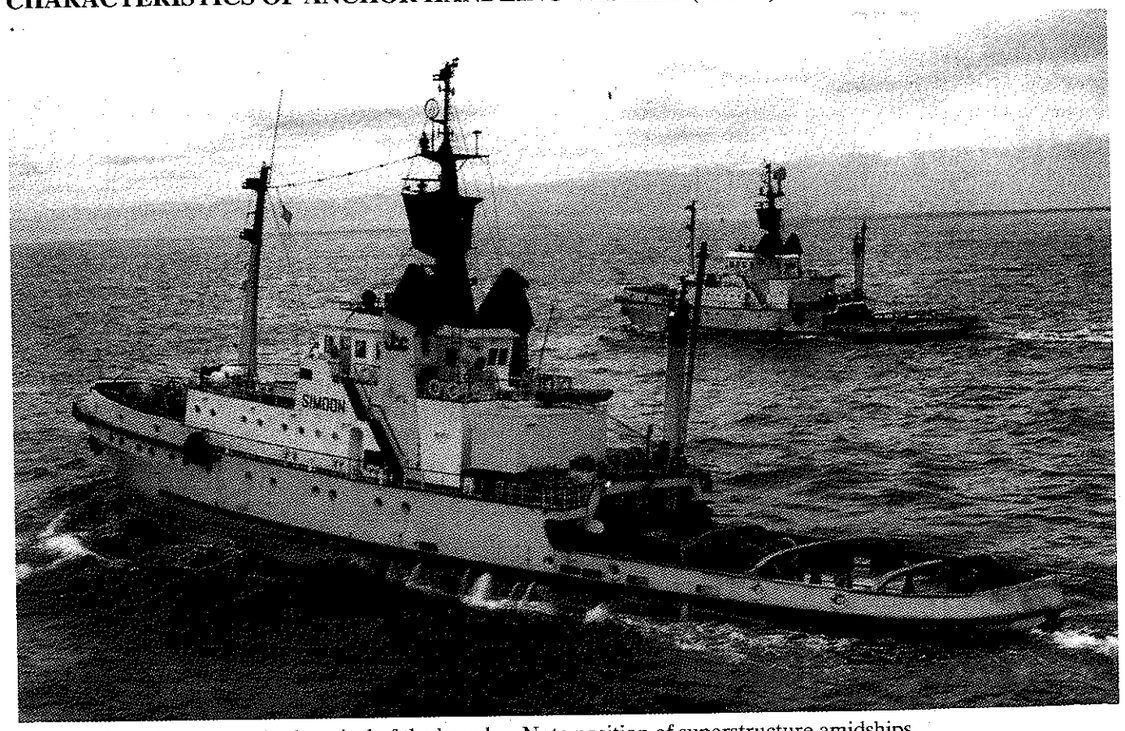
1. The rescue and salvage of vessels of all types at sea. In this role fire fighting, damage control and towing operations are envisaged.
2. The assistance of salvage operations of beached and sunken vessels, aircraft and other objects.

Applications (cont'd)

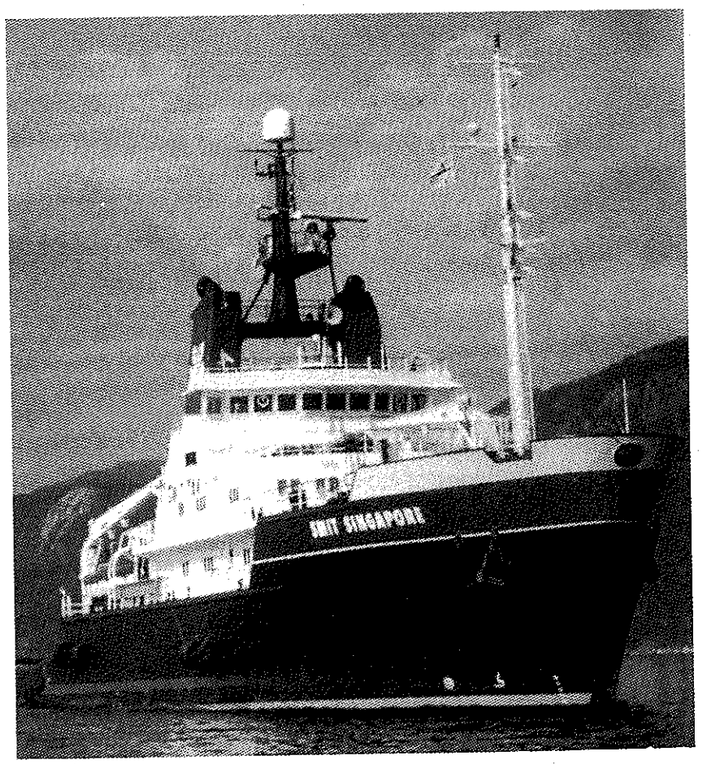
3. The towage of all kinds of floating objects and vessels over transoceanic distances.
4. Highly specialised marine operations, both civil and military requiring a vessel of excellent seakeeping ability able to operate self contained for prolonged periods in remote locations.

Limitations (for oilfield work)

1. Not suitable for oilfield anchor handling operations; winches usually wrong type, stern roller too small, stern area wrong shape and working deck too confined for decking large anchors etc.
2. Not very agile compared to oilfield AHT/AHTS class vessels. Slow to manoeuvre, cumbersome and awkward to operate in very confined spaces.
3. Deep draft can be serious limitation in shallow water.
4. When towing specialised oilfield units, especially manned jack-ups and semi-submersibles, careful briefing and cooperation is required between tug master and those in charge of the unit. This is especially important in heavy weather where ignorance on both sides may lead to incorrect voyage planning and decision making.



Ocean going salvage tugs, both typical of the breed — Note position of superstructure amidships. Length and relatively narrow beam allows high free running speeds, economic operation and good endurance but only moderate close quarters manoeuvring capabilities.



PART 2. EQUIPMENT LAYOUT AND FUNCTION

a. Standard deck layouts
The following sketches show standard layouts for the two basic types of oilfield vessel engaged in anchor handling.

Only the "business end" of the boat is considered and obviously much variation in layouts exist, some boats being specifically outfitted for working in an area where work patterns or environmental conditions require variations or additions.

A brief description where appropriate is added alongside each item.

The working deck
The photograph shows the working deck of Maersk Co. 8000 BHP 100 ton bollard pull "B" class anchor handling tug.

The following features are notable and show how carefully the design is adapted to the work of anchor handling.

The very large steel deck area allows anchors and buoys to be landed and dragged about the deck without damage to the vessel.

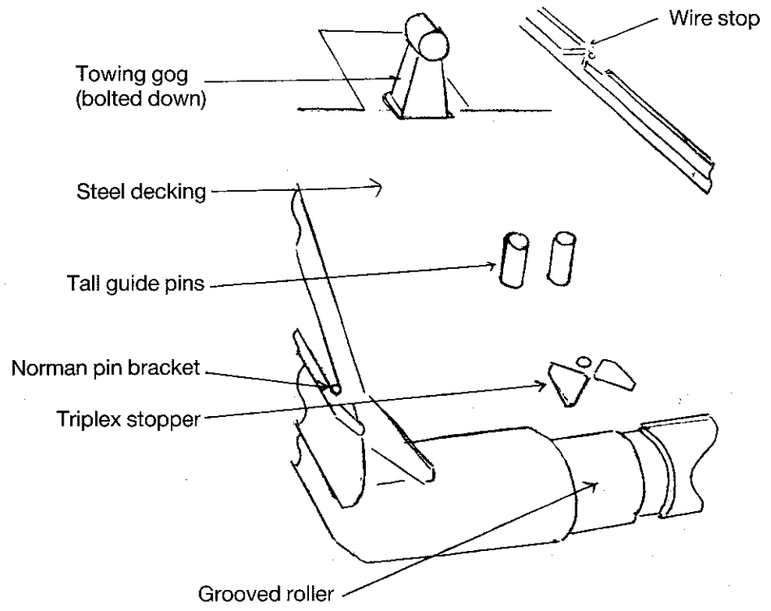
The guide pins (hydraulic) are extra high allowing the pins to be kept raised during anchor decking and deployment giving much greater control especially when the boat is moving in a seaway.

The combination wire/chain stopper is positioned aft of the guide pins. This allows stoppering off of wire or chain while it's still constrained laterally by the guide pins. During some types of anchor work this facility is vital for crew safety.

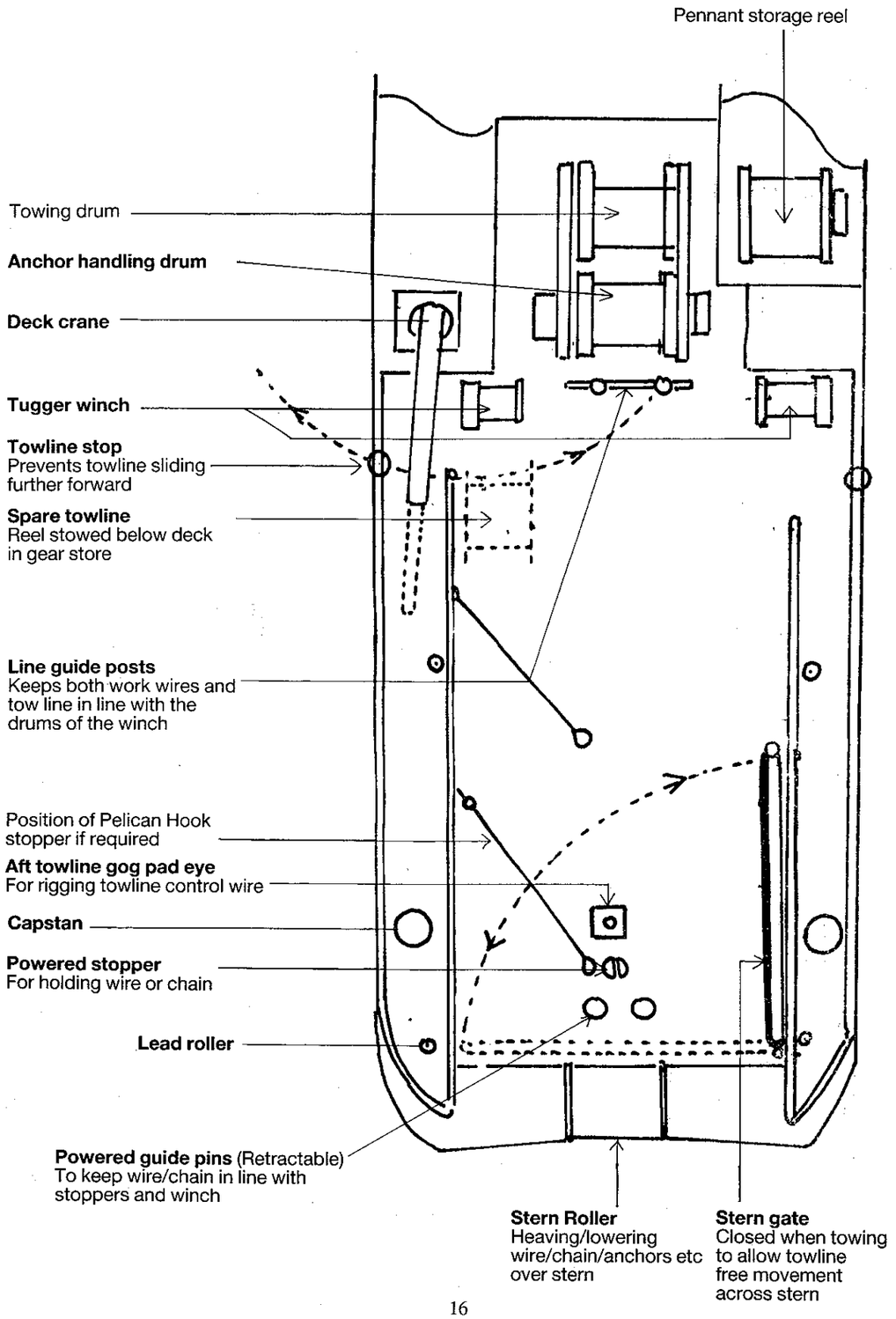
The roller is heavily grooved effectively trapping the anchor pennant wire when under tension. Such a feature is particularly useful when working lay barge suitcase type buoys. Even if the buoy jumps the roller onto the deck, once the wire is in the groove and tensioned the buoy is constrained between roller and guide pins (see part 5).

Deck layout of anchor handling tug

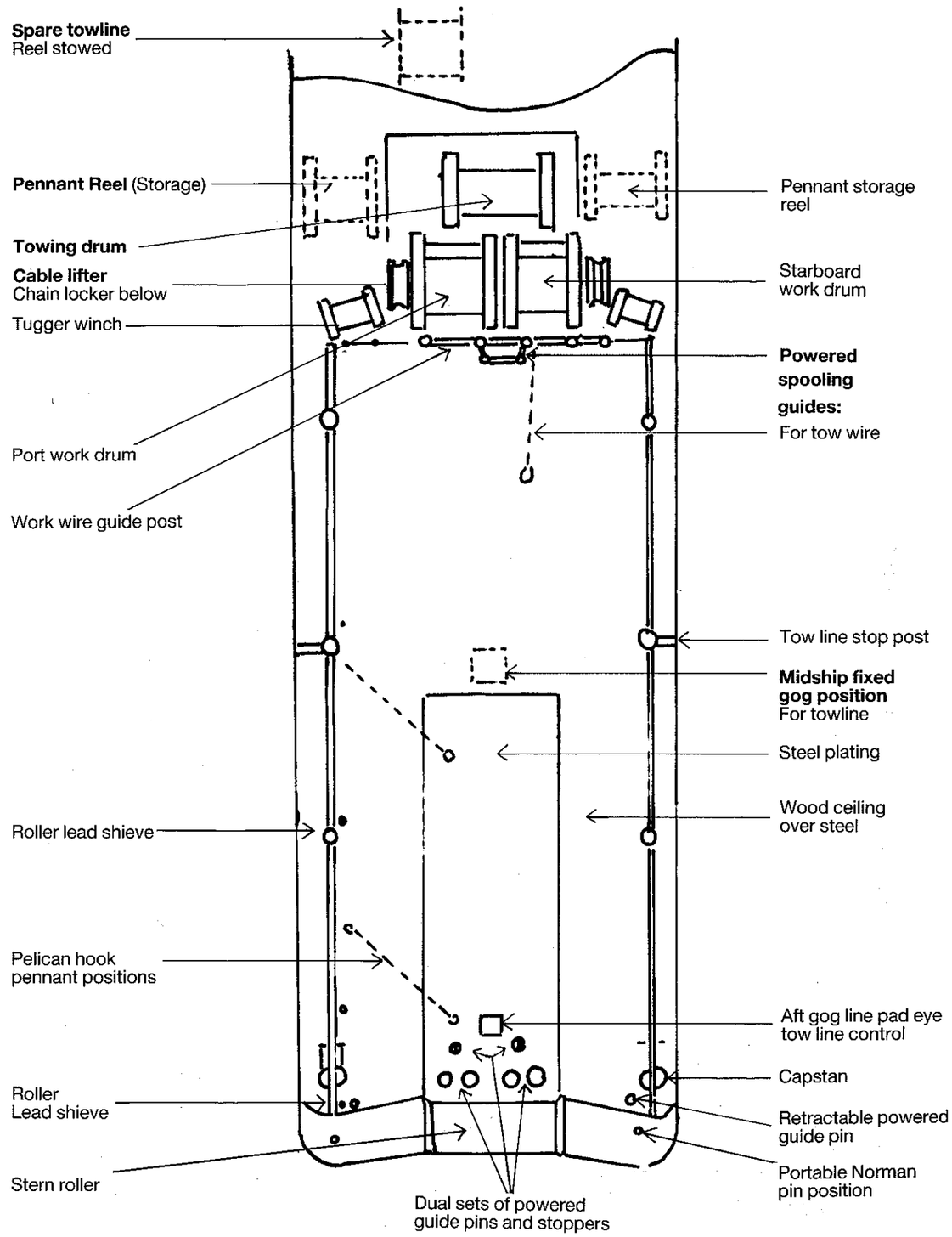
NORTH EUROPE ANCHOR HANDLING TUG — MAERSK BATTLER



DECK LAYOUT — ANCHOR HANDLING TUG



DECK LAYOUT — LARGE ANCHOR HANDLING TUG SUPPLY VESSEL



b. Guide pins, stoppers and similar equipment

Prior to the introduction of power operated equipment, pennant wire, chain and other equipment which had to be held in position whilst under tension during anchor handling, was controlled using traditional tools such as carpenter stoppers for wire rope, devil's claws for chain and modified senhouse slips, pelican hooks, where a quick release device was required.

The wire or chain under tension was guided into the reach of the stopping device by grooved stern rollers, portable pins and in some vessels by a variety of lead block systems.

The introduction of the KARM Fork, the Ulstein Shark Jaw and Triplex System has made the handling of wire and chain much faster and more positive as well as providing a greater degree of safety than previous equipment.

Most modern systems have a wide variety of "insert" plates or dies so that the stopper system can handle a variety of wire rope diameters and chain diameters, including wedges for midline stopping applications.

In general modern systems comprise two parts, the holding device (stopper) and a set of guide pins positioned aft of the stopper(s).

The pins are positioned so that the wire or chain if located between the posts (or pins) will lead over the stopper although some adjustment of position may be needed by using tugger or capstan wires. Alternatively swinging the stern of the boat may move the wire/chain sufficiently to bring it into alignment over the stopper.

The majority of systems are hydraulically operated with control stations inside the crash rails at the aft end of the boat and on the bridge at the aft control station.

Although the stopper is not designed for taking extreme loads the modern units are very robust with high safe working loads. Most types have an emergency release mechanism at the control stations and both KARM Forks and Ulstein jaws incorporate manually fitted safety pins which prevent the wire or chain jumping out of the stopper especially if an upward pull is experienced.

The guide pins, also hydraulically operated, incorporate an outer sleeve which is free to rotate so when wire or chain is being hauled or veered around the pin it experiences little or no resistance.

Some pin designs have swivelling top plates or in the case of Triplex gear the pins meet at the top when fully raised. This feature is a safety device to prevent a wire or chain jumping over the pins.

Both Ulstein Jaws and KARM Forks, when in operation hold the wire or chain up off the deck allowing the manipulation of shackles, connecting links or pelican hooks/pulling hooks to be readily attached or disconnected. As these types of unit can be held at any required height between fully extended and fully retracted this makes work much easier for the deck crew.

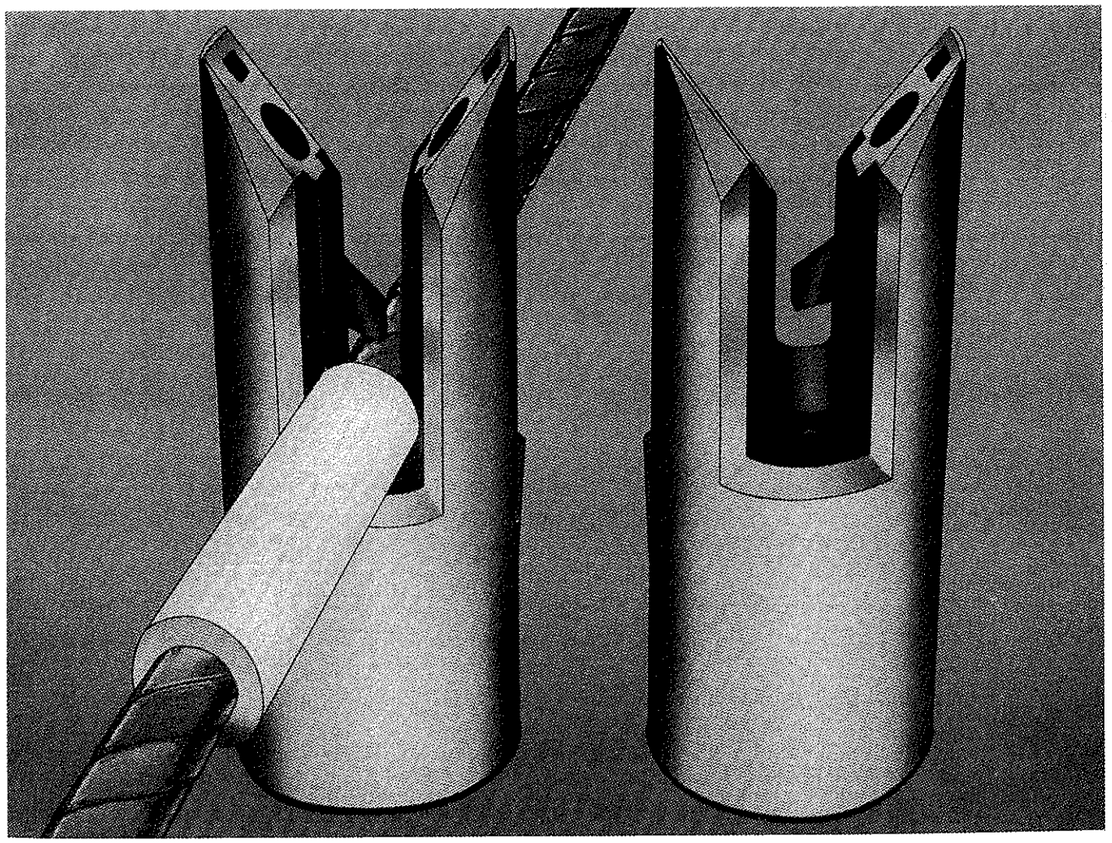
Triplex stoppers usually have a small retractable post just forward of the stopper plates. This post, when extended lifts the wire or chain clear of the deck whilst still securely held in the stopper.

It is well worth studying the system fitted to any particular boat in order to note the following points.

b. Guide pins, stoppers and similar equipment

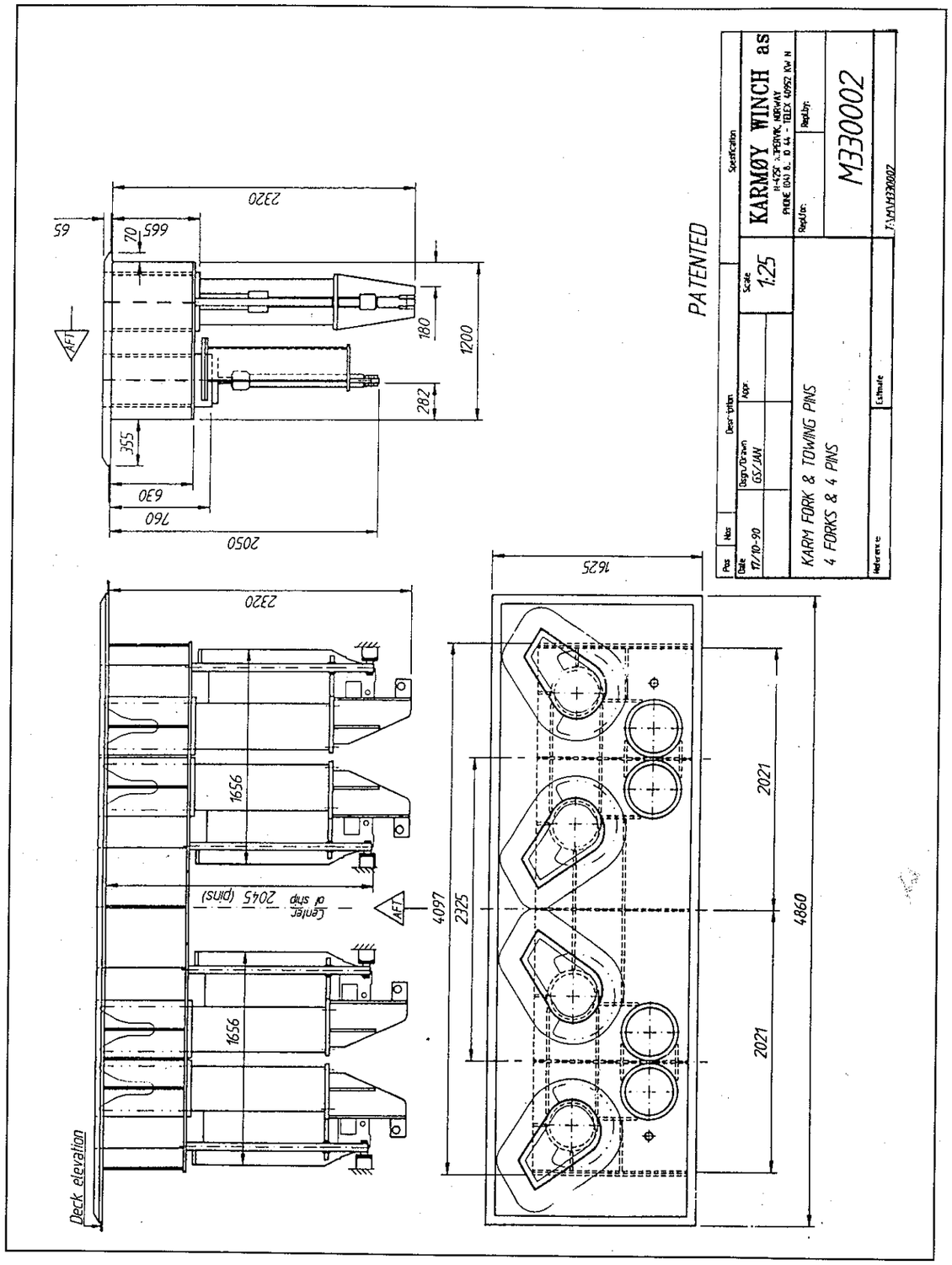
1. If the hydraulic pressure is lost do the pins and stoppers collapse or retract.
2. Can the pins or stoppers be operated from their hydraulic power pack usually hidden away in the stern using manual overides on solenoids or shuttle valves.
3. Can the pins or stoppers be operated manually or by accumulator.
4. Will the emergency release function operate under full rated load.
5. Is the compartment containing the hydraulic power pack and electric motor alarmed for water ingress (flooding). If it floods will the whole system be out of action.
6. Note if the pin/stopper seals in way of the deck are in good order so that water flooding onto the main deck doesn't fill up the compartment.

In every case read the instruction manual, trace out the system and practice with it. If it incorporates safety pins, interchangeable dies or plates ensure that all these items are available in good condition and the change out procedure is well understood with all the tools butts etc. kept properly stowed and marked in the deck store.

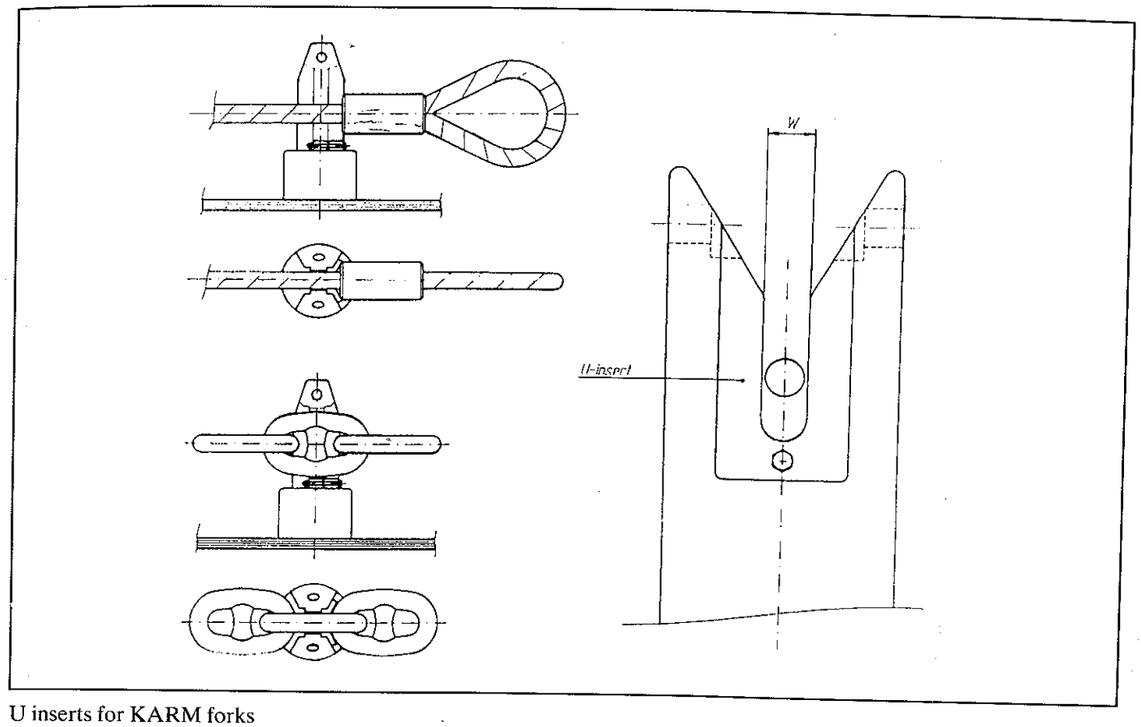


The KARM Fork pennant wire/chain stoppers are available as a standard model rated for 500 ton SWL, 4 inch chain and 102mm wire and giant model rated for 800 ton SWL, 5½ inch chain and 120mm wire.

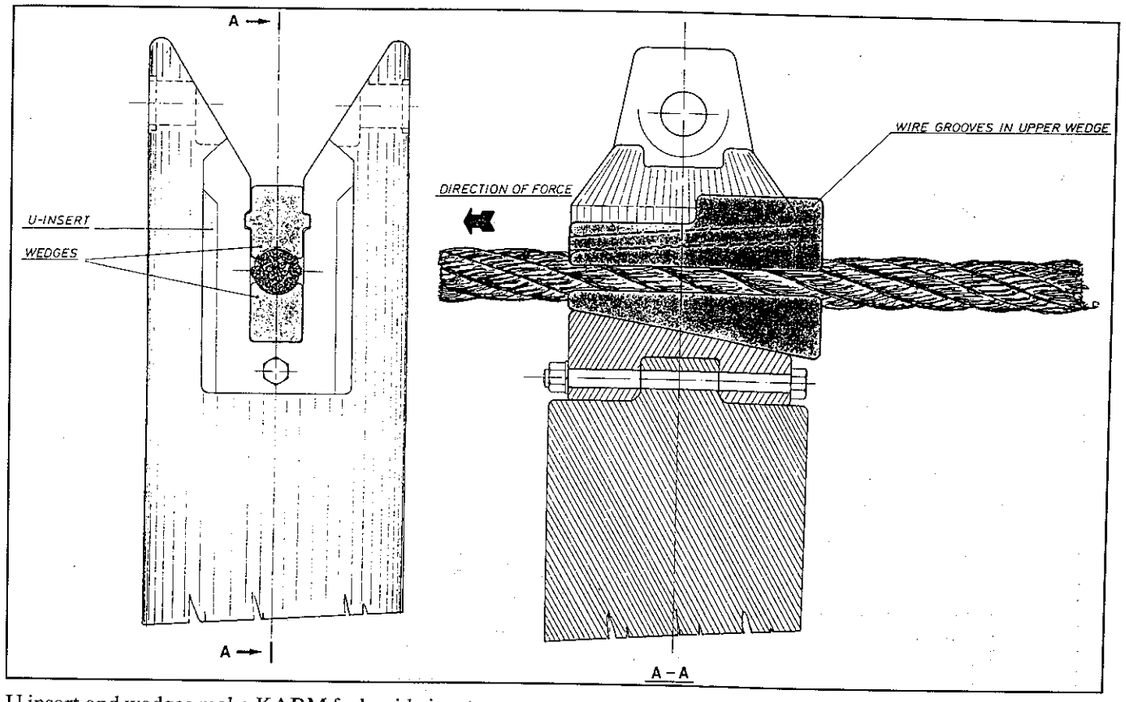
b) Guide pins, stoppers and similar equipment



b) Guide pins, stoppers and similar equipment

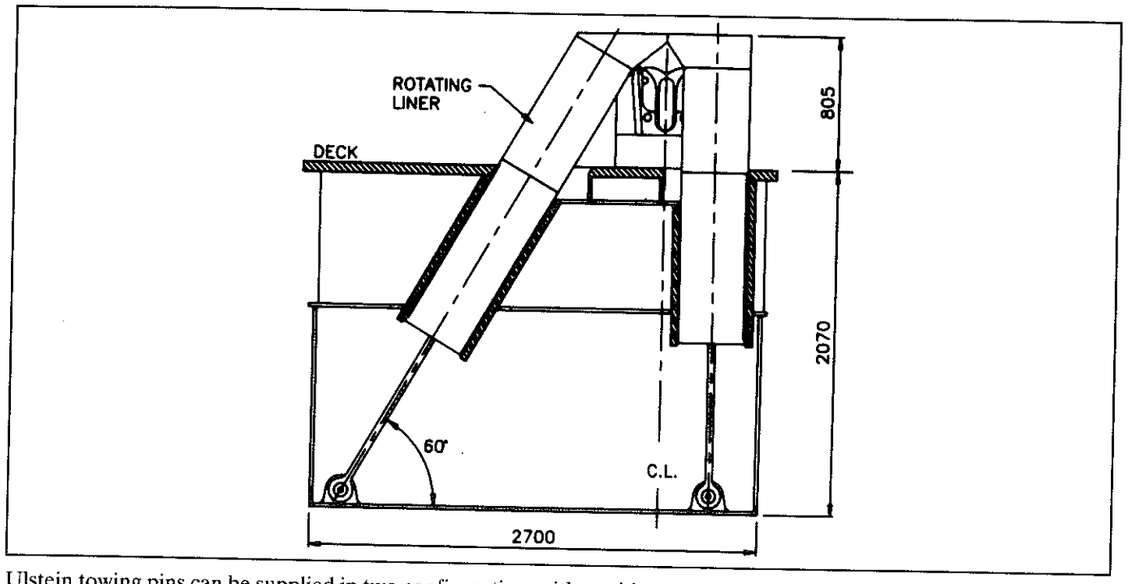


U inserts for KARM forks

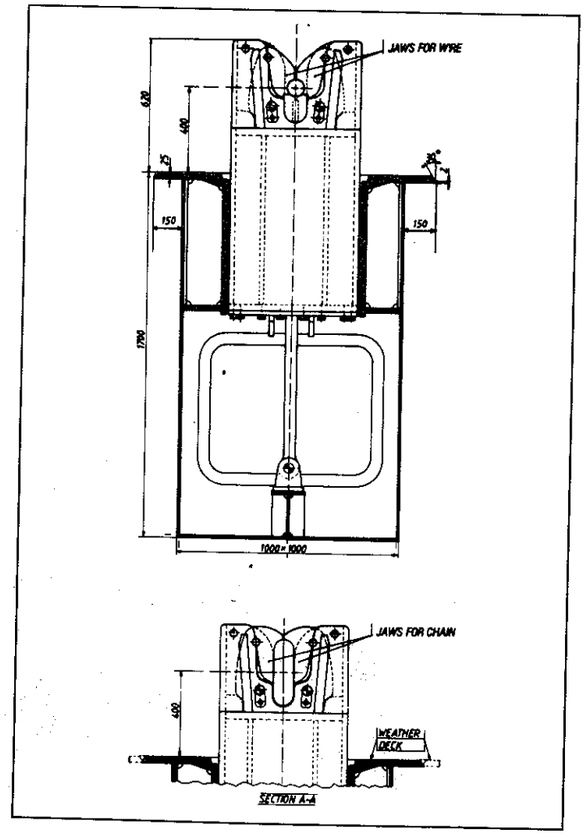


U insert and wedges make KARM fork midwire stopper

b) Guide pins, stoppers and similar equipment



Ulstein towing pins can be supplied in two configurations either with two vertical pins or with one pin operating at an angle (as shown) to provide a locking facility



The Ulstein shark jaw rated at 440 tons SWL shown above in wire and chain configurations

c) Stern rollers and stern gates

Anchor handling tugs and some designs of anchor handling tug supply vessels have a stern gate or bar which pivots (it is hinged) on one quarter and swings into position across the stern during **towing** operations.

This heavy bar allows the towline free unobstructed movement over a wide angle from the fixed gog position and on an anchor handler with wide high quarters and fairing down to the roller, the lack of a stern gate can cause some problems during towing operations. The towline has to ride up the quarter fairing before clearing the stern.

The photograph of the aft end of "President Hubert" (see page 7) shows the stern gate folded in alongside the port crash rail.

Because of the nature of the work that pure AHT class vessels are engaged in, towing often with the line broad out on one side then rapid changes of direction to bring the towline around to the other side, there must be no possibility of the towline catching or snagging in way of the stern area and thus the fitting of the "gate".

Note particularly in the photograph that the centre of the "gate" has two recessed areas. These contain hydraulically operated guide pins to centre the towline when required. Note also that the aft side of the gate incorporates a roller to ease the passage of the towline across the broad smooth surface of the gate when it's closed in use during towing operations.

The stern roller enables heavy equipment, anchors buoys etc and wire and chain to be hauled and veered over the stern with minimal resistance. It is a universally common feature of all modern oilfield tugs and multiple support vessels.

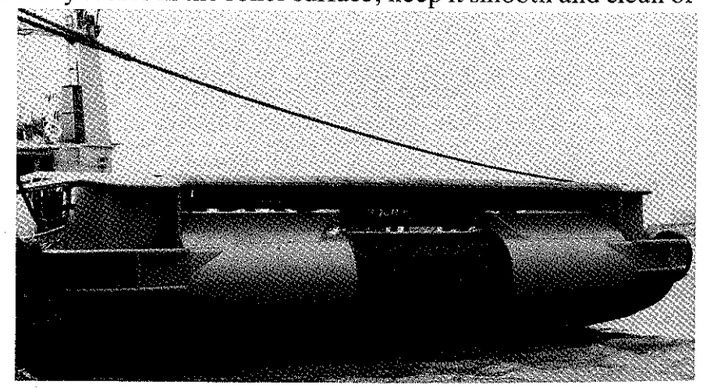
It is a cylinder, heavily reinforced mounted horizontally on a high quality shaft and bearing arrangement. Designs vary from straight cylinder to hour glass shape.

From an operational point of view it is important to keep the following in mind.

1. Check that the shaft bearings do or do not require lubrication and if they do have to be greased don't neglect them.

2. Grind off all nicks, jags, burrs and heavy scores in the roller surface, keep it smooth and clean of heavy scale, paint etc.

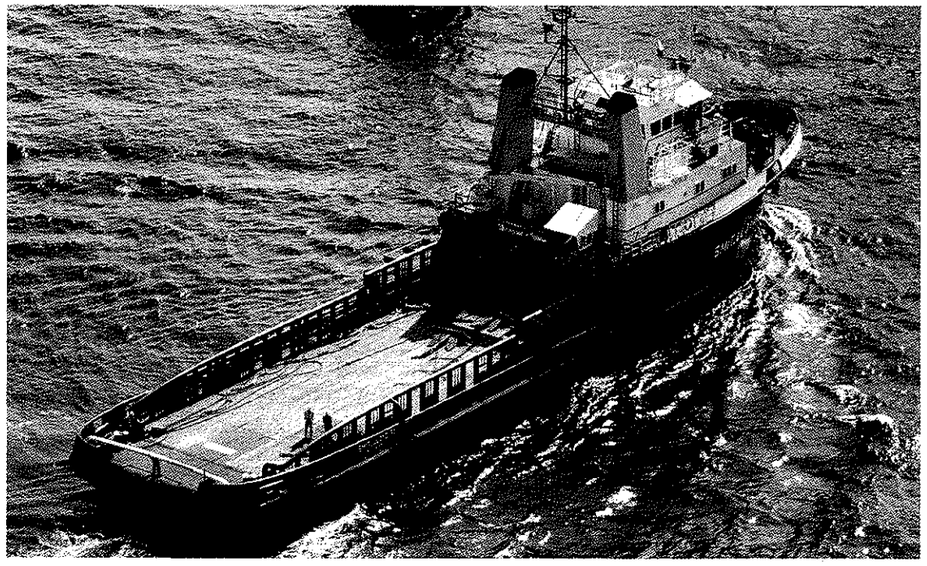
3. Check the condition of the steel work and fairing adjacent to the ends of the roller. Repair any damage and keep these areas smooth and clean. Don't allow gouges or scores which could cause a wire under tension to "hang up", thus preventing it running or sliding smoothly onto the roller from the quarter areas adjacent.



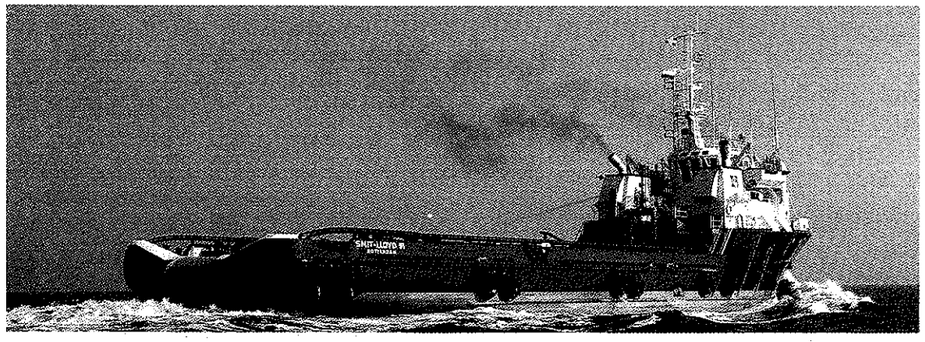
Stern gate in shut position showing fair continuation of the bulwark top across the stern.

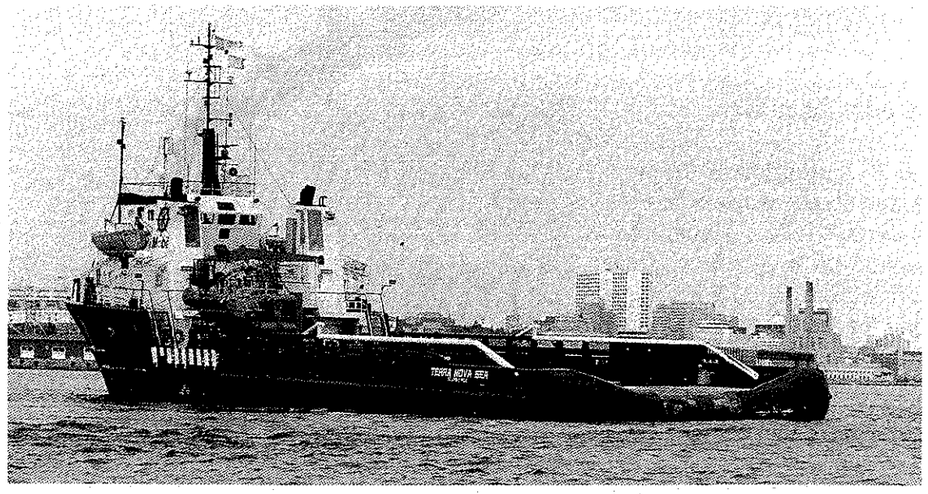
EQUIPMENT LAYOUT AND FUNCTION (cont'd)

c) Stern rollers and stern gates



Stern gate as shown above allows unobstructed movement over wide angles





Pictures above show the smooth well rounded quarters of the modern AHTS

EQUIPMENT LAYOUT AND FUNCTION (cont'd)

Norman pins and guide pins

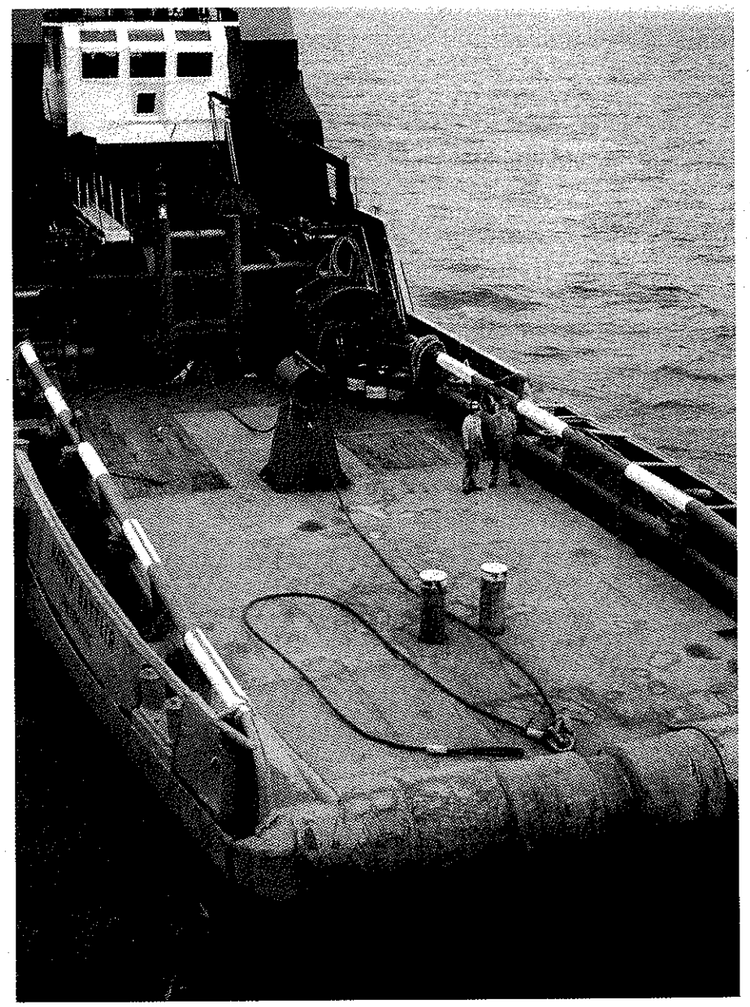
Norman pins and guide pins are heavy steel pins, either man portable, hinged or hydraulically operated which are located on the outboard corners of the stern.

Their purpose is to keep work wires/tow lines or other cables etc. within the confines of the stern area.

Many Master's will not use them during anchor handling operations, fearing that should work wires or pennant wires come up hard against them when under heavy strains the pins will bend allowing the wire to jump over the side rail.

During towing operations, when large course alterations are not required the pins do provide extra security, when combined with a heavy aft gog, in confining the tow line within the stern area.

In this author's opinion there is a good case for using the pins during both anchor handling and towing, especially on AHTS class vessels because the consequences of pennant wire **slip over** (see part 13h) are best avoided.



An AHT of the Maersk B-Type backs up to pass tow gear. Guide pins are clearly visible.

d. Anchor handling winches

There are a wide variety of winch systems and configurations but on modern vessels they share common characteristics — namely:

1. The anchor handling drum or drums share a common drive system with the towing drum.

2. The dimensions and capacity of the anchor handling drums are nearly the same as the towing drum.

3. The anchor handling winch drum usually has a faster hauling speed or multiple gear range to allow high pulling force at low gearing.

4. The anchor handling drum may have a power payout system to assist in lowering heavy loads under high tension.

5. Many modern systems have a braking arrangement with variable braking power. This facility allows a boat to say, run out to an anchor using a chain chaser system, with the brake tension set at a low value. On reaching the anchor the brake pressure is overcome and the winch pays out allowing time to bring the boat to a halt slowly while maintaining plenty of tension on the work wire yet without danger of parting the wire.

6. Remote control of all functions is common place with local control only used as back up. The control console usually provides all the appropriate functions including tension and wire deployment gauging.

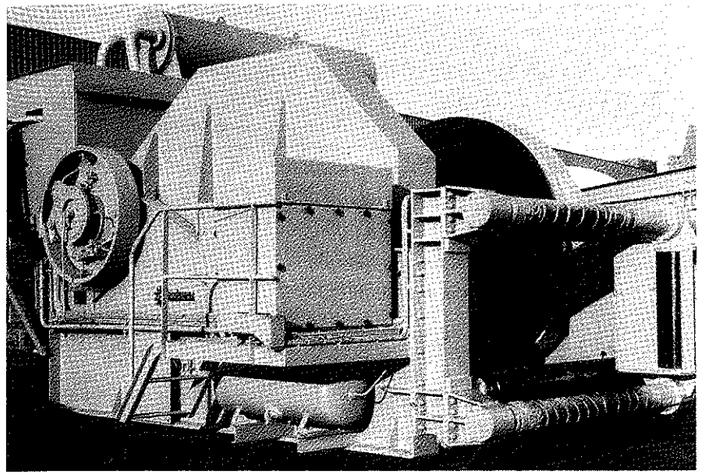
Boats and owners, with a few exceptions, (in North Europe) tend to outfit with high or low pressure hydraulic winch systems whereas North American practice favours electric or diesel driven winch systems.

Normal practice is to have the anchor handling drum rotating in the overwind direction the wire reeling off the top of the drum to the aft end of the boat at a slight downward direction.

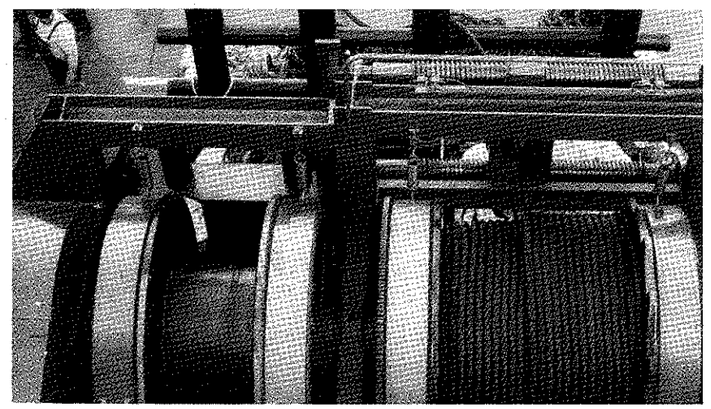
Spooling gear is not usually fitted as it inhibits some aspects of anchor handling work especially during fast pay out and recovery.

Chain handling sprockets or wildcats are usually fitted either side of the work drum and rotate with it. If they are being used the work wire is fully spooled up and secured on the drum. It is common to have at least two sizes of wild cat available for the handling of different chain sizes.

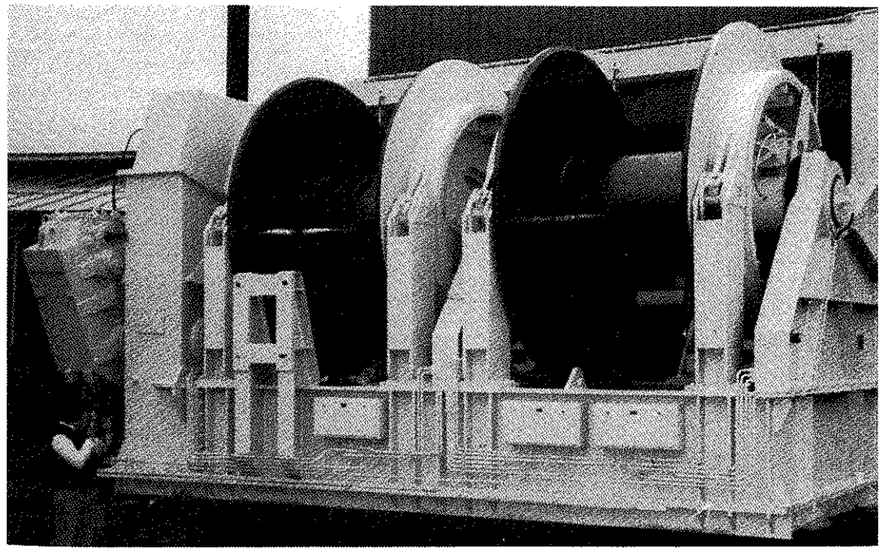
d. Anchor handling winches



Bodewes diesel driven single drum mooring winch with local control stand, pneumatic friction clutch and spooling device, type S980. Pulls 200 tons.



Bodewes diesel driven two drums anchor handling towing winch, one drum with pneumatic controlled spooling device. Pulls 200 tons.

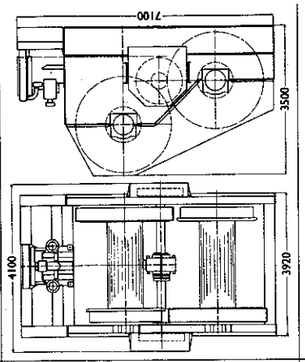


Bodewes anchor handling towing winch. Pulls 350 tons.

d. Anchor handling winches — typical specification data

DATA

	M 980	T 980	S 980
DRUM DIMENSIONS			
Drum diameter	: 980 mm (38.58")		
Flange diameter S/T	: 2500 mm (98.4 ")		
Flange diameter M	: 2200 mm (86.6 ")		
Drum length	: 2400 mm (94.48")		
BRAKES			
Drum slip brake			
Stat. holding power 1st layer	: 2000 kN (441,000 lbs)		
Drum brake diameter	: 2000 mm		
width	: 250 mm		
Dyn. brake power	: 1200 kW (2640,500 lbs)		
Parking brake			
Holding power 1st layer	: 2500 kN (551,000 lbs)		
Winch frame suitable for holding power (slip brake + parking brake)	: 3500 kN (771,000 lbs)		

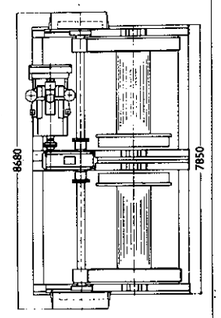


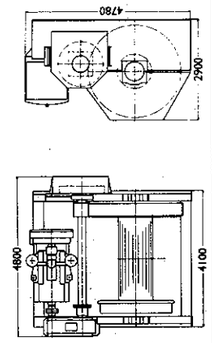
SPOOLING CAPACITY

2¼" rope	: 2215 m (7260')	: 3110 m (10200')	: 3110 m (10200')
2½" rope	: 1824 m (5980')	: 2640 m (8660')	: 2640 m (8660')
3" rope	: 1350 m (3940')	: 1880 m (6170')	: 1880 m (6170')

WEIGHT

with standard drive	: 57.000 kgs (125,680 lbs)	: 57.000 kgs (125,680 lbs)	: 36000 kgs (79,400 lbs)





With Detroit Diesel 12V-71N and Allison powershift transmission CLT 6061 with TC 680 torque converter and 2½" wire rope.

		first layer line pull	line speed	full drum line pull	line speed
High 70%					
1st gear	483 kN (108,595 lbs)	487 kN (109,540 lbs)	21 mpm (70 fpm)	197 kN (44,325 lbs)	53 mpm (173 fpm)
6th gear	2780 kN (600,600 lbs)	82 kN (18,375 lbs)	127 mpm (417 fpm)	33 kN (7,435 lbs)	314 mpm (1030 fpm)
Max. eff.					
1st gear	1200 kN (269,260 lbs)	842 kN (189,390 lbs)	15 mpm (50 fpm)	341 kN (76,640 lbs)	38 mpm (124 fpm)
6th gear	1500 kN (333,330 lbs)	141 kN (31,770 lbs)	91 mpm (299 fpm)	57 kN (12,855 lbs)	226 mpm (740 fpm)
Low 70%					
1st gear	1170 kN (251,920 lbs)	1170 kN (263,330 lbs)	9 mpm (29 fpm)	474 kN (106,555 lbs)	22 mpm (72 fpm)
6th gear	1200 kN (225,485 lbs)	196 kN (44,175 lbs)	53 mpm (174 fpm)	79 kN (17,875 lbs)	131 mpm (430 fpm)
Stall					
1st gear	1750 kN (393,750 lbs)	1750 kN (393,750 lbs)		708 kN (159,330 lbs)	
6th gear	1750 kN (393,750 lbs)	294 kN (66,050 lbs)		119 kN (26,738 lbs)	

With Detroit Diesel 16V-71N and Allison powershift transmission CLT 5861 with TC 580 torque converter and 2½" wire rope.

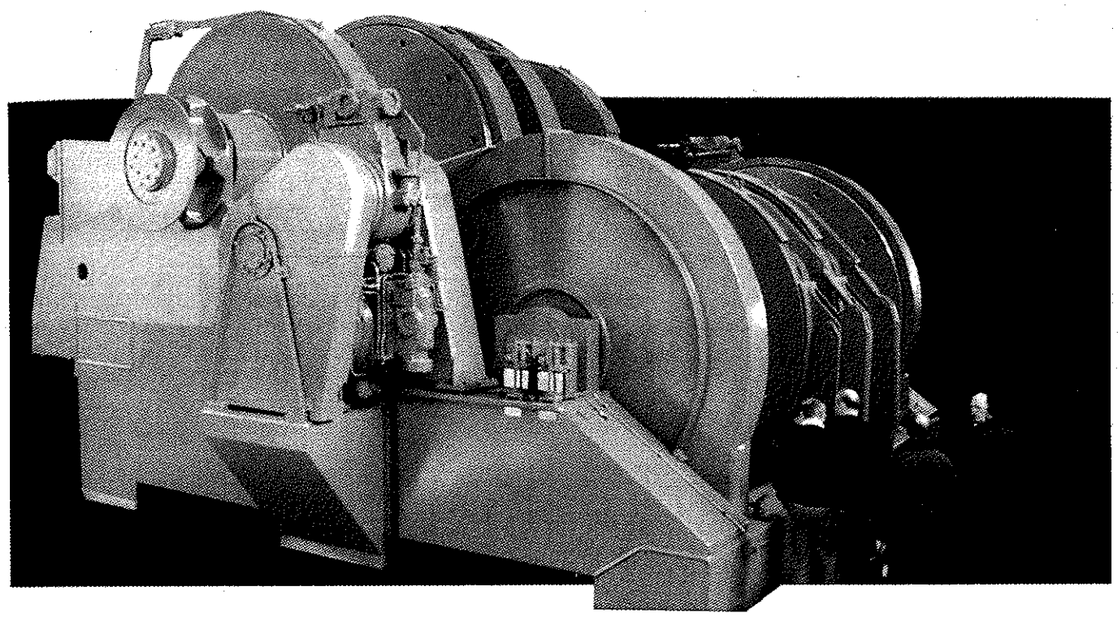
		first layer line pull	line speed	full drum line pull	line speed
High 70%					
1st gear	694 kN (156,170 lbs)	694 kN (156,170 lbs)	21 mpm (70 fpm)	281 kN (63,195 lbs)	53 mpm (173 fpm)
6th gear	1164 kN (261,900 lbs)	116 kN (26,200 lbs)	127 mpm (417 fpm)	47 kN (10,600 lbs)	314 mpm (1030 fpm)
Max. eff.					
1st gear	1200 kN (270,010 lbs)	1200 kN (270,010 lbs)	15 mpm (50 fpm)	486 kN (109,260 lbs)	38 mpm (124 fpm)
6th gear	201 kN (45,294 lbs)	201 kN (45,294 lbs)	91 mpm (300 fpm)	82 kN (83,330 lbs)	226 mpm (740 fpm)
Low 70%					
1st gear	1669 kN (375,330 lbs)	1669 kN (375,330 lbs)	9 mpm (29 fpm)	675 kN (151,920 lbs)	22 mpm (72 fpm)
6th gear	280 kN (62,980 lbs)	280 kN (62,980 lbs)	53 mpm (174 fpm)	113 kN (25,485 lbs)	131 mpm (430 fpm)
Stall*					
1st gear	1750 kN (393,750 lbs)	1750 kN (393,750 lbs)		708 kN (159,330 lbs)	
6th gear	419 kN (94,170 lbs)	419 kN (94,170 lbs)		169 kN (38,105 lbs)	

* limited torque

All specifications subject to change without notice.

BØDEWES WINCHES

d. Anchor handling winches



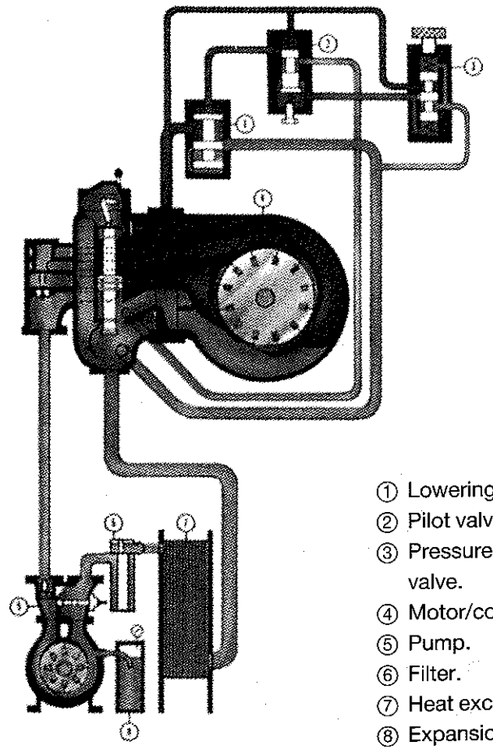
This winch from Ulstein Brattvaag illustrates the size and power of today's installations

Dynamic breaking

Operation
Control handle at stop.
Brake off.
Main pump is running.
Oil cooler on.
By operating the valve ③ speed and tension are controlled.
Main pump is running to circulate oil for cooling.

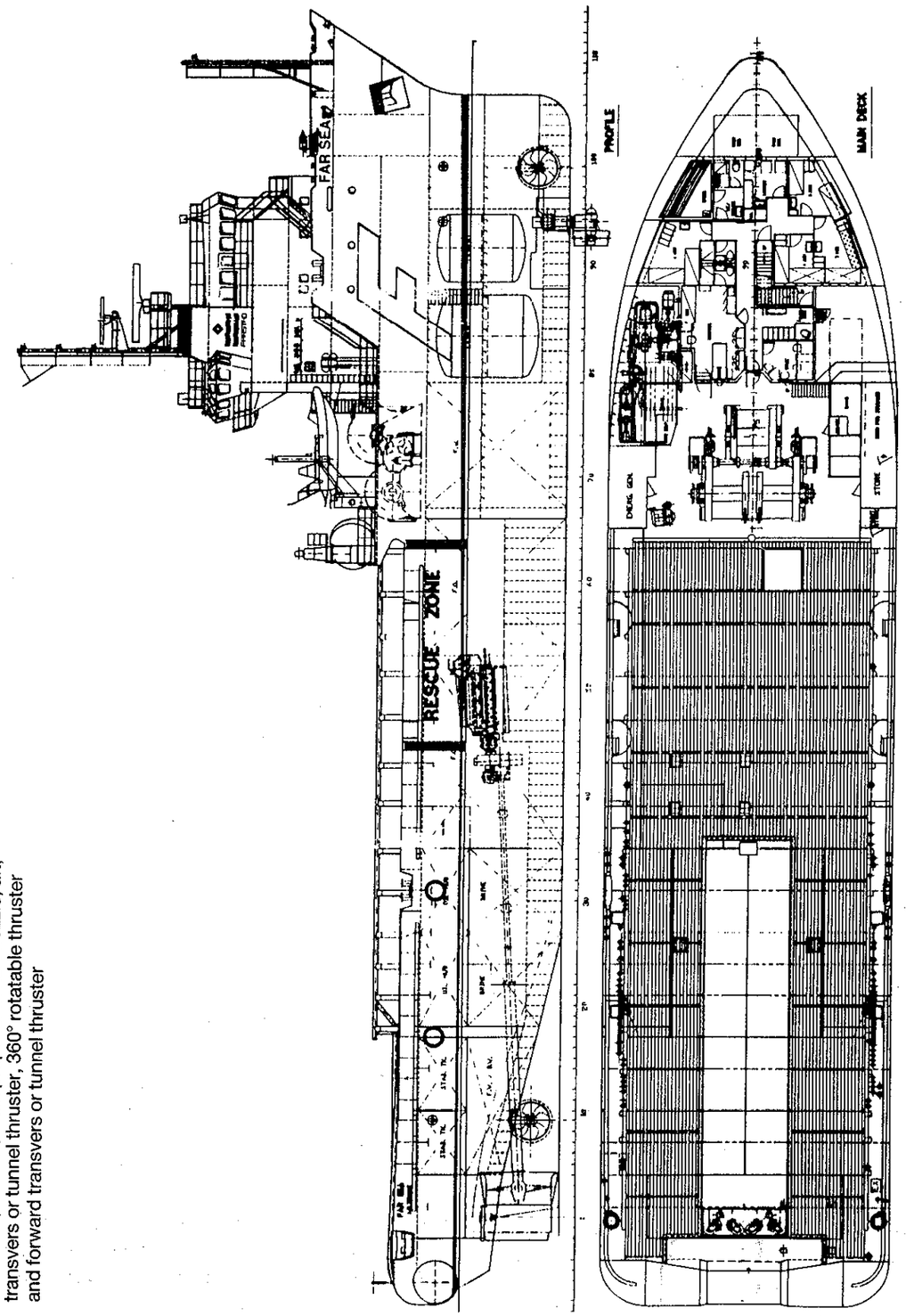
Advantages of hydraulic controlled anchor setting.

- Easy to operate.
- A clean and closed system.
- No wear of brake linings.
- Operation during blackout (24V emergency supply when electric remote control).
- High speed.



① Lowering limit valve.
② Pilot valve.
③ Pressure reducing valve.
④ Motor/control valve.
⑤ Pump.
⑥ Filter.
⑦ Heat exchanger.
⑧ Expansion tank.

e) Thrusters, rudders and nozzles



Installation aboard a modern AHTS with, from stem to bow:
Becker flap rudder, main propeller in kort nozzle, aft,
transvers or tunnel thruster, 360° rotatable thruster
and forward transvers or tunnel thruster

e. Thrusters, rudders and nozzles

To maximise propeller efficiency and remove the athwartships force vectors created by a rotating propellor when the vessel is stopped or manoeuvring at very slow speeds, the usual practice is to enclose the propellor in a nozzle shaped shroud. The kort nozzle may also form the rudder thus directing the thrust in the direction it is turned.

Nozzles also provide some protection to the propellor from wire and chain leading over and under the stern of the boat.

Rudders

Most modern day vessels have semi-balanced spade rudders if fitted with fixed kort nozzles. The rudders are often quite large and in some cases may consist of more than one blade mounted side by side.

In order to further increase slow speed manoeuvring characteristics a trim tab is often added to the main rudder. One of the best known being the Becker flap. The effect of the flap is to maximise the rudders efficiency on the water passing it allowing the thrust of the propellor to be directed nearly athwartships in the hard over position. This greatly assists in "walking" the vessel sideways which is an integral part of anchor handling manoeuvring.

Main propulsion requirements

Anchor handling tugs require a propulsion system which provides the following capabilities.

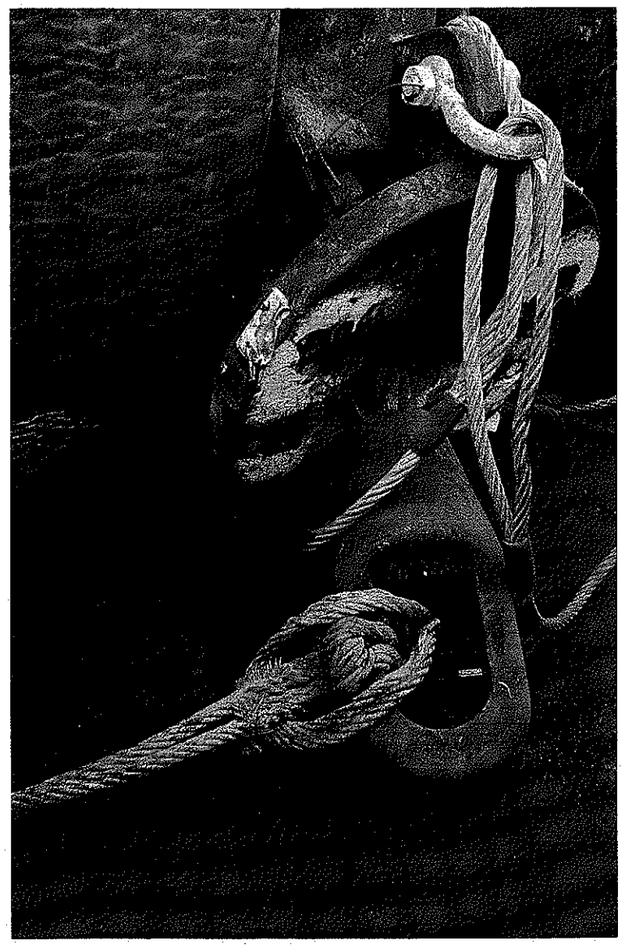
1. Rapid reversal of propellor thrust ahead to astern.
2. Rapid response to power demand variations.
3. High output power at slow speeds i.e. ability to apply maximum propellor thrust with the boat almost stopped and ability to provide thrust over a wide range — nil to full.
4. Good fuel economy.
5. Moderate free running speed.
6. High reliability and low maintenance.

In most modern boats this is achieved by the use of medium speed diesel engines driving variable pitch propellors. The advantage of variable pitch is the rapidity of response to changes in output thrust and direction.

Modern variable pitch propellors can translate shaft output into thrust over a very wide range from just "creeping" to maximum output smoothly and quickly.

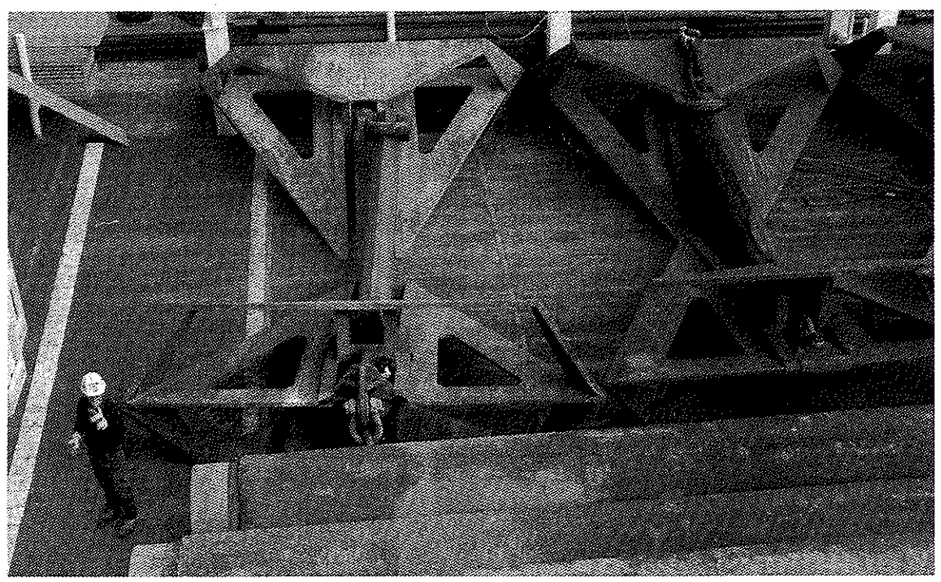
Side thrusters

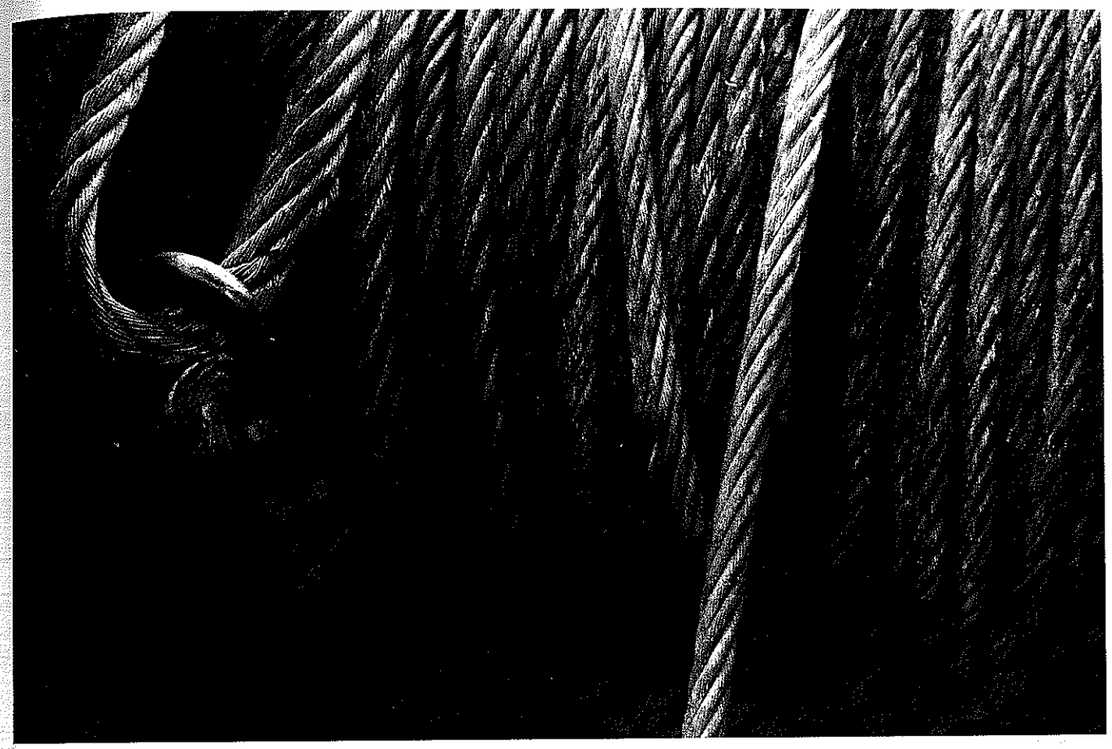
The evolution of the anchor handling vessel (and offshore support craft in general) has required ever more powerful propulsion units designed to allow the vessel to hold a stationary position against the influences of wind wave and currents, to move sideways or diagonally ahead and astern and to turn in any direction without moving ahead or astern.



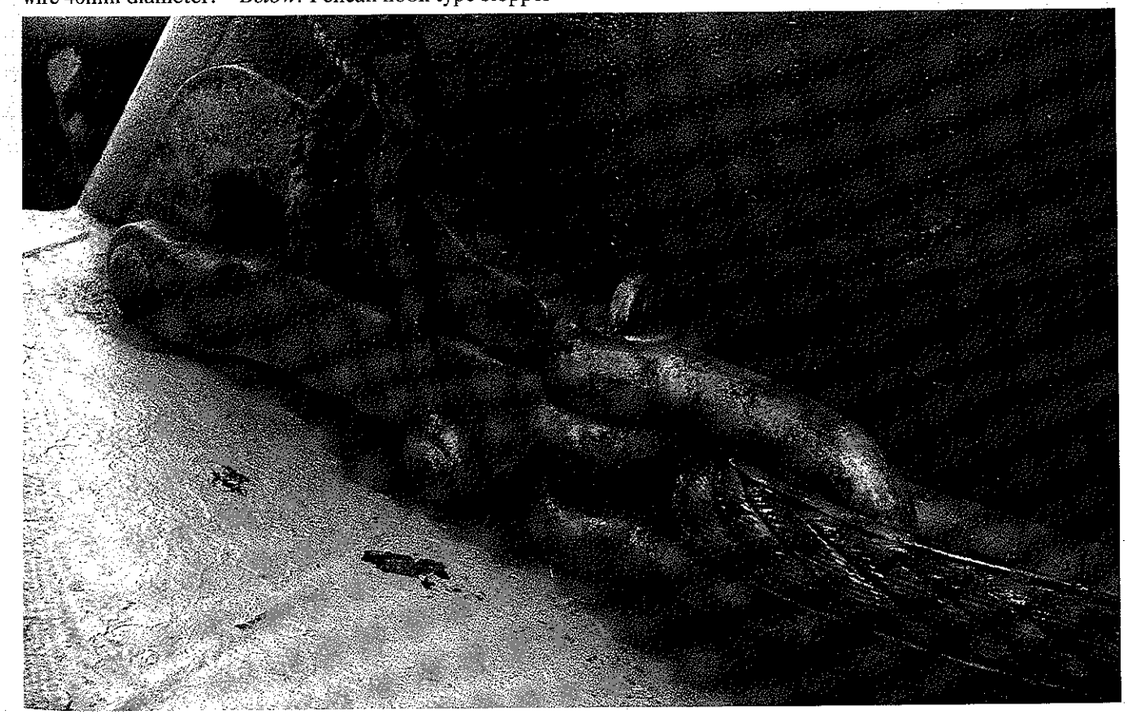
Left:
Suitcase buoy rig
The eye of the pennant to the anchor is visible and the catching strop can be seen turned up around the pennant wire socket

Below:
Laybarge anchors
20 tonne high holding power anchors of the Vryhof flipper delta type.





Laybarge anchor handling gear
Above: Work winch stowed with 62mm heavy pennant — drum end high strength bow shackle (SWL 55 tonnes) suitcase wire 40mm diameter. *Below:* Pelican hook type stopper



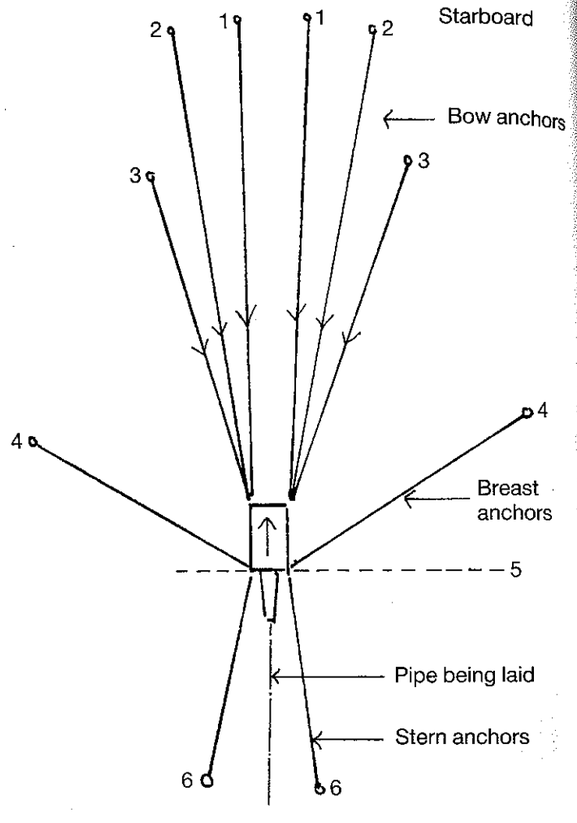
b. Sequence of events

Diag 35.

Shows basic anchor spread of a large laybarge.

Typically the bow anchors are deployed at a length at least twice that of the stern anchors. Maximum pulling power is required at the bow to keep tension on the pipe as it's laid and heave ahead the stern anchors hold the stern while the breast anchors keep the barge on line.

Steering around curves is achieved by altering the angle of pull of the bow anchors and breast anchors.

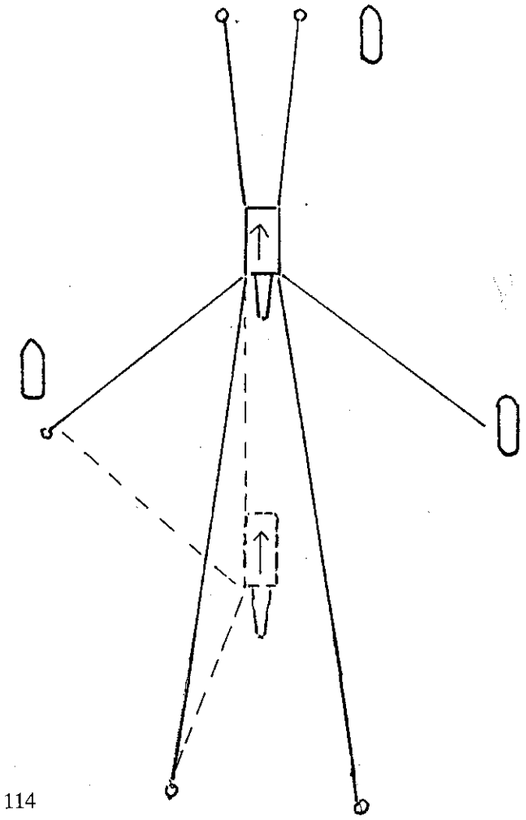


Diag 36.

Having shortened up the bow anchors to about ½ their original deployed lengths, they are picked up and run out again.

Breast anchors, originally run forward of the beam, are moved up when they lead aft of the beam.

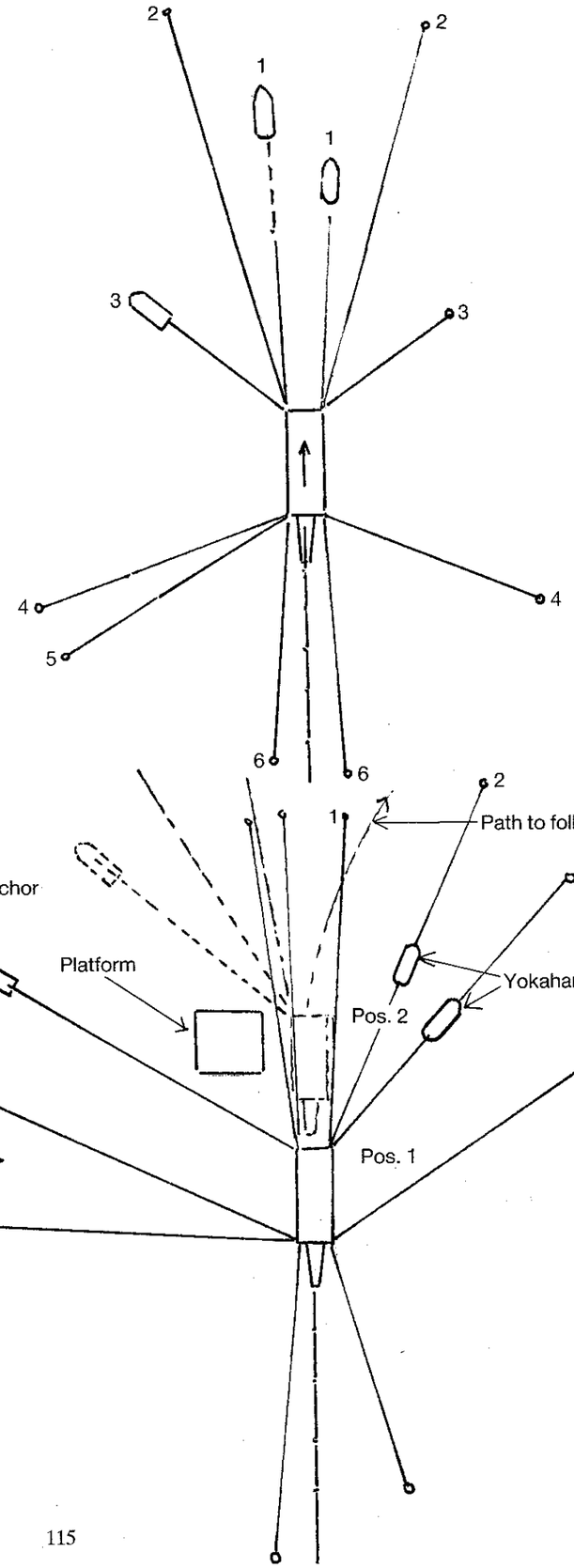
The boats are deployed to pick up groups of anchors. The sequence of anchors movements is not rigid but the aim is to preserve the general pattern of the anchor spread as shown in diagram 35.



b. Sequence of events

Diag 37.

Here the barge is moving up the No. 1 P+S anchors together having already rerun the No. 2 anchors. The boat on No. 3 port anchor is acting as live anchor.



Diag 38.

The laybarge is approaching a platform where anchor positioning is confined by both surface and subsurface obstructions. The boat on No. 3 port will remain as the "live" anchor until No. 3 can be deployed past the platform.

As the barge has to turn to starboard No. 2 + 3 are spread at broad angle. A subsea obstruction requires Nos. 2 + 3 starboard to be supported above it so Yokahama fenders are attached

Diag 39. DECK RIGGED FOR SNATCHING LAYBARGE BUOYS — RIG 1

A. Suitcase Wire (see detail sketch)
Consists of 25mm diameter wire sufficiently long to reach stern roller with 5/6 turns on the drum. Anchor handling hook shackled into end of wire.

B. Port tugger (pick up winch)
Rigged with short chain and BKL safety hook for catching buoy pennant.

C. Starboard tugger
Trip off winch (see detail sketch)
Rigged with short chain and open hook for tripping off anchor handling hook.

D. Boat hook
With heaving line attached.

E. Pelican hook
Prepared for use with barge pennant wire size.

F. Snatch blocks
Rigged on quarters for pick up line.

G. Suitcase wire — Spare
Lashed on deck ready for use.

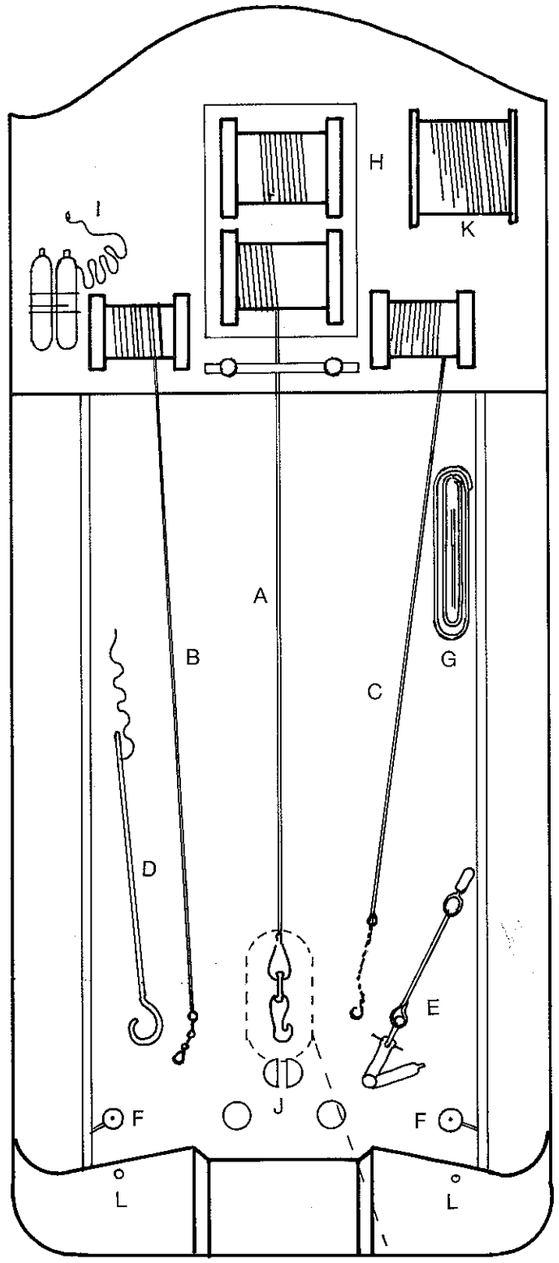
H. Towing drum
Usually rigged with tow wire but may be rigged with heavy work wire 60 metres long.

I. Cutting gear
Ready for immediate use with cabling (hoses) sufficiently long to reach to aft end.

J. KARM fork
Dressed for pennant wire size in use on the barge.

K. Storage reel
Spare main work wire.

L. Norman pins
Fitted especially in heavy weather.



For detail see other diagrams in this chapter

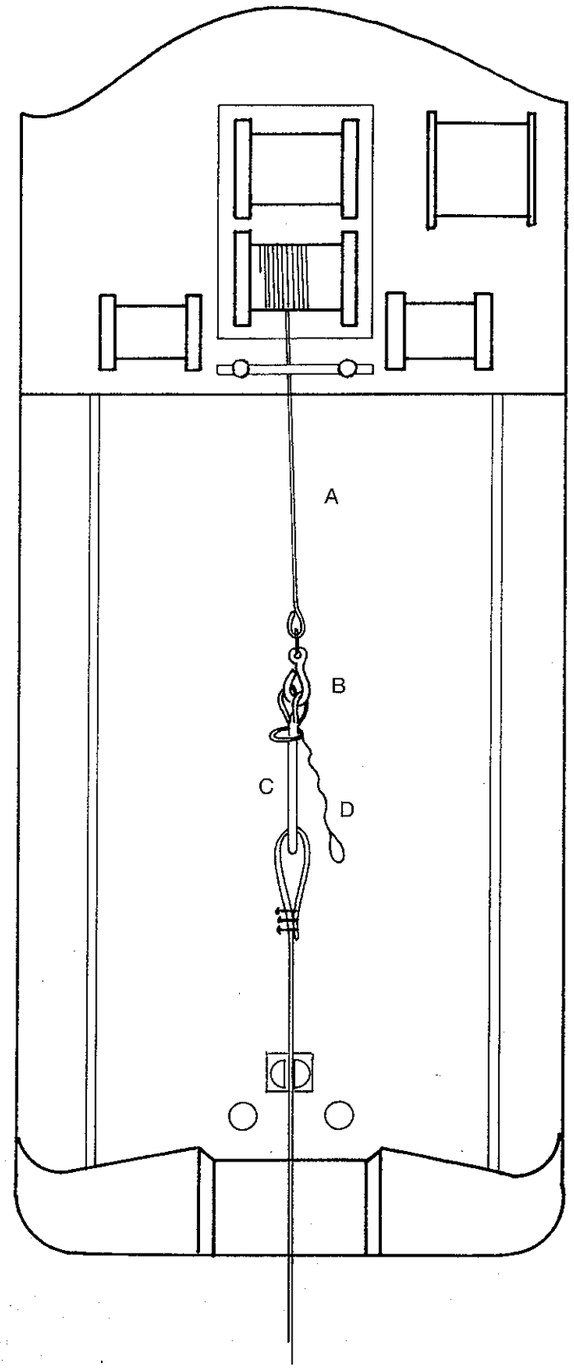
Diag 40. DECK RIGGED FOR BUOY/WIRE HANDLING GEAR — RIG 1

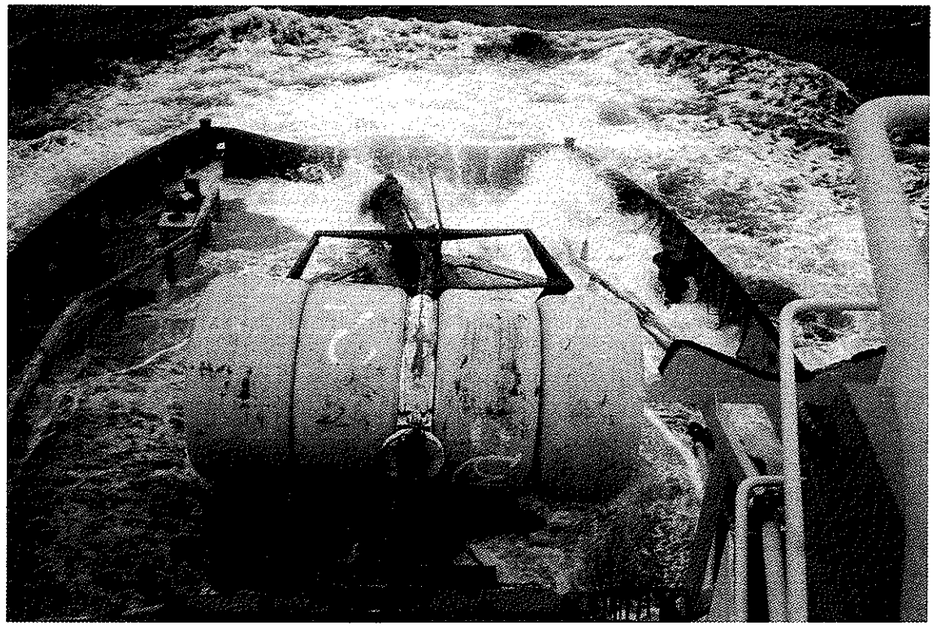
A. Suitcase Wire
25mm diameter

B. BKL type safety hook.
SWL 16 tonnes

C. "Joker" (pennant strop)
25mm diameter soft eyes
6 metres long

D. Polypropylene catching rope
5 metres long. 26/28mm diameter

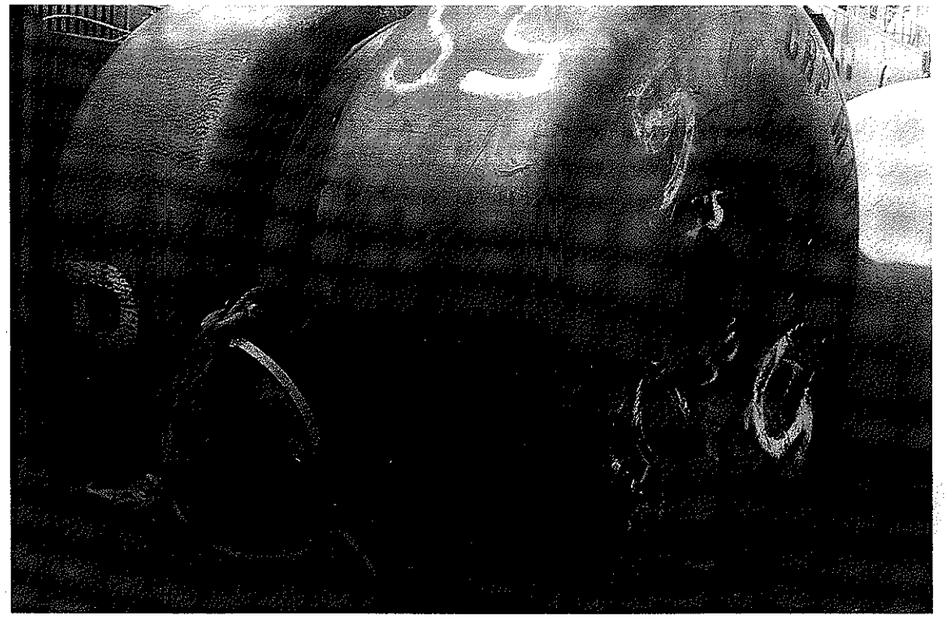




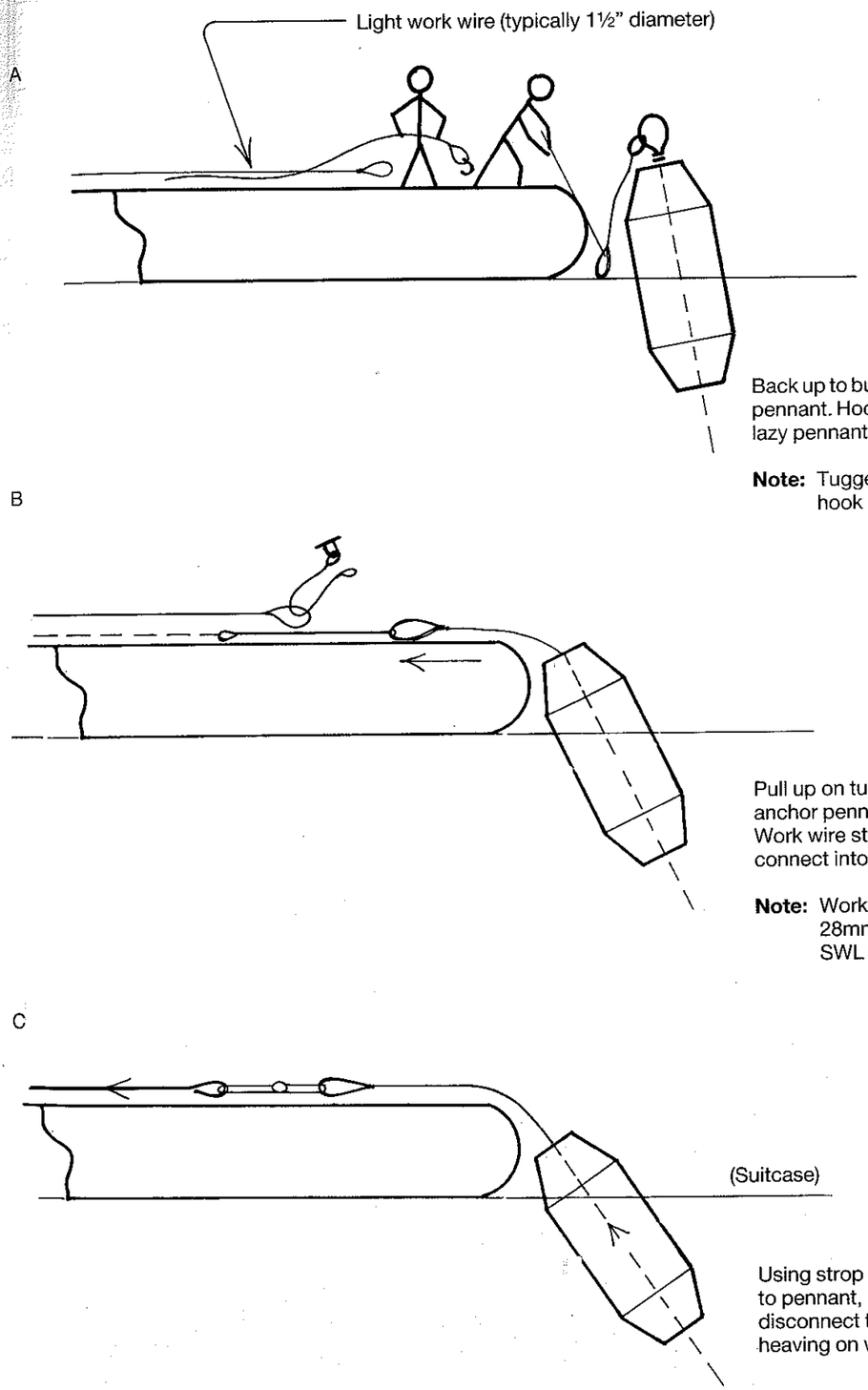
Above: **Suitcase buoy rig**
Buoy and anchor decked — note anchor mooring wire has fouled the buoy pennant and will have to be cleared before deploying the anchor.

Below: **Modern "soft" suitcase buoy**
Consisting of two Eurethene cased, foam filled, buoyancy modules, bolted to circular ring. The ring contains a guide tube through which the anchor pennant passes. The eye of the pennant is visible.

This buoy can support 500 feet of 76mm diameter wire and be only about ½ submerged or less.

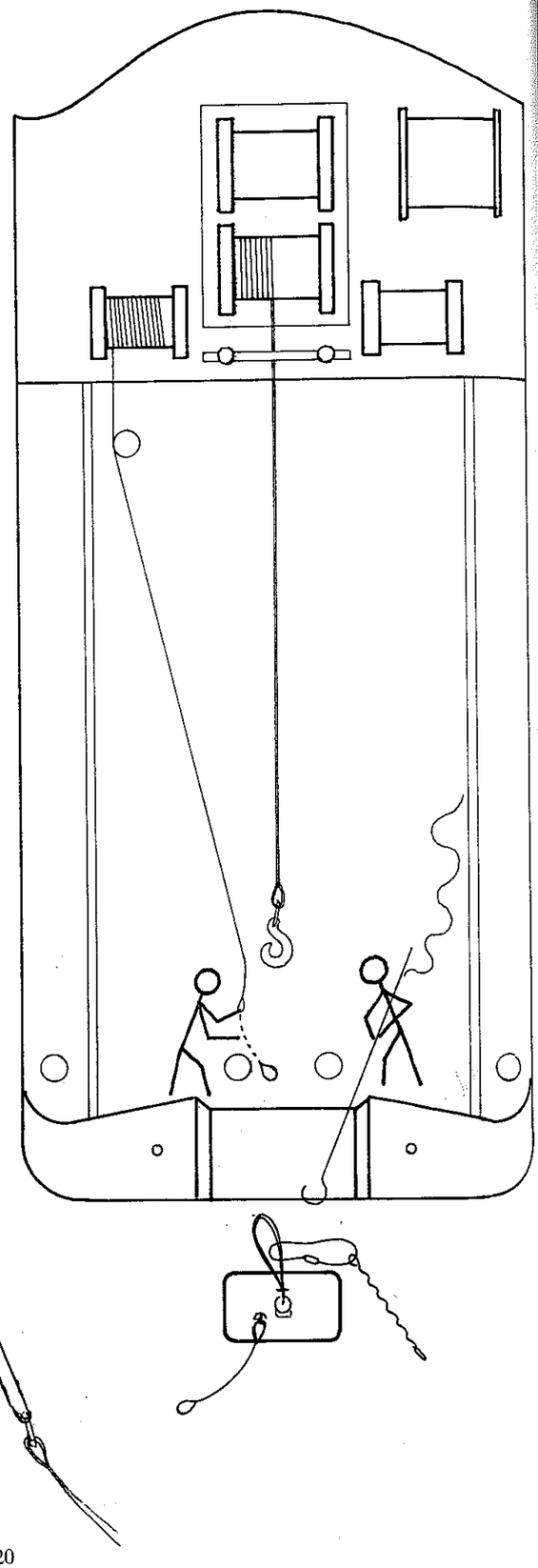


Diag 41. PICKING UP BUOY PENNANT

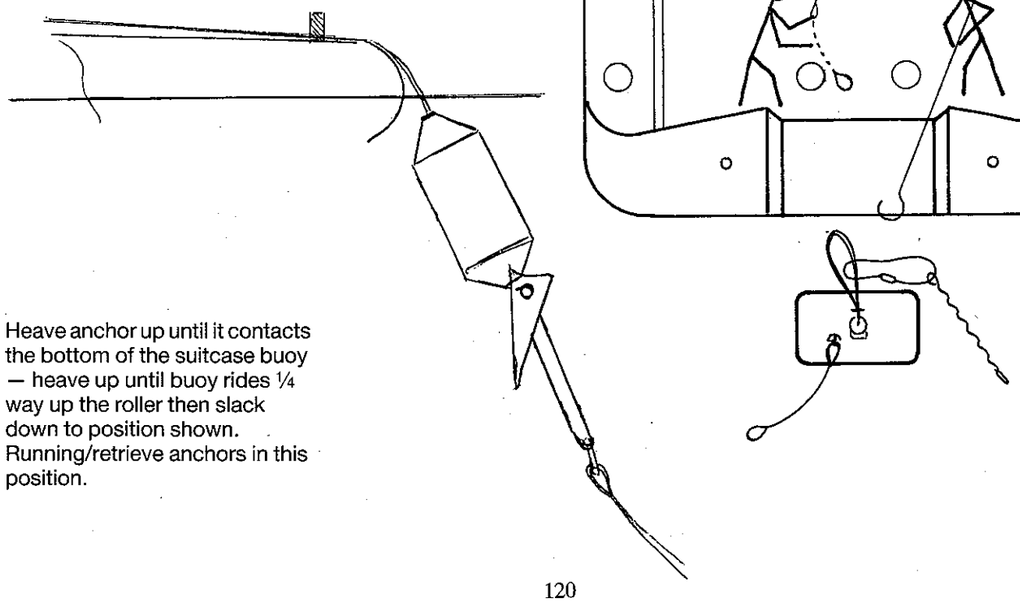


Diag 42. PREPARING TO HEAVE UP PENNANT

1. Picking up pennant
2. Port tugger ready to be hooked into pennant joker sling.



Diag 43. SUITCASE BUOY

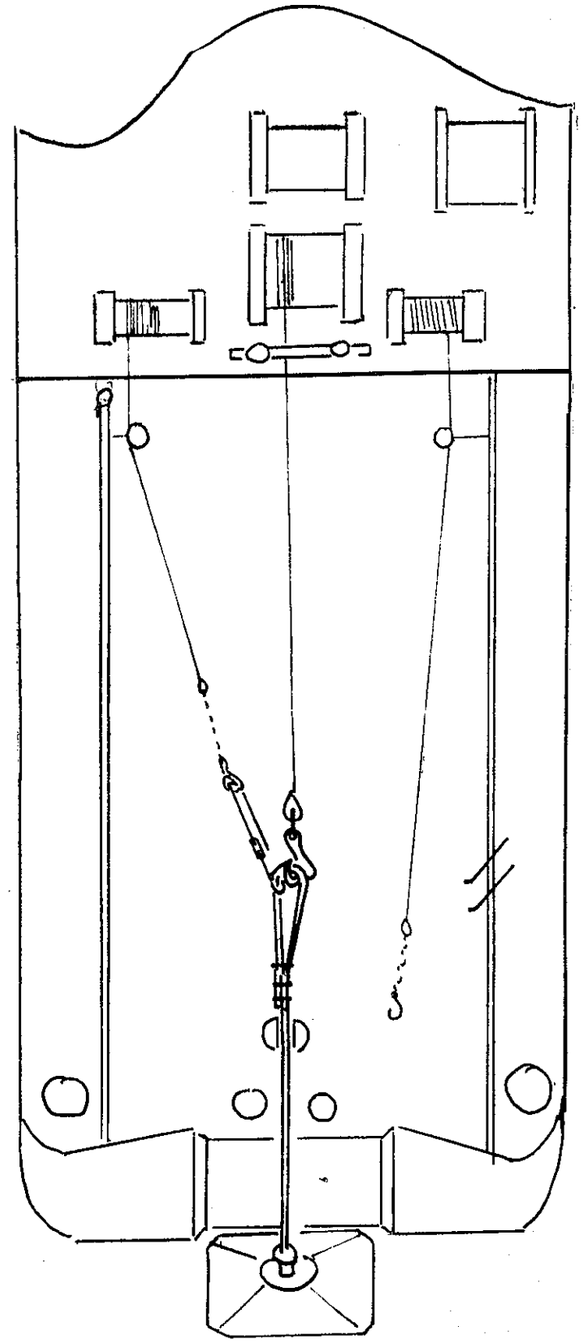


Heave anchor up until it contacts the bottom of the suitcase buoy — heave up until buoy rides ¼ way up the roller then slack down to position shown. Running/retrieve anchors in this position.

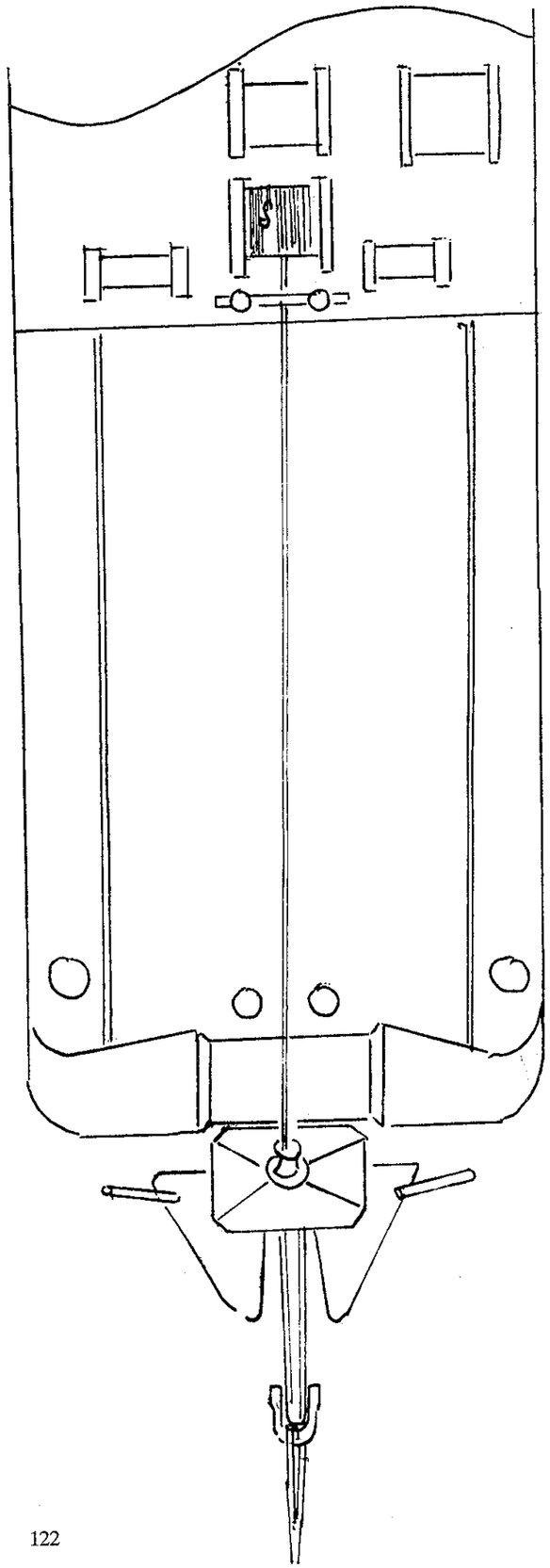
Diag 44. HOLDING PENNANT ON DECK

1. Port tugger holding pennant on joker sling.
2. Suitcase wire hooked into pennant wire eye.
3. Shark jaw may be used to hold pennant while suitcase wire is hooked in.

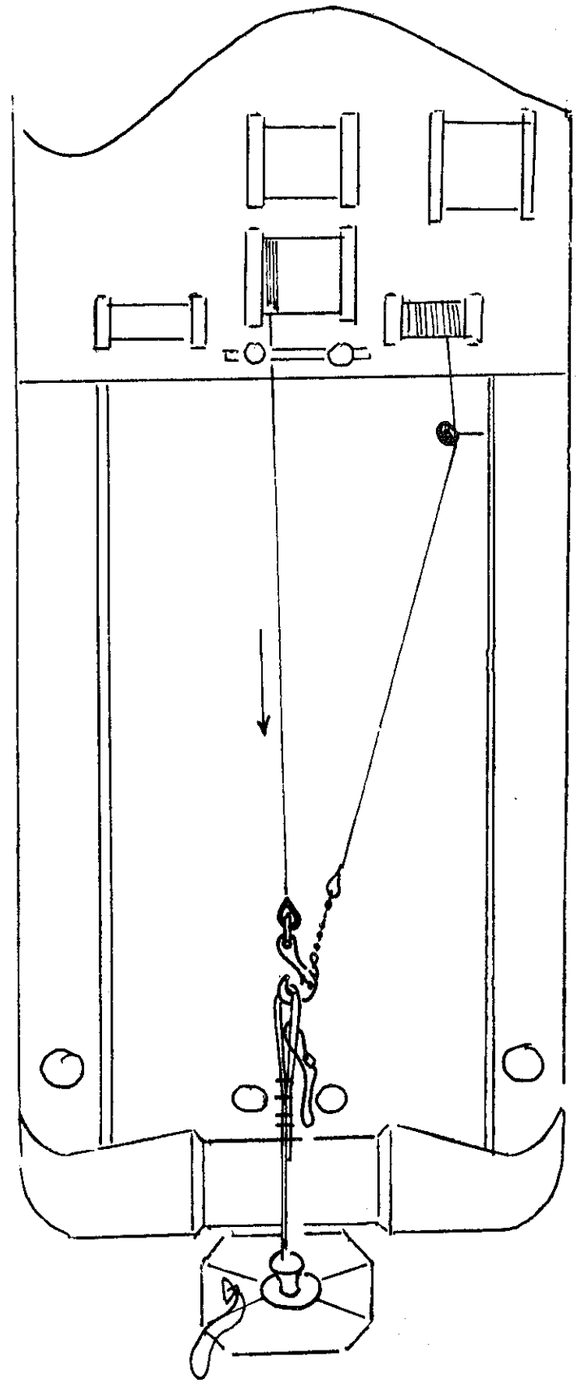
Note: Two crowbars ready to open pennant eye if squashed in order to get anchor hook attached.



Diag 45. ANCHOR AND BUOY AT ROLLER — RUNNING OR RETRIEVING

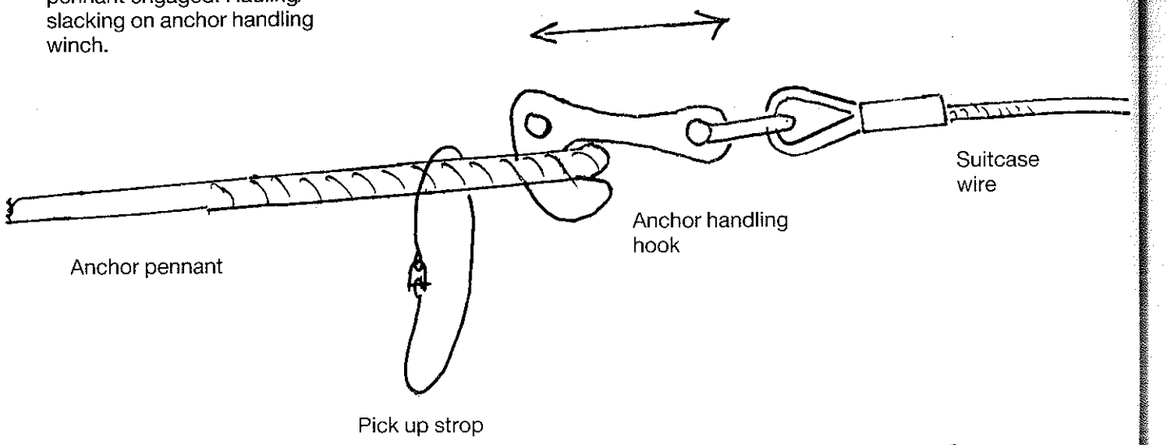


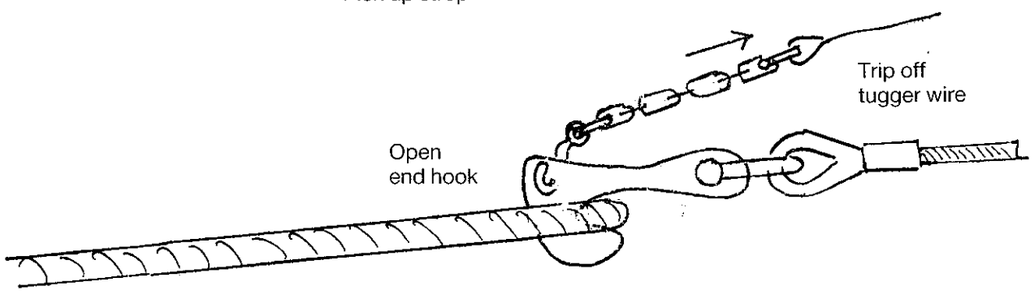
Diag 46. PREPARE TO LET GO ANCHOR BUOY PENNANT — anchor on bottom (see anchor handling hook detail next page)



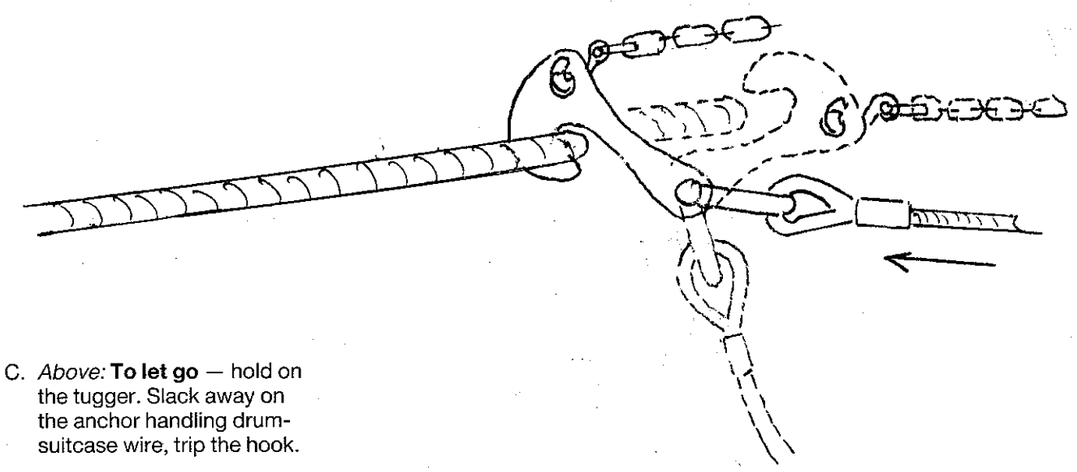
Diag 47. ANCHOR HANDLING HOOK DETAIL

A. *Below:* Anchor hook with pennant engaged. Hauling/ slacking on anchor handling winch.



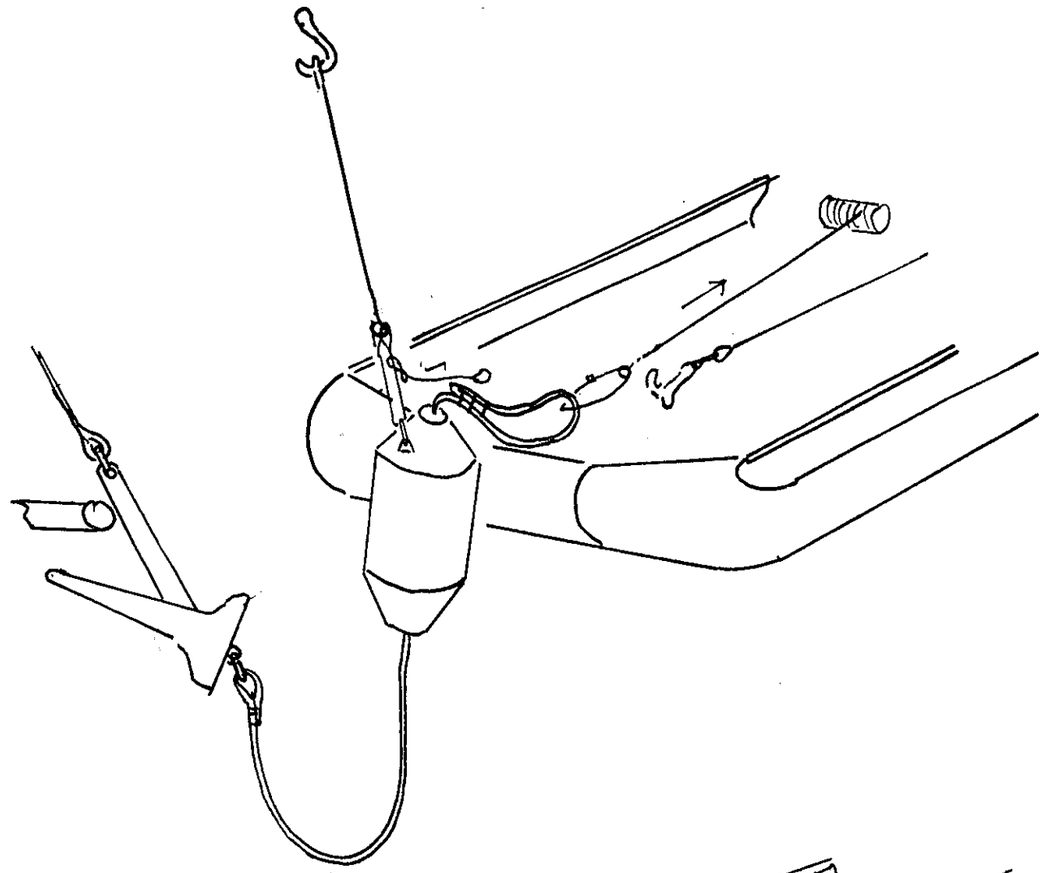


B. *Above:* Attach trip off tugger hook to eye of anchor handling hook, take up slack tugger wire.

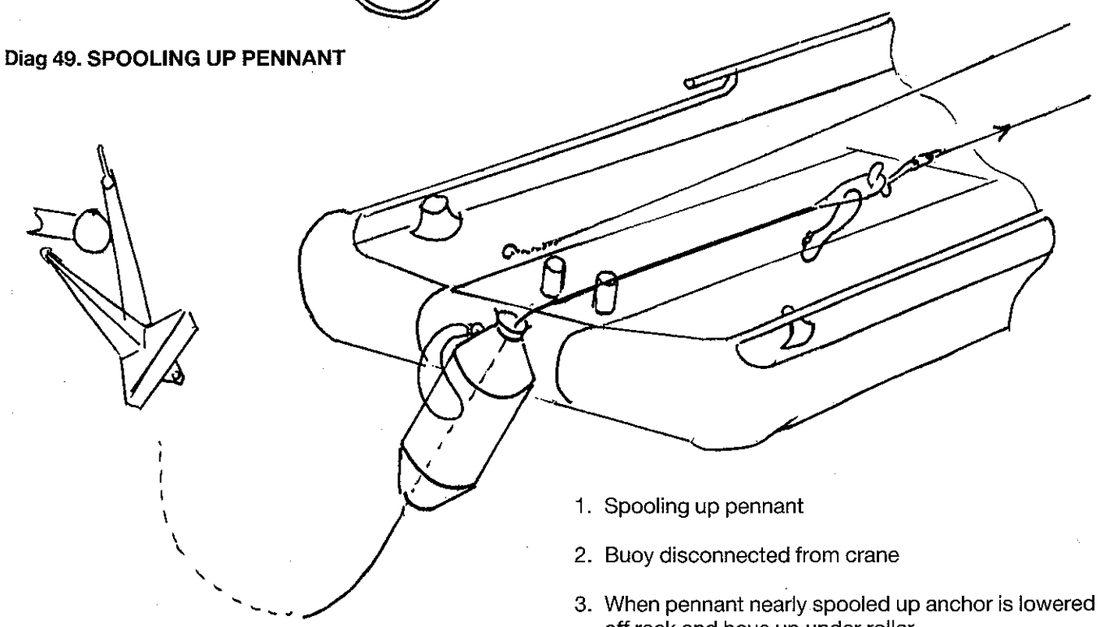


C. *Above:* **To let go** — hold on the tugger. Slack away on the anchor handling drum-suitcase wire, trip the hook.

Diag 48. RECEIVING BUOY AND ANCHOR FROM BARGE

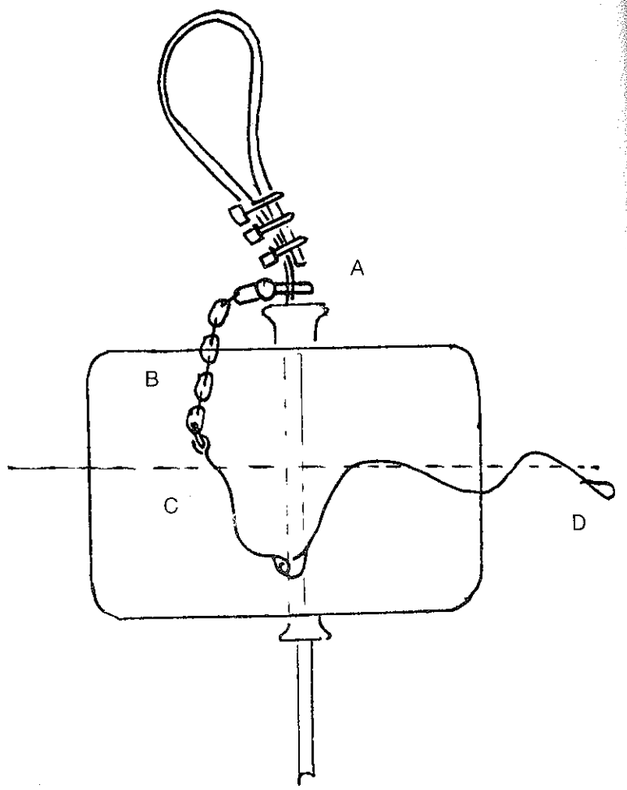


Diag 49. SPOOLING UP PENNANT



1. Spooling up pennant
2. Buoy disconnected from crane
3. When pennant nearly spooled up anchor is lowered off rack and hove up under roller

Diag 50. BUOY CATCHING SYSTEM



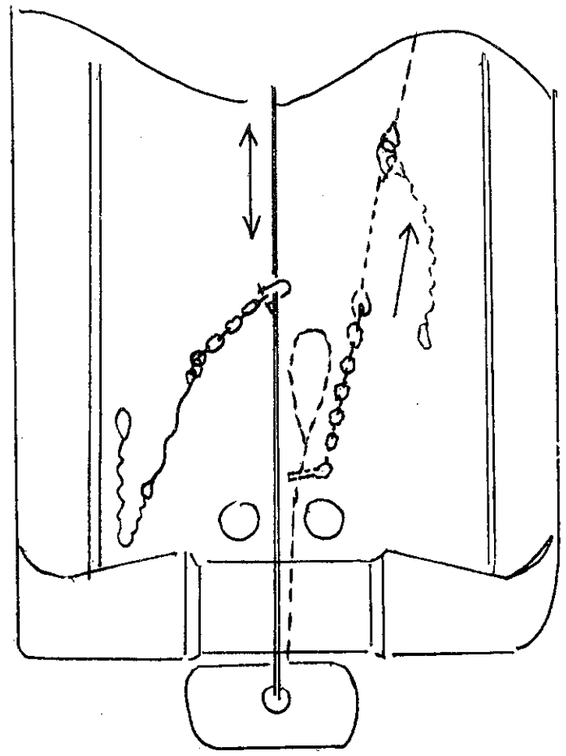
A running shackle is fitted around the pennant wire, too large to pass through the buoy — A

A short length of chain — B

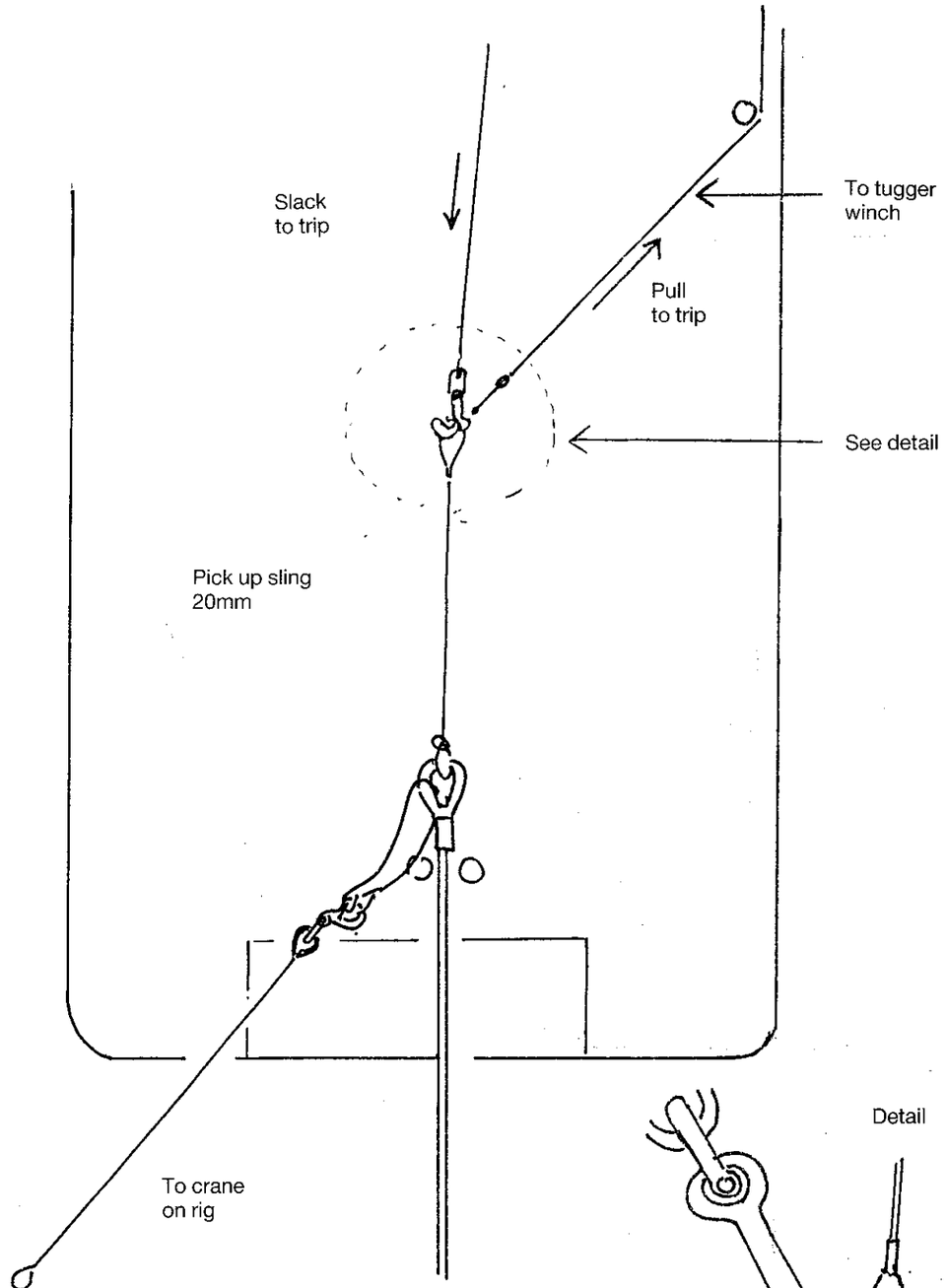
Then a short wire — C

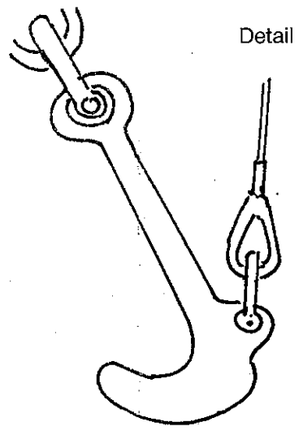
Strop is shackled to this running shackle. To the end of the strop about 3 metres of 24mm polypropylene — D rope is spliced. As this rope floats catching the buoy pennant is much easier.

1. Catch the rope with boat hook.
2. By hand haul inboard until strop eye is on deck.
3. Connect tugger wire to eye of strop.
4. Haul pennant eye on board.



Diag 51. LETTING GO PENNANT WITH TRIP HOOK

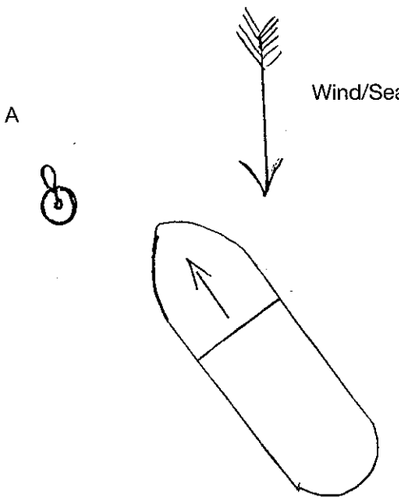




A method used when aft deck may be heavily awash (see Diag 53) in way of shark jaw or when jaws are faulty. Much faster than using heavy pelican hook but only good for passing back single pennants — SWL about 5 tonne.

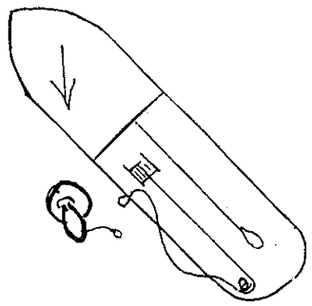
Diag 52. ROUGH WEATHER BUOY PICK UP TECHNIQUE

A



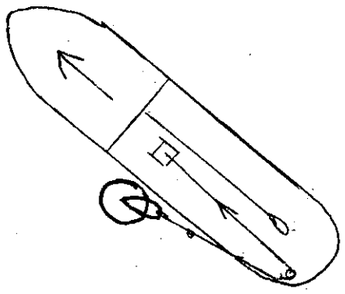
Approach buoy about 30° off weather

B



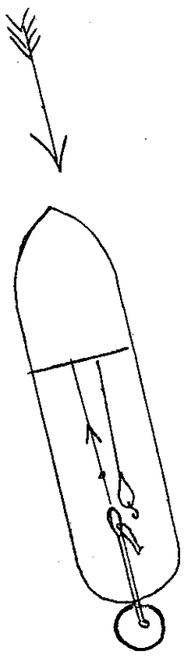
Bring buoy to break of working deck, then maintaining heading 30/45° off weather drift down onto buoy. Have tugger wire with hook ready as shown. Tugger led around guide pin aft. (See also diag 53)

C



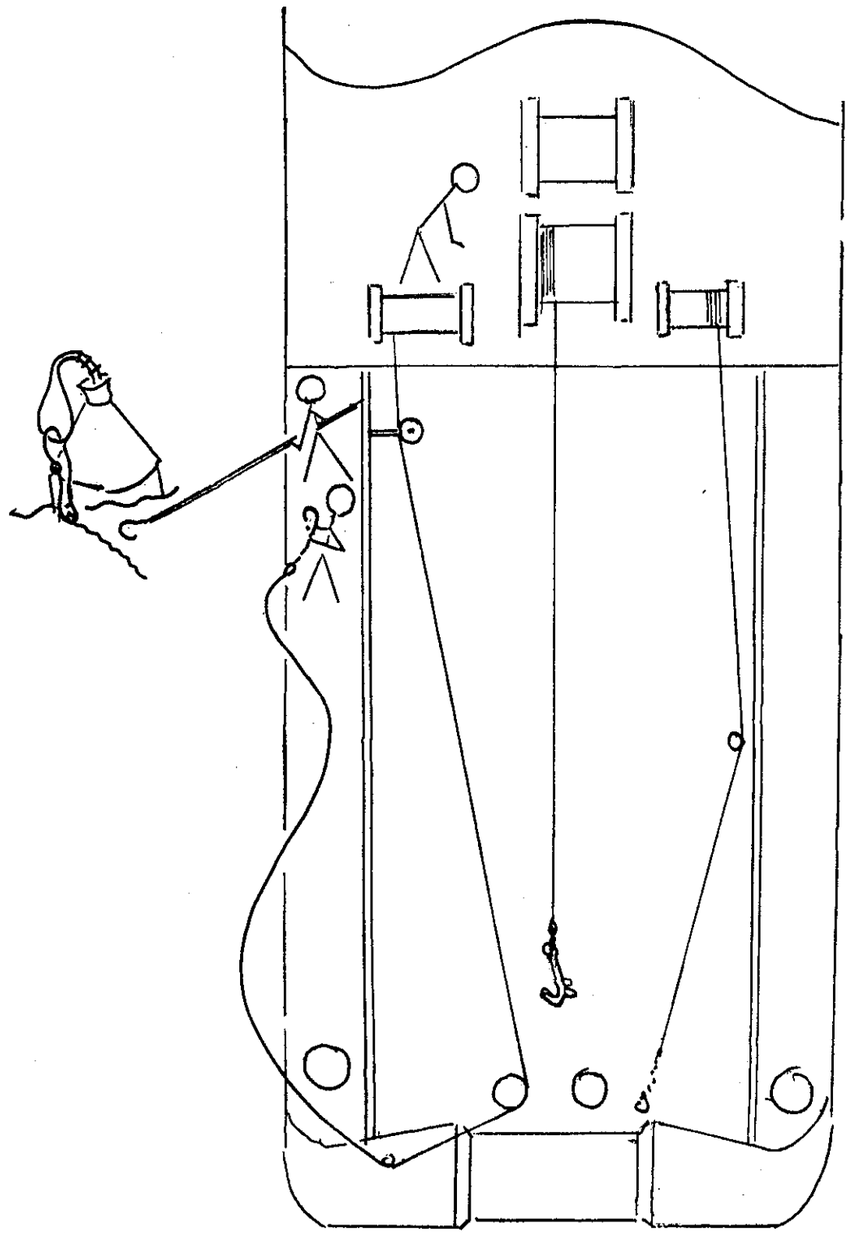
As buoy comes alongside hook up the pennant pick up strop and make fast to tugger wire. Take up slack on tugger. Start steaming boat ahead to bring buoy aft.

D

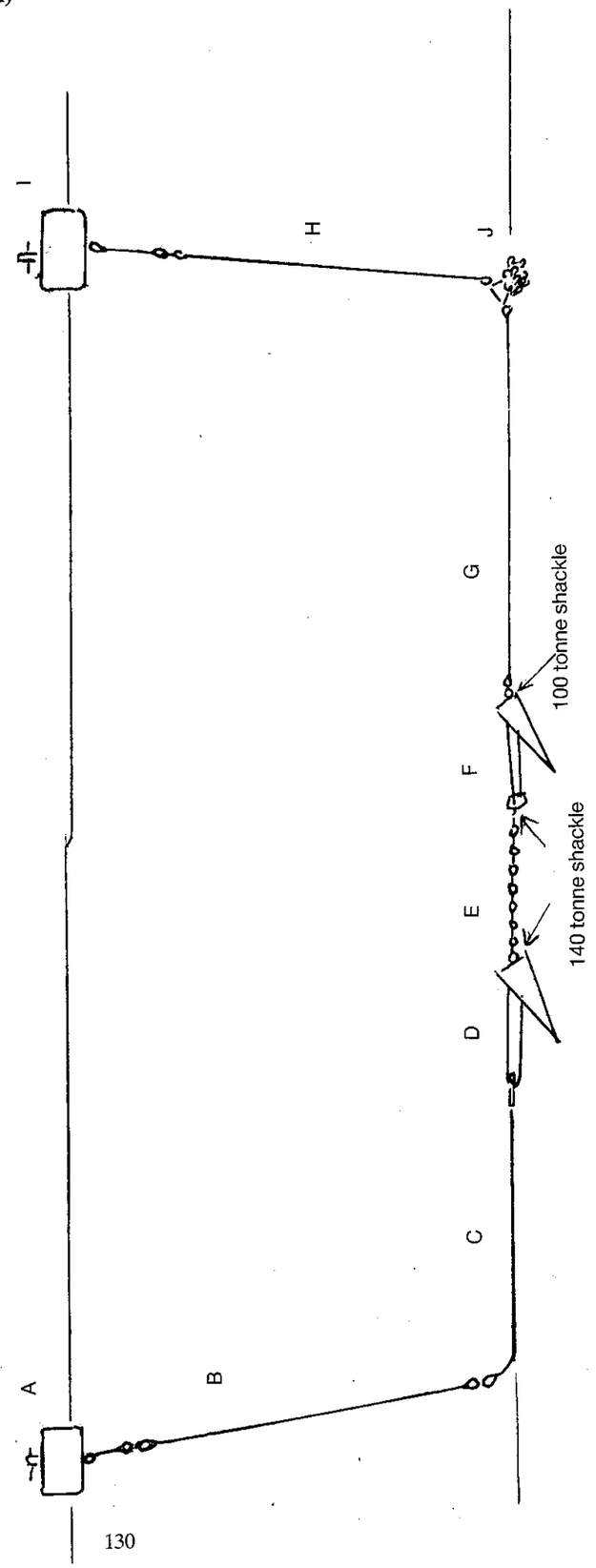


Turn up into weather and heave buoy pennant aboard to make fast to work wire.

Diag 53. DECK RIGGED FOR SIDE PICK-UP



A Surface buoy — 5/8 tonne cap
B Riser pennant — 230 metres x 45mm diameter
C Ground leg — 1000 metres x 76mm diameter
D 30 tonne HHP anchor
E Chain 5 metres x 76mm
F 30 tonne HHP anchor
G Retrieval pennant 1000 metres x 76mm wire
H Surface pennant 250 metres x 45mm diameter wire
I Surface buoy 5/8 tonne cap
J Clump weight 2 tonne — 64mm chain



Diag 54. THE "DEAD MAN" ANCHOR SYSTEM (DMA)

Diag 55. RUNNING DMA SYSTEM — DECK LAYOUT

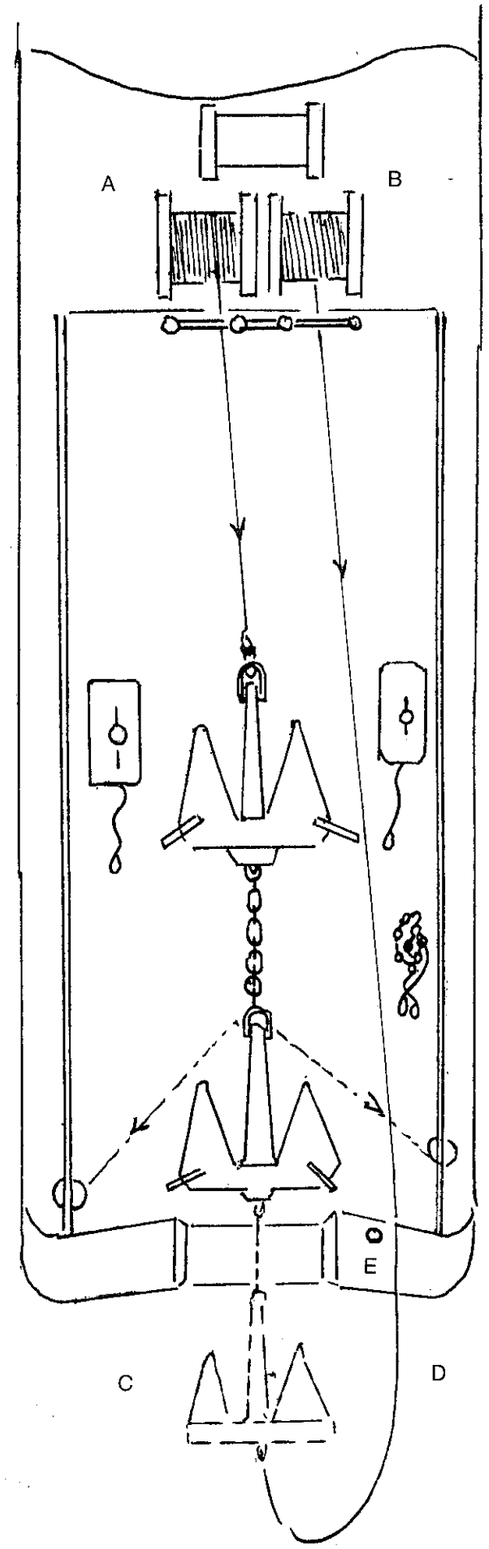
A **Port anchor handling drum**
Riser pennant and ground leg — ground leg on top

B **Starboard anchor handling drum**
Surface pennant and retrieval wire
Retrieval wire on top

C Pull **back up anchor** over stern will capstans/tuggers

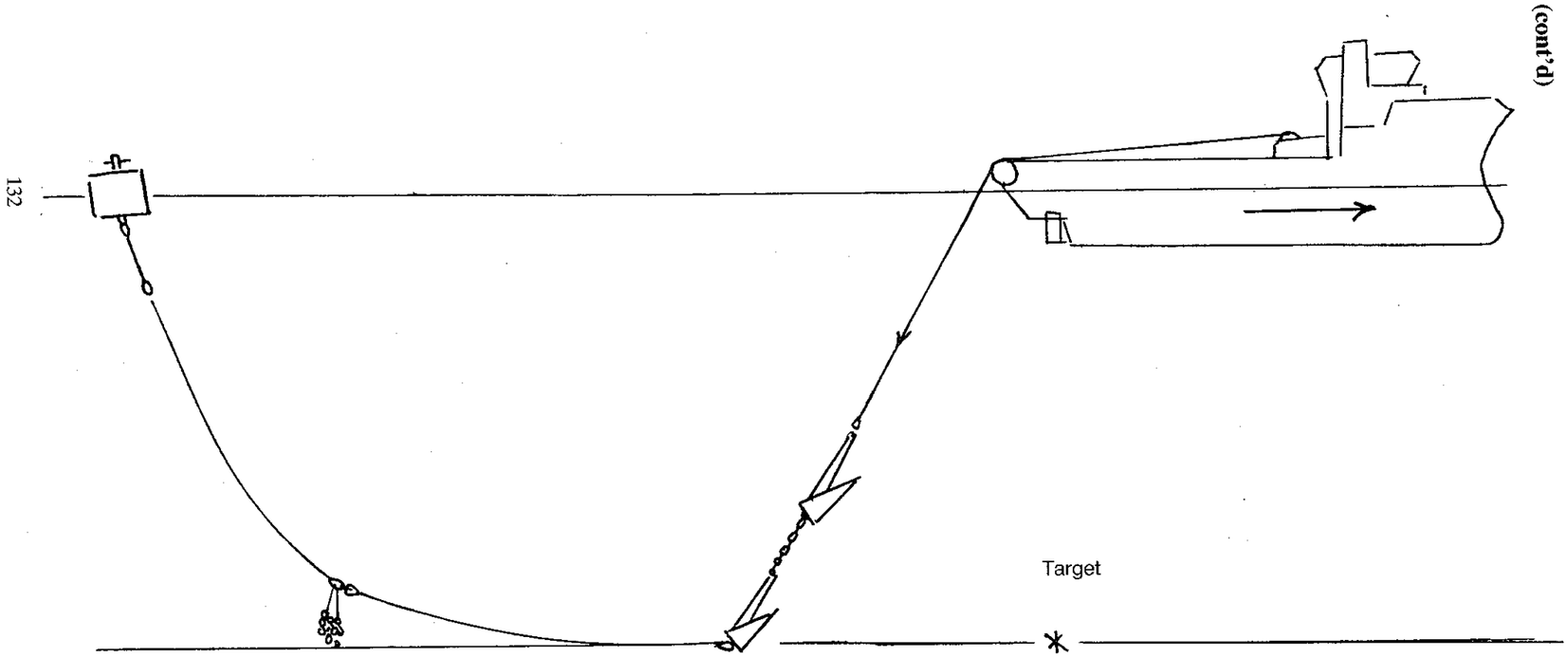
D Slack out starboard anchor handling drum

E Surface pennant/retrieval wire lead outboard with dolly pin in position

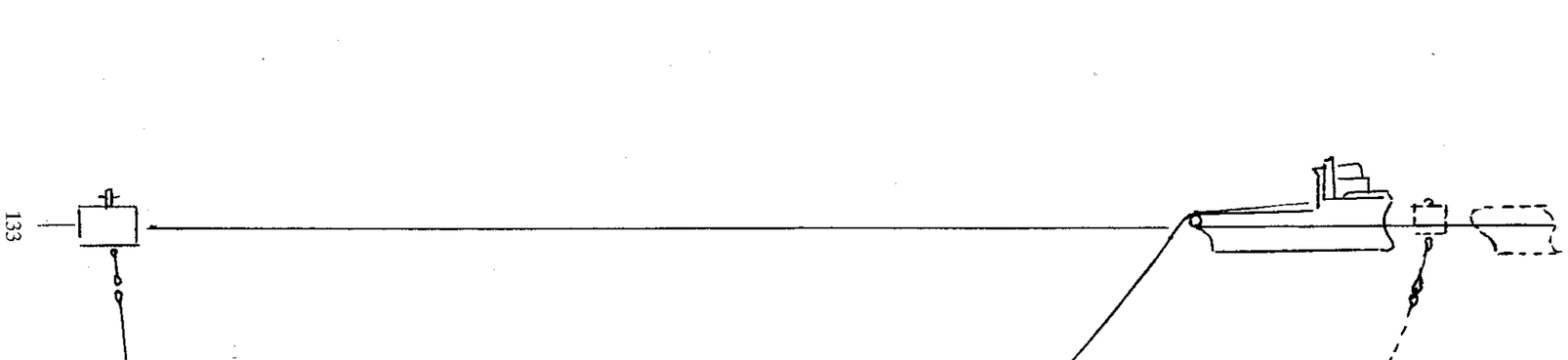


Diag 56. RUNNING DMA SYSTEM — APPROACHING LAY-DOWN POINT

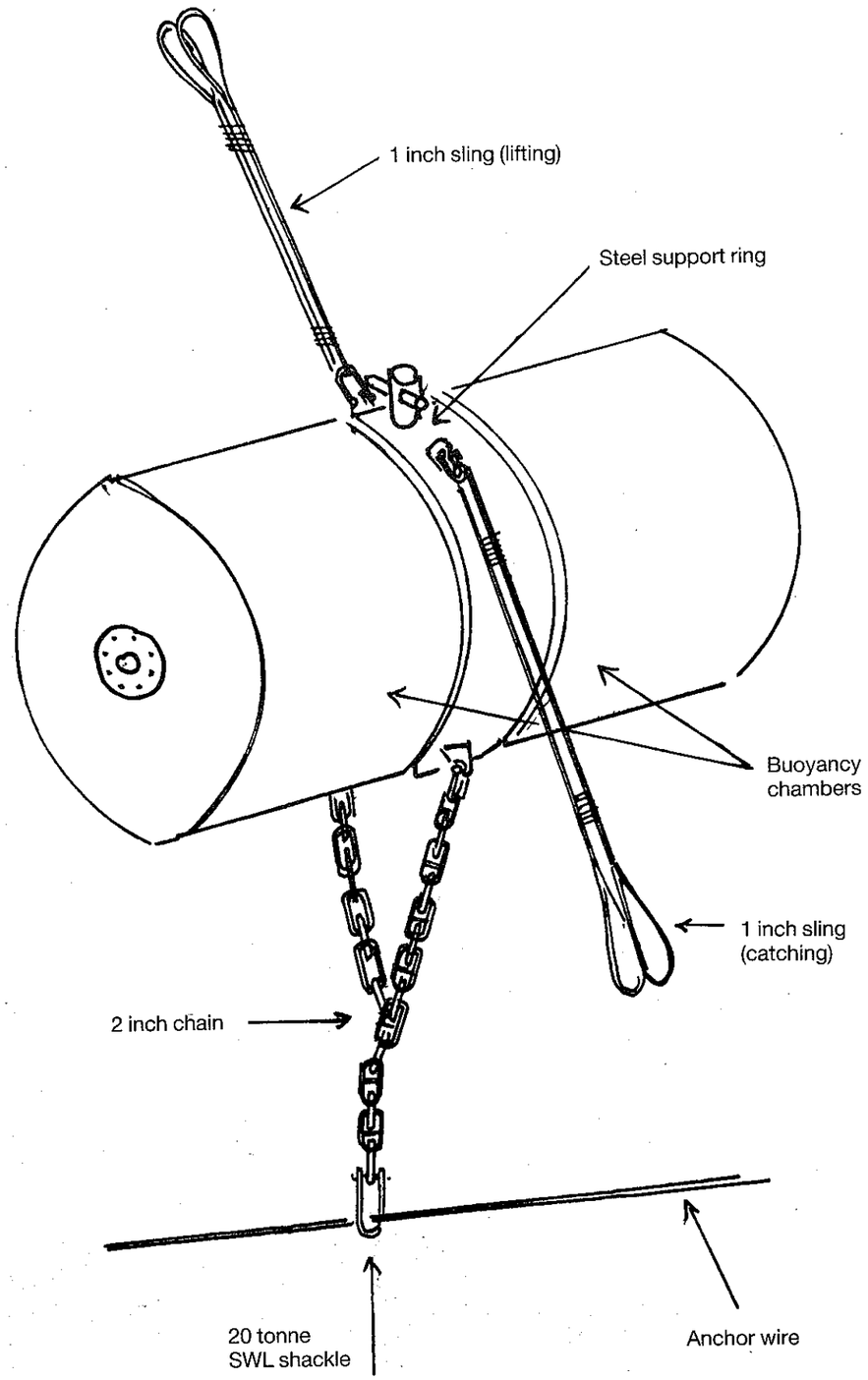
Steaming dead slow — too much speed will cause anchors to turn/twist.
Retrieving string fully streamed
Anchor lowered close to bottom as target position is approached



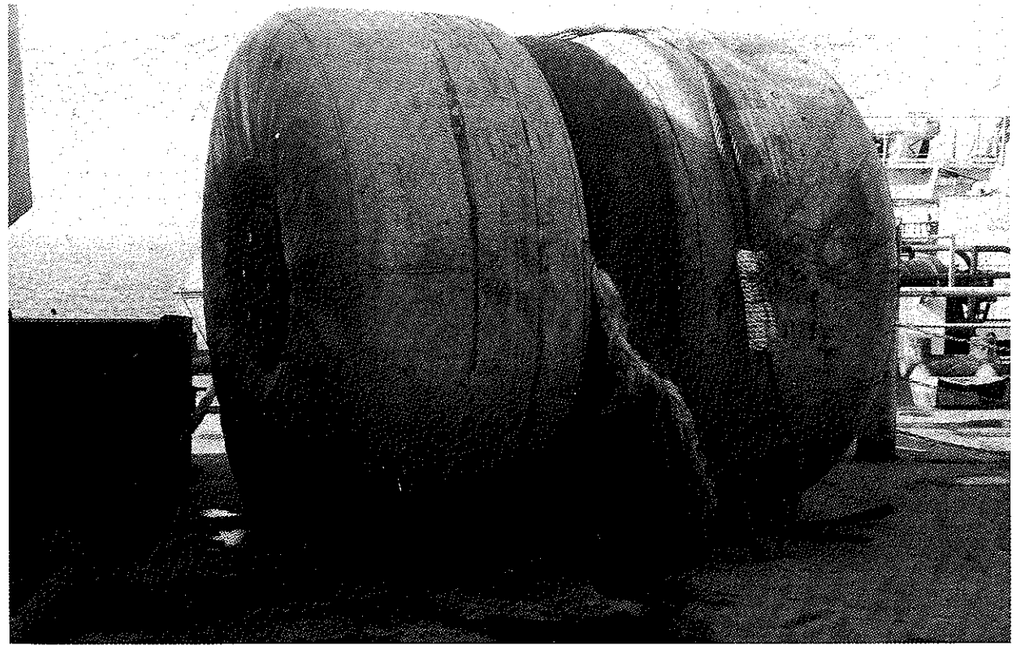
Diag 57. DMA SYSTEM — ANCHOR LAID



Diag 58. CONSTRUCTION BARGE ANCHOR BUOY RIG



Anchor buoy rig. This foam filled eurethene encased "soft buoy" is rigged with a chain tail which runs on the one piece anchor pennant. Found on construction barges. The pennant is held below the buoy on a running shackle. After decking the buoy the suitcase wire is connected into the pennant and spool up commences without disconnecting the buoy. Rapid anchor handling is possible because the pennants are single section.

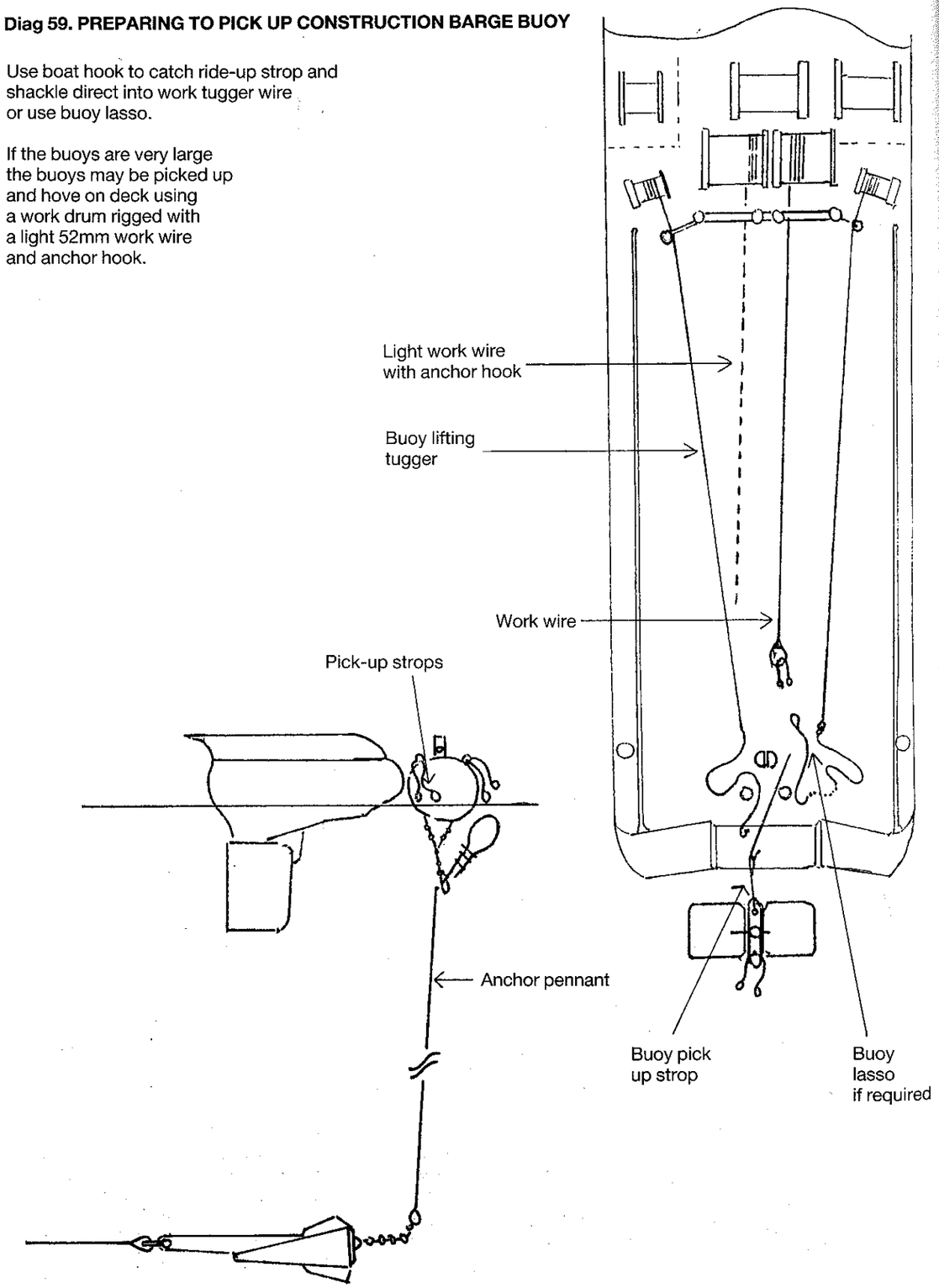


Anchor buoy This buoy type mainly found on construction barges has floatation sections attached to heavy steel ring and is rigged with "running" chain tail. Note buoy catching sling.

Diag 59. PREPARING TO PICK UP CONSTRUCTION BARGE BUOY

Use boat hook to catch ride-up strop and shackle direct into work tugger wire or use buoy lasso.

If the buoys are very large the buoys may be picked up and hove on deck using a work drum rigged with a light 52mm work wire and anchor hook.



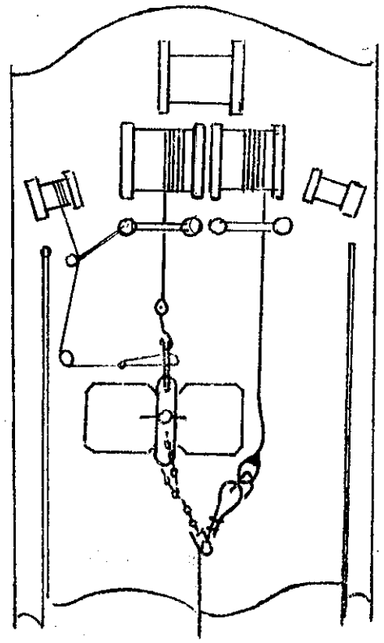
Diag 60. CONNECTING THE WORK WIRE

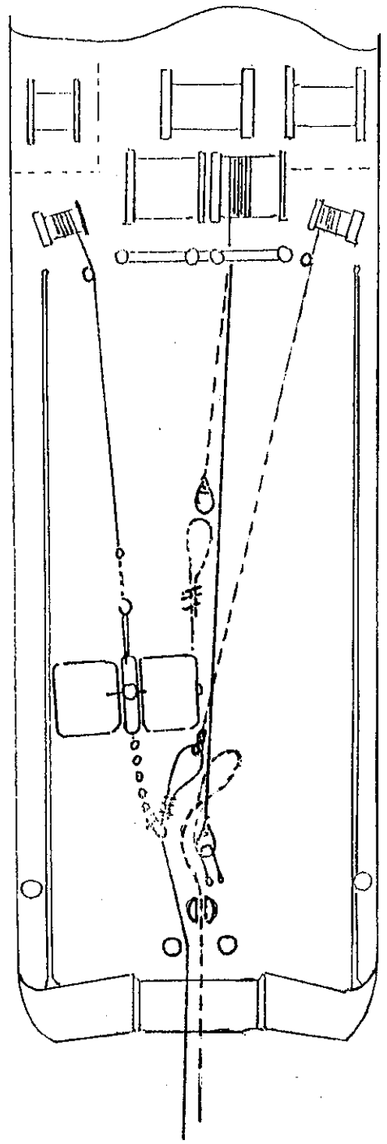
Buoy decked and hauled forward sufficient to get running shackle and pennant eye onto deck.

The work wire may now be shackled into the pennant without stopping off but it depends on weather conditions and pennant length.

The starboard tugger is sometimes used to pull the pennant eye clear of the buoy.

The hydraulic stopper aft may be "dressed" with insert sections so that it can accept and hold wire rope acting like a carpenter stopper "midline stopper".

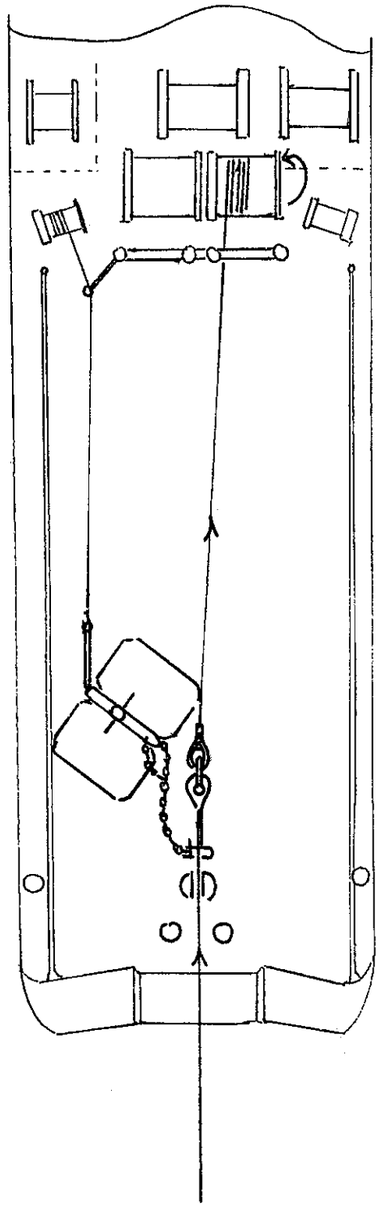


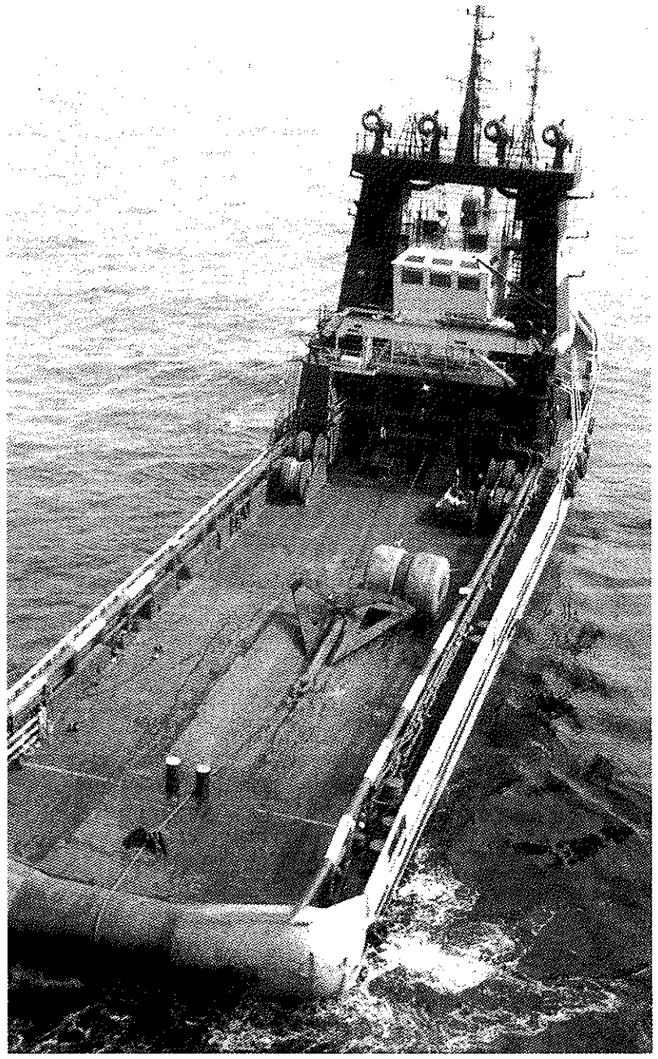


Buoy decked and hove up using light work wire and work drum — the light wire is fitted with an anchor hook. No stoppers are used, the wire (heavy duty) is on the starboard drum and shackled into the pennant as shown. A tugger is used to help secure the buoy in rough weather.

Diag 61. SPOOL UP

Pennant connected to work wire
buoy held by tugger winch
heaving away on work wire

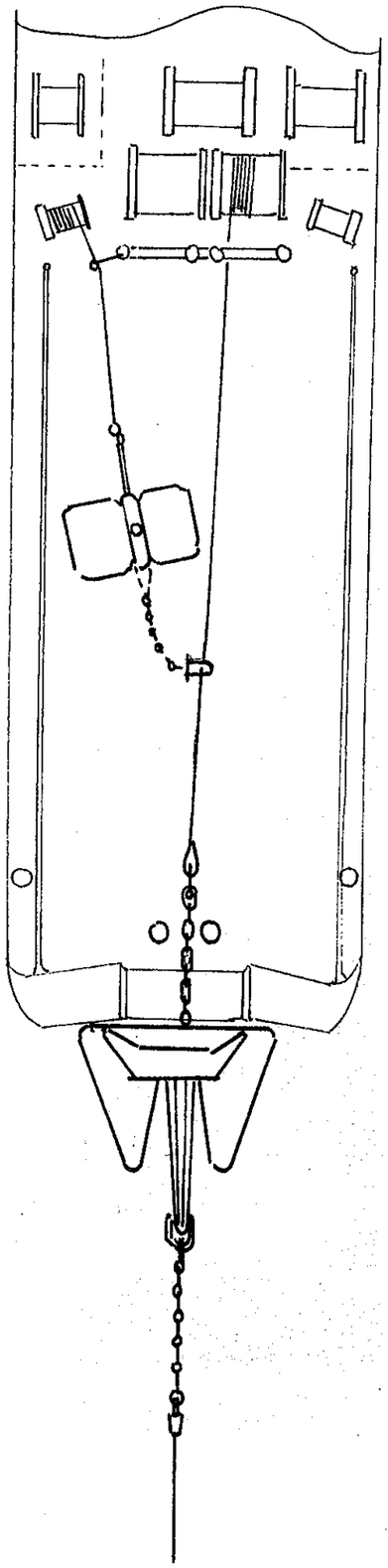




In the picture above the buoy has already been decked, pennant spooled and anchor decked.

Diag 62. LIFTING ANCHOR TO ROLLER — RUNNING/RETRIEVING

Anchor hove up to roller
buoy held by tugger with pennant
sliding through running shackle



Six hundred feet down lies the reason for another "fishing job". Here an anchor has become disconnected from the chain after the swivel turnlock pin "fell out".

PART 6. FISHING AND GRAPPLING OPERATIONS

a. Introduction

Barges and similar vessels using spread mooring systems will frequently incur problems of anchor deployment and retrieval when the normal methods cannot be used. These situations usually come about for the following reasons.

1. Buoy pennants part and fall to seabed on buoyed systems.

2. Chasing pennants part on PCC systems.

3. Chain or wire moorings part or are dropped without any recovery pennants or buoys.

In general there are three methods of retrieval:

1. Fishing with a J-hook type chaser.

2. Fishing with a multi-pronged grapple.

3. Fishing with chasing block, usually only found with wire moorings.

The diagrams show the various types of chasing/fishing gear currently available. There are various types of hinged chasers on the market but in general the AHT master is presented with a J-hook and four prong grapple and told to get on with it.

Most fishing/grappling is done under unfavourable conditions and requires both skill and patience if it is to be successful.

b. How it's done — setting up the gear

Taking the most common example — a barge with three inch chain moorings and a permanent chasing system has lost the chaser pennant on one mooring line. The chaser ring and pennant are somewhere on the chain, the barge is moored in 500 feet of water and there is about 4,300 feet of chain out. The holding ground is good and the anchors well dug in.

Available for fishing is a short shanked heavy duty J-chaser, a heavy duty 4 prong grapple, non-locking type, a 4 prong chain grapple and a spare chaser ring (non opening type).

c. Methods of recovery

The methods available for retrieval are:

1. If the barge is leaving location the problem anchor could be recovered last with the barge's own winches by simply hauling the barge to the anchor. The chaser ring would then fetch up the anchor and its pennant could be recovered by the barge crew with the help of the AHT.

2. The barge could pay out his chain until he reached a joining link (you would need about 300 feet of slack chain). This link would be distinctly marked and lowered to the anchor rack. The AHT would then pass a messenger around the chain, followed by his work wire and haul the bight of chain on board in way of the link, stop off both parts of the chain, disconnect the joining link, fit the spare chasing ring, attached already, to his work wire and sufficient pennants (2-3 times water depth), reconnect the chain, tension the chain up and chase out forcing the lost chaser ring to the anchor and recover the lot. This is a satisfactory method and very sure.

3. **Grapple** a bight of chain close to the barge. Rig an **oilfield chaser** using a length of 3" anchor chain about 15/20 feet long (see diagrams). This is also a satisfactory method and again usually successful, especially if there are no suitable joining links.

4. **Fish the chain** with a J-hook and chase out forcing the permanent chaser to the anchor and recover the anchor (see diagram).

Note:
Whenever J-hooks, grapples or other chasing/fishing devices are used it's a good idea to fit a length of chain about 15/20 feet long, 2½" or 2¾" diameter between the tool and the work wire/pennant string because the roller of the AHT imposes very severe bending forces on the pennant eye as it comes over the roller especially when loaded with the mass of anchor, chain and tangled pennants.

d. Cautions

1. Fishing jobs impose at times very heavy forces on wires, grapples and winches. Needlessly exposing the deck crew to the equipment under tension is foolhardy in the extreme.

2. If you intend to grapple a chain or wire instead of chasing it get as much data as possible on the position of the anchor, the direction of the mooring line and length, plus information on any other seabed obstructions in the vicinity.

e. Hints on recovery

1. In a busy offshore oilfield there may be a diving support vessel available which, using its remote operated vehicle, could locate the anchor you have to recover fix its position and observe the position where a grapple or J-hook dragging across the seabed would have a good chance of catching the mooring line this would save time and effort chasing out to the anchor.

2. A portable laser range finder in combination with the barge's winch distance counter can be used to assist the "fishing" boat in knowing the whereabouts of the J-hook or grapple when chasing out to the anchor.

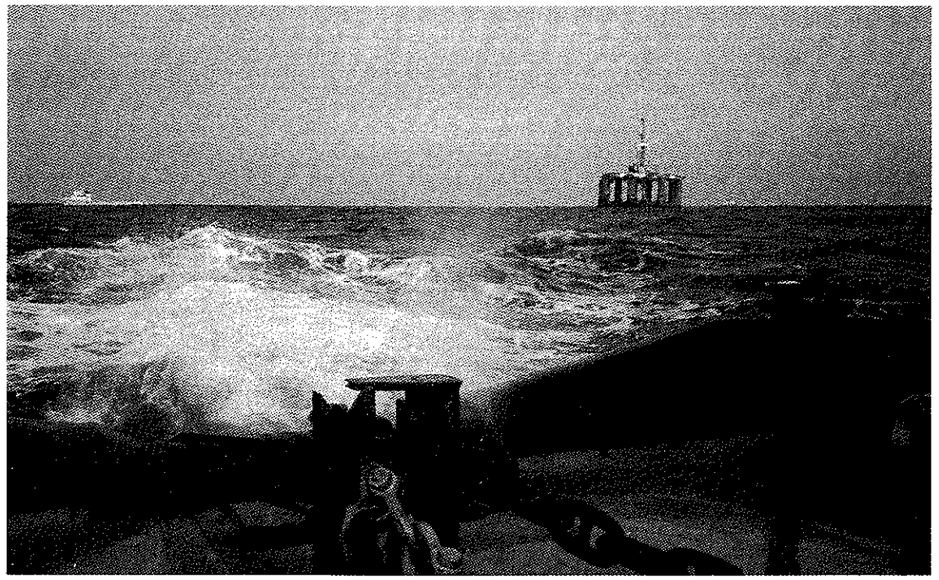
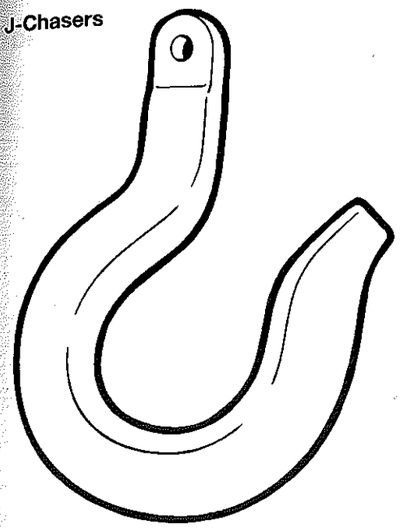


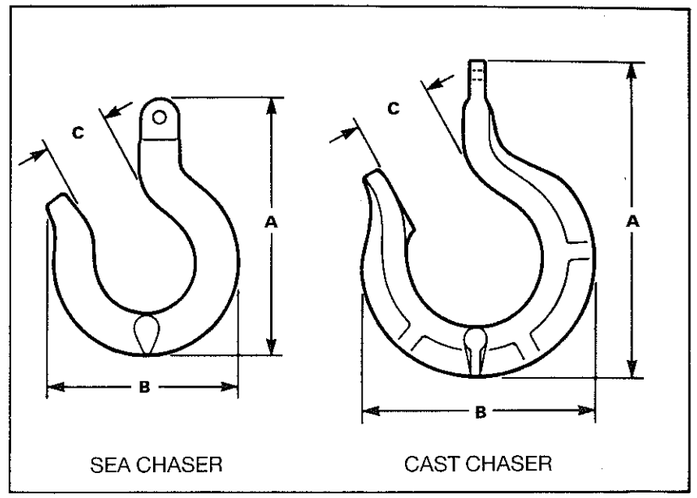
Photo supplied by Wijsmüller, Holland

Fishing job — piggy back anchors Picking up anchors both forks are in use, the left hand fork is holding pennant to piggy back anchor, right hand fork holds chains to rig (in background) — the main anchor is decked.

f. Specifications of useful recovery gear *(data reproduced by permission of the HER Group)*

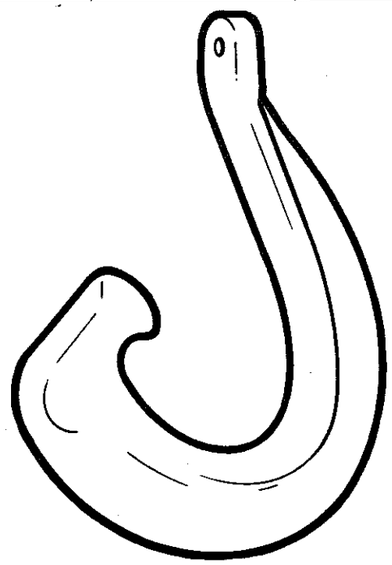
J-Chasers

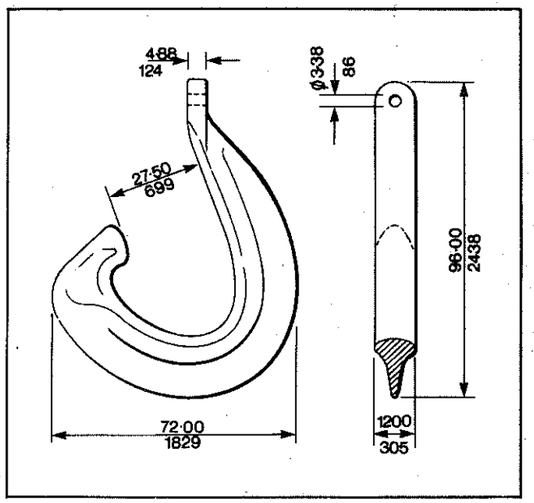




SEA CHASER CAST CHASER

Type	S.W.L. Tonnes	Proof Load Tonnes	Weight		A		B		C	
			kg	lb	mm	in	mm	in	mm	in
Forged	50	100	475	1095	1500	59	1160	45	450	18
Forged	75	150	830	1830	1820	72	1420	56	560	22
Cast	75	150	1587	3500	2285	90	1830	72	610	24

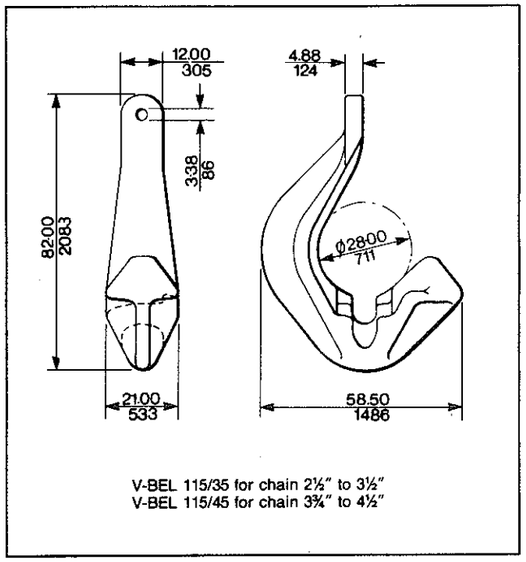




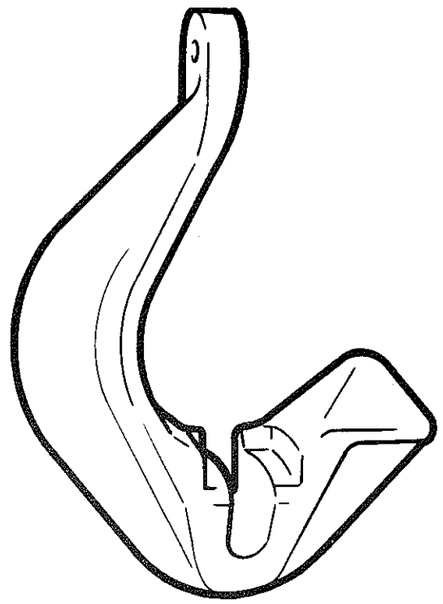
Type	S.W.L. Tonnes	Proof Test Load Tonnes	Weight	
			kg	lb
BEL 101	100	250	1882	4150
Material: BS 2789 GRADE 420/12 ASTM A 536 GRADE 65/45/12				

f. Specifications of useful recovery gear (cont'd)

J-lock chain chasers

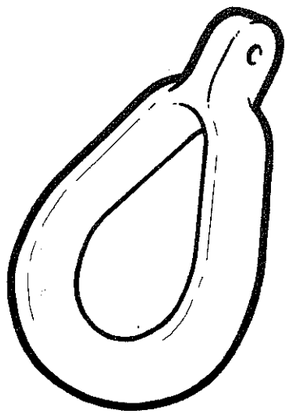


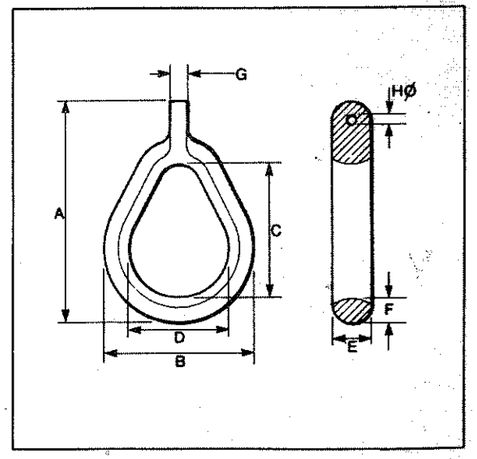
V-BEL 115/35 for chain 2½" to 3½"
V-BEL 115/45 for chain 3¾" to 4½"



Type	S.W.L. Tonnes	Proof Test Load Tonnes	Weight kg	Weight lb
VRIJHOF-BEL 115	100	250	1778	3920
Material: BS 2789 GRADE 420/12 ASTM A 536 GRADE 65/45/12				

Permanent chain chasers

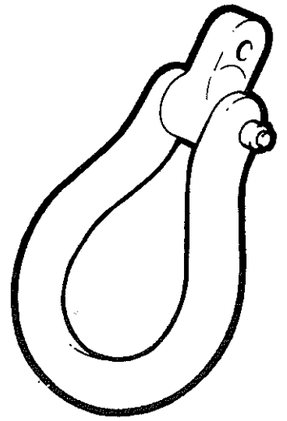


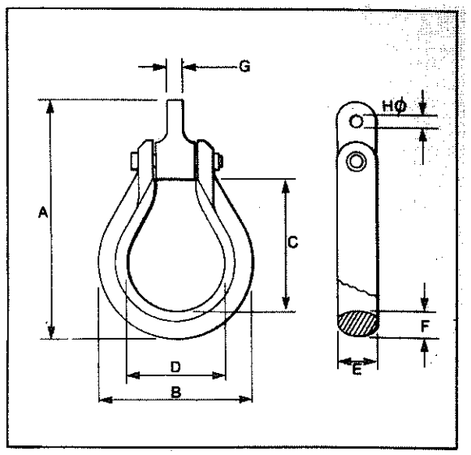


Type	S.W.L. Tonnes	Proof Test Tonnes	Weight kg	Weight lb		A	B	C	D	E	F	G	H
					in	65.25	45.00	39.00	30.00	12.00	7.50	4.88	3.38
BEL 102	100	250	1088	2400	mm	1657	1143	991	762	305	191	124	86
					in	67.00	46.00	39.00	30.00	15.00	8.00	5.13	3.88
BEL 106	130	250	1451	3200	mm	1702	1168	991	762	381	203	130	99
					in	73.50	49.00	44.50	33.00	13.00	8.00	5.13	3.88
BEL 110	130	250	1433	3160	mm	1867	1245	1130	838	330	203	130	99
Material: BS 2789 GRADE 420/12						Lifting eye dimensions shown are standard for each type. Specials can be made to suit customer's requirements.							

f. Specifications of useful recovery gear (cont'd)

Detachable permanent chain chasers

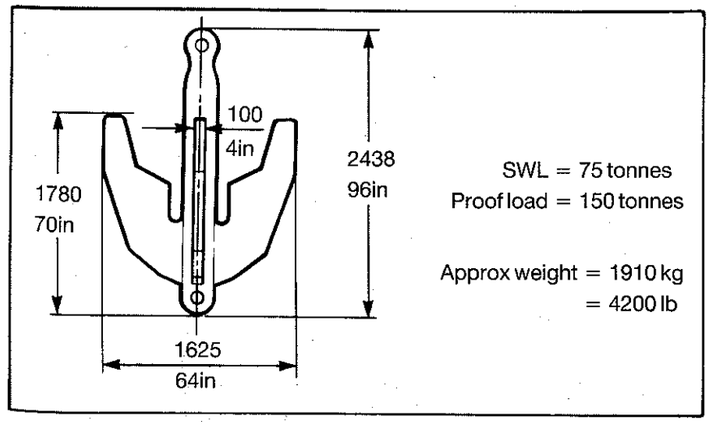




Type	S.W.L. Tonnes	Proof Test Tonnes	Weight kg	Weight lb		A	B	C	D	E	F	G	H
					in	74.25	45.00	42.50	30.00	12.00	7.50	4.88	3.38
BEL 107	100	250	1238	2730	mm	1886	1143	1080	762	305	191	124	86
					in	76.00	46.00	42.00	30.00	15.00	8.00	5.13	3.88
BEL 108	130	250	1656	3650	mm	1931	1168	1067	762	381	203	130	99
					in	78.50	49.00	44.50	33.00	13.00	8.00	5.13	3.88
BEL 111	130	250	1742	3840	mm	1994	1245	1130	838	330	203	130	99

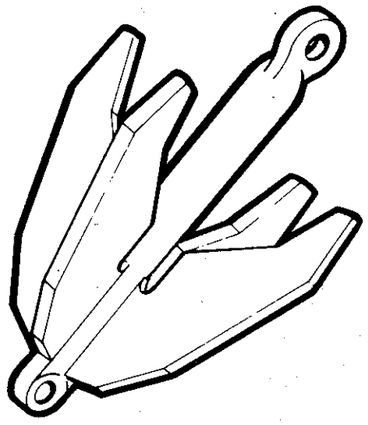
Materials: Body and eye piece — BS 2789 GRADE 420/12 ASTM A 536 GRADE 65/45/12
Hinge Bolt — NI-CR-MO Steel
Nut — Stainless Steel
Lifting eye dimensions shown are standard for each type.
Specials can be made to suit customer's requirements.

Cast 4-pronged grapnels



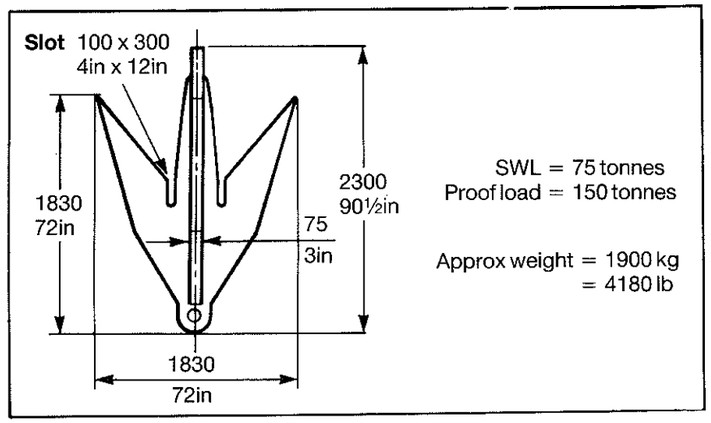
SWL = 75 tonnes
Proof load = 150 tonnes

Approx weight = 1910 kg
= 4200 lb



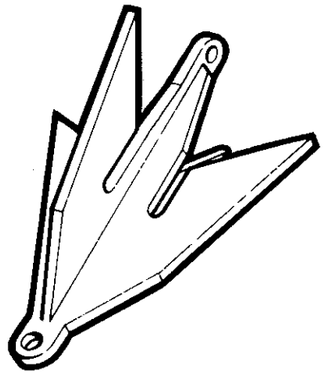
f. Specifications of useful recovery gear (cont'd)

Fabricated 4 pronged grapnels

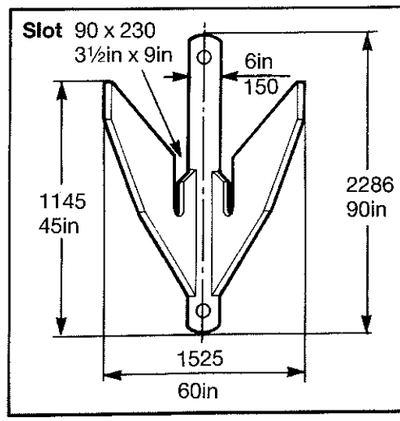


SWL = 75 tonnes
Proof load = 150 tonnes

Approx weight = 1900 kg
= 4180 lb

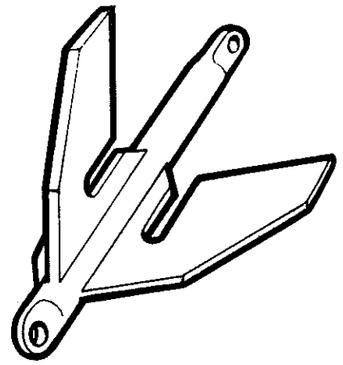


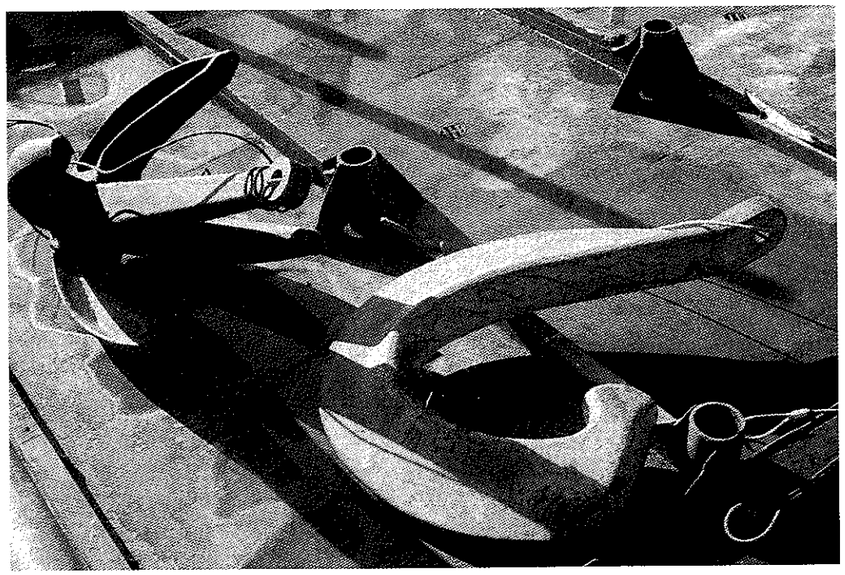
Fabricated 3 pronged grapnels



SWL = 75 tonnes
Proof load = 150 tonnes

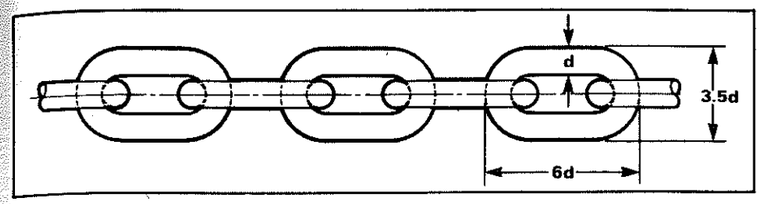
Approx weight = 1450 kg
= 3200 lb





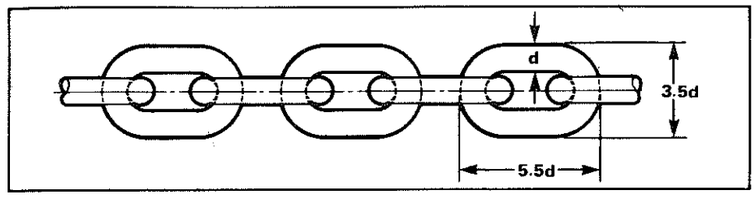
Standard 4 prong grapnel (left) and J-hook (right) both rated to 110 tonne SWL

g. Common mooring chain specifications/sizes



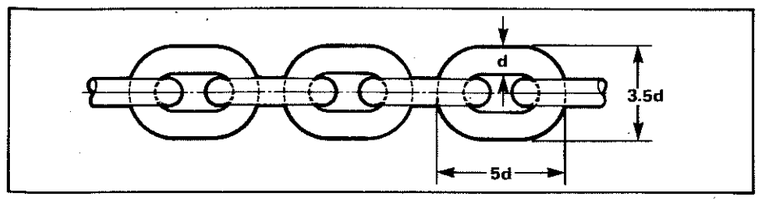
Open (long link) mooring chain

Size		Weight		Proof Load		Breaking Load	
mm	in	kg/m	lb/ft	kg	lb	kg	lb
13	½	3.34	2.25	3190	7034	7970	17584
16	⅝	5.06	3.40	4830	10662	12090	26658
19	¾	7.14	4.80	6820	15030	17050	37587
22	⅞	10.46	7.03	10000	22042	24990	55082
26	1	13.38	8.99	12770	28158	31940	70403



Medium link mooring chain

Size		Weight		Proof Load		Breaking Load	
mm	in	kg/m	lb/ft	kg	lb	kg	lb
13	½	3.50	2.40	3200	7056	6400	14112
16	⅝	5.20	3.50	4800	10584	9600	21168
19	¾	7.40	5.00	6800	14994	13600	29988
22	⅞	10.00	6.70	9100	20066	18200	40131
25	1	12.80	8.60	11800	26019	23600	52038
28	1⅛	16.50	11.10	14800	32634	29500	65048
32	1¼	21.00	14.10	19400	42777	38700	85334
34	1⅜	23.50	15.80	21800	48069	43600	96138
38	1½	29.50	19.80	27300	60197	54600	120393
42	1⅝	36.00	24.20	33300	73427	66600	146853
44	1¾	39.50	26.50	36600	80703	73200	161406
48	1⅞	47.00	31.60	43500	95918	87000	191835
51	2	53.00	35.60	49200	108486	98300	216751

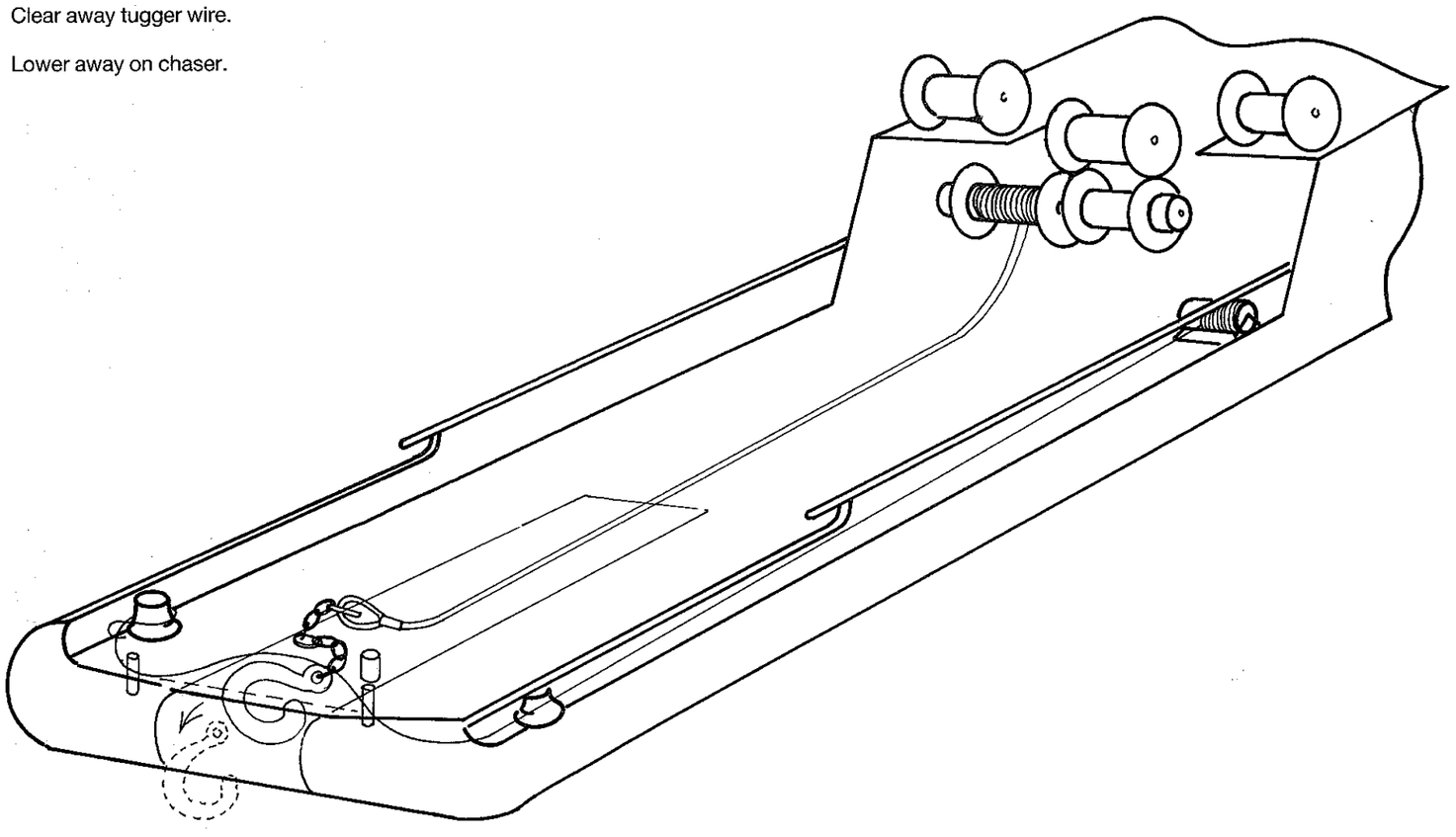


Short link mooring chain

Size		Weight		Proof Load		Breaking Load	
mm	in	kg/m	lb/ft	kg	lb	kg	lb
11	7/16	2.67	1.79	2280	5040	5710	12591
13	½	3.72	2.50	3190	7034	7970	17584
16	⅝	5.64	3.79	4830	10663	12090	26658
19	¾	7.96	5.35	6820	15030	17050	37587

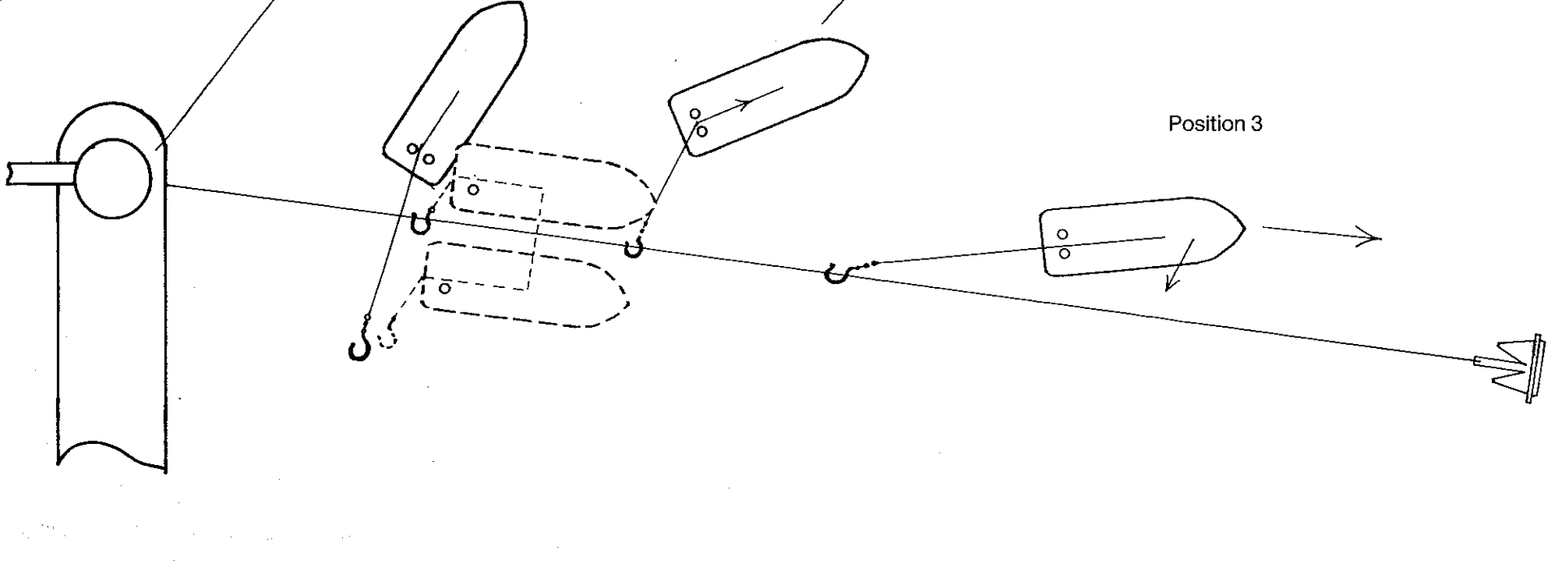
Diag 63. USING J-HOOK CHASER — "GETTING IT OVER THE STERN"

1. Run out tugger wire as shown, reeve end through shackle of chaser chain. Install Norman pins on stern.
2. Heave up on tugger and clip the chaser aft over the roller.
3. Clear away tugger wire.
4. Lower away on chaser.



Diag 64. CATCHING THE HOOK

1. Barge tensions up line.
2. Boat slacks out about ½ water depth on fishing string.
3. Boat steams slowly across line or (position 1) 'walks' sideways 'A' to 'B' and catches hook on mooring line.
4. Heave up slowly on work wire. Turn onto line of chain. Keep moving slowly ahead (position 2).
5. Move out along line of chain, slack slowly on work wire — to correct length 1½ water depth but slack out under tension to keep hook fast (position 3). Move out to anchor. Barge must keep tension on the mooring line.

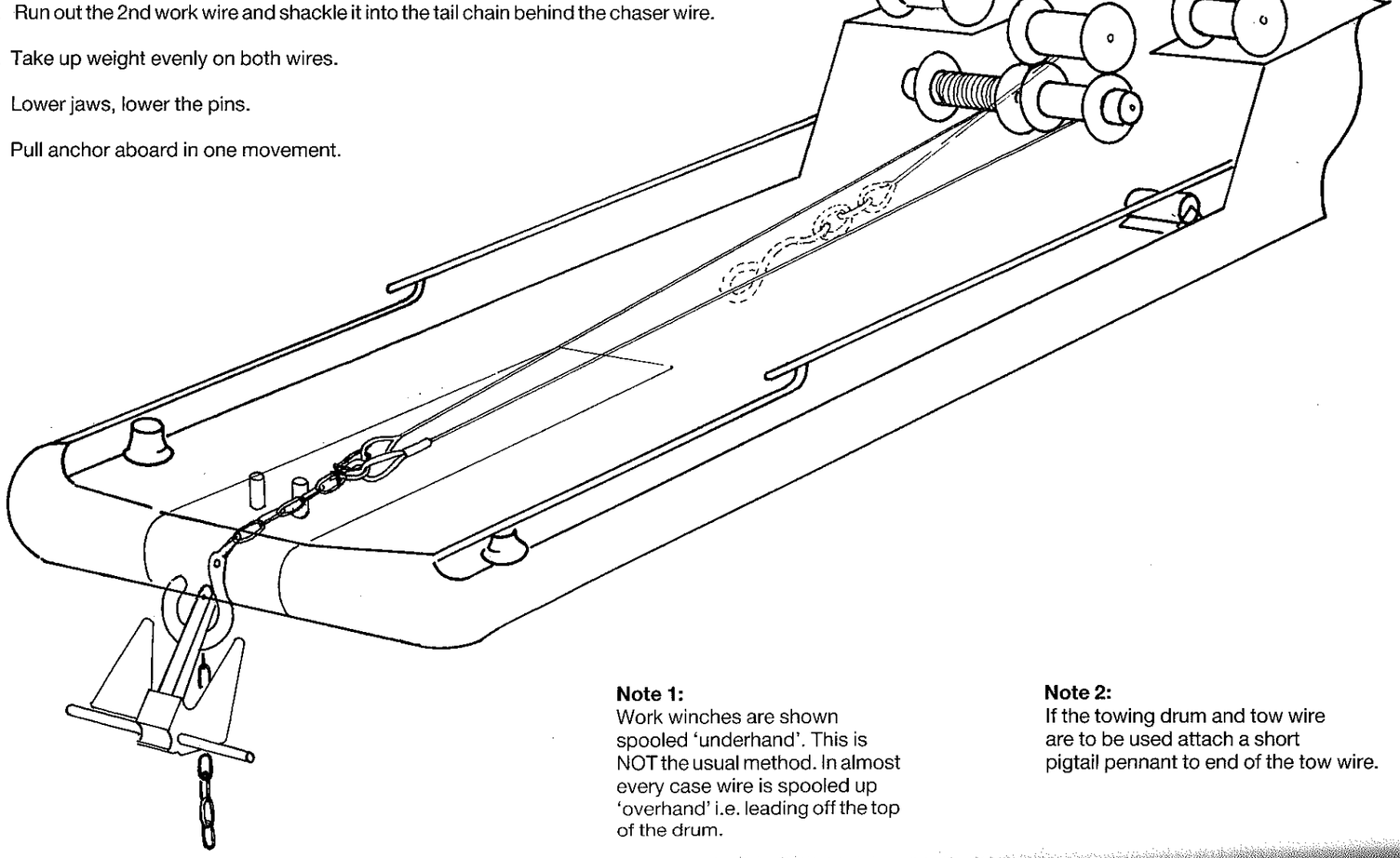


Diag 65. BOARDING THE ANCHOR

This is the time of **very high tensions**, especially on the shank of the J-hook. If your winch cannot pull the whole mass on board then back it up with the other work drum or towing drum.

Sequence

1. Secure the J-hook tail chain in the shark jaw.
2. Run out the 2nd work wire and shackle it into the tail chain behind the chaser wire.
3. Take up weight evenly on both wires.
4. Lower jaws, lower the pins.
5. Pull anchor aboard in one movement.

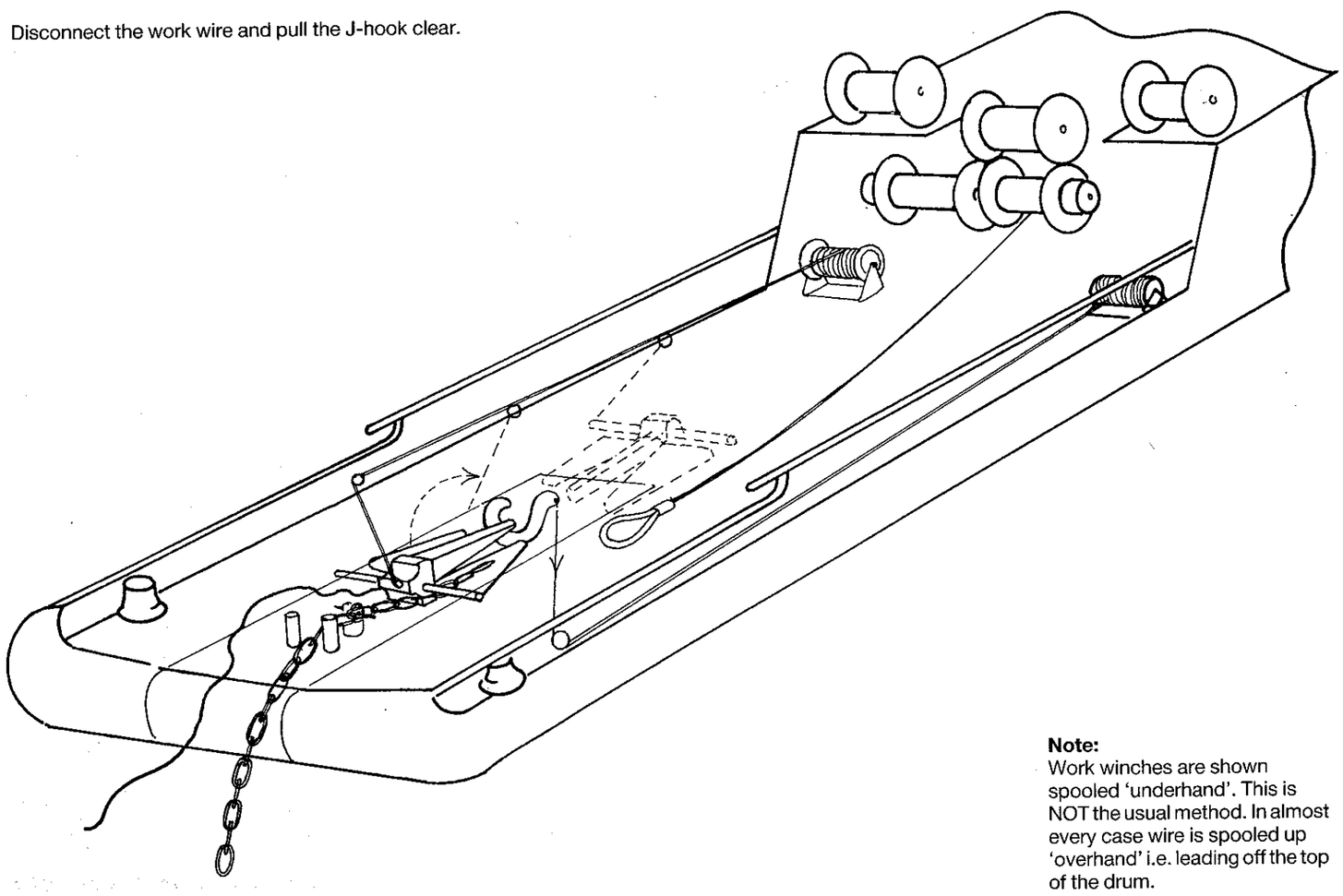


Note 1:
Work winches are shown spooled 'underhand'. This is NOT the usual method. In almost every case wire is spooled up 'overhand' i.e. leading off the top of the drum.

Note 2:
If the towing drum and tow wire are to be used attach a short pigtail pennant to end of the tow wire.

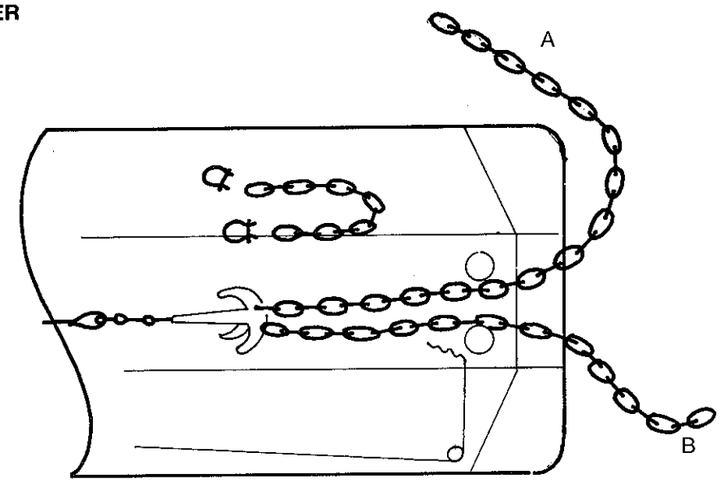
Diag 66. CLEARING THE CHASER/ANCHOR

1. After boarding the anchor secure the mooring chain in the jaws.
2. Rig tuggers as shown and turn the anchor.
3. Disconnect the work wire and pull the J-hook clear.

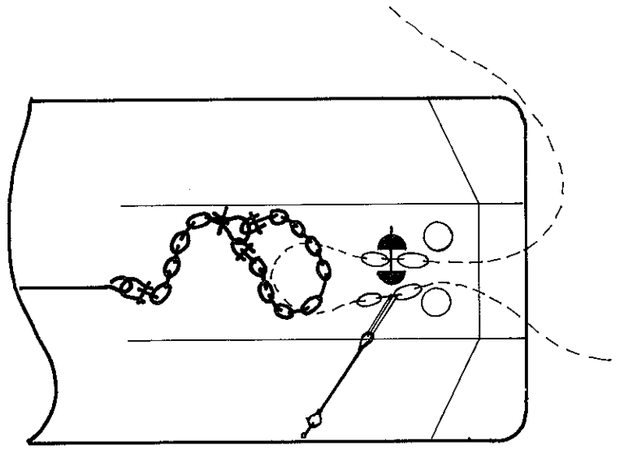


Note:
Work winches are shown spooled 'underhand'. This is NOT the usual method. In almost every case wire is spooled up 'overhand' i.e. leading off the top of the drum.

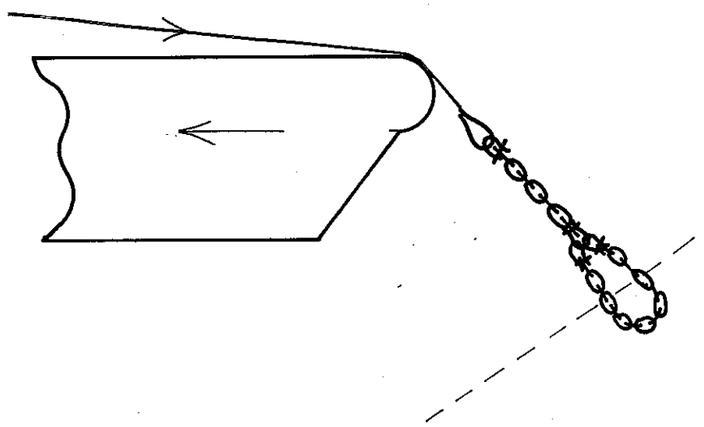
Diag 67. RIGGING AN OILFIELD CHASER



1. Rig four prong grapnel and grapple bight of chain close to the barge.
2. Barge slacks off. Pull bight aboard.
3. The oilfield chaser consists of 5 metres 76mm chain with studs burnt out of end links and two 85 tonne bow shackles.
4. Rig tuggers aft.



1. Jaw off bight A (to anchor)
2. Secure bight B (to barge) with 24mm strops and pigtail
3. Clear grapnel — pull 'chaser' around anchor chain and shackle both ends to chain on work wire.
4. Short length of chain on end of work wire (chasing string).

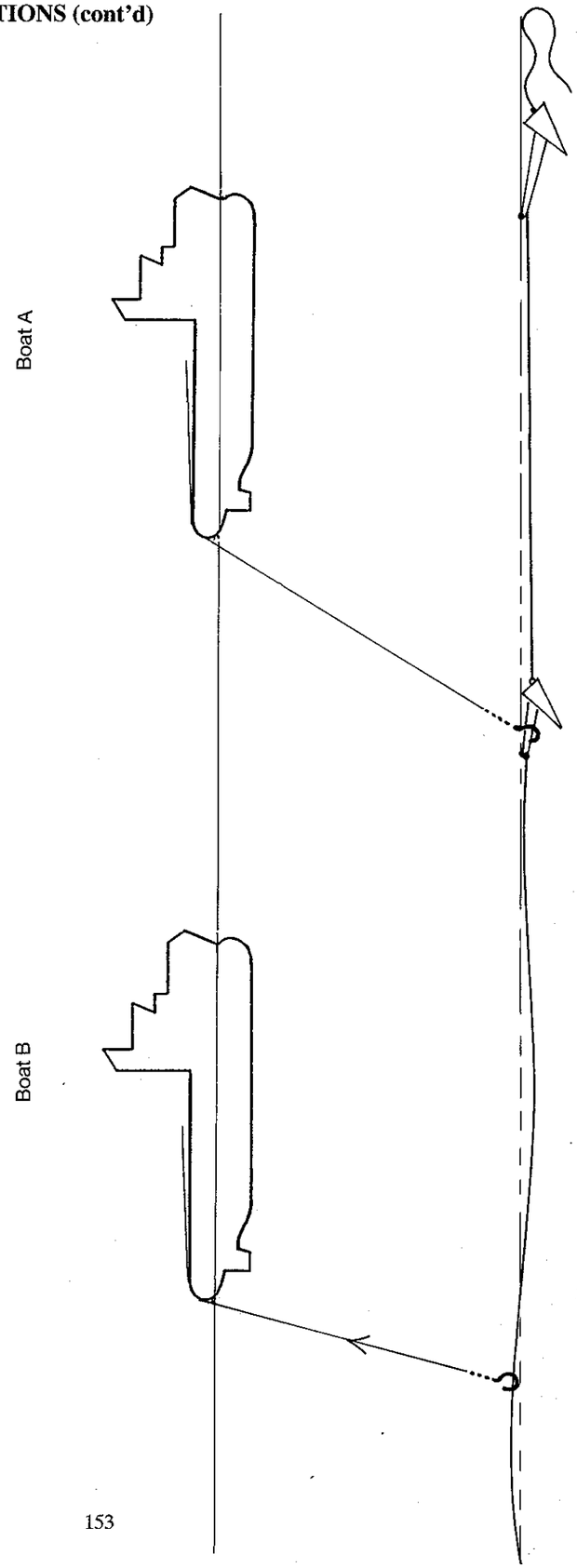


1. Heave up on winch. Take weight of bight.
2. Remove strops to B. Lower jaw on A.
3. Slack out winch. Barge heaves up all slack out of mooring chain.
4. Commence chasing out to anchor as for PCC system.

Diag 68. RETRIEVING PIGGY BACK ANCHORS WITH J-HOOK AFTER LOOSING PENNANT

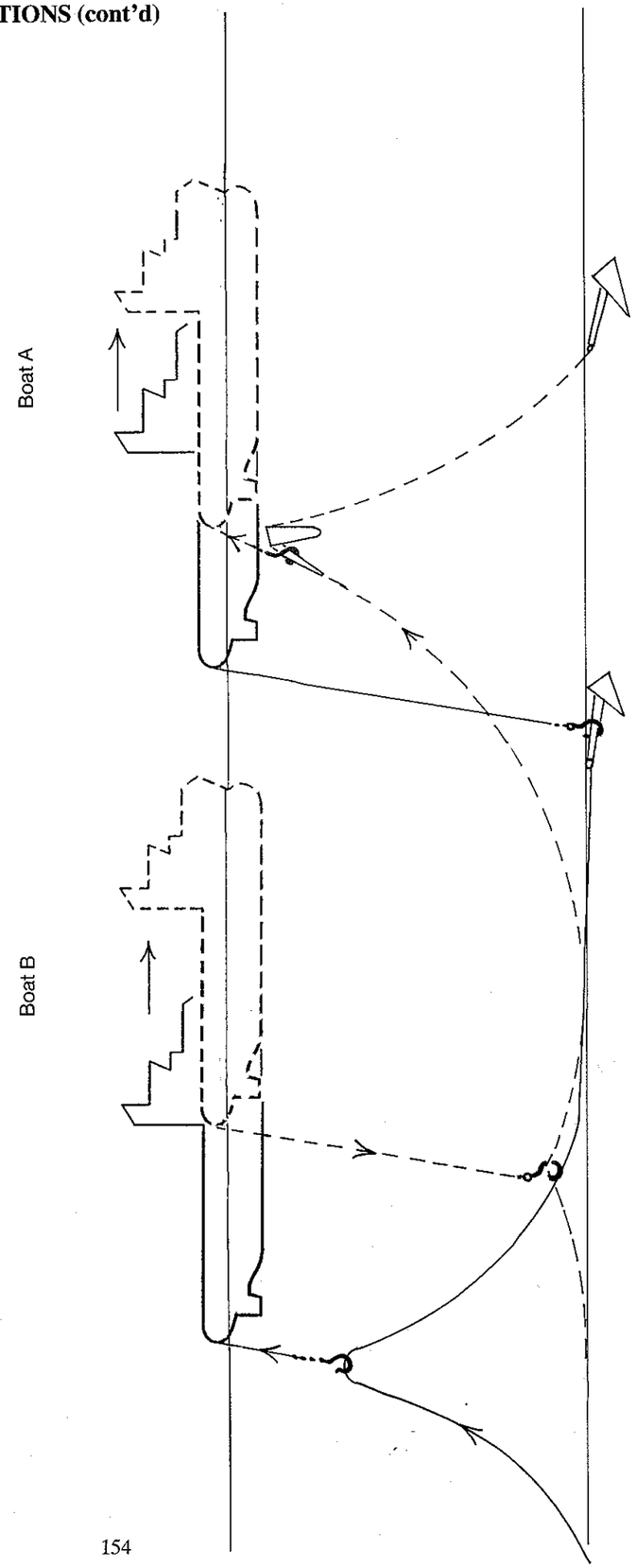
Boat A chases out to main anchor with J-hook — heave too, shorten up on pennant.

Boat B chases out towards main anchor about ½ to ⅔ deployed distance, shortens up pennant and lifts bight off bottom.



Diag 69. RETRIEVING PIGGY BACK ANCHORS WITH J-HOOK AFTER LOOSING PENNANT

1. Barge slacks off chain as much as possible. Boat B heaves up on work wire, pulls bight towards roller.
2. When barge has slacked as much as possible Boat B slacks back bight to bottom, keep chaser on chain. Boat A commences heaving to break out and retrieve primary anchor. Very heavy strains are experienced during this operation.

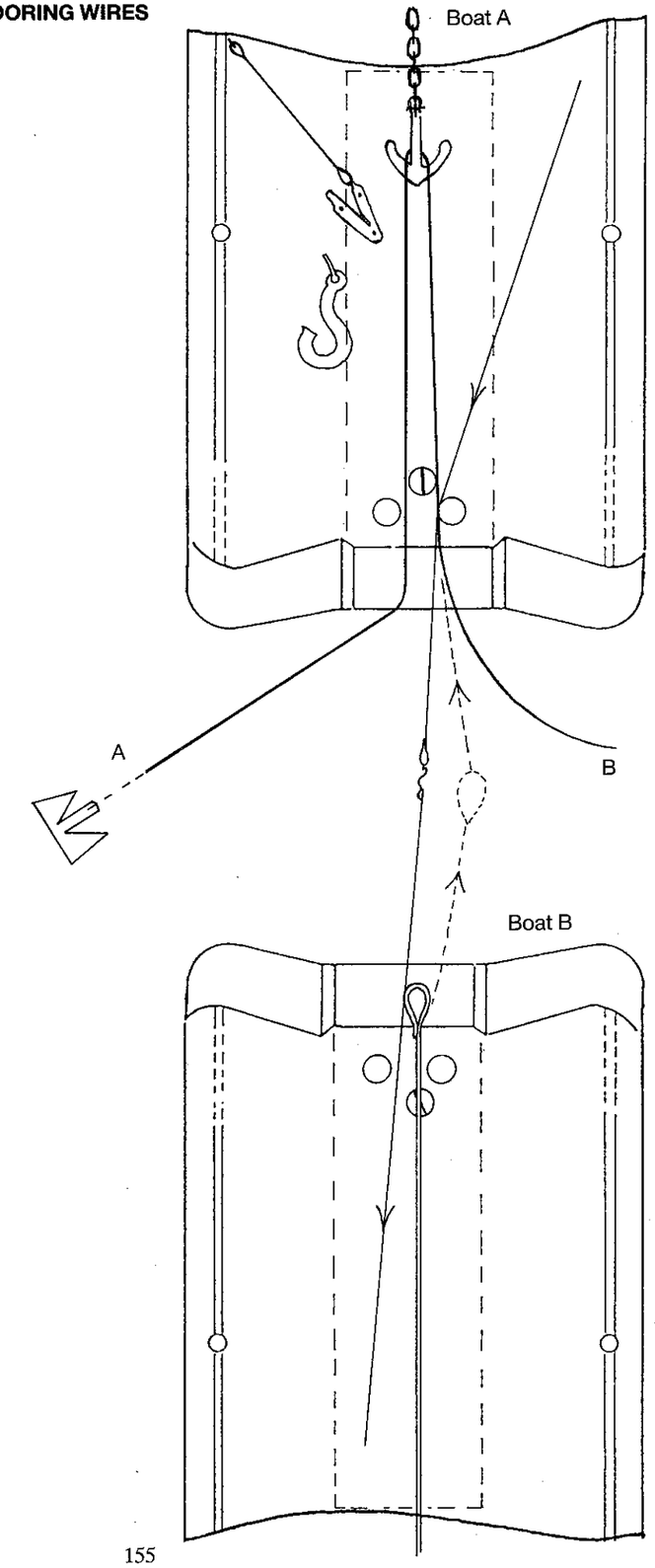


Diag 70. GRAPPLING/RECOVERY OF MOORING WIRES

Problem
A barge has dropped a complete mooring wire — say 9000 feet of 3 inch diameter wire with a 20 tonne anchor. Recover both anchor and wire.
Two boats available.

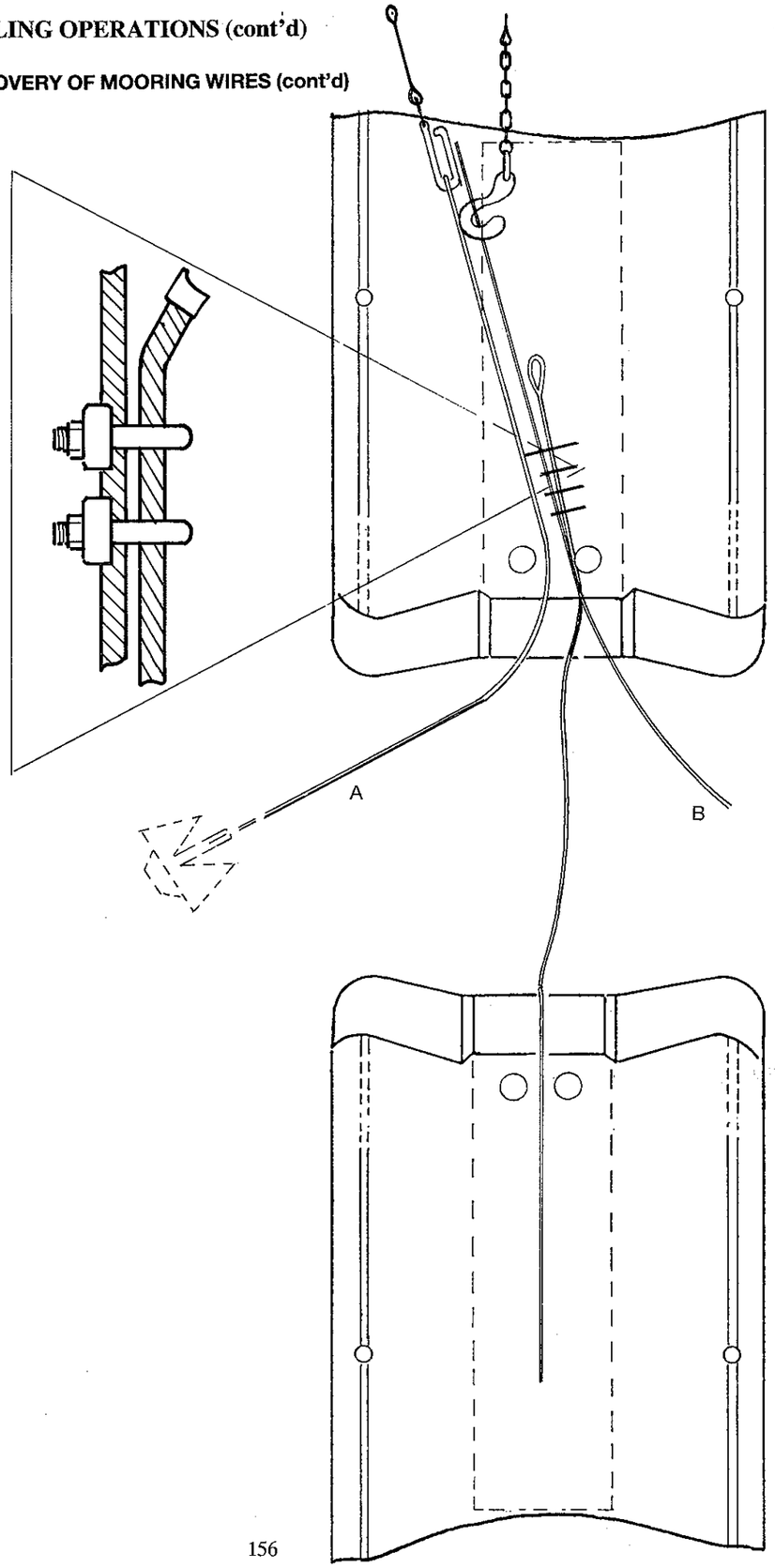
Sequence
1. Rig up both boats with chasing strings about 2½ x water depth long.
2. Boat A rigs up 4 prong grapnel and grapples a bight of wire about ½ to ⅓ distance from either end.
3. With bight on deck, secure it with pelican hook and dead pennant.
4. Boat B backs up towards A and with heaving line takes a tugger wire from A and sends across her work wire.
5. Boat A should have her J-chaser ready.

Note:
Pre-planning at the initial grappling operation will ensure that as the bight is brought on board it will be obvious which Part (A) belongs to anchor end and which Part (B) belongs to free end.



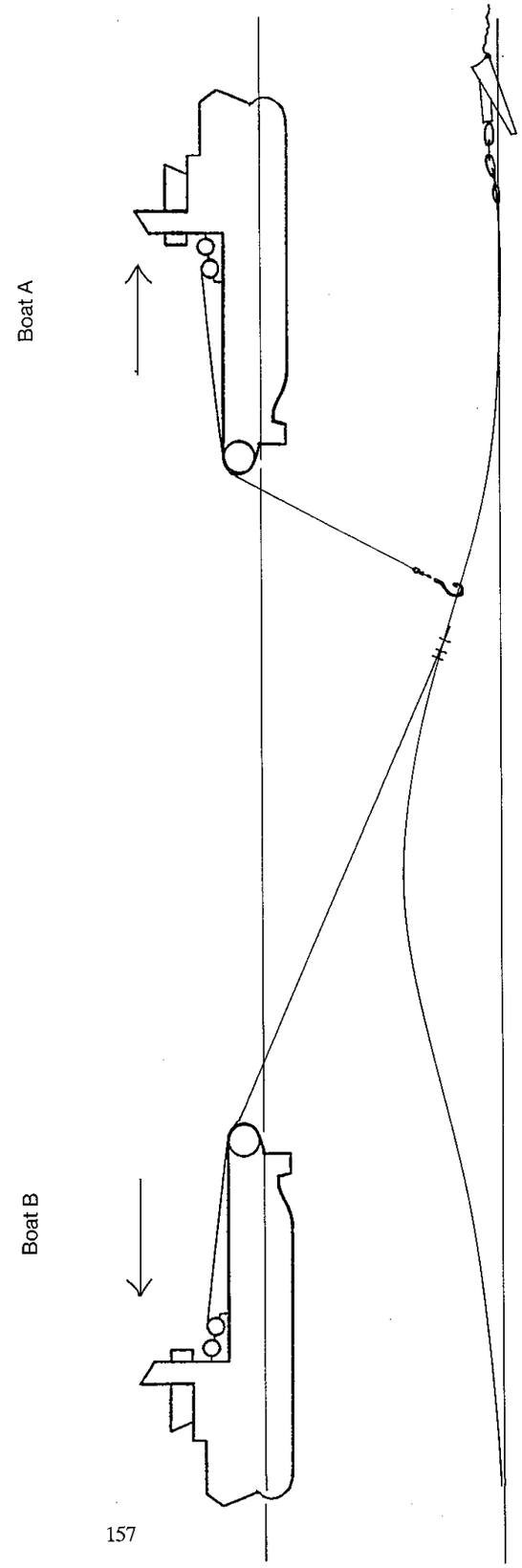
Diag 71. GRAPPLING/RECOVERY OF MOORING WIRES (cont'd)

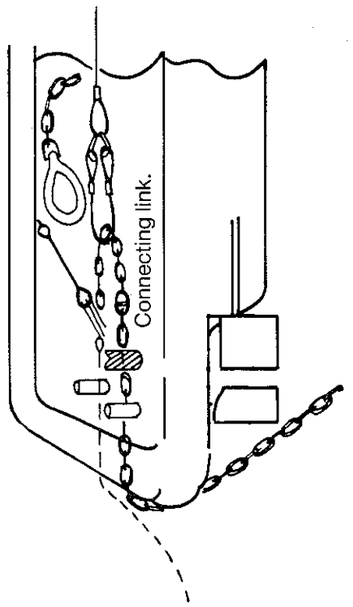
6. Boat A secures bight of swept wire with pelican hook.
7. Boat A clamps the work wire of B to the bight off wire towards the free end. Use 5/6 clamps.
8. Boat A unrigs the grapple and inserts the J-chaser in the bight.
9. Take weight of bight on J-hook and remove pelican hook.
10. Stream the bight and J-chaser.



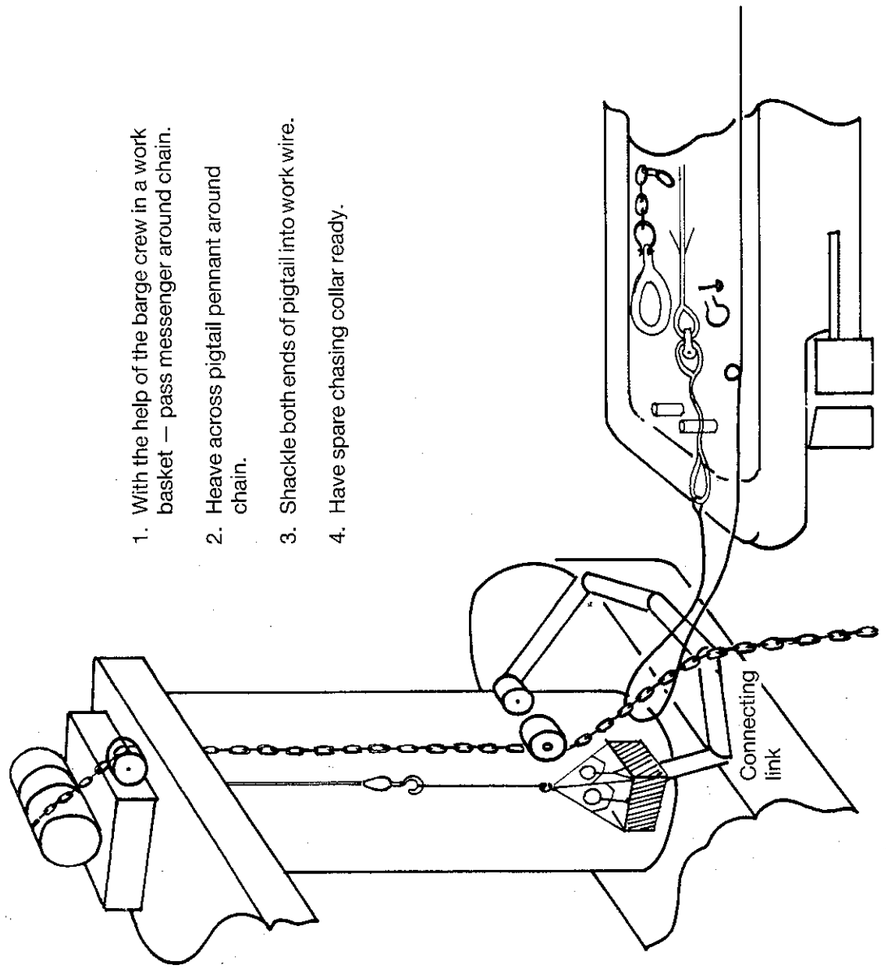
Diag 72. GRAPPLING/RECOVERY OF MOORING WIRES (cont'd)

11. Boat B steams ahead and tensions up on the mooring wire — maintaining 30/50% power.
12. Boat A chases out to the anchor and recovers same.
13. With the anchor on deck, disconnect mooring wire from the anchor.
14. The mooring wire might now be hauled aboard A in bights, a very long process, or buoyed off for recovery by a boat fitted with a large capacity storage reel, or towed to the barge and attached to messenger wire. The barge might then recover the wire with her own winches.





1. With bight of chain on board, jaw off bight to anchor — heaviest.
2. Stop off other bight to barge with several turns of 24mm strop and pigtail to pad eye.
3. Break chain at connecting links.
4. Feed chain through chase ring. Reconnect chain.



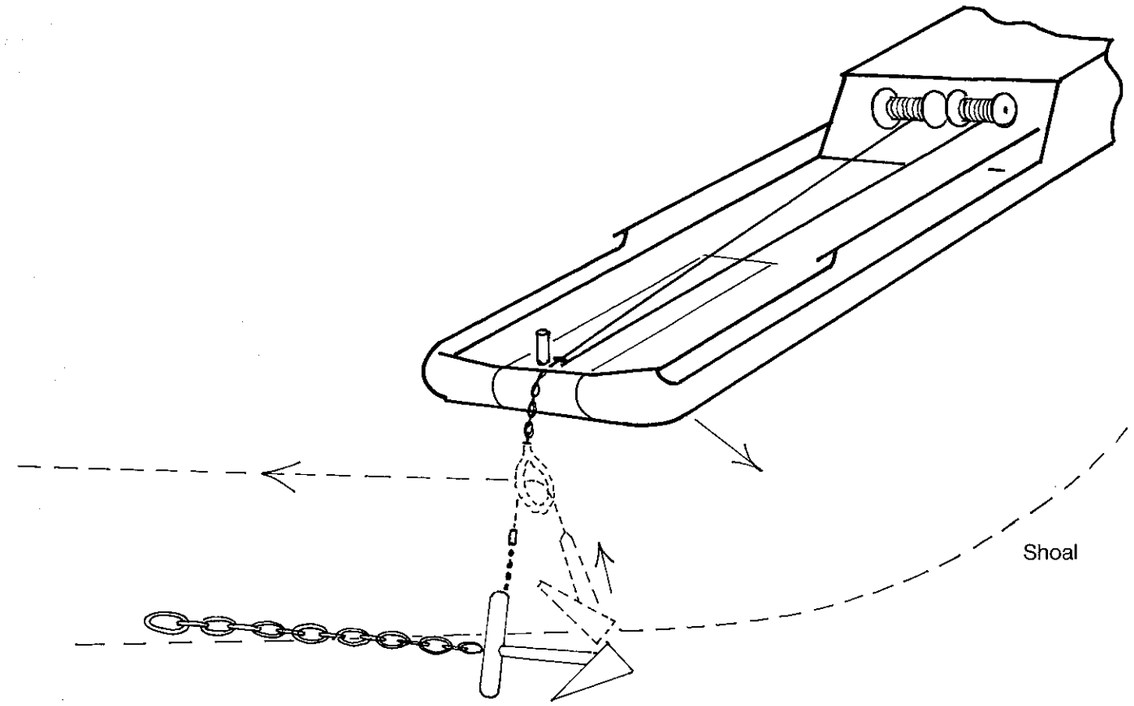
1. With the help of the barge crew in a work basket — pass messenger around chain.
2. Heave across pigtail pennant around chain.
3. Shackle both ends of pigtail into work wire.
4. Have spare chasing collar ready.

Diag 73. RE-RIGGING A HORSE COLLAR CHASER

Diag 74. SHALLOW WATER ANCHOR RECOVERY

In the example the barge's anchor has been placed with shoal ground close to it. The anchor handling tug cannot deploy enough wire to chase past the anchor position.

This is a common problem when barge anchors are layed in shallow water (20/30 metres) without buoys and crown pennants.



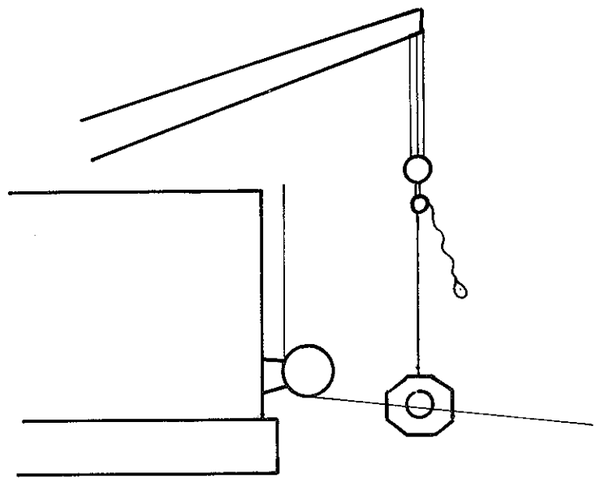
Note:
Work winches are shown spooled 'underhand'. This is NOT the usual method. In almost every case wire is spooled up 'overhand' i.e. leading off the top of the drum.

To recover the anchor

1. Chase out to anchor getting as close as possible.
2. Slack off on the chain. Boat hauls up bight of chain until chaser is below roller. Double secure the chaser with another work wire.
3. Barge tensions up hard on the chain and uses the chasing ring like a lead block to break the anchor out vertically.
4. The boat thrusts sideways to keep over the anchor.

Diag 75. FISHING FOR ANCHORS USING A CHASING BLOCK

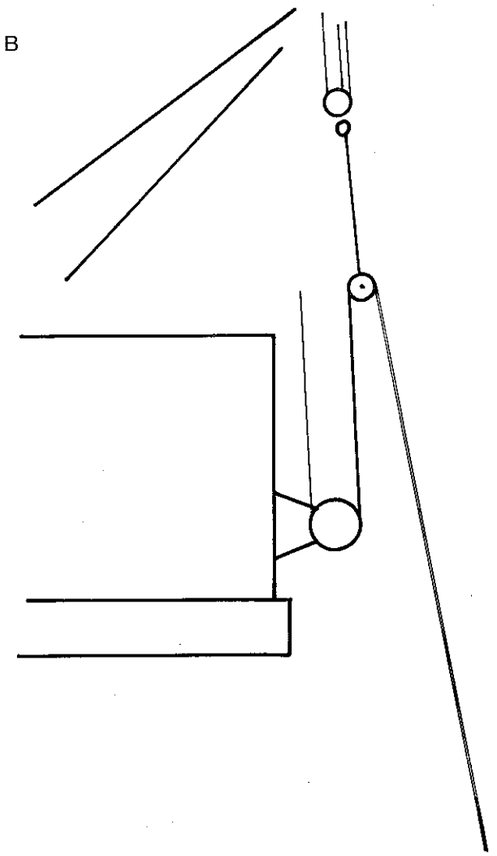
A



After a pennant is lost or broken the usual method of retrieving the anchor to re-rig it, is by use of a chasing block which is similar to a large snatch block.

First the block on a short heavy pennant is swung by crane into a position where it contacts the mooring wire concerned. The side latch is left open and the block hooked into the wire.

B

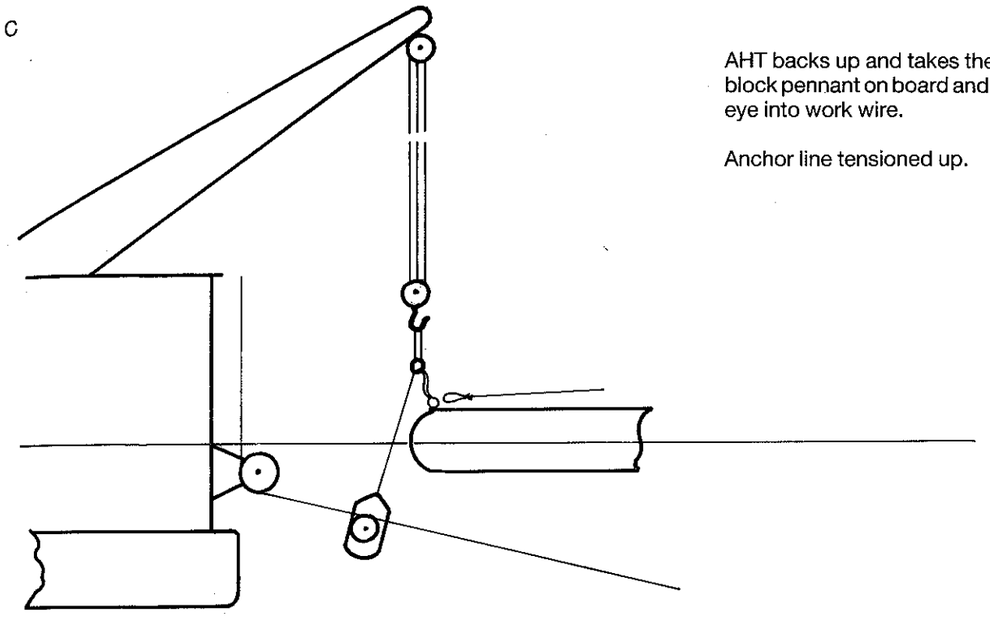


When the mooring wire is seated in the block the crane picks it up and the winch is slacked off. The block picked up to deck level and swung in board so that the **sidelatch** can be closed and secured.

The block is now attached to the wire.

Diag 76. FISHING FOR ANCHORS USING A CHASING BLOCK (cont'd)

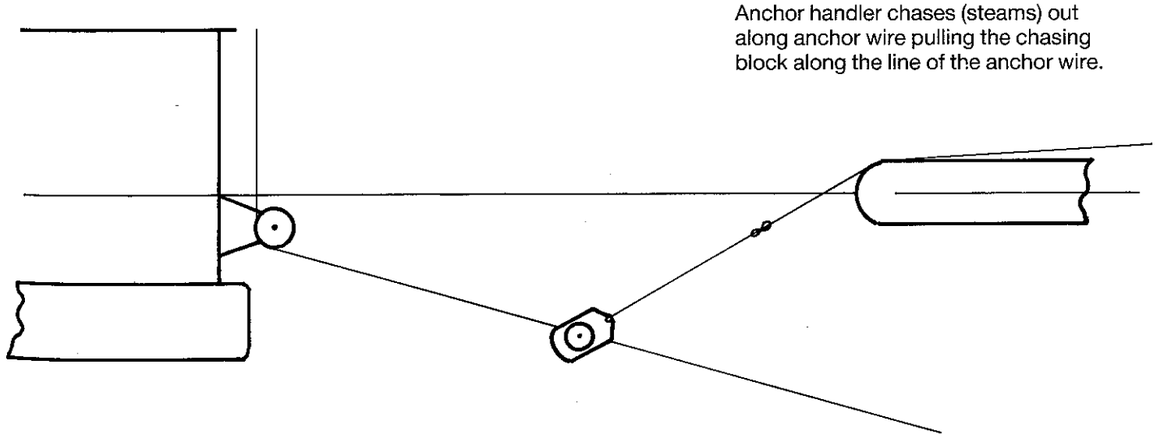
C



AHT backs up and takes the chasing block pennant on board and secures its eye into work wire.

Anchor line tensioned up.

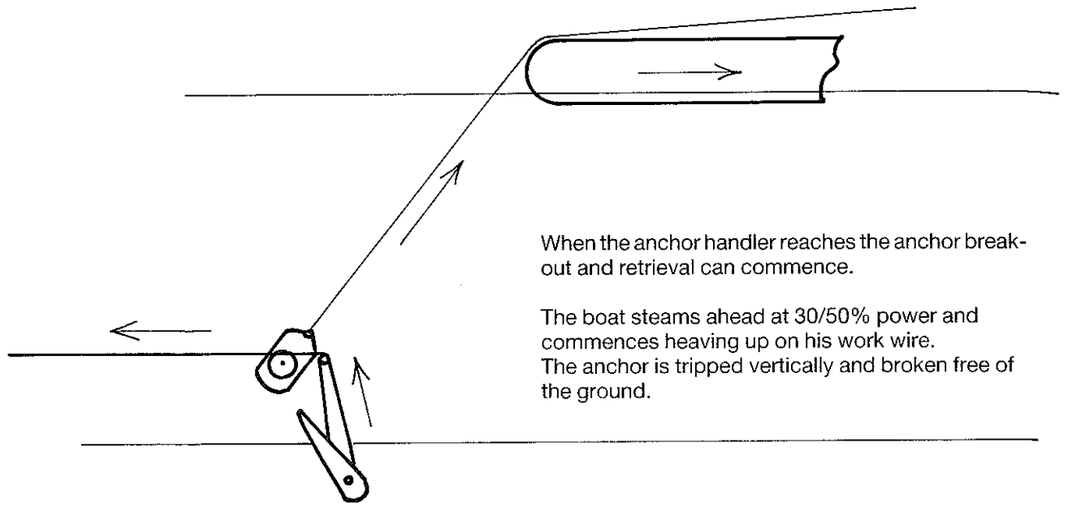
D



Anchor handler chases (steams) out along anchor wire pulling the chasing block along the line of the anchor wire.

Diag 77. FISHING FOR ANCHORS USING A CHASING BLOCK (cont'd)

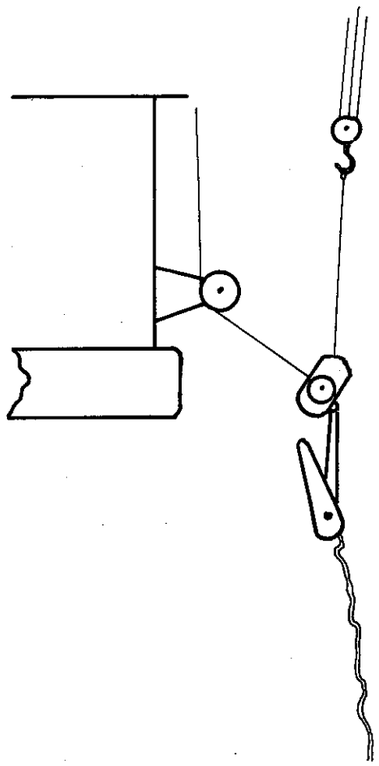
E



When the anchor handler reaches the anchor break-out and retrieval can commence.

The boat steams ahead at 30/50% power and commences heaving up on his work wire.
The anchor is tripped vertically and broken free of the ground.

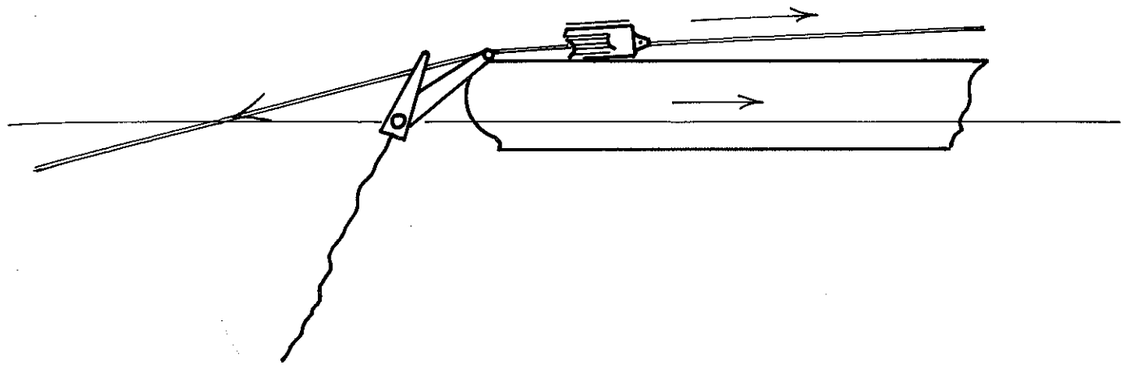
F



Sometimes the boat will not deck the anchor but after "break out" it will be hauled back to the barge by means of the barge's mooring winch.

Once alongside the boat passes the chasing block pennant to the barge crane which hauls the anchor clear of the sea, the pulling force of the crane and winch balancing one another to keep the anchor suspended. The boat then backs under the anchor and catches the pennant and strips it out to re-rig it.

Diag 78. FISHING FOR ANCHORS USING A CHASING BLOCK (cont'd)

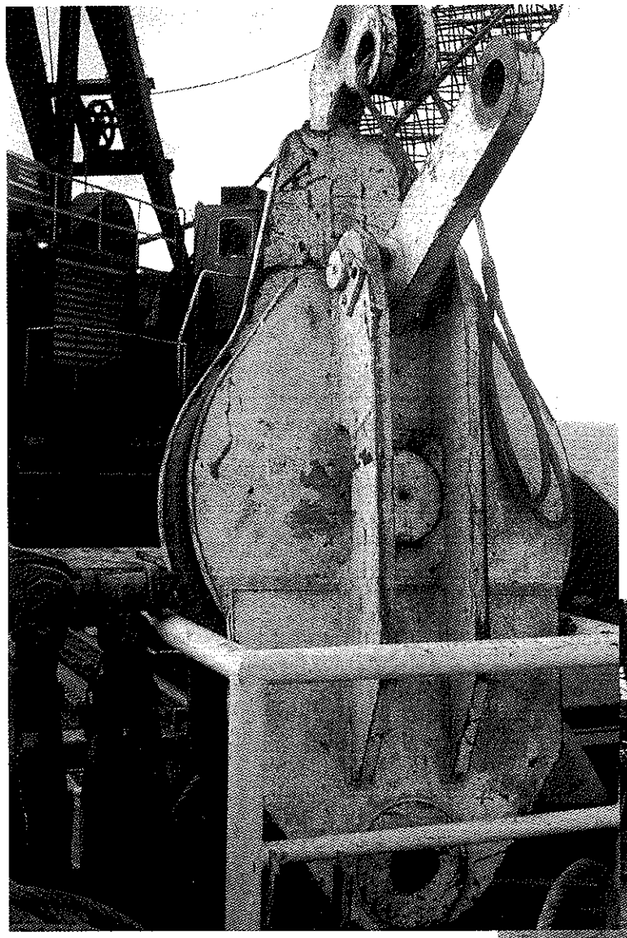


The anchor may be hauled aboard the boat by using the combination of boat engines working ahead, hauling on the work wire/stripping block and holding back on the barge mooring line.

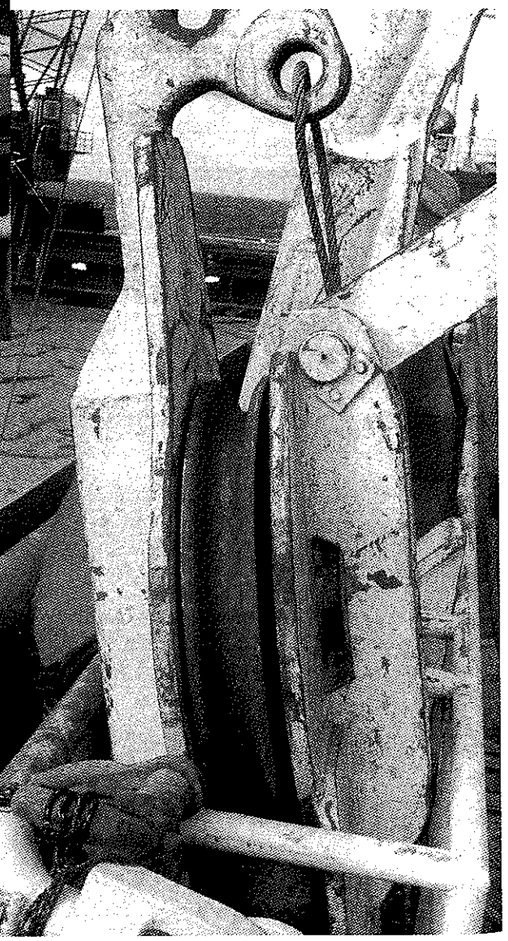
To accomplish this it is best to get the **stripping block onto the boats deck first.** This can be done by letting the anchor slip below the boat.

This allows the stripping block to act as a lead sheave. The boat winch, boat propellors and barge winch now work together pulling slowly against each other to bring the anchor first to the roller of the boat, then, provided its orientation is correct (i.e. flukes swung) outboard of the stern roller, it is pulled aboard, secured and then retrieval, re-rigging of the lost pennant can take place.

J-hook chasers can be used for this operation and with some very heavy types of anchors this works better, as the J-hook can be pulled onto the anchor stock which makes break-out from the ground easier.

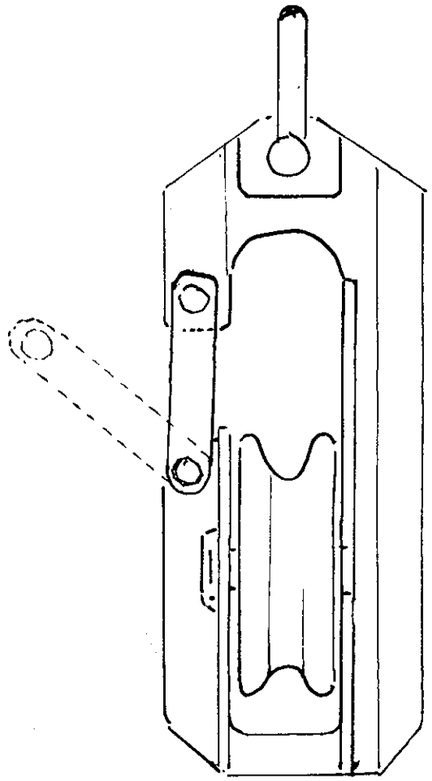


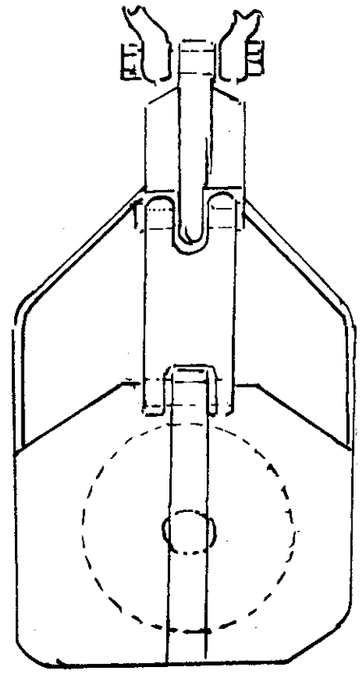
Wire mooring chasing block. The "latch" is open — when the block is fitted on to the mooring line the latch is closed.



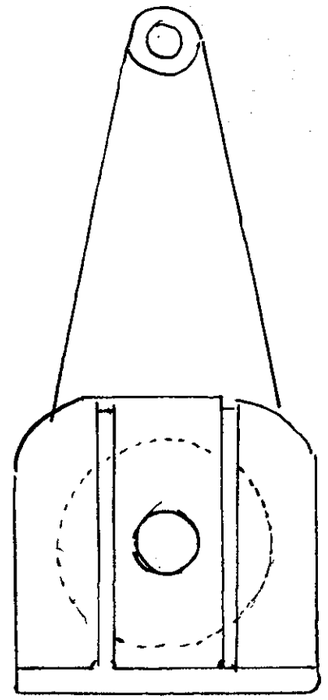
Wire mooring chasing block This view shows the sheave suitable for 76mm diameter wire.

Diag 79. GRAPPLING AND CHASING BLOCKS





Chasing block for wire rope moorings 100 tonnes SWL

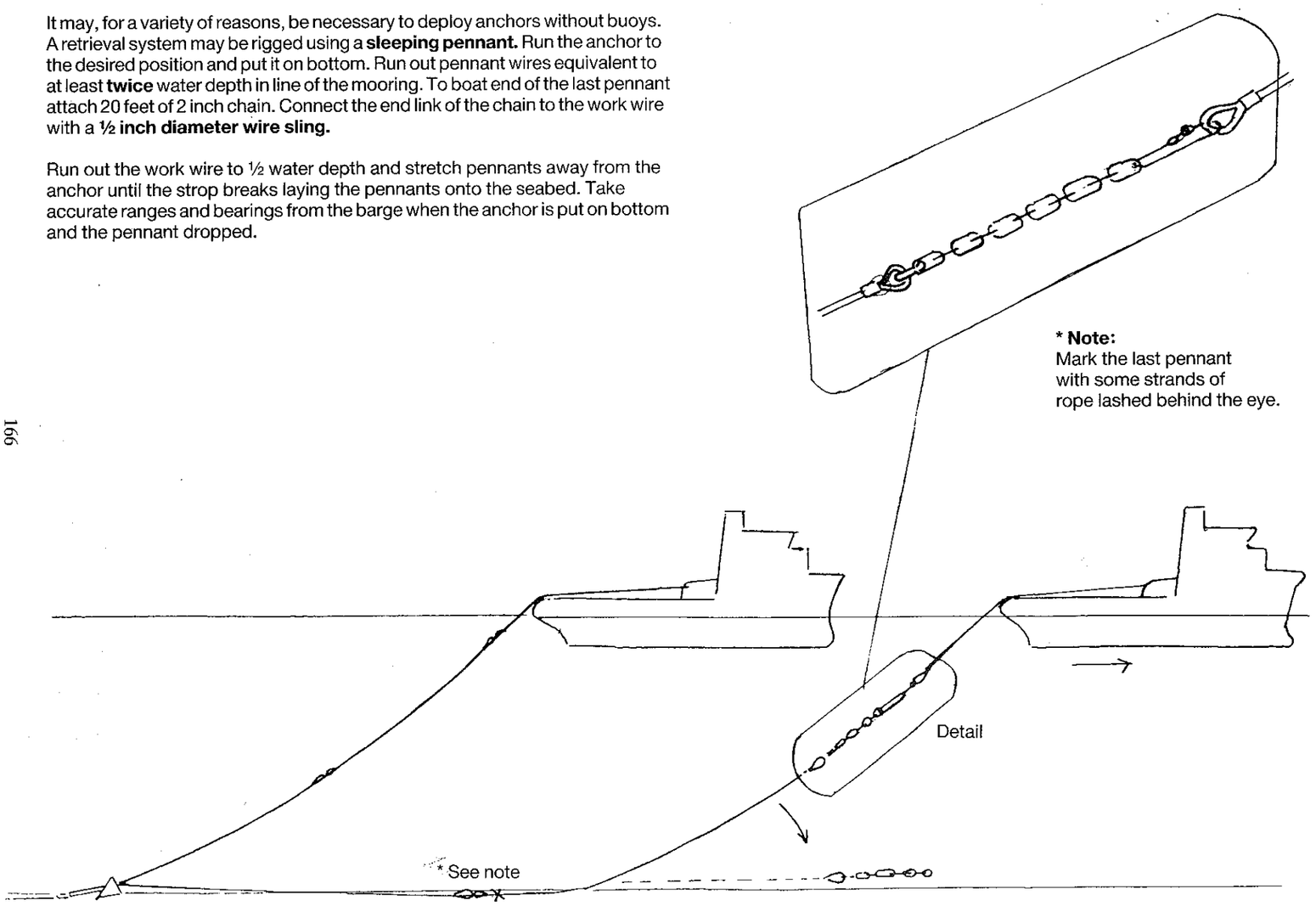


Grappling block for catching pennants and mooring wires

Diag 80. RUNNING SLEEPING PENNANTS

It may, for a variety of reasons, be necessary to deploy anchors without buoys. A retrieval system may be rigged using a **sleeping pennant.** Run the anchor to the desired position and put it on bottom. Run out pennant wires equivalent to at least **twice** water depth in line of the mooring. To boat end of the last pennant attach 20 feet of 2 inch chain. Connect the end link of the chain to the work wire with a **½ inch diameter wire sling.**

Run out the work wire to ½ water depth and stretch pennants away from the anchor until the strop breaks laying the pennants onto the seabed. Take accurate ranges and bearings from the barge when the anchor is put on bottom and the pennant dropped.

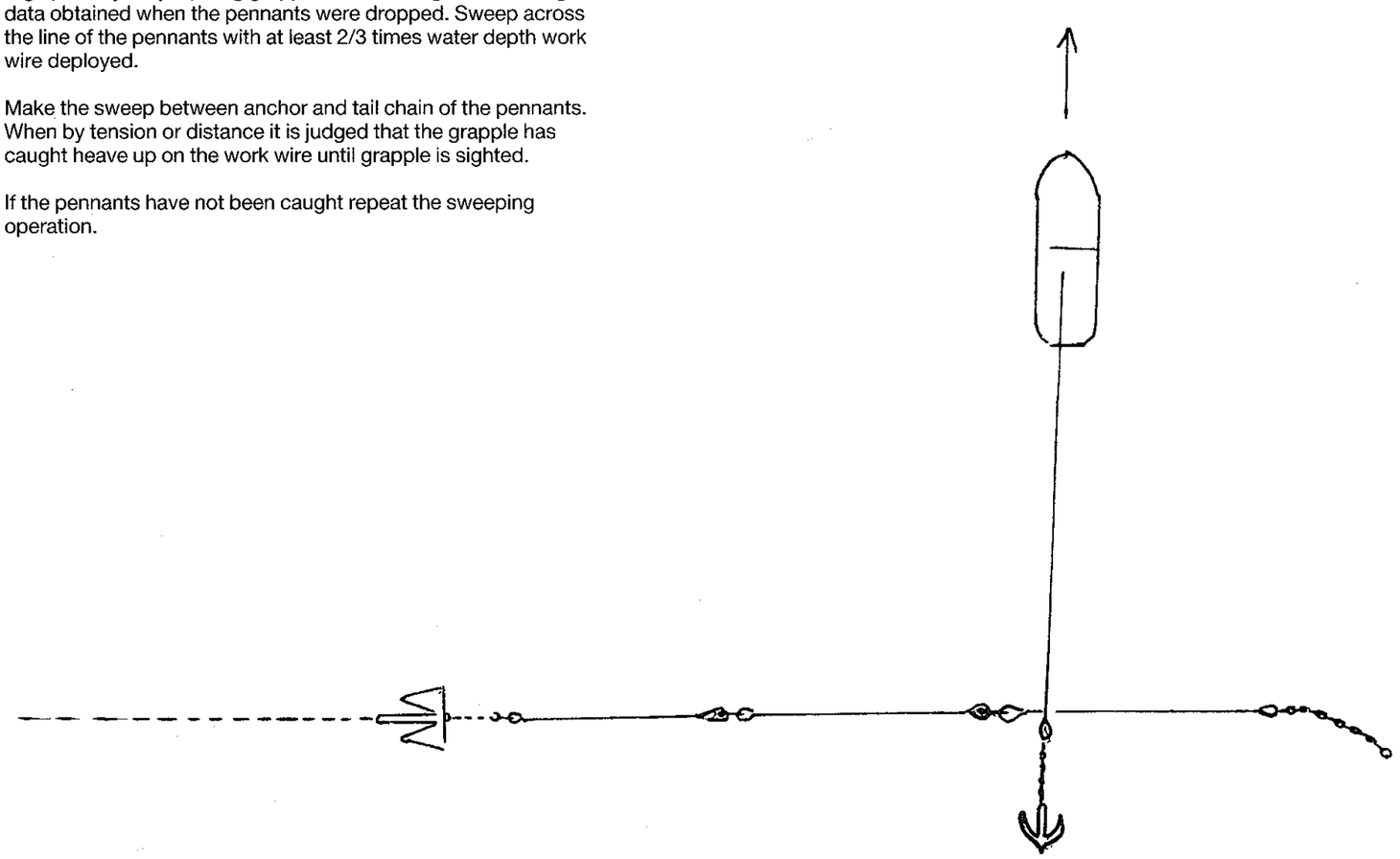


***Diag 81.* RETRIEVING SLEEPING PENNANTS**

Rig up heavy duty 3 prong grapple with the range and bearing data obtained when the pennants were dropped. Sweep across the line of the pennants with at least 2/3 times water depth work wire deployed.

Make the sweep between anchor and tail chain of the pennants. When by tension or distance it is judged that the grapple has caught heave up on the work wire until grapple is sighted.

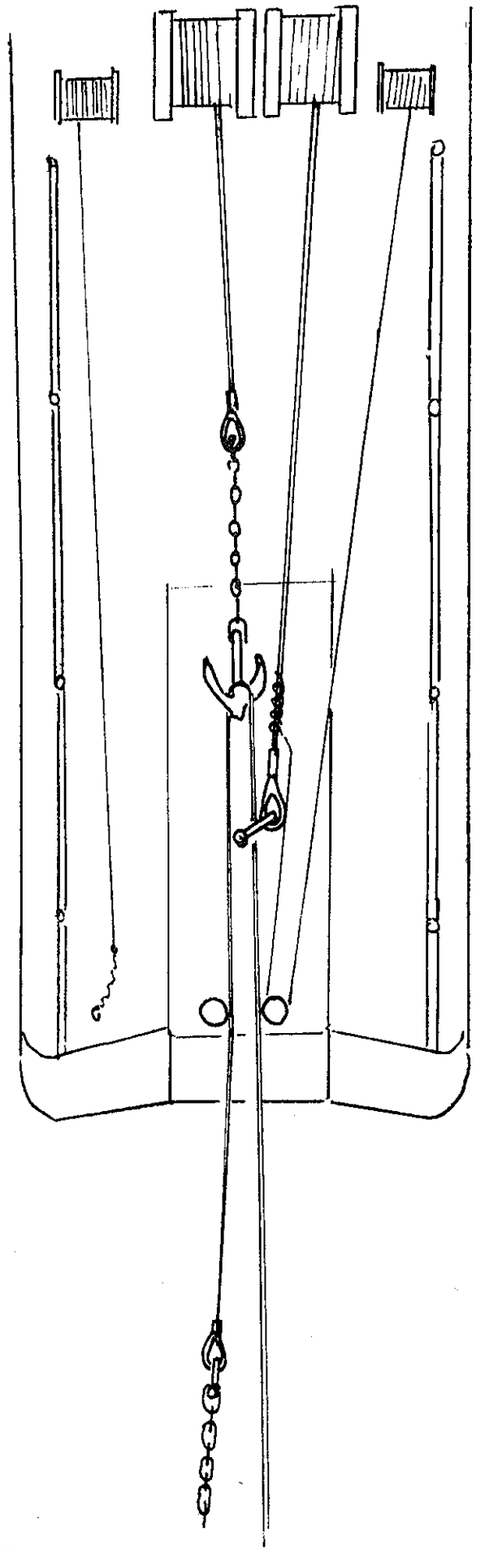
If the pennants have not been caught repeat the sweeping operation.



Diag 82. RETRIEVING SLEEPING PENNANTS (cont'd)

With the grapple on deck and hove up to the mid deck area, run the second work wire down and rig a running shackle on the bight as shown. Use the starboard tugger to hold the work wire in position. Steam slowly ahead, pulling the bight of pennant wire through the grapple and running shackle until pennant wire eye has been decked and can be positioned to **jaw off.**

Note:
The running shackle is a safety precaution to ensure that the pennants are not lost if they begin to **run** through the grapple.



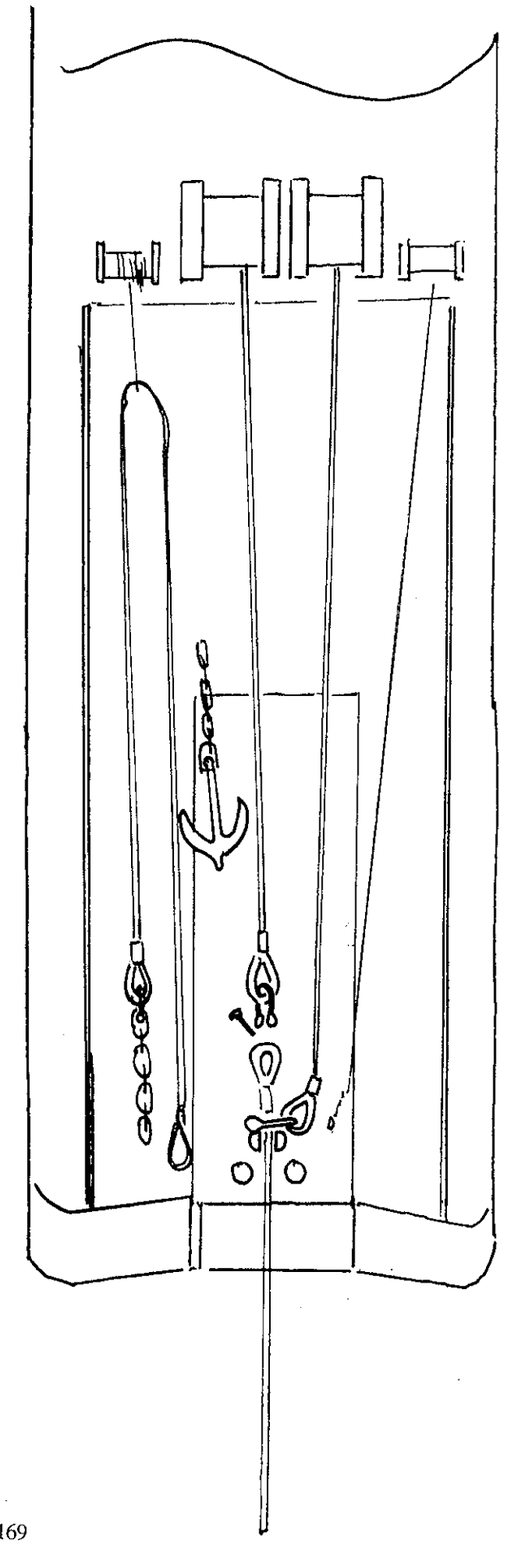
Diag 83. RETRIEVING SLEEPING PENNANTS (cont'd)

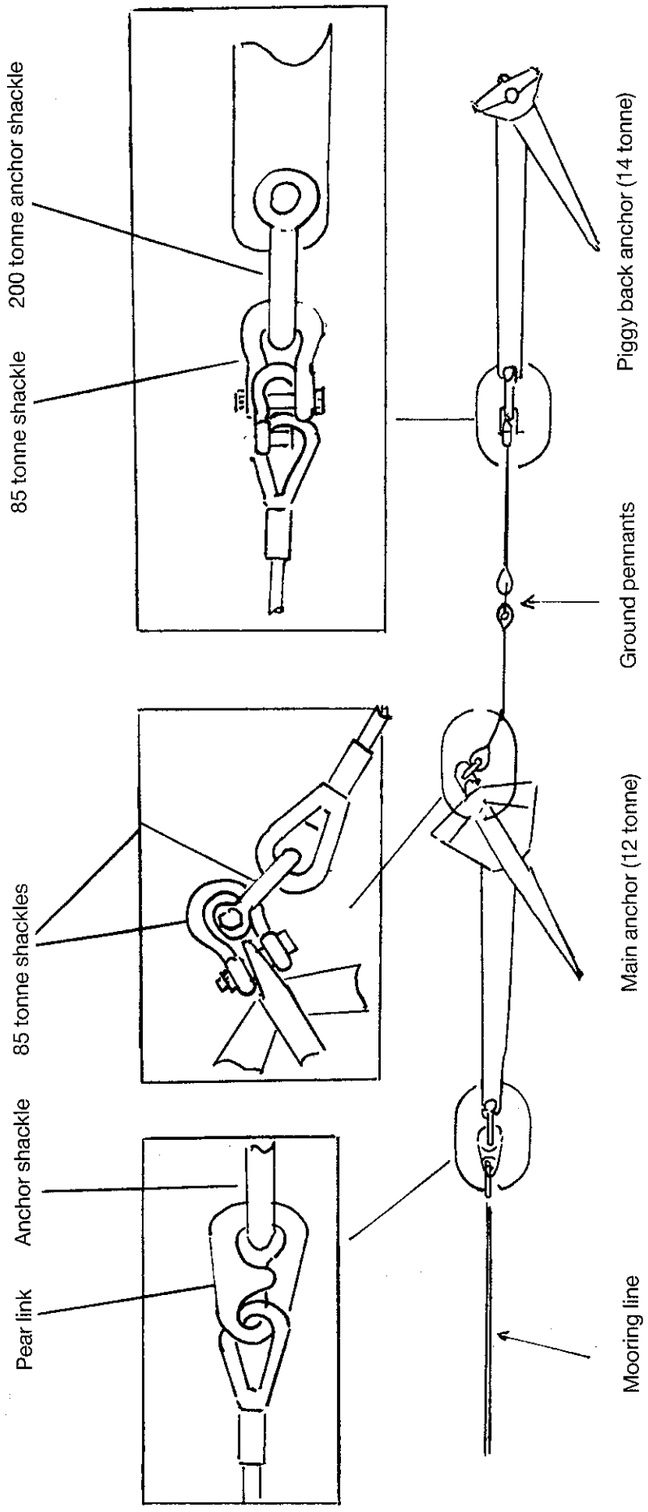
Jaw off the pennant leading to the anchor.

Clear the grapple and pennant using tuggers.

Shackle port work wire into the anchor pennants. Take up the weight and clear the starboard work wire.

Clear up the deck and commence retrieving the anchors.





Ground pennants 2¾ inch diameter

Pennant connections 85 tonne bow shackles

Diag 84. PIGGY BACK ANCHORS – DETAILS OF TYPICAL CONNECTIONS

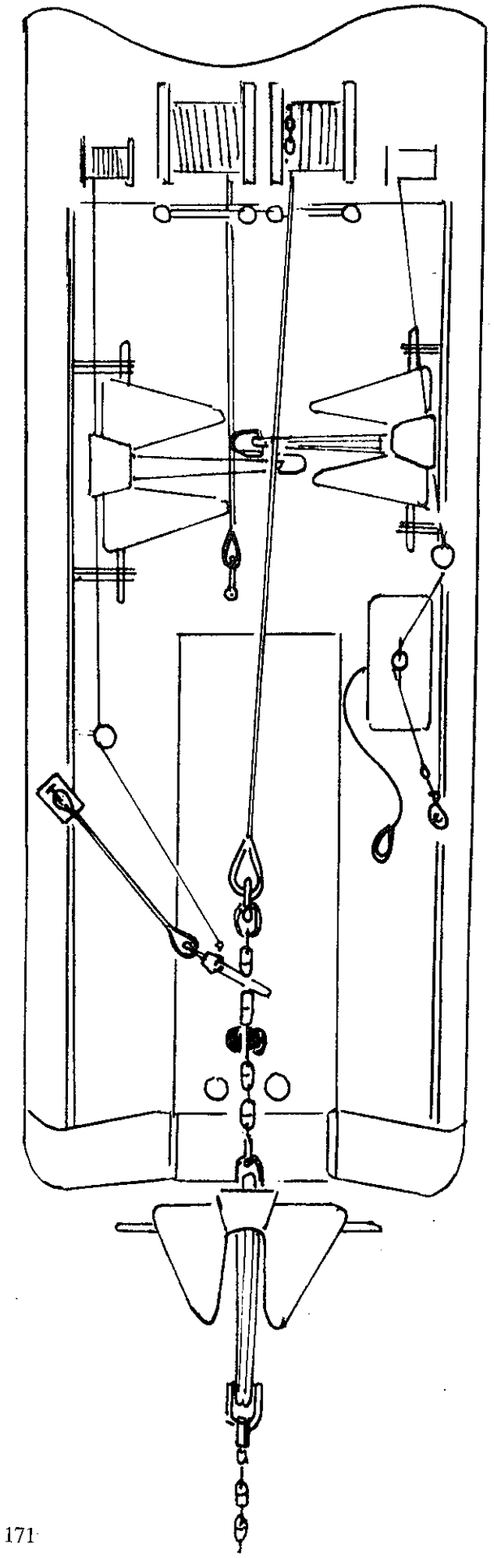
Diag 85. RUNNING ANCHORS BUOYED SYSTEM WITH PIGGY BACK ANCHORS ON DECK

Take buoy on deck from barge and secure with tugger.

Take pennant from barge in normal manner. When secured to work wire heave anchor to roller.

Prior to running secure the anchor by putting its pennant tail chain in the shark jaw or using pelican hook.

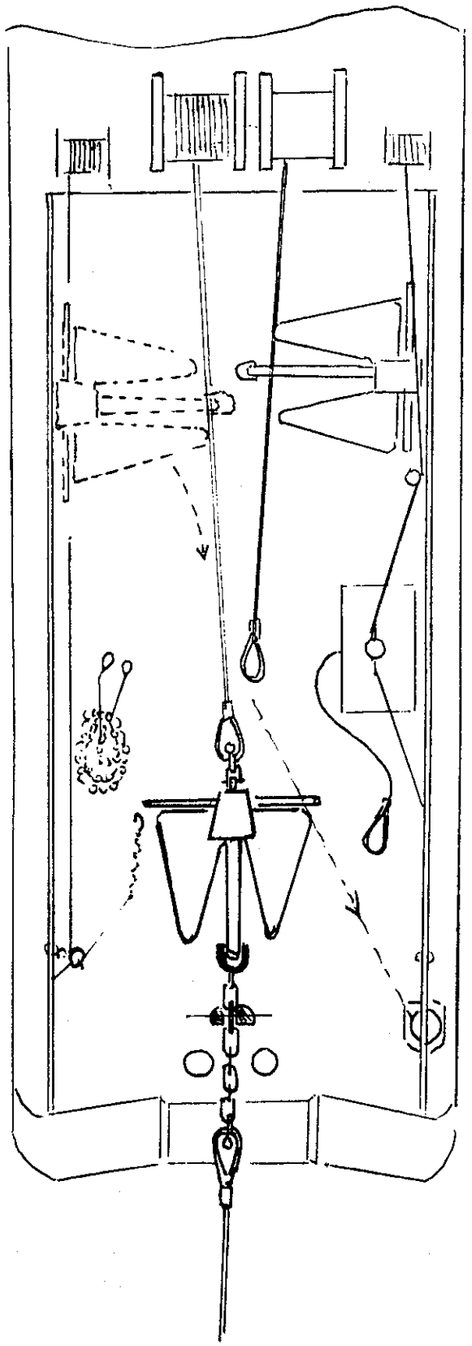
Note:
You should have spooled up the buoy pennants in the correct order on the work drum with shackled connections at one side of the drum to prevent jamming.



Diag 86. PREPARING AND RUNNING PIGGY BACK ANCHOR

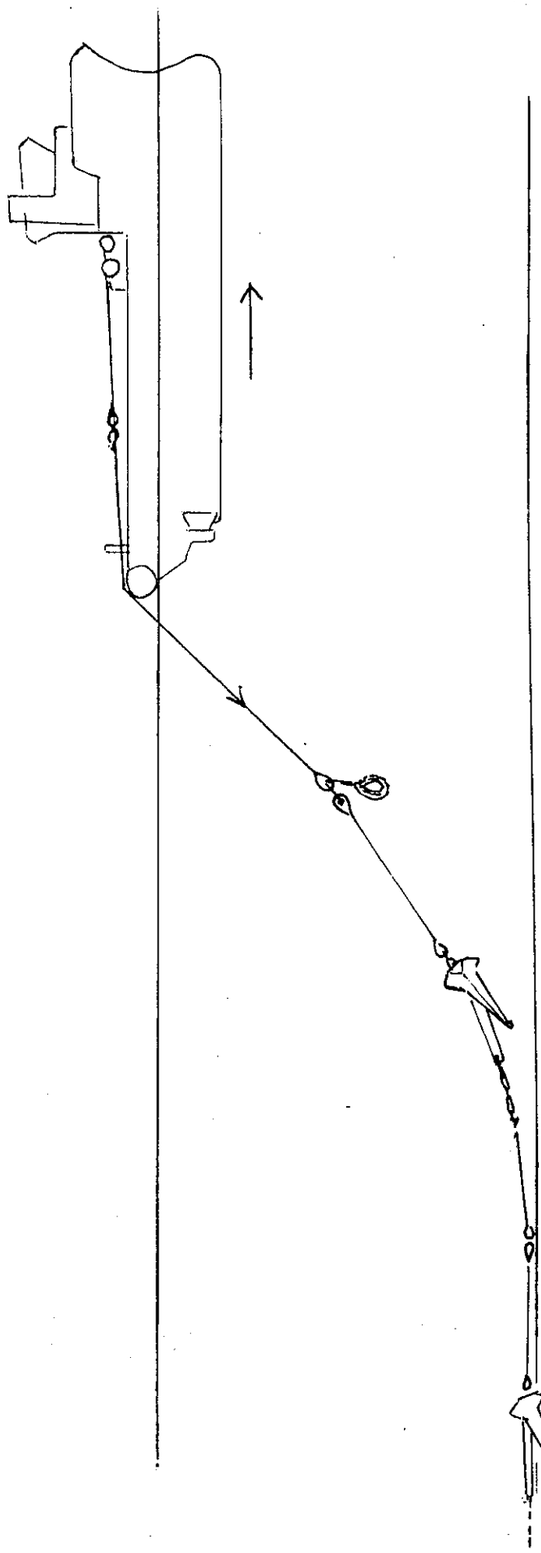
1. Deck prepared for running piggy back. Main anchor on bottom.

2. Attaching piggy back anchor to pennant. Rigging surface pennants to piggy back anchor crown.



Diag 87. PREPARING AND RUNNING PIGGY BACK ANCHOR (cont'd)

3. Running piggy back anchor to bottom.



h. Running anchors over obstructions

Barges of all types are frequently required to deploy their moorings over or across obstructions. These can be on the seafloor or may be another vessel's mooring lines. It is frequently judged possible to maintain sufficient safe clearance by means of line tension alone without the use of support buoys.

To both deploy and retrieve such a mooring line, the use of two boats is by far the safest method. The first boat handles the anchor in the normal way and the second uses a chain chaser, "J" type, to hold the mooring line clear of the obstruction during deployment and retrieval.

The boat handling the anchor will almost always be instructed to "double secure" the anchor during handling (see diagrams of methods).

The boat using the chaser must have a suitable radar for accurate distance measurement and the barge may utilise a "laser range finder" to assist in positioning the chasing boat.

The chasing boat must also keep very careful checks on the amount of work wire deployed so that the distance from the boats stern to the chasing hook and thus the bight of mooring line being supported is known at all times.

Well equipped AHTS with J-hook and piggy back anchors visible.

Diag 88. DOUBLE SECURING ANCHORS

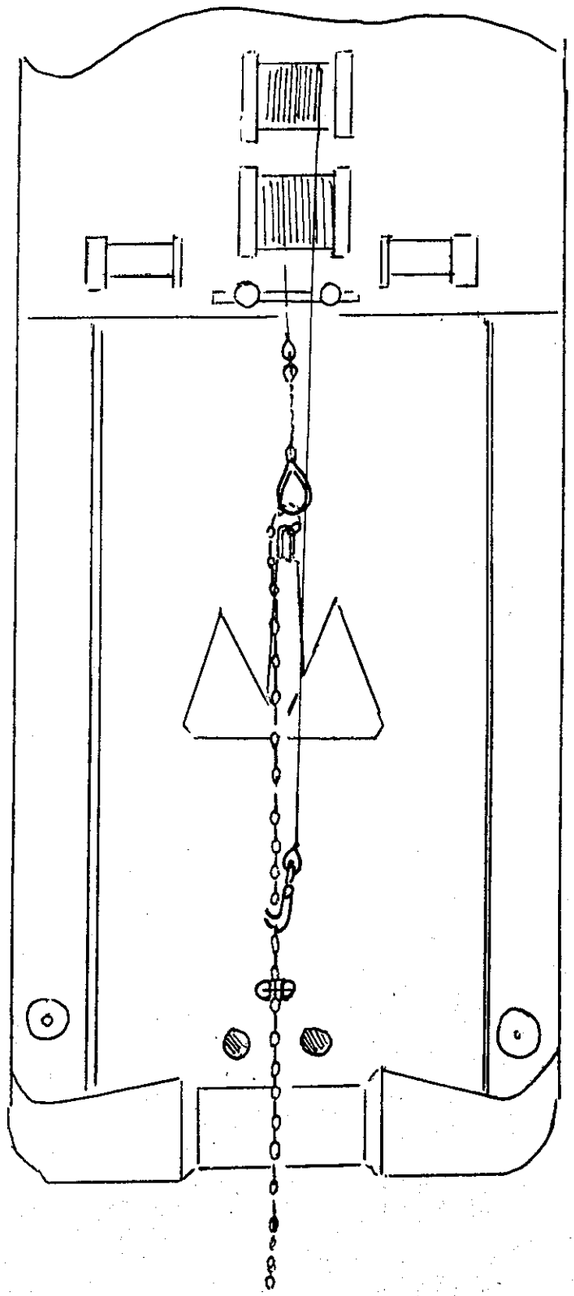
Caution

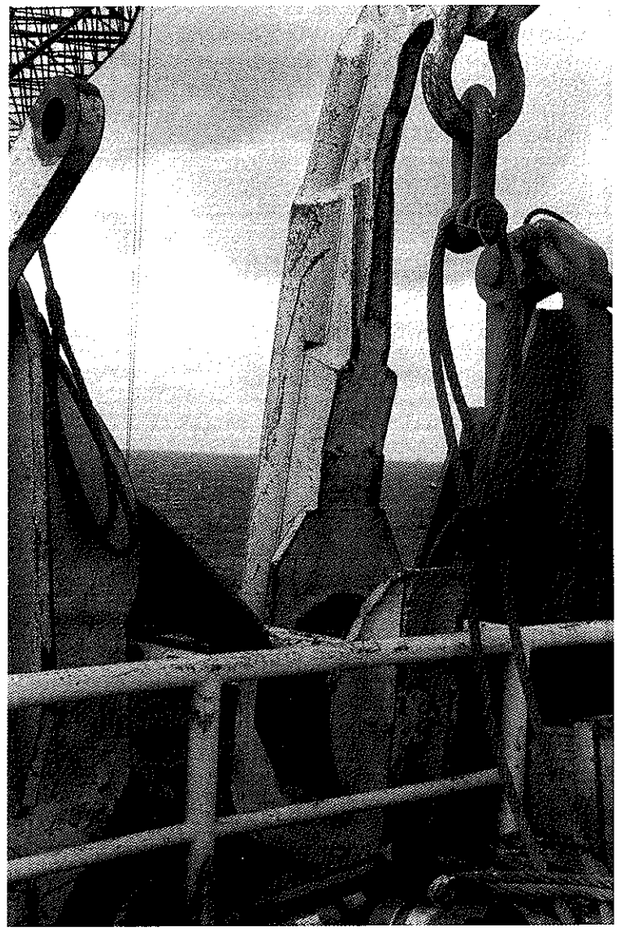
Some types of modern stoppers — notably Ulstein and KARM fork types are not designed (in practice) to take towing forces which may be needed when manoeuvring across pipelines etc.

A method of double securing anchors such as StevPris types without disconnecting them is to use a Devils Claw onto the main anchor chain which is made fast to the tow wire.

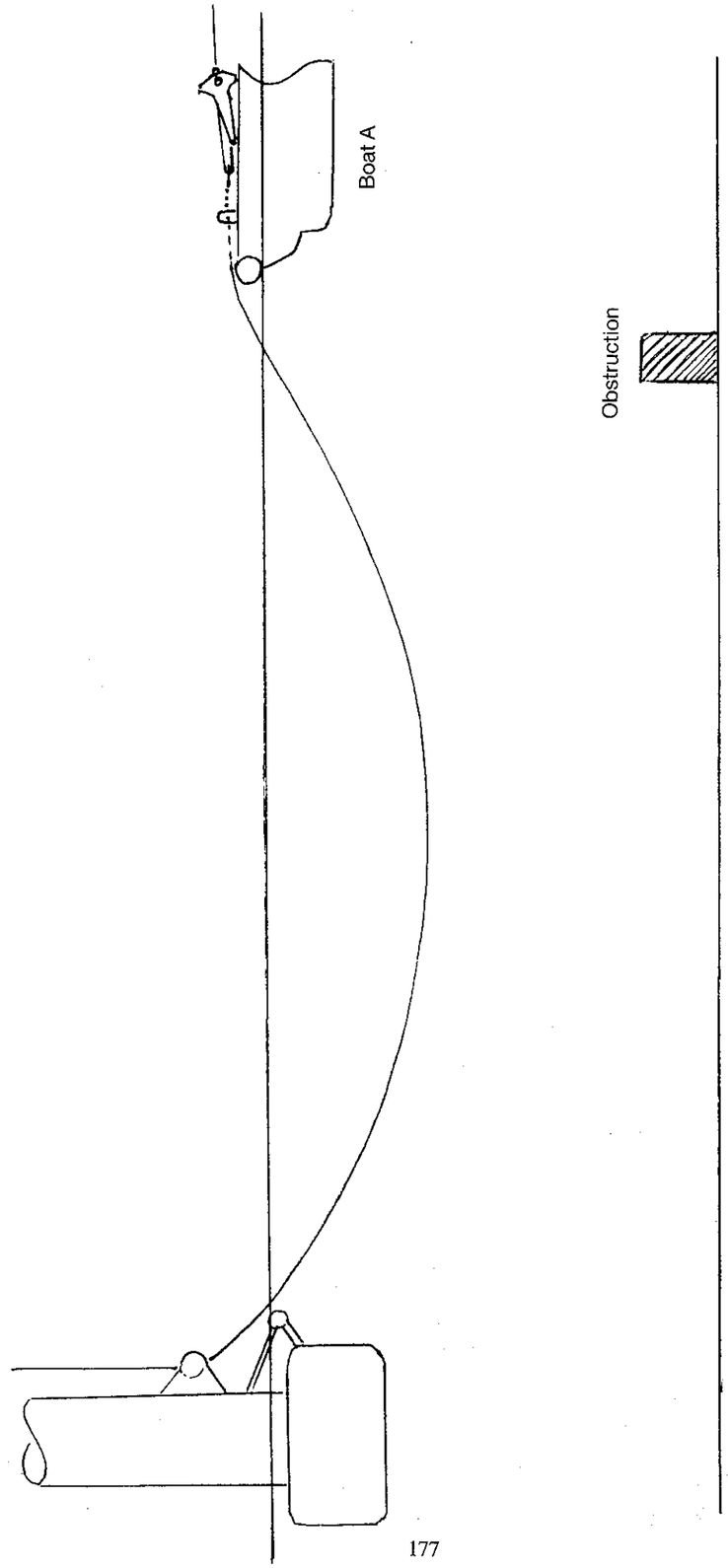
The weight is taken evenly by work wire and tow wire.

The alternative is to disconnect the anchor and attach both tow wire and work wire to a shackle fitted to the end of the chain.





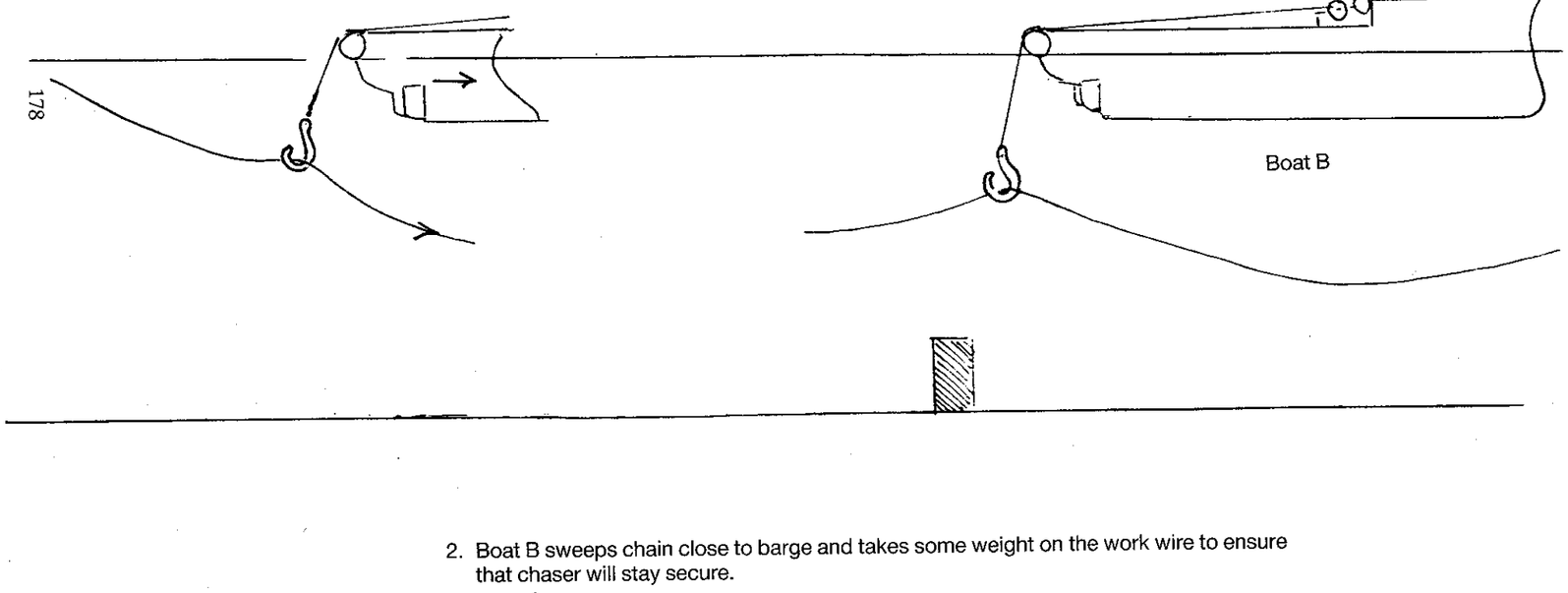
Right and below:
Fishing/support block
This block is used to hold the bight of the mooring line up, clear of an obstruction. It can be engaged or disengaged without difficulty being "open". It may also be used for minor (light weight) fishing jobs such as catching dropped pennants.



Diag 89. RUNNING ANCHORS OVER OBSTRUCTIONS

1. Boat A with anchor secured runs out to a position just past the obstruction. Maintains tension as instructed by barge to hold bight clear.

Diag 90. RUNNING ANCHORS OVER OBSTRUCTIONS

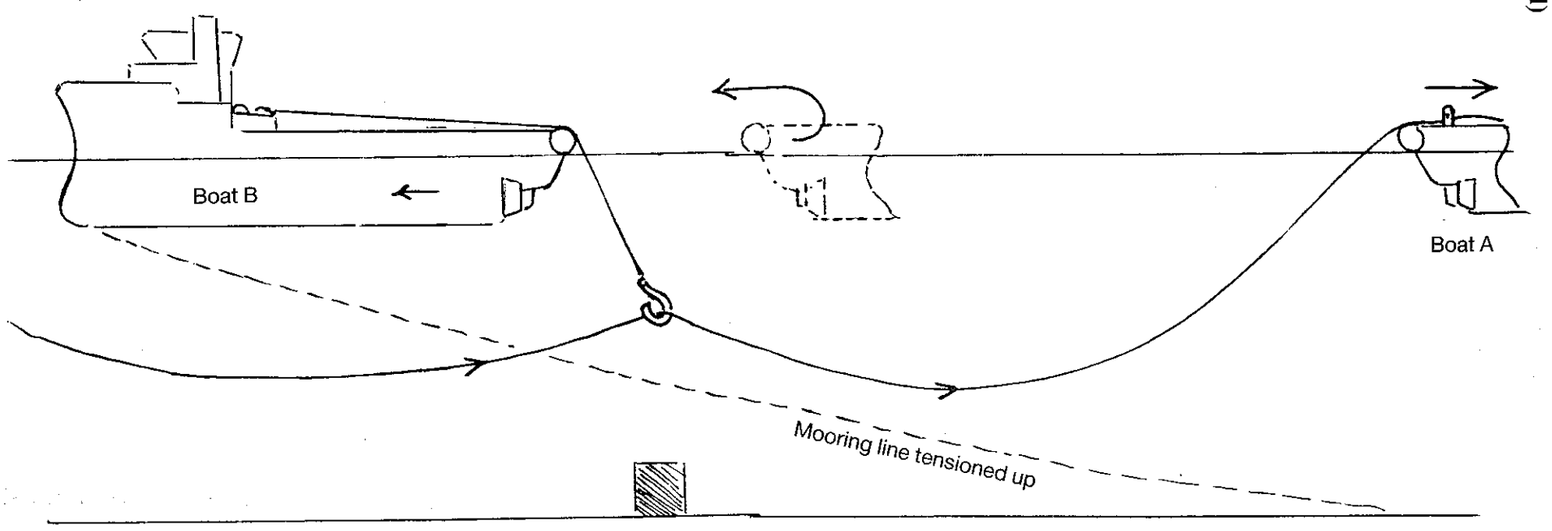


2. Boat B sweeps chain close to barge and takes some weight on the work wire to ensure that chaser will stay secure.

Diag 91. RUNNING ANCHORS OVER OBSTRUCTIONS

3. Barge slacks away, both boats go out together until chasing boat is over the obstruction. Boat B (chaser) turns and maintains position over the obstruction (by radar/laser) while boat A pulls anchor to target.

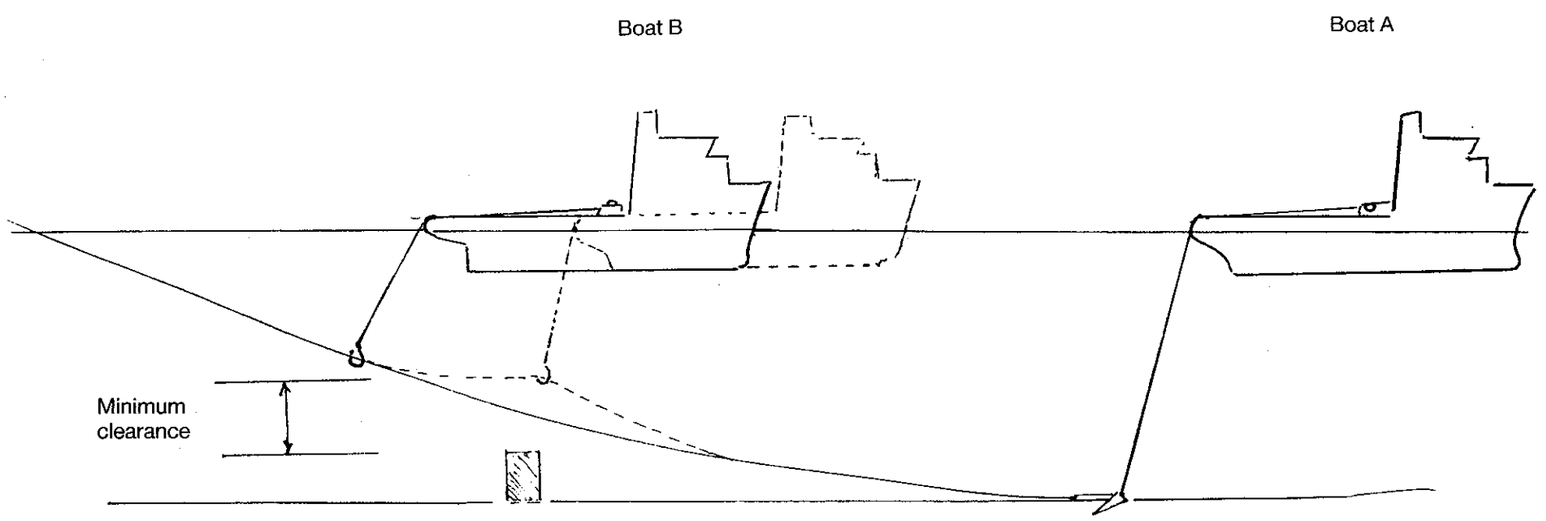
   Boat B drops but does not release chaser until anchor is seated and tensioned so that the mooring line is clear of the obstruction.



Diag 92. RETRIEVING ANCHORS OVER OBSTRUCTIONS

1. **Boat A** Proceeds to buoy — picks up and prepares to unseat anchor. Barge maintains tension on mooring.

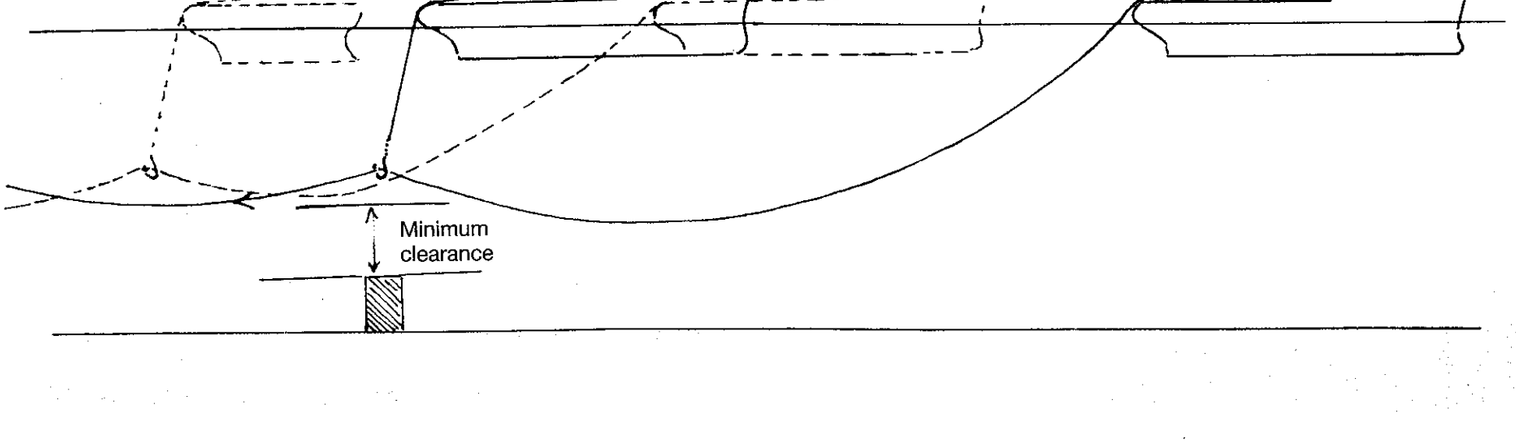
2. **Boat B** Rigs and deploys J-hook chaser and sweeps chain close to barge. Boat B proceeds out along the line of the mooring with tension on the work wire to keep J-hook on the chain. Stops in position as shown — maintains position and work wire tension. Boat B should have pre-calculated **maximum** allowable work wire to pay out and to maintain safe clearance.



Diag 93. RETRIEVING ANCHORS OVER OBSTRUCTIONS

3. **Boat A** Breaks out anchor and heaves up. Decks anchor and double secure. Barge commences heaving in. Boat B observes radar distances and bearings. Maintains position as chain is hauled through the chaser. Boat A maintains tension.

4. As mooring is shortened up and boats close boat B moves astern and when boat A is over the obstruction and maintained clearance tension, boat B clears chaser and moves off out of the way.



i. Unusual anchor handling methods — without use of winches and surface pennants

An anchor handling tug may suffer damage to its anchor winch or control systems such that the winch is inoperative.

Depending on the type of damage and the nature of the contract, the loss of the winch does not render the boat useless and the following technique is a development of a much used method well known to those seamen who have to work dredgers in port, where single screw tugs are used to tow the spoil barges to and from the dredger and move its anchors when required.

Obviously the anchors are on wire mooring lines and the possibility of dropping the anchors on expensive seabed obstructions, such as pipelines etc. is a constraint.

To rig up for this technique utilise a large chasing block rigged on two heavy pennants as shown in diagram 94.

A tugger winch or capstan wire is rigged to enable the block to be hauled inboard when engaging/ disengaging the mooring wire.

Diagram 95 shows the block hove on deck and another tugger winch used to haul the bight of mooring wire on deck for placing into the chasing block.

Diagram 96 shows the boat moving to the anchor position with the mooring wire relatively slack. Once at the anchor position the boat applies power and the barge hauls in on the winch cable. The anchor is tripped and broken out and then brought up to a position below the chasing block (diagram 97).

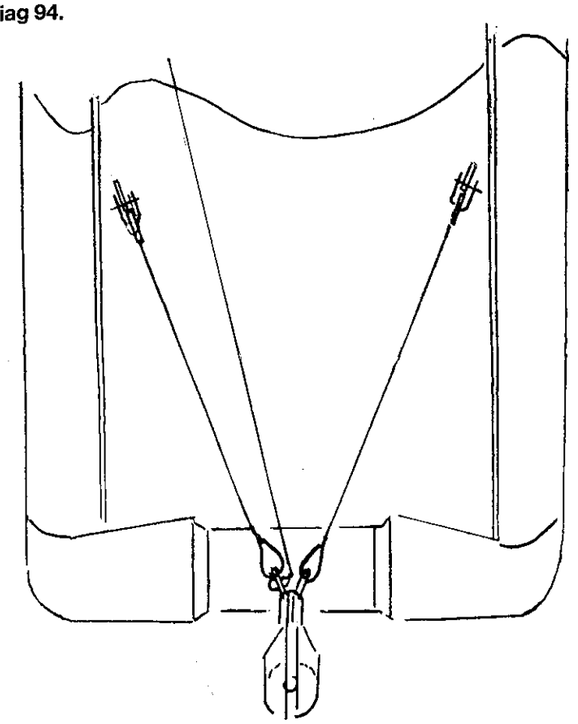
The boat then works into the correct position for anchor redeployment and moves out to the new required position. When in position as directed by the barge the winch on the barge relaxes enough tension to allow the anchor to go to the bottom.

The boat eases off ahead power and then, backs towards the barge letting the wire run through the block. On arrival at the barge the wire is slipped from the block using a bight of the tugger wire.

Diagrams 98, 99 and 100 show the origin of the technique using single screw vessels which in some circumstances may be of use. Most modern anchor handling tugs have "soft" stems, without substantial bitts or fenders, so that chasing out anchors over the bows is not usually possible.

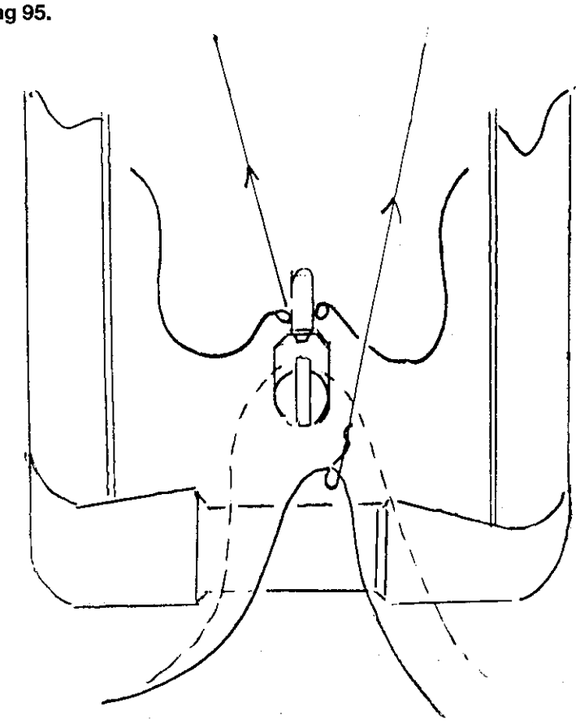
These techniques have also been used when boats have severely damaged their stern rollers.

Diag 94.



1. Chasing block rigged on two 58mm pennants with 85 tonne shackles.
2. Tugger wire also attached to hauling block inboard.

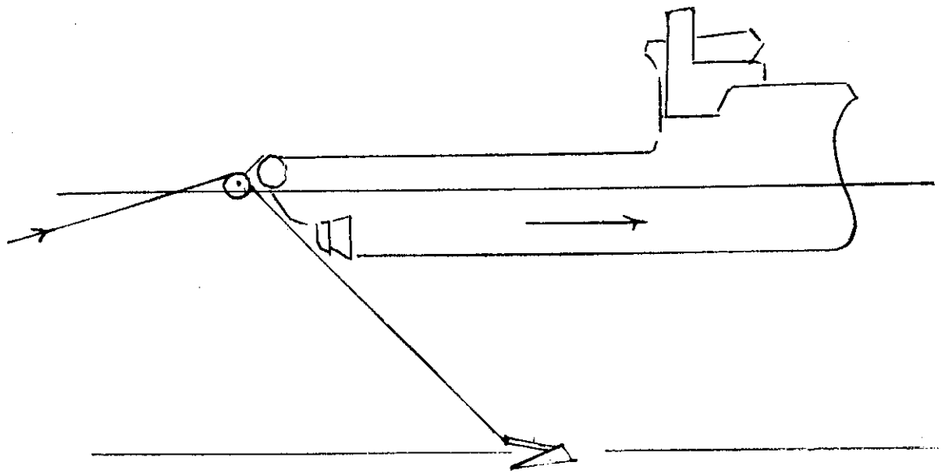
Diag 95.



Chasing block on deck and open to receive bight of mooring wire.

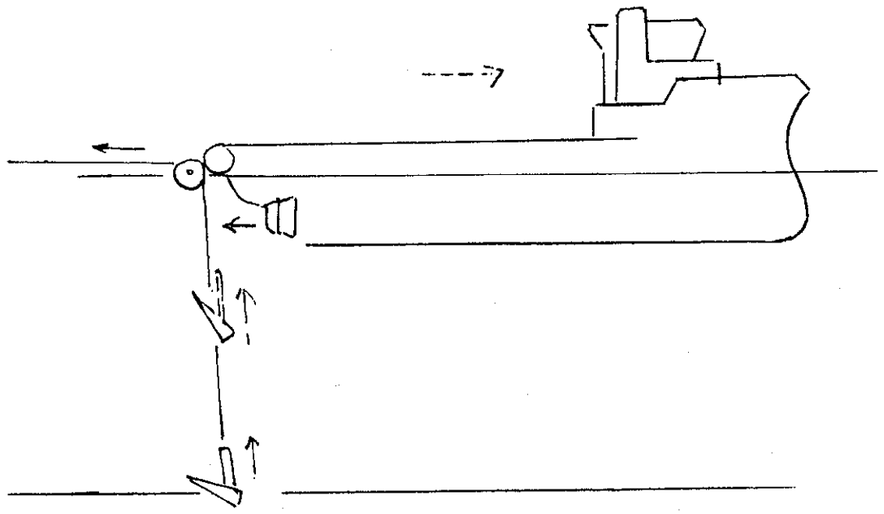
Another tugger used to haul bight of wire into block mouth.

Diag 96.



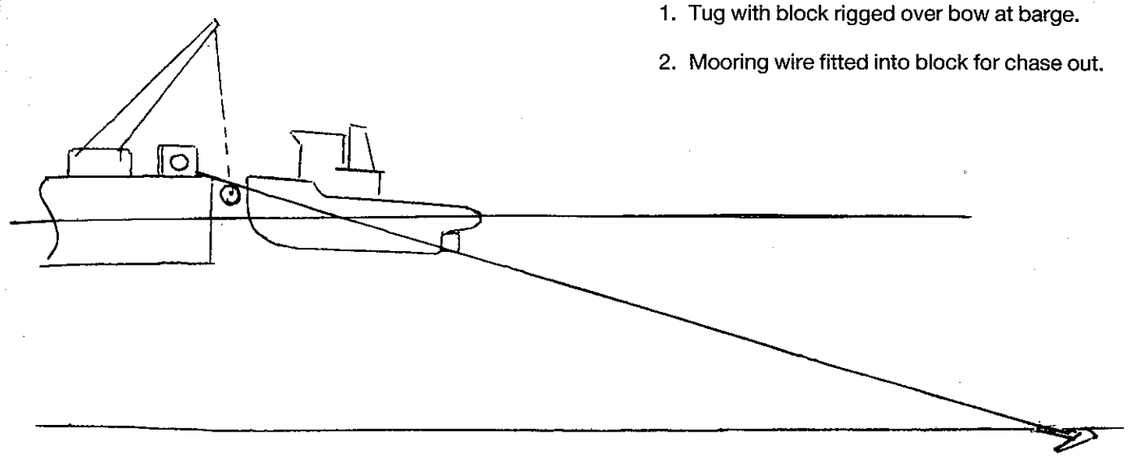
1. Moving out to the anchor.
2. Barge slacks wire to enable boat to reach a position above the anchor.

Diag 97.



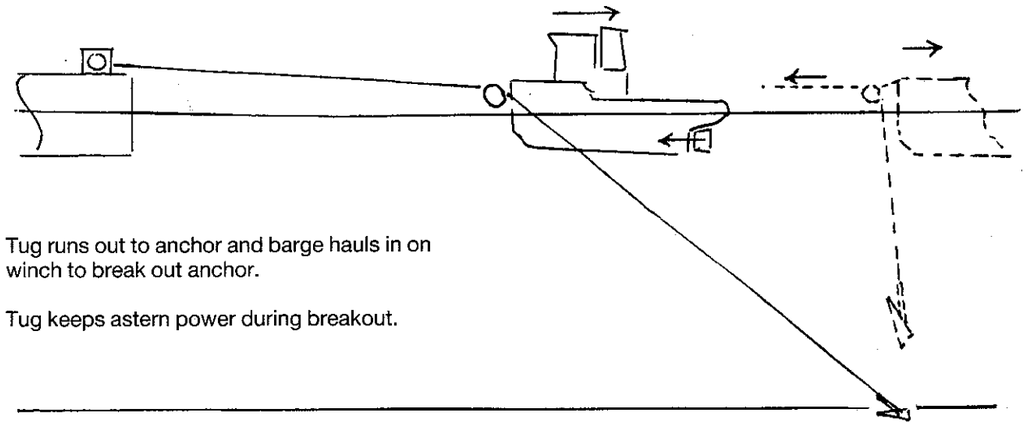
1. Boat at anchor position.
2. Barge hauls on mooring wire. Boat goes ahead and combination of forces pulls anchor out of the ground and up to boats stern.
3. By maintaining ahead power boat keeps anchor snugged up under the block.

Diag 98.



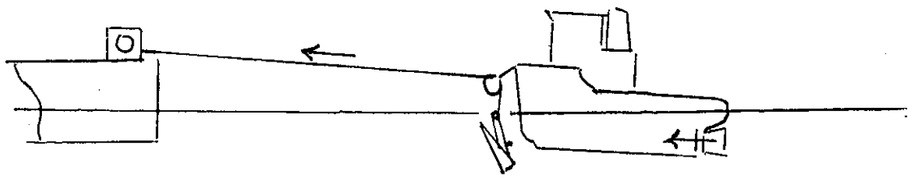
1. Tug with block rigged over bow at barge.
2. Mooring wire fitted into block for chase out.

Diag 99.



1. Tug runs out to anchor and barge hauls in on winch to break out anchor.
2. Tug keeps astern power during breakout.

Diag 100.



1. Tug brings anchor to barge or repositions.
2. Tug must keep going astern to ensure that anchor remains two blocked as shown.

j. Ultra deep water anchor handling

Only in specialised circumstances and utilising custom designed mooring equipment are work barges, drilling units and similar vessels moored in water depths exceeding 2000 feet. Even at this water depth the handling of chain mooring systems imposes severe strains on the anchor handling equipment.

For example in 2000 feet of water, with the anchor at the boat's roller and 2000 feet of chain suspended vertically the tension on the work wire is in the order of 85 tonnes if the chain is 76mm diameter (3") at 77.4lbs foot submerged weight and the anchor weight is 15 tonnes.

It is common to use buoyed anchor systems in extreme water depths, over 400 metres (1300 feet) because in such conditions a permanent chaser system would require a work wire of over 3000 feet, 2½ times water depth, and many anchor handlers winches would have considerable problems stowing much more than 4500 feet of say 2½ inch wire, on their drums.

It will be appreciated that with the anchor at the roller in 2000 feet of water, using the example above and a fairly high specification boat, the winch drum will be about three quarters full and pulling power is reduced to about half the maximum pull available on first layer.

Examination of the Bodewes winch type 986, data (see part 2d) well shows that at 1st layer — lowest gear the winch can pull is 375,330lb, whereas at full drum lowest gear the line pull has reduced to 151,920lbs.

As well as the available pulling power of the winches the other factors to consider are the brake performance and ability to control the load when lowering the anchor to the bottom, especially as this will occur with the boat steaming ahead to keep the deployed chain tensioned.

It is usual to employ boats with multiple work drums, storage reels and winches of higher power, if available, than normal.

The length and weight of the anchor pennant system presents special problems. If the pennants are about 2000 feet long for 2000 feet water depth then their weight will be about 13 tonnes for 70mm wire. It is usual to spool up one pennant string per work winch drum. The other alternative, if storage reels are available is to divide the pennant strings into sections and run the anchor to bottom in two or more stages. This allows the work drum to carry only about half the required wire to buoy off one anchor.

The anchor is run half way to the bottom, the pennant stopped off, the other half of the pennant string is stowed on the second work drum, which is then connected up, and the anchor run to the bottom.

The work drums are then respooled with another pennant string from the storage reels.

Picking up is the reverse order. Half the anchor pennant string is recovered on one drum and half on the other.

j. Ultra deep water anchor handling (cont'd)

If only one drum must (and can take) the full string for an anchor, it is usual to take the following precautions before **running the anchor**.

After receiving the crown pennant from the barge, the anchor handling spools off the whole length of the string and then respools under good tension. This helps avoid the "ripping down" of the top turns into the body of wire when the drum is nearly full and the anchor is being "stretched" prior to putting it on the bottom.

There are two methods used to buoy off anchors in deep water.

The first involves the use of large sub-surface polyfoam fitted support buoys and a surface buoy.

On the following pages the pennant string rig up is shown in the sketches using this method.

The other method is to use "pop-up" buoys, which are buoys attached to clump weights by acoustically released latches.

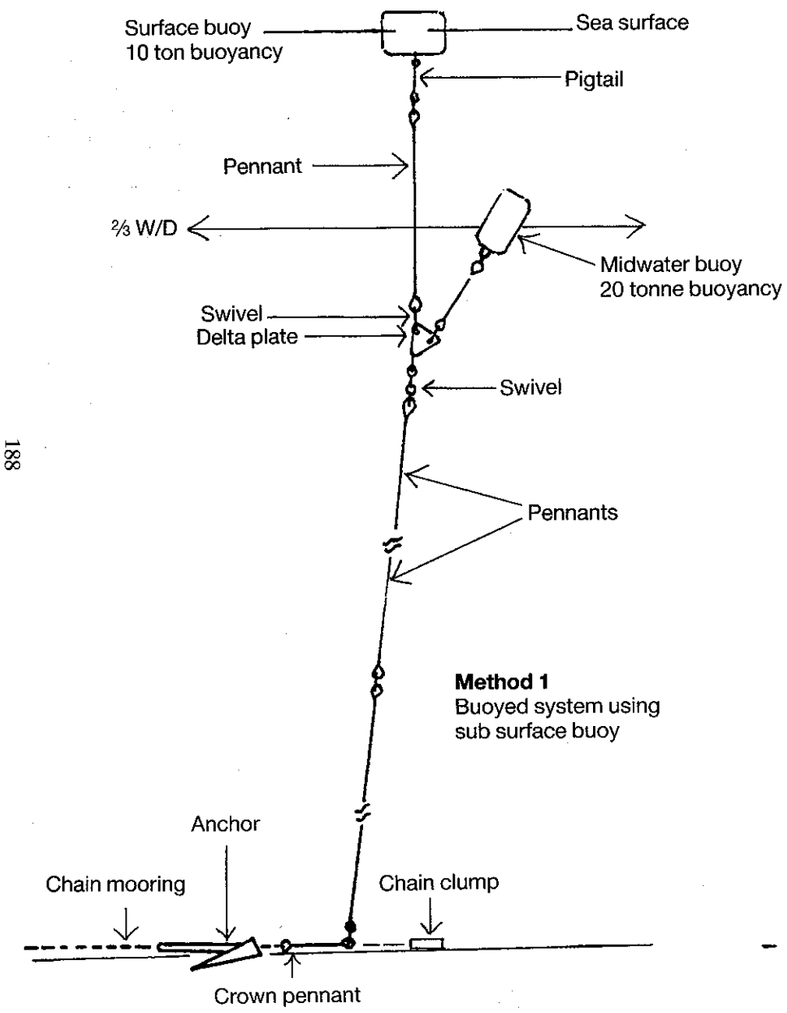
The method is to run the anchor and position it. The anchor retrieval pennant is then connected to a light wire, say 30 to 35mm diameter and the heavy pennant lowered to bottom. To the end of the light wire is attached the pop-up buoy and its clump weight, this is dumped overboard and put on bottom although it is better to try and run it to bottom on a bight of heavy rope which can be slipped.

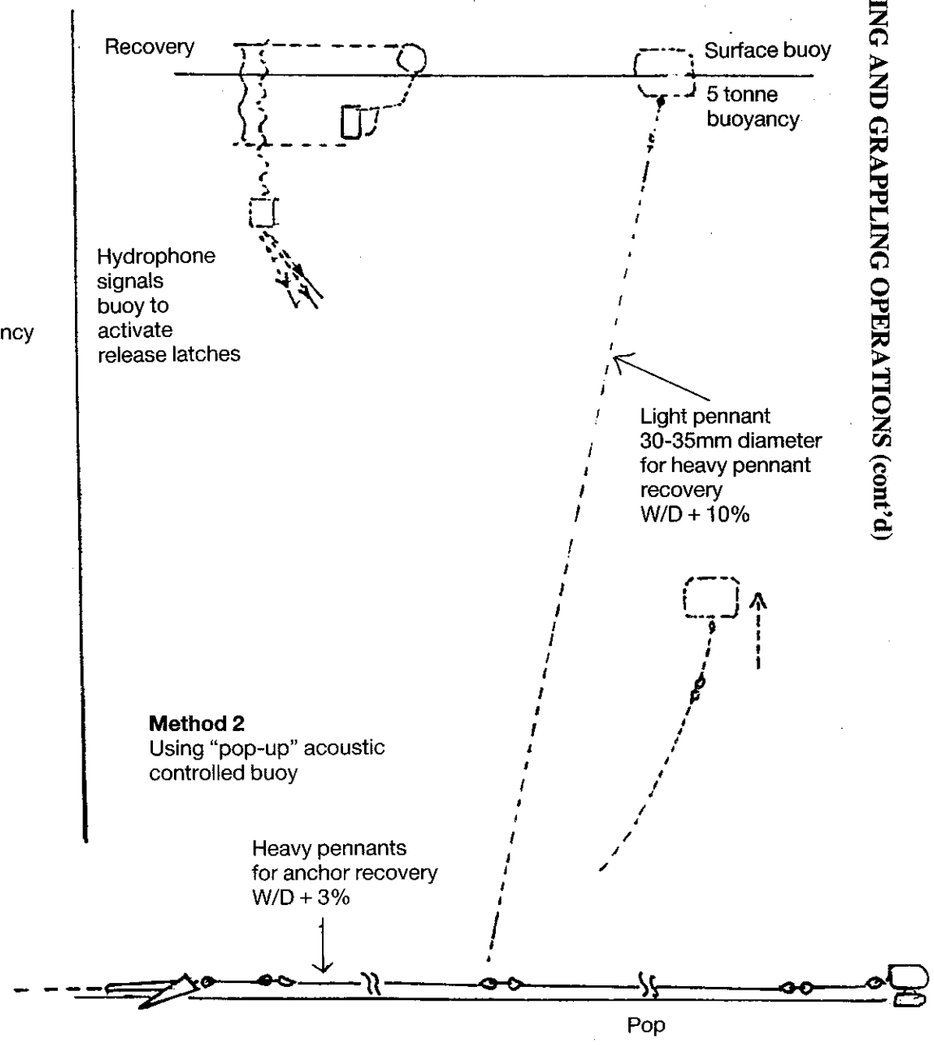
Recovery is by means of sending an acoustic signal to the buoy which unlatches from its weight and comes to the surface. The heavy pennant is then recovered followed by the anchor. The rigging, for all these operations and the deep deployment and recovery work is time consuming and arduous but must be very carefully planned.

Vessels using combination chain and wire mooring spreads are less difficult to deal with as the weight of the gear is less due to the small amount of chain involved and therefore anchors can be run more easily and the strain on the winches is often much less, although the drums will be equally full of pennant wire strings.

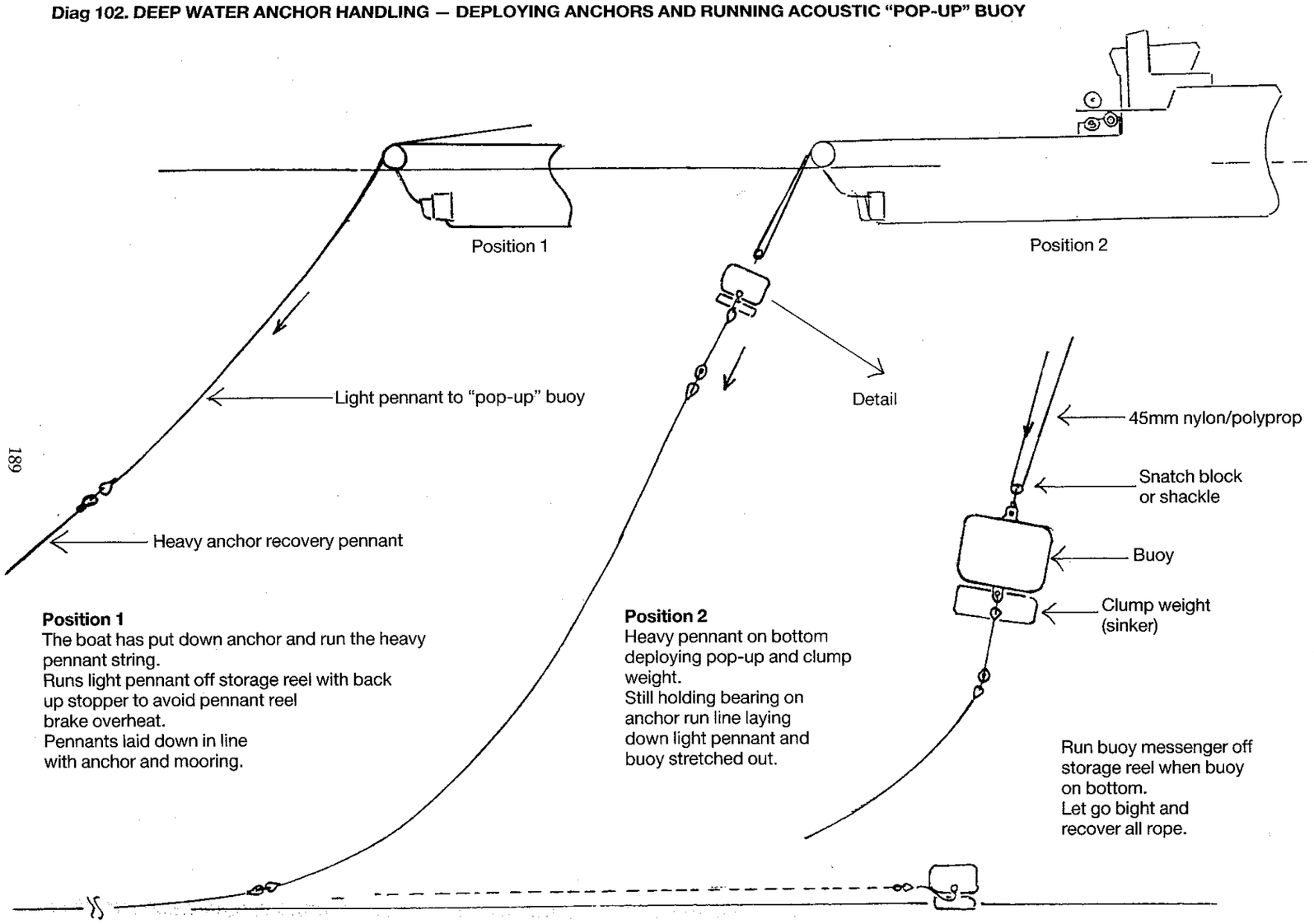
Diag 101. DEEP WATER ANCHOR HANDLING — TWO METHODS OF BUOYING OFF ANCHORS

Note: W/D = water depth

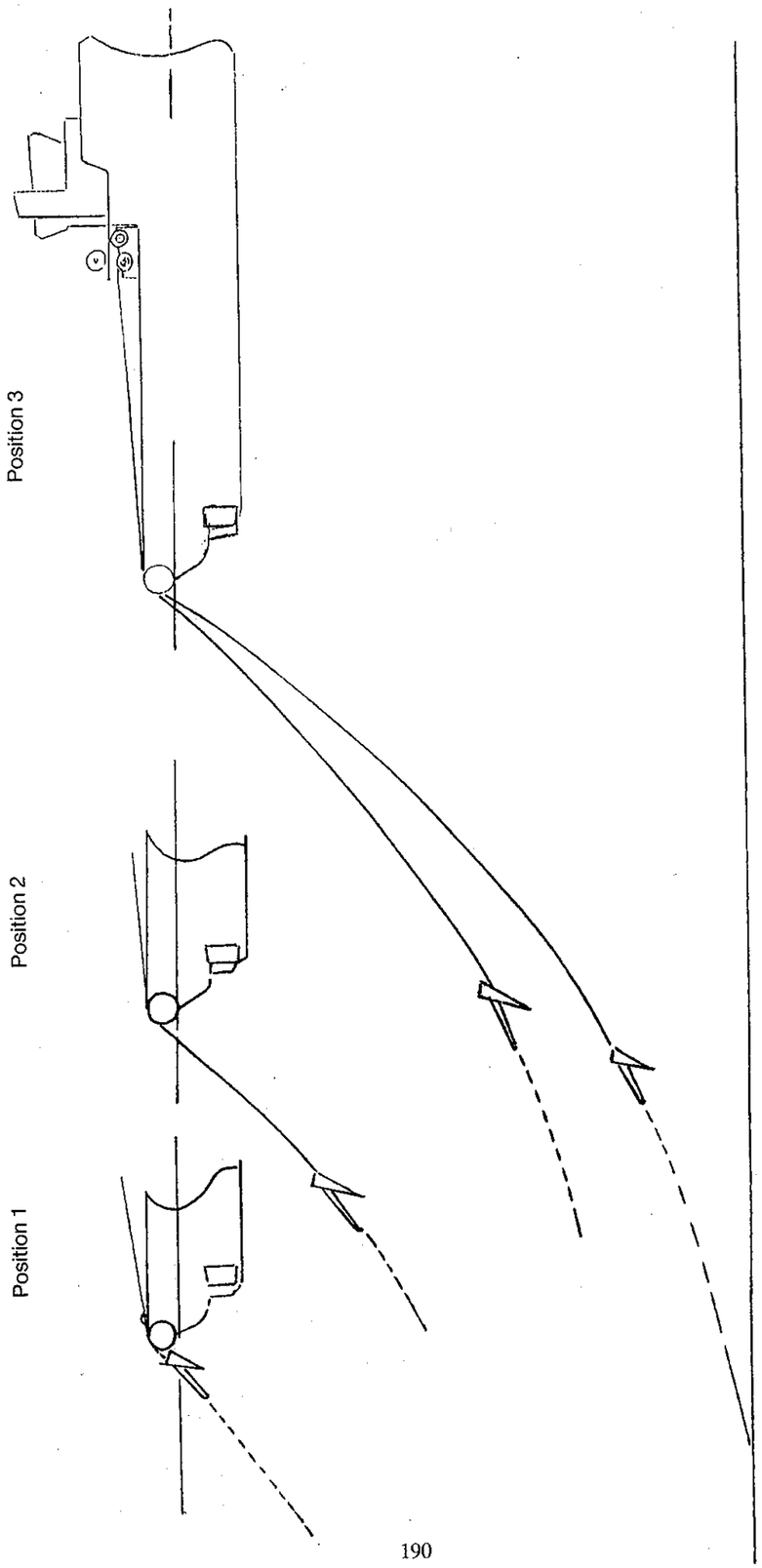




Diag 102. DEEP WATER ANCHOR HANDLING — DEPLOYING ANCHORS AND RUNNING ACOUSTIC "POP-UP" BUOY



Diag 103. DEEP WATER ANCHOR HANDLING — DEPLOYING ANCHORS ONE WORK DRUM ONLY



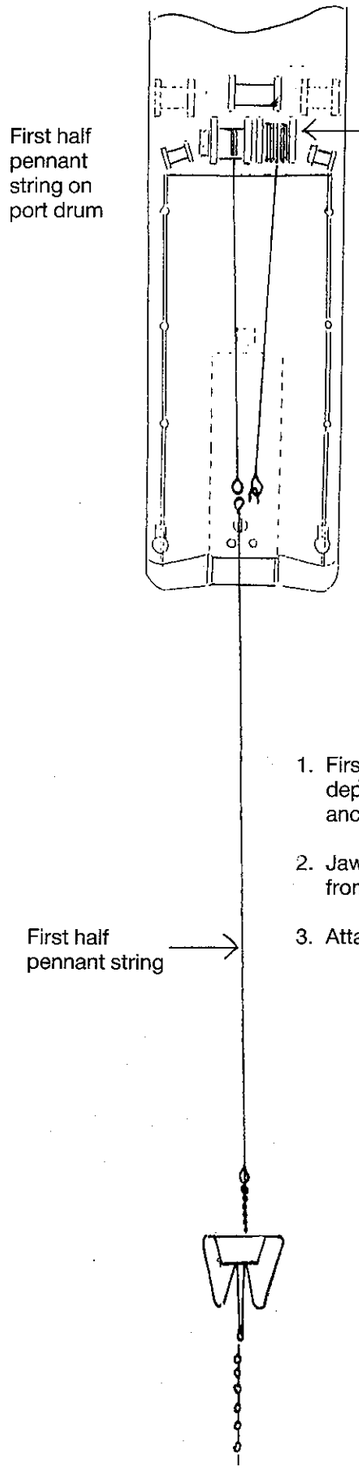
Running anchor to bottom — deep water — method where work drum at limits of brake capacity

Position 1 — About half way to anchor drop position anchor at roller

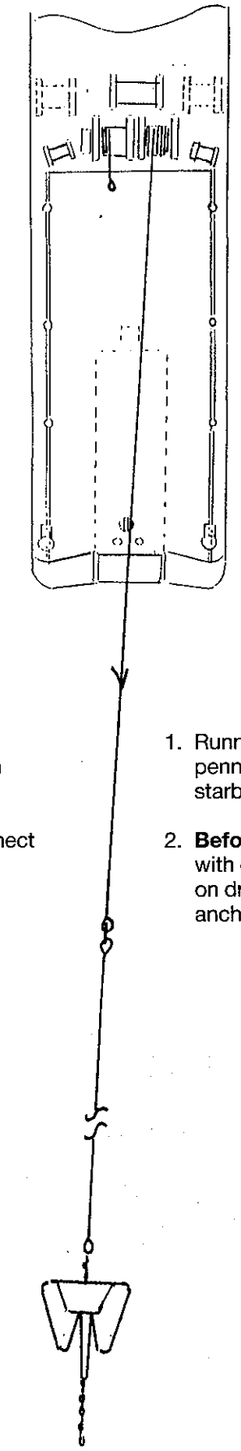
Position 2 — About ⅔ way to anchor drop position — slack out ⅓ pennant length

Position 3 — Nearly at drop position ½ pennant string deployed — stretching chain — applying maximum power.

Diag 104. DEEP WATER ANCHOR HANDLING — DEPLOYING ANCHORS USING TWO WORK DRUMS



1. First half of pennant string deployed. Taking full stretch on anchor.
2. Jaw off after stretching. Disconnect from work drum tail wire.
3. Attach second half pennant.



1. Running second half of pennant string from starboard drum.
2. **Before** anchor put on bottom with only a minimum wire left on drum take full stretch on anchor to remove slack.

PART 7. HANDLING CHAIN

a. Operations where chain handling is required
Anchor handling tugs are routinely required to handle chain cable. This work is fatiguing, both physically and mentally, often prolonged and frequently dangerous.

To carry out the operations with success and in an efficient manner the following are basic requirements.

1. Understand exactly what the purpose of the operation is.

2. Explain to the deck crew what is to be done and how.

3. Rig up the boat and prepare all the available gear before starting work.

The following list shows those operations which are **fairly standard** and occur at regular intervals.

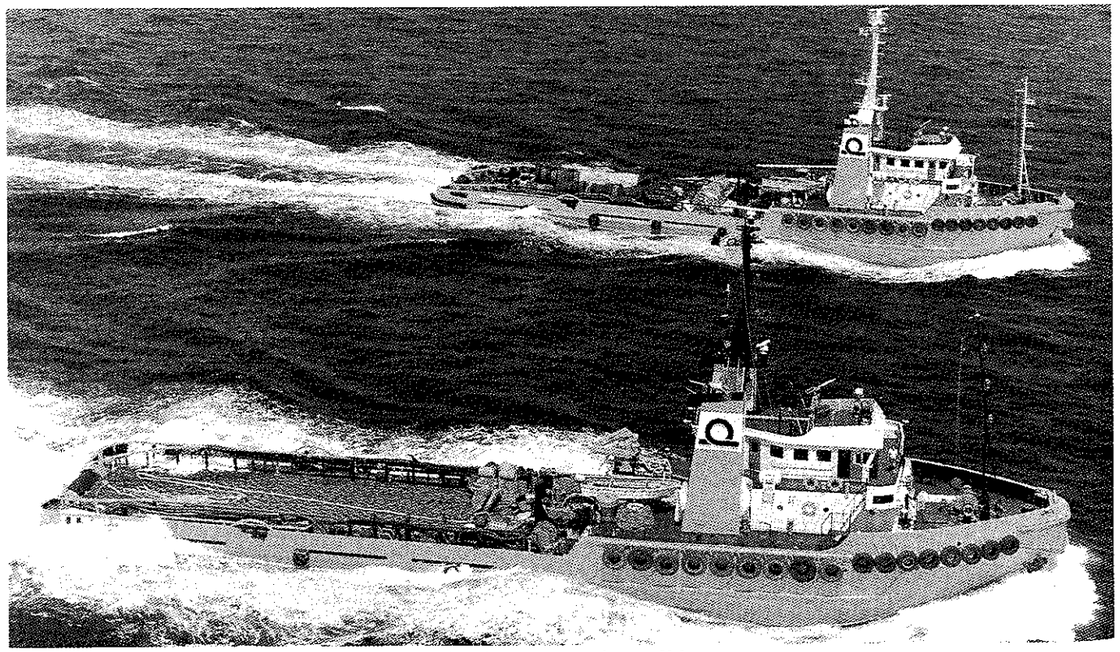
b. Routine operations
1. Changing out the mooring chains of a semi submersible drilling unit or work vessel.

2. Adding extra chain lengths to a vessel's existing mooring lines (chains) prior to going onto a new work location (a semi-submersible going into deeper than normal water depths).

3. Replacing a single mooring chain or part of a mooring chain.

4. Adding extra chain lengths to a semi-submersible unit's mooring spread **after** deployment to provide a more secure mooring system.

5. Removing the mooring chains from a vessel.



Chain, anchors and buoys stowed on deck prior to operations offshore

c. Non routine operations
1. Pre-laying a chain mooring spread prior to the arrival of a vessel, for example a floating production unit.

2. Pre-laying the moorings for a variety of loading buoys or similar structures.

3. "Fishing" part or complete lengths of a mooring system after they have been lost or jettisoned from a vessel. For example while running out a mooring line from a drilling unit the brakes of the barge winch fail and the chain "runs" away.

4. Deploying combination chain and wire multi-point support moorings often used in existing oilfields where a work barge or drilling unit's moorings must be run across pipelines, well heads and manifolds (on the seabed).

5. Routine and non routine inspection of the anchor chains of a vessel where the work boat is used as the platform for carrying out the inspection.

d. Basic checks
Before commencing the work there are a number of basic checks which a competent master will carry out.

1. Check that the windlass gypsy(s) are of the correct size for the chain to be handled. It is both dangerous and foolish to attempt to haul chain using either an undersized or oversized gypsy and severe damage to chains, gypsies and sometimes men can result.

2. Check that the chain lockers of the boat are in a fit state to be loaded with chain and how much can be handled of the size under consideration. The **space requirements (locker space)** for the five most common chain sizes are:

Chain diameter	Weight per 100 metres	Locker volume per 100 metres
64mm	9191kg	4.5m^3
76mm	12837kg	7.0m^3
92mm	19040kg	9.5m^3
102mm	23260kg	11.8m^3
111mm	27420kg	14.0m^3

Note: Locker space requirement is considerably in excess of **actual volume.**

In practical terms let us say that a boat has two chain lockers each of 100 cubic metres volume and they are to be filled with 76mm diameter chain, then each locker could take about:

$100 \div 7 = 14 \times 100$ metres = 1400 metres of chain **less** 20% broken stow
Practically speaking about **1100 metres** or 3600 feet

Another commonly used figure is to allow about 0.5 to 0.7 cubic metres per metric tonne of chain.

3. If chain is to be carried on deck check that the vessel will have sufficient **stability** when fully loaded.

4. If both chains anchors and other gear (buoys) etc. are to be carried on deck work out how much can be handled, stowed and worked at sea. Loading the vessel up in port then going offshore and having to run chains and deploy anchors can be hazardous in even moderate weather if the deck is crowded.

e. Tools and equipment for chain handling
The following list of equipment shows what should be available when working chain.

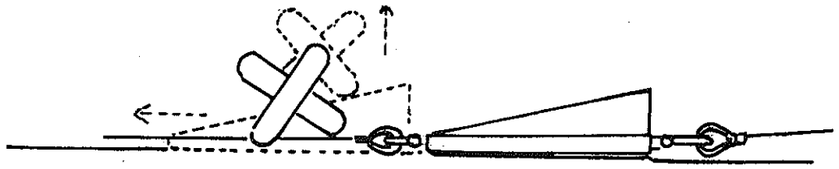
1. Devils claws, chain hooks sized to fit the chain being handled (see sketches).

2. Chain strops of at least proof load 50 tonnes for use in hauling bights of chain. Grade 8 about ⅝" diameter 16mm.

3. Heavy duty snatch blocks, strops and shackles (20 tonne SWL).

4. Tugger winches rigged with correct size wires not lightweight gear. If the tuggers are rated at 10 tonnes SWL then the wires should be about 26 to 28mm diameter to give 5 to 1 safety factor.

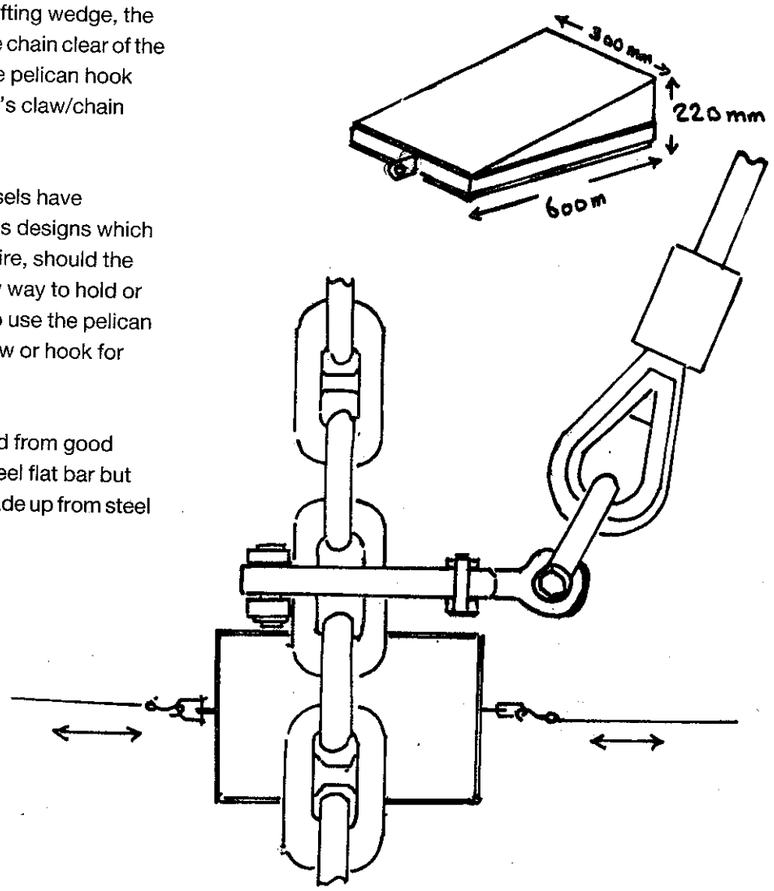
Diag 105.



The sketch shows a chain lifting wedge, the purpose of which is to lift the chain clear of the deck in order to fit either the pelican hook stopper as shown or a devil's claw/chain hook.

Although most modern vessels have hydraulic stoppers of various designs which both hold and lift chain or wire, should the system break down the only way to hold or heave on the chain will be to use the pelican hook for holding and the claw or hook for heaving.

The wedge can be fabricated from good quality timber bound with steel flat bar but some versions have been made up from steel plate.



e. Tools and equipment for chain handling (see also diagrams in Part 2g)
4. (cont'd) Connection shackles, safety hooks and other small gear should also be sized correctly.

Chain strops and stoppers should be of ⅝inch/16mm diameter grade 8 quality which has a working load of 8.5 tonnes and safety factor 4 to 1.

5. Pelican hooks and pennants for chain size to be handled.

6. Sledge Hammers,

7. Pin punches for joining link pins, both long and short versions (see Part 2g).

8. Crowbars

9. Lead shot for joining shackle pin securing.

10. Casing wedges — see diagram 105.

11. Lashing rope

12. Chain hooks (cable hooks) for manipulating/pulling chain by hand.

13. Oxyacetylene cutting gear, Correct size cutting nozzles, bottles full and set to correct pressures.

14. Rosebud heating nozzles, goggles and sparker. Bucket of high quality grade 2 grease.

15. Selection of hand tools, hammers, pipe wrenches, adjustable spanners, hacksaws and blades.

16. Portable lights for chain lockers and lead lights for use on deck aft.

17. White paint and brushes.

18. Set of steel number and letter punches for marking links — and sharp cold chisels.

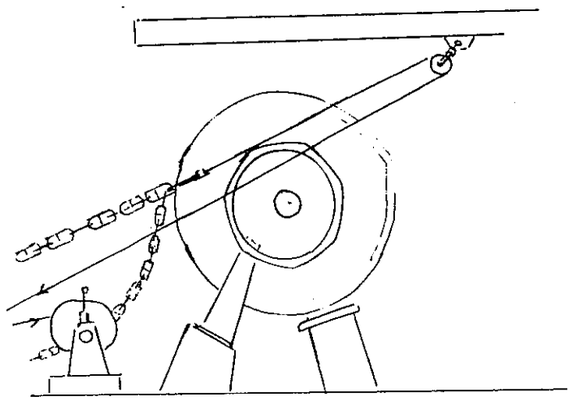
19. Stainless steel banding and banding tool.

20. Crew to have steel toed boots with good ankle protection, leather riggers gloves and overalls.

21. Welding gear to be on hand.

e. Tools and equipment for chain handling

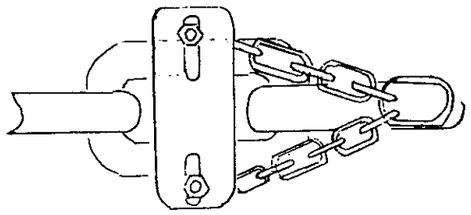
Diag 106. CHAIN HANDLING STOPPER

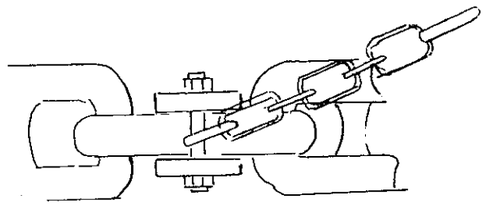


Rig up to get chain bight/bitter end over gypsy of work winch.

Note:
If under-running, chain fittings such as chain breakers may have to be removed.

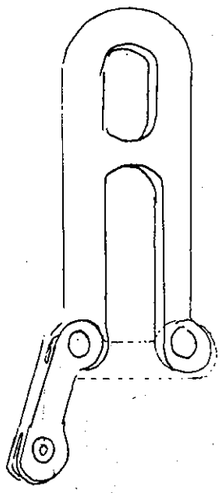
Chain handling stopper made from 22mm plate, bolts 26mm, chain grade 80, HT 15mm.

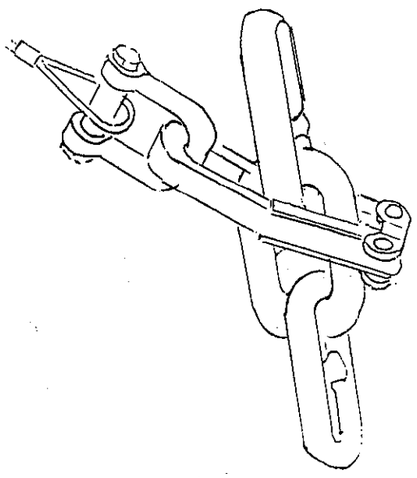




Diag 107. PULLING STOPPER

Designed for handling bights of chain where heavy loads may be required
SWL 75 tonnes





f. Rigging up for handling chain into lockers
The set of sketches show a typical start up of filling the boat's lockers with chain.

The situation at the start is as follows — the boat is to retrieve 3500 feet (1100 metres) of 76mm diameter chain and an anchor (16 tonnes) which is laid in 450 feet/138 metres of water and give it back to the barge which inadvertently dropped it. The anchor is buoyed off.

Proceed as follows. It is estimated that the chain will fit in both lockers. The work barge has said that on no account must the chain be cut and it must be returned to the vessel the same way that it came off.

The boat's gypsies are sized for chain link diameter/size 70mm to 84mm (2¾" to 3¼"). She has a set of gypsies (interchangeable for chain cable sizes 92mm to 102mm (3½"-4").

1. Get all the tools and equipment (see part 7e) ready.

2. Open up both chain lockers, check they are empty and clear of any obstructions.

3. Rig/dress the (patent) stoppers (aft end) for 76mm chain.

4. Rig up the pelican hooks port and starboard aft on their pennants,

5. Strip off the work drums so that only the short work wire is left.

6. Catch the anchor buoy and recover the anchor onto the deck, pull it up forward and engage the stoppers on the chain.

7. Disconnect the chain from the anchor and pull the anchor to the side rail, lashing it firmly into place.

8. Shackle the devil's claw or chain hook to the work wire and overhaul it to the stern using a tugger (see diagram 108), and hook on just forward of the stoppers.

9. Take up the weight of the chain — check that the hook or claw is firmly seated, release the stoppers and haul the chain bight as far forward as possible, engage stoppers and disconnect the hook.

   Spool up and secure the work wire on the drum.

10. Attach tugger to chain end and reeve it as shown in diagram 109. Start heaving on tugger and turn the work winch and wildcat at the same time, thus hauling the chain end onto the gypsy and commence feeding chain into the locker.

    Release tuggers and commence hauling chain into the locker.

The next set of diagrams (110-114) show the continuation of the chain handling operation.

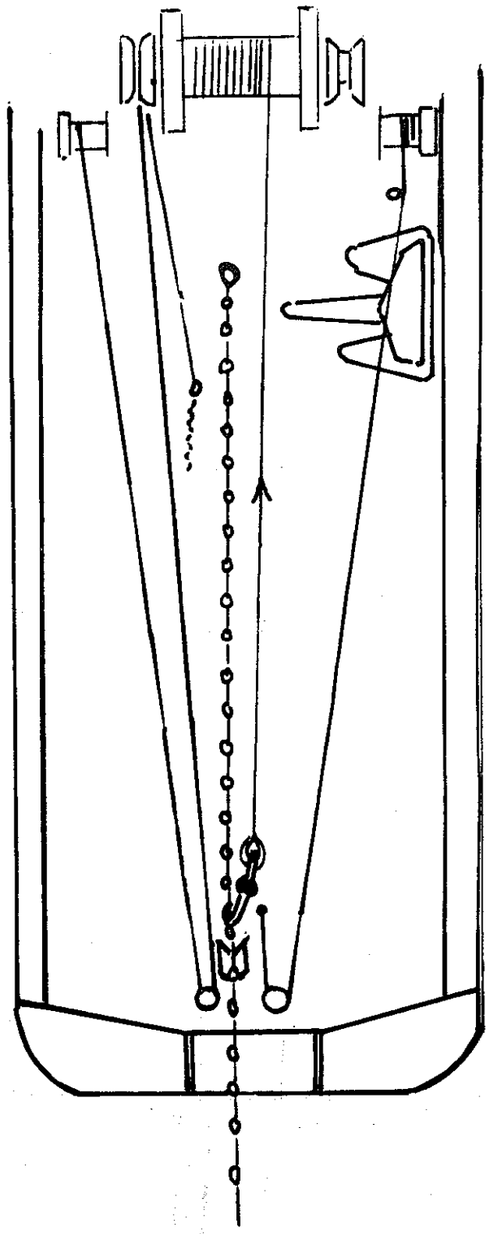
g. Caution and hints
After reeling about 20 to 40 feet of chain into the locker **paint the chain white** over about 3 to 5 links. It will give you a guide as to how much chain is left in the locker when you come to reel it out again.

ANCHOR DECKED, DISCONNECTED AND SECURED

Diag 108.
Anchor decked — disconnected and secured.

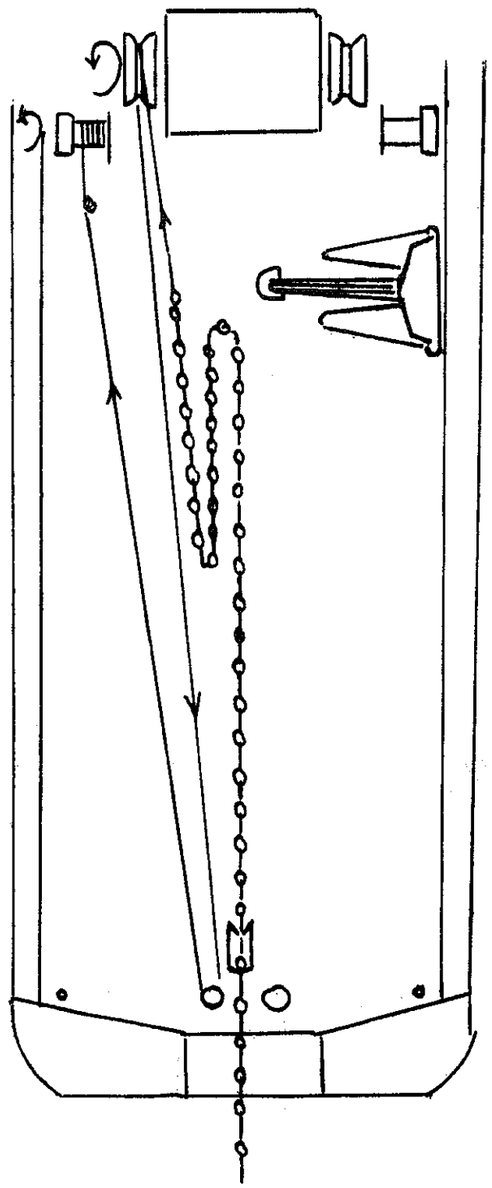
Devil's claw/chain hook attached to work wire and overhauled to stern using starboard tugger winch.

Prepare to heave chain on board with work winch.



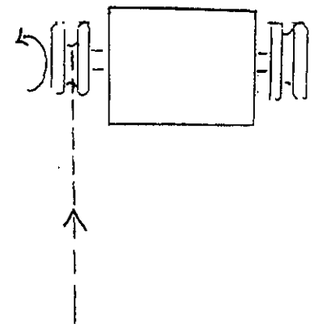
Diag 109.
Bight of chain hauled aboard, chain secured by stopper. Devil's claw/hook disconnected and work wire spooled up.

Port side tugger attached to chain and rigged over gypsy ready to haul end of chain onto winch gypsy.



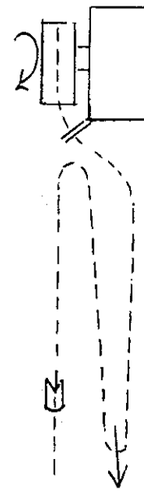
STOWING INTO LOCKERS

Diag 110. Filling up port drum locker

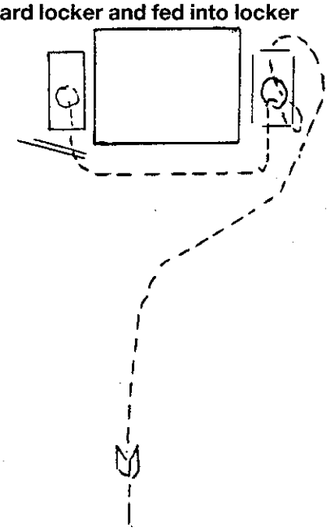


Diag 111. Port locker full

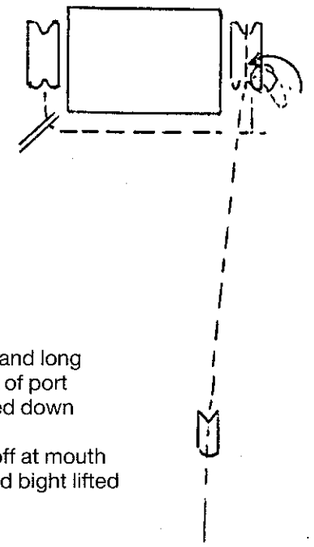
1. Chain held in stopper
2. Winch reversed and long bight hauled out of port locker and fleeted down deck.
3. Chain stopped off at mouth of port locker and bight lifted off port gypsy.



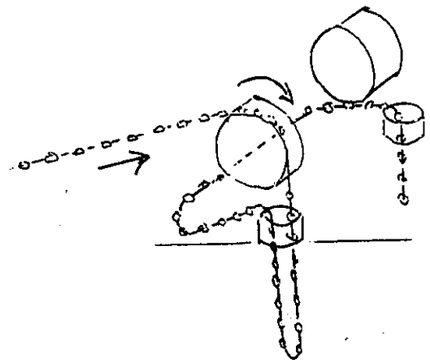
Diag 112. Bight dragged around to mouth of starboard locker and fed into locker



Diag 113. Shows chain bight lifted onto starboard gypsy



Diag 114. Ready to resume hauling into starboard locker



Note:
The position of towing/anchor handling drum guide posts and other structures aft of the winch and gypsies may prevent use of this method, because the area below and aft of the gypsies must be clear to manipulate bights.

If this is not the case then to fill the other locker the chain must be cut.

HANDLING CHA

ANCHOR DECKE

Diag 108.
Anchor decke

Devil's cla
overhaule

Prepar

the methods of stowing chain on deck in fleets, a time consuming

ain end over the gypsy, use the work wire and claw/hook as shown

ach bight at each end of the deck.

quence of set steps and a rythmic work pattern can be established which should help
gue. It is of crucial importance that the tugger wires and shackles are of the best quality
shackle pins are properly secured with mousings or safety pins.

ne crew should be thoroughly briefed beforehand and the master should try to position the vessel head to sea and wind, this is to avoid excessive rolling and provide some shelter for the crew.

It is common to underestimate the time such an operation will take even with an experienced crew. A period of 4 to 6 hours is not uncommon to handle say 1000 metres of chain onto the deck or into lockers.

If heaving the chain off a muddy bottom take time to hose off excess mud as it accumulates on deck. Its presence makes life difficult, dirty and dangerous.

i. Marking chains
When anchor chains are handled connecting links may have to be both inserted or removed. These connecting links are usually supplied with pre-stamped marks.

Check and record the serial numbers and if they are damaged or faint — re-mark the links under the direction of the barge personnel.

At times stainless steel bands with marks or serial numbers are supplied to be inserted adjacent to connecting links. These bands are fitted to the **stud** of the links not the body of the link.

When handling chain note the number and rough location of connecting links and when "feeding" a new chain to a rig or barge (which you have loaded in port), mark the position of each connecting link with bright coloured insulation tape (yellow) informing the barge as it disappears off your stern, that a connecting link is "on the way", this allows the barge crew to check the link for security, orientation and position in the chain length.

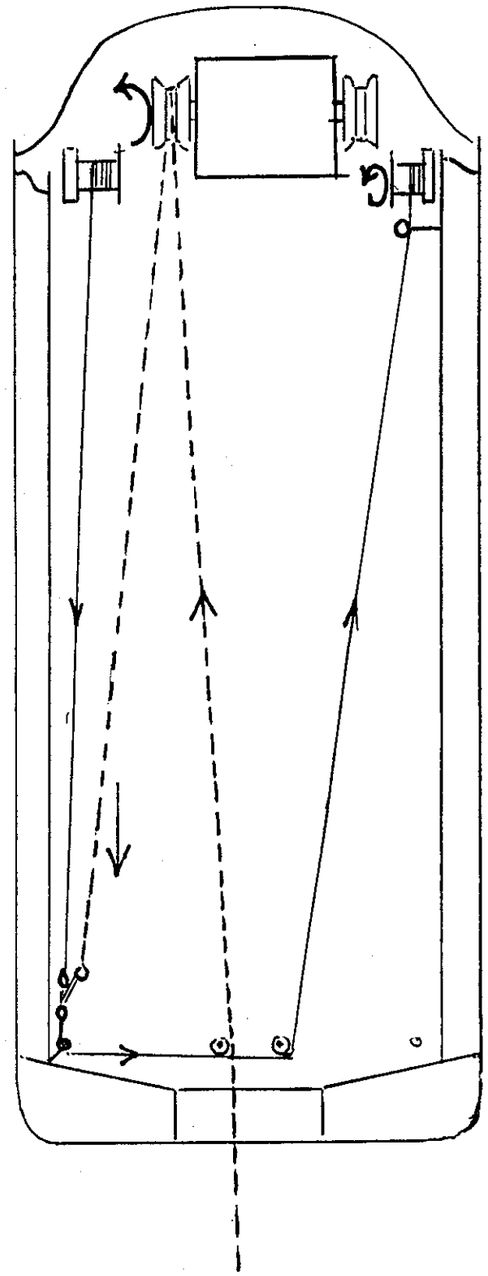
Have an electric or air driven wire brush handy for cleaning up markings on links but **do not** remove numbers unless instructed and if instructed to remove old numbers and remark, use a grinding disk gently. Don't gouge into the link material leaving sharp edged grooves or scores.

Always report damage noted on any chain handled — including loose studs, bent links, gouges, cracks and obvious wear and tear.

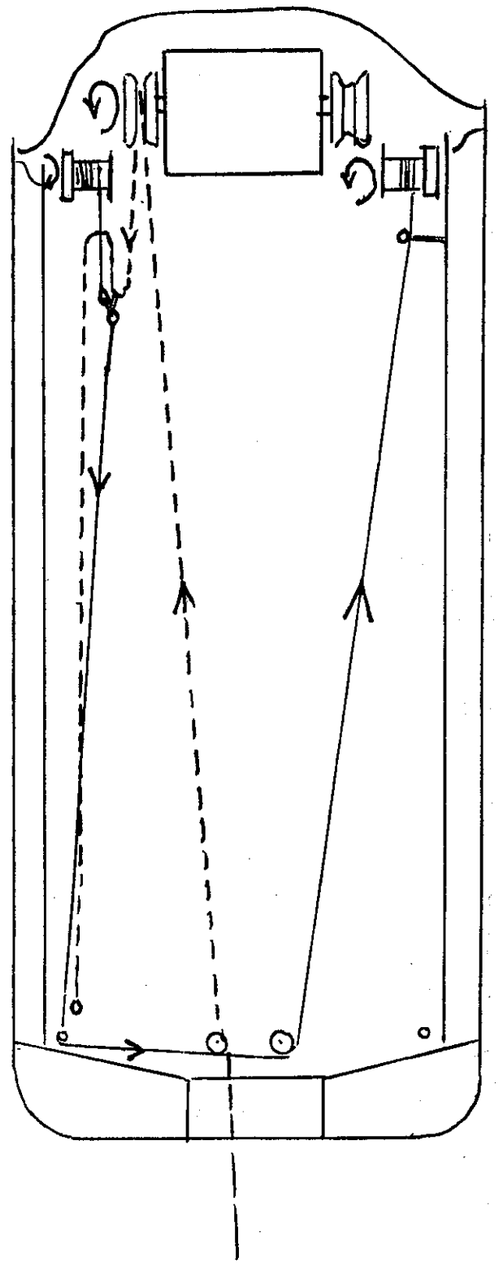
HANDLING CHAIN (cont'd)

STOWAGE OF CHAIN ON DECK — HALF DECK STOW

Diag 115.
Haul chain end down the deck and stop off.



Diag 116.
Overhaul the tuggers and make fast to the chain bight under the gypsy. Heave away again on the gypsy and commence pulling the bight aft.



ANCHOR DECKE

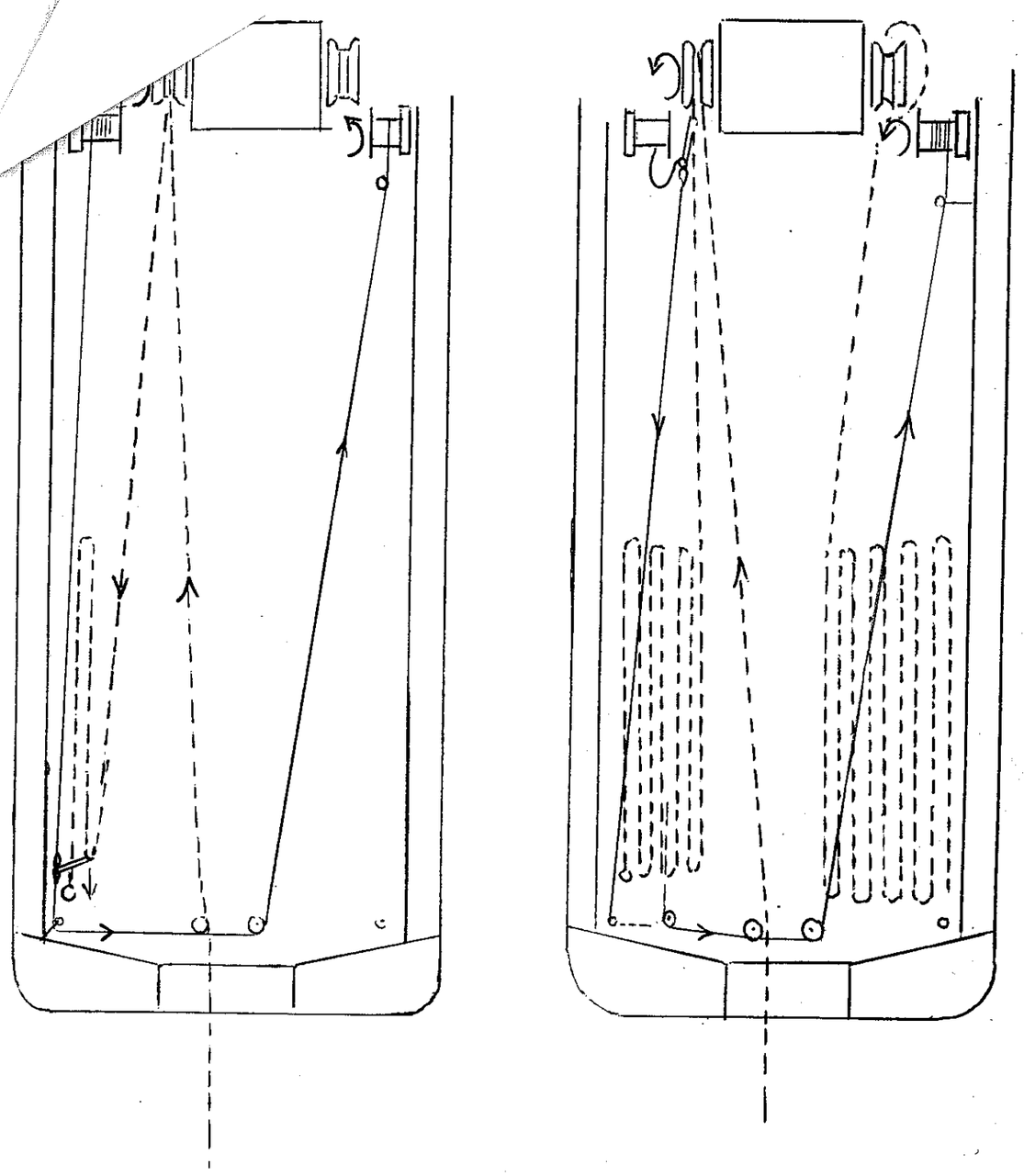
ALF DECK STOW (cont'd)

Diag 108.
Anchor decke

Devil's cla
overhaule

Prepar

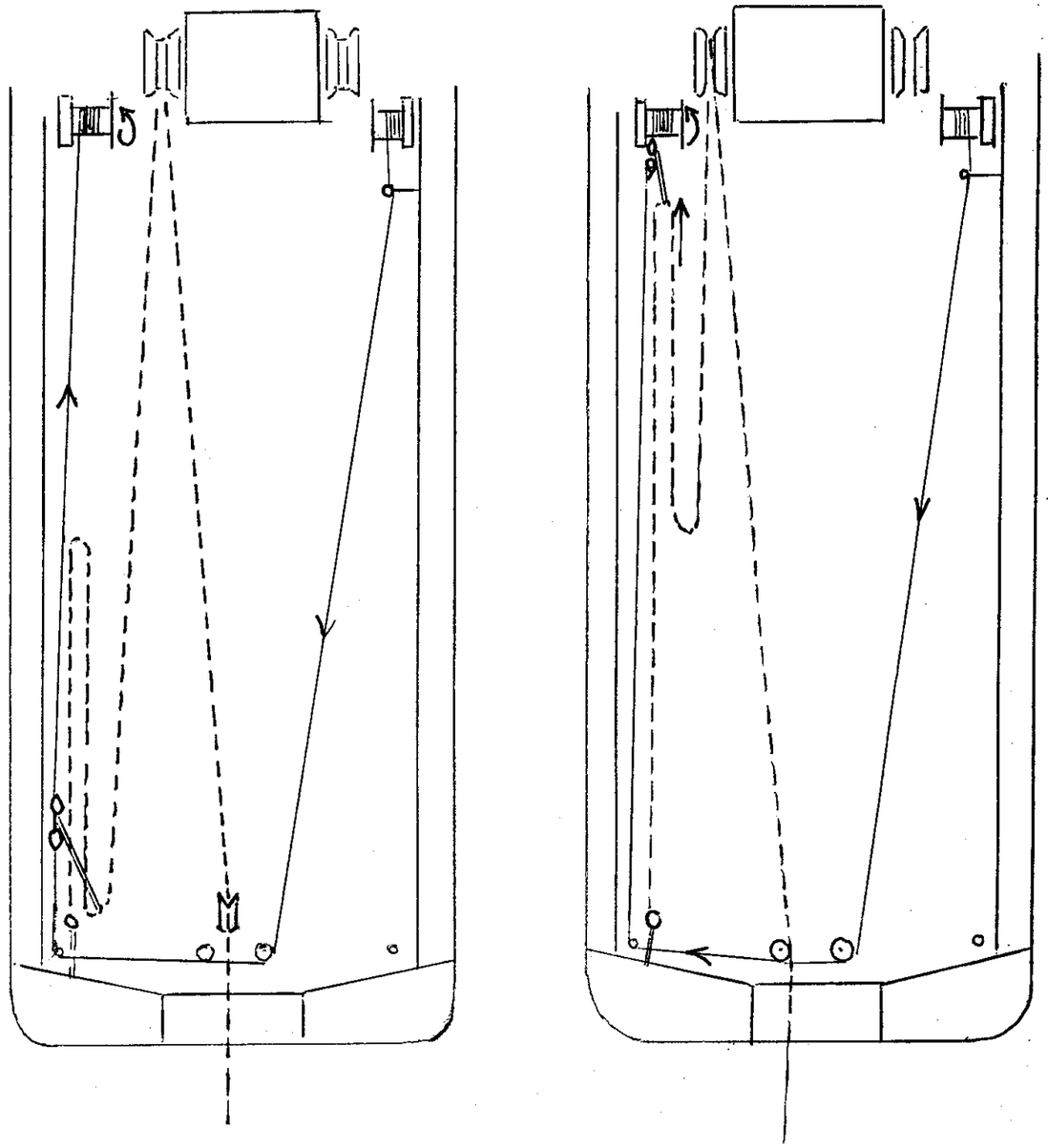
Diag 118.
Shows deck stowed both sides leaving fore end clear for anchors etc.



STOWAGE OF CHAIN ON DECK — FULL DECK STOW

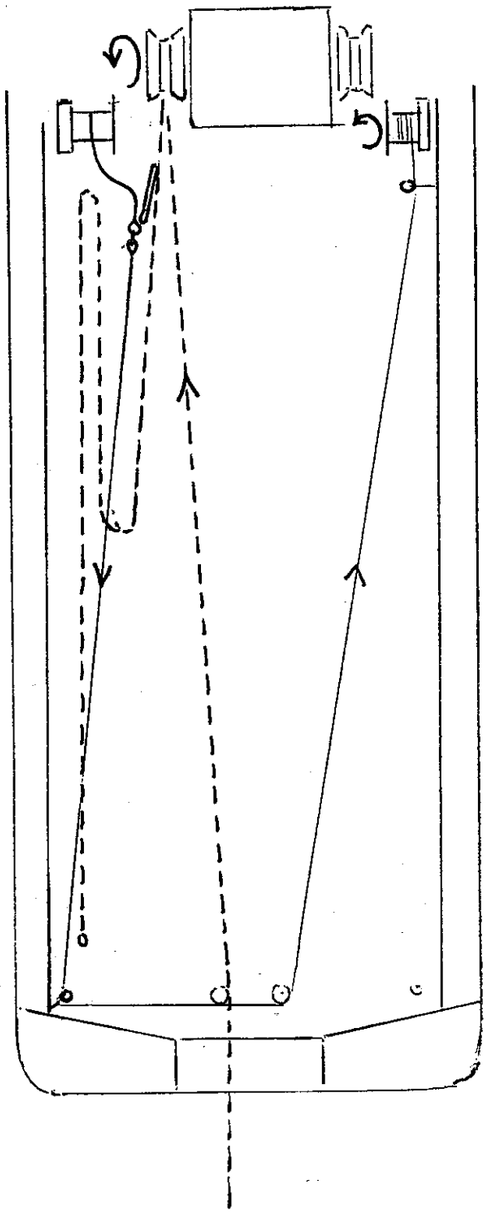
Diag 119.
Starting from diagram 117, having overhauled the first bight to the stern, pull it back up forward making a complete "fleet" of the deck.

Diag 120.
Shows first fleet completed. Windlass stopped.

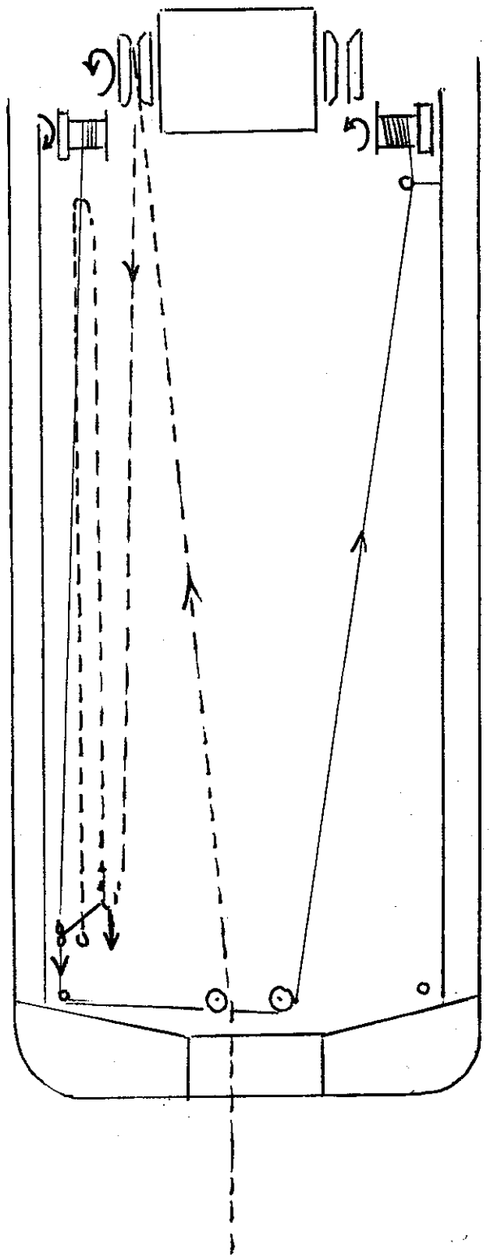


STOWAGE OF CHAIN ON DECK — FULL DECK STOW (cont'd)

Diag 121.
Make fast tuggers to the chain below gypsy, commence heaving on windlass and tuggers to create second fleet.

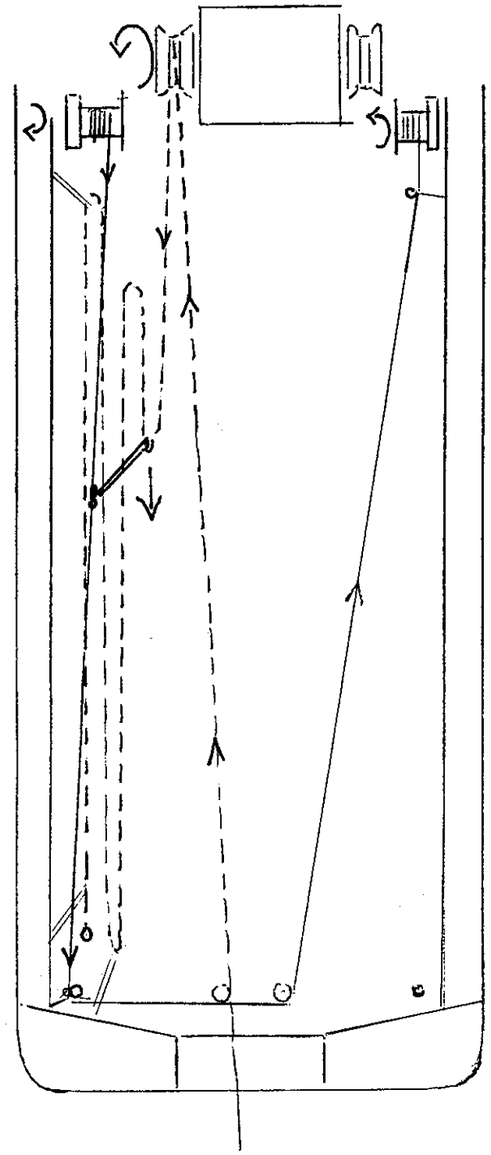


Diag 122.
Second fleet pulled aft.

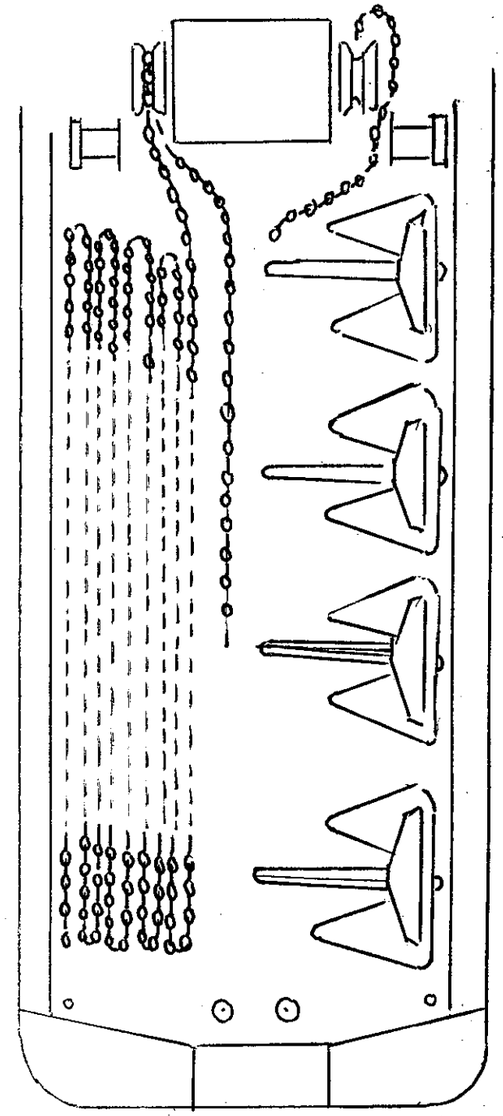


STOWAGE OF CHAIN ON DECK — FULL DECK STOW (cont'd)

Diag 123.
First and second fleet made — slipped off tuggers overhauled. Starting on third fleet repeat steps as shown in diagrams 120-122.



Diag 124.
Deck completely filled on port side with chain.
Starboard locker full.
Starboard side stowed with anchors.



Diag 125. STOWAGE OF CHAIN ON DECK — STOPPING OFF AND OTHER DETAIL

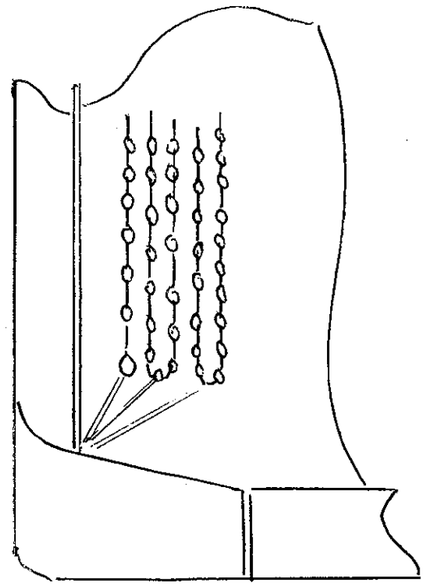
A. All fleets of chain should be stopped off with rope both forward and aft.

B Tuggers rigged to form "overhaul" rig. Connection between tuggers consists of shackles and large dual Kuplex ring to which is shackled a safety hook (Ramnes type).

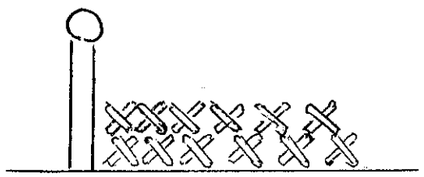
An endless loop of 12/15mm diameter grade 80 open link chain about 1½ metres long is used as the attachment between tuggers and cable.

C Several layers of chain may be stowed one on top of the others but the first and subsequent layers must be tightly stowed to ease strains on tuggers when overhauling bights.

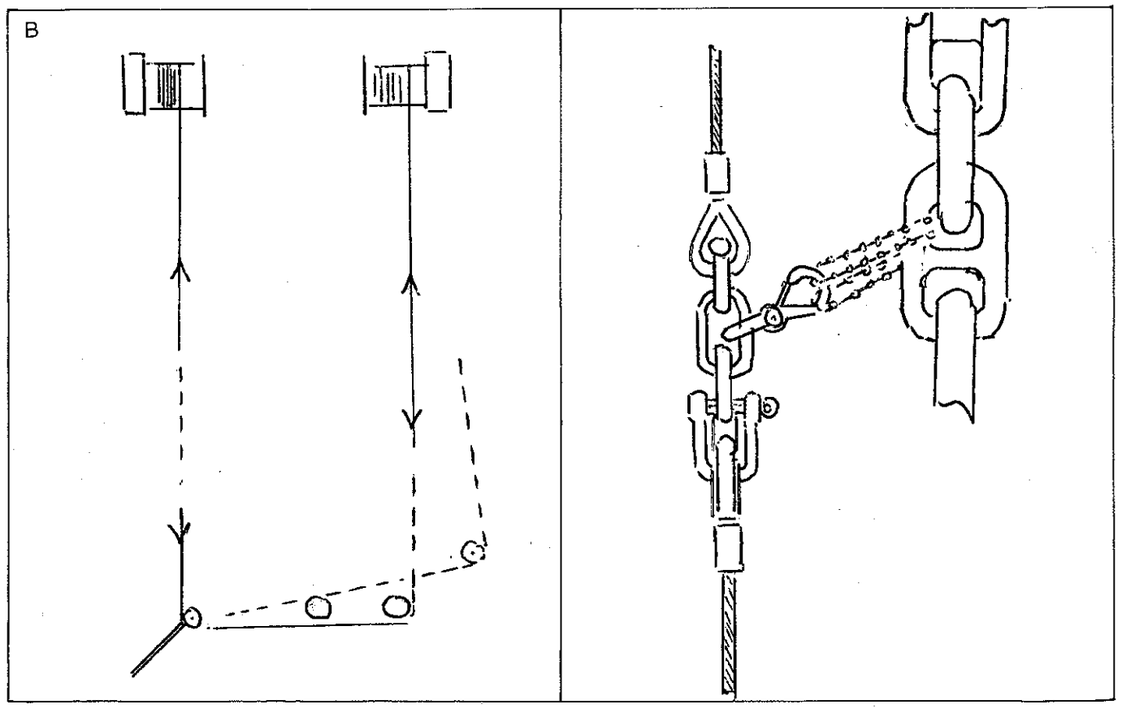
A



C



B



j. Making and breaking* connecting links and types of connecting links

During chain handling operations especially when deploying new chains to a barge or some similar operation the boat may be required to fit connecting links between various lengths of chain or between chain and wires. The connecting links will be sent aboard and it's often left up to the boat to "get on with it".

Before discussing the various problems there are two rules which must be observed.:

1. **Always** clean up and take off the numbers and marks on the connecting link before you "break it" (disassemble it). Make a list of the numbers and marks applicable to each connector and using some broad good quality synthetic wrapping tape (Duct tape), put a "tale" on the connector, marking it Number 1 etc., so that connector number 1 with its serial number is readily checkable from your list.

2. **Never** dissassemble a connecting link without first **punch marking** each section so that it goes back together the same way it came apart.

The illustrations show the most common types of connecting/joining links found offshore. The following hints may assist in assembly/disassembly of these items.

k. Assembly/disassembly notes

1. When breaking Kenter type links don't hammer in way of the joins of the constituent parts. Use two sledge hammers on each shoulder of the link striking simultaneously.

2. Don't apply heat with the oxy/acetylene torch or rosebud unless as a last resort and then only with the permission of the barge or chain owner. If heat is used do it gradually and allow the link to cool naturally without the application of a fire hose. Sudden cooling like excessive heating can damage the metallic structure of the connector seriously weakening it.

3. When receiving connecting links from a barge offshore always check that they can be easily "broken" before leaving the vicinity of the crane as a barge's workshop is generally better fitted out than the boat's for applying force to open the connector up.

4. Once a connector has been broken down into its constituent parts clean all the mating surfaces thoroughly with diesel oil and a power wire brush. Coat the mating surfaces thoroughly with a good quality **light grease**, No. 2 grade. Heavy greases and such compounds as Never Seize, Copperslip and others may prevent finely machined surfaces matching up, providing frustrating and doomed efforts to get the link back together.

5. Remember that many patent connecting link locking pins are tapered and the pin should fit without anything other than light tapping. Seat it with sharp blows using the correct sized pin punch.

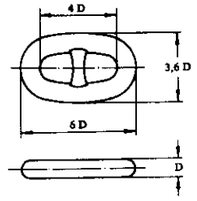
6. When putting in the lead plug use a plug that fills up the hole completely. In a connecting Kenter link for 76mm diameter chain the lead plug should be about 40mm to 50mm long and 20mm to 25mm diameter.

8. When inserting connecting links into lengths of chain orientate the link **in line** with **both pieces of chain** don't throw a half turn in the chain by manipulating one piece of chain. Sometimes to achieve this correct orientation and avoid a twisted chain it will be necessary to **cut off** one link from the end of one piece.

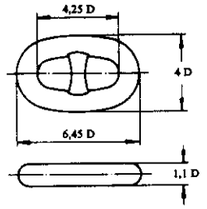
** NOTE: "Breaking" or to "break" a connector means to dissassemble it. "Making" means to re-assemble it.*

Diag 126. CONNECTING LINKS AND SHACKLES

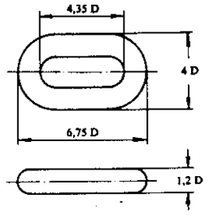
a/Common link



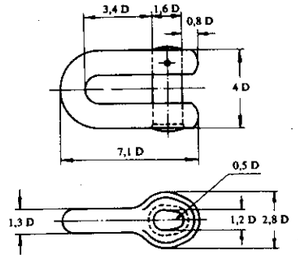
b/Enlarged link



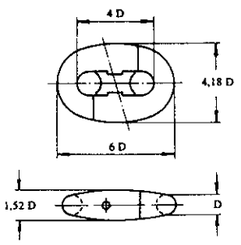
c/End link



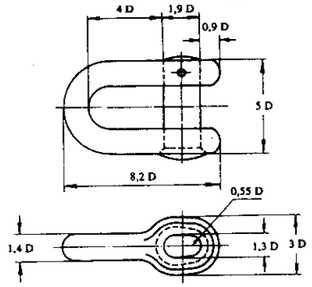
d/Joining shackle type D



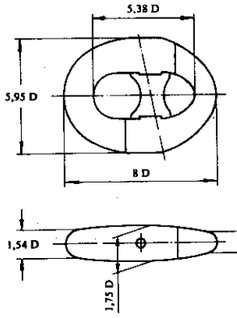
e/Joining shackle type Kenter



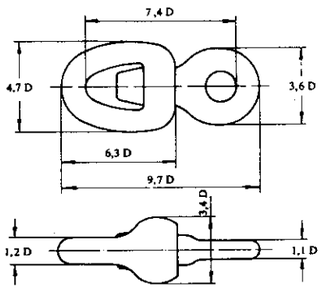
f/Anchor shackle type D



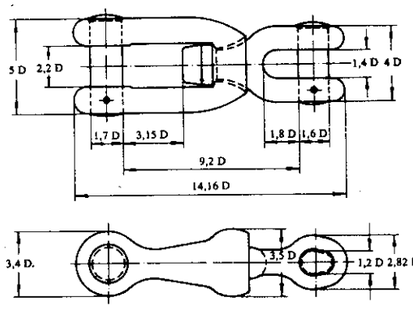
g/Anchor shackle type Kenter



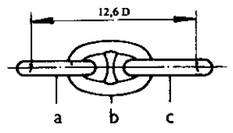
h/Swivel (Grade 2)



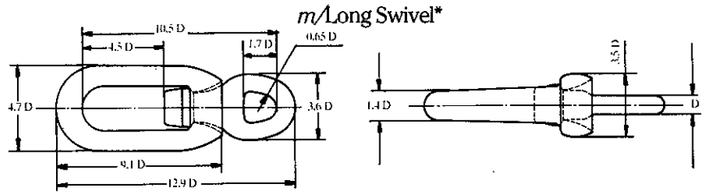
i/Swivel shackle (All Grades)*



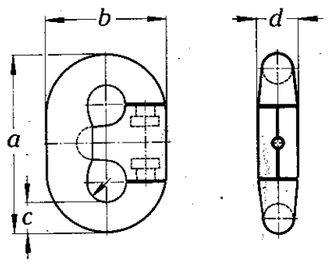
k/Adaptor



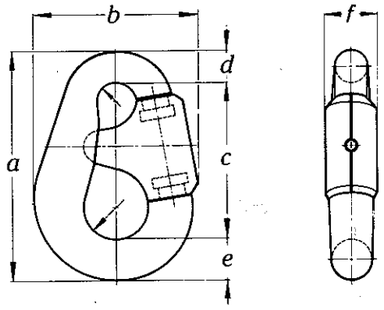
m/Long Swivel*



n/Detachable chain connecting link**



o/Detachable Anchor connecting link**

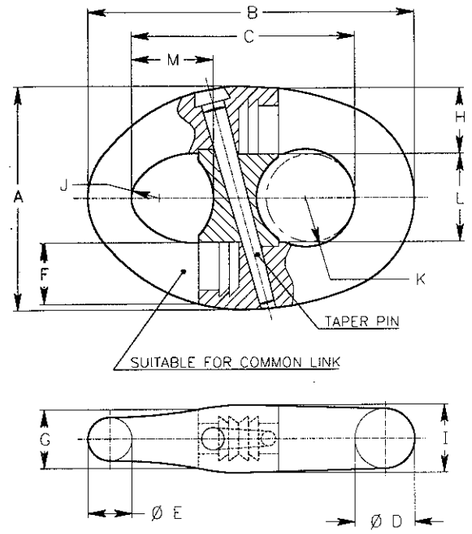


D = nominal diameter of Chain

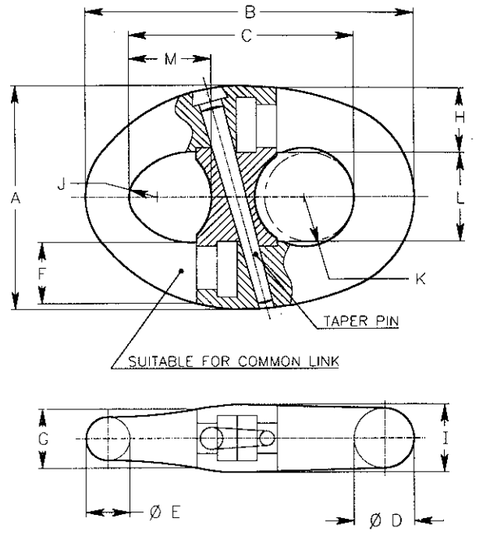
Chain Length over 5 Links:
Min. = 22d Max. = 22.55d

Diag 127. CONNECTING LINKS AND SHACKLES (cont'd)

RAMFOR™ Anchor shackle

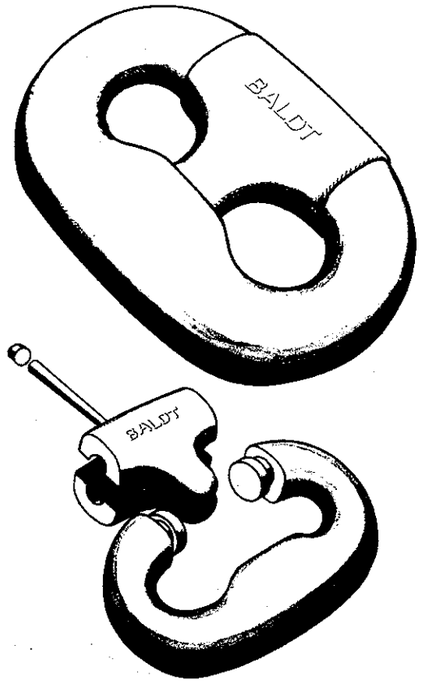


KENTER Anchor shackle

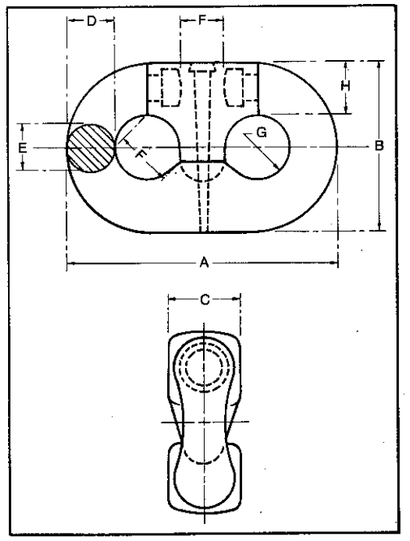


Common link Ø	A	B	C	D	E	F	G	H	I	J	K	L	M
76 mm	405	588	402	108	78	109	112	116	123	51	89	160	133
84 mm	440	640	437	118	85	118	122	126	134	55	96	174	145
95 mm	497	723	494	132	96	134	138	143	152	62	109	196	164

Forging tolerances ± 2,5%

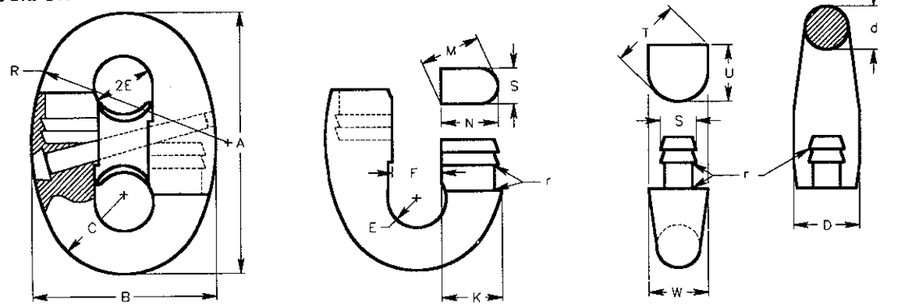


CHAIN SIZE INCHES	CHAIN SIZE MM	A	B	C	D	E	F	G	H	PROOF TEST IN POUNDS	BREAK TEST IN POUNDS
3	76	18½	12⅝	4½	3¼	3¼	3⅜	1²¹/₃₂	4⁹/₃₂	810800	1274000

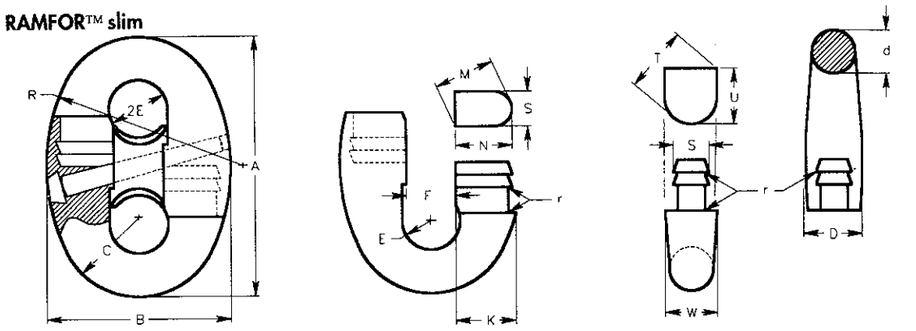


Diag 128. CONNECTING LINKS AND SHACKLES (cont'd)

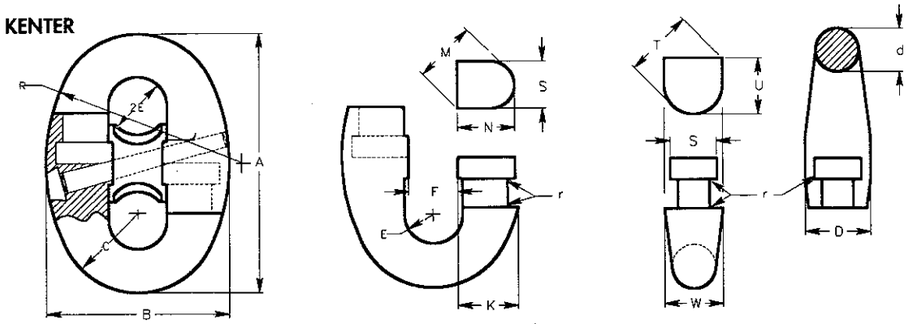
RAMFOR™



RAMFOR™ slim

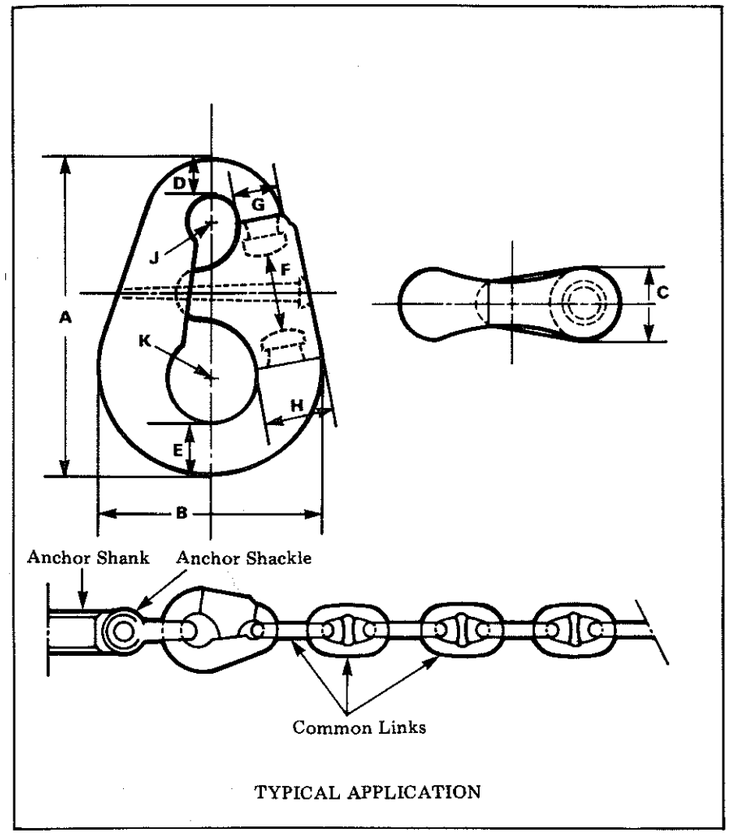


KENTER

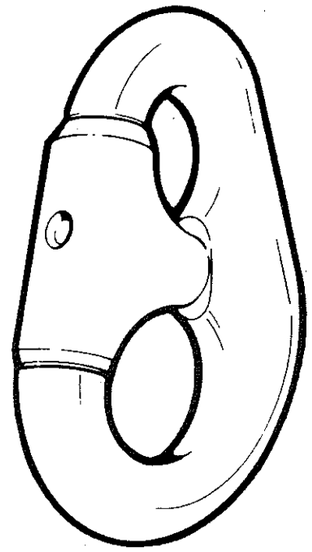


Dimension designation	RAMFOR™ nominal dimension times d.	RAMFOR™ slim nominal dimension times d.	Kenter nominal dimension times d.	Tolerance % +	Tolerance % −
A	6,00	6,00	6,00	2,0	2,0
B	4,20	4,20	4,20	2,0	2,0
C	1,83	1,83	1,83	2,5	2,0
E	0,67	0,67	0,67	0,0	2,5
R	4,50	4,50	4,50	2,5	2,0
K	1,40	1,40	1,40	2,5	2,0
S	1,00	0,82	1,10	2,5	2,5
M	1,41	1,41	1,45	2,5	2,5
N	1,28	1,32	1,32	2,5	2,5
W	1,34	1,22	1,34	2,5	2,0
F	1,13	1,13	1,13	0,0	2,5
T	1,59	1,59	1,59	2,5	2,0
U	1,30	1,30	1,30	2,5	2,0
D	1,52	1,30	1,52	2,5	2,0
d	1,00	1,00	1,00	2,0	2,0
r	0,03	0,03	0,03	–	–

Diag 129. CONNECTING LINKS AND SHACKLES (cont'd)

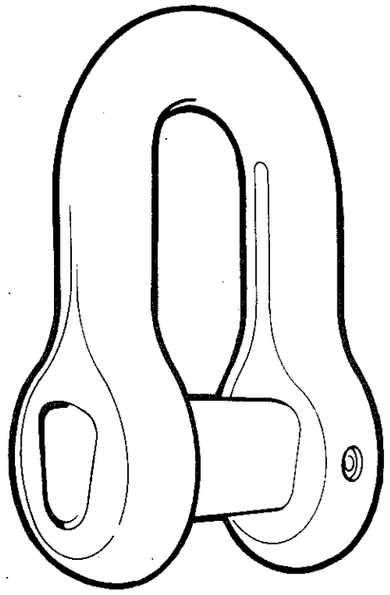


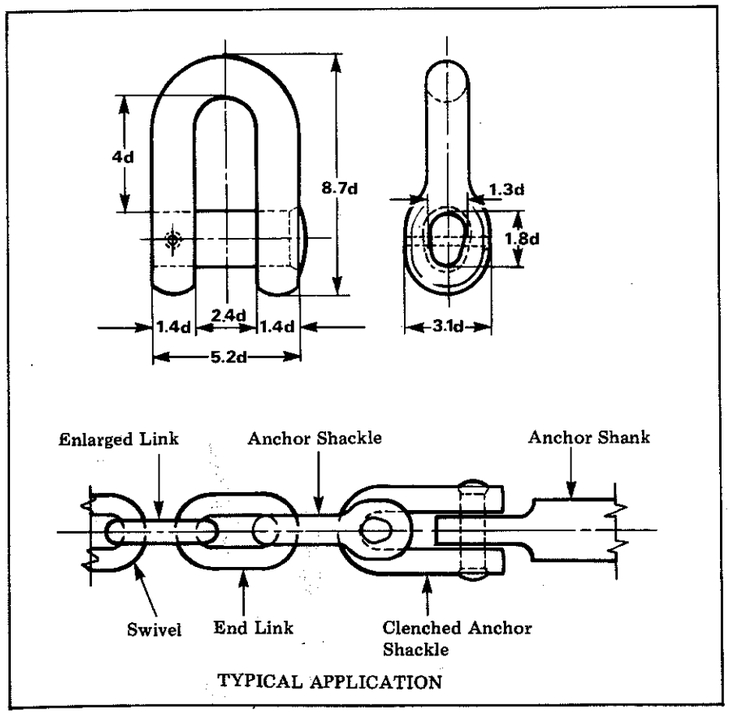
TYPICAL APPLICATION



No.	Chain Size mm / in	A	B	C	D	E	F	G	H	J	K	Proof Load kg / lb	Weight kg / lb
3	25 — 30 1 — 1 3/16	238 9 3/8	165 6 1/2	44 1 3/4	32 1 1/4	38 1 1/2	73 2 7/8	32 1 1/4	44 1 3/4	19 3/4	35 1 3/8	53515 118000	6.4 14
4	32 — 40 1 1/4 — 1 9/16	298 11 3/4	206 8 1/8	57 2 1/4	38 1 1/2	48 1 7/8	83 3 1/4	44 1 3/4	57 2 1/4	29 1 1/8	44 1 3/4	90947 200500	12.7 28
5	42 — 51 1 5/8 — 2	379 14 7/8	260 10 1/4	76 3	51 2	64 2 1/2	98 3 7/8	60 2 3/8	73 2 7/8	32 1 1/4	54 2 1/8	146060 322000	27 60
6	52 — 60 2 1/16 — 2 3/8	454 17 7/8	311 12 1/4	89 3 1/2	60 2 3/8	76 3	121 4 3/4	73 2 7/8	89 3 1/2	38 1 1/2	64 2 1/2	202758 447000	48 107
7	62 — 79 2 7/16 — 3 1/8	562 22 1/8	375 14 3/4	117 4 5/8	79 3 1/8	95 3 3/4	150 5 7/8	86 3 3/8	111 4 3/8	48 1 7/8	76 3	339293 748000	94 208
8	81 — 92 3 3/16 — 3 5/8	654 25 3/4	419 16 1/2	133 5 1/4	92 3 5/8	124 4 7/8	150 5 7/8	111 4 3/8	133 5 1/4	54 2 1/8	79 3 1/8	463126 1021000	149 328
9	94 — 95 3 11/16 — 3 3/4	692 27 1/4	435 17 1/8	149 5 3/4	98 3 7/8	130 5 1/8	159 6 1/4	137 5 3/8	140 5 1/2	57 2 1/4	83 3 1/4	508032 1120000	236 520

Diag 130. CONNECTING LINKS AND SHACKLES (cont'd)





TYPICAL APPLICATION

Size		Weight	
mm	in	kg	lb
19	¾	2.5	5.5
22	⅞	3.8	8.4
25	1	6.0	13.2
29	1⅛	8.4	18.5
32	1¼	11.3	24.9
35	1⅜	15.5	34.1
38	1½	19.8	43.6
42	1⅝	26	57
44	1¾	32	70
48	1⅞	39	86
51	2	48	106
54	2⅛	57	125
57	2¼	67	147
60	2⅜	80	176
64	2½	93	205
67	2⅝	106	233
70	2¾	121	266
73	2⅞	141	310
76	3	159	350
79	3⅛	182	401
83	3¼	203	447
86	3⅜	230	507
89	3½	255	561
92	3⅝	281	620
95	3¾	310	682
98	3⅞	345	761
102	4	378	832

1. Cutting chain

When a chain has to be cut, the chain owner's permission having been obtained and the position of the cut agreed, set up the job so that the operation can be done efficiently and quickly.

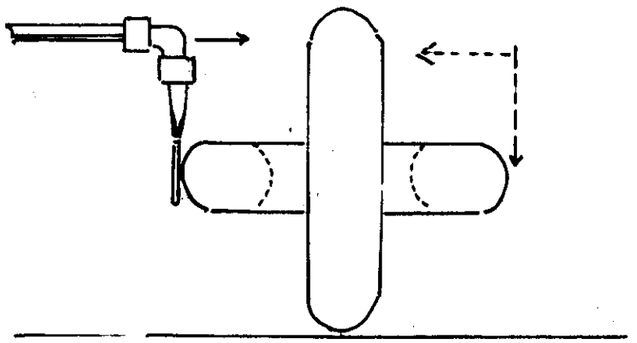
The oxygen and acetylene bottle pressures must be correctly set and the nozzle of the torch the correct size for the job (see relevant section in volume 4 of this series, Towing, for table of pressures and nozzle types).

Orientate the link to be cut so that "downhand" cutting is used and cut the link as shown in the sketch.

Bring the metal to melting point before applying full nozzle pressure then cut continuously at a speed so that molten metal flows away in a stream without pause.

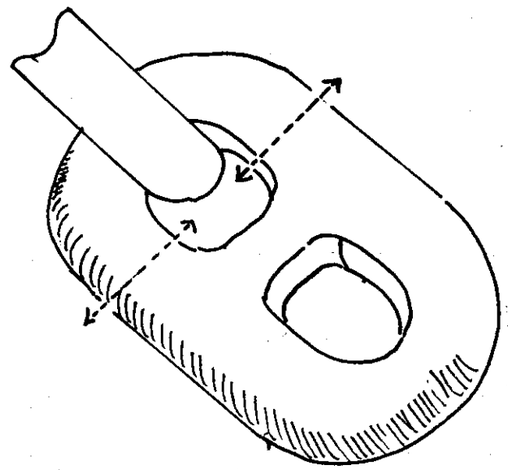
Using a good set of equipment and moderate skill a 76mm chain link can be cut off in about five minutes.

Diag 131.



Orientate the links with crowbars so that the link to be cut lies horizontal; cut in from each side.

The dotted lines show the cut positions.



HANDLING CHAIN (cont'd)

m. General chain handling notes
Many masters, after their first experience of handling large amounts of chain, will modify and improve their procedures to make a similar job go better next time.

The following are typical ideas which can be usefully adopted.

1. "Obtain" (perhaps from a junk piece of chain) two thirty foot long lengths of 76mm chain and keep these in the chain lockers (burn out the studs from the end links). These **tails** are easily hauled up over the gypsies by a tugger, when next you have to handle chain and it saves much time and effort in dragging a chain up and over the wildcat.

2. Take photographs, make notes and sketches on how a particular "chain job" was done so that next time life can be made easier, the file staying with the boat.

3. If the configuration of the chain lockers, or design of the winch gypsies makes work particularly difficult, explain to the "customer" that extra time may be needed outside his expectations, before starting the job.

PART 8. SUPPORT MOORING OPERATIONS

a. Introduction
Four types of mooring system are shown, all typical of what might be expected.

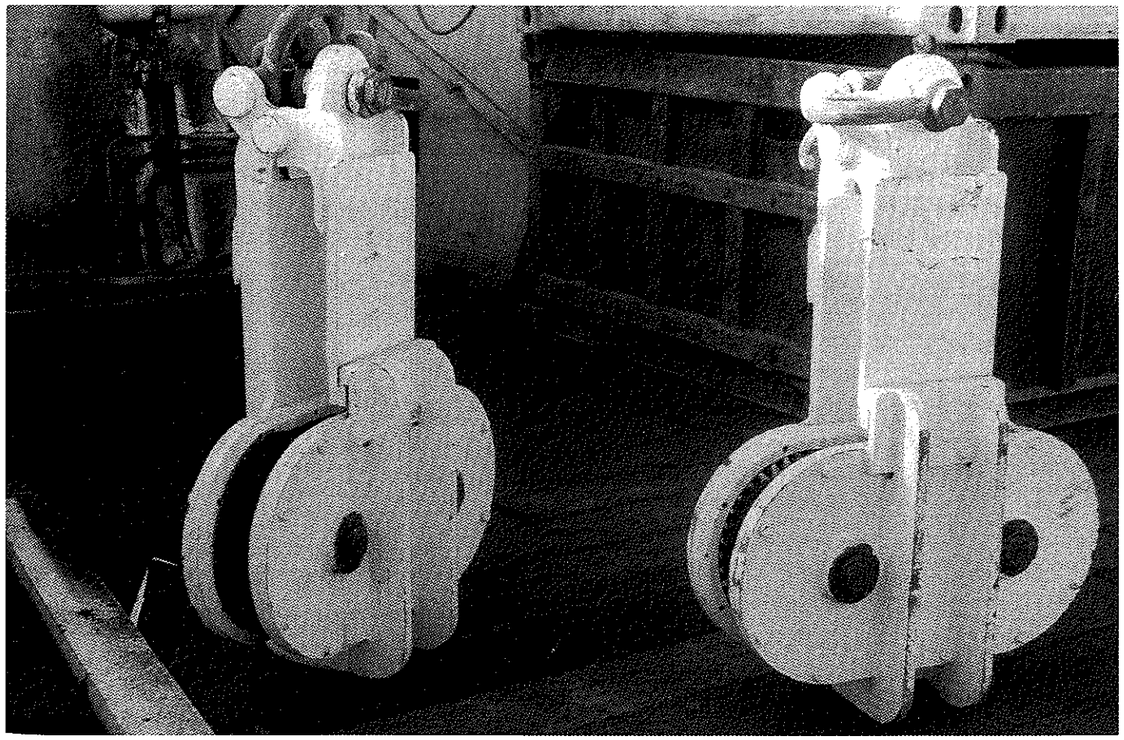
The first is running a Yokahama fender on a laybarge mooring wire to enable it to be held clear of a pipeline (diagram 132).

In the simplest form the Yokahama is clamped to the mooring wire above the obstruction after fishing the wire with a chasing block.

More sophisticated methods involve the use of patent support mooring blocks which are designed to allow the tug to tow the buoy and block out along the mooring wire to the desired point of support and there let it go. When the anchor has to be repositioned further ahead the tug picks up the anchor and as the wire is taken out the support block "walks" in the opposite direction maintaining its position over the obstruction (diagram 133).

The third example shows the running of a subsurface buoy to hold a mooring chain above a single seabed obstruction. The reason the subsurface buoy is used is to keep the sea surface clear for the traffic moving in the area (diagram 134).

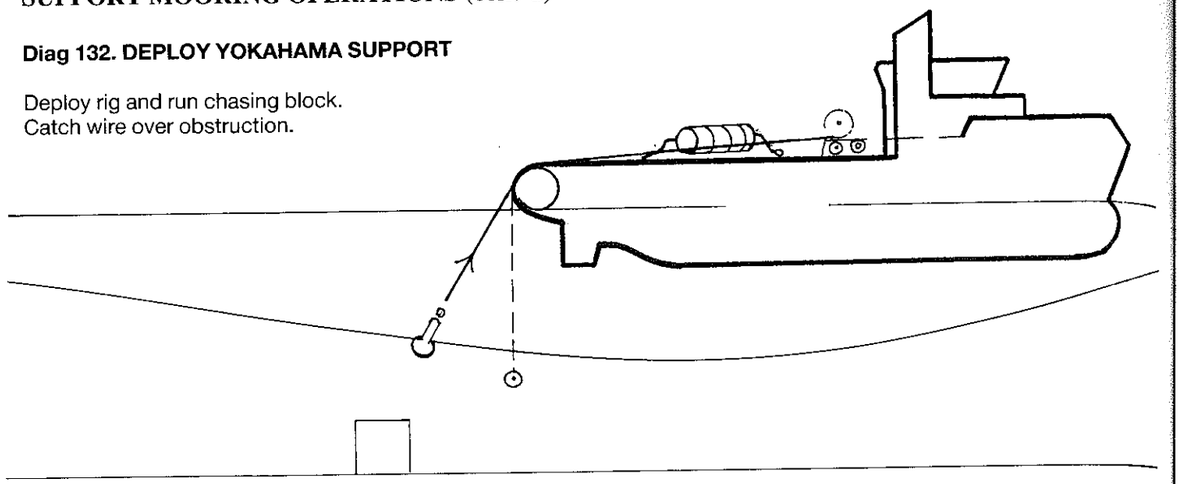
The fourth example details the more complex support systems used to run heavy moorings over multiple seabed obstructions (see diagram 135).



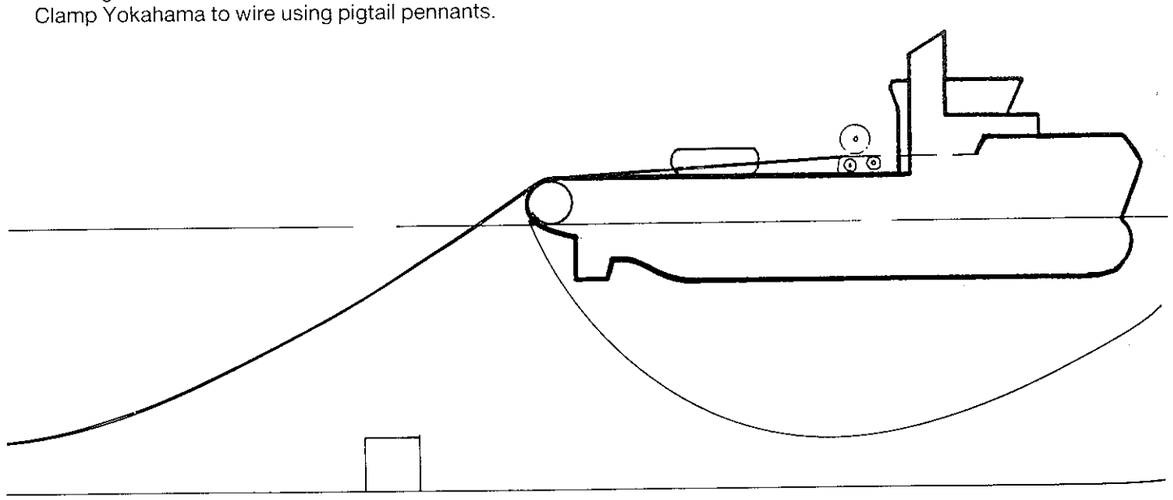
Midline support buoy blocks
These patent blocks are positioned at the desired support point on the mooring wire over the obstruction and connected to a large mooring buoy. The action of the sheaves will keep the buoy in the desired position.

Diag 132. DEPLOY YOKAHAMA SUPPORT

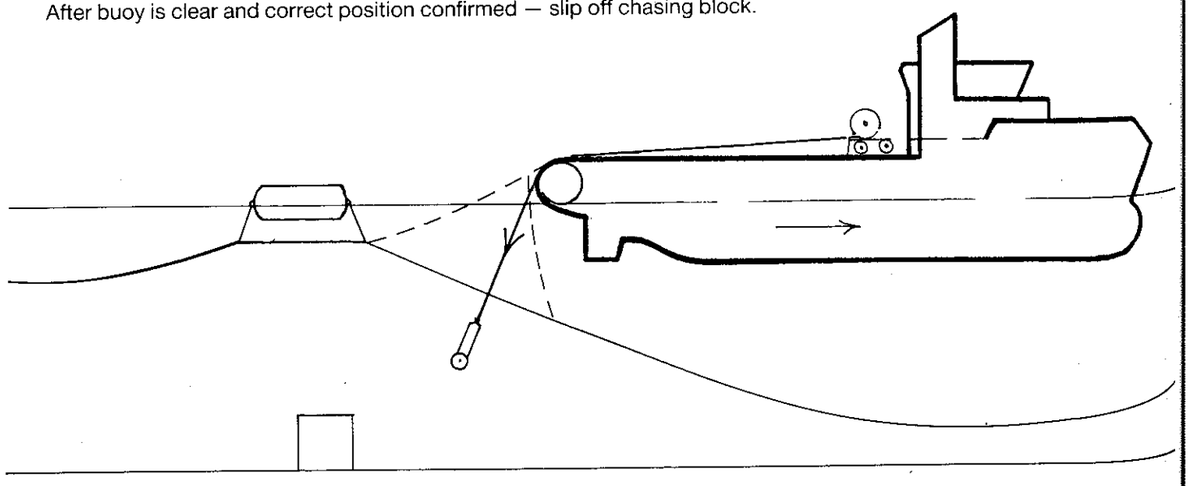
Deploy rig and run chasing block.
Catch wire over obstruction.



Haul bight of wire aboard — hold bight in block.
Clamp Yokahama to wire using pigtail pennants.

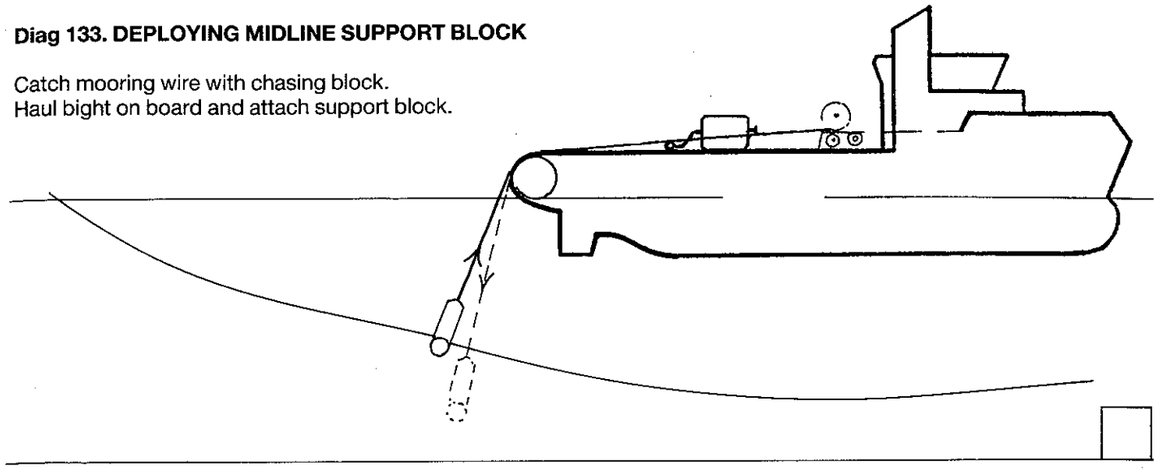


Launch Yokahama by steaming ahead and slacking on chasing block.
After buoy is clear and correct position confirmed — slip off chasing block.

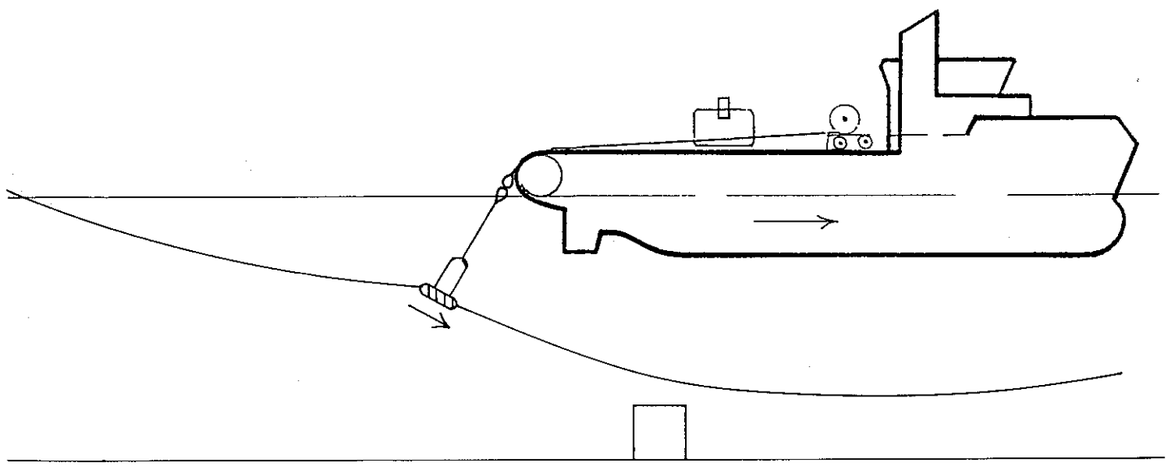


Diag 133. DEPLOYING MIDLINE SUPPORT BLOCK

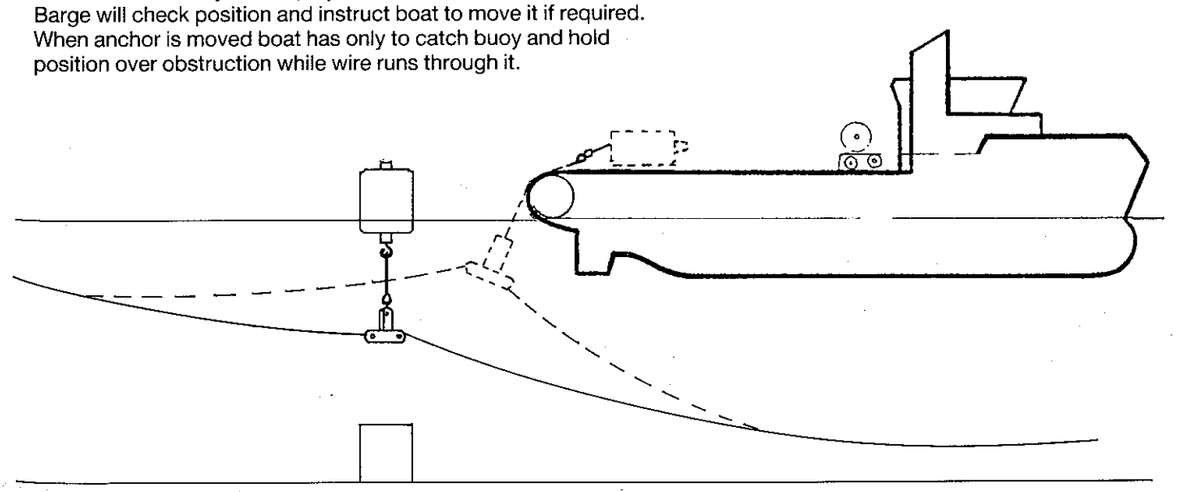
Catch mooring wire with chasing block.
Haul bight on board and attach support block.



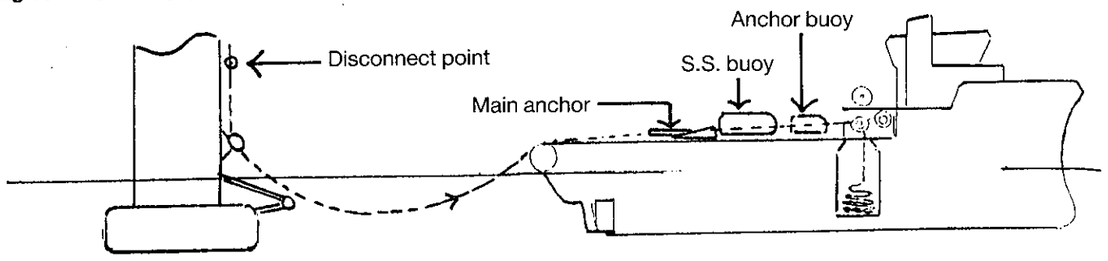
Run out to position over obstruction.



Attach surface buoy and deploy.
Barge will check position and instruct boat to move it if required.
When anchor is moved boat has only to catch buoy and hold position over obstruction while wire runs through it.

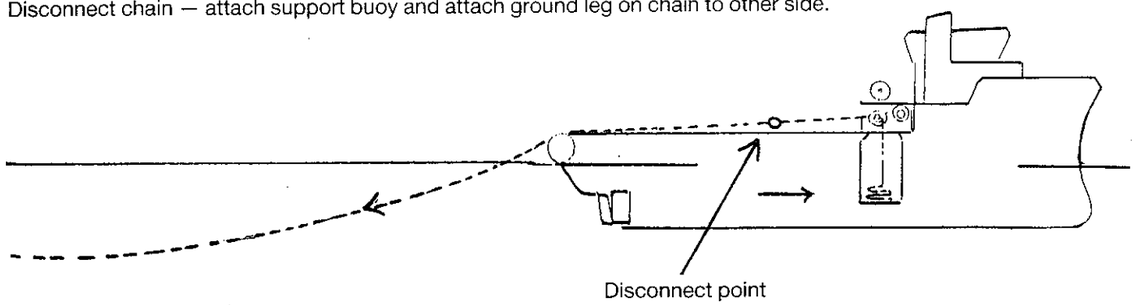


Diag 134. RUNNING SUB-SURFACE SUPPORT BUOY

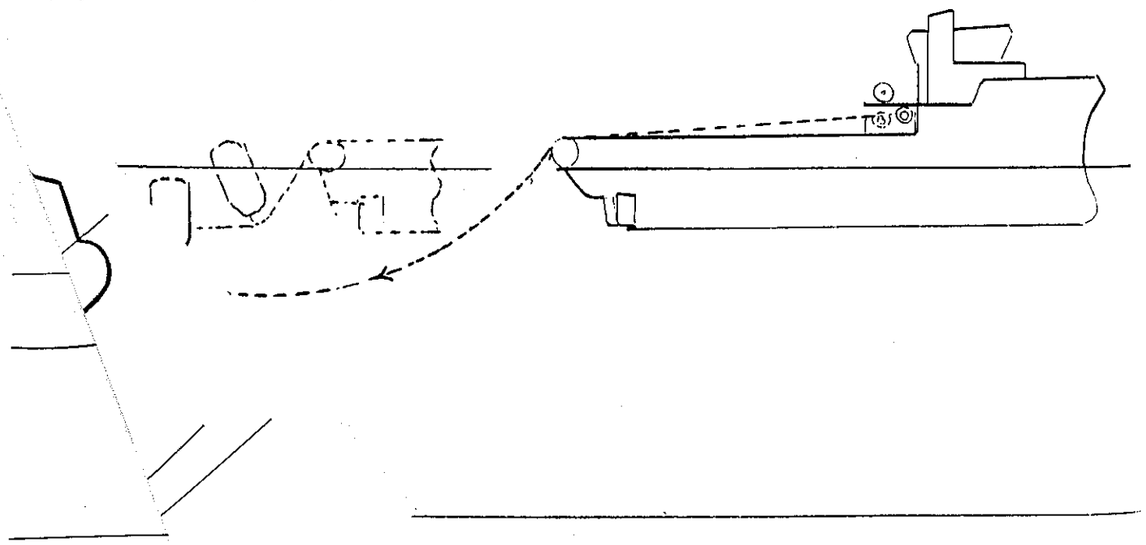


Boat takes barge anchor on board — disconnects from chain.
Boat hauls chain into locker until stop mark reached.
The stop mark (connection link).

Boat commences moving out to position over obstruction reeling out chain from locker.
Stop mark should now be on deck.
Disconnect chain — attach support buoy and attach ground leg on chain to other side.

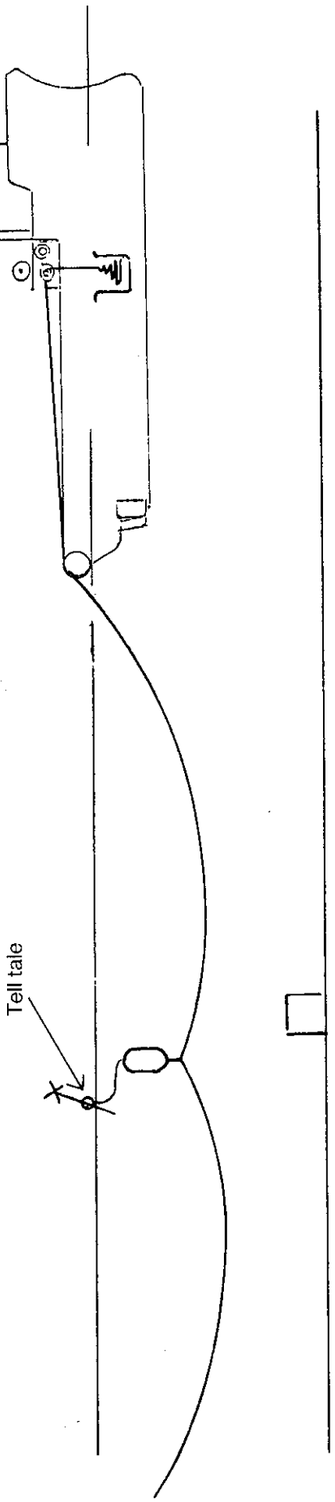


Deploy sub-surface buoy — keep slacking out chain



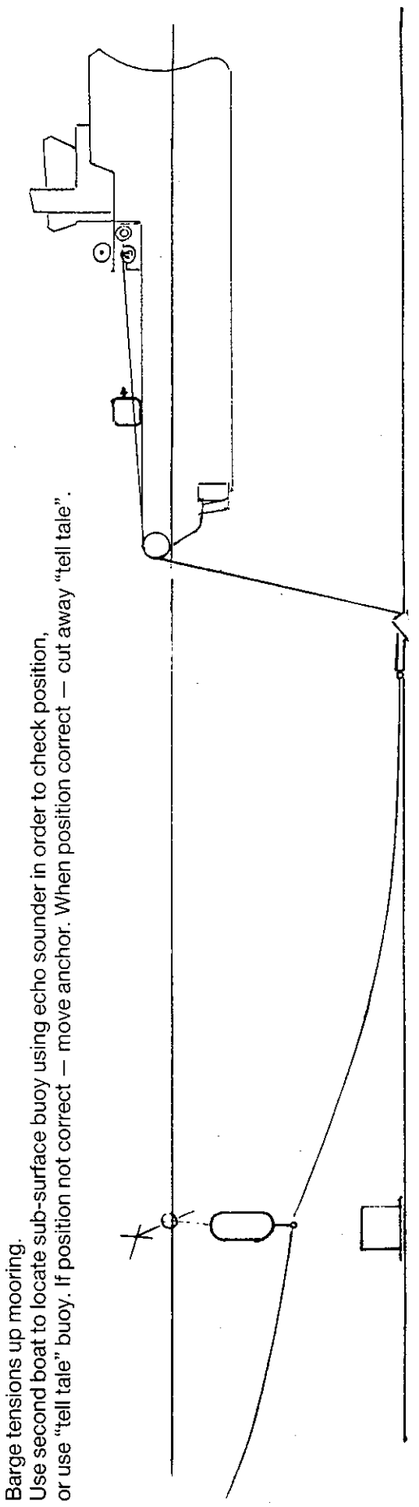
Diag 134. RUNNING SUB-SURFACE SUPPORT BUOY (cont'd)

Deploy remaining chain

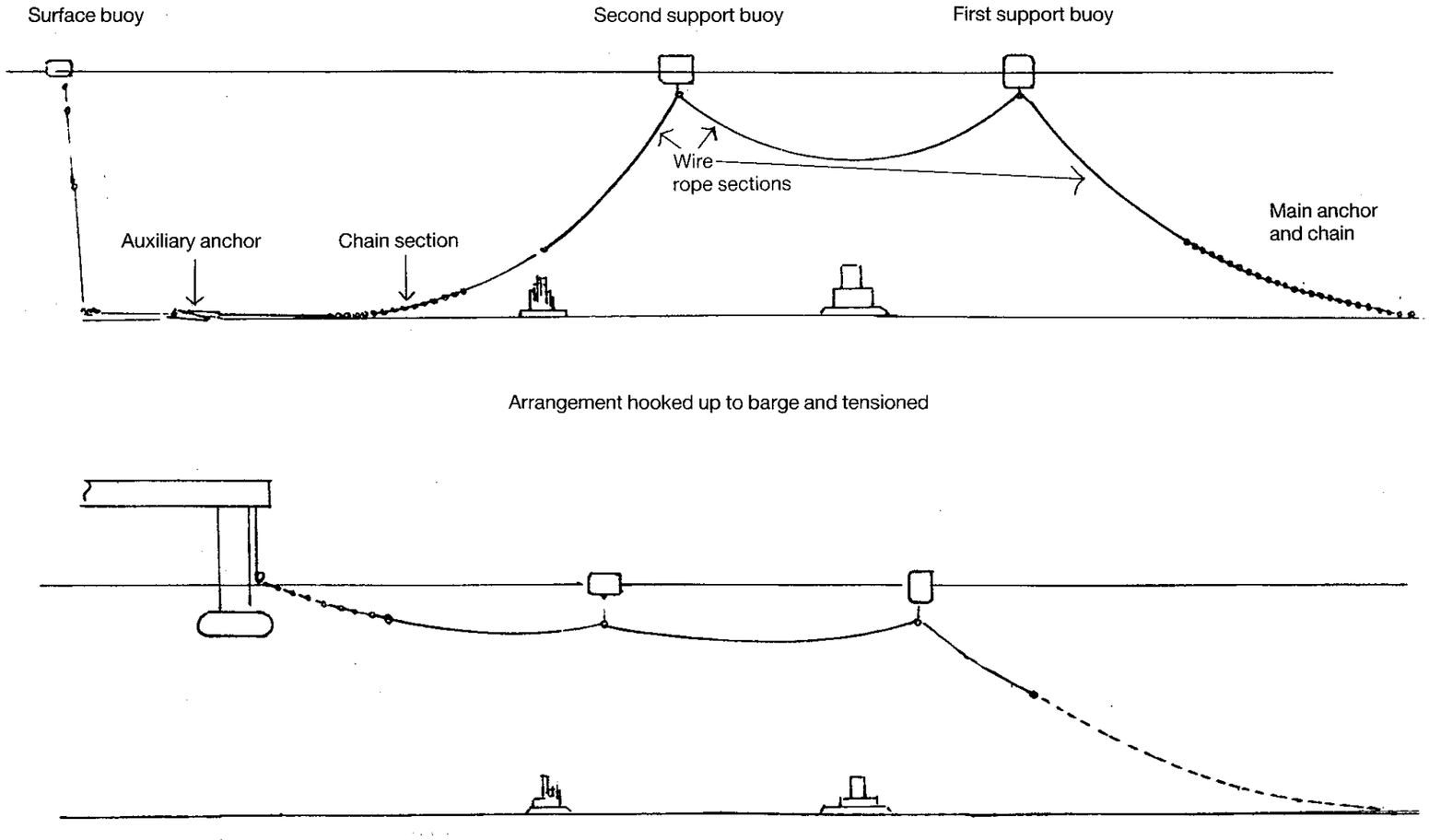


Tell tale Polypropylene rope riser
one metre diameter float with radar reflector

Attach anchor and run to bottom.
Barge tensions up mooring.
Use second boat to locate sub-surface buoy using echo sounder in order to check position,
or use "tell tale" buoy. If position not correct — move anchor. When position correct — cut away "tell tale".

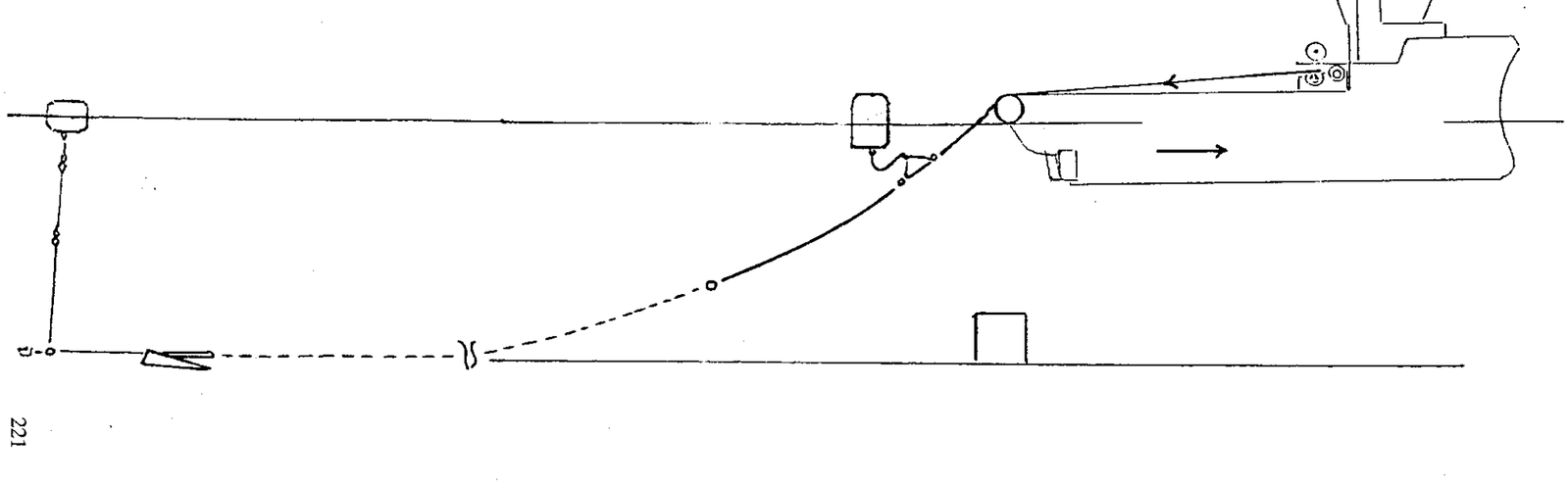


Diag 135. MULTIPLE POINT SUPPORT MOORING — ARRANGEMENT PRELAID AWAITING BARGE

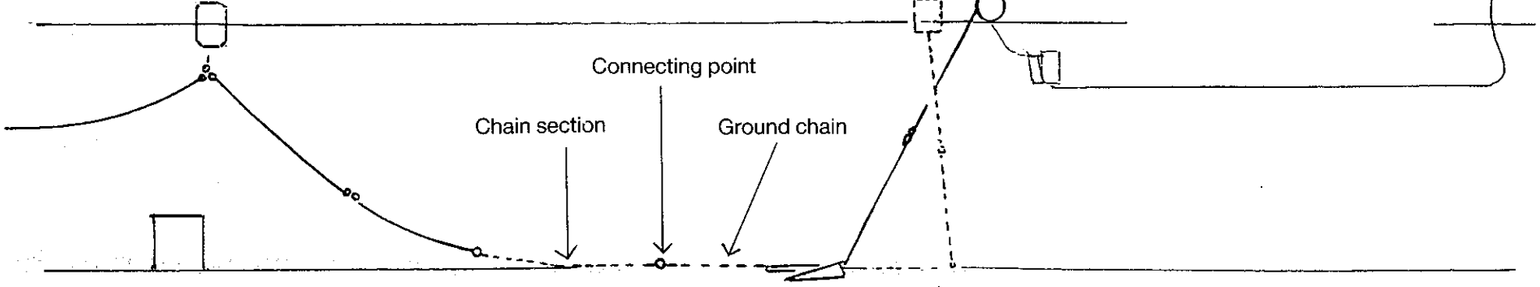


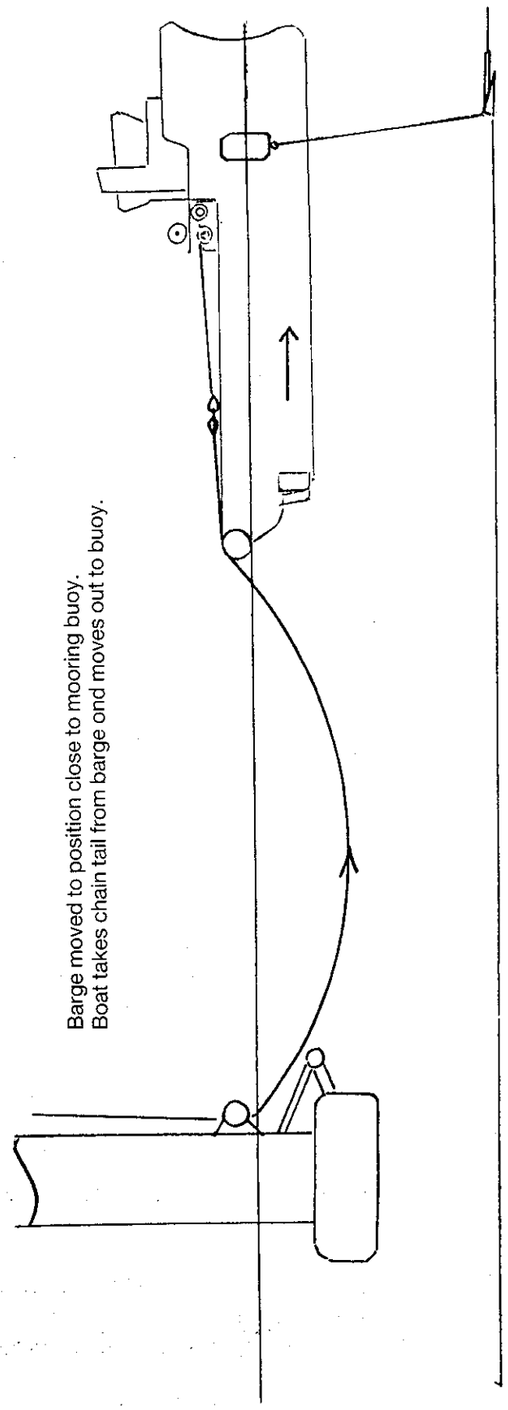
Diag 135. MULTIPLE POINT SUPPORT MOORING (cont'd)

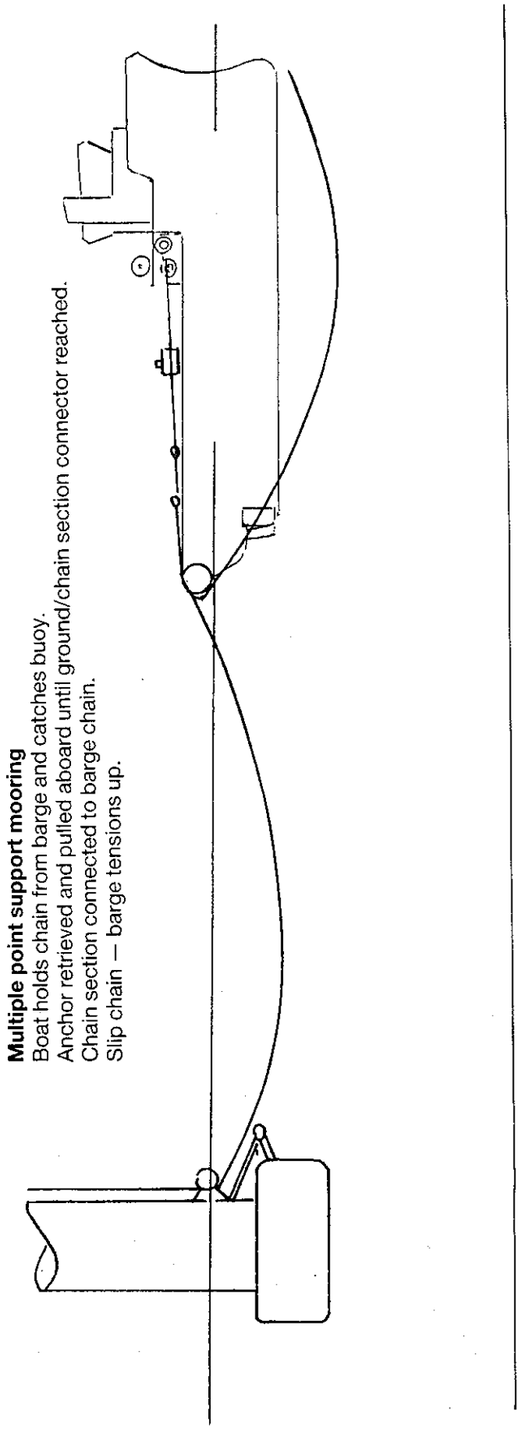
Main anchor and ground chain laid and pretensioned.
Running first section of wire and first support buoy.



Multiple point support mooring
Second support buoy run
Last section of wire and chain section deployed.
Auxiliary anchor run — tensioned and buoyed off — wait on barge arrival.







Diag 135. MULTIPLE POINT SUPPORT MOORING (cont'd)

b. Pre-laid mooring systems

Towing and positioning the floating structure (of whatever type) onto location and assisting in the hook-up of the mooring spread, is a complex operation.

The AHT may be required to assist in the movement of a dedicated pulling barge whose own mooring spread will have to be shifted as it's used to tension and connect up all the elements of the system.

In some cases the anchor handling vessel will be re-rigged with specially designed wildcats to handle the particular chain type and size being used. Heavy duty A-frames may be rigged at the stern to provide headroom when tensioning or pulling on mooring line sections.

There will be detailed installation plans and procedures to follow and vessel selection for the operation is often based on quite rigid criteria.

In a multi-leg mooring system the designer of the system will have established a set of criteria defining the capabilities of the "spread" in terms of holding power and allowable movement of the moored structure. In order to achieve these parameters the anchors will have to be precisely located and embedded and the "legs" of the system must all be tensioned to within fairly rigid values. All the elements of the system, the anchors, the ground legs, the suspended sections and the connection and locking mechanisms on the structure to be moored are often custom designed so only generalisations can be given here.

c. Pre-laid moorings

There are a number of different types of structures found in the offshore oilfields which are held in place by catenary mooring systems specifically designed for that structure.

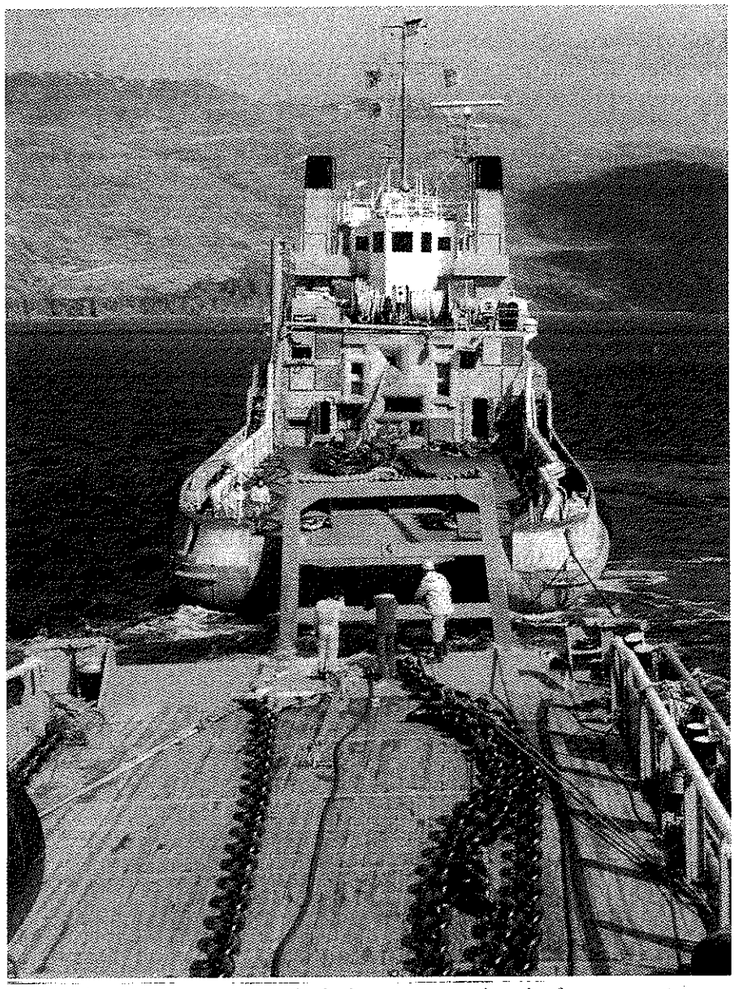
The structures themselves are not designed to deploy or manipulate the mooring system to any large extent and therefore the systems are put in place prior to the arrival of the structure which is then made fast to the mooring lines.

Examples of such systems are single buoy moorings for the export of gas and oil into tankers, various types of floating tower structures to which a production vessel is moored, (FSU) floating storage units, semi-submersible and ship shaped production and export vessels.

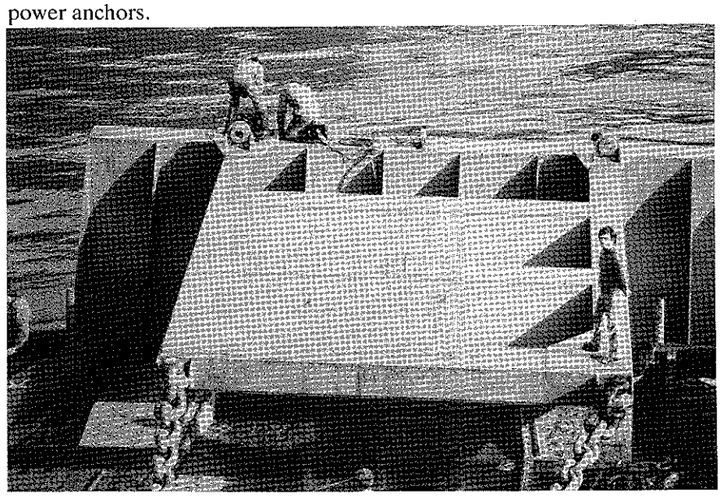
Many of these mooring systems are made up of piled anchors or extremely large clump anchors installed with specialist work vessels. The mooring lines may consist of chains up to 180mm diameter or more and these chains are usually deployed using work barges assisted by tugs.

During the period that these very large systems are being put in place the role of the anchor handling tug is limited to assisting the work barges.

If the system to be installed is within the capability of large AHTS class vessels then their duties might include deployment of high holding power specialist anchors, running the mooring chains, tensioning the anchors, tensioning the chains, rigging and laying the main mooring spread retrieval system.



Laying the mooring spread at the inshore construction site for a concrete gravity structure — Note specially designed and fabricated high holding power anchors.



d. Testing pre-laid moorings

In the following diagrams an operation to install a support mooring is shown where the AHT lays down the primary anchor and embeds and tensions it prior to laying the rest of the support mooring.

The procedure for laying and test pulling high holding power anchors requires quite careful planning if the operation is to achieve its aim which is to deploy embed and test the mooring line to its full design capability.

All the following factors should be known or evaluated before starting the operation.

1. The soil characteristics of the seabed in the area concerned (soil profile).

2. The likely behaviour of the anchor type to be used in the particular soil type where it must operate. Drag, penetration, holding power.

3. The method of deployment, pull in (embedment) distance and the values to be achieved at full test tension.

4. The length of the "ground leg" at full test tension so that no vertical up lift on the anchor will occur.

5. The method of vessel positioning to be employed so that the anchors are correctly placed, initially after dragging and embedment, reach their defined "target" positions so that the mooring line reaches the structure or vessel to be moored and is not too long or too short.

6. The mooring line scope must be closely defined in terms of hook up working tension and test tension. Anchor surveys may well be needed after test tensioning using an ROV with TV camera.

7. The organisation of the various elements of the mooring system must be planned so that the work boats are rigged up with the gear in the proper order. The interconnections between elements of the mooring system may require rigid control by third party to satisfy underwriters and other interested parties and these same third parties may require detailed certification packages on all the gear used. Test tension data from load cells or tension meter printouts and survey data, including video tape of the anchors after test loading at the completion of the operation.

In most cases the work boat master can expect the representatives of the various interested groups to live aboard his vessel for the duration of the work and he will be expected to fully cooperate with them. If the master of the boat is not fully familiar with either the particular operation or similar work, he should ask the attending representatives for their advice as many of them are highly experienced mariners. Their job is to assist in the work and they will in most cases offer many valuable and time saving ideas on how to achieve the desired aim.

d. Testing pre-laid moorings (cont'd)

CAUTION
Whenever drag embedment anchors are going to be used especially for pre-laid mooring operations and support mooring systems where anchor target positions are critical to properly deploy the system, it is usual to carry out a drag test on site with the actual equipment before placing the anchor.

This test is to confirm that the assumptions and calculations made by the designer are correct. Failure to carry out a test can lead to much time wasting effort when it is found that what look like perfectly satisfactory ideas on the drawing board don't work in practice.

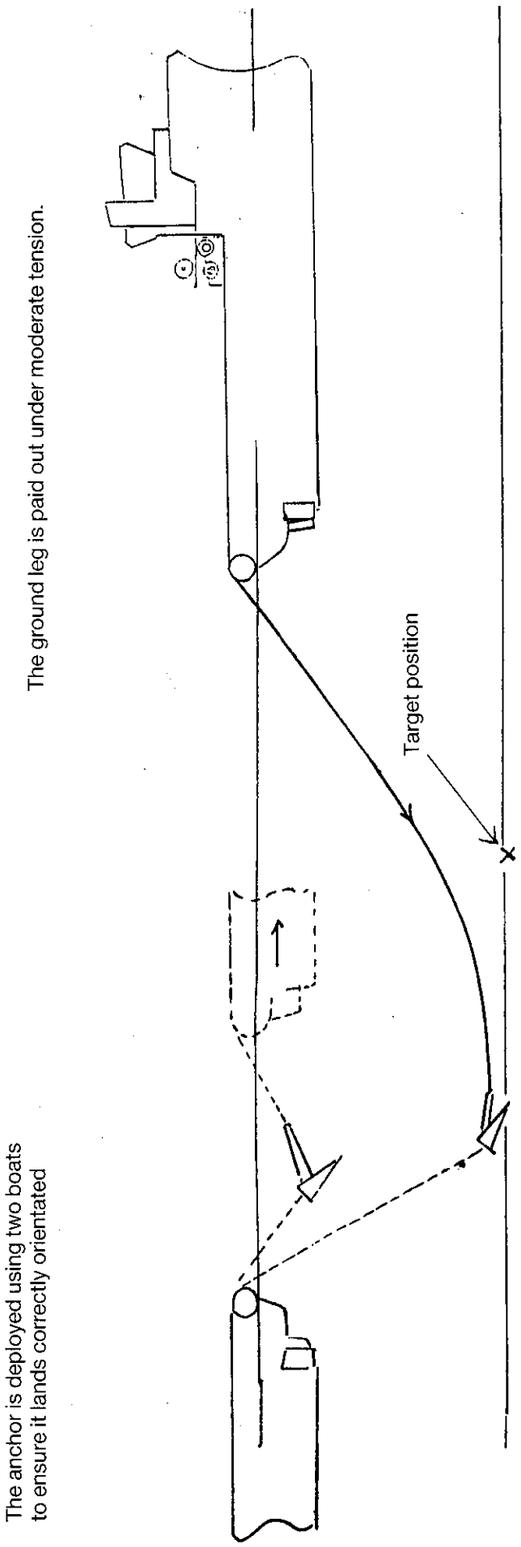
Procedure
The basic procedure for deployment and testing is shown in the diagrams.

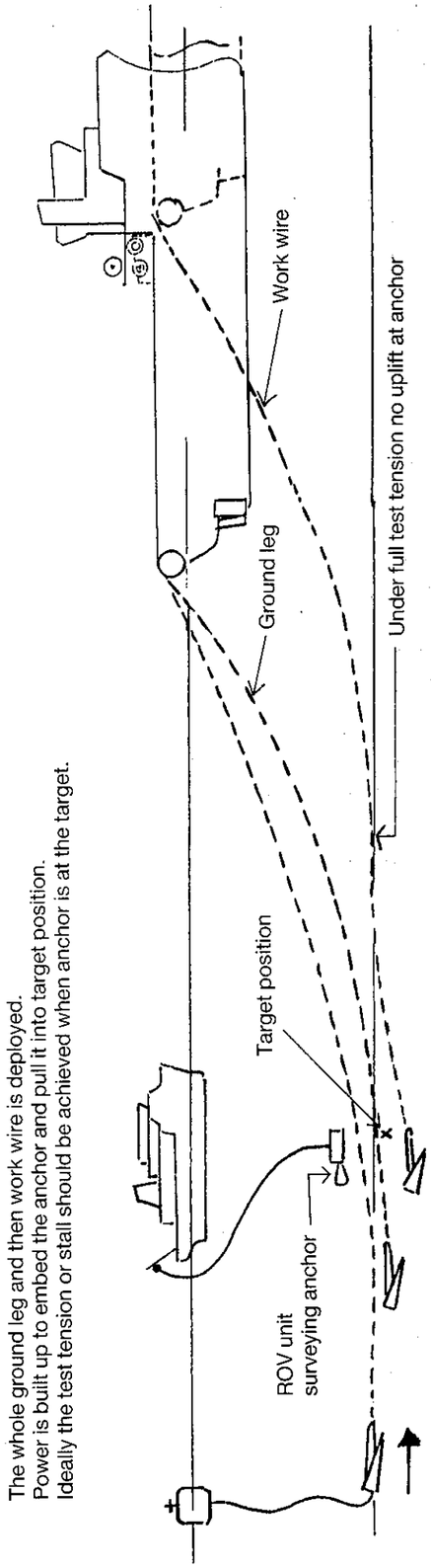
After initial deployment the anchor is checked by ROV to ensure that it is lying on bottom in the correct attitude.

The pulling boat then commences to pay out the "ground leg" to its full scope on current bearing line using moderate tension.

The end of the "ground leg" is then connected to a heavy work wire which is as long as necessary to achieve horizontal pull on the anchor at full test tension (see calculations/formula section)

The boat then builds up the power gradually pulling the anchor slowly into the ground. Observation by ROV may be continuous. The aim is to achieve full test tension with the anchor fully embedded and "stalled". The test tension may be applied several times with relaxation interval. After satisfying the criteria in terms of test tension and anchor position then mooring line is laid down and buoyed off as required.





Diag 136. RUNNING PRE-LAID ANCHORS

The anchor is deployed using two boats to ensure it lands correctly orientated

The whole ground leg and then work wire is deployed. Power is built up to embed the anchor and pull it into target position. Ideally the test tension or stall should be achieved when anchor is at the target.

e. Installation of single point mooring spread — example

The following example describes the basic procedure for the installation of a loading buoy designed to moor a tanker of 100,000 tonnes during loading of crude oil from a nearby floating production unit. The catenary anchored loading and mooring buoy (CALM) is moored by 8 chains and 40,000lb high holding power anchors.

The buoy has a swivelling arm to which the tanker mooring rope and floating loading hose are connected. Crude oil is pumped from the production vessel via a pipeline on the sea bed, which enters a manifold on the seabed below the buoy. From this manifold an export riser line is connected to the buoy.

The buoy maintains the same orientation in reference to its mooring chains, while the tanker can swing in any direction whilst moored, the hose bundle as likewise arranged. The following diagrams show layout of components.

The basic procedure for installation of the buoy is as follows.

1. The export manifold structure is installed below the buoy's position using a DSV (diving support vessel).

2. Two large AHTS vessels, one with a heavy A-frame rigged at the stern are mobilised with the anchors and mooring chains.

3. Using a positioning package, the anchors are laid and pull tested. Each anchor being observed using the ROV from the DSV. Each chain is laid towards the final buoy position and then the buoy end lowered to the sea bed with retrieval pennants and surface buoy. At the completion of laying, a pattern of eight buoys marks the CALM position.

4. The CALM is towed out onto location and temporarily moored within the buoy pattern using polypropylene hawsers run to four of the anchor chain surface buoys.

5. The work boats with the A-frames connect the anchor chains to the CALM as follows:

   A. Dummy pennants are pre-rigged on the CALM at each chain slot.

   B. The workboat retrieves the chosen surface buoy and backs up to the CALM taking aboard both ends of the dummy pennant. The end leading below the CALM is connected to the pennant wire leading to the chain. The upper end of the dummy pennant is connected to the work drum and the pennant hove up to a set point where it is stopped off on the CALM.

   C. The process is repeated until all 8 mooring chain pennants are connected to the CALM and evenly tensioned to keep the CALM located over the manifold.

6. The boat now works around the buoy heaving on the pennants until the bitter ends of all chains are located just into the patent stoppers fitted at each mooring point on the CALM skirt.

7. Tensioning now begins, hauling each chain in a set order using the A-frame and winches until the correct pretension value and catenary curve of the mooring spread is achieved. The chains are stopped off at each stage of the tensioning process.

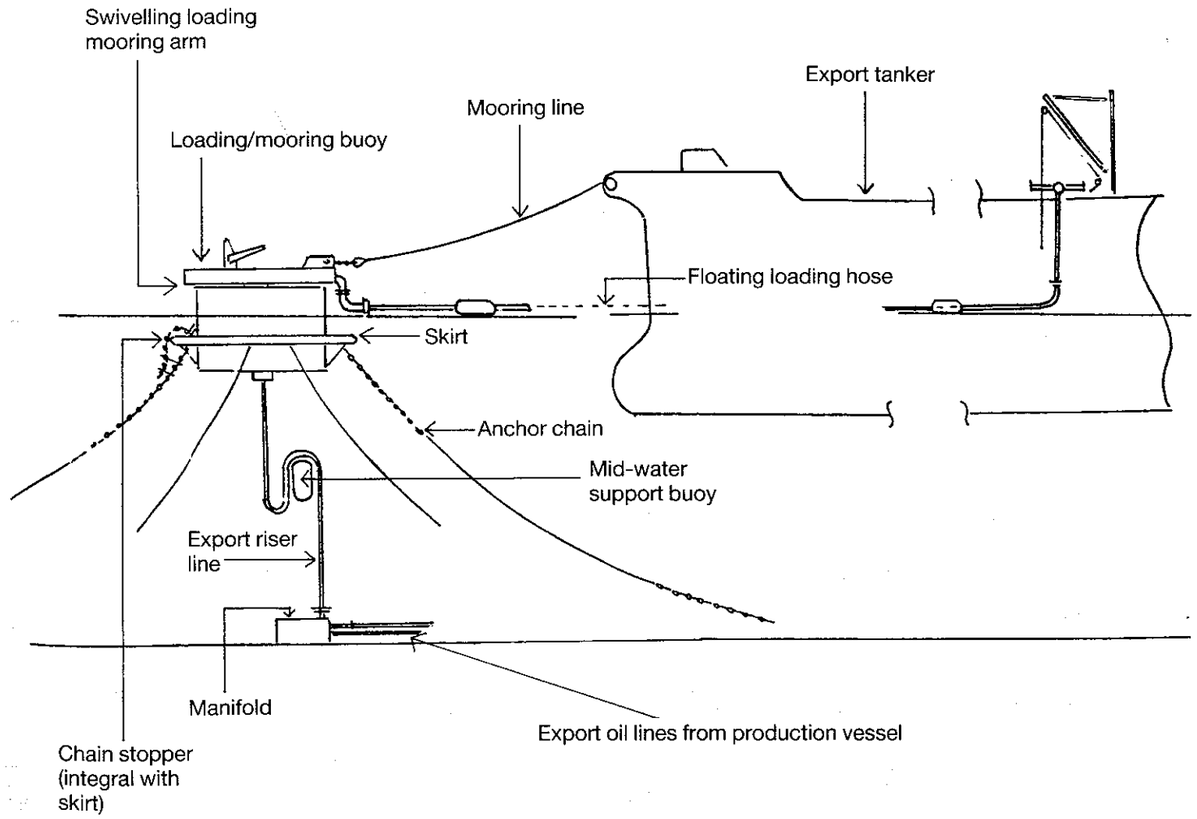
e. Installation of single point mooring spread — example (cont'd)

8. The ROV is used to confirm chain touchdown points and anchor embedment as well as ensuring that the CALM is located correctly with reference to the export manifold on the seabed.

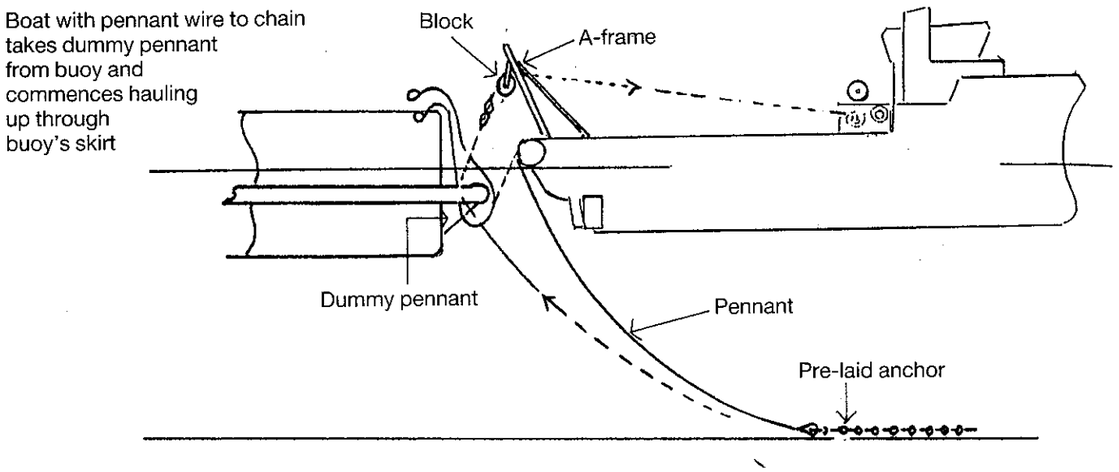
9. After adjustments the excess chain tail hanging out of the stoppers on the CALM skirt is cut off and the tails secured.

10. Hook up of the CALM to its export riser and attachment of mooring lines and loading hose for the tanker can now take place.

Diag 137. SINGLE POINT MOORING SYSTEM



Diag 138. INSTALLATION OF CALM BUOY



PART 9. SAFETY PROCEDURES

a. Anchor handling safety — general

Anchor handling work is inherently dangerous for the following reasons:

1. Heavily loaded wires and pulling equipment pose an obvious danger should the equipment break and men are in the way.

2. The operations are often carried out with the work boat's deck partly awash and the danger of losing deck crews overboard or having them washed hard against unyielding crash rails or bulwarks is ever present.

3. Violent and unexpected movements of the ship can result in buoys anchors or other equipment on deck breaking loose and injuring men in their path.

4. Unexpected actions on the part of the boat's master or barge crew can pose serious risks to the boat and her deck crew. For example mis-operation of an anchor winch on a barge when only a short scope of mooring chain/wire is out. The boat is still connected to the pennant but the boat's crew are preparing to disconnect it and are in way of the wire on their deck.

5. Collision between boat and barge or boat and anchor buoy, hull damage to boat caused by improper technique when boarding anchors or pulling anchors to the roller.

b. General safety precautions

1. The boats gear must be kept up to the highest possible standard especially the main work wires, tow wires and deck tugger wires (see section on wire rope inspection).

2. Prior to carrying out any operation use the Check List in part 12 to ensure that gear is thoroughly examined.

3. The boats master must himself fully understand the operation he is required to carry out and he must have an operational plan in his mind as to how the work will be done.

4. The boats master must brief his mate, chief engineer and deck crew on the sequence of events to be carried out and peculiarities or departures from normal procedures which will take place.

5. An anchor handler's deck must always be a neat orderly and thoroughly seamanlike place. Gear must be stowed in its proper place readily accessible and available for immediate use.

c. Clothing of deck crew

The basic dress of deck crews working in North Europe should comprise the following.

1. Deck work suits of the Mullion or Heli-Hansen inherently bouyant type-exposure suits with or without integral safety boots.

2. **Short** wellington boots with safety toes.

3. Hard hat with chin strap and hood.

4. Good quality riggers work gloves or national oilwell polka dot gloves.

c. Clothing of deck crew (cont'd)

5. If the crew cannot be provided with work suits as described in (a) then they should wear the best quality single piece or bib and brace/jacket oilskins with Mae West type lifejacket over the top.

Work suits, life jackets, hard hats and tough boots with toe protector and ankle support must be of top quality

Notes

1. With reference to life vests Nauteknik A/S make a suitable (CO_2) inflatable type. Always fit the jackets with lifejacket lights of the self activating type. Similarly the inflatable jackets which self inflate are the best type. Billy Pugh type work vests (3 buoyant panels) are cumbersome but a cheap alternative.

2. **Safety helmets** should be of a highly visible colour and a strip of retro reflective tape on the top is a good idea. Crew must use chin straps.

3. All outer garments, either work suits or oilskins must have retro reflective tape on strips on shoulders, back, chest and arms.

d. Lighting

Adequate lighting at the aft end of any anchor handler is extremely difficult to achieve.

Modern boats with large arrays of floodlights do give fairly good levels aft but for close up work even these lights are at times inadequate.

d. Lighting (cont'd)

Some masters rig up the temporary power leads down each side of the deck between bulwark and crash rails and then a waterproof portable Halogen floodlight with 10/15 metres of cable. Waterproof deck sockets are put on the ends of the power leads.

The floodlight so described is sometimes positioned opposite the shark's jaw and secured with plastic cable under the crash rail top. Other masters rig a box aft where the light and its lead are kept when not in use.

Searchlights mounted on the aft and forward end of the bridge structure are invaluable aids during night operations but failure to ensure that there are sufficient spare bulbs is negligence.

e. Communications

There is a constant necessity for communication between deck crew and bridge.

Even the most well trained deck crew will have to report various items of information to the master and answer his queries.

The provision of high quality reliable talkback systems, hand held VHF/UHF communications and loudspeaker systems are of utmost importance. If the mate or deck foreman is to use a portable VHF it must be either waterproof or enclosed in a waterproof cover such as the "Aquaman" bag.

The VHF microphone should be securely fastened to the jacket of the person wearing it with the cable to the TX/RX unit so arranged that it will not get caught up when carrying out manual tasks.

Hands free type transmitters are of use but can be expensive.

Use of headsets integral with safety helmets have been used with some success.

In order to cut down background noise when using handheld VHF's in high winds — cover the microphone in a layer of 10/15mm of soft foam rubber.

f. Deck organisation for safety

The following lists some well tried practices which enhance both safety and deck efficiency.

1. **Tool box/rack**
   A suitable rack should be constructed aft adjacent to the shark jaw between the crash rails and bulwarks to hold mauls, drivers, crow bars and a tool bucket.

   A rigid routine should be organised so that tools are returned to their stowage position after use. Some crews designate one member as the tool fetcher and gatherer whose job is to anticipate the needs of the others in respect of tools and be responsible for keeping track of and collecting up the portable tools.

2. **High visibility paint**
   The use of high visibility paint on the chain/hook tails of tugger winches, outboard end splice of the work wire, on the handles of tools can greatly assist both deck crew and master in locating equipment and tools in darkness or when the deck is intermittently awash.

f. Deck organisation for safety (cont'd)

3. **Tugger wire ends**

The ends of deck working tugger wires suffer considerable abuse, they are after all used for pulling, holding, snatching and dragging all sizes and shapes of equipment around the deck.

In order to reduce the damage to their ends rig them up as shown in diagram 139, with chain tails and hooks.

Refer to Parts 2 and 3 for other types of rig up.

4. **Using wire rope strops**

Many boat crews find it very expedient to use short wire rope strops with soft eyes to make fast tugger wire ends when pulling anchor chain, pennant wires or anchors about the deck — although this practice is not necessarily dangerous the abuse suffered by the wire-rope is considerable and often neglected due to the cost of obtaining suitable strops.

A better safer solution is to use 10/13mm grade 80 open link chain loops of various lengths joined with coupling links

Chain strops

Chain strops are stronger, less liable to abuse and easily manipulated through and around the objects they are connected to.

A boat might have half a dozen made up in various size/length and configurations which may be used both as stoppers and strops.

g. Avoiding injury

It is obvious that the potential exists on the deck of the anchor handler for particularly horrific man killing injuries. Specifically the effect of a 70mm pennant wire parting and whipping back into men on deck or the damage created by an out of control 20 tonne anchor or even falling or being washed the whole length of the boat's deck and dashed finally against the winch housing should make all concerned think of the following simple rules.

1. Don't put men on deck when there is no need for them to be there.

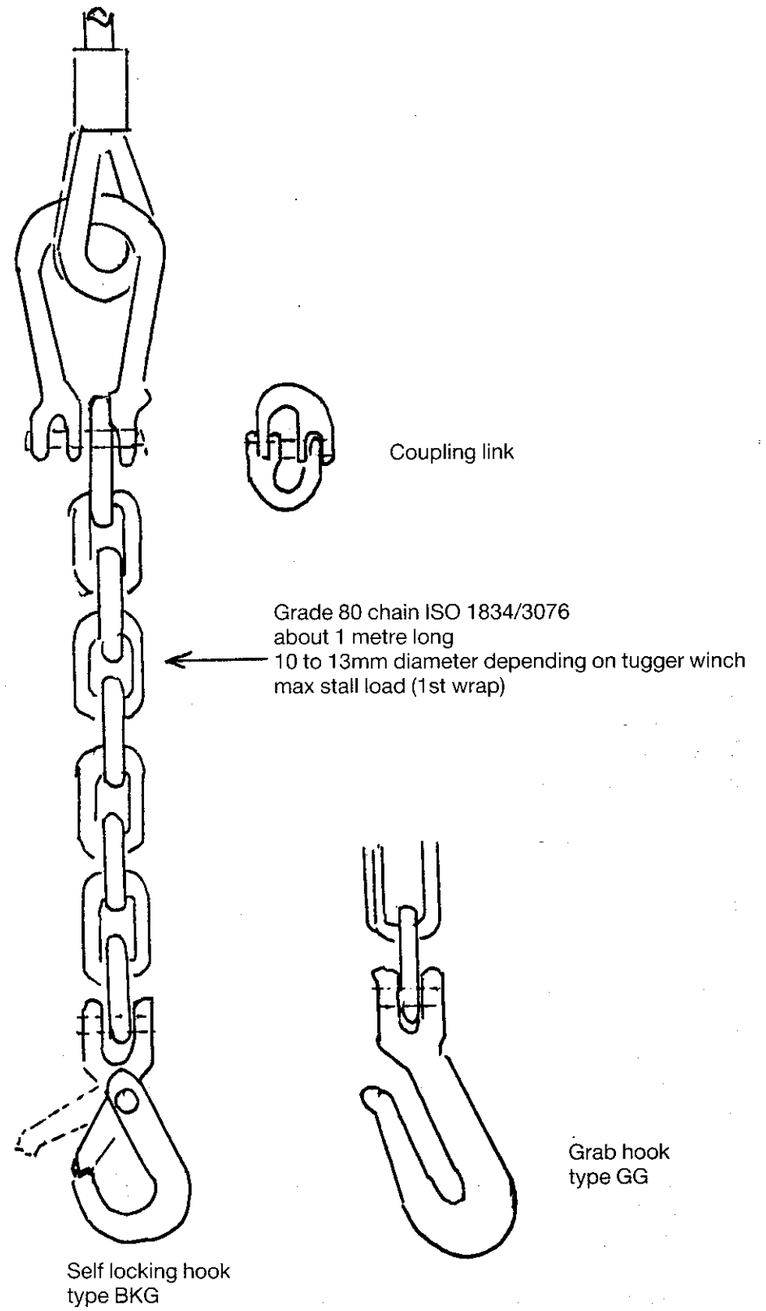
2. Anticipate the possible movement of buoys/anchors you intend to bring on deck — can the ships motion be eased by changing heading.

3. When bringing pennant sockets to the point of securing them in the shark jaw, don't allow the crew onto the deck until the socket is secured and most of the work wire weight has been slacked off.

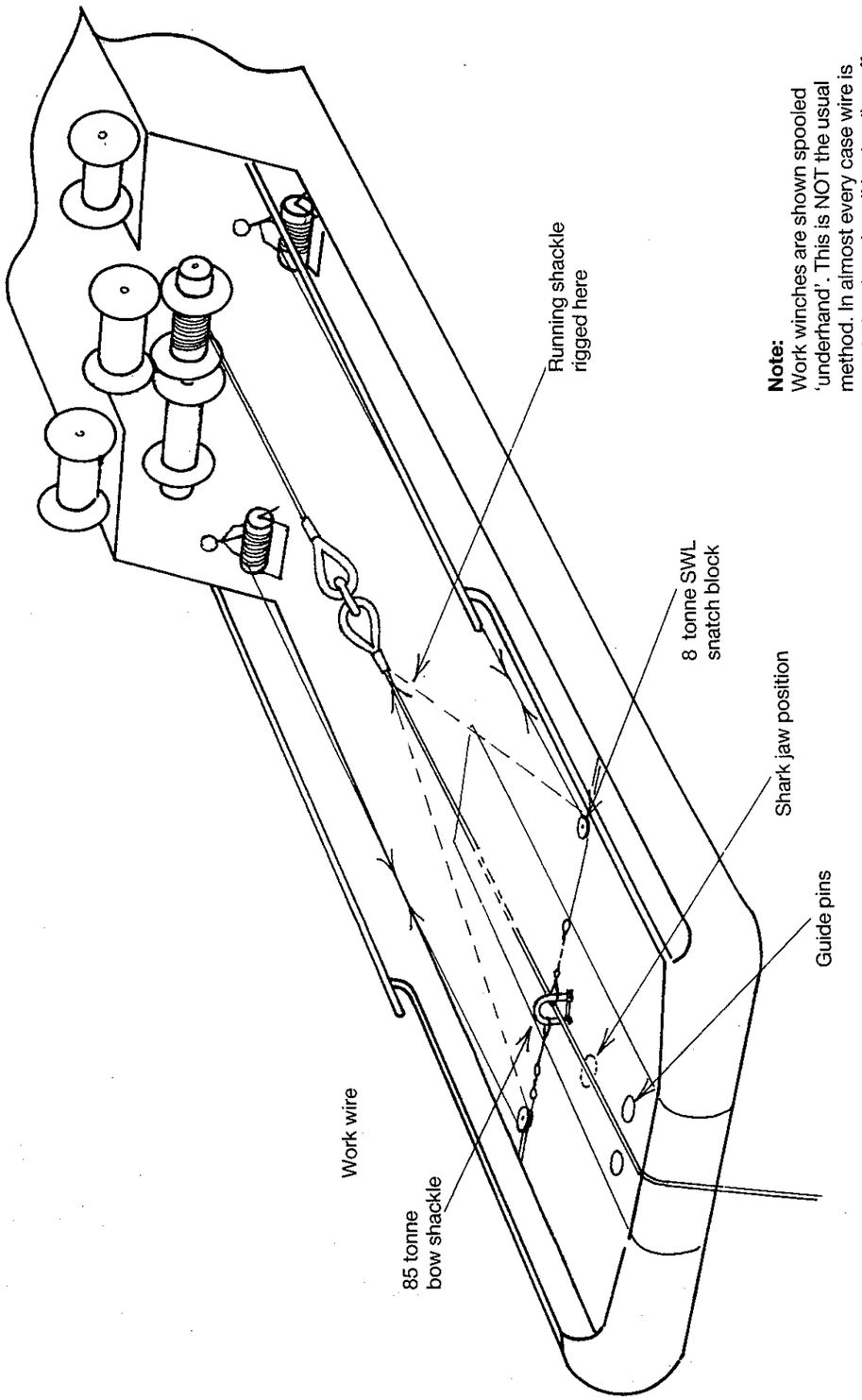
4. If, because of sea conditions or particular type of operation you are doing, there are constant delays in positioning the pennant wire so that the shark jaw catches it, rig up the deck tuggers as shown in the diagram and use them instead of the aft capstans.

   Put the running shackle on the pennant wire you intend to "jaw off" before it comes over the stern (see diagram 140).

Diag 139. DECK TUGGER WIRE END FITTINGS



Note end hook SWL depends on tugger max SWL at 1st wrap stall



Note:
Work winches are shown spooled 'underhand'. This is NOT the usual method. In almost every case wire is spooled up 'overhand' i.e. leading off the top of the drum.

Diag 140. TUGGER RIGGED TO ASSIST IN POSITIONING WORK WIRE

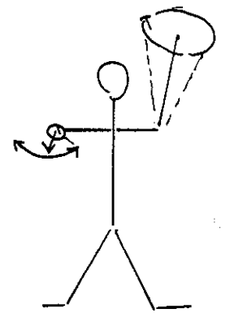
g. Avoiding injury (cont'd)

5. Teach the crew correct techniques for pushing, pulling, lifting and carrying.

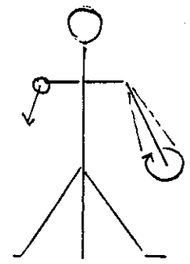
   Most work on the deck of the boat is heavy and physical. Back injuries, sprained ankles, pulled muscles etc, can be avoided especially if intelligent use is made of mechanical handling devices.

6. **Communications — hand signals**
   There are many times when deck crews wish to communicate their requirements to the boat's bridge or to the barge's crane. It helps if a standard set of hand signals are used (see diagrams) and everyone understands what they mean. Shouting and gesticulation leads to misunderstanding and tension between deck and bridge.

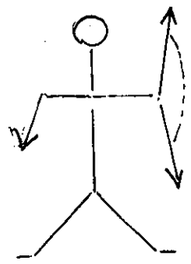
DECK HAND SIGNALS



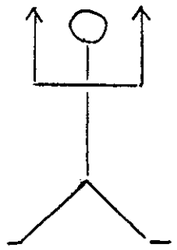
Heave away
Point with other hand at winch drum crane hook, tugger



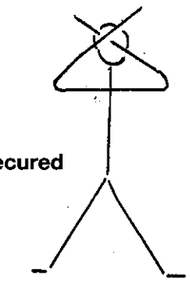
Slack away
Point with other hand at winch etc.



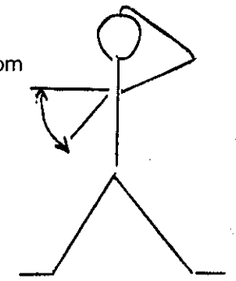
Raise/lower pins/jaws
Point at pin/jaw with other hand



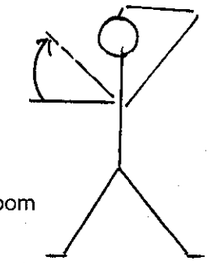
ALL STOP



ALL fast/secured



Raise
Crane boom



Lower
Crane Boom

g. Avoiding injury (cont'd)

7. **Handling wire rope**
   Most anchor pennant and work wire is made of plough steel, its jaggs are particularly sharp and can produce very deep cuts to hands and legs. To avoid injury many crews when they have to move wires by hand use a short length, about 1½ metres, of 25mm polypropylene rope with a soft eye spliced in each end. It is passed around the wire and both eyes are held while the rope is pulled in the desired direction.

h. Crew team work

The crew on deck must work as a team, each knowing the precise sequence of events and each contributing equally to the effort.

For example when connecting pennant wire shackles, the placement and duties of each man must be precise otherwise serious injuries can occur (see diagram 141).

When disconnecting pennants that have been under heavy load watch out for the torque which may have been induced into the pennant lying between winch drum and jawed off connection. When the shackle pin or hinge link is disconnected the wire is liable to spin. Placing the crew properly and being aware of what may occur, by "feel" of the crow bar used to turn the shackle/link for disconnection will tell you if this problem exists.

When the shackle butt is driven out the crowbar man must be ready to pull his bar clear quickly.

When driving out shackle butts (pins) make sure that the other crew members are not in the arc of swing or liable to have the butt (pin) hit them on their shins or feet.

i. Securing pennant wire eyes in KARM forks/shark jaws

A number of serious accidents have been reported recently when using fork or jaw type stoppers.

The sequence of events has been as follows:

1. The pennant wire eye has been positioned into the stopper with, as usual, the shoulder area of the Talurit/Ferrule hard against the inboard side (see diagram 142)

   A heavy force has been applied to the pennant pulling it into the stopper. The Talurit/Ferrule splice has split and then peeled away (see diagram 143), thus parting the pennant — pulling out the splice.

   Producers of this type of splice have now stated that their device, especially the Talurit designed to take loading in the manner imposed by the fork/jaw type stopper and using splice for this purpose is **incorrect use**.

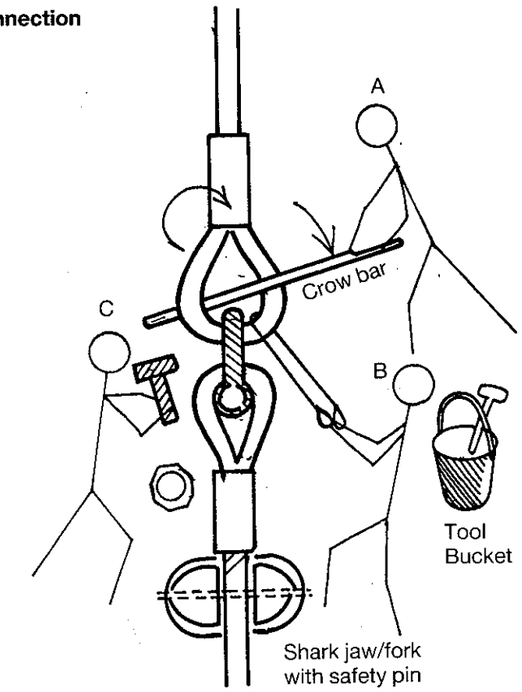
   Three links of stud link chain of suitable size between pennant connections typically and 76mm diameter (see diagram 144).

   Users of hydraulic stoppers, particularly Karmoy have available wedge stoppers their fork type stopper. Although use of the sliding wedge insert adds extra stopping off pennants it is, by current thinking a much safer method.

Diag 140. TUGGER RIGGED TO ASSIST

Diag 141. CONNECTING WIRES

Make Connection



Crew duties sequence

Crewman A uses bar to orientate pennant wire eye.

Man B has already put shackle bow into pennant wire and pulled it into position.

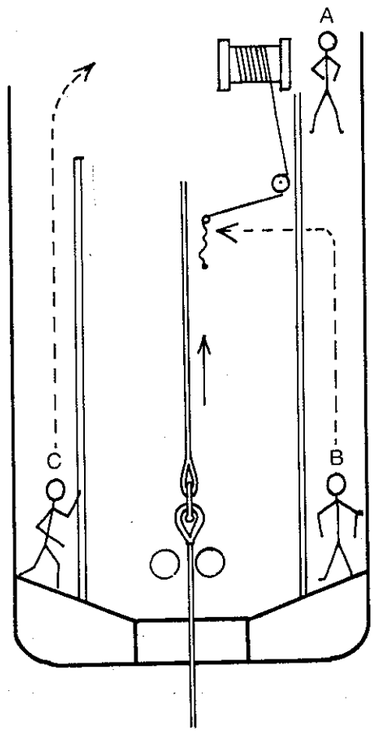
Man C has shackle bolt and nut. He puts in bolt and screws up nut.

Man B taps up the nut with his hand maul, fits split pin and opens it up.

All these items are in his bucket. He removes his bucket and tools to their rack after use.

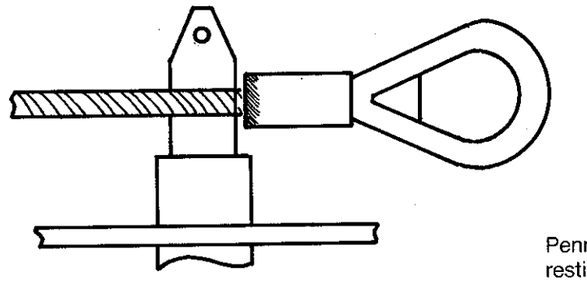
Man C checks connection, sees that A and B are clear, signals bridge and removes fork safety pin. All crew go outside crash rail — operations resume.

Heaving Away



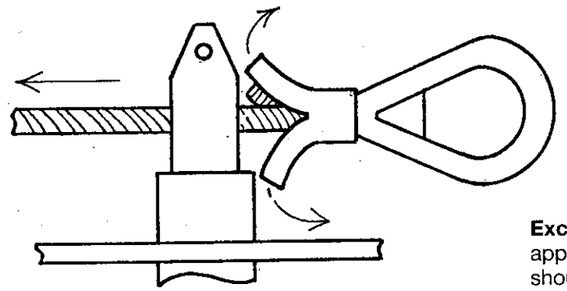
A stands ready at tugger winch to pull pennant wire sideways so that it spools up neatly. C and B move as shown to assist A

Diag 142. CORRECT USE OF KARM FORK STOPPER



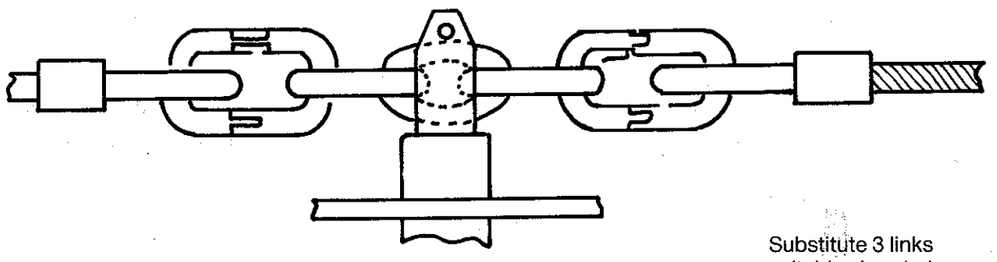
Pennant eye splice resting in fork stopper

Diag 143. EXCESSIVE FORCE APPLIED TO PENNANT IN STOPPER



Excessive force applied to pennant shoulders of Talurit splice forced open. Splice parts, pennant lost

Diag 144. SOLUTION USING CHAIN IN STOPPER

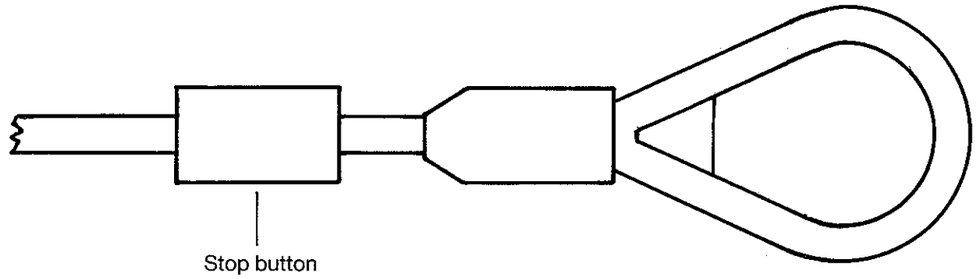


Substitute 3 links suitable size chain **say 76mm** between pennant connections. Strain taken by chain link.

i. Securing pennant wire eyes in KARK forks/shark jaws (cont'd)

3. **Stop button**
   A leading UK company has submitted a proposal to the Department of Transport for a button to be swaged to the wire ahead of the pennant wire eye. See diagram 145, to act as a stop.

Diag 145. SOLUTION USING "STOP BUTTON"



Stop button

j. Securing anchors and buoys (see diagram 146)
There are numerous operations where buoys and anchors will be carried on deck or brought aboard.

Ship motion in heavy weather, combined with working decks awash, can cause these items to charge about the decks out of control or if not properly secured, they can break away and present the crew with a highly dangerous situation.

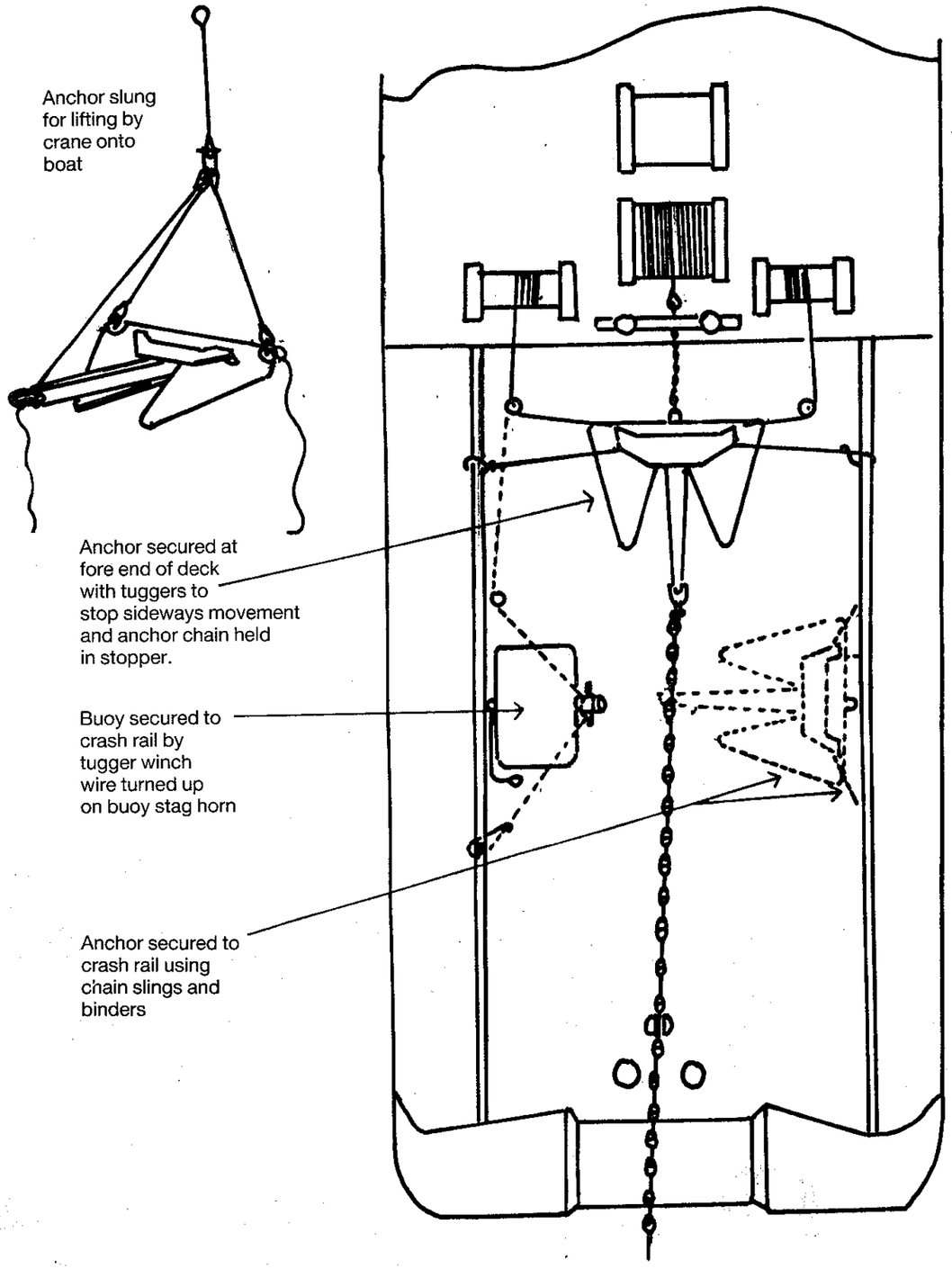
Buoys are particularly prone to being washed about if not secured, and having landed a buoy on deck of conventional pennant type the first consideration should be to haul it clear after disconnection and secure it to the crash rail.

Anchors due to the shape and weight can be particularly difficult to drag clear of the work wire area (centre of deck) but the use of the tuggers rigged around deck leads on the crash rails should enable a good crew to pull them into position and then secure them with chain and load binders. Typically 10 or 12mm diameter open link grade 8 chain is used for this purpose.

When anchors are loaded onto the work boat by the barge at sea they should be slung as shown (see diagram 146) with rope tag lines to enable the boat crew to manipulate the load before it is landed.

Typically a 15 tonne anchor lifting rig will consist of 3 soft eye slings 10 meters long and 26mm diameter, a 35 tonne SWL bow shackle to join the three legs and a centre leg consisting of a sling about 4 metres long and 35mm diameter. These wires will be working with a safety factor of about 5.

Diag 146. BUOYS AND ANCHORS SECURED ON DECK



PART 10. MAINTENANCE OF EQUIPMENT

a. Deck equipment

Winches, tuggers and other equipment should ideally be under a system of planned maintenance and inspection. Failure to carry out routine greasing, lubrication, filter changes and other activities inevitably leads to down time, usually at the most inconvenient moment.

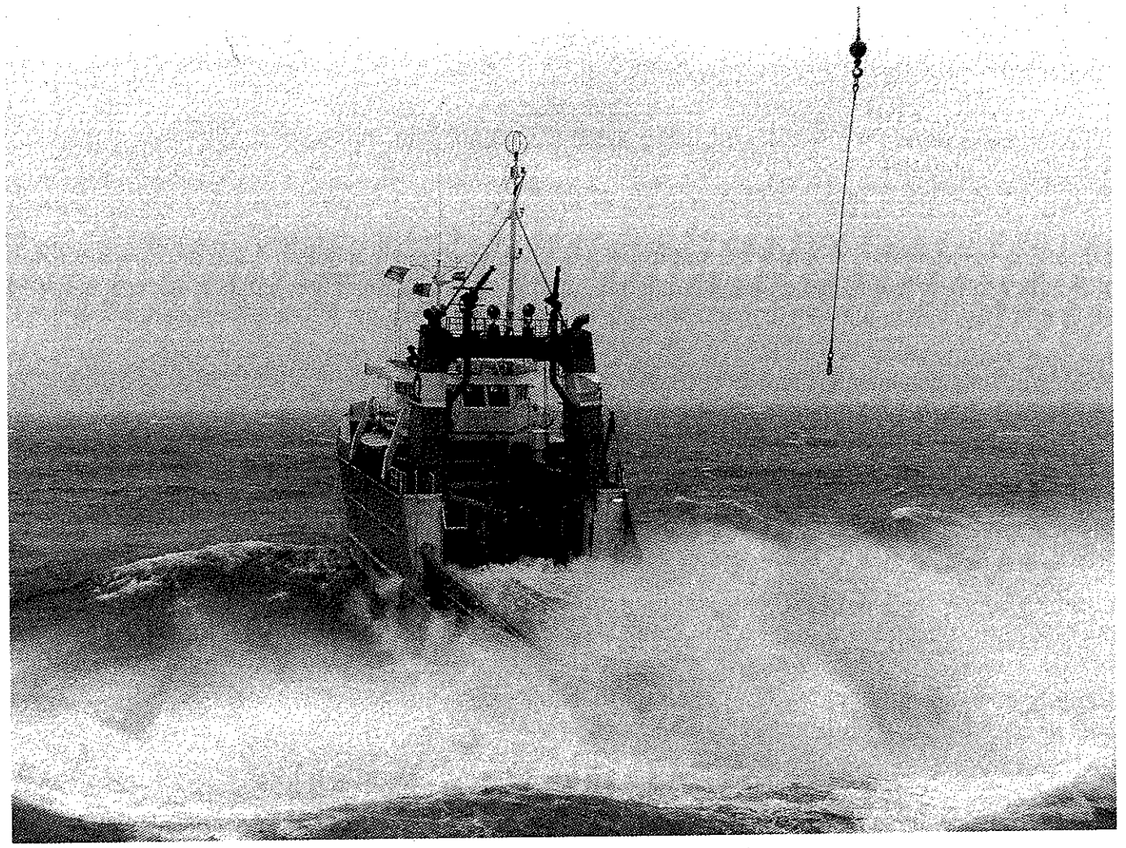
Hydraulic winch systems can suffer irreparable damage if the oil is contaminated and the most rigorous measures to control the quality and characteristics of the oil must be in place.

The most simple acts of negligence can have very serious consequences.

For example failure to inspect the roller and crash rails for gouges, scores and surface damage can result in the cutting and parting of pennant wires when least expected.

Failure to ensure that the securing system of the work wire to work drum (dead end) is kept in a state that allows it to be disconnected in a few minutes can cause unacceptable delays. Allowing leakage to occur into the flat below hydraulic pins and stoppers, due to faulty seals, could cause large amounts of water to enter the space if working in heavy weather with the decks awash.

Allowing the securing arrangements on water tight hatch ways at the stern of the boat to become defective is asking for trouble during heavy weather work.



Allowing the securing arrangements on water tight hatch ways at the stern of the boat to become defective is asking for trouble during heavy weather work.

Diag 146. BUO

ages show various typical types of damage to wire rope. It is of the d how easily damaged and weakened wire rope can become and that only from a commercial point of view but from the safety aspect too, the r rope under high tension not only represents a man killing situation but e damage to the boat including the immobilising of propulsion and steering

e, work wires, pennants, tuggers and slings should be routinely inspected. Splices, himbles and swaged eyes should be similarly examined and ropes re-terminated as required arded.

Lubrication of work wires is good practice (see diagram 148), as they see hard service and often require change out at frequent intervals. On boats which have particularly long and large diameter work wires they should receive the same attention, or more, as the towing wire.

Tugger winch wires receive probably the most abuse and therefore their inspection should be frequent and they should be examined and re-spooled as often as required.

Masters should impress upon their crews the necessity to use good practice, with tugger lines as they are frequently the cause of serious injury.

Tugger wire ends, chain tails and safety hooks take a severe beating. The failure of these components is often traced to poor inspection practice. Safety hooks are not designed for side loading and the latch of a safety hook which is damaged makes this characteristic useless and probably more dangerous than if it has an open hook. At least if it was a plain open hook the crew would stand well clear if it was likely to pull free under tension.

Avoid cutting shackles to make "home made" hooks for various purposes. Although useful these items are often overloaded, the user being unaware that he has interfered with the design of a piece of equipment whose function as a shackle was quite satisfactory.

Colour coding shackles to identify their safe working load is a good idea often used providing the coding and painting is kept up to date.

Stowing shackles, hinge links, Baldt connectors and similar gear away after use in neat racks should be the norm and no piece of such gear should be stowed without first checking it for damage, cleaning it and lubricating its parts.

Using hand tools, sledge hammers, hand hammers, cold chisels and other such items is part of the days work for an anchor handler.

Replace broken hammer handles, secure loose hammer heads, dress and sharpen cold chisels, dress and grind off the burrs on pin punches and similar tools. Hack saw blades should be discarded if the teeth are worn or chipped.

The deck store, bosun's locker and gear stores should all be tidy, properly stowed and kept in a seamanlike manner. There is nothing more infuriating than spending time looking for tools and equipment which is either buried amongst heaps of tangled gear or 'borrowed' and not returned.

b. Wire rope inspection (cont'd)

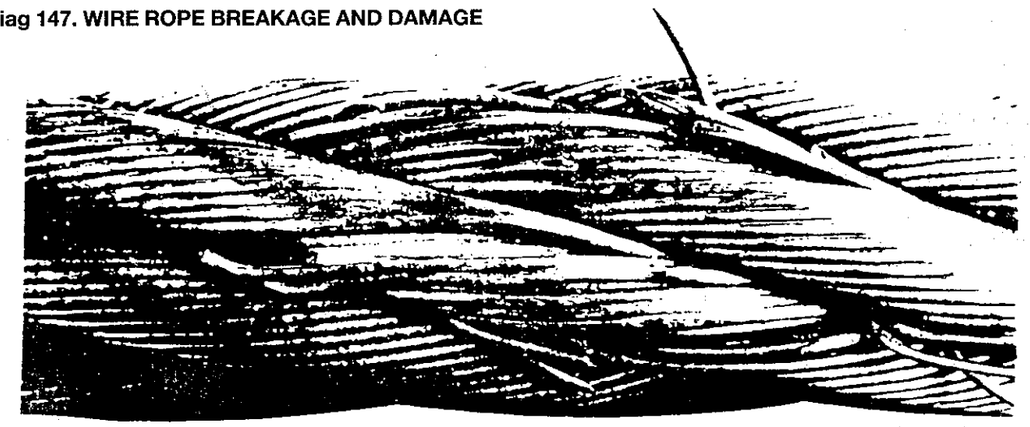
The best organised boats keep detailed inventories of all their spare wires and running gear. The inventory shows the description of the gear, certificate numbers and stowage location. In a large gear store each item on the inventory is labelled so that amongst several large coils of wire or pennants the individual items can be identified.

Mention has already been made of organising the "ready use" deck lockers so that the fetching of say, split pins for 110 tonne bow safety shackles, is a matter of simply reading down a list of clearly marked "bins" and taking the correct item from the correct bin.

Hand tool "shadow boards" are easily made and can be of considerable use especially if specialist tools such as pin punches for various size and type anchor chain connecting links are clearly named as well as profiled on the board.

There is value in painting the tops of capstans, hydraulic pins and stopper cover plates a bright contrasting colour to the surrounding deck. It helps location on a wave swept deck at night in poor visibility both for the deck crew and bridge team.

Diag 147. WIRE ROPE BREAKAGE AND DAMAGE



Wire breaks and wire displacement over two adjacent strands in an ordinary lay rope — *justification for discard*

A large number of wire breaks, associated with heavy wear in an ordinary lay rope — *justification for immediate discard*

Diag 147. WIRE ROPE BREAKAGE AND DAMAGE (cont'd)

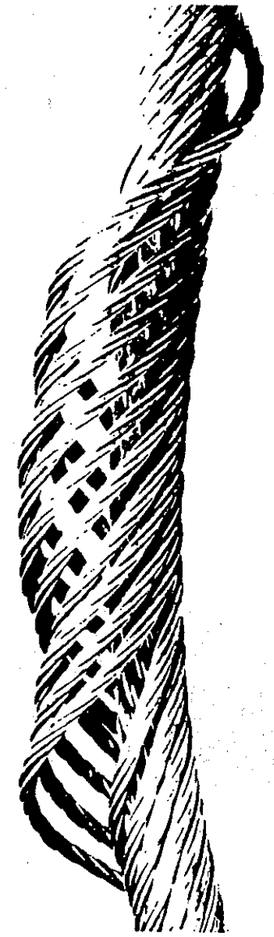
Wire breaks in one strand, associated with slight wear in a Langs lay rope — justification for further operation if this condition represents the worst condition (fractured wires should be broken out so that the end is at the strand gusset; this prevents further damage to the adjacent wires)

One strand only affected by wire extrusion, although examination over a length of rope shows that deformation is visible at regular intervals, normally of one lay length

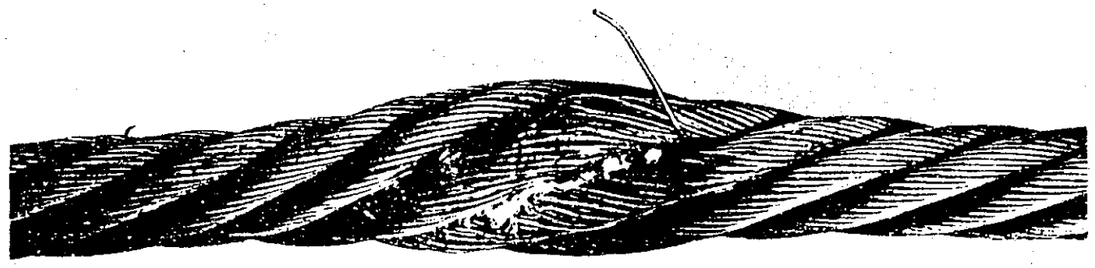
Aggravation of the previous fault to a degree of severity *justifying immediate discard of the rope* (typical of a hoist rope on a piling machine)

Diag 147. WIRE ROPE BREAKAGE AND DAMAGE (cont'd)

Local increase in diameter of a Langs lay wire rope caused by distortion of the steel core resulting from shock loading — *justification for immediate discard.*



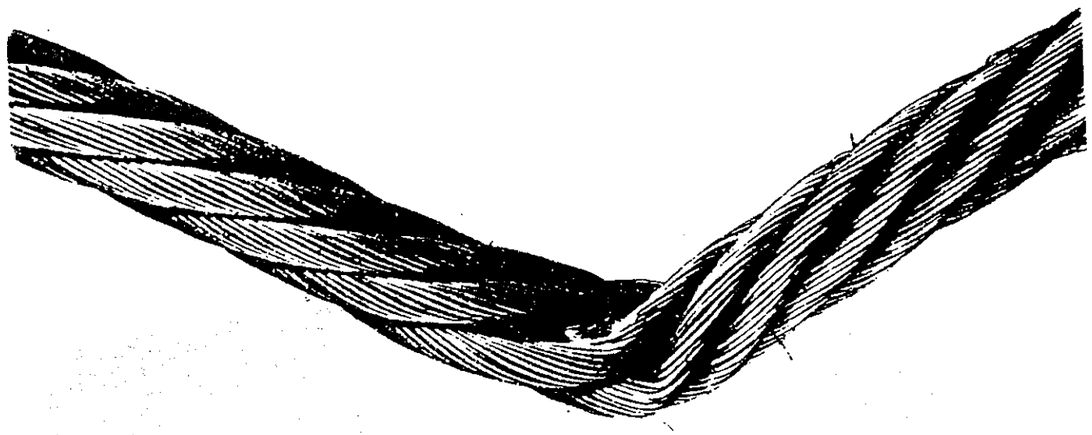
Basket (bird cage) deformation of a multi-strand construction — *justification for immediate discard*



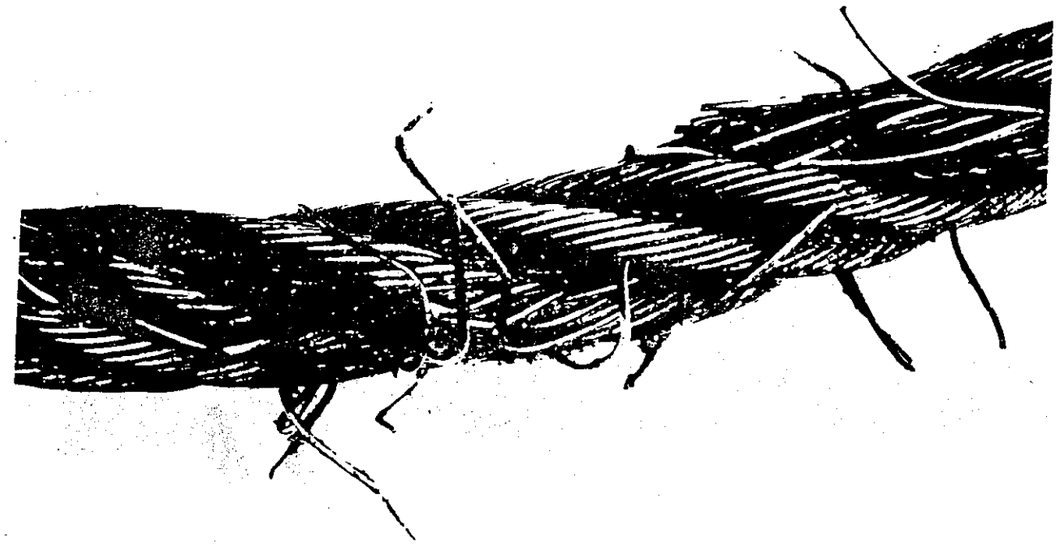
Flattened portion due to local crushing, creating unbalance in the strands and associated with broken wires — *justification for discard*

Diag 147. WIRE ROPE BREAKAGE AND DAMAGE (cont'd)

Flattened portion of multi-strand rope caused by miscoiling on a drum — note how the lay length of the outer layer of strands has increased. Again there will be unbalance of stress under load conditions — *justification for discard*



Example of severe bend — *justification for discard*



Typical example of when the wire rope has jumped out of a pulley groove and wedged up. A deformation in the form of "flattened portion" has resulted and there is local wear and many wire breaks — *justification for immediate discard*

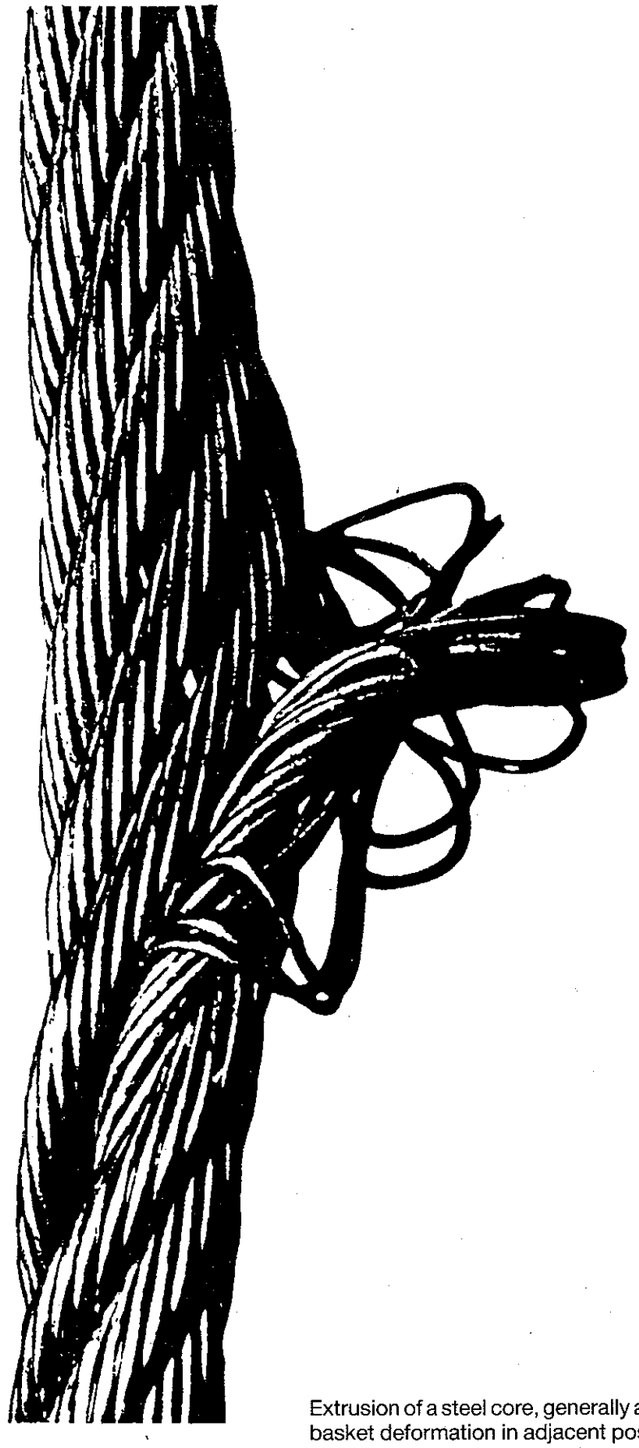
Diag 147. WIRE ROPE BREAKAGE AND DAMAGE (cont'd)

Cumulative effects of severe deteriorating factors — note in particular the severe wear of the outer wires leading to looseness of the wires such that a basket type deformation is forming. There are several wire breaks — *justification for immediate discard*

Wire breaks in several strands, local to a compensating pulley (and sometimes hidden by this pulley) — *justification for discard*

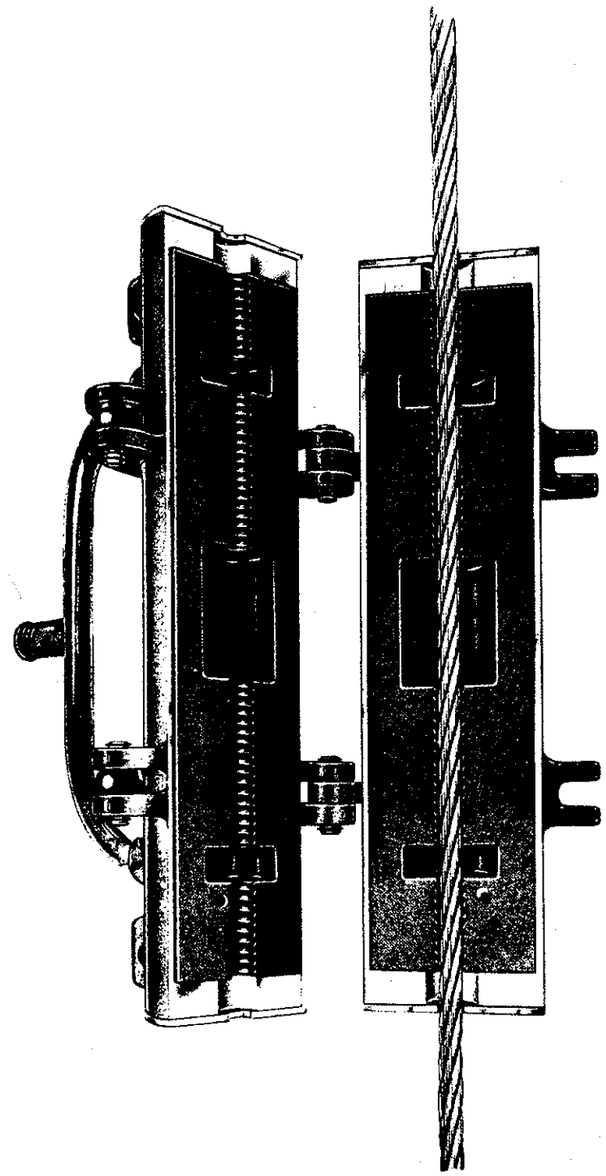
Wire breaks in two strands, local to a compensating pulley and associated with local severe wear, caused by the jamming of the pulley — *justification for discard*

Diag 147. WIRE ROPE BREAKAGE AND DAMAGE (cont'd)



Extrusion of a steel core, generally associated with a basket deformation in adjacent position — *justification for immediate discard*

Diag 148. WIRE ROPE LUBRICATION



Dynalube — a new system of wire rope lubrication suitable for use with wire rope service dressings such as Brilube 70. This black thixotropic gel formulation produces a long lasting protective dressing highly resistant to "fling off" and cracking with excellent lubrication qualities from −55° to 100°+.

PART 11. BOAT/BARGE CO-OPERATION

a. Understanding the operation and operational planning
The nature of oilfield anchor handling is such that obtaining a clear idea of exactly what is expected of the work boat on arrival at a barge can at times be extremely difficult, leaving the master in something of a dilemma.

Some barge staff issue detailed, written and precise procedures as to what, when, how and where a boat is to work, others give such vague instructions (that are often countermanded) that a work boat captain is left with the feeling that his presence is more an inconvenience than a help.

Lay barges and work barges are notorious for their habit of ignoring a boat for long unexplained periods, then suddenly issuing a stream of instructions which if not instantly complied with will result in the boat being dismissed.

Masters are sometimes required to use a degree of diplomacy, in order to gleen instructions and details of their role in whatever operation is planned, that would qualify them for a job in any country's foreign service department.

As most conversations and orders will take place and are given via VHF radio the lack of face to face contact adds another difficulty to the work.

It is a fact of life that the anchor handler is the servant of the barge but equally a poorly instructed servant is worse than useless, therefore it is imperative that a clear understanding of what a particular operation involves is both given and understood.

The basic data required by the work boat is the layout of the actual or proposed anchor spread, the rig up of the anchors, the limitations on deployment speed, the presence of seabed obstructions and any special precautions to take.

On arrival at the barge the boat should be in all respects ready to work, unless particular circumstances dictate otherwise. No matter what the boat captain's personal feelings his first contact with the barge will often set the tone of the relationship so a willing, cheerful, authoritative manner will go far towards forming a working partnership.

b. Assisting the barge
On arrival at the barge it is wise to have ready a pro-forma data sheet which will contain all the data about the vessel.

This data sheet can be in the form of the **Survey Report** with dates of surveys etc. kept up to date, as well as bunker figures.

In addition to this it is useful to add the capacity of work winch drums and pennant storage reels expressed in terms of X metres of wire of a particular diameter. Similarly the capacity of chain lockers (rig) is frequently requested.

There is no reason why the data sheets cannot be sent up to the barge by crane and if this option is chosen it gives the work boat a chance to examine the barge for possible problems in manoeuvring close to.

When the outline of the proposed operation has been explained and understood check that the anchor handler is capable of actually doing the work.

b. Assisting the barge (cont'd)
If the vessel does not have enough power to run out (for example) 4500 feet of chain across a 1½ knot side current, because she simply doesn't have enough horse power then tell the barge but **always** try to suggest an alternative method of carrying out the work — use two vessels in this case perhaps, the second boat working with a J-hook.

It is important to offer constructive suggestions if there is a way to carry out any particular operation more efficiently than that proposed, similarly when problems occur, a workable solution should be suggested rather than always waiting for the barge to tell the boat what to do.

The solution to many problems is not immediately obvious to the barge control staff especially if it's occurring a thousand or more feet away.

c. Inspection and repair of equipment
During the course of a mooring operation the boat will be handling large amounts of equipment belonging to the barge in the form of anchors, mooring lines (wire/chain), buoys, pennants and other gear.

In order to avoid damage, breakages, fishing jobs and other time consuming operations the careful master will take every opportunity to inspect and rectify defects and reject items which pose a hazard or may lead to breakages etc.

The following list shows typical defects which may go unnoticed by the barge crew but which could be rectified by the boat or at least brought to the attention of the barge. The list is not comprehensive.

Anchors
1. Loose anchor to mooring line connection
2. Bent anchor swivels
3. Bent/broken anchor flukes
4. Loose stabiliser bars
5. Bent anchor shank
6. Loose/bent/distorted crown shackle

Chaser Rings
1. Cracked or badly worn at bearing surface of ring
2. Cracked/bent/loose chaser pennant to chaser ring connection

Pennants
1. Severe damage to wire (see diagram 147 for illustrations)
2. Thimble broken, thimble crushed
3. Talurit splice split, heavily worn
   Note: Report defects to barge, ask for replacement pennant or work wire.

Shackles
1. Bent, twisted, badly worn, wrong size
2. Pin securing nut thread damaged, nut won't screw up
3. Safety shackle split pins missing, wrong size, corroded

c. Inspection and repair of equipment (cont'd)
Buoys
1. Steel buoys — holed, split, cracked
2. Urethene cased soft buoys — cracked, holed
3. Sectional buoys — securing bolts sheared, broken sections loose.
4. Suitcase buoys — Pick-up rope damaged, buoy split, leaking

Jewelery — Patent connecting links etc.
1. Securing pin missing, loose
2. Link twisted, damaged

Chain (Mooring or tail) — Links stretched, bent, gouged, studs missing, worn.

Chasers/Grapples — Cracked, bent, badly worn

d. Machinery breakdown
From time to time both minor and major breakdowns occur which adversely affect the boat's performance when either the winching or manoeuvring capability is reduced by breakdown. The boat captain should inform the barge giving clear and succinct description of the problem, how it is being solved, what capability remains and how long it will take to rectify.

The boat captain's attitude must be positive and if help from the barge staff or facilities may be of use, it is often freely given provided a harmonious relationship has been already established.

When working with gear supplied by the barge or a third party whose strength or condition is doubtful it is wise to bring these doubts to the attention of the barge **before** starting work. A chasing pennant whose condition looks poor may part, resulting in a long "fishing job". It is not constructive or helpful, after breaking the pennant, to use phrases like — "well I thought it looked a bit damaged when the crane gave it to me".

Failure to check a shackle connection, chain connecting link or some other such item, made up by someone other than your own crew before you use it is asking for trouble and the blame will initially be put onto the boat.

Machinery breakdowns aboard the barge may not always be fully reported to a boat other than the order to STOP whatever operation is in progress and wait on orders. This waiting period can stretch into hours without being told anything. Patience is the only solution unless the boat cannot maintain position or has to put an anchor on bottom in which case the barge must be informed and permission obtained.

Boat captains sometimes forget that in the pandemonium caused by a major winch failure aboard the barge, the presence of the boat hanging on the end of the mooring chain or wire is a secondary consideration.

e. Working within the boat's limitations
Although most anchor handling vessels are by design robust, seaworthy and well outfitted, if machinery such as winches, thrusters and main engines are worked at the highest limits of their output the only result will be a shortlived, albeit impressive, performance and the damage to machinery can be very expensive.

e. Working within the boat's limitations (cont'd)
Use only sufficient power to achieve the desired aim, keeping something always in reserve for the time it is really needed.

As weather conditions worsen there comes a point where it may be impossible to work due to the vessel being unable to hold position or the decks being so wave swept that the crew are in considerable danger. In these circumstances the master must inform the barge that he cannot carry out their instructions.

When working in heavy weather, vessels will have great difficulty in running anchor across with wind and sea in a straight line as the bow thrusters may not be able to hold up the fore end into the weather nor may the boat be able to deviate from the desired anchor direction and here is another case when the boat should explain to the barge why they can't achieve the desired aim.

During buoy catching work especially when large vessels with high freeboard are involved it may be extremely difficult to get alongside the buoy in heavy seas and a side catching technique may be out of the question. A small anchor handling tug in this instance may achieve what a large AHTS finds almost impossible.

If the decks are confined by buoys, anchors and gear (even if it is well lashed), heavy ship motion, with water sweeping over the deck can present considerable danger should an anchor come loose. Decking anchors in heavy weather can be frought with danger — as the anchor comes aboard onto the steel apron and before it is pulled ahead of the guide pins and stoppers (which can be raised to catch the mooring chain), the anchor can be thrown from side to side across the deck by heavy ship motion.

Not only is gaining control difficult but should the crew have to go near it before it can be controlled using the pins and stoppers, they will be in grave danger and several men have been killed during a "capture" operation.

Masters should carefully study the behaviour and response to controls of their vessels and make sound judgements as to when operations should be suspended due to heavy weather.

f. Log books and records
The oil industry often seems overburdened with paper work some of which falls on the work boat.

It is usual to keep a number of log and record books, typically the official log of the flag state, the Owner's Deck Log Book, Charterer's Log Book and an Anchor Handling Report Log.

In most cases the logs would contain the following entries when for example picking up anchors at a barge.

Entry	Time	Date	Remarks
Arrival at barge	Time	Date	Bunker figures on board
Given chase pennant	Time	Date	Anchor number noted
Start chase out	Time	Date	
Anchor off bottom	Time	Date	
Anchor at roller	Time	Date	Anchor decked and inspected
Anchor racked	Time	Date	
Pennant handed back	Time	Date	

f. Log books and records (cont'd)
When running anchors the following entries are typical.

Example — Running anchors PCC System

Entry	Time	Date	Remarks
Handed chase pennant	Time	Date	Anchor No.
Anchor at roller	Time	Date	
Start run out	Time	Date	
Anchor on bottom	Time	Date	Bearing and distance from barge
Chaser stripped off	Time	Date	
Chaser pennant handed back	Time	Date	

Delays, breakdowns and damage are fully recorded as is the amount and type of equipment given to the boat by third party.

When handling buoyed mooring systems it is usual to record the following phases of the operation:

Buoy on Deck Anchor off bottom Anchor at roller Anchor racked Pennant handed back	Retrieving anchors
Pennant received Anchor at roller Start running to position Anchor on bottom Buoy in water	Running anchors

When running piggy back anchors it is usual to record the length of pennants run between main and piggy back anchor as well as the shackles used.

During the deployment of a buoyed system it is also useful to record the length and number of pennants used between the anchor and the surface or intermediate (spring buoys).

At the completion of work the boat's bunker figures are often required and should be recorded.

Checklist for anchor handling operations
The following checklists detail the major items which should be verified/confirmed as ready or available prior to starting work.

On many boats this formalised system is not used, the boats crew carrying out all the steps as a matter of course, but it may serve as an aid to a new crew joining a boat, for officers under training and as a periodic check for experienced personnel to ensure that they are not overlooking some vital point.

CHECKLIST FOR ANCHOR HANDLING

Boat name **Date** **Location**

1 MAIN SYSTEMS

	Item	Checked	Notes
A	Main engines running at correct speed		
B	Main engine alarm annunciators tested		
C	Shafts engaged		
D	Pitch controls/clutch controls tested		
E	Control transfer forward–aft OK		
F	Steering gear tested		
G	Thrusters tested		
H	Pos. con system tested		
I	Gyro compass error known		
J	Radars functioning		
K	External communications tested		
L	Stability within prescribed limits		
M	Trim correct/adjusted		

CHECKLIST FOR ANCHOR HANDLING

Boat name | Date | Location

2 SUB SYSTEMS

	Item	Checked	Notes
A	Towing/anchor handling winch function tested		
B	Winch brakes adjusted		
C	Gauging/alarms tested — winch system		
D	Guide pins, stoppers function tested (remote and local)		
E	Tuggers, capstans, deck crane tested		
F	Pennant reels function tested		
G	Deck lighting fully functional		
H	Search lights functional		
I	Echo sounder operational		
J	Navigation lights displayed		

CHECKLIST FOR ANCHOR HANDLING

Boat name | Date | Location

3 OPERATIONAL SAFETY

	Item	Checked	Notes
A	Crew properly dressed		
B	Deck communications tested		
C	Crew briefed on operation		
D	Present and future weather conditions appraised		
E	Crew rested, watches set		
F	Bridge windows clean — washers/wipers checked		

CHECKLIST FOR ANCHOR HANDLING

Boat name | Date | Location

4 DECK RIGGING

	Item	Checked	Notes
A	Work winch/work wire properly attached spooled and ready		
B	Hand tools in position aft		
C	Tuggers spooled, safety hooks, chain tails checked and secure		
D	Boat hooks, hand grapple heaving lines, buoy lassos safety slings, chain snotters ready		
E	Oxy-Acetylene cutting gear tested ready		
F	Shackles, hinge links, chain links checked		
G	Pelican hooks and pennants checked		
H	Grapple, J-hook available		

CHECKLIST FOR ANCHOR HANDLING

Boat name | Date | Location

5 PREPARATIONS — DECK

	Item	Checked	Notes
A	Dies, plates, inserts for stoppers dressed ready		
B	Stopper safety pins ready		
C	Norman pins ready		
D*	Pennants received, checked, length confirmed, spooled up as required		
E*	Shackles, hinge links, connections received, checked — dressed		
F*	Suitcase wires checked, spooled up		
G*	Buoys, anchors, chasing gear checked		
H	Roller surface clean		
I	Fenders secured		
J	Deck clear or items fully secured, clear of work area		

** Refers to gear given to boat by Charterer-Barge for job*

CHECKLIST FOR ANCHOR HANDLING

Boat name | Date | Location

6 OPERATIONAL PLANNING

	Item	Checked	Notes
A	**Bunkers/Consumables**		
	Fuel		
	Pot, water		
	Lubricating oil		
	Hydraulic oil		
	Food		
	Record amounts, calculate endurance		
B	**Anchor handling plan**		
	Received, clarified, understood, modified		
C	**Special precautions noted**		
	Sub surface obstructions, running parameters decking of anchors etc.		
D	**Special operations understood**		
	Fishing, grappling, rigging, deployment of buoys speed of deployment, support mooring rig		
E	**Rig up of anchor system confirmed**		
	Clarified — pennant make-up connections to use, buoy handling system		
F	**Barge particulars**		
	Number and type of anchors, bearings, distances peculiarities of barge-crane outreach limitations, below water hull, projections, winch characteristics		
G	**Logs/Records**		
	Anchor handling log ready		
	Manifested gear checked as received		

CHECKLIST FOR ANCHOR HANDLING

Boat name | Date | Location

7 OPERATIONAL COMPLETION

	Item	Checked	Notes
A	Bunkers ROB figures recorded and passed to barge/charterer		
B	Third party equipment returned		
C	Damage to third party equipment noted and charterer informed		
D	Damage to boat or equipment logged, and statement passed to charterer		
E	Barge given bearing distance of any anchor deployed		
F	Barge given details of pennant/buoy rig up used		

All pre-operational checks completed, the Smit Lloyd 117 steams to her next job

PART 13. BOAT HANDLING

a. Basic techniques

Most oilfield anchor handling work is done at low speeds and requires the boat to hold itself on precise courses going both ahead, astern and sideways. It will also be required to hold a stationary position for quite prolonged periods.

The most common propulsion and steering configuration consists of two propellors aft in Kort nozzles, a bow thruster and two spade rudders which may be operated together or individually.

The boat "driver" is most often controlling the ship from the aft end of the bridge overlooking the working deck and winches.

Diagram 149 shows the differences in open and shrouded propellors. It is important, with open screws to understand the transverse thrust effect produced by the propellor because it has its greatest leverage at the very slow speeds or stationary (holding position) that the vessel operates at.

The art of ship handling is the ability to visualise the effect of the propellor thrust against rudder position and an appreciation of the direction **each** end of the ship will move under the influence of the applied force.

If one propellor is going ahead and the other astern the vessel will turn her bow towards the side of the propellor going astern, the stern will move towards the side of the propellor going ahead.

Going ahead or astern on one propellor with the other side stopped or feathered (in the case of CP units) will cause the boat to turn towards the side of the stopped propellor.

If the boat is to be turned without any advance then more astern power must be applied than ahead thrust, due to the propellors being more efficient when working in the ahead direction.

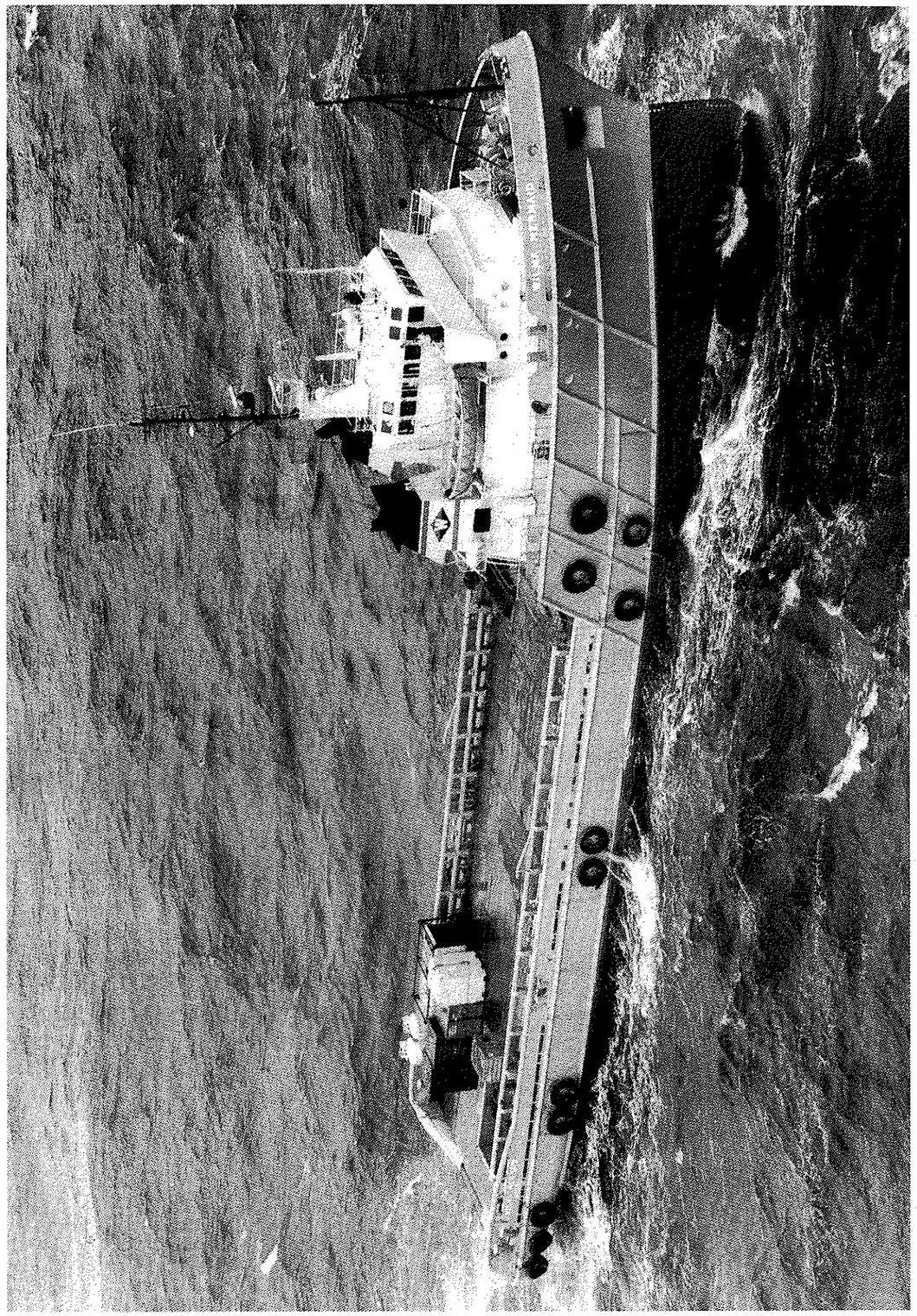
The bow thruster can be used to augment turns, slow the rate of turn or hold the boat at an angle to the line of advance.

In heavy weather the bow thruster will lose some of its efficiency as the bow pitches up (see illustration).

Most operations, such as running/retrieving anchors, fishing or similar work is carried out, as far as direction goes, in terms of Azimuth. The boat being directed to steer a particular course in reference to true north. A Gyro compass repeater mounted next to the aft end control console is a considerable help, provided the boat driver realises that the bow is behind him and that the course to steer is in reference to where the bow is heading.

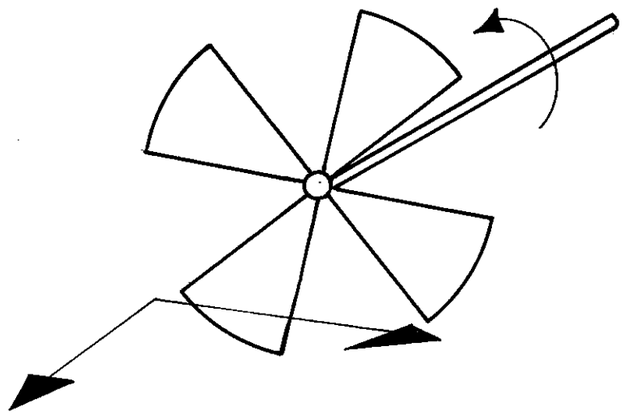
Most people soon get used to working the vessel facing aft and do not become confused with regard to heading.

The one important aspect which is often neglected, is the effect that wind, sea or current are having on the bow. There will be times when the driver is concentrating so intensely on the activity at the stern that the bow may begin falling off the desired direction and getting it back could prove a serious problem if it's allowed to fall off too far.



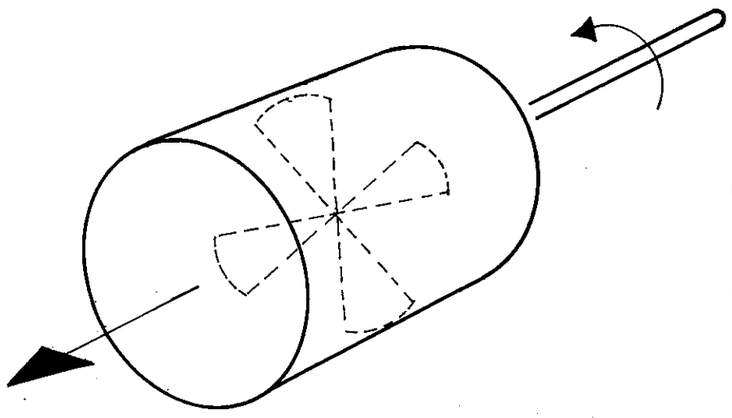
Pitching reduces thruster efficiency by exposing the screw — Note tunnel clearly visible on this illustration

Diag 149. FORCE VECTORS OF CONVENTIONAL OPEN PROPELLORS



If the vessel is stationary and the propellor commences to turn, ahead in this case, there will be a transverse thrust component as well as thrust in the ahead direction.
When the vessel gathers way this component is masked.

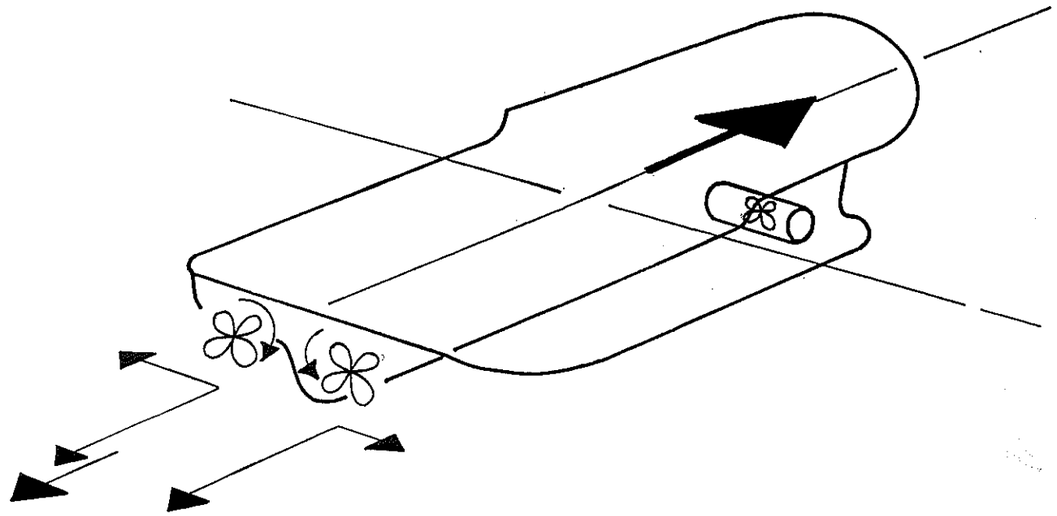
Diag 150. FORCE VECTORS OF PROPELLOR IN KORT NOZZLE



Enclosing the propellor in a tubular shroud or nozzle masks the transverse component of the thrust and increases propulsion output power.

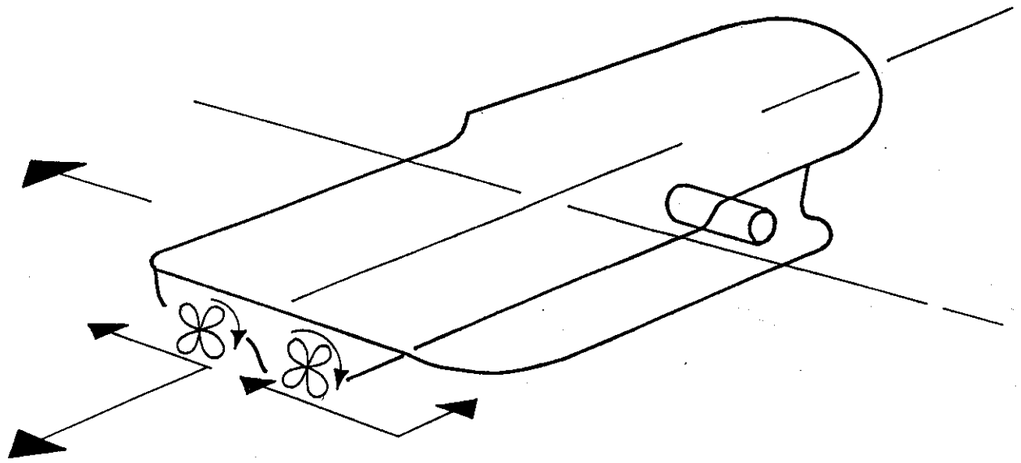
Diag 151. MOVING AHEAD

Open propellors — Inward turning both engines ahead — no transverse thrust — cancelled out



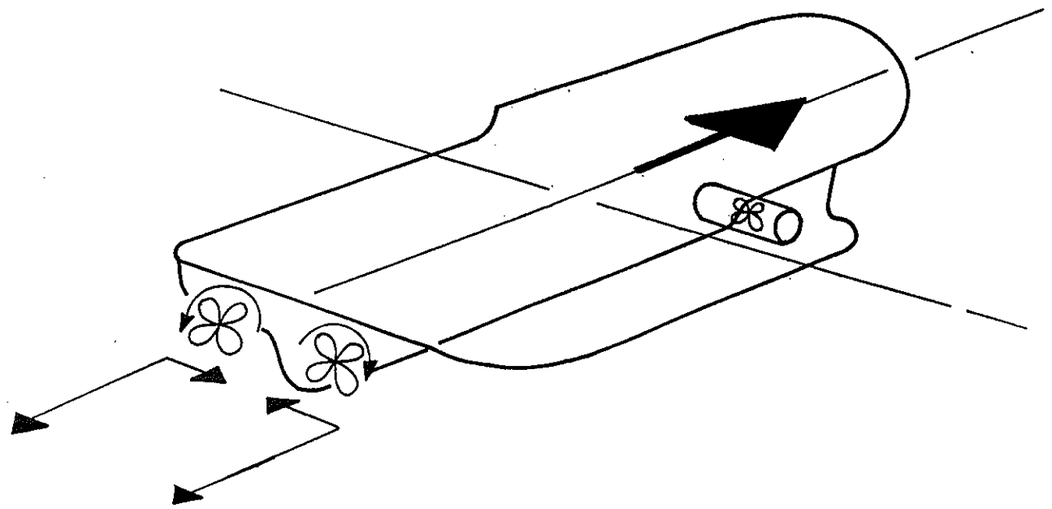
Diag 152. TURNING HEAD TO STARBOARD ON ENGINES

Open propellors — inward turning, port ahead, starboard astern
Transverse thrust **reduces** movement of stern to port against the desired direction.



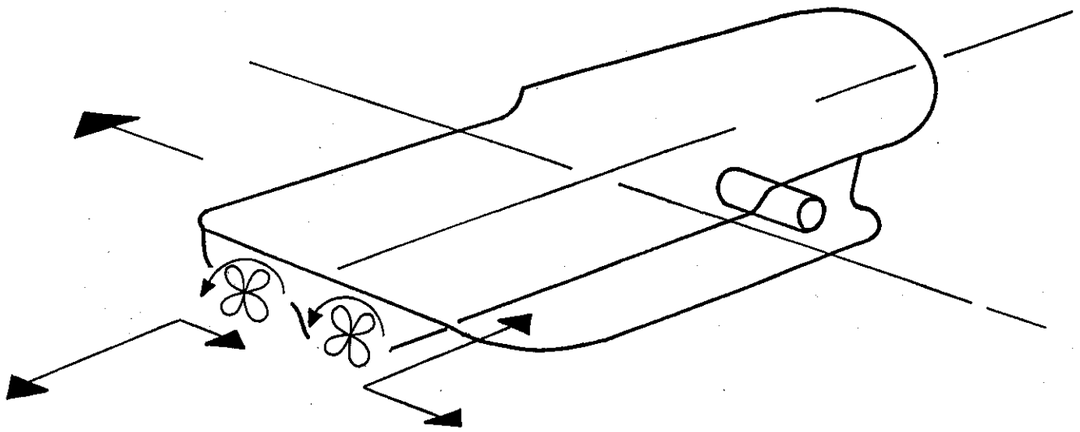
Diag 153. MOVING AHEAD

Open propellors — Outward turning
Both engines ahead — transverse thrust cancels out



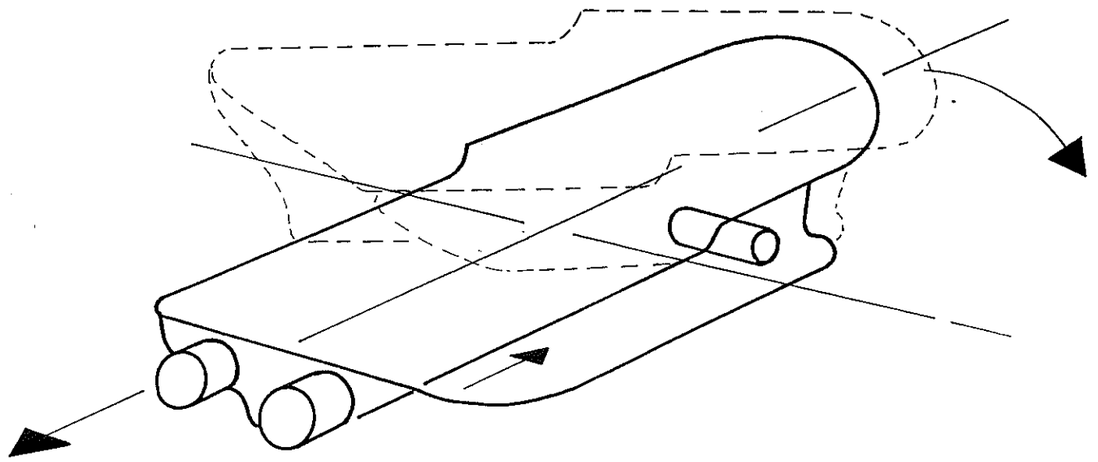
Diag 154. TURNING HEAD TO STARBOARD

Open propellors — outward turning, port engine ahead, starboard astern
Transverse thrust **assists** turning moment.



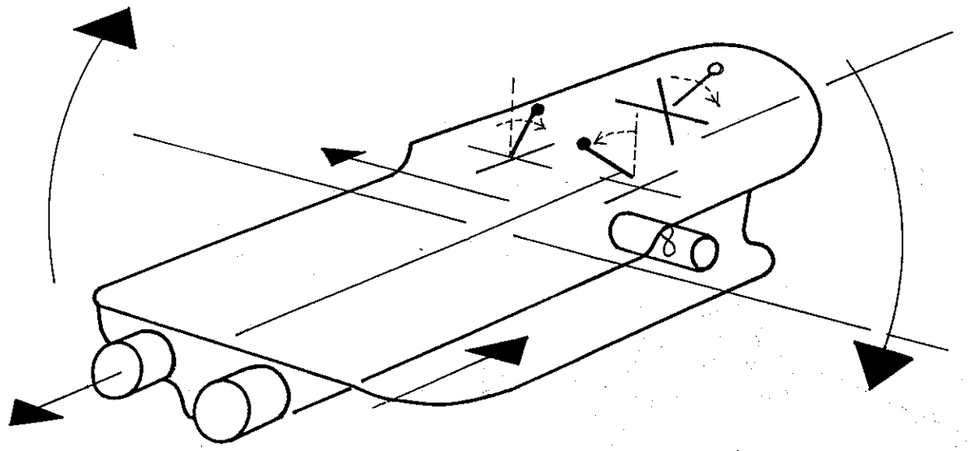
Diag 155. TURNING SHORT ROUND — HEAD TO STARBOARD

Port propellor ahead, starboard propellor astern



Diag 156. TURNING SHORT ROUND TO STARBOARD — PIVOTING NO ADVANCE

Port propellor ahead ⅓ starboard propellor, astern ½, bow thrust pushing bow to starboard



b. Walking sideways

Moving bodily sideways is an ability of the modern offshore workboat which is required constantly. In anchor handling the boat must move sideways or resist a sideways force under a wide variety of conditions.

The boat is required to use this movement while picking up or handing back pennants to a barge, keeping on line while running and retrieving anchors manoeuvring to pick-up buoys, holding position on line of bearing during anchor retrieval and deployment, moving sideways at an angle to a vessel making way and in any number of other situations.

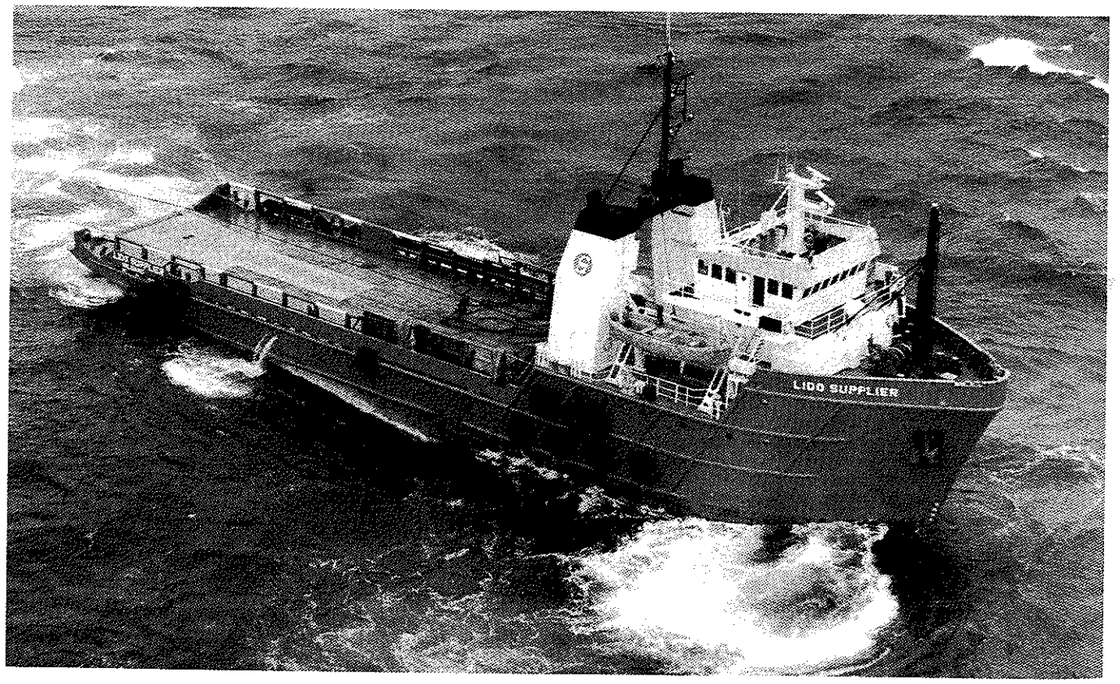
The diagrams show the combined use of main propellors and bow thruster. In making a sideways movement it is usual to get the stern moving in the required direction then apply bow thrust power to start the head moving. The diagrams also show the effect of rudder movement and position which can be used to assist the side step or to slow it down.

Some masters like to work with the rudders turned inboard facing each other. Where individual rudder control is fitted this enables the master to forget the rudders, knowing that the application of propellor thrust will have the required transverse component to "walk the stern" in the direction required.

Very high efficiency rudders, such as Becker flapped rudders which have a trim tab to create a much greater sideways thrust component than conventional spade rudders and are favoured by some owners.

The ship may frequently be required to move sideways at an angle to her heading. For example moving into position to pick up a pennant hanging on the crane of a barge underway or moving in to pick up a buoy.

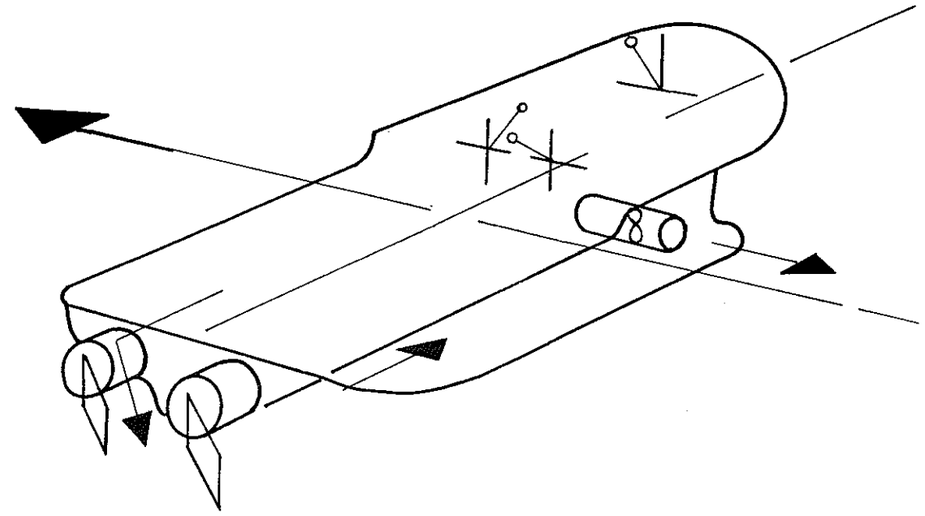
At other times during anchor running the vessel may have to get up onto the current bearing using this technique.



Moving bodily sideways is an ability of the modern offshore workboat. Here Lido Supplier, now re-named the Alpha 702, applies 3 tonnes of corrective thrust in a short burst.

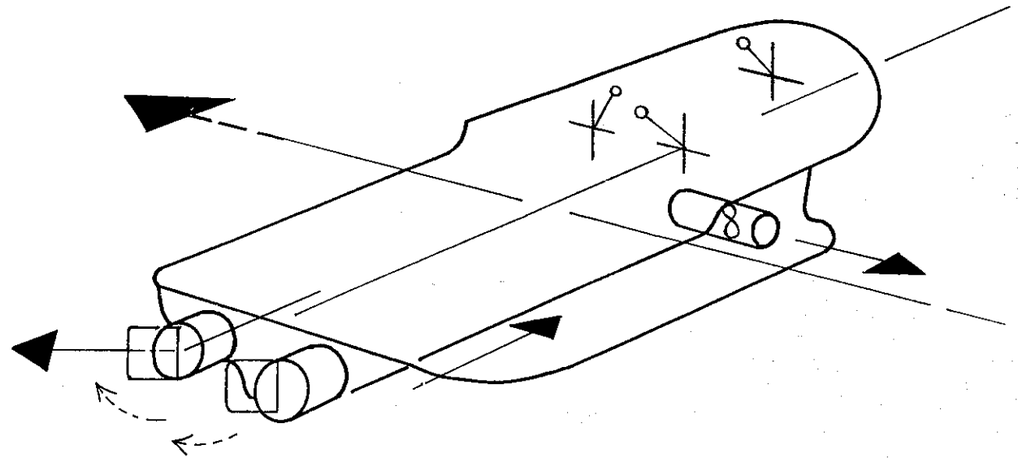
Diag 157. WALKING SIDEWAYS BODILY TO PORT

Linked rudders to starboard, more astern power required than ahead to stop advance



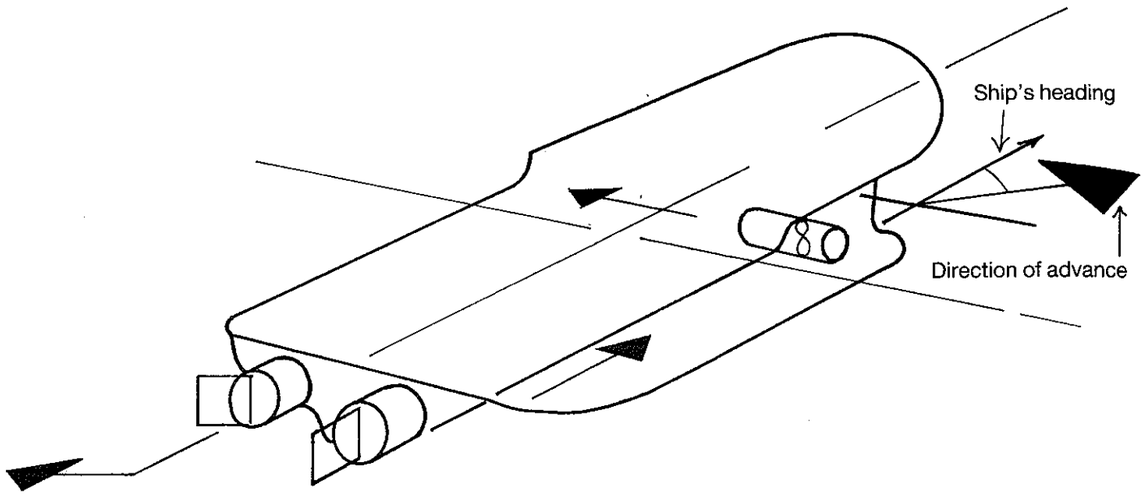
Diag 158. WALKING SIDEWAYS

Checking rate of movement by moving linked rudders **to port**



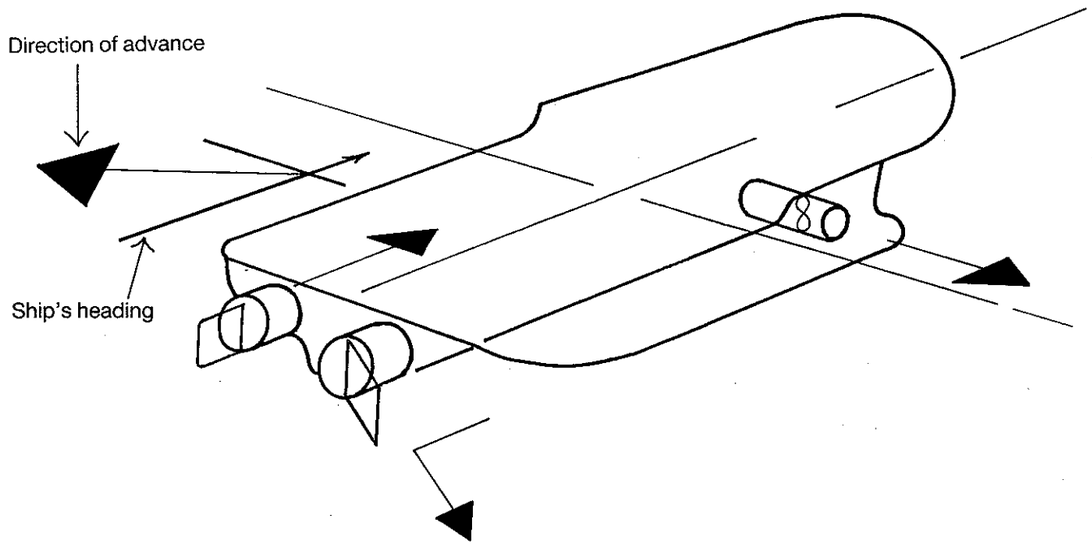
Diag 159. ADVANCE AT ANGLE TO SHIP'S HEADING

Port engine and port rudder create movement of stern to starboard and ahead. Bow thruster pushes bow to starboard. Starboard engine check advance



Diag 160. MAKE STERNWAY AT ANGLE TO SHIP'S HEADING

Starboard engine moves stern across to port. Bow thruster pushes bow to port. Port engine gives sternway.



c. Using wind and tide

Wind, current and waves will complicate the problems of station keeping but in many cases these forces may be used to advantage to assist the boat. It is much easier to hold bearing or position if the thrust of propellors and side thrusters can be precisely balanced against the wind and sea and a skilled ship handler will use them to advantage.

Holding position for long periods while working on an anchor which is decked for some reason, can be made easier by turning the boat to a point where environmental thrusts, wind or current are acting on the boat in such a way as to hold her stationary against the propellor thrust.

Anchor handling in high tidal current areas gives the most scope for using the tide as an extra thruster and if a boat has a particularly weak bow thruster then it will be vital to utilise the current force to help the boats activities.

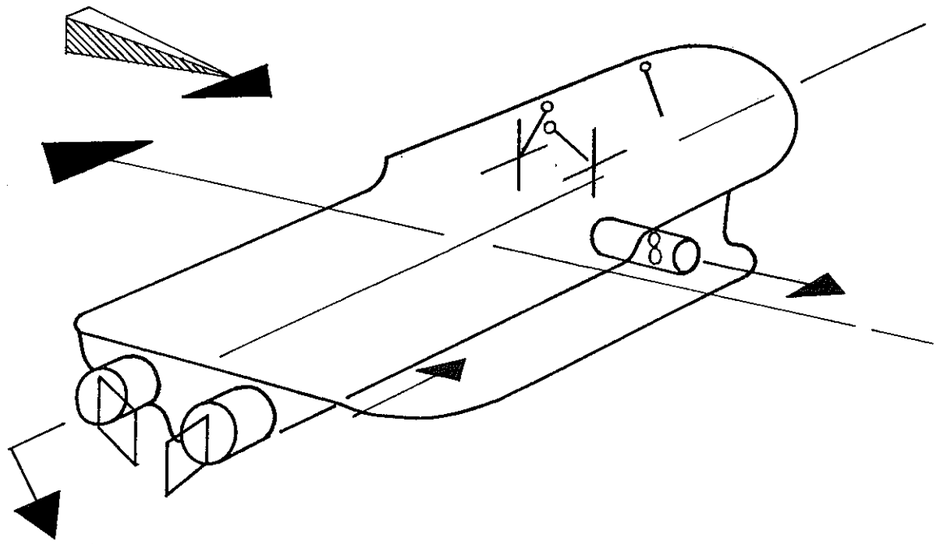
During fishing operations, which require a delicate touch, when engaging the hook on the line, some masters set the boat up on the ideal cross course and then reduce power so that wind and current carry the boat across the mooring line at dead slow speed.

When catching buoys the problem is often complicated by the propellor wash, which can "blow" the buoy away just as the lasso is about to be thrown. To avoid this the boat can be set up so that wind and or current carry the boat onto the buoy using minimum engine power.

If, for example, a boat has to remain for long periods broadside onto the wind and current, bow thrusters may overheat and it's wise to work with rather than against the natural forces.

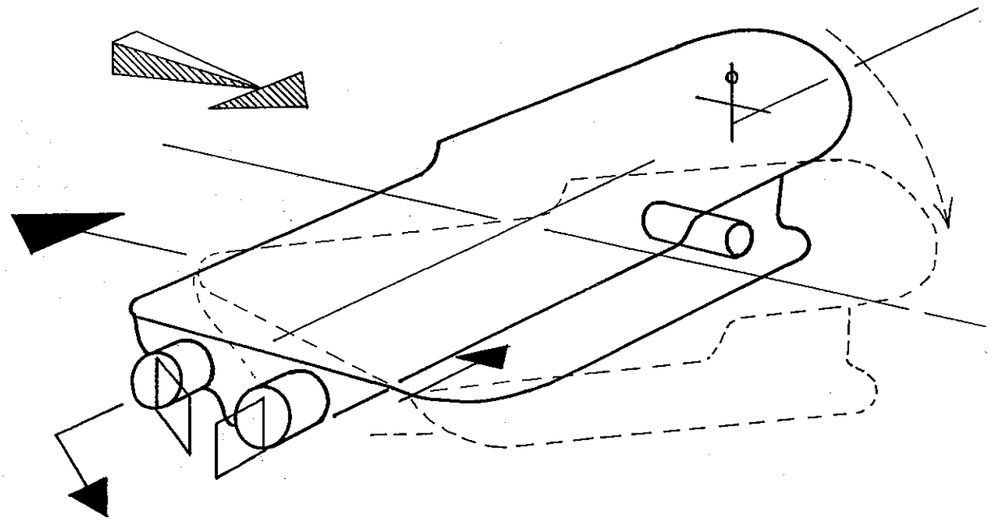
Diag 161. HOLDING POSITION

Against wind and sea from port beam, engine and thruster force balanced against environmental force. Port rudder – starboard helm on starboard rudder amidships



Diag 162. HOLD STERN IN POSITION

Allow head to swing to starboard — reduce bow thruster output

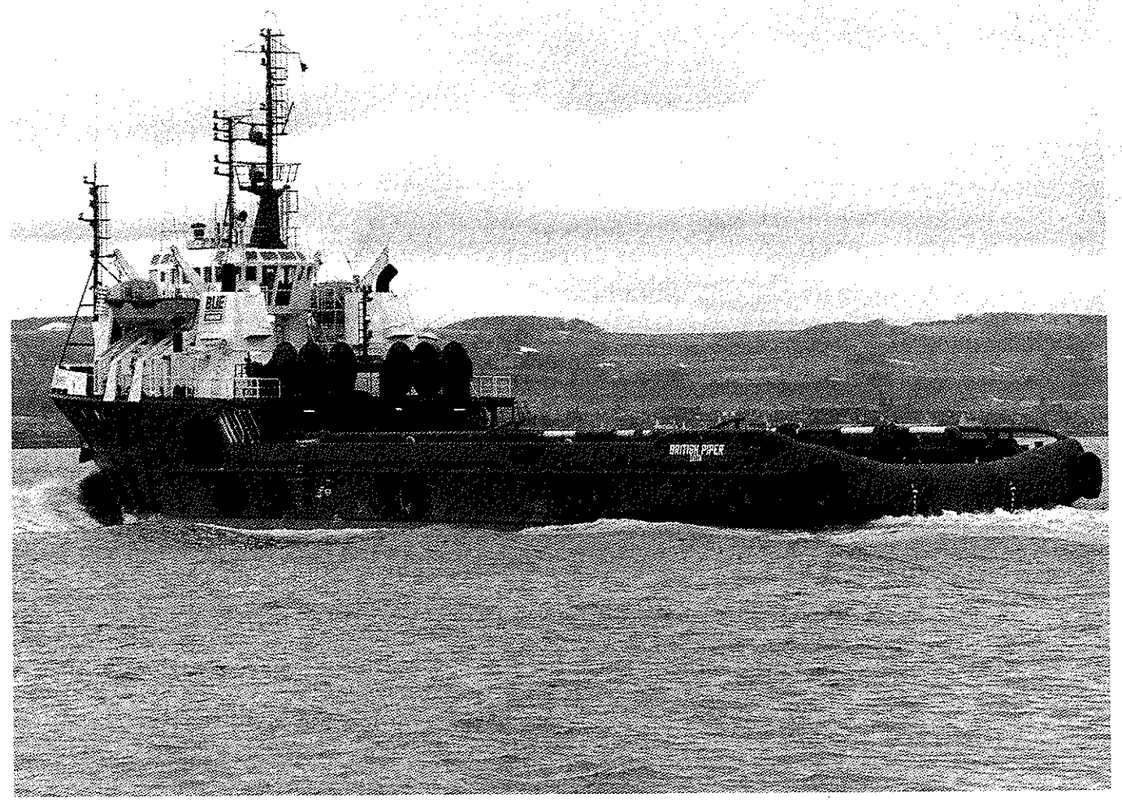


d. Running anchors across wind and current

As noted in (c) try always to use the forces of wind and current to best advantage but there will be times when the boat is obliged to run an anchor out across a beam wind or side current.

Try to position the boat at the start of the run so that she proceeds along the desired bearing but the boat in fact moves at a considerable angle to the bearing line with the bow turned into the wind/current force. This reduces its impact and effective thrust on the boat — a crabwise movement.

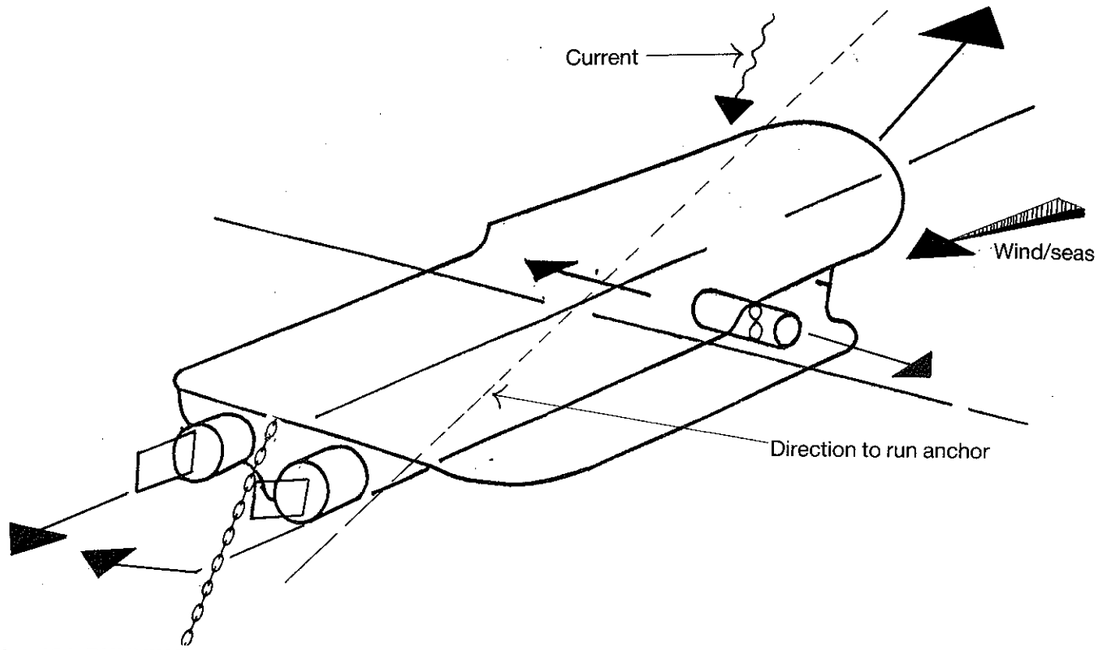
Another technique is to move both crabwise and to windward or up current of the bearing line so that as the boat approaches the anchor drop point she is on line of bearing. This must be done with considerable skill, especially when running chains because the anchor line could be run in a curve which will be difficult to pull straight by means of the barge winch.



No matter how powerful the boat always try to use the forces of wind and current to best advantage. The British Piper illustrated has now changed ownership and is renamed OSA Venturer

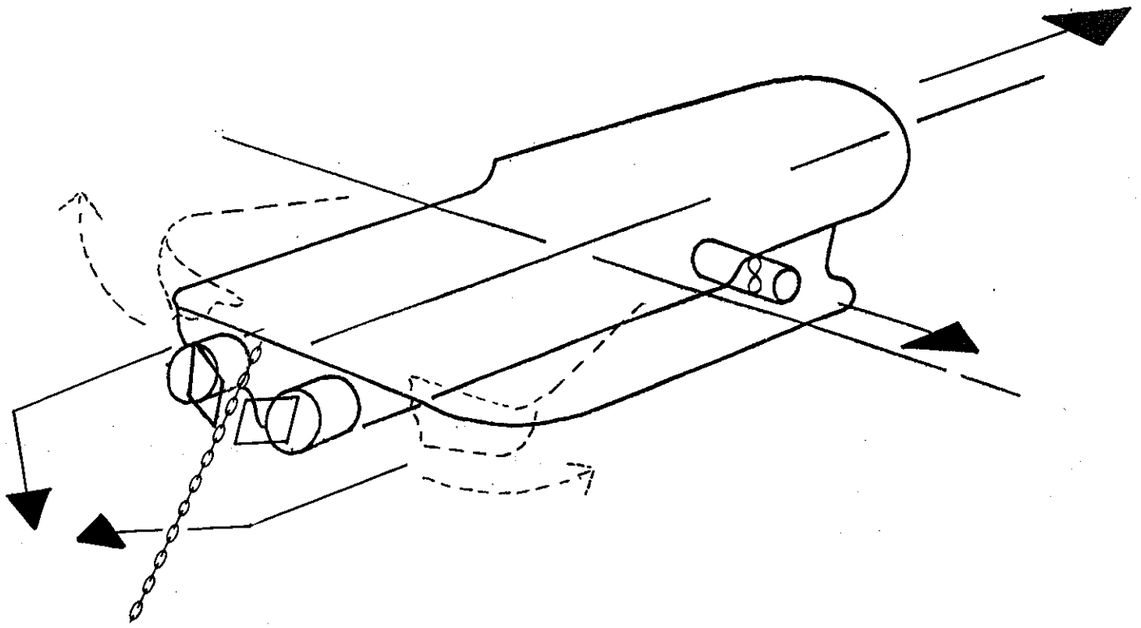
Diag 163. RUNNING ANCHORS

Current from port bow — strong wind starboard side
Angle boat across line to be followed to ease bow thruster. Get current on leebow to assist

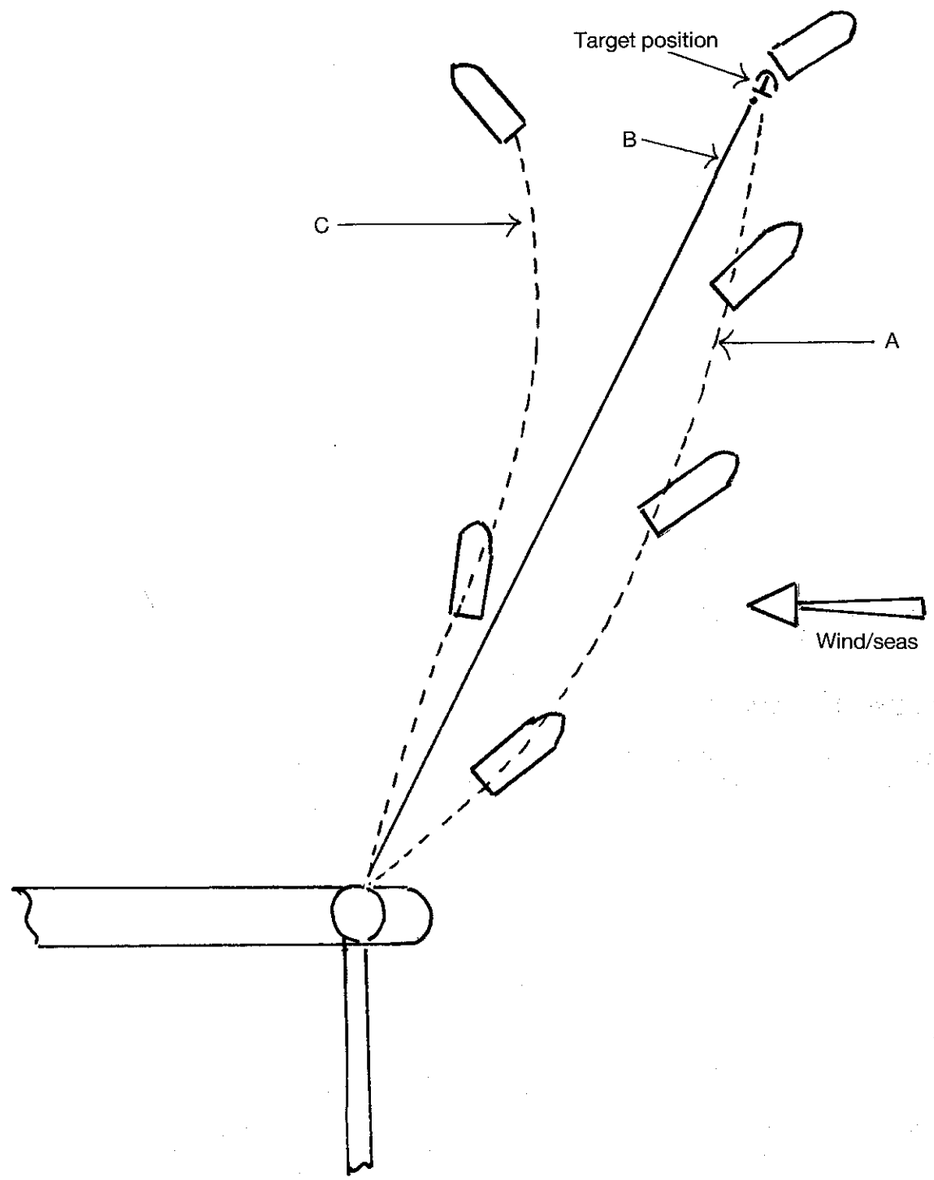


Diag 164. RUNNING ANCHORS

Rudders turned inboard — increase in ahead power on one engine moves stern to that side. Use bow thruster to push bow over — e.g. to move to port. Increase port engine power, bow thruster push to starboard



Diag 165. RUNNING ANCHORS ACROSS WIND AND SEA



A. Shows course made good with boat angled across with wind so as to hold the position to windward of the line.

B. Shows the required line of bearing for the anchor.

C. Shows a boat trying to run out along the ideal bearing line but unable to hold up against the wind force and as a result falling off to leeward. This anchor will probably have to be hauled in and re-run.

e. Avoiding and recognising danger

Anchor handling work is often close quarters ship handling in marginal weather where a wrong movement can result in a serious collision between boats or the barge they are working. Error margins are small and at times non-existent, wires under very high tension, large weights being handled, all add danger to the deck crew who may well be working intermittantly submerged by seas boarding the anchor handler.

The following list shows particularly hazardous times where very skilfull ship handling and awareness of exactly what operations are occurring is the only way to keep out of danger.

1. **Standing by to run the bow anchor of a barge** which, having dropped its stern anchor on the run into location, starts to brake the anchor winch. The barge may suddenly slew violently away or towards the boat at the bow which is usually very close (and sometimes attached to the bow anchor pennant). By listening to the commands on the radio issued to the winch operator the boat should be able to work out when to expect the swing to occur.

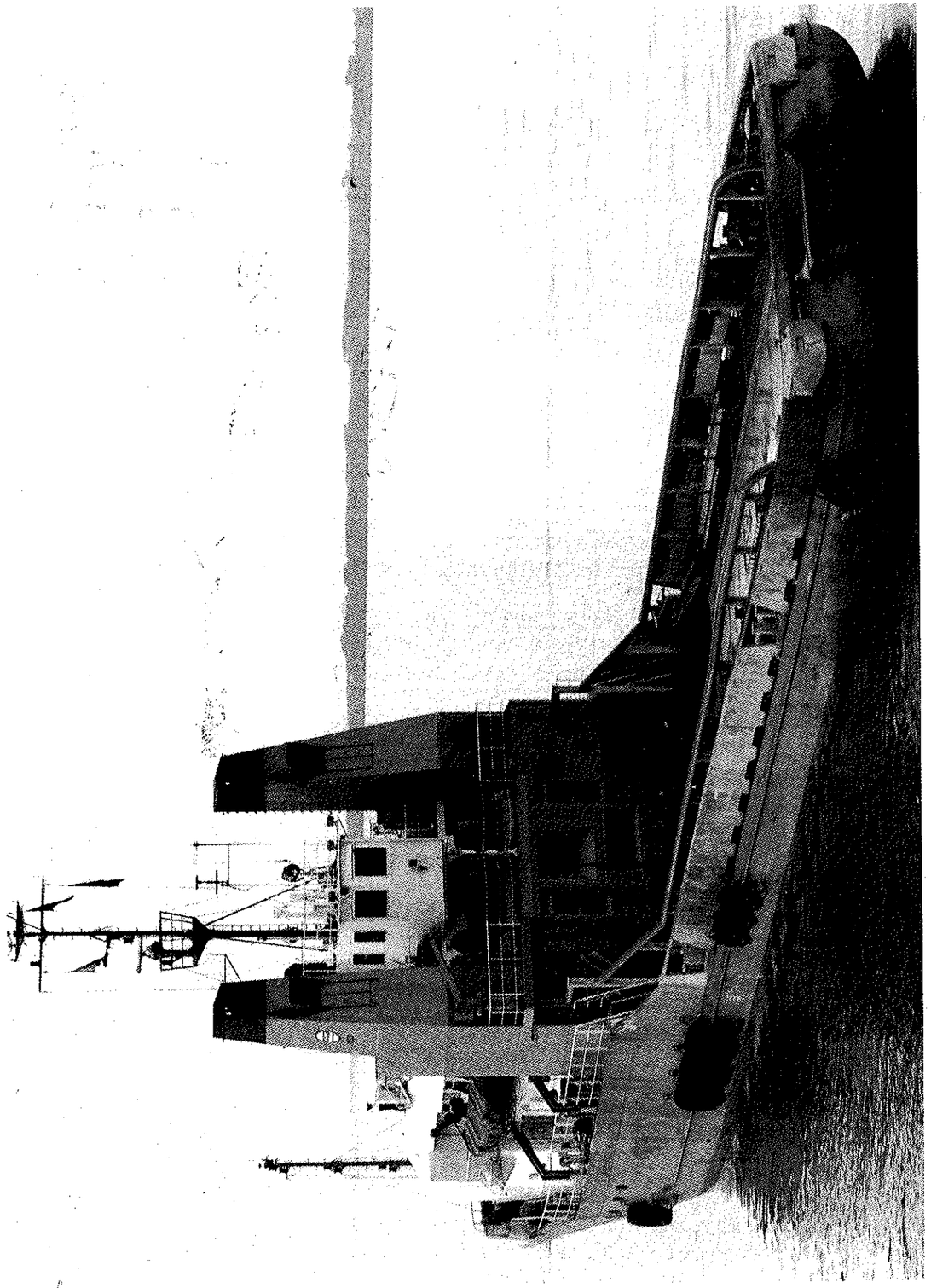
2. **Passing back the chaser pennant to a barge** (PCC system) **after running the anchor.**
   This operation requires the boat to stand-by very close to the anchor racks and is constrained by the length of the chase pennant, typically 30 to 60 metres long and the outreach of the crane.

3. **Picking up the last (typically) stern anchor of a barge which is getting underway.**
   As soon as the chain or mooring wire breaks free of the bottom the anchor handler is at the mercy of the winch operator on the barge. If the barge begins moving, either with tugs or its own propulsion before the last anchor is racked, the boat must chase the barge while the anchor is shortened up to the rack. She must then pass the pennant while making stern way. The barge may also be drifting either towards or away from the anchor handler.

4. **Approaching location with two anchor handlers on the bow anchor pennants and one tug towing on the bridle**
   In this situation the room for manoeuvre is very restricted. The towing vessel may be maing quite large course alterations and the boats on the anchor pennants must be aware of the effect this may have, e.g. one boat trailing behind and the other in danger of being struck by the barge as it turns.

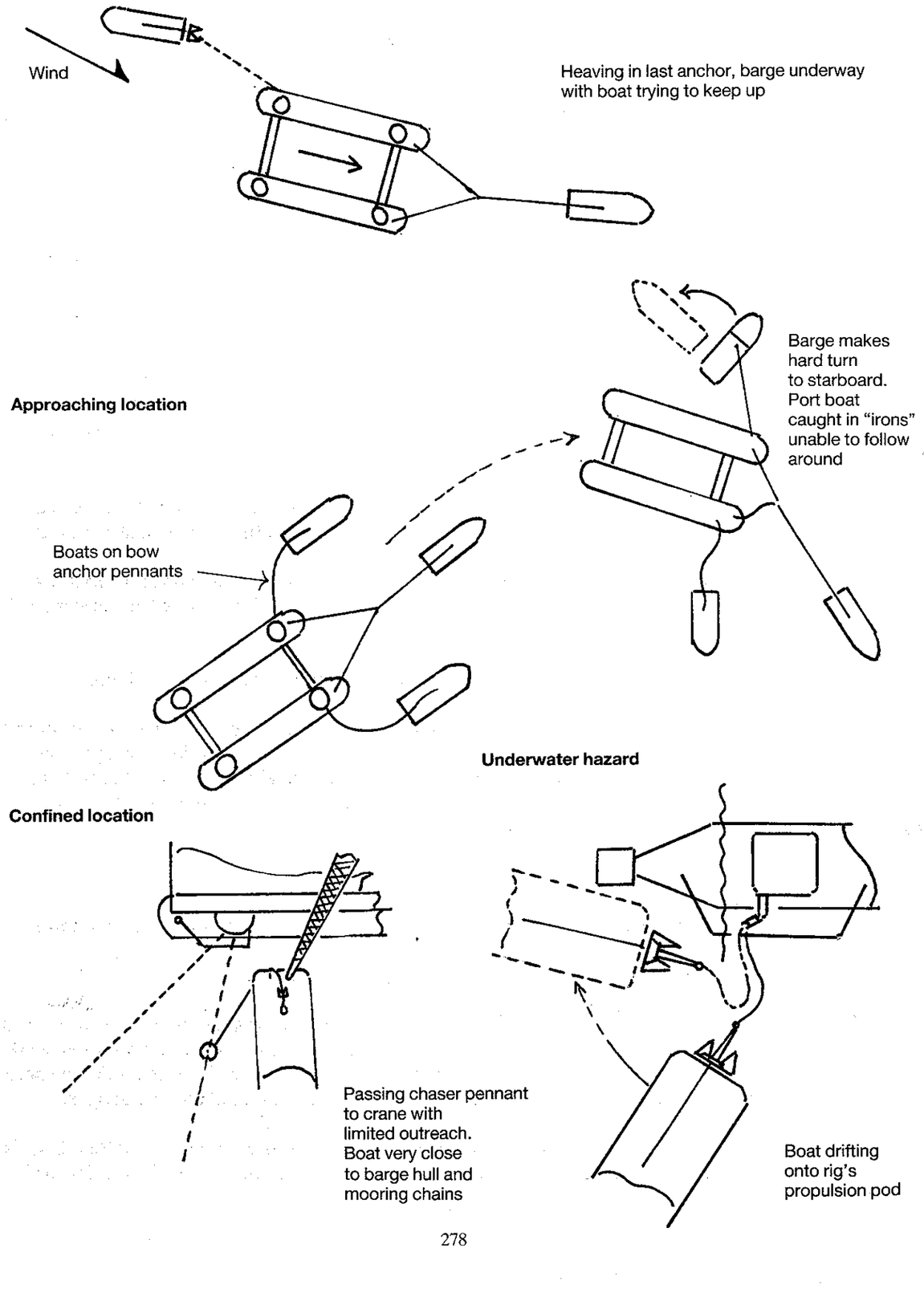
Darkness adds another difficulty to anchor handling especially when working close alongside. The lower hull and anchor racks winch are usually unlit so that distance off can be difficult to judge. A large searchlight kept trained on the lower hull structure is invaluable.

Underwater projections such as propulsion machinery pods, lower hull extensions etc, all frequently found on drilling rigs and work barges add a further difficulty especially when moving in close to pick up or pass back pennants.



Skilful ship handling and awareness can avoid serious and often very dangerous situations evolving

Diag 166. DANGER SITUATIONS



f. PosCon systems

PosCon is a term which means position control and refers to a microprocessor based single lever control system for operating propellor output, thruster output and rudder position via a single omni-directional lever.

On modern boats with multiple thrusters and split rudder controls, the person driving the boat may have up to six control levers to manipulate when manoeuvring. This has prompted the development of single lever control systems which greatly reduce operator fatigue as the most modern systems, if properly set up, are extremely easy to use.

Generally the systems allow the operator to set the boat on any desired heading and then move in any desired direction, forward, aft, sideways or any combination, by simply pushing the joystick in the direction you want the boat to go.

If the system's electronic processors are properly set up and calibrated they will allow ship handlers of mediocre skill to manoeuvre the boat. However even the most up to date equipment lacks the degree of sensitivity that a skilled ship handler is used to when "driving on the sticks" and many very experienced masters will not use the PosCon when very fine or dangerous manoeuvring is required. The human eye and brain, with its ability to "feel" the vessel's response to wind seas and any propellor thrust will outperform these systems.

It is a useful aid but personnel learning how to handle a boat should be discouraged from using the PosCon until they are able to perform the necessary manoeuvres with the normal control systems.

The electronic complexity of these systems may be of interest to some and knowing how to fine tune a particular set up is useful knowledge but should be secondary to knowing what happens if it develops a fault and the precise sequence for disabling it.

Some systems may use excessive power and behave violently when working at their limits.

The other aspect of these systems which is not well understood is that very few of them are designed in such a way that power output can be adjusted to exactly counter wind or tide pushing the vessel away from the desired position. A good ship handler using the normal controls, would set them up to do exactly that, thus making the expensive PosCon equipment somewhat redundant.

g. Working bow/stern to the weather

Anchor handling work often takes place in marginal conditions as regards sea state and wind force.

Modern boats are expected to work to the limits of their capabilities.

The two most common causes of having to cease operations due to weather conditions are, wind speeds and sea states which overcome the ability of the boat to hold up into the weather while running an anchor on the desired bearing and positioning it where required and secondly the deck being so heavily and frequently wave swept that the crew are placed in unacceptable danger.

Associated causes might be wind and sea states which impose such forces on the boat that if she is working close to a barge on the windward side a collision might occur despite the best effort of the master.

Joy stick control system console from Kongsberg Albatross

Aquamaster single lever control console for omni-directional thruster unit.

g. Working bow/stern to the weather (cont'd)

Buoy catching in heavy weather is particularly difficult. Backing up to a buoy may give the master a better view of the quarry and because he is using astern power to make the approach the buoy will not be blasted away by ahead wash on the propellors, but the disadvantage is that the square stern of the modern AHTS class boat tends to cause seas to steepen, heap up and break over the stern greatly hazarding the crew trying to catch the buoy.

Working head up to the seas, especially in marginal conditions can present a master with the problem of trying to hold the bow head into the weather while backing down onto a buoy. If a particularly heavy sea throws the bow off the wind it may prove extremely difficult to regain control and too much ahead power may wash the buoy out of reach or, if going astern, suck it into the propellor.

Side catching, the technique described in Part 5 — diagram 53 may be appropriate but on high freeboard boats with a crew unfamiliar in its use the effort might be wasted.

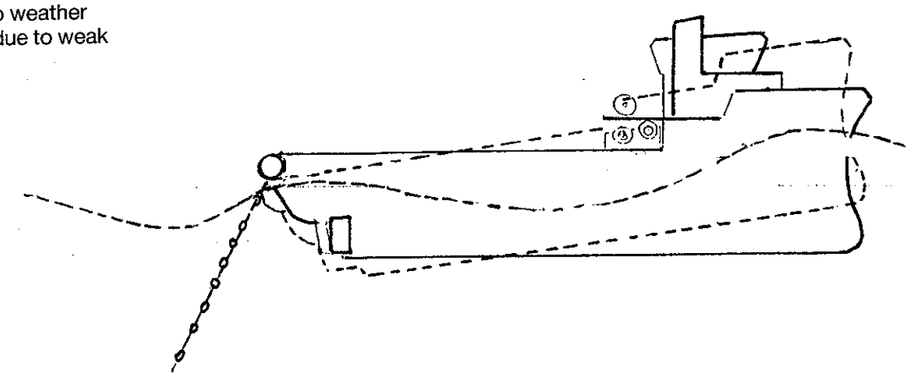
When chasing out anchors with a PCC system many masters will run out to the anchor and should the weather be from astern they will not attempt to turn head up to the seas even though the deck may be heavily awash. Having reached the anchor they will "soak" it out of the ground using the seas and pitch of the boat to do the work. After break out and with the anchor short up to the roller, provided the crew do not have to go on deck, it is usual to allow the boat to take up her natural position in relation to the weather, which, being restrained by the barge anchor, is stern into the seas.

If the crew have to work on deck at the stern the boat should turn head up to the seas in heavy weather. If anchors have to be decked and worked on it is essential to avoid significant rolling which may cause anchors and buoys to slide suddenly risking the crew as they attempt to secure them. Before decking anchors or buoys turn the boat to the best position (head or stern to seas) where rolling is at a minimum.

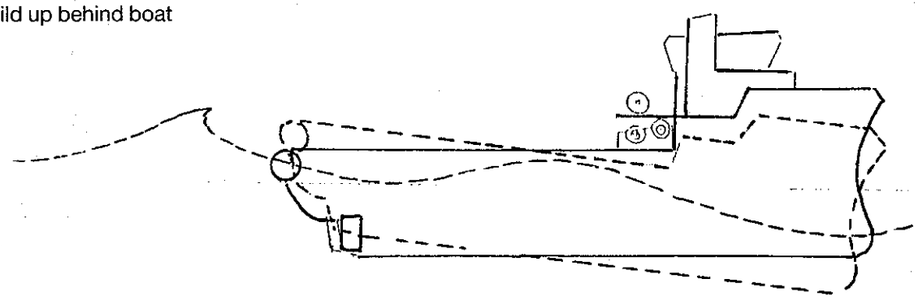
The square stern of modern AHTS designs cause seas to steepen, heap up and break over, sweeping the deck throughout its length.

Diag 167. WORKING HEAD/STERN UP TO WEATHER AND SEAS

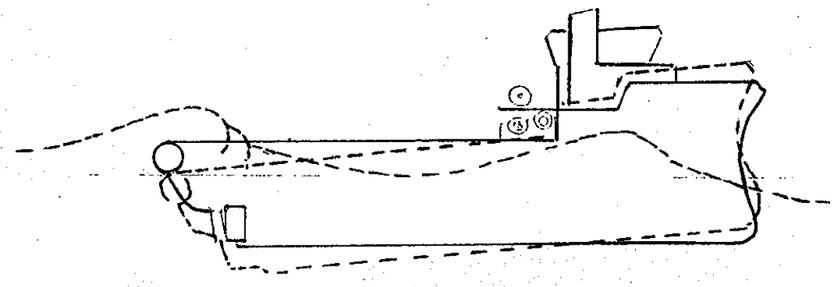
Working head into heavy seas
Decks dry except for slop
but keeping head to weather
may be a problem due to weak
bow thruster



Working stern up to weather/seas
Waves tend to build up behind boat



Working stern up to heavy seas
As boat pitches bow up heavy
seas can board over the stern
and wash whole length of the deck



h. "Slip over" problems
When running or retrieving anchors the work wire must be kept leading astern over the roller. If it should jump or slide or be pulled sideways off the roller it is liable, especially if there is significant strain on it to run up the ship's crash rail, coming to rest at the rail stop.

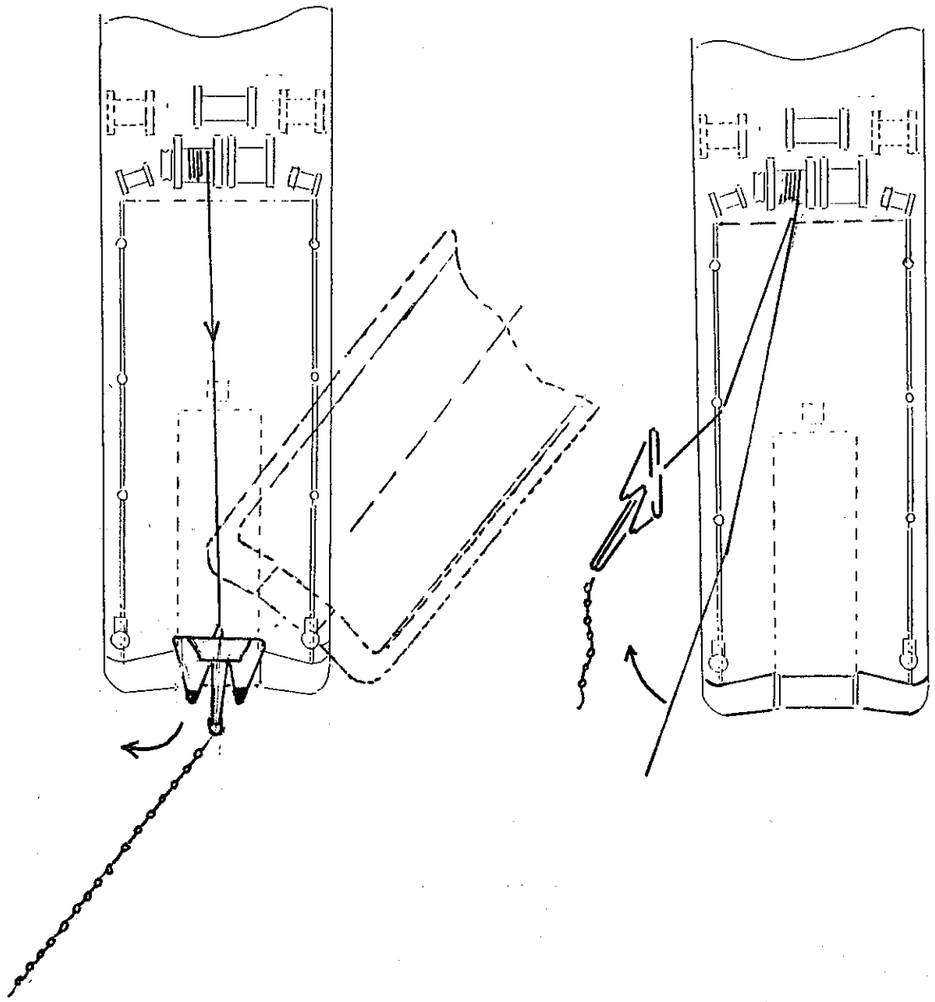
The most common situation is when launching an anchor off the deck, there will be a moment when the anchor is balanced on the stern roller without any constraint, in the form of guide pins, to stop lateral movement. If the ship is off line or the speed of deployment is too slow, or the ship is rolling significantly, the anchor may dive off the quarter dragging the pennant with it up the side rail.

To avoid the problem launching anchors should be done with the boat exactly on line and as fast as possible.

The diagrams show a possible method of rectifying the problem once it has occurred. Other solutions may well occur depending on the particular circumstances including cutting the pennant wire and dumping the anchor, then fishing for it. This option may however not be permitted.

The rail stops are clearly visible on this illustration of the AHTS Nordfonn, now the Normand Borg

Diag 168. SLIPOVER PROBLEMS — ANCHOR ON ROLLER



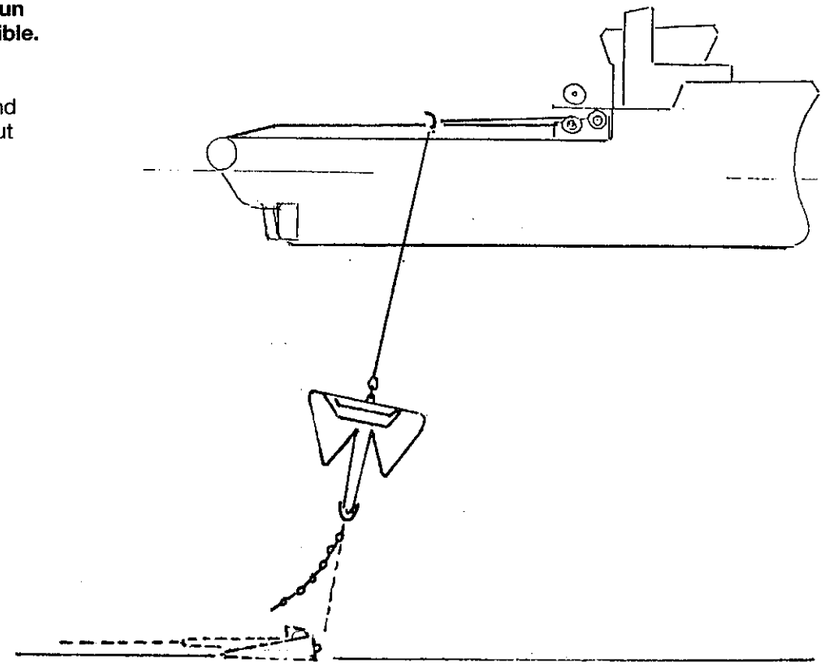
Anchor balanced on roller, boat off line of chain, side pull on anchor, winch payout speed too slow

Anchor slips sideways off roller and falls over the quarter. Work wire dragged up crash rail to stop

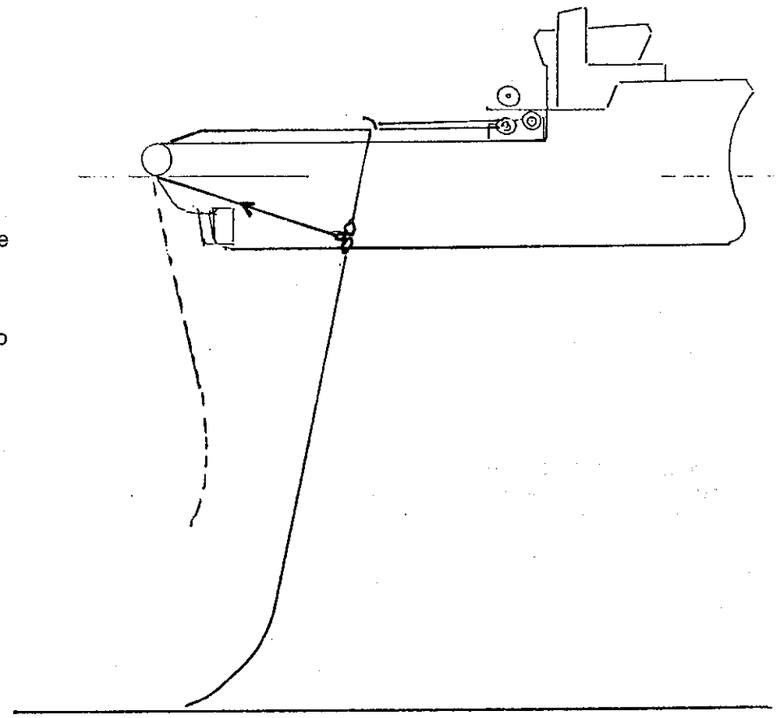
Diag 169. RECOVERY OF PENNANT/WORK WIRE AFTER SLIPOVER

Slack out on work wire, run anchor to bottom if possible.

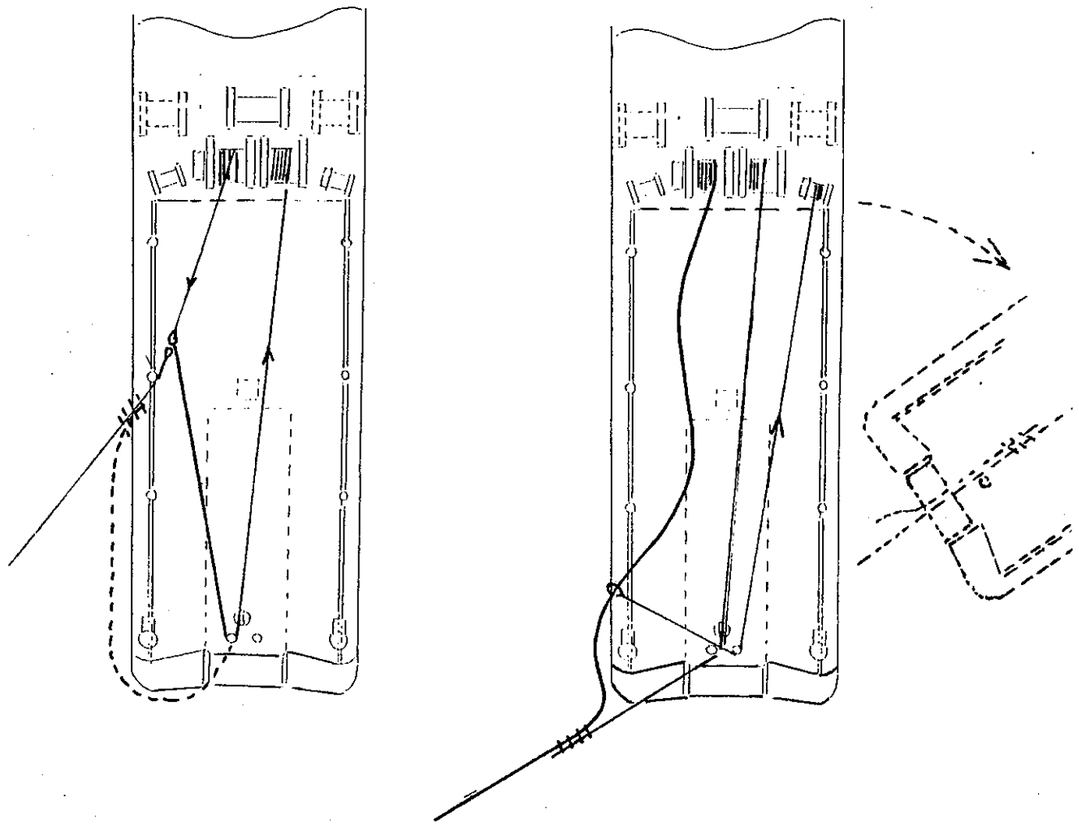
Note
Due to weight of anchor and chain the pennant might cut through the crash rail — i.e. rip down



If the anchor can be put on bottom take off all weight on the pennant/work wire. Run a work wire from the other anchor handling drum or towing drum aft and outboard shackling it into the pennant and hauling the bight aft



Diag 169. RECOVERY OF PENNANT/WORK WIRE AFTER SLIPOVER (cont'd)



The starboard work wire has been lead aft and then back to the port wire where it is connected to a pennant joining shackle.

This method will work if the anchor can be run to bottom and does not cause the (port) fouled wire to rip down.

If the anchor cannot be put on bottom and ripping down is likely, the starboard wire is run outboard on the portside and bulldog grips are used to attach it as shown

With the starboard wire connected, the weight is taken up and the port wire slacked off so that the strain is transferred to the starboard wire.

The boat may be swung to assist and the fouled wire can be cleared. If it has ripped down and cannot be cleared then cutting the port wire may be the only option.

i. Trimming the boat for anchor handling

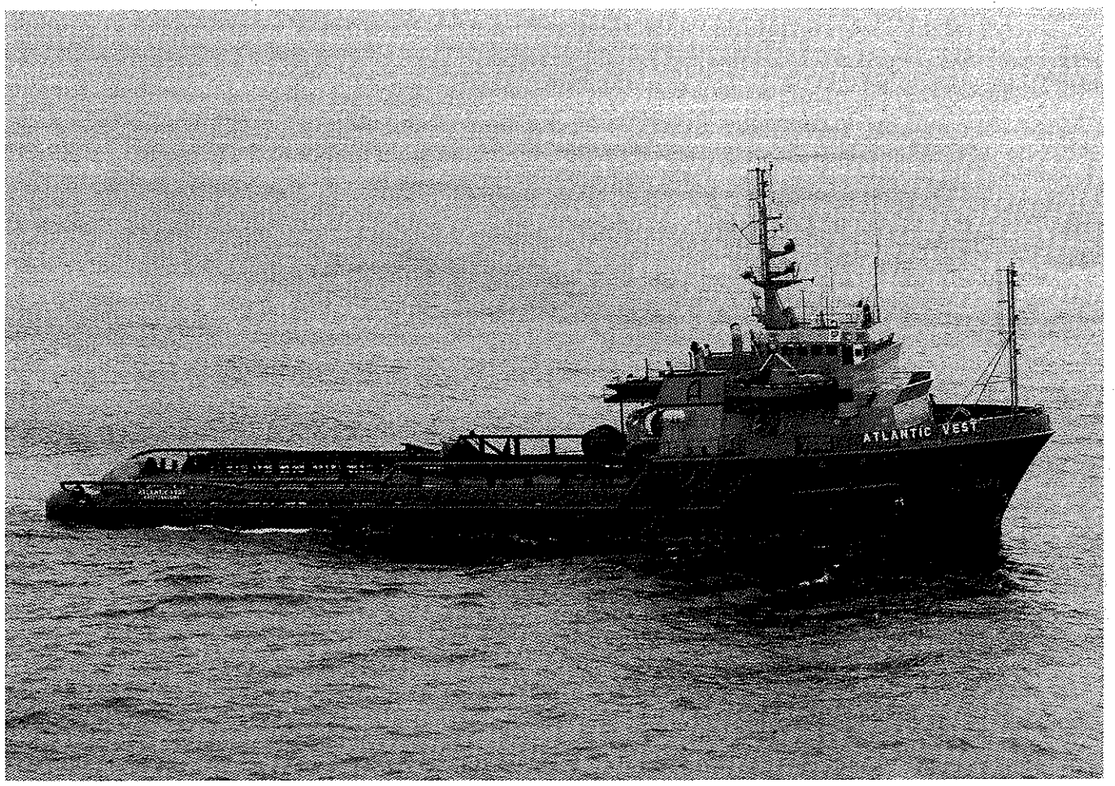
There will be some operations, especially those in which very heavy anchors and chains must be worked, when it is desirable to alter the trim of the boat so that when maximum loads are imposed on the stern, the boat does not trim down too heavily.

Some masters prefer to have their vessel's trimmed by the stern for all anchor handling work, especially if the boat is large with high freeboard aft, trimming the boat stern down allows a better view of buoys as they are approached and eases the problem of buoy catching.

In general every effort should be made to have the boat level and preferably drawing at least ⅔ or ¾ of her maximum load draft to give propellors and rudders as good a "grip" as possible.

On vessel's where bow thrust power is limited, trimming by the bow can assist in keeping the thruster immersed allowing it the best chance to operate at full power.

Vessel's vary greatly in their manoeuvring characteristics and masters should experiement to discover the ideal trim, suitable for a particular anchor handling operation.



Some masters prefer to have their vessels trimmed slightly by the stern for all anchor handling work. The AHTS Atlantic Vest is now renamed Birgitte Viking.

j. Avoiding damage

Some parts of an anchor handling operation are inherently dangerous and the boat is likely to suffer damage or cause damage to anchor chain/wires or other equipment. This short list shows some of these more common problems.

1. **Damage and breakage of pennant wires**

   Some of the heaviest loads on pennants are experienced when decking anchors or when breaking them out of the ground. It is not possible to avoid breakages on occasions but when pulling anchors on deck it is critical that the anchor is correctly orientated before attempting to pull it over the roller. Some anchors can **only** be decked if properly aligned particularly Bruce and some Vryhof types.

   When using pennants with pressed ferrule eyes and without tail chains on the anchors there comes a point in the decking operation when the ferrule is under extreme bending and pulling forces and it is at this point that it can part.

   If the anchor is not dressed with a tail chain and still has to be checked, the only way to accomplish it is with the greatest care at dead slow hauling speed making sure that the boat is positioned so that the mooring line (chain or wire) is up and down.

2. **Damage to rudders, nozzles and propellors**

   Modern anchor handlers are designed to work with the work wire leading underneath the stern to quite a steep angle, however boat's will suffer damage to rudders, propellors and Kort nozzles if the angle and position of any wire leading under the stern is not controlled accurately.

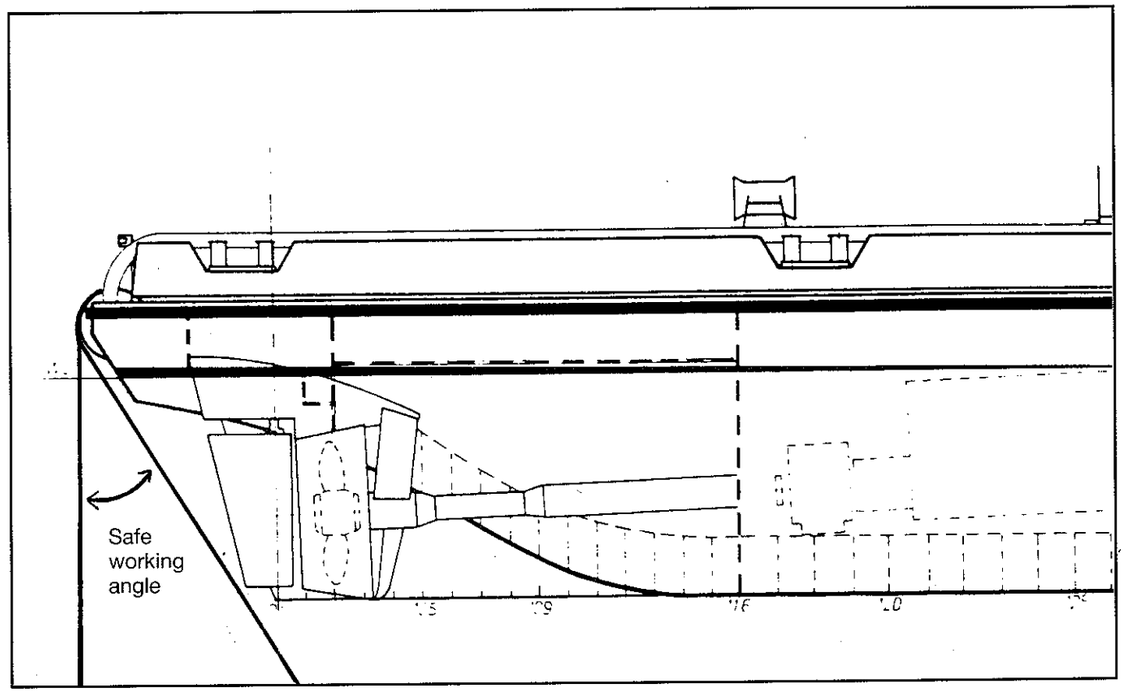
   A careful inspection of the vessel's plans will reveal the precise location of those items liable to damage and the master must keep a mental picture of the underwater stern area in order to enable him to judge just where a work wire will be and what manoeuvres to avoid.

When picking up or returning PCC pennants the boat will have to work in close proximity to previously deployed anchor lines and the possibility of snagging one may be a real risk, especially when barges are ballasted up for anchor work (chain moorings).

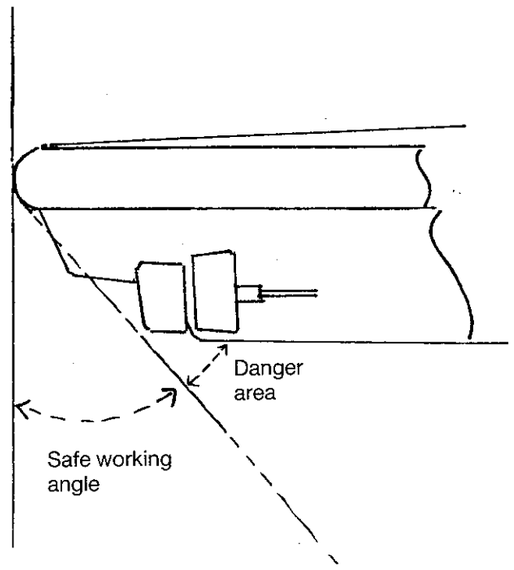
On barges with wire systems the angle of entry into the water of the mooring lines may be very shallow presenting an obvious hazard visible in daylight but not so obvious at night.

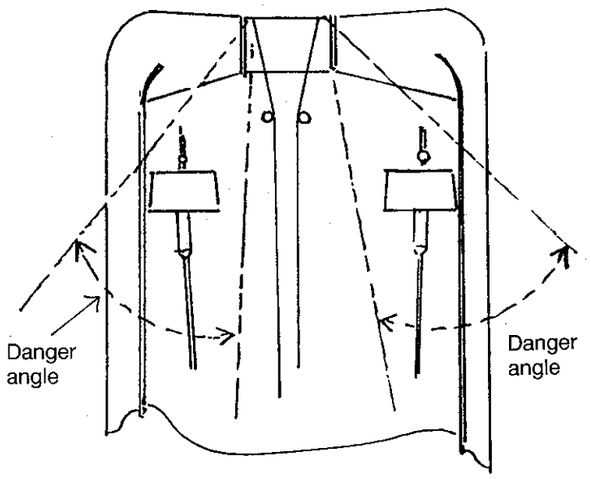
Vessels with open propellors are more at risk than those with Kort nozzles and wires should only be allowed to go under the stern if the lead can be kept on the boat's centreline.

Diag 170. FOULING RUDDERS AND NOZZLES



A careful inspection of the vessel's plans will assist the master in building up a mental picture of the underwater stern area and of the maximum angle permissible for pennants/work wires running under (except when positioned on the boats centreline)

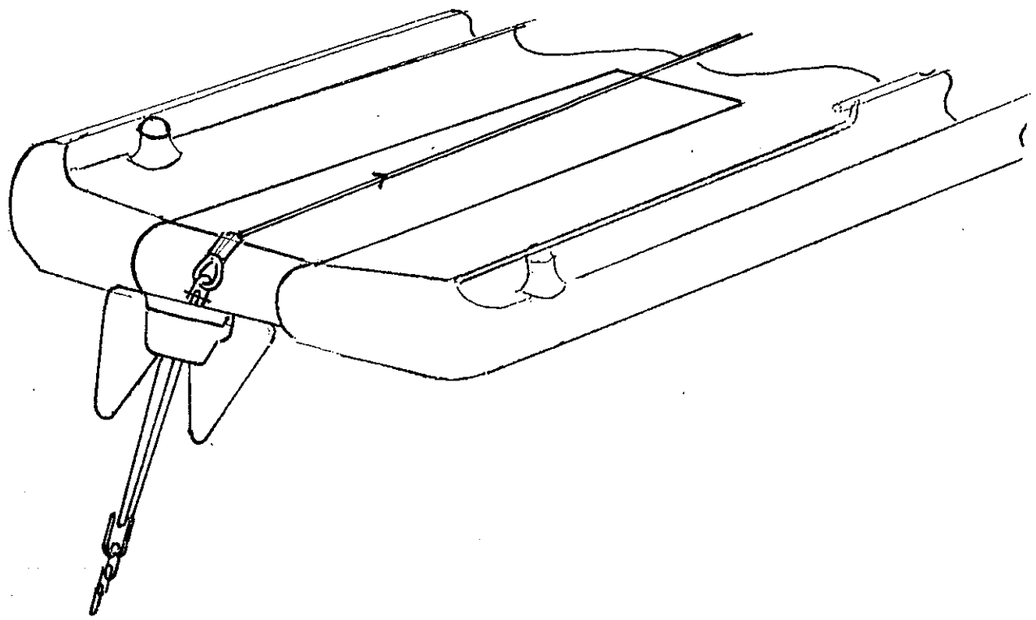




Working with wires and chain below the stern. Diagrams show the safe working angles under the stern

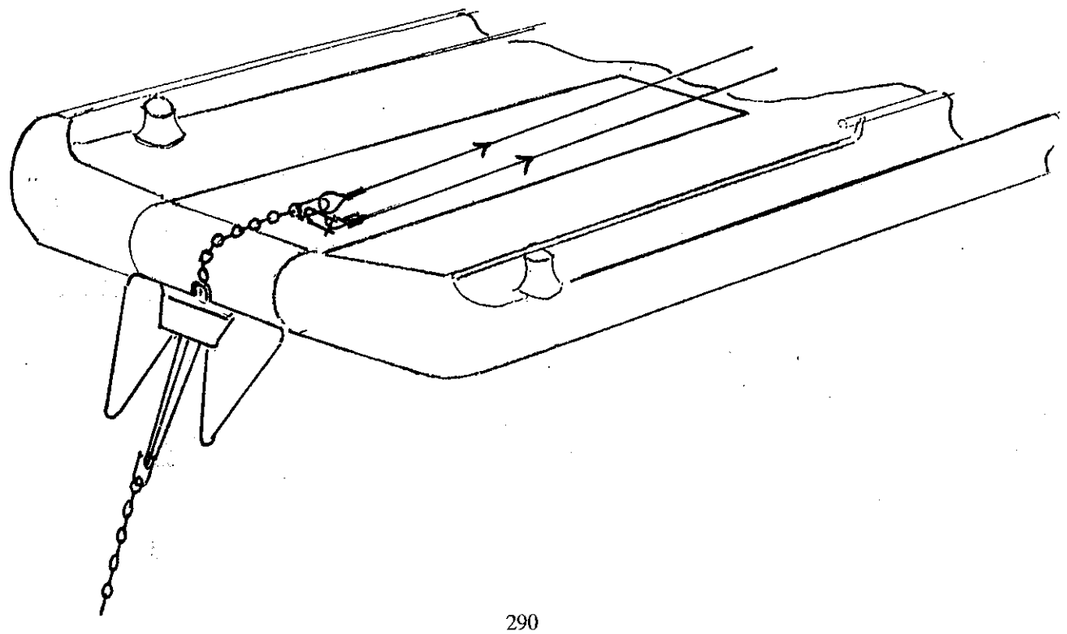
Diag 171. BRINGING ANCHOR ONBOARD WITHOUT TAIL CHAIN FITTED

Very severe bending movements imposed on ferrule — liable to part



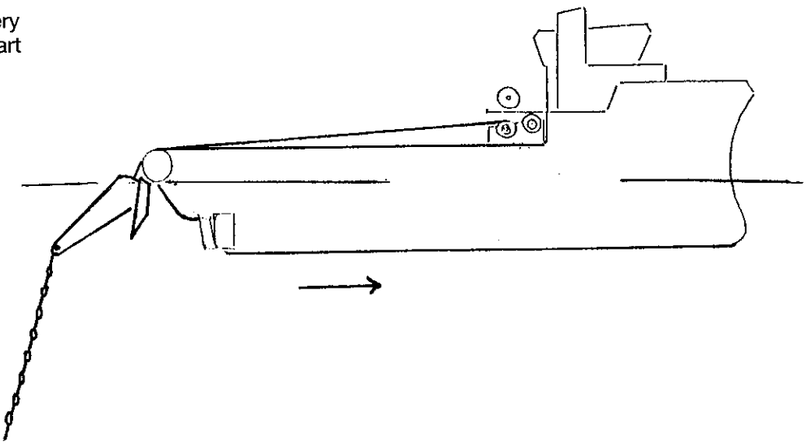
Diag 172. BRINGING ANCHOR ONBOARD WITH DOUBLED PENNANT

If very heavy strains expected a second wire is attached as shown and the anchor decked with two drums

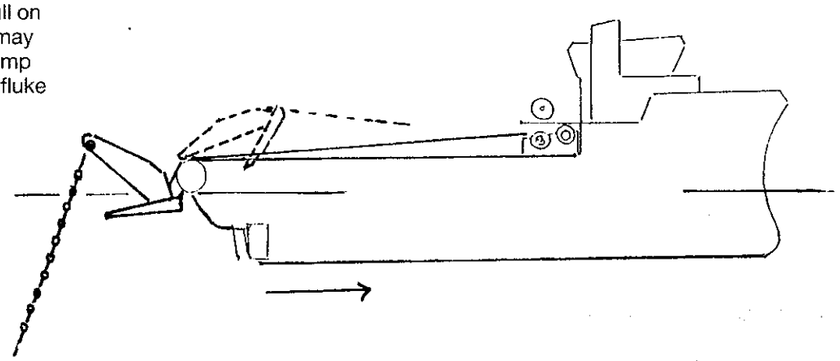


Diag 173. ATTEMPTING TO DECK ANCHOR THE WRONG WAY ROUND

Anchor caught under roller. Very heavy strain on wire liable to part

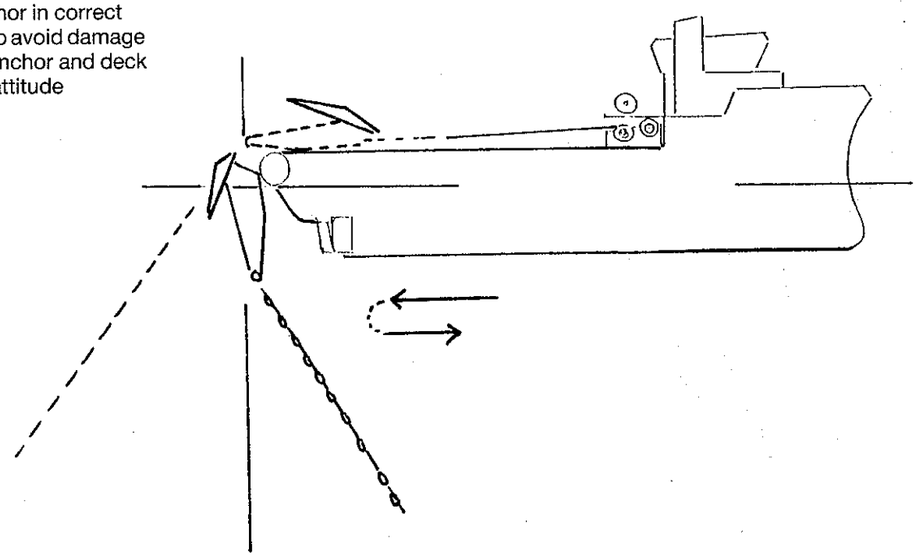


If the boat continues to pull on the work wire the anchor may come free. It could then jump over the roller and dig the fluke tips into the deck.

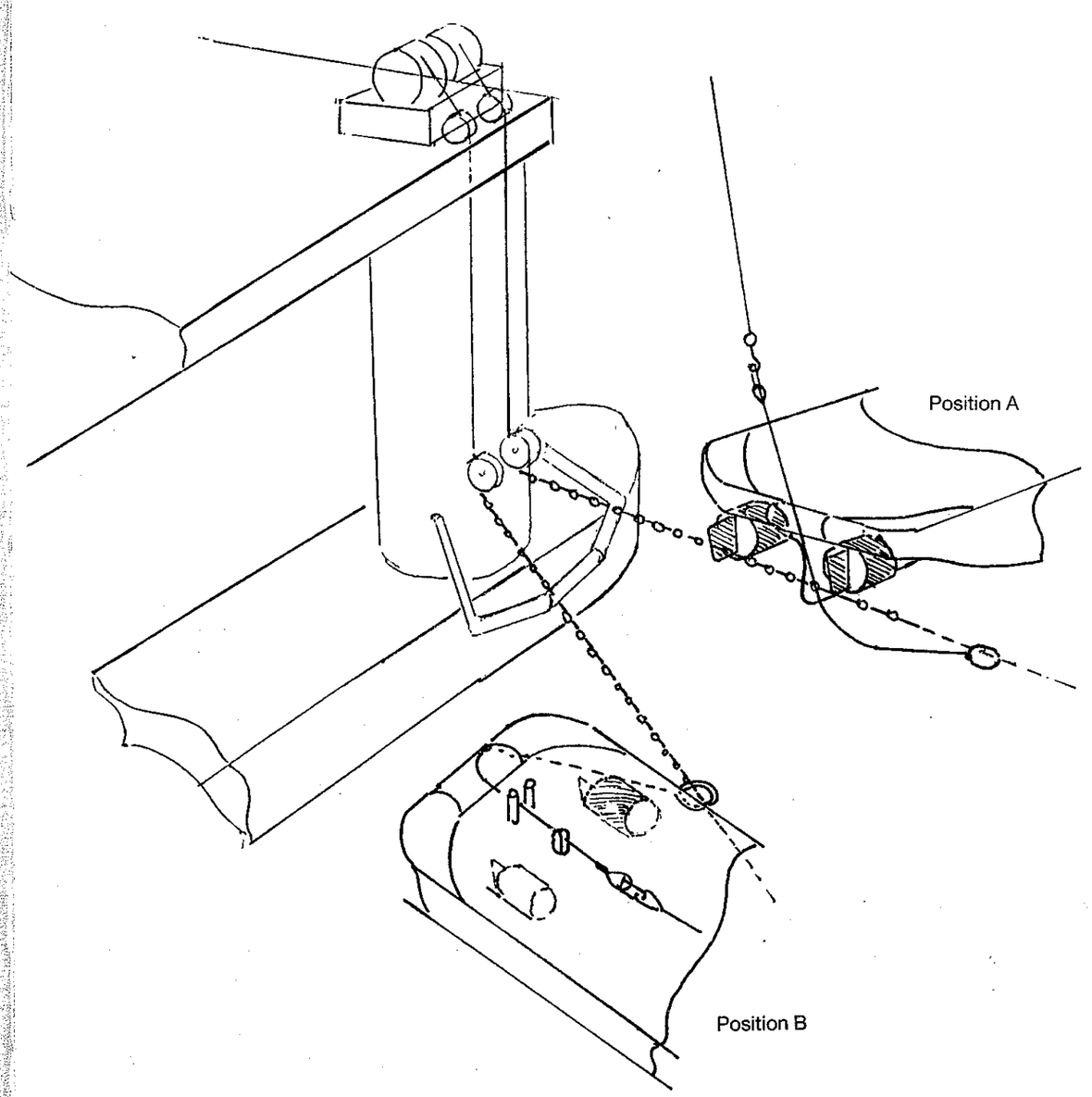


Diag 174. RE-ORIENTATION AND CORRECT DECKING

To deck the anchor in correct orientation and to avoid damage go astern, turn anchor and deck it in the correct attitude



Diag 175. FOULING MOORING CHAINS



Position A Backing down to receive chaser pennant the stern area and rudder and propellors are liable to foul rig's mooring line especially if boat swings to starboard.

Position B Safe position to pass back pennant but boat must not move stern any more to port otherwise pennant could foul portside rudder/nozzle because the pennant is short and tight to the boat.

PART 14. ANCHOR POSITIONING EQUIPMENT

a. General remarks

Within the confines of an oilfield where numerous seabed obstructions exist including pipelines, wellheads, manifolds etc, anchor running will frequently occur as work barges, drilling units and pipeplay vessels perform their wide variety of tasks.

Running and positioning the anchors within such an area requires precise knowledge of the location, of the obstructions and a means of directing the anchor handling tugs to keep them clear of the seabed equipment.

There are a variety of systems in common use with the ability to achieve anchor placement within very close tolerances.

Take a typical example of a drilling unit with a 10 anchor chain mooring spread moving into position over a subsea template to carry out a drilling programme. Flowlines, control lines and satellite wells are all located within the anchor pattern. The drilling vessel will be navigated and positioned using a Differential Global Positioning System backed up by a Radio Hyperbolic System such as Syledis or Pulse 8. Indeed the signals from the systems may be combined to give reliable position data within a tolerance of ± 3 to 5 metres or less under ideal conditions.

During anchor running operations two systems may be used.

b. Laser range finding

A laser range finder is directly and electronically connected to the rig's positioning system and being portable the laser is placed on some suitable place where it can observe the tug during the running of any particular anchor.

The anchor bearing and distance will have been planned and is displayed on the rigs master positioning VDU.

After receiving the anchor and prepared herself for the run, the rig mover will direct the boat onto the correct bearing and advise the laser operator that the "run" is about to commence.

The tug begins to move off on the given bearing and the laser operator begins "shooting" the stern of the boat. The range and bearing as computed by the laser is displayed on the rig's master VDU and shots may be taken at say 20 second intervals allowing the rig mover to alter the tugs course based on the track shown on his display in relation to the desired bearing of the anchor.

At the anchor target distance the rig mover will direct the boat to stop or adjust position based on the laser ranges, stretch up the mooring chain and place the anchor on bottom. When the anchor has landed the range is again taken and from this data the anchor position is compared with the required position.

Electronic laser range finders are reliable to distances of several kilometers with an accuracy of at best 0.5 metres but varying with range. They can be affected by fog, mist and heavy rain. Although the laser beam is very narrow and precise boat crews are always advised never to look in the direction of the laser station when in use. At times an anchor handler may be required to have a unit on board which is manned by a suitably trained technician and the range and bearing data can be transmitted to another position by radio link or used on board with a display for some operations.

ANCHOR POSITIONING EQUIPMENT (cont'd)

c. Tug management systems

The increasingly sophisticated DGPS Systems now in use as well as the radio signal derived positioning systems like Syledis Pulse 8 etc, can be expanded to incorporate position data in real time from several tugs operating around a vessel running anchors.

A receiver/transmitter package is placed aboard each tug being used. This package may consist of a DGPS receiver and radio data link to the main station (in this case the rig); the tugs position is then continuously displayed on the rig's master display in terms of true bearing and range. This enables the rig mover to run anchors on required bearings and distances, at all times being able to observe the progress of the tug along the given bearing.

On board the tug a VDU is available to the master enabling him to continuously observe his vessel's position in relation to the anchor bearing line which is on his display. The bearing line and range is drawn on his screen automatically by the technicians manning the rigs master positioning display package, then transmitted via the data link.

The most modern systems give the tug master real time data on his speed, course, range to target, course to steer to target, offset distance from the required bearing line and sufficient detail showing subsurface obstructions close to his bearing line.

Such systems are very useful when two boats are employed to carry or hold mooring lines up over obstructions on the seabed because the boat in position over an obstruction with a J-hook has only to watch the display and move the boat in response to the screen data in order to maintain precise position.

It is however true to say that the data observed by the tug master can be incorrect or "freeze" or malfunction, such over reliance on the "video game" can lead a tug master to false conclusions. It is therefore necessary to utilise standard radar ranges and bearings to back up the tug management system as well as simple observation by eye of the boat's position in relation to the barge being worked.

Many masters find the VDU a distraction and a nuisance during anchor handling when their whole attention and concentration must be directed at the behaviour and handling of the boat, the operation of the winches and the activities of the deck crew. It is also a fact that too much data is supplied sometimes, backed up by a constant flow of advice and instruction from the barge mover, who should, and would, were it not for all the fancy equipment, allow the tug to get on with his work unless circumstances dictate otherwise.

Modern daylight radar display systems are common and the more electronically minded masters will utilise the full capability of their systems to assist in maintaining position during anchor work when presented with a new "toy", its possible worth and features should be fully investigated and exploited if they will assist the boat's activities.

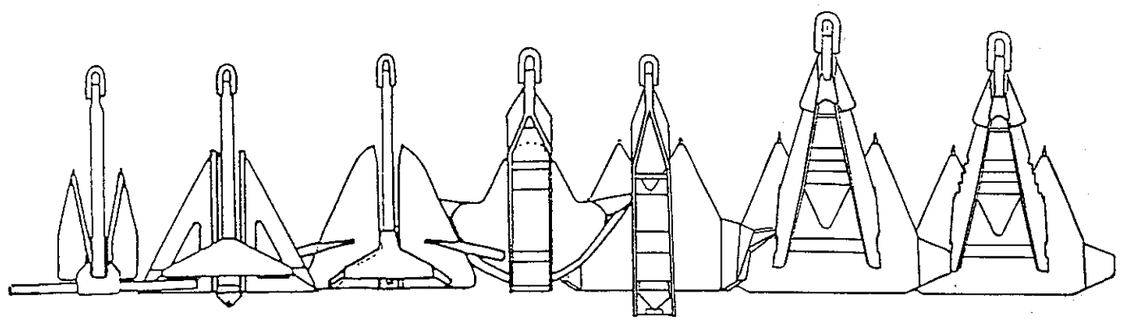
d. Echo sounding systems

Some boats are equipped with high specification echo sounders which can be used to pick up sub-surface mooring buoys and large seabed obstructions. It is not unknown for a barge move to require a boat to conduct sweeps for such objects, especially sub-surface support mooring equipment, prior to or after running the gear and it is a tool too frequently neglected.

PART 15. USEFUL TABLES, FORMULA AND DATA

a. Common types of oilfield high holding power anchors

Drawing shows the anchors of equal weight drawn to scale



Danforth Flipper Delta Stevin Mk3 Bruce TS Bruce FF Stevpris Stevshark

b. Mooring line calculations — formula abbreviation

T Tension at fairlead or winch. It has both a horizontal and vertical component

W Weight per unit length of the mooring line in sea water

S Suspended length of mooring line or catenary (*See note below) from point of suspension (Fairlead to touchdown)

D Horizontal distance between fairlead and touchdown *or* between two points of suspension

d Depth between point of suspension and seabed

C Catenary depth distance of lowest point of mooring line below sea surface when suspended between barge and workboat

V Vertical component of mooring line tension

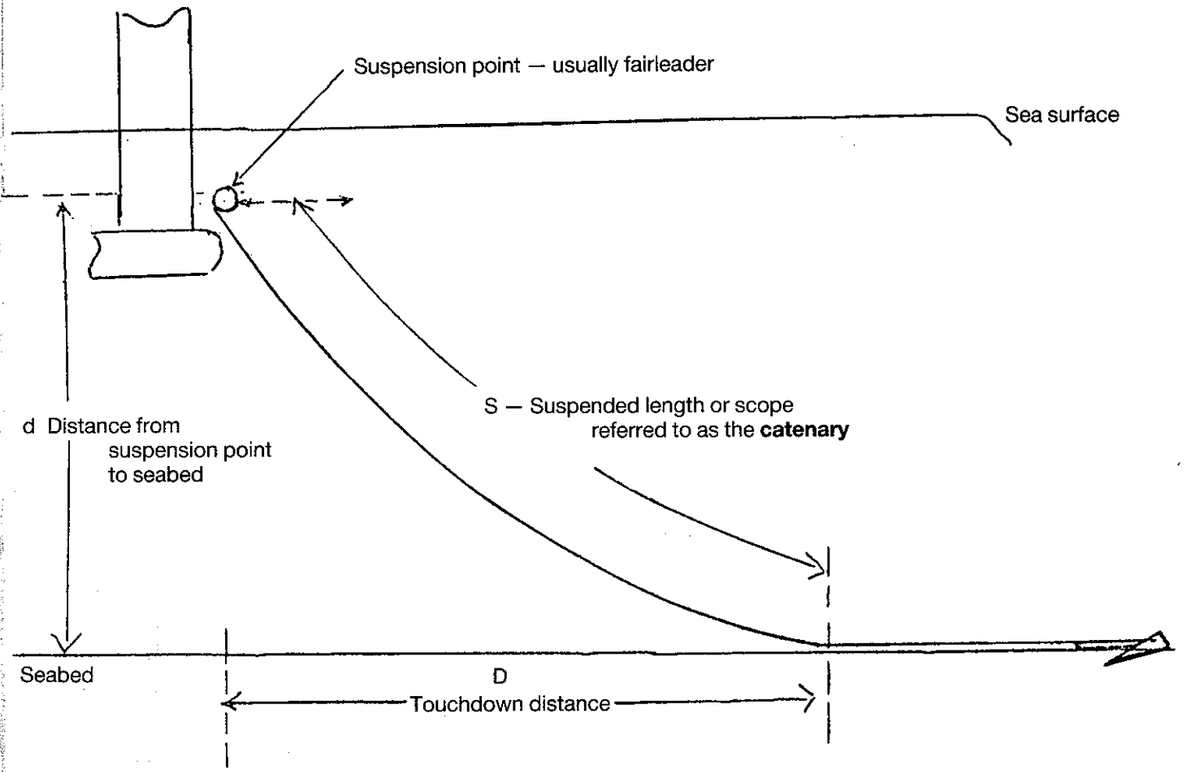
H Horizontal component of mooring line tension

* **NOTE** Catenary in this context means half catenary

Note on units

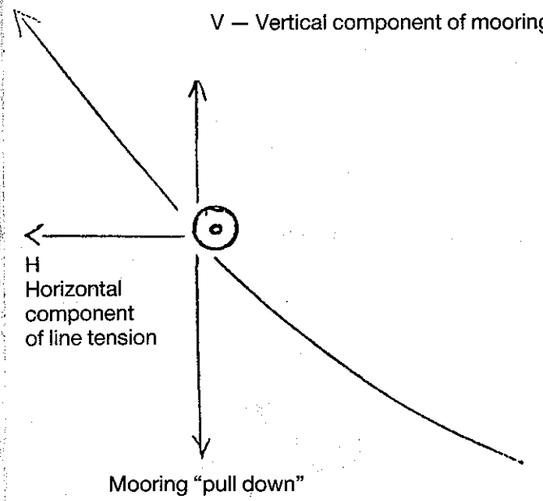
Metric units	Tension — in kilogrammes; Line distance — in metres Weight per length — kilogramme per metre; (Water) depths — metres
Imperial units	Tension — in pounds; Line distances — in feet Weight per length — pounds per foot; Depths — feet
NOTE	1 kip = 1000 lbs 9.81 kn =101.94 kilograms

c. Mooring line catenary data — nomenclature



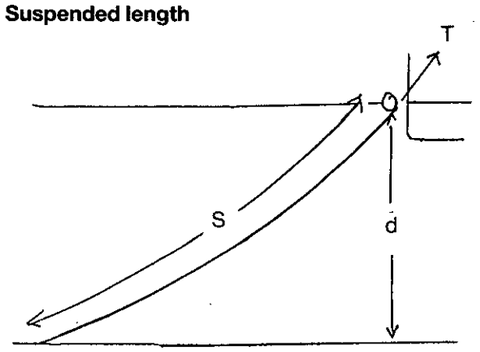
Tension T — tension at fairleader as sensed by winch — line tension

V — Vertical component of mooring line tension



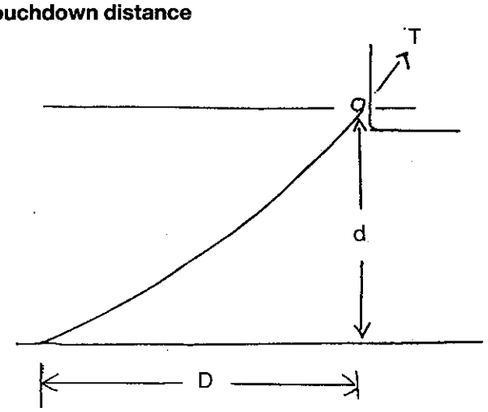
d. Mooring line calculation formulae

1. Suspended length



$$S = \sqrt{d\left[\frac{2T}{W} - d\right]} \quad \text{or} \quad S = \sqrt{\left[2d \times \frac{T}{W}\right] - d^2}$$

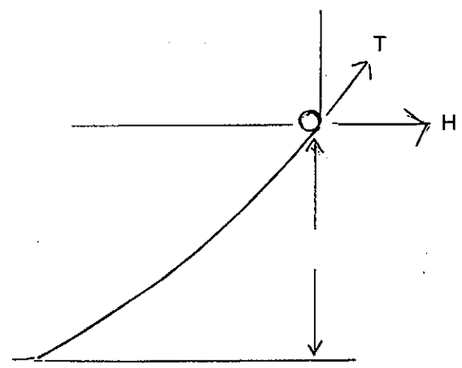
2. Touchdown distance



$$D = \frac{T}{W} - d \, \text{CosH}^{-1}\left[\frac{\frac{T}{W}}{\frac{T}{W} - d}\right]$$

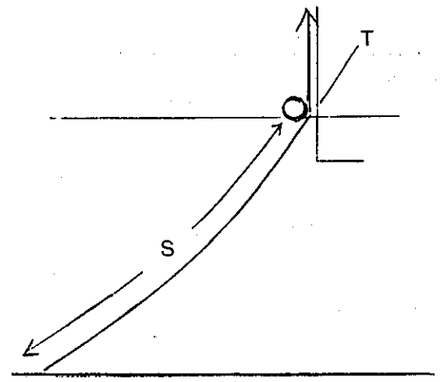
Note: CosH^{-1} is the Hyperbolic function of Cosine **see table**

3. Horizontal tension



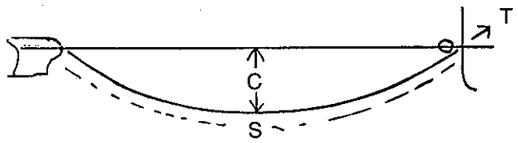
$$H = \sqrt{T^2 - V^2}$$

4. Vertical tension



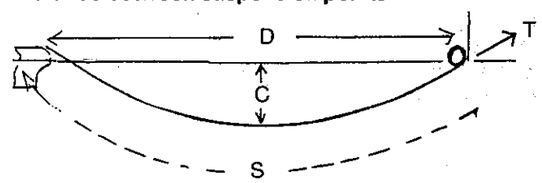
$$V = \sqrt{2 \times T \times d \times W - (d \times W)^2} \quad \text{or} \quad V = WS$$

5. Catenary depth



$$C = \frac{S^2 \times W}{8 \times T} \quad \text{or} \quad C = \frac{T}{W} - \frac{T}{W}\sqrt{1 - \left[\frac{WS}{2T}\right]^2}$$

6. Distance between suspension points

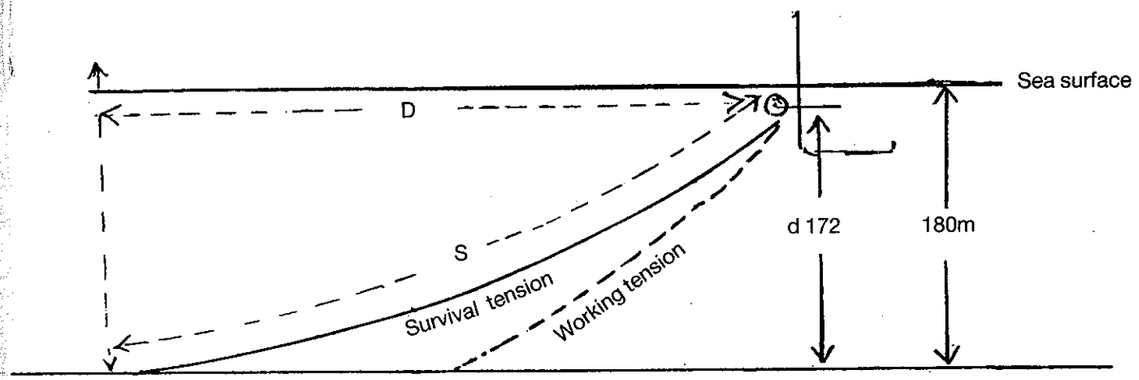


$$D = S\left[1 - \frac{WC}{3T}\right]$$

e. Use of catenary formula — example

A drilling barge (semi-submersible) has available 1400 metres of chain on each mooring line chain size 76mm diameter ORQ-3. If it is to be moored in 180 metres of water, what will be the **suspended length** and **touchdown point** of the mooring lines when the barge experiences **survival storm** conditions (approximately ½ breaking strain)?

At working draft the mooring line fairleads are 8 metres below the surface.



Chain 76mm diameter breakload 471 tonnes ∴ ½ BL = 236 W = **118kg/mt**

Suspended length

$$S = \sqrt{\frac{2d \times T - d^2}{W}}$$

$$S = \sqrt{\frac{2 \times 172 \times 236000 - 172^2}{118}}$$

$$S = \sqrt{688000 - 29584}$$

$$S = \sqrt{65846}$$

S = **811.4 mt**

If barge deploys 1200 metres of chain, at survival tension about 400 metres will be left on seabed

Touchdown point

$$D = \frac{T}{W} - d\ \text{CosH}^{-1}\left[\frac{\frac{T}{W}}{\frac{T-d}{W}}\right]$$

$$D = \frac{236000}{118} - 172\ \text{CosH}^{-1}\left[\frac{\frac{236000}{1.8}}{\frac{236000-172}{118}}\right]$$

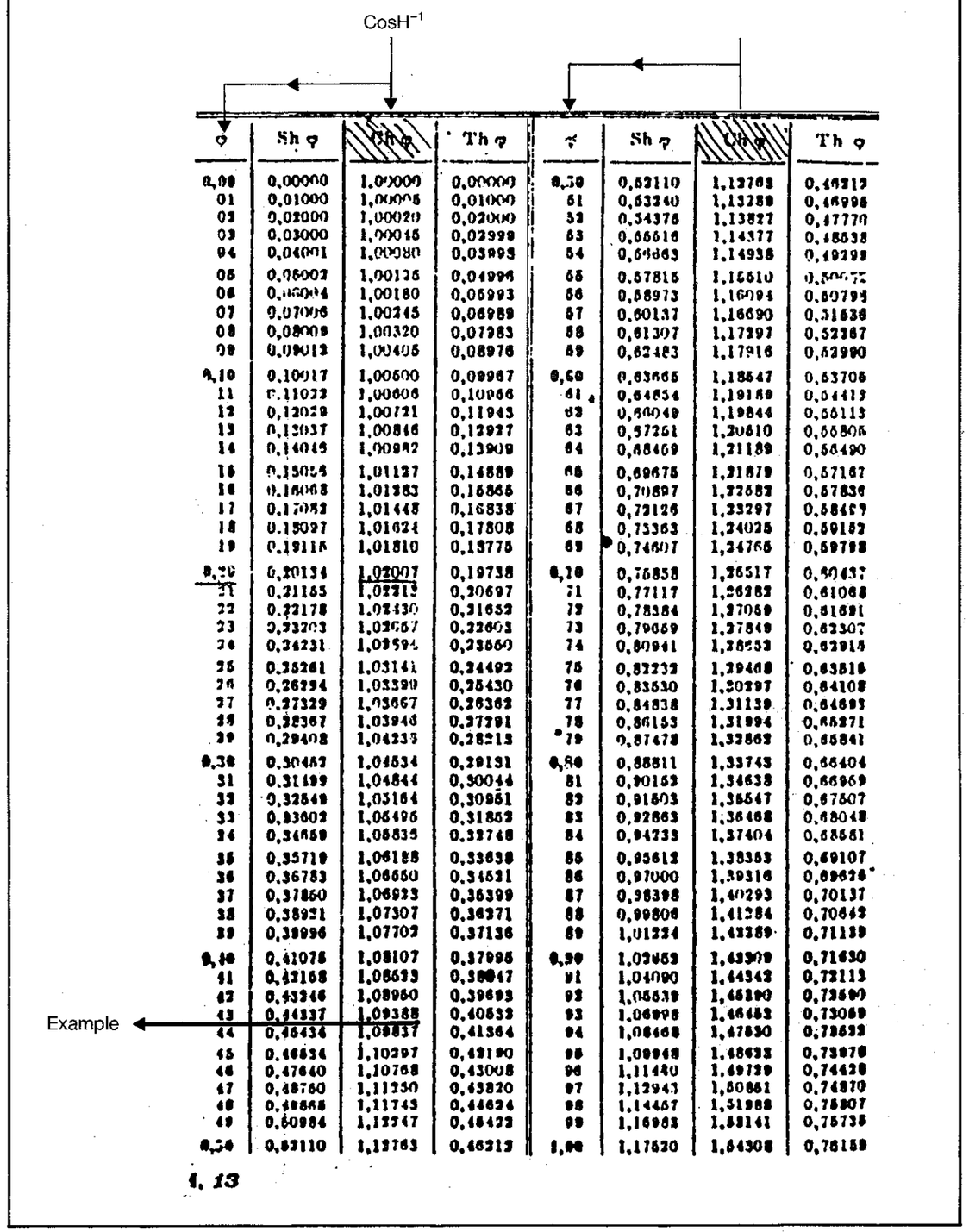
$$D = 1828\ \text{CosH}^{-1}\left[\frac{2000}{1828}\right]$$

$$D = 1828\ \text{CosH}^{-1}\ [1.0941]$$

$$D = 1828 \times 0.43$$

D = **786.0 metres**

f. Table of Hyperbolic functions



CosH^{-1}

φ	Sh φ	Ch φ	Th φ	φ	Sh φ	Ch φ	Th φ
0,00	0,00000	1,00000	0,00000	0,50	0,52110	1,12763	0,46212
01	0,01000	1,00005	0,01000	51	0,53240	1,13289	0,46996
02	0,02000	1,00020	0,02000	52	0,54375	1,13827	0,47770
03	0,03000	1,00045	0,02999	53	0,55516	1,14377	0,48538
04	0,04001	1,00080	0,03995	54	0,56663	1,14938	0,49299
05	0,05002	1,00125	0,04996	55	0,57815	1,15510	0,50052
06	0,06004	1,00180	0,05993	56	0,58973	1,16094	0,50795
07	0,07006	1,00245	0,06989	57	0,60137	1,16690	0,51530
08	0,08009	1,00320	0,07983	58	0,61307	1,17297	0,52257
09	0,09013	1,00405	0,08976	59	0,62483	1,17916	0,52990
0,10	0,10017	1,00500	0,09967	0,60	0,63665	1,18547	0,53706
11	0,11022	1,00606	0,10956	61	0,64854	1,19189	0,54413
12	0,12029	1,00721	0,11943	62	0,66049	1,19844	0,55113
13	0,13037	1,00846	0,12927	63	0,67251	1,20510	0,55805
14	0,14046	1,00982	0,13909	64	0,68469	1,21189	0,56490
15	0,15056	1,01127	0,14889	65	0,69675	1,21879	0,57167
16	0,16068	1,01283	0,15865	66	0,70897	1,22582	0,57836
17	0,17082	1,01448	0,16838	67	0,72126	1,23297	0,58497
18	0,18097	1,01624	0,17808	68	0,73363	1,24025	0,59152
19	0,19115	1,01810	0,18775	69	0,74607	1,24766	0,59798
0,20	0,20134	1,02007	0,19738	0,70	0,75858	1,25517	0,60437
21	0,21155	1,02215	0,20697	71	0,77117	1,26282	0,61068
22	0,22178	1,02430	0,21652	72	0,78384	1,27059	0,61691
23	0,23203	1,02667	0,22603	73	0,79659	1,27849	0,62307
24	0,24231	1,02894	0,23550	74	0,80941	1,28653	0,62915
25	0,25261	1,03141	0,24492	75	0,82232	1,29468	0,63515
26	0,26294	1,03399	0,25430	76	0,83530	1,30297	0,64108
27	0,27329	1,03667	0,26362	77	0,84838	1,31139	0,64693
28	0,28367	1,03946	0,27291	78	0,86153	1,31994	0,65271
29	0,29408	1,04235	0,28213	79	0,87478	1,32862	0,65841
0,30	0,30452	1,04534	0,29131	0,80	0,88811	1,33743	0,66404
31	0,31499	1,04844	0,30044	81	0,90153	1,34638	0,66959
32	0,32549	1,05164	0,30951	82	0,91503	1,35547	0,67507
33	0,33602	1,05496	0,31853	83	0,92863	1,36468	0,68048
34	0,34659	1,05839	0,32748	84	0,94233	1,37404	0,68581
35	0,35719	1,06193	0,33638	85	0,95612	1,38353	0,69107
36	0,36783	1,06560	0,34521	86	0,97000	1,39316	0,69626
37	0,37850	1,06938	0,35399	87	0,98398	1,40293	0,70137
38	0,38921	1,07307	0,36271	88	0,99806	1,41284	0,70642
39	0,39996	1,07702	0,37136	89	1,01224	1,42289	0,71139
0,40	0,41075	1,08107	0,37995	0,90	1,02653	1,43309	0,71630
41	0,42158	1,08523	0,38847	91	1,04090	1,44342	0,72113
42	0,43246	1,08950	0,39693	92	1,05539	1,45390	0,72590
43	0,44337	1,09388	0,40532	93	1,06998	1,46453	0,73059
44	0,45434	1,09837	0,41364	94	1,08468	1,47530	0,73522
45	0,46534	1,10297	0,42190	95	1,09948	1,48622	0,73978
46	0,47640	1,10768	0,43008	96	1,11440	1,49729	0,74428
47	0,48750	1,11250	0,43820	97	1,12943	1,50851	0,74870
48	0,49866	1,11743	0,44624	98	1,14457	1,51988	0,75307
49	0,50984	1,12247	0,45422	99	1,15983	1,53141	0,75738
0,50	0,52110	1,12763	0,46212	1,00	1,17520	1,54308	0,76159

Example → 1, 13

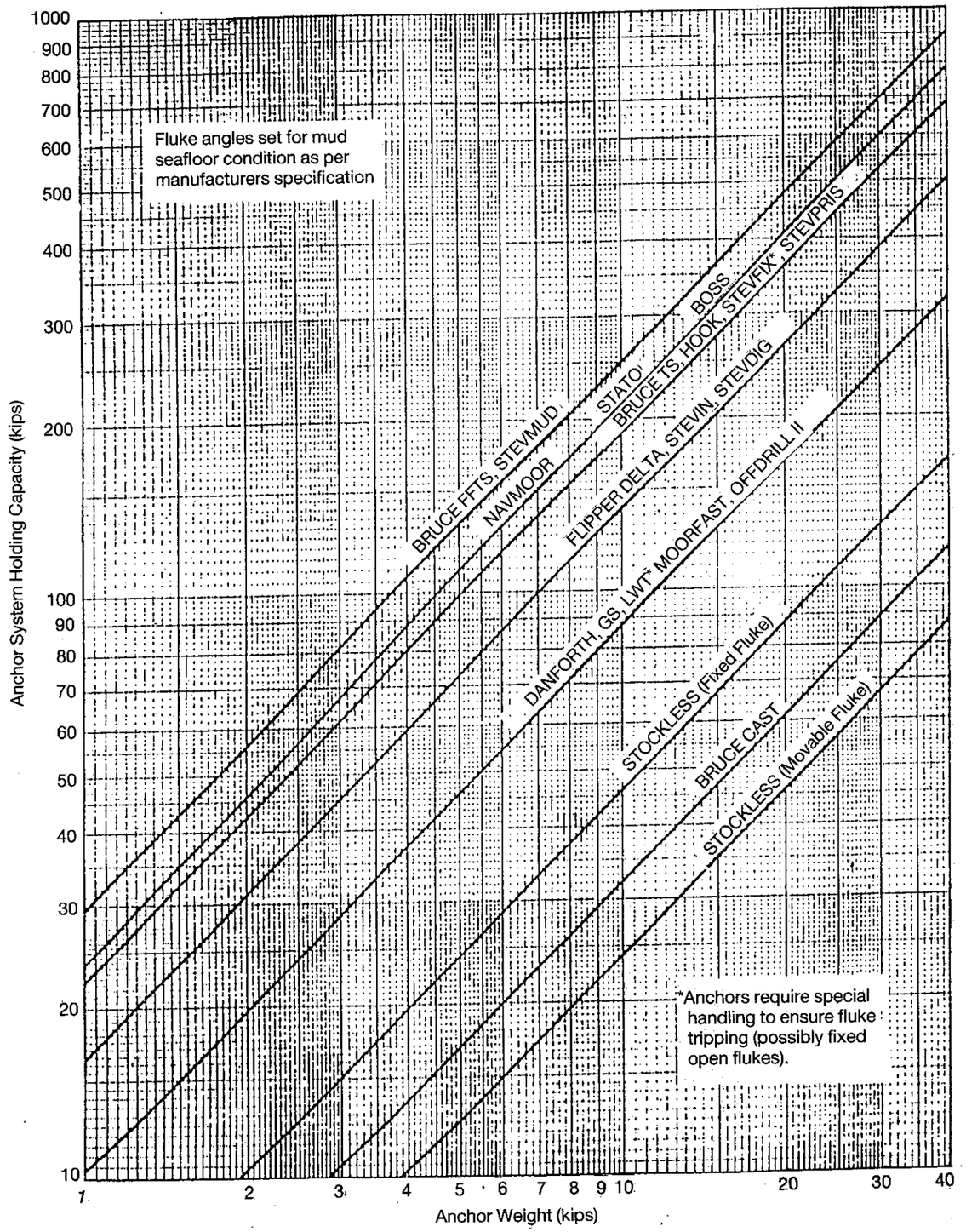
f. Table of Hyperbolic functions (cont'd)

CosH^{-1} CosH^{-1}

φ	Sh φ	Ch φ	Th φ	φ	Sh φ	Ch φ	Th φ
1,00	1,17520	1,54308	0,76159	1,50	2,12928	2,35241	0,90515
01	1,19069	1,55491	0,76576	51	2,15291	2,37382	0,90689
02	1,20630	1,56689	0,76987	52	2,17676	2,39547	0,90861
03	1,22203	1,57904	0,77391	53	2,20082	2,41736	0,91049
04	1,23788	1,59134	0,77789	54	2,22510	2,43949	0,91215
05	1,25386	1,60379	0,78181	55	2,24961	2,46186	0,91378
06	1,26996	1,61641	0,78566	56	2,27434	2,48448	0,91543
07	1,28619	1,62919	0,78946	57	2,29930	2,50735	0,91703
08	1,30254	1,64214	0,79320	1,60	2,32557	2,53748	0,92161
09	1,31903	1,65525	0,79688	70	2,54563	2,83832	0,93543
1,10	1,33565	1,66852	0,80050	80	2,94217	3,10747	0,94681
11	1,35240	1,68196	0,80406	90	3,26516	3,41773	0,95537
12	1,36929	1,69557	0,80757	2,00	3,62686	3,76220	0,96403
13	1,38631	1,70934	0,81102	10	4,02188	4,14431	0,97043
14	1,40347	1,72329	0,81441	20	4,45711	4,56791	0,97574
15	1,42078	1,73741	0,81775	30	4,93696	5,03722	0,98010
16	1,43822	1,75171	0,82104	40	5,46623	5,55696	0,98363
17	1,45581	1,76618	0,82427	50	6,05020	6,13229	0,98661
18	1,47355	1,78083	0,82745	60	6,69473	6,76991	0,98901
19	1,49143	1,79566	0,83058	70	7,40626	7,47347	0,99101
1,20	1,50946	1,81066	0,83365	80	8,19192	8,25273	0,99263
21	1,52764	1,82584	0,83668	90	9,05966	9,11458	0,99391
22	1,54598	1,84121	0,83965	3,00	10,01787	10,05766	0,99505
23	1,56447	1,85676	0,84258	10	11,07646	11,13150	0,99591
24	1,58311	1,87250	0,84546	20	12,24588	12,28666	0,99661
25	1,60192	1,88842	0,84828	30	13,53788	13,57479	0,99721
26	1,62088	1,90454	0,85106	40	14,96636	14,99874	0,99771
27	1,64001	1,92084	0,85380	50	16,54263	16,57282	0,99811
28	1,65930	1,93734	0,85648	60	18,28846	18,31278	0,99843
29	1,67876	1,95403	0,85913	70	20,21139	20,23601	0,99878
1,30	1,69838	1,97091	0,86172	80	22,33941	22,36178	0,99900
31	1,71818	1,98800	0,86428	90	24,69110	24,71135	0,99918
32	1,73814	2,00528	0,86678	4,00	27,28992	27,30823	0,99933
33	1,75828	2,02276	0,86925	10	30,16186	30,17843	0,99945
34	1,77860	2,04044	0,87167	20	33,33067	33,35066	0,99951
35	1,79909	2,05833	0,87405	30	36,84311	36,85668	0,99963
36	1,81977	2,07643	0,87639	40	40,71930	40,73167	0,99970
37	1,84063	2,09473	0,87869	50	45,00301	45,01412	0,99975
38	1,86166	2,11324	0,88096	60	49,73713	49,74718	0,99980
39	1,88289	2,13196	0,88317	70	54,96904	54,97813	0,99983
1,40	1,90430	2,15090	0,88535	80	60,75109	60,75932	0,99986
41	1,92591	2,17005	0,88749	90	67,14117	67,14861	0,99988
42	1,94770	2,18942	0,88960	5,00	74,20321	74,20996	0,99991
43	1,96970	2,20900	0,89167	10	82,00791	82,00140	0,99993
44	1,99188	2,22881	0,89370	20	90,63336	90,63888	0,99994
45	2,01427	2,24884	0,89569	30	100,1659	100,1709	0,99995
46	2,03686	2,26910	0,89765	40	110,7009	110,7055	0,99996
47	2,05965	2,28958	0,89958	50	122,3439	122,3480	0,99997
48	2,08265	2,31029	0,90147	60	135,2114	135,2150	0,99997
49	2,10586	2,33123	0,90332	70	149,4320	149,4354	0,99998
1,50	2,12928	2,35241	0,90515	80	165,1463	165,1513	0,99998
				90	182,5174	182,5201	0,99999
				6,00	201,7133	201,7156	0,99999
				50	272,2850	272,2869	0,99999

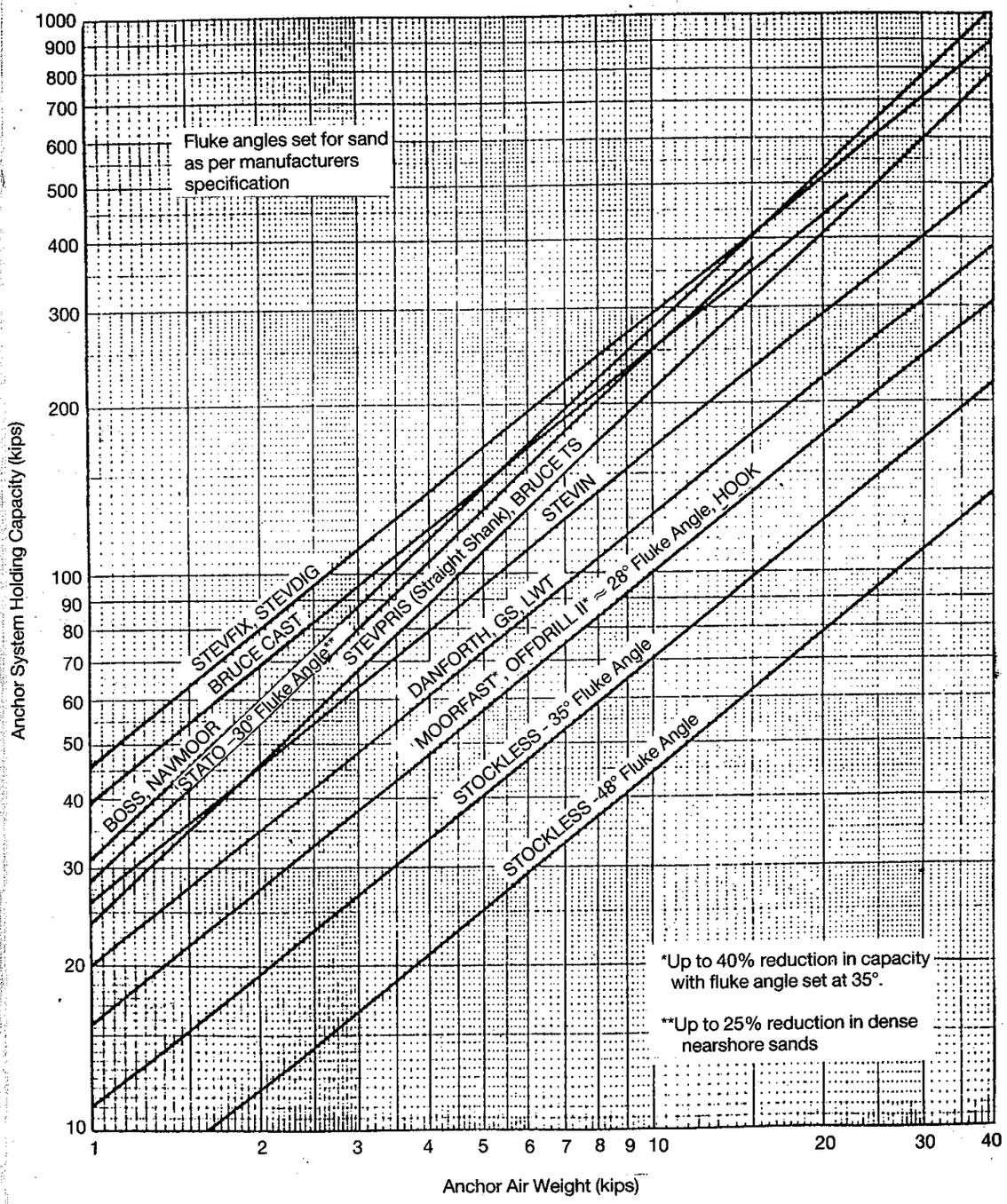
For * vedasi tab. 13.

g. Anchor system holding capacity in mud



ANCHOR POSITIONING EQUIPMENT (cont'd)

h. Anchor system holding capacity in sand



ANCHOR POSITIONING EQUIPMENT (cont'd)

i. Soil and drag anchor capacity

Soil	Description	Anchor Capacity
Mud	Normally consolidated, very soft to soft, silt to clay size sediment typical of harbors and bays.	Holding capacity is reasonably consistent provided anchor flukes trip open.
	Soil strength increases linearly with depth at 12 psf/ft ± 4psf/ft. Approximately equates to standard penetration resistance (SPT) of 2 blows/ft at 20-ft depth.	Certain anchors (see figure 2) require special care during installation to ensure fluke tripping.
Sand	Medium to dense sand with bulk wet density ($_b$) of 110 to 140 pcf typical of most nearshore deposits.	Holding capacity is consistent provided sand fluke angle is used.
	SPT range - - 25 to 50 blows/ft.	
Clay	Medium to stiff cohesive soil. Soil shear strength (s_u) considered constant with depth.	Good holding capacity which will range between that provided for sand and mud.
	S_u range - - 3-½ to 14 psi.	For stiff clay ($s_u > 7$ psi) use sand capacity, Figure 3.
	SPT range - - 4 to 16 blows/ft.	For stiff clay ($s_u > 7$ psi) use sand fluke angle.
Hard Soil	Very stiff and hard clay ($s_u > 14$ psi, STP > 16) and very dense sand (SPT > 50, $_b > 140$ pcf).	Holding capacity is consistent provided anchor penetrates; must have to fix flukes open at sand fluke angle to enhance embedment, jetting may be required.
	Seafloor type can occur in high current, glaciated, dredged areas.	
Layered Seafloor	Heterogeneous seafloors of sand, gravel, clay, and/or mud layers or mixtures.	Anchor performance can be erratic. Contact NCEL for assistance if anchors cannot be proof-loaded to verify safe capacity.
Coral/Rock	Can also include areas where coral or rock is overlain by a thin sediment layer that is insufficient to develop anchor capacity.	Unsatisfactory seafloor for permanent moorings.
		Can be suitable for temporary anchoring if anchor snags on an outcrop or falls into a crevice.
		Consider propellant-embedded anchors; contact NCEL for assistance.

ANCH[illegible]TIONING EQUIPMENT (cont'd)

h. A[illegible]prove anchor performance

	Symptom	Possible Reason	Possible Solution
[illegible]ud [illegible]rmance	Near constant line tension ½ to 2 times weight of anchor and mooring line on seabed	Flukes not tripping	Increase size of tripping palms; add stabilizer. Weld or hold flukes in open position.
	Drop in tension during proof-loading with continued drag.	Anchor unstable.	Add stabilizers. Increase stabilizer length Use different or larger anchor.
		Soil more competent than anticipated.	Reduce fluke angle to sand setting or if possible by a smaller (5° to 10° reduction).
	Proof-load tension less than needed	Seafloor softer than expected. Less sediment than needed over harder substrata.	Use larger anchor. Use different anchor. Add chain. Use backup anchor.
Poor Sand/Hard Soil Performance	Near constant tension 1 to 3 times weight of anchor and mooring line on seabed.	Flukes not tripping	Sharpen fluke tips; add fluke tip barbs to break up soil. Weld or block flukes in open position. Extend anchor crown by light weight pipe or plate construction. Water jet anchor flukes into seabed.
	Variable tension 3 to 10 times weight of anchor and mooring line on seabed.	Flukes not penetrating.	Reduce fluke angle; reduction to as little as 25° may be needed for very dense or hard soils. Sharpen flukes. Extend or add stabilizers. Use larger or different anchor.
	Rapid drop in tension during proof-loading with continued drag.	Anchor unstable	Extend or add stabilizers. Use larger or different anchor.
	Proof-load tension less than needed.	Less sediment than needed. Very hard seafloor.	Use larger or different anchor. Add chain. Use backup anchor. Use pile anchor.

ANCHOR POSITIONING EQUIPMENT (cont'd)

Fluke/shank angle

The fluke shank angle is one of the factors that determines the soil penetration of an anchor.

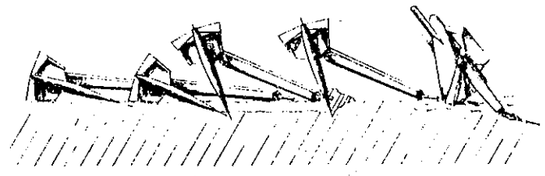
For hinging anchor types such as the Stevin or Danforth etc. The fluke shank angle is determined by the angle of the anchor shackle, the hinge and the fluke tip. With fixed anchor types such as the Stevpris the angle is that between the anchor shackle, the rear of the fluke and the fluke tip.

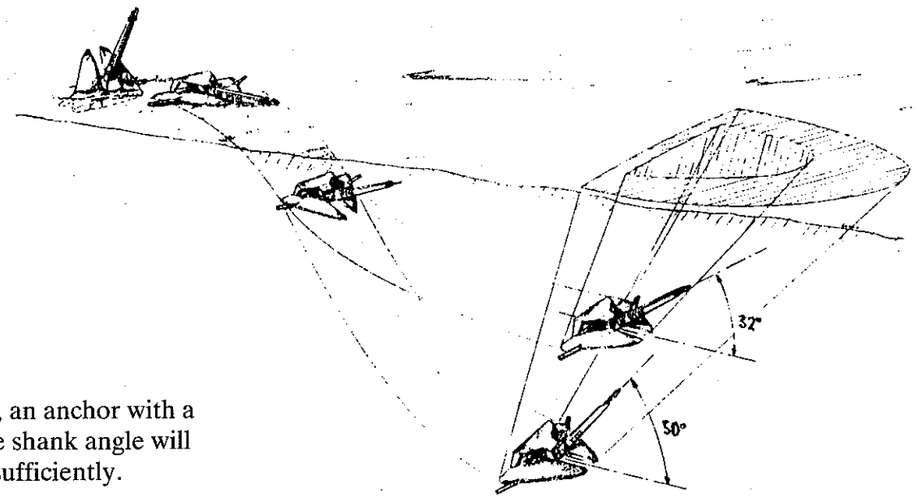
In normal anchor grounds and hard soils, a 32 degree fluke shank angle must be used. In soft mud, a 50 degree fluke shank angle offers optimal penetration.

If an anchor is used with an incorrect fluke shank angle, it will negatively influence performance. This is true for all anchor types.

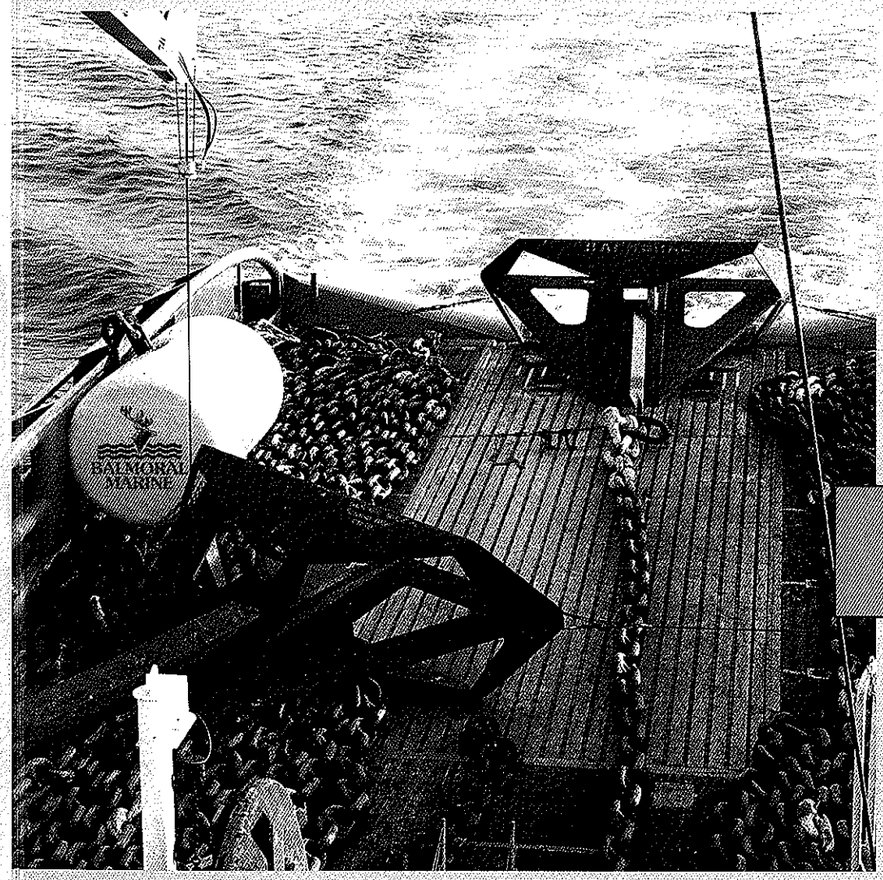
In hard soil, an anchor with a fluke angle of 32 degrees will give the highest holding power.

In hard soil a 50 degree fluke shank angle will obstruct penetration and the anchor will begin to trip, fall aside and slide along the seabed.





If used in mud, an anchor with a 32 degree fluke shank angle will not penetrate sufficiently.



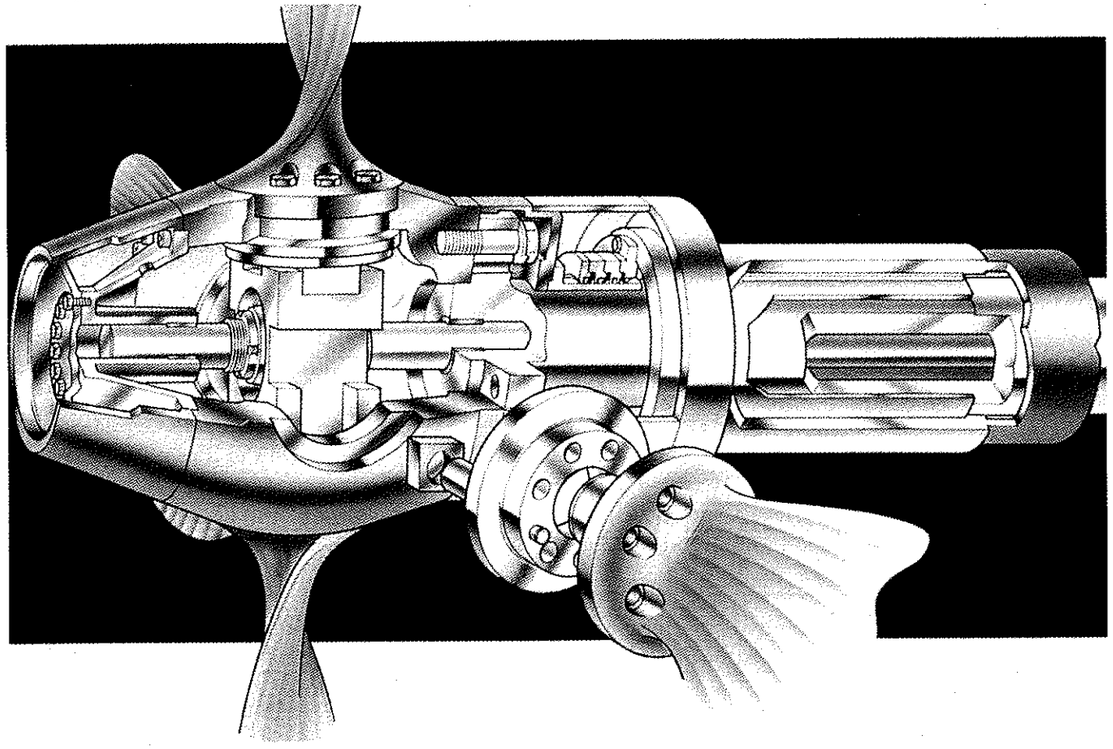
OILFIELD SEAMANSHIP

Volume Three

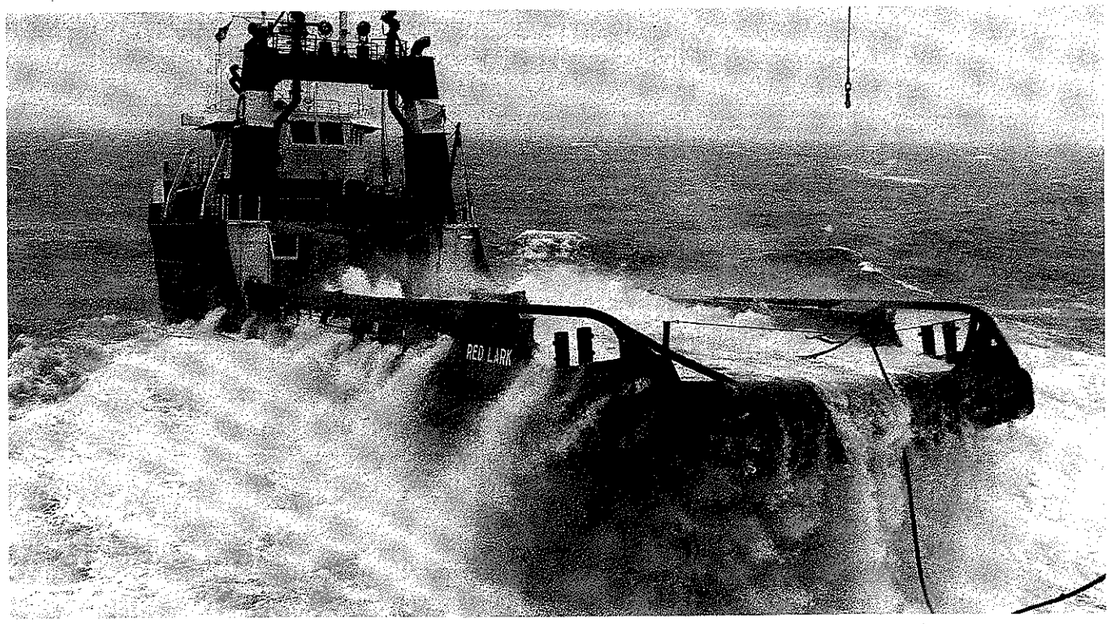
by Michael Hancox

OPL

e) Thrusters, rudders and nozzles
Main propulsion requirements

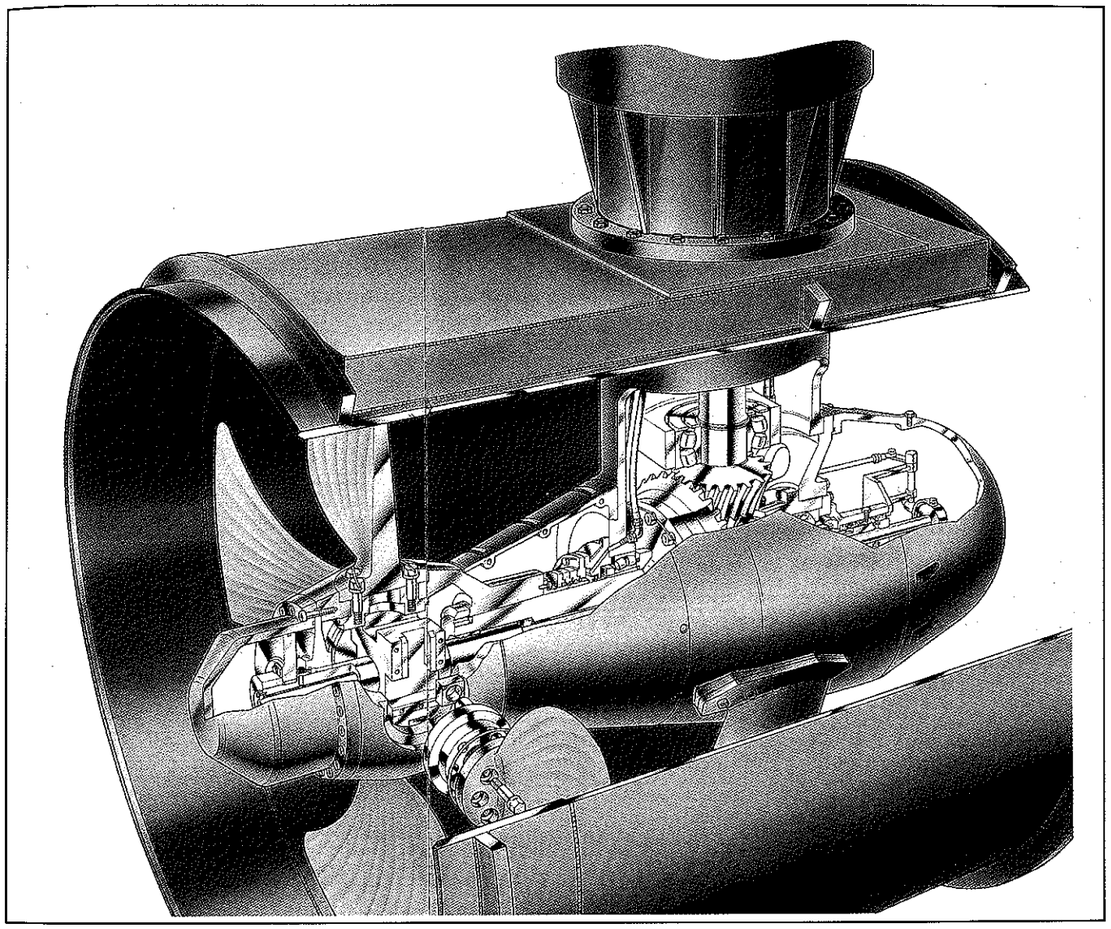


Variable/controlable pitch propellors, such as this unit from Ulstein can translate shaft output into thrust over a very wide range from "creep" to maximum output smoothly and quickly.

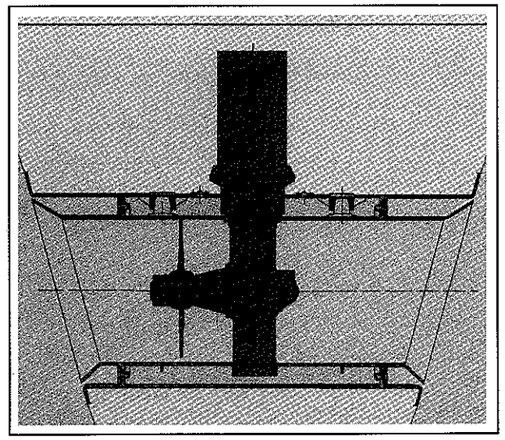


Port propellor nozzle is just visible through the white water under the stern.

e. Thrusters, rudders and nozzles



The Ulstein-Liaaen transverse tunnel thruster designed with double walls through the full tunnel length to reduce noise levels when in operation.



Installation of the Ulstein-Liaaen transverse tunnel thruster in the forward section of an AHTS's hull.

e. Thrusters, rudders and nozzles

To achieve this side thrusters have long been in use. They come in a wide variety of designs all with their own particular characteristics.

The most common types are the tunnel thruster where a propellor is mounted in an athwartships tunnel at the bow and in large vessels also at the stern.

The propellor is usually driven by an electric motor or diesel engine mounted above the tunnel. More often than not the tunnel thruster propellor is of the controllable pitch type, so reversing the direction of notation of the motor and thus propellor to alter thrust direction does not arise. Older types where the motor had to be stopped and restarted turning in the opposite direction to achieve opposite thrust are still found.

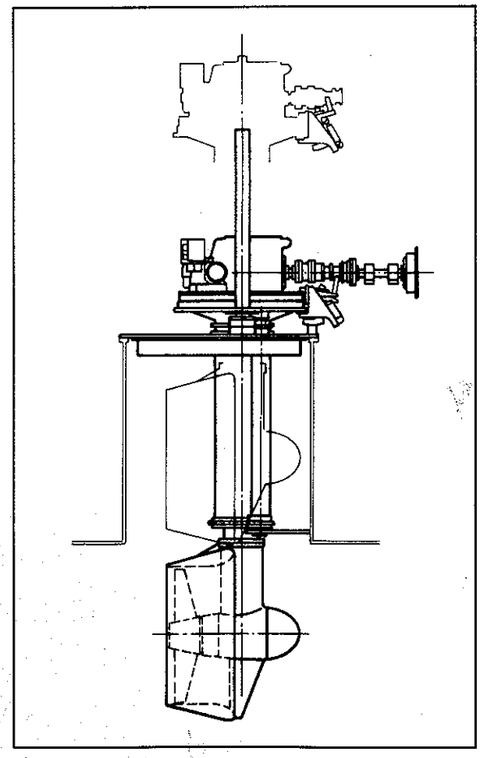
Azimuthing thrusters, projecting below the hull are highly versatile allowing 360° rotation and thus excellent control of thrust direction. The best known are those made by Aquamaster Rauma Ltd and Ulstein. Such units are often retractable to avoid damage in shallow water.

Azimuthing thrusters of the type described have been used as main propulsion units on a few anchor handling vessels but there is some reluctance to change the well tried configuration of twin C.P. propellors, fixed kort nozzles and high efficiency rudders backed up by multiple tunnel thrusters with C.P. propellors and electric drives.

The reluctance is partly due to the fear that wire and gear below the stern of the vessel could cause very expensive damage if it fouled this type of thruster/ propulsion unit.

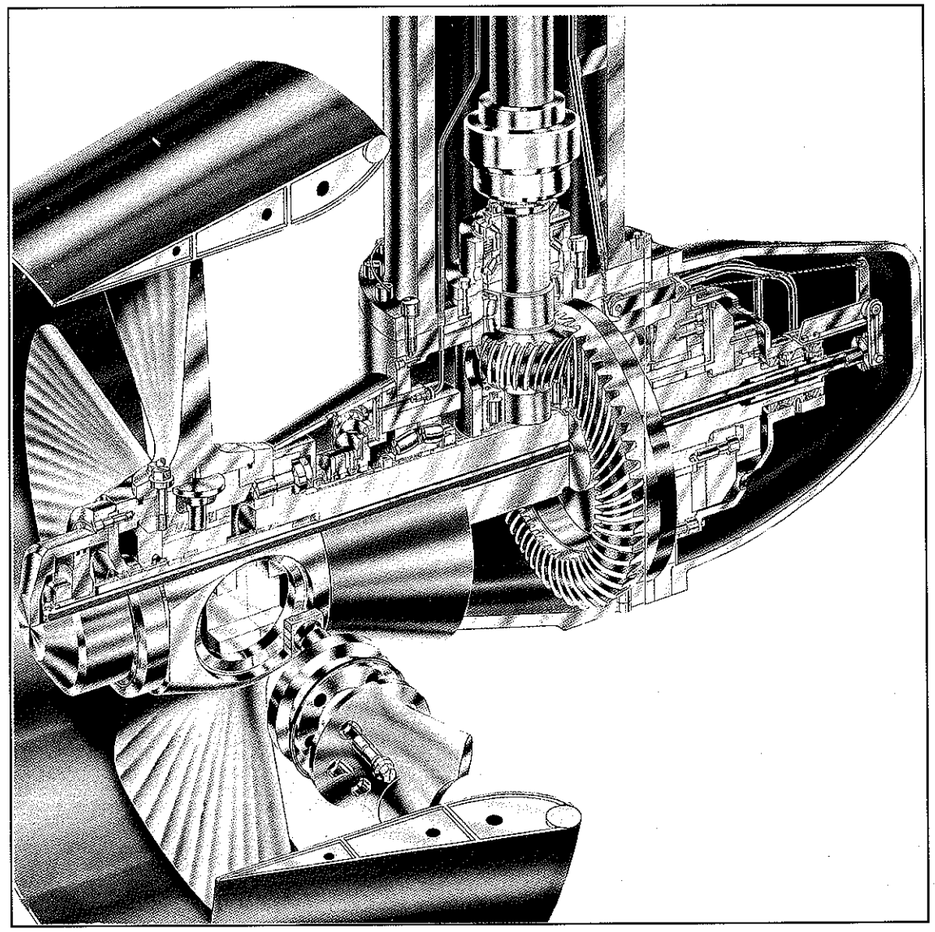
Users of omni directional thrusters such as Aquamaster or Ulstein Compass, including this author find them far superior to tunnel units because of the very exact control of thrust direction and power which can be so precisely balanced against main propellor output. The ability to perform very controlled turns, side-steps and diagonal turning manoeuvres must be experienced in order to appreciate the versatility of the design.

In this general outline of propulsion and manoeuvring equipment no attempt can be made to favour one system over another. Much depends upon the inter-relationship between hull design, superstructure design and propulsion equipment and power output of the particular vessel. Also the abilities of particular boat "drivers" varies as widely as the boats they serve on. Ship handling is a skill to be practised and studied and no matter how good the equipment, some personnel will always be mediocre or plain useless whereas others with the most awkward and inefficient equipment will make their boats perform extraordinary manoeuvres with an ease which is a pleasure to see.

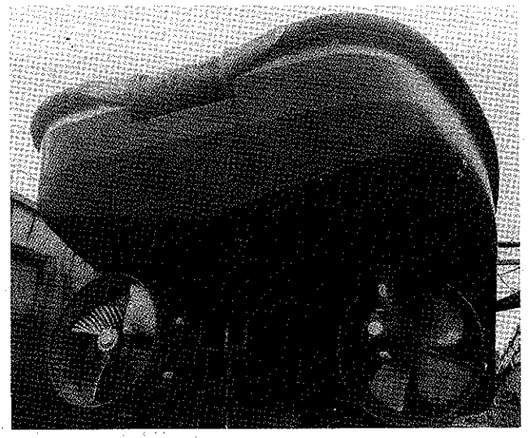


The Aquamaster hull mounted retractable thruster system provides additional manoeuvrability and is suitable for main propulsion units of up to 4,000 HP

Side thruster



The Ulstein Liaaen compass (360°) controllable pitch (CP) thruster is a complete steering and propulsion system



Typical twin CP compass thruster installation on an AHTS provides very high turning efficiency

f. Control station layouts

Anchor handling tugs are mostly operated from the aft end of the bridge. This gives the best view of the working deck and winches where the activity takes place. As most operations occur in relation to the stern of the boat it is logical to group all the controls here.

The photographs show a typical layout and the variations are those of size and complexity rather than basic design.

All the controls for main engines, rudders, thrusters and communications are grouped to allow single man operation.

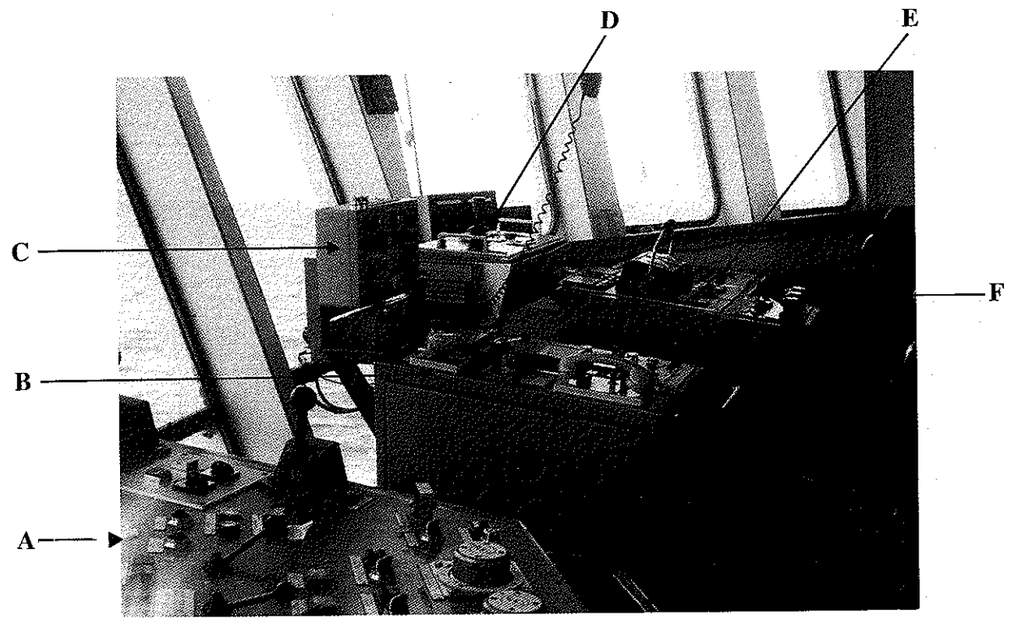
Some designs allow this single man to also operate the winches, tuggers and stoppers/pins etc. but as boats have become larger, with more elaborate multi-drum winches, multiple thrusters etc. it is becoming more common to split the control station into a two man system where one man manoeuvres the boat and the other operates all the winches and deck gear.

Although the introduction of single stick manoeuvring control systems, POSCON, allow the "driver" to both control the boat and operate the winch system, where two man control consoles exist the normal practice is to use it as a two man operation.

Driving seats are almost universal and are not to be shunned by personnel who must often spend long hours performing operations requiring extreme mental concentration.

Large AHTS showing excellent visibility afforded over the deck from the aft end of the bridge

Control station of large AHTS type vessel



A **Winch control panel**
For anchor handling and towing drums, tugger winches, towing/guide pins and stoppers

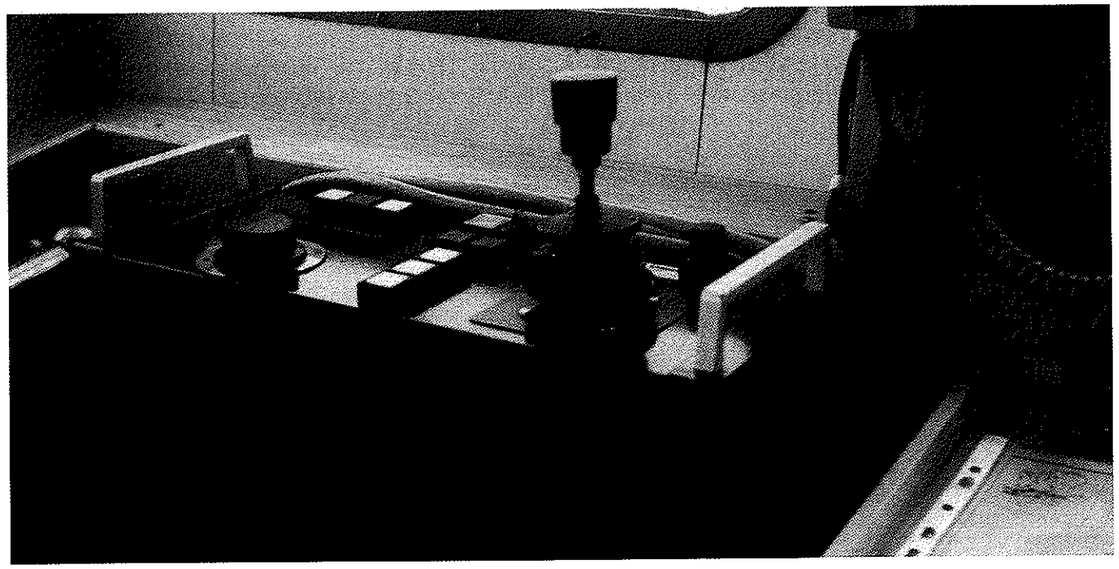
B **Thruster control panel**
Controls for bow and stern thrusters

C **Poscon Control Panel**
Joystick controller for one hand operation of thrusters and main engines

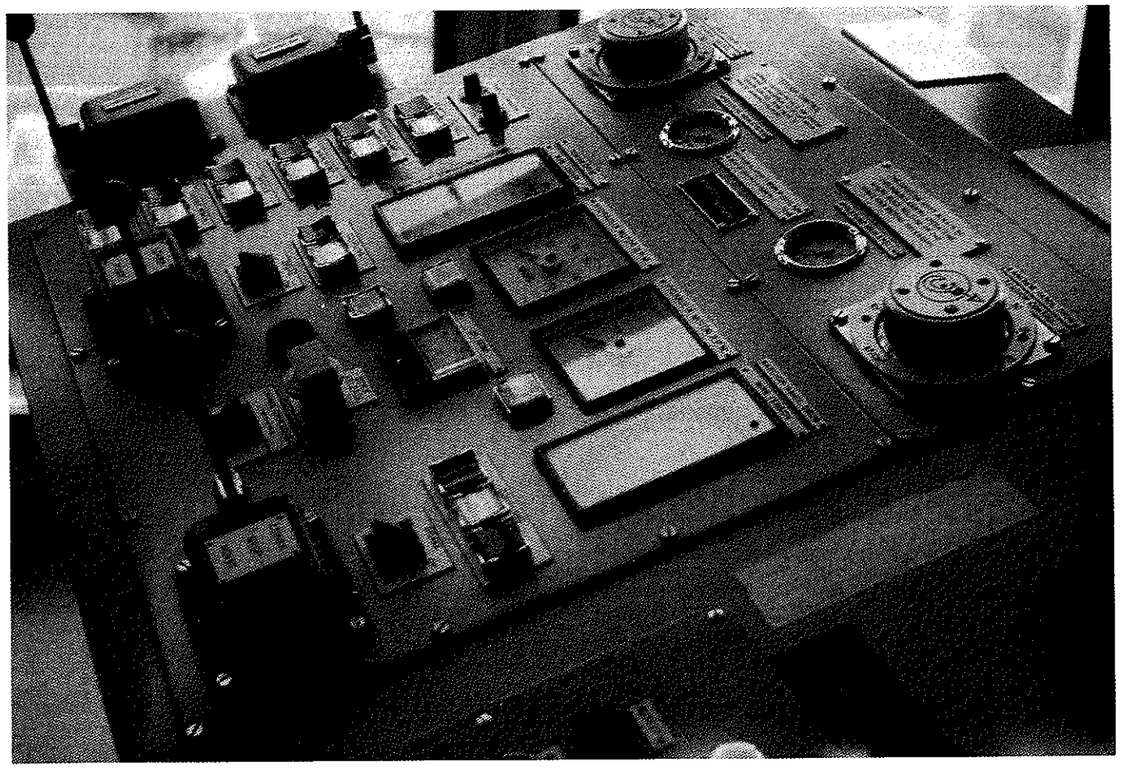
D **Daylight radar display**

E **Main engine control desk**
Controls for main engine revolutions and pitch control levers ahead/astern

F **Steering control panel**
Rudder angle controls for individual or interlinked modes.



Joystick Poscon Control Box
This system allows all thrusters and main propellors to be controlled by movement of single lever. The boat goes in the direction you push the lever. The more you push the more power is applied. The black knob, left of the joystick is for setting a fixed heading or changing heading.



Towing/anchor handling winch control desk
The panel contains clutch and drive coupling controls, single lever heave/lower controls for each drum, brake controls, brake tension setting controls, wire tension indication. On extreme top of photo are single lever controls for tugger winches (remote).

g. Anchors, wire rope, shackles and gear
The following tables, photographs and diagrams show the common types of equipment used by a typical anchor handler in its working operations.

The descriptions are for the most part self explanatory and will become clearer as the reader works through the text.

The wire rope table shows the most usual size, type and breakloads of the wires used.

The chaser hook descriptions apply to a wide variety of operations and the majority of boats will only carry a simple J-hook chaser and grapple but may from time to time be presented with chasers of the designs shown when engaged in particular jobs.

The anchor types are those most commonly found and used for many types of barge or structure mooring purposes.

TABLE OF WORKING WIRES

	Size nominal diameter	Fibre Core			Steel Core		
		Approximate Mass	1770 tensile grade		Approximate Mass	1770 tensile grade	
			Minimum Breaking Load	Minimum Breaking Force		Minimum Breaking Load	Minimum Breaking Force
	mm	kg/100m	tonnes(t)	kN	kg/100m	tonnes(t)	kN
	8	23.1	3.81	37.4	25.5	4.11	40.3
	9	29.2	4.82	47.3	32.2	5.20	51.0
	10	36.1	5.95	58.4	39.8	6.42	63.0
	11	43.7	7.21	70.7	48.2	7.77	76.2
	12	52.0	8.57	84.1	57.3	9.25	90.7
Small slings, lashing wire	13	61.0	10.1	98.7	67.3	10.8	106
	14	70.8	11.6	114	78.0	12.6	124
	16	92.4	15.3	150	102	16.4	161
	18	117	19.3	189	129	20.8	204
	19	130	21.5	211	144	23.1	227
Tugger wires buoy lassoes slings	20	144	23.9	234	159	25.7	252
	22	175	28.8	283	193	31.1	305
	24	208	34.3	336	229	37.0	363
	26	244	40.3	395	269	43.4	426
	28	283	46.7	458	312	50.4	494
Suitcase wires heavy strops slings	32	370	61.0	598	408	65.7	645
	35	442	73.0	716	488	78.7	772
	36	468	77.2	757	516	83.3	817
	38	521	85.9	843	575	92.8	910
	40	578	95.3	935	637	103	1 008
	44				771	124	1 220
	48				917	148	1 452
	52				1 076	174	1 704
	54				1 161	187	1 837
	56				1 248	201	1 976
Work wires anchor handling pennants – chasing	60				1 433	231	2 268
	64				1 660	262	2 570
	67				1 830	288	2 825
	68				1 880	297	2 914
	70				1 990	314	3 080
Heavy chasing pennants heavy suspended mooring pennants	72				2 100	333	3 267
	73				2 170	341	3 345
	76				2 340	370	3 630
	83				2 790	442	4 336
	89				3 210	508	4 983
	96				3 740	591	5 797
	103				4 340	653	6 405

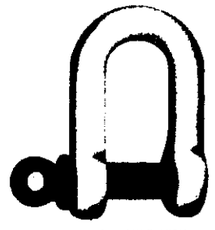
Reproduced by courtesy of Bridon Ropes

g. Anchors, wire rope, shackles and gear

Green Pin® 'Standard' shackles
Material: body and pin high tensile steel, quenched and tempered. Safety factor: 6 times S.W.L. = minimum breaking strength. Finish: galvanised. Standard: U.S. Federal Specification RR-C-271.

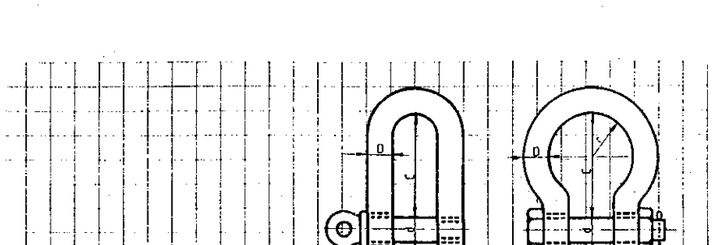
SAFE WORKING LOAD	DIA BOW	DIA PIN	INSIDE WIDTH	INSIDE LENGTH		WIDTH OF BOW	APPROX. WEIGHT EACH	
				CHAIN TYPE	ANCHOR TYPE			
	D	d	a	C	C	2r	in kos.	
metric tons	mm	mm	mm	mm	mm	mm	SCREW PIN	SAFETY PIN
0.33	5	6	10		22	16	0.02	–
0.5	6	8	12		29	20	0.06	0.07
0.75	8	10	13.5	27	32	21	0.11	0.13
1	10	11	16	31	36	26	0.15	0.17
1.5	11	13	18	37	43	29	0.21	0.25
2	13	16	22	43	51	32	0.37	0.44
3.25	16	19	27	51	64	43	0.65	0.79
4.75	19	22	31	59	76	51	1.06	1.26
6.5	22	25	36	73	83	58	1.56	1.88
8.5	25	28	43	85	95	68	2.32	2.78
9.5	28	32	47	90	108	75	3.28	3.87
12	32	35	51	94	115	83	4.51	5.26
13.5	35	38	57	115	133	92	5.93	6.94
17	38	42	60	127	146	99	7.89	8.79
25	45	50	74	149	178	126	13.40	14.99
35	50	57	83	171	197	146	18.85	20.65
42.5	57	65	95	190	222	160	26.06	29.01
55	65	70	105	203	254	185	37.86	41.05
85	75	80	127	230	330	190	58.68	62.24
120	89	95	146	267	381	238		110

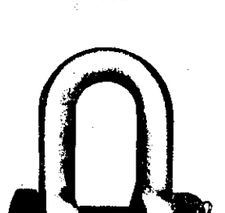
ANCHOR SHACKLE WITH SCREW PIN (TYPE IV, CLASS 1)
G-4161



CHAIN SHACKLE WITH SCREW PIN (TYPE IV, CLASS 2)
G-4151

SAFETY ANCHOR SHACKLE BOLT TYPE (TYPE IV, CLASS 6)
G-4163





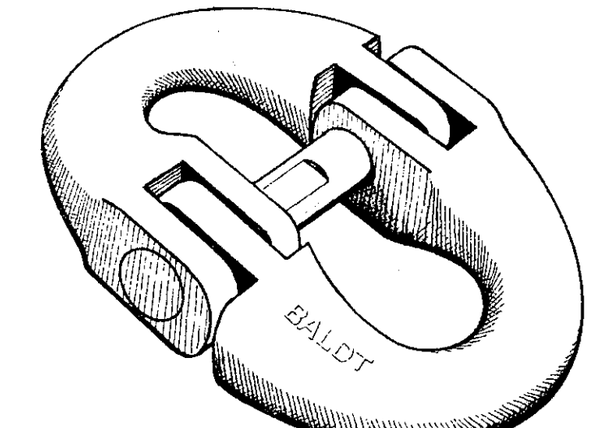
SAFETY CHAIN SHACKLE BOLT TYPE (TYPE IV, CLASS 7)
G-4153

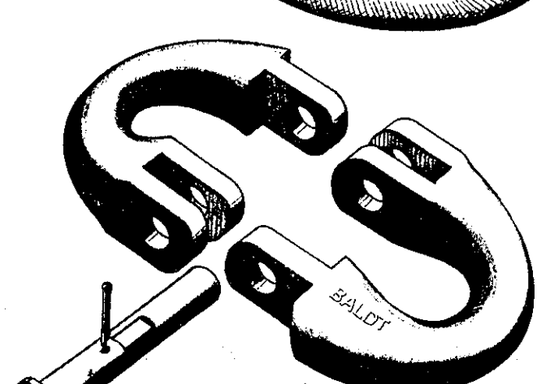
g. Anchors, wire rope, shackles and gear

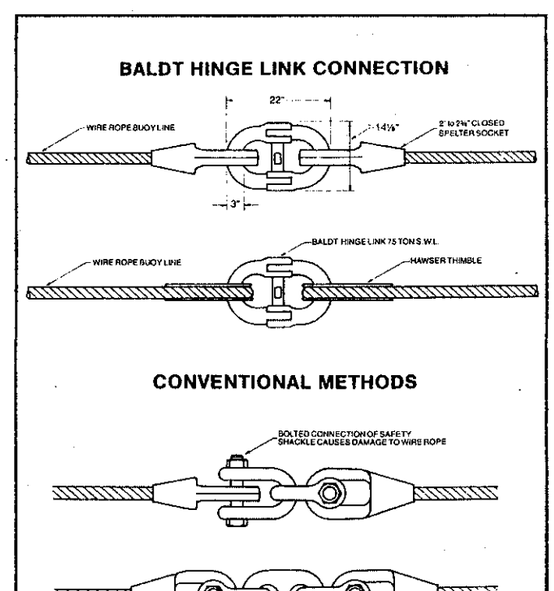
The Baldt Hinge Link
The 110-ton S.W.L. Baldt Hinge Link is specifically designed to provide a single, fast, easy connection to spelter sockets or thimbles that will hinge when passing over a wire rope drum. Baldt's Hinge Link can be used to connect 2" to 3" wire rope closed spelter sockets and thimbles on anchor pendant lines.

A typical connection made without the Baldt Hinge Link might be a large chain connecting link, two shackles back-to-back or two shackles joined with a connecting link. When shackles are used in this way to make the pendent line connection, the nut and bolt may cut and damage the wire rope. In contrast, the Baldt Hinge Link has clean lines and no projections to damage wire rope.

All parts of the Baldt Hinge Link are interchangeable. The C-link sections and hinge pins are selectively drilled and fitted, and the pins have two unique features designed and built into them. The flat on the head prevents the pin from rolling, and the flats in the centre allow easy rotation of the pin to remove the keeper key.



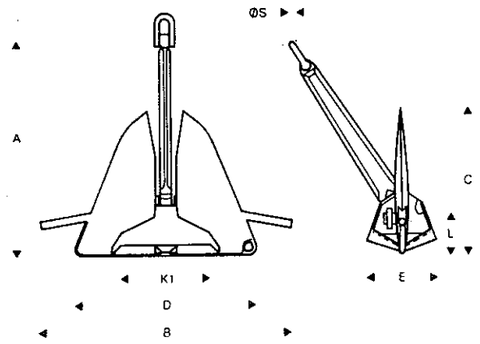




g. Anchors, wire rope, shackles and gear

Typical high holding power anchors — Vryhof type

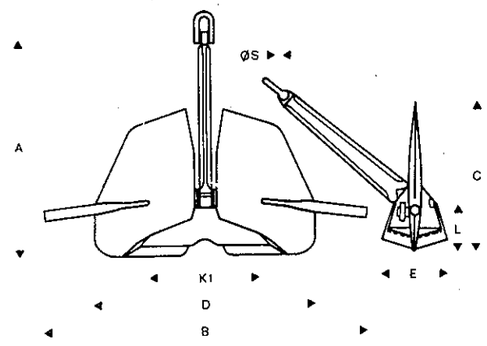
STEVIN ANCHOR



TYPE STEVIN MK3 Main dimensions in mm
Anchorweight in kgs

WEIGHT	1000	1500	3000	5000	7000	9000	12000	15000	20000	30000
A	2341	2680	3376	4003	4478	4869	5366	5780	6362	7283
B	2645	3038	3828	4538	5077	5521	5892	6347	6986	7997
C	1559	1785	2249	2667	2983	3244	3458	3725	4100	4694
D	2023	2316	2918	3460	3871	4209	4490	4837	5324	6094
E	737	843	1063	1260	1409	1533	1728	1861	2048	2345
K	1010	1156	1456	1727	1932	2100	2255	2430	2674	3061
L	412	471	594	704	788	857	914	984	1083	1240
OS	60	65	80	80	90	100	130	150	160	180

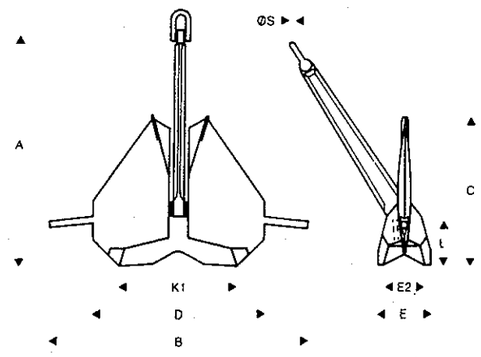
STEVMUD ANCHOR*



In millimeters **Weights not mentioned are available at Vryhof Ankers, pls contact us**

	1 T.	3 T.	5 T.	7 T.	9 T.	12 T.	15 T.	20 T.	30 T.
A	2375	3430	4065	4550	4945	5445	5865	6455	7390
B	3550	5120	6070	6790	7385	8125	8755	9635	11030
C	1650	2380	2820	3155	3430	3780	4070	4480	5125
D	2370	3420	4055	4535	4930	5430	5850	6435	7370
E	755	1090	1290	1445	1570	1730	1865	2050	2350
K1	1440	2075	2465	2755	2995	3300	3555	3910	4480
L	570	825	980	1100	1195	1315	1415	1560	1785
ØS	65	90	100	120	130	140	150	170	200

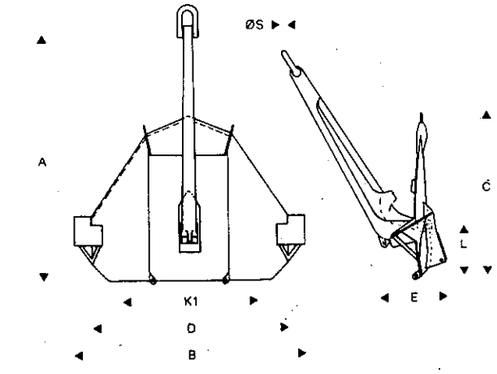
STEVFIX ANCHOR*



In millimeters **Weights not mentioned are available at Vryhof Ankers, pls contact us**

	1 T	1.5 T.	3 T	5 T.	7 T	9 T	12 T	15 T	20 T	30 T
A	2475	2830	3565	4230	4730	5145	5660	6100	6710	7685
B	3045	3485	4390	5205	5820	6330	6970	7505	8260	9455
C	1665	1905	2400	2845	3185	3460	3810	4105	4515	5170
D	1915	2195	2760	3275	3665	3985	4385	4725	5200	5950
E1	730	835	1050	1245	1390	1515	1665	1795	1975	2260
E2	490	560	700	835	930	1015	1115	1200	1325	1515
K1	1235	1410	1780	2110	2355	2565	2825	3040	3345	3830
L	590	680	850	1010	1130	1230	1355	1455	1605	1835
ØS	60	70	90	100	115	125	140	150	165	190

HOOK ANCHOR*



In millimeters **Weights not mentioned are available at Vryhof Ankers, pls contact us**

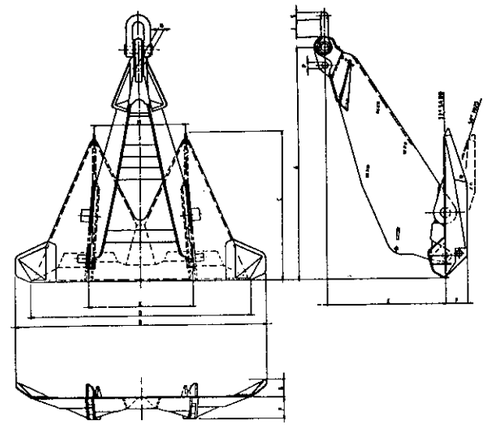
T	10.0	12.5	15.0	20.0	25.0	30.0	35.0	40.0	50.0	60.0
A	5945	6400	6805	7490	8065	8570	9025	9435	10165	10800
B	5465	5885	6255	6885	7420	7885	8300	8675	9345	9935
C	3940	4240	4510	4960	5345	5680	5980	6250	6735	7160
D	4635	4990	5305	5840	6290	6685	7035	7360	7925	8425
E	1285	1380	1470	1615	1740	1850	1950	2040	2195	2335
ØS	140	150	160	180	190	205	215	225	245	260

** No longer manufactured – surpassed by Stevpris anchor.*

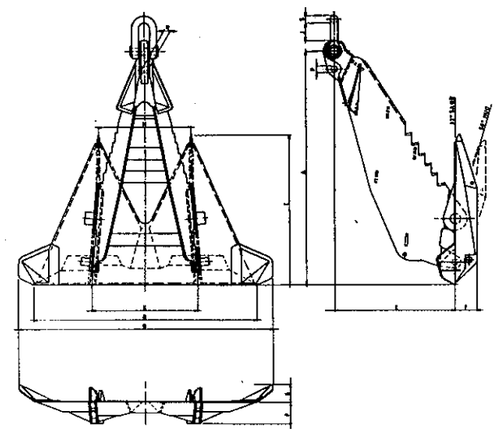
g. Anchors, wire rope, shackles and gear

Typical high holding power anchors — Vryhof type

STEVPRIS



STEVSHARK



TYPE STEVPRIS Main dimensions in mm
Anchorweight in kgs

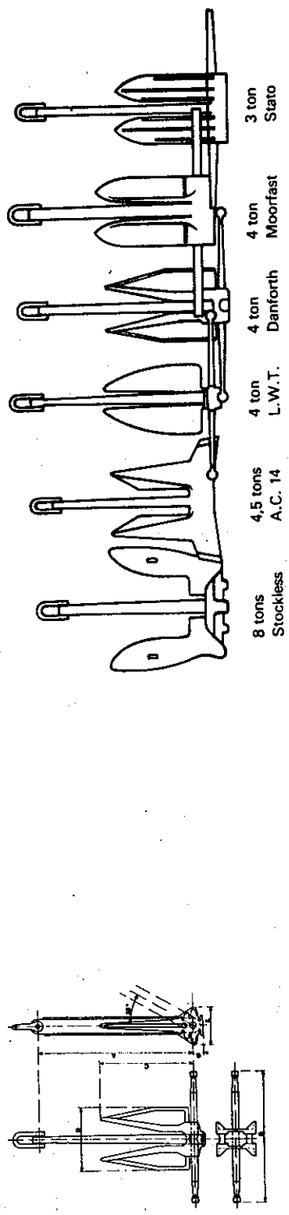
WEIGHT	1500	3000	5000	8000	10000	12000	15000	18000	20000	22000	25000	30000	65000
A	2787	3511	4163	4869	5245	5574	6004	6381	6609	6822	7119	7565	9789
B	3034	3823	4533	5301	5711	6068	6537	6947	7195	7427	7750	8236	10657
C	1792	2258	2677	3131	3372	3584	3861	4102	4249	4386	4577	4864	6294
D	2666	3359	3983	4659	5018	5333	5745	6105	6323	6527	6811	7238	9366
E	1419	1788	2120	2480	2671	2839	3058	3250	3366	3474	3626	3853	4985
F	258	326	386	452	487	517	557	592	613	633	661	702	908
G	211	266	315	369	397	422	455	483	501	517	539	573	741
H	1097	1382	1639	1917	2065	2195	2364	2512	2602	2686	2803	2979	3854
J	212	223	282	329	376	400	423	447	482	505	505	552	752
K	1257	1584	1878	2196	2366	2514	2709	2878	2981	3077	3211	3413	4416
N	70	75	95	120	140	150	150	160	180	180	180	210	280
P	70	70	95	110	130	140	140	150	170	170	170	200	260
S	80	90	110	130	150	160	170	180	190	200	200	220	300

TYPE STEVSHARK Main dimensions in mm
Anchorweight in kgs

WEIGHT	1500	3000	5000	8000	10000	12000	15000	18000	20000	22000	25000	30000	65000
A	2623	3305	3918	4583	4937	5246	5651	6005	6219	6420	6700	7119	9212
B	2856	3598	4266	4989	5375	5711	6152	6538	6771	6990	7294	7751	10030
C	1687	2125	2519	2946	3174	3373	3633	3861	3999	4128	4308	4577	5923
D	2510	3162	3749	4385	4723	5019	5407	5745	5951	6143	6410	6812	8814
E	1336	1683	1996	2334	2514	2672	2878	3058	3168	3270	3412	3626	4692
F	244	307	364	426	459	487	525	558	578	596	622	661	856
G	199	251	297	347	374	398	428	455	471	487	508	540	698
H	1033	1301	1543	1805	1944	2066	2225	2365	2449	2528	2638	2804	3628
J	212	223	282	329	376	400	423	447	482	505	505	552	752
K	1183	1491	1768	2067	2227	2366	2549	2709	2806	2896	3022	3212	4156
N	70	75	95	120	140	150	150	160	180	180	180	210	280
P	70	70	95	110	130	140	140	150	170	170	170	200	260
S	80	90	110	130	150	160	170	180	190	200	200	220	300

g. Anchors, wire rope, shackles and gear

Dimensions of other anchor types



AC 14 anchors

lbs	kg	A(cm)	B(cm)	C(cm)	D(cm)	E(cm)	Ø(mm)
2,843	1,290	273	156	106	98	47	69
3,505	1,590	293	168	114	105	50	74
4,629	2,100	321	184	125	115	55	81
5,423	2,460	339	194	132	122	58	85
6,745	3,060	364	209	142	131	62	92
9,523	4,320	409	234	159	147	70	103
10,780	4,890	426	244	166	153	73	107
12,367	5,610	446	255	174	160	76	112
14,219	6,450	467	268	182	168	80	117
18,297	8,300	508	291	198	183	87	128
20,501	9,300	528	302	206	190	90	133
23,147	10,500	550	315	214	197	94	138
29,760	13,500	598	342	233	215	102	151
37,256	16,900	644	369	251	231	110	162
41,444	18,800	667	382	260	240	114	168
44,090	20,000	681	390	266	245	117	171
50,703	23,000	714	409	278	257	122	180

Moorfast anchors

lbs	kg	A(cm)	B(cm)	C(cm)	D(cm)	E(cm)	Ø(mm)
1,000	453	154	190	93	63	48	50
3,000	1,360	223	276	137	93	68	76
6,000	2,721	256	363	154	106	78	88
8,000	3,628	309	388	190	129	96	88
10,000	4,536	332	398	203	139	104	101
12,000	5,443	353	424	215	147	109	101
14,000	6,350	373	449	228	154	114	101
16,000	7,257	388	474	238	162	121	114
20,000	9,072	416	497	259	175	129	114
30,000	13,608	480	551	299	200	149	127
40,000	18,144	543	629	322	218	160	139
50,000	22,680	583	652	335	226	167	152
60,000	27,216	589	688	335	241	177	152
70,000	31,752	619	695	373	254	185	152
80,000	36,288	647	756	391	266	195	165
90,000	40,824	675	787	406	276	203	165
100,000	45,360	698	812	421	287	210	177

All figures are subject to alteration by Vryhof.

LWT anchors

lbs	kg	A(cm)	B(cm)	C(cm)	D(cm)	E(cm)	Ø(mm)
350	158	134	127	82	53	41	31
450	204	152	143	93	60	46	31
750	340	175	163	106	72	53	31
1,000	453	190	180	116	74	62	50
2,000	907	234	215	143	94	76	63
3,000	1,360	275	264	167	102	88	76
4,000	1,814	294	279	180	111	95	76
5,000	2,268	299	284	182	113	98	88
7,000	3,175	314	299	193	120	104	101
9,000	4,082	337	320	206	132	114	101
10,000	4,536	365	347	223	140	124	114
12,000	5,443	370	351	226	145	126	114
13,000	5,896	381	361	232	149	130	127
14,000	6,350	391	370	238	153	133	127
16,000	7,257	408	387	249	160	139	127
18,000	8,164	424	402	259	166	144	127
20,000	9,072	439	416	269	172	149	139

US Navy Stockless anchors

lbs	kg	A(cm)	B(cm)	C(cm)	D(cm)	E(cm)	Ø(mm)
1,000	453	108	84	76	76	76	76
2,000	907	136	105	97	97	97	97
3,000	1,360	156	120	111	111	111	111
4,000	1,814	171	133	121	121	121	121
5,000	2,268	185	141	132	132	132	132
7,000	3,175	207	160	147	147	147	147
9,000	4,082	226	175	161	161	161	161
10,000	4,536	233	180	166	166	166	166
13,000	5,896	255	198	180	180	180	180
15,000	6,804	267	208	186	186	186	186
18,000	8,164	284	218	202	202	202	202
20,000	9,072	294	226	209	209	209	209
22,000	9,979	304	233	215	215	215	215
25,000	11,340	317	239	220	220	220	220
28,000	12,700	330	250	228	228	228	228
30,000	13,608	337	254	233	233	233	233
34,000	15,422	345	262	236	236	236	236

Danforth anchors

lbs	kg	A(cm)	B(cm)	C(cm)	D(cm)	E(cm)	Ø(mm)
200	90	133	115	83	54	54	54
500	226	160	138	100	67	67	67
1,000	453	182	157	115	77	77	77
2,000	907	210	182	132	88	88	88
3,000	1,360	238	226	149	99	99	99
4,000	1,814	264	250	166	99	99	99
5,000	2,268	284	270	179	119	119	119
6,000	2,721	299	284	187	125	125	125
8,000	3,628	327	311	196	131	131	131
10,000	4,536	350	332	220	147	147	147
12,000	5,443	368	368	231	154	154	154
14,000	6,350	386	386	243	162	162	162
16,000	7,257	406	406	256	170	170	170
20,000	9,072	436	414	275	183	183	183
30,000	13,608	500	474	284	189	189	189
40,000	18,144	548	520	312	208	208	208
50,000	22,680	589	563	337	225	225	225

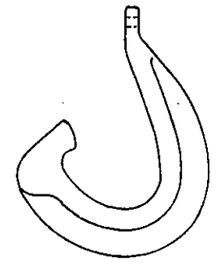
Stato anchors

lbs	kg	A(cm)	B(cm)	C(cm)	D(cm)	E(cm)	Ø(mm)
3,000	1,360	327	276	182	121	86	44
6,000	2,721	365	363	233	137	96	57
9,000	4,082	406	431	254	152	109	69
12,000	5,443	472	500	287	177	127	76
15,000	6,804	518	568	320	193	137	88
20,000	9,072	533	584	327	200	142	88
25,000	11,340	574	624	347	215	154	101
30,000	13,608	596	652	368	223	157	127
35,000	15,876	629	688	388	236	167	133
40,000	18,144	655	718	406	246	175	139
45,000	20,412	683	749	421	256	182	146
50,000	22,680	703	769	434	264	187	152
60,000	27,216	754	812	457	281	200	152
70,000	31,752	787	853	485	294	210	165
80,000	36,288	817	889	508	307	218	165
90,000	40,824	876	929	523	330	236	177
100,000	45,360	889	965	548	335	238	190

g. Anchors, wire rope, shackles and gear

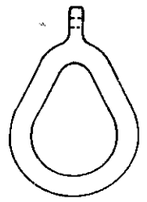
Chasers

The J-Chaser



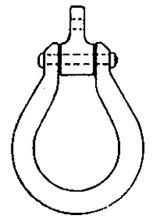
The 'J' chain chaser is deployed over the stern roller of an AHV at approximately ⅓ of the water depth. The chaser is towed across the mooring catenary until it catches the chain. It is then towed into contact with the anchor shank/fluke for anchor break-out and retrieval.

The Permanent Chain Chaser



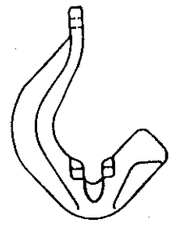
As a practical alternative to the buoy and pennant, permanent chain chasers were introduced. Originally, simple shackles were used; these were followed by special cast oval rings which were attached to a pennant by a 'bight' of chain and shackle. Very soon afterwards the pear-shaped chaser with shackle eye was introduced. The design of these chasers offered superior sliding and penetration properties.

The Detachable Chain Chaser



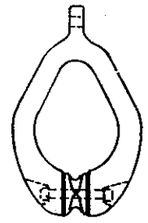
For rigs in service it is sometimes preferred to equip the mooring with a chaser which does not require the anchor chain to be broken and re-made. Detachable chain chasers were introduced to satisfy this need. The withdrawal and replacement of the single hinge bolt permits easy assembly of the chaser on the mooring cable.

The J-Lock Chaser



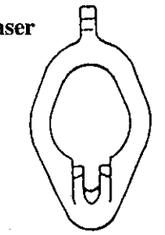
The J-lock chaser is based on the same principle as the permanent lock chaser. However, the J-shape permits catching the anchor chain after the anchor has been installed. This means that this chaser can be used to assist in unforeseen circumstances. The well-balanced and 'guiding design of the chaser enables catching the chain when the chaser approaches a mooring at the point where the catenary angle is as high as 45 degrees.

The Permanent Wire Chaser



The permanent wire chaser was introduced when the rigs moved to yet deeper waters, and composite wire/chain mooring systems became necessary.
The chaser incorporates a 'rocker' which is centrally mounted on a hinge bolt. The rocker has two opposing wire grooves, and when the chaser is engaged with the mooring cable, the wire slides through one of these grooves irrespective of the angle which the chaser makes with the mooring.
The large radius at the base of the wire groove assists in reducing wear of the rocker and avoids severe 'opening' of the lay of the wire if a loop of wire is pulled during the handling process. The material of the rocker is not hard as the material of the wire. This means that wear is taken by the rocker without damage to the wire and, because the rocker is easily removable, replacement is relatively inexpensive. The permanent wire chaser is easily detachable by withdrawal and re-assembly of the hinge bolt and rocker.
Some designs of wire chaser incorporate fully rotating rollers over which the mooring wire passes. To be effective such rollers need to be of large diameter and require to be supported on bearings. They are consequently larger, heavier and much more costly than the permanent wire chasers discussed above, and because of their size, they require more power at the AHV to penetrate the sea bed and reach the anchor.

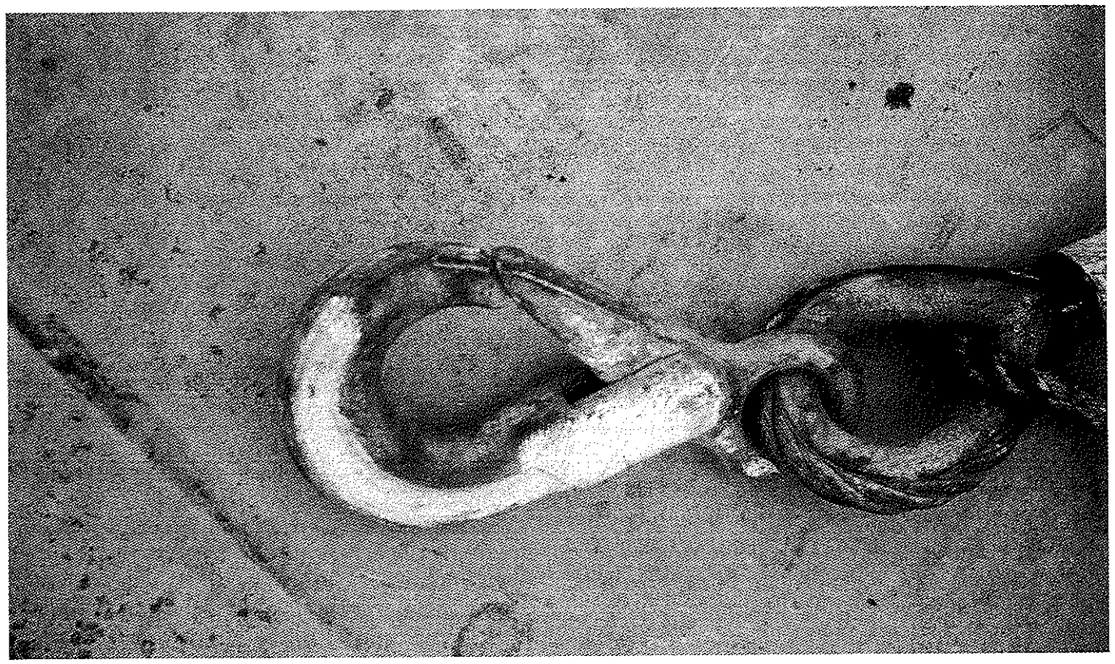
The Permanent Chain-Lock Chaser



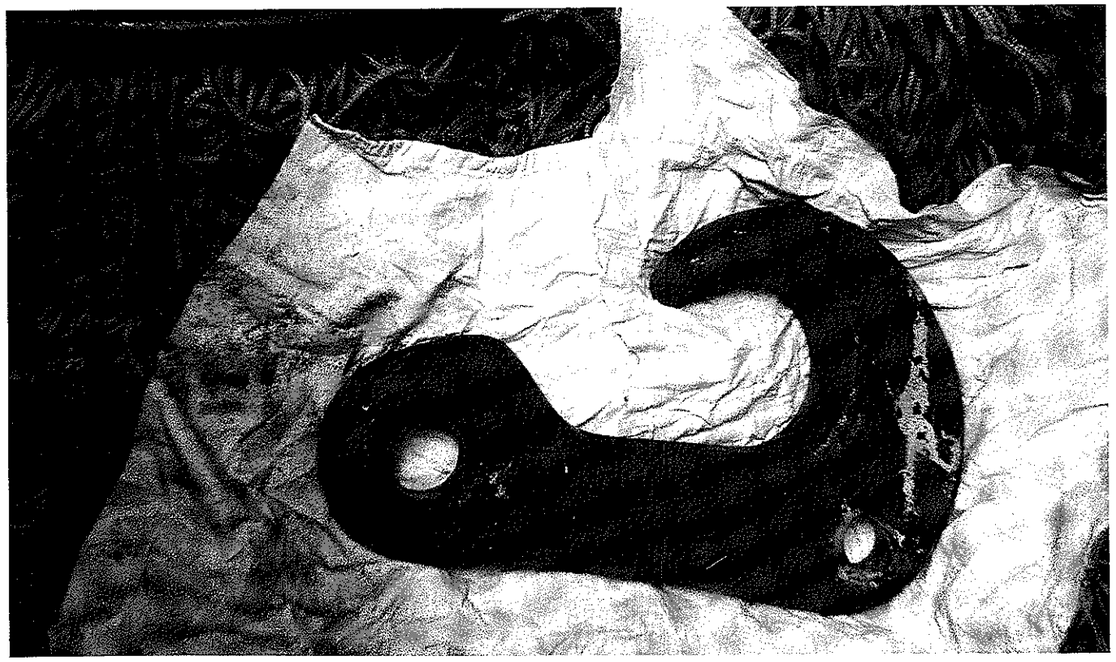
Increased rig dimensions and anchor forces lead to higher requirements for the breaking out force. Whilst the greater force may be available with the larger AHV's, the need was seen for a chaser which could break-out an anchor without having to contend with the force in the mooring which opposes breaking out.
The chain-lock chaser, currently under development and field trials, fulfills this requirement. By locking on the chain ahead of the anchor shackle, the mooring tension can be completely relaxed and the AHV has to deal only with the weight of the anchor and its resistance to break out.

g. Anchors, wire rope, shackles and gear

Fittings for tugger wires chain stoppers and small slings



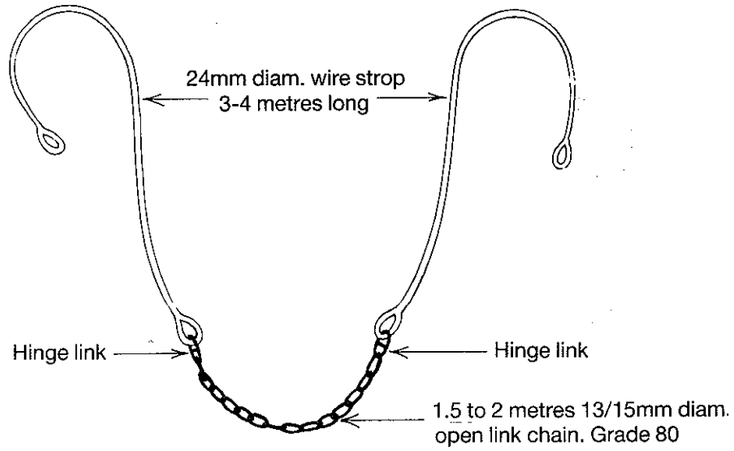
Safety Hook Typical modern type excellent for many applications, particularly at ends of tugger wires. Ratings 1 tonne — 25 tonne SWL



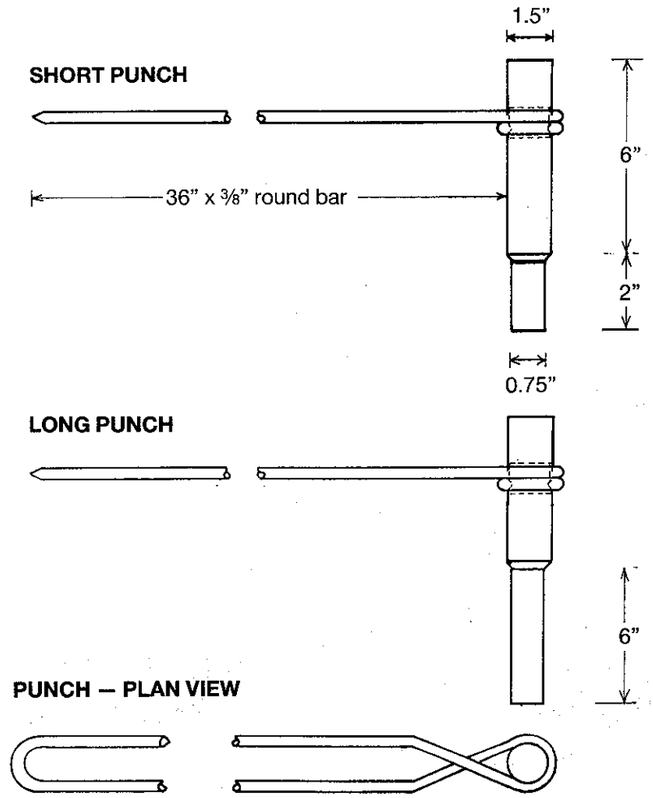
Anchor Handling Hook Used at outboard end of the suitcase wire. Rated 25 tonne SWL

g. Anchors, wire rope, shackles and gear

BUOY CATCHER LASSO

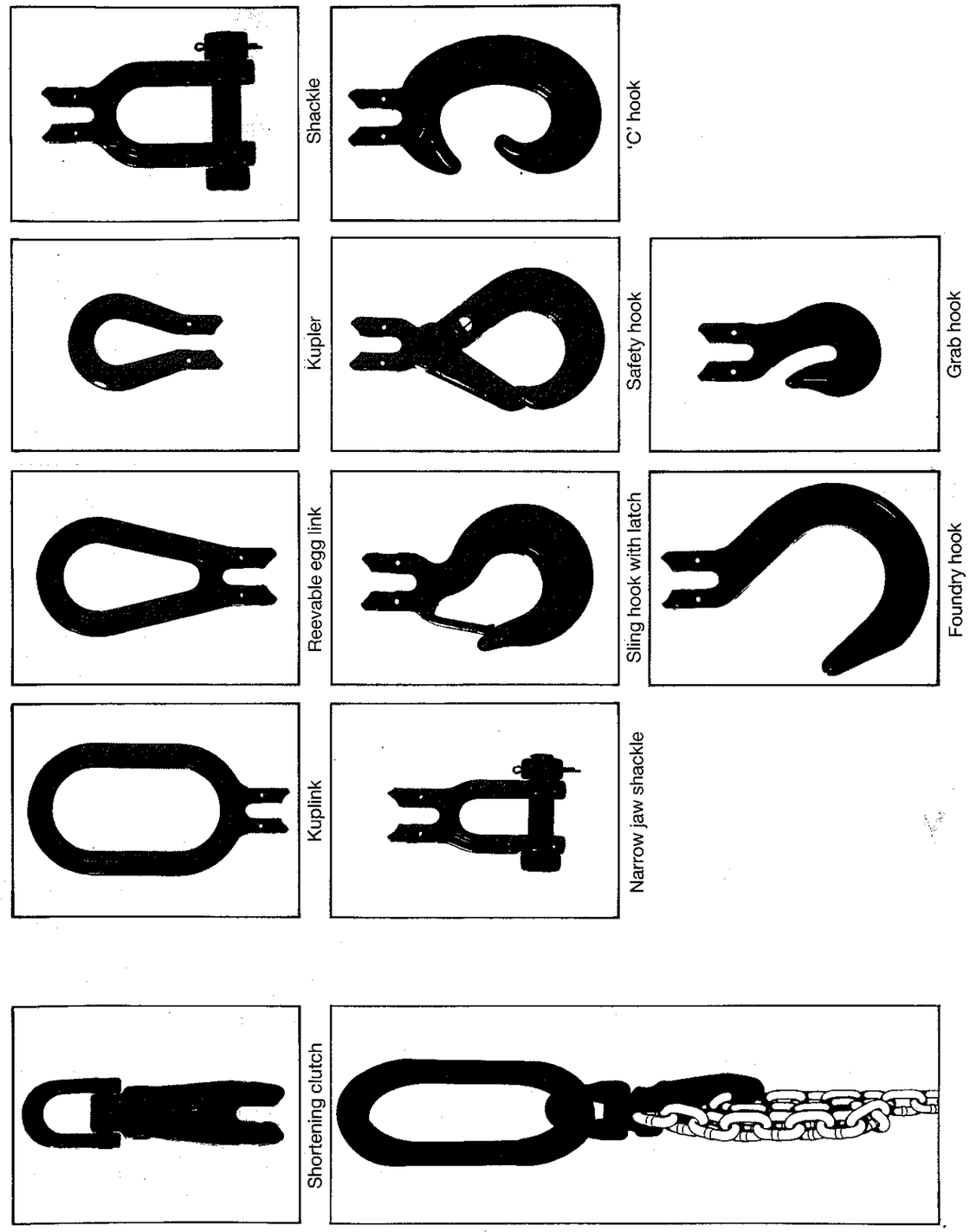


Pin punches
Used for securing and breaking out pins of chain joining shackles, Kenter links and Baldt links.
Punch material — tool steel hardened (see diagram).



g. Anchors, wire rope, shackles and gear

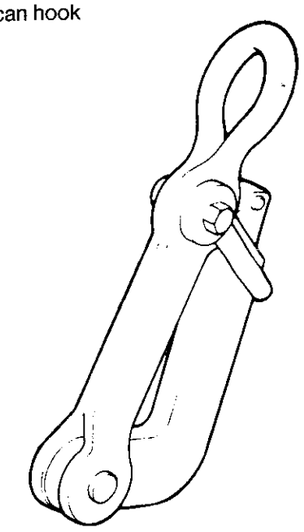
LINKS, SWIVELS AND HOOKS — KUPLEX® TYPES

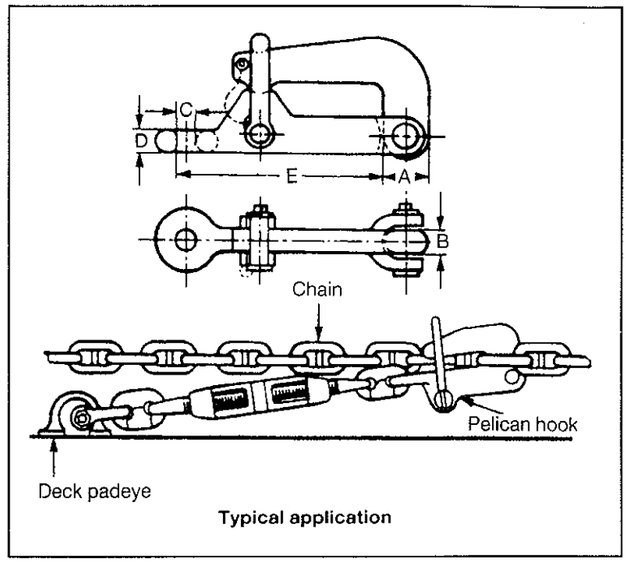


g. Anchors, wire rope, shackles and gear

PELICAN HOOKS, SLIP HOOKS AND SWIVELS

Pelican hook

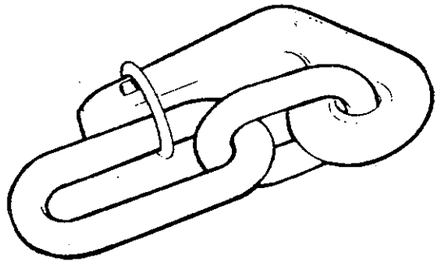


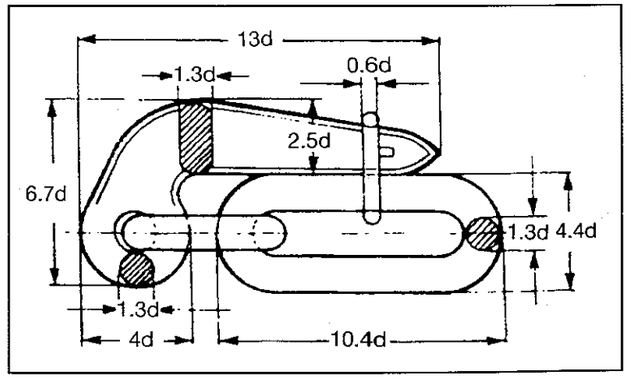


Typical application

Chain Size mm	A mm	B mm	C mm	D mm	E mm	S.W.L. Tonnes
25-28	90	35	38	30	358	10
32	100	40	45	35	390	15
34-42	110	45	55	42	430	25
44-48	120	50	60	50	475	35
51-58	135	60	75	60	525	50
60-64	150	70	86	70	600	60
67-70	170	80	90	80	705	75
76-83	200	100	105	100	880	100

Slip hook

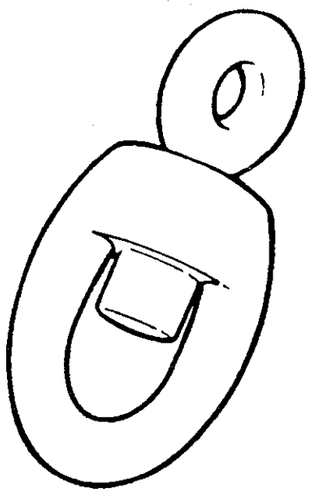


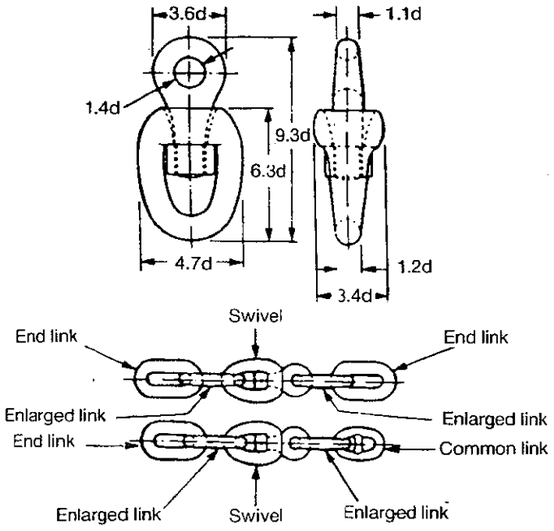


Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg
19	4.3	**32**	19	**44**	55	**57**	115	**70**	208	**83**	348	**95**	532
22	6.6	**35**	27	**48**	66	**60**	137	**73**	241	**86**	394	**98**	593
25	10	**38**	34	**51**	82	**64**	159	**76**	272	**89**	437	**102**	649
29	14	**41**	44	**54**	98	**67**	183	**79**	312	**92**	483		

g. Anchors, wire rope, shackles and gear

Bow and eye swivel

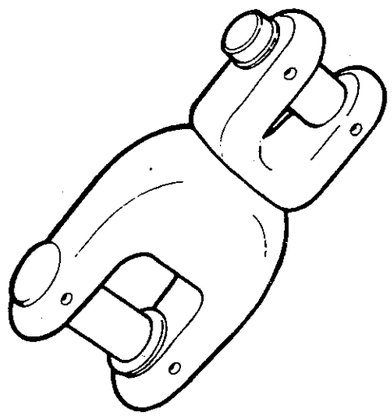




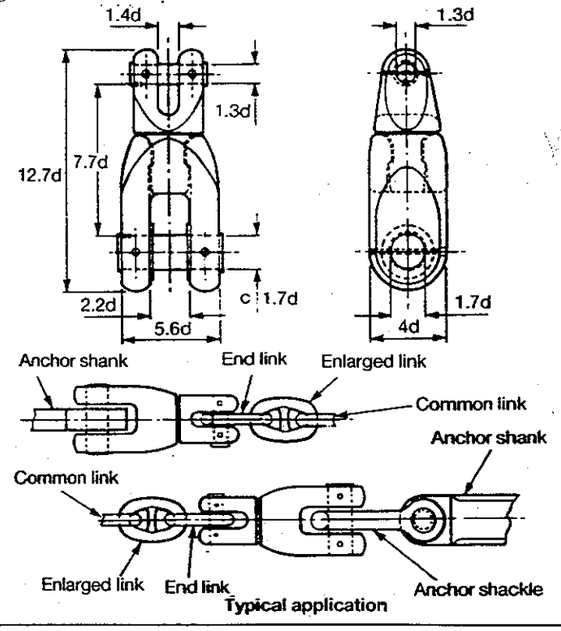
Typical swivel assemblies

Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg
19	2.8	**32**	12.7	**44**	36	**57**	75	**70**	137	**83**	229	**95**	349
22	4.4	**35**	17.5	**48**	43	**60**	90	**73**	159	**86**	259	**98**	389
25	6.8	**38**	22	**51**	54	**64**	104	**76**	179	**89**	287	**102**	426
29	9.4	**41**	29	**54**	64	**67**	120	**79**	205	**92**	317		

Jaw and Jaw Swivel



Size mm	Weight kg	Size mm	Weight kg	Size mm	Weight kg
51	90	**67**	180	**83**	399
54	100	**70**	200	**89**	539
57	128	**73**	250	**95**	610
60	140	**76**	299	**102**	772
64	155				



Typical application

g. Anchors, wire rope, shackles and gear

Chain — engineering specification — Crosby type

Crosby Proof Coil — Spectrum 3 Chain						
Trade Size (in.)	Size Material (in.)	Working Load Limit (lbs)	Maximum Inside Length (in.)	Minimum Inside Width (in.)	Maximum Length 100 links (in.)	Weight Per 100 Feet (lbs.)
3/16	.217	800	.98	.30	98	39
1/4	.276	1300	1.24	.38	124	65
5/16	.315	1900	1.29	.44	129	100
3/8	.394	2650	1.38	.55	138	144
1/2	.512	4500	1.79	.72	179	250
5/8	.630	6900	2.20	.79	220	421
3/4	.787	10600	2.75	.98	275	649

Crosby High Test — Spectrum 4 Chain						
Trade Size (in.)	Size Material (in.)	Working Load Limit (lbs.)	Maximum Inside Length (in.)	Minimum Inside Width (in.)	Maximum Length 100 links (in.)	Weight Per 100 Feet (lbs.)
1/4	.276	2600	1.24	.38	124	70
5/16	.315	3900	1.29	.44	129	106
3/8	.394	5400	1.38	.55	138	154
7/16	.468	7200	1.40	.65	129	205
1/2	.512	9200	1.79	.72	179	267
5/8	.630	11500	2.20	.79	220	402
3/4	.787	16200	2.76	.98	276	567

Crosby Transport — Spectrum 7 Chain						
Trade Size (in.)	Size Material (in.)	Working Load Limit (lbs.)	Maximum Inside Length (in.)	Minimum Inside Width (in.)	Maximum Length 100 links (in.)	Weight Per 100 Feet (lbs.)
1/4	.276	3150	1.24	.38	124	81
5/16	.343	4700	1.32	.48	132	98
3/8	.394	6600	1.38	.55	138	141
7/16	.468	8750	1.64	.65	164	216
1/2	.512	11300	1.79	.72	179	246

Crosby Alloy — Spectrum 8 Chain						
Trade Size (in.)	Size Material (in.)	Working Load Limit (lbs.)	Maximum Inside Length (in.)	Minimum Inside Width (in.)	Maximum Length 100 links (in.)	Weight Per 100 Feet (lbs.)
9/32 (1/4)	.276	3500	.90	.34	90	72
5/16	.343	4500	1.00	.48	100	108
3/8	.394	7100	1.25	.49	125	148
1/2	.512	12000	1.64	.64	164	243
5/8	.630	18100	2.02	.79	202	351
3/4	.787	28300	2.52	.98	252	584
7/8	.866	34200	2.77	1.08	277	705

g. Anchors, wire rope, shackles and gear

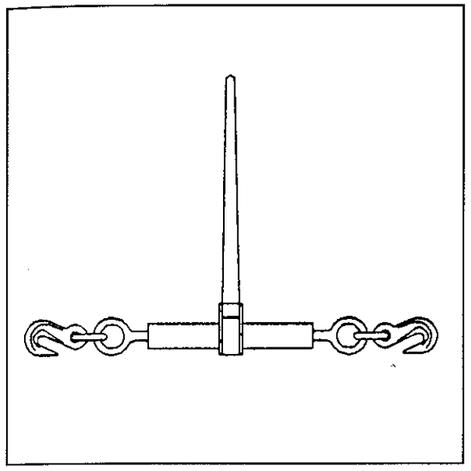
Snatch blocks — McKissick type

Sheave Diameter (in.)	Bearing Code	Stock No. 418 with Hook	Stock No. 419 with Shackle	Stock No. 404 Tail Board	Wire Rope Size (in.)††	Working Load Limit * (metric tons)	Weight Each (lbs.) 418 with Hook	Weight Each (lbs.) 419 with Shackle	Weight Each (lbs.) 404 Tail Board
** 3	BB	169043	†169212	177132	5/16	2	4.3	3	3
** 3	BB	108038	†109037	102016	3/8	2	4.3	3	3
**4½	BB	169089	169249	167866	3/8	4	11	12	6
**4½	BB	108065	109064	102025	½	4	11	12	6
6	BB RB	168419 199644	169258 202658	177203 177258	5/8	8	26	27	15
6	BB RB	108127 108154	109126 109153	102098 102114	3/4	8	26	27	15
8	BB RB	199671 199715	169301 202710	177294 167893	5/8	8	33	34	21
8	BB RB	108225 108252	109224 109251	102169 102187	3/4	8	33	34	21
10	BB RB	199788 199840	202872 169338	177409 177463	5/8	8	41	42	29
10	BB RB	108323 108350	109322 109359	102230 102258	3/4	8	41	42	29
12	BB RB	169169 199911	202961 169347	178890 178934	5/8	8	48	49	36
12	BB RB	108421 108458	109420 109457	102301 102329	3/4	8	48	49	36
14	BB RB	194920 199948	169356 167857	— —	5/8	8	55	56	—
14	BB RB	108528 108546	109527 109545	— —	3/4	8	55	56	—
16	BB RB	199975 200008	203041 203087	— —	3/4	15	130	135	—
16	BB RB	108608 108626	109607 109625	— —	7/8	15	130	135	—
18	BB RB	200099 200151	203130 203176	— —	7/8	15	150	155	—
18	BB RB	108644 108662	109643 109661	— —	1	15	150	155	—

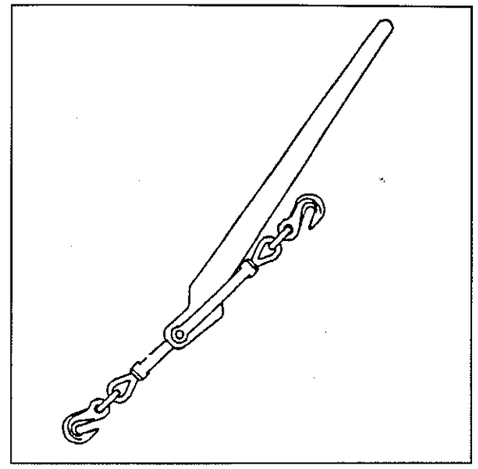
* Ultimate Load is 4 times the Working Load Limit.
** Available in Bronze Bushed only. 3" and 4½" have self lubricating Bronze Bushing.
† Fitted with 1¼" I D Swivel Eye.
†† May be furnished in other wire rope sizes.

g. Anchors, wire rope, shackles and gear

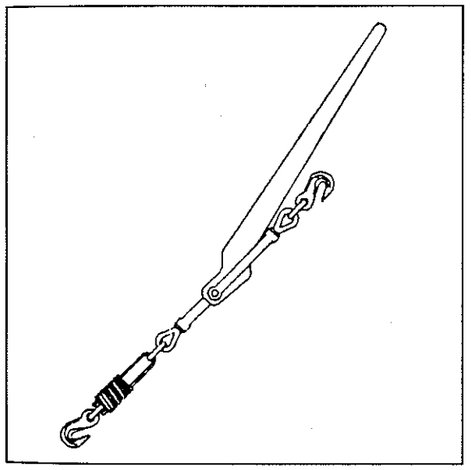
LOAD BINDERS



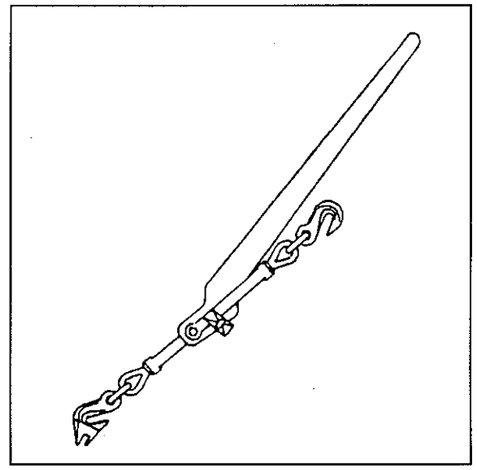
◀ Ratchet Type



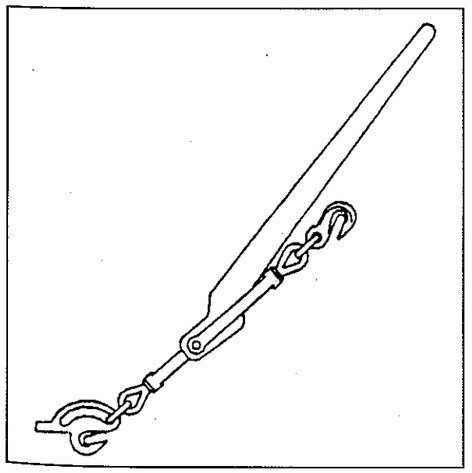
Lever ▶ Type



◀ Lever Snubbing Type



Lever ▶ Walking Type



◀ Lever Releasing Type

Mechanical Advantage

Lever type binder = 25 : 1
Ratchet Type Binder = 50 : 1

Example: 100 pounds of effort applied to the binder results in the following force on the binder.

Lever type:
2500 (100 lbs. x 25) lbs. of force

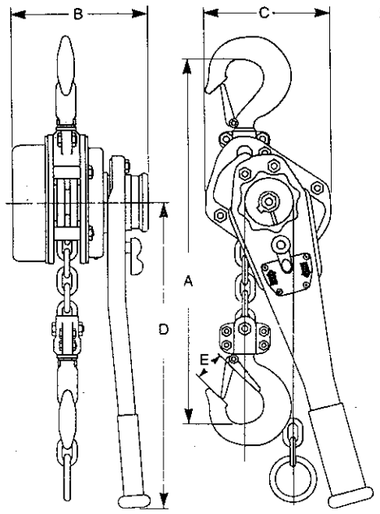
Ratchet type:
5000 (100 lbs. x 50) lbs. of force

EQUIPMENT LAYOUT AND FUNCTION (cont'd)

g. Anchors, wire rope, shackles and gear

Chain hoists — Ingersoll Rand type

Lever chain hoist



Specifications

Model No.	Capacity tonnes	Standard Lift m	Standard Lift ft	Pull to Lift Rated Load kg	No. of Falls	Net Weight kg
R3-150-5	¾	1.5	5	16	1	6.9
R3-300-5	1½	1.5	5	18	1	9.7
R3E-600-5	3	1.5	5	33	1	15.4
R3E-1200-5	6	1.5	5	35	2	28.0

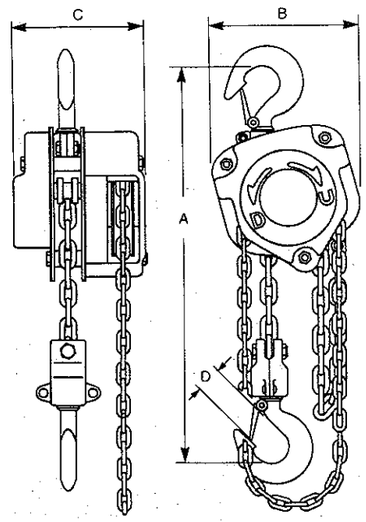
Note: Roustabout is also stocked in 3.0m, 4.5m and 6.0m (10, 15 and 20ft) lifts.
Replace the suffix '5' in the standard lift model number with 10, 15 or 20 to obtain the appropriate longer lift.

Dimensions

Model No.	A (Min.) mm	B mm	C mm	D mm	E mm
R3-150	311	143	127	260	27
R3-300	352	159	146	368	34
R3E-600	425	187	183	368	34
R3E-1200	565	187	244	368	47

Note: Dimensions are approximate and subject to change, please contact distributor for certified prints.

Manual chain hoist



Specifications

Model No.	Capacity tonnes	Standard Lift m	Standard Lift ft	Pull to Lift Load kg	Chain Overhauled to Lift Load One Metre m	Net Weight kg	Shipping Weight kg	Chain Size mm	Chain Falls
MCH5-005	½	3	10	25	25	8.6	9.0	5.0	1
MCH5-010	1	3	10	33	39	11.5	12.0	6.3	1
MCH5-015	1½	3	10	34	58	13.8	14.5	7.1	1
MCH5-020	2	3	10	34	75	21.6	22.5	8.0	1
MCH5-030	3	3	10	35	116	22.0	23.5	7.1	2
MCH5-050	5	3	10	39	187	41.0	42.5	9.0	2

Dimensions

Model No.	A (Min.) mm	B mm	C mm	D mm
MCH5-005	305	144	127	27
MCH5-010	345	157	147	30
MCH5-015	370	174	147	34
MCH5-020	425	204	179	37
MCH5-030	505	206	147	43
MCH5-050	635	263	179	47

Note: Dimensions are approximate and subject to change, please contact distributor for certified prints.

Note: MCH5 is stocked in 3.0m and 6.0m (10ft and 20ft) lifts. Specify suffix –10 –8 (10ft lift; 8ft hand chain drop) or –20 –18 (20ft lift; 18ft hand chain drop) to obtain full model number for ordering.

PART 3. RIGGING FOR ANCHOR HANDLING

Introduction

The rigging for various types of anchor handling operations are shown in the following diagrams.

Rigging will have geographical area differences reflecting local practice and dependent upon the actual boat's equipment, there will be variations.

For example if only one work drum is available and one pennant reel, then it will not be sensible or possible to spool up all the pennants for 3 or 4 anchors when running a buoyed system. The coils will have to remain on the deck and spool up will take place between running one anchor and another.

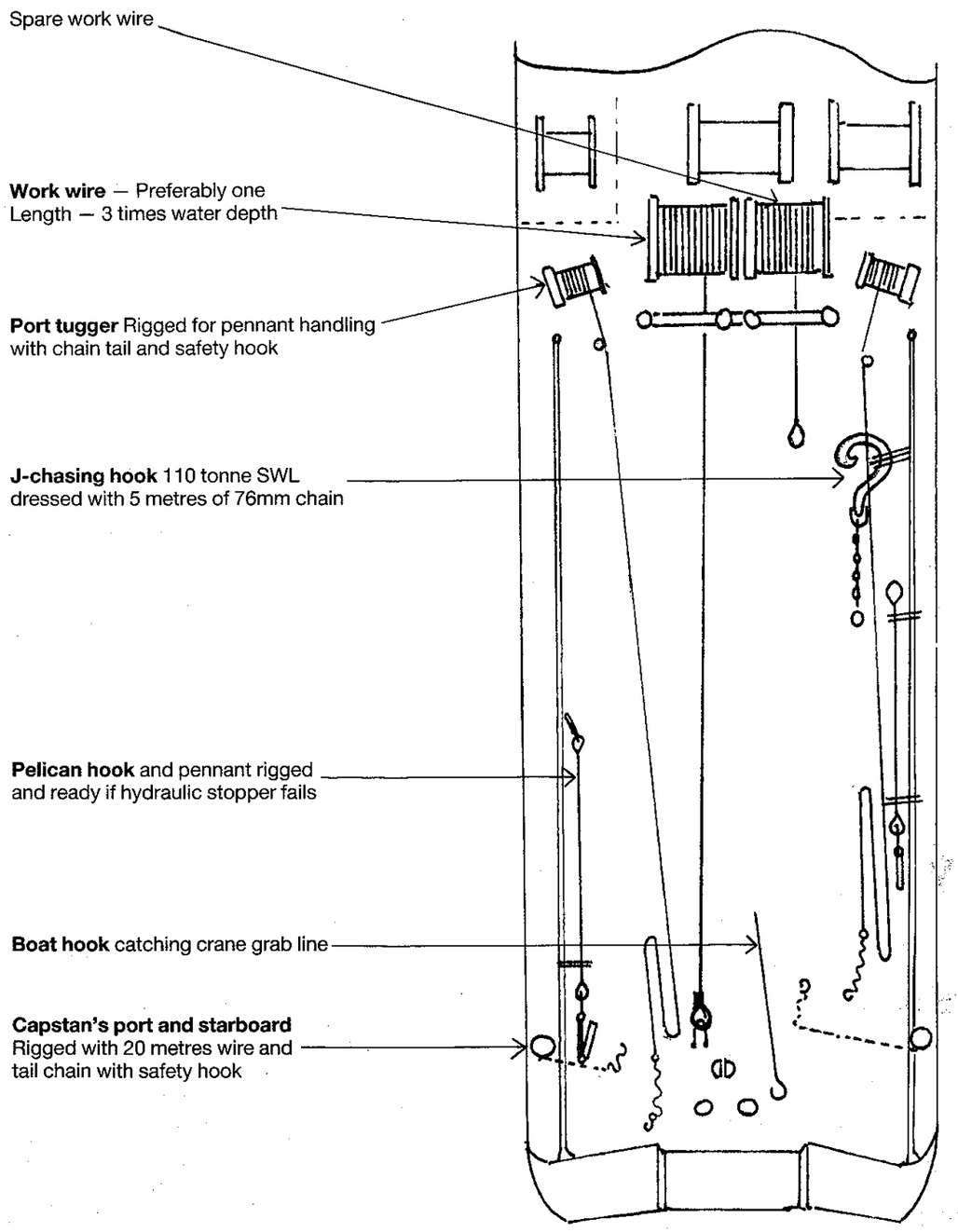
Some boats rig the work drum, during lay barge work, with a short heavy work wire followed by the light suitcase wire and anchor hook.

When working permanent chain chaser systems it is possible that instead of a one piece work wire of 2 or 3 times the water depth being supplied it will consist of two sections.

A modern high performance AHTS showing moderately high free running speed.

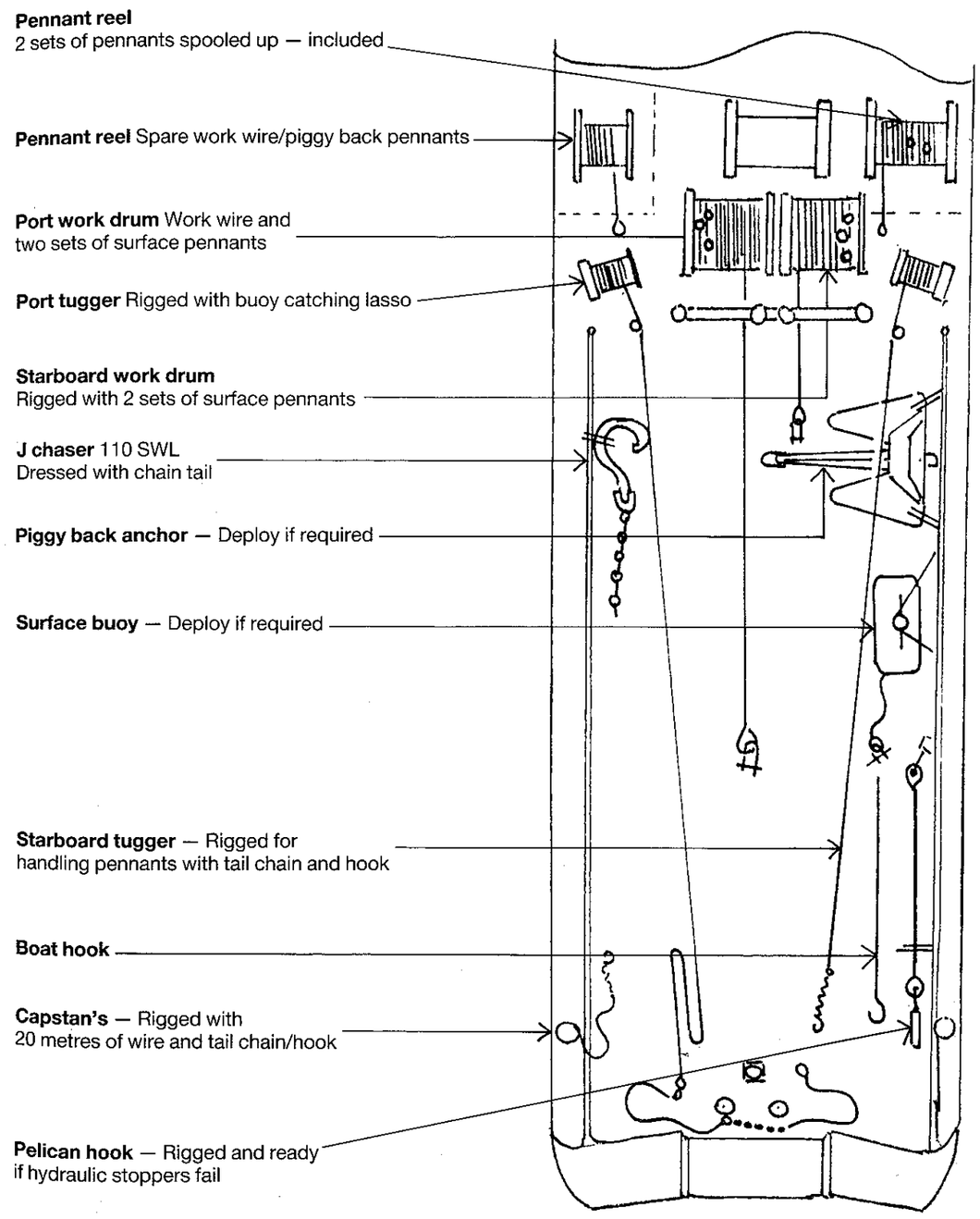
RIGGING FOR ANCHOR HANDLING (cont'd)

a. Deck rigged for anchor handling — permanent chain chaser (PCC) system

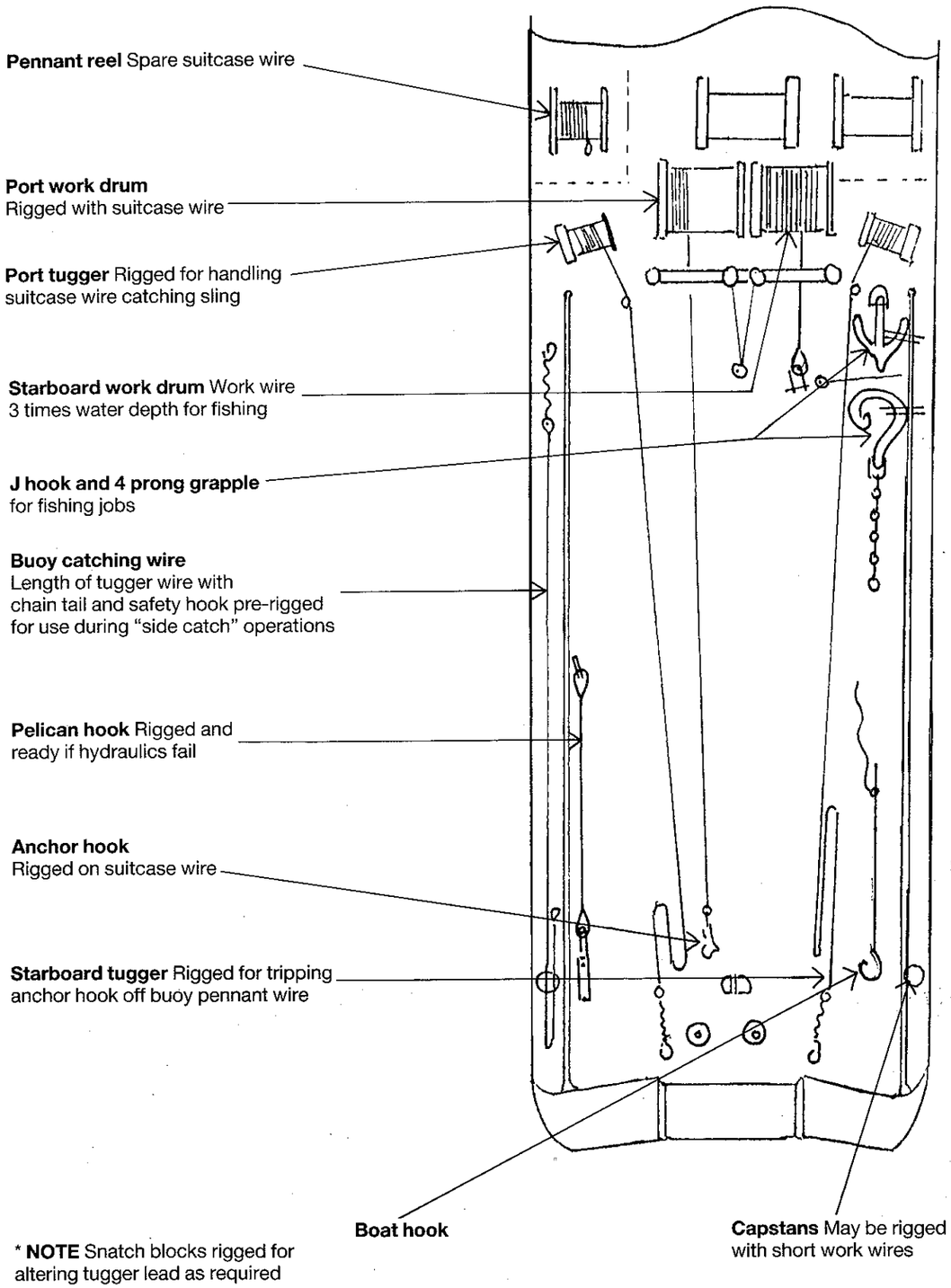


RIGGING FOR ANCHOR HANDLING (cont'd)

b. Deck rigged for anchor handling — buoyed system



c. Deck rigged for lay barge anchor handling — suitcase buoys



* **NOTE** Snatch blocks rigged for altering tugger lead as required

d. Equipment preparations for anchor handling
Prior to the start of operations the following items should be attended to.

1. **Work winch**
   Function tested, greased, brakes adjusted and work wire spooled up correctly.

2. **Towing drum**
   Function tested, greased and brakes adjusted.

3. **Guide pins, hydraulic stoppers**
   Function tested and checked for local and remote operation. Hydraulic power unit checked.

4. **Deck tugger winches/capstans**
   Function tested, brakes adjusted, wires properly spooled up and end fittings (chain tails, safety hooks) checked.

5. **Portable tools**
   Checked, cleaned and bucket prepared.

6. **Deck lighting**
   Tested, checked and defects made good.

7. **Communications**
   Deck to bridge communications tested and loud hailer systems tested.

8. **Gas cutting gear**
   Checked and ready.

9. **Rigging gear**
   Shackles, hinge links, chain stoppers, anchor hooks, snatch blocks, chain lashings, chain binders, placed on ready use racks, greased, checked soft line lashing rope, wire slings, chain strops ready for use.

   A check should also be made that the contents of the deck gear locker are stowed and placed to hand. For example split pins, leadshot, punches, hacksaws, spanners, wire cutters etc. are all in their correct places. Bull dog grips, socket wrench set and all the other gear normally found in the deck store should be checked in place.

10. **Pennant reels**
    (If fitted) and clear of gear should be tested and prepared with light leaders wire if it is anticipated that they will be required.

Note: The check list in Part 12 can be used to ensure that the boat is fully prepared.

e. Inventory of anchor handling equipment

The following list shows the gear that a well found anchor handler would be expected to have aboard at all times. The boat is a 10 to 12000 BHP vessel.

1. **Work wires** 2 x 60 metres — 70mm diam
   1 x 30 metres — 70mm diam
   1 x 30 metres — 45mm diam suitcase

2. **Shackles** Bow safety type 3 x 110 tonne
   6 x 85 tonne
   6 x 55 tonne
   4 x 25 tonne
   6 x 12 tonne
   6 x 8 tonne
   6 x 6 tonne

3. **Pennants — pelican hook**
   3 x 8 metres with hard eyes usually 70/72mm diam.

4. **Pelican hooks**
   2 suitable for wires up to 70mm diam.

5. **Devils claw chain handling hook**
   SWL 110 tonne.

6. **Anchor hooks — Lowery trip type**
   SWL 30 tonne — 3.

7. **Buoy catching lassos**
   2 complete.

8. **Hinge links Baldt type**
   3 — 110 tonne SWL.

9. **J chaser**
   110 tonne SWL.

10. **Grapple heavy duty**
    4 prong type 100 tonne SWL.

11. **Grapple. Light duty fabricated type**
    For wire size 76mm.

12. **Carpenter stoppers**
    2 for 70mm diam wire.

Note: These are extremely safe and useful items of equipment although they are not often found aboard todays anchor handling vessels.

13. **Pelican hook**
    1 suitable for 76mm chain.

e. Inventory of anchor handling equipment

14. **Tugger wires (spares)**
    4 suitably sized to tuggers max roll with 5 to 1 safety factors.

15. **Snatch blocks**
    4 — SWL 8-10 tonnes.

16. **Bull dog grips**
    6 each sizes 64mm (wire diam)
    68mm
    70mm
    72mm
    76mm

17. **Wire cutters**
    Manual hydraulic type able to cut at least 35mm wire.

18. **Rigging spares**
    Grade 8 — high strength chain — 15mm
    Hinge links grade 8 for chain
    Safety hooks — Ramnes types SWL 8 tonne
    Wire rope (coils of) 22mm, 24mm, 30mm and 35mm sizes
    Polypropylene rope — coils 15mm, 25mm 30mm and 35mm diam sizes
    Chain blocks — 2 sets — 5 tonne SWL

19. **Tool kit deck**

Sledge hammers — 2 x 7lb	Hand spikes — wooden — 3
Mauls — 2 x 4lb	Bull dog grip. Item 16
Spare handles for sledge and maul	Spanners — 2 each to fit each size of grip
Ball pean hammers — 2	Files — metal, heavy duty, coarse, flat and round — 3 each
Axes — long handled — 2	Wood saw — 36" bow type
Crow bars — heavy duty — 6	ith spare blades
Cold chisels — heavy duty — 6	Air driven/electric disc grinder
Joining shackle pin punches — 4	5" diam disc with discs for both cutting and grinding
Pliers — heavy duty — 2	Water proof torches — 4
Pipe wrenches — 2 each — 12", 24", and 36"	Mole grips — 2
Marlin spikes — 2 each — 12" and 18"	Fids wooden 8", 12" and 16"
Hacksaws — heavy duty — 2	Sail makers kit
Adjustable spanners — 4 each 8" and 12"	
Ring spanner set	
Socket set	

20. **The deck store** should contain the following, as well as the tool kit.
    a. Hydraulic stopper inserts set for changing to suit various wire/chain sizes with any special spanners/tools.
    b. Nails — various sizes 2" to 6"
    c. Lead shot — for joining links
    d. Split pins — for each size safety shackles
    e. Handy billy
    f. Seizing wire, seizing twines, small stuff

e. Inventory of anchor handling equipment

20. Deck store contents (cont'd)

g. Small single sheave blocks
h. Small shackles
i. Chain stoppers
j. Rope stoppers
k. wire slings and strops — various sizes – SWL 3, 5, 8 tonnes about 3 metres long
l. Rope slings various
m. Webbing strops — SWL 3, 5, 8 tonnes
n. thimbles for tugger/capstan wires
o. Chain hooks — hand type
p. Wires/brushes/scrapers
q. Electric drill 15mm chuck with comprehensive set of drill bits
r. Portable floodlight, water proof — 2
s. Leads for drill or floodlights
t. Dies for dressing bold shackles Bolt threads sizes — 55, 85, 110 tonne
u. Grease gun — nipples various
v. Never sieze compound, grade 2 grease, WD40, plus gas liquid wrench

21. The Oxy/acetylene cutting gear. This should comprise

Bottles with regulators and flash back arresters
Hoses long enough to reach beyond stern roller
Cutting torch (pistol)
Cutting nozzles — set of, suitable for cutting steel up to 80mm thick
Rosebud heating nozzles — set of
Nozzle cleaning kit, nozzle dressing kit
Burning goggles, welders apron, welders gloves, spare lenses for goggles
Hose splicing kit
Spare pistol
Cylinder keys
Sparkers with spare flints.

Anchor handling crews will make a habit, if well trained, of "collecting" useful equipment which should be rapidly painted in the owner's colours to form part of the ship's equipment — shackles, slings, connections, fittings etc.

From the barge the boat is working it would be normal to supply split pins, shackles, slings etc. including suitcase wires and anchor hooks.

Note 1. — Shackles
All shackles should be thoroughly greased and colour coded (also to identify your own gear). You should also have a thorough inventory of shackle, wire, chains etc. certificates of test. All shackles with split pins should have pins inserted but not opened. This ensures that when you need a shackle it is **complete.**

Note 2. Burning gear
Set up and tested — make sure that the spare cylinders are available. Burning gear consists of the cylinders, regulators, hoses, hand piece, cylinder key, burning goggles, spare nozzles, nozzle tip cleaning set, hose splicing kit. 1 complete spare pistol.

Note 3. Wire strops
Various sizes should be included but usually with safe working loads of from 3 to 8 tonnes about 4 metres in length with a soft eye. A couple of 10mm diameter strops about 1 metre in length with soft eyes will also be invaluable.

f. Spooling up pennant wires
This task is a regular feature of anchor work especially when buoyed systems are run, multiple length pennants are fitted between anchor and surface buoys or between piggy backs (multiple anchors). The following points should be noted.

1. Know the colour coding or marking system and identify the bundles of pennants. Sort them out by length. Typical lengths are 20, 30, 50 and 100 metres. 5 metre lengths are called pigtails.

2. Spool up the pennant 'string' onto the drum (work winch) in reverse order. If the pennant string is to be say — anchor, crown pennant, 30 metre, 30 metre, 20 metres pigtail, buoy, then the spool up order will be 20, 30, 30, the pigtail being attached to the surface buoy.

3. Insert pennant wire shackles, if 'D' or bow type with the pin outboard (facing towards the stern) this makes the turns on the wire less likely to jam in way of the shackles.

4. Stow the wire neatly on the drum, ideally with all the shackle connections at one side of the barrel. Try to apply some tension during spool up to get a good even stow, to avoid top layers pulling down and burying themselves when under tension.

5. Don't open up coils of pennant wire by making one end fast and kicking the bundle off the stern. It may work but often it will end up as what is called "a bunch of bastards", a tangle in other words, but the slang expression exactly describes what the end result can be.

   Put the coil over one of the guide pins, raise the pin through the centre, cut the bundle binding strap and pull the end out as shown in the sketches.

6. Carefully check the length and quantity of each length as you spool up so that you know how many and of what size have been spooled up.

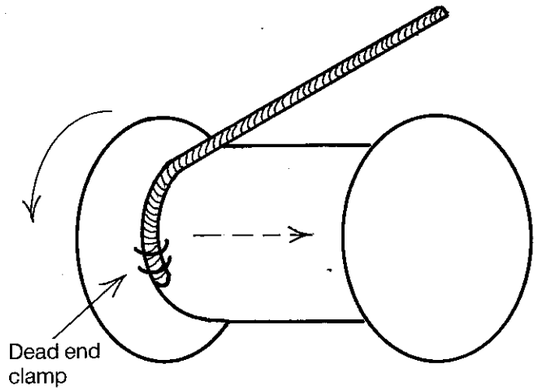
7. Don't overfill the anchor handling (work drum) with wire especially when running heavy anchors 12-15 tonnes or larger in moderate later depths. Spool up one string (one anchor set) on the work drums and the other sets on storage reels.

8. If using storage reels make up the anchor strings in sets remembering that as you are going to transfer them to the work drum later the spool up order on the storage reel is **opposite** that on the work drums (see item 2).

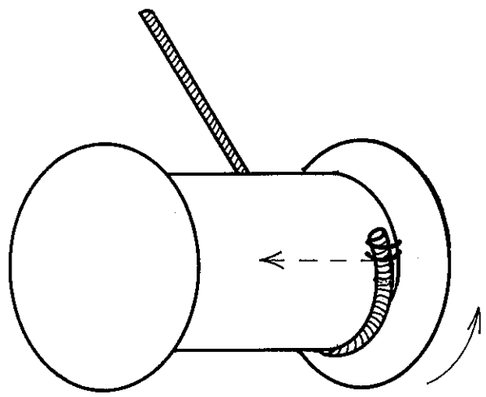
9. Check the condition of the pennants as you spool up rejecting any that are significantly damaged.

f. Spooling up pennant wires

RIGHT HAND LAY ROPE

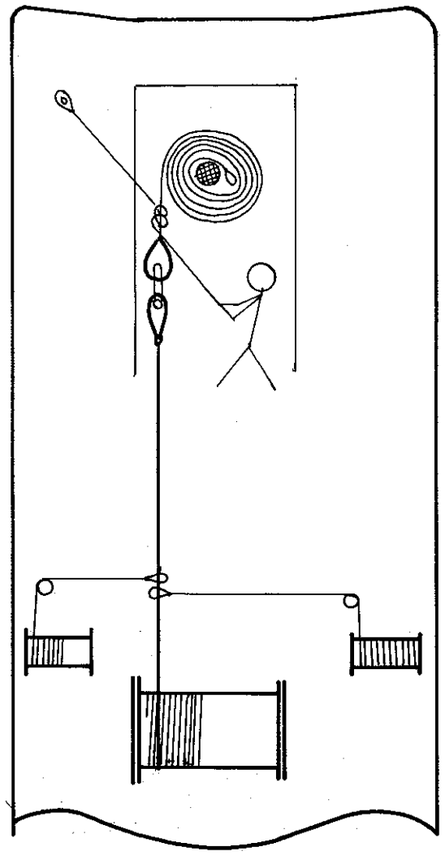


Overwind drum
Wind from left to right onto drum



Underwind drum
Wind from right to left onto drum

Before starting spool up check position of dead end clamp and then haul in direction of drum when operated from bridge control

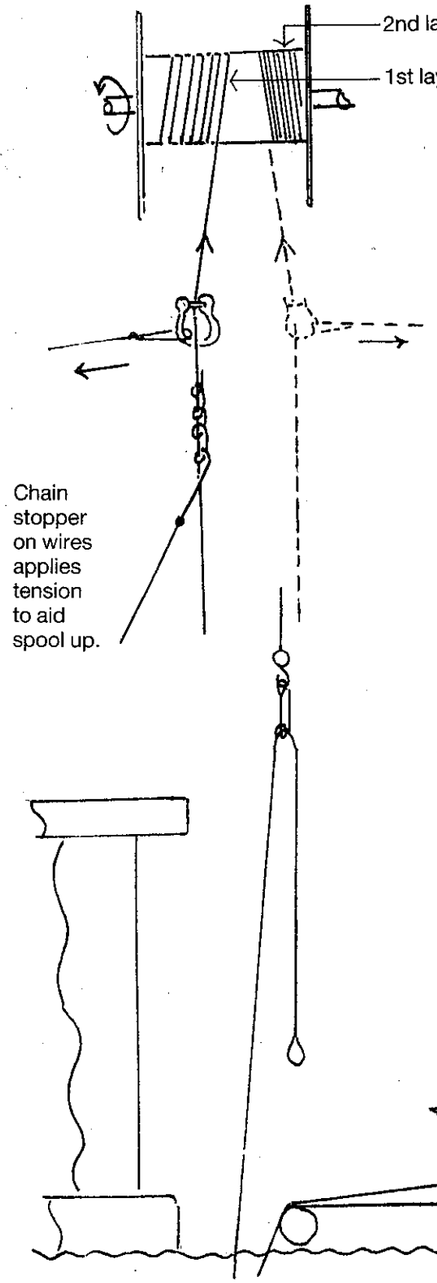


Spooling up pennants

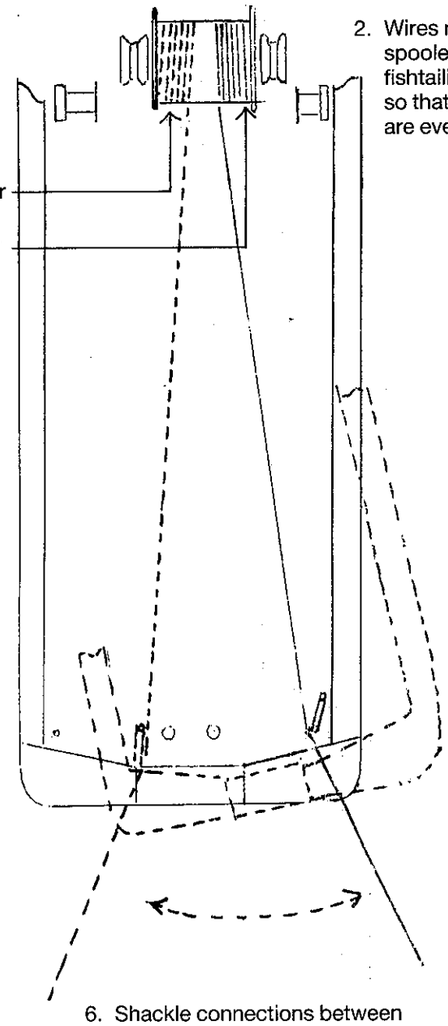
1. Place coil centre over guide pin. Raise guide pin.
2. Connect work wire to pennant eye.
3. Commence spooling up.
4. Use one or two tuggers to keep the layers of wire even on the winch drum and tightly packed.
5. Use sliding chain stopper on pennant to ensure a moderate tension when spooling up.

f. Spooling up pennant wires

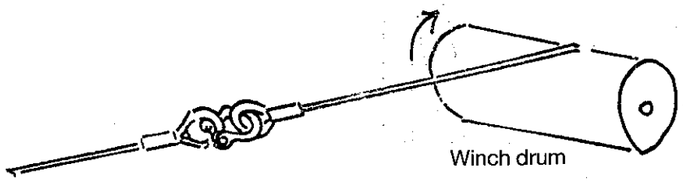
1. Use tuggers to haul wire hard up against succeeding turns to get a neat even stow.



2. Wires may also be spooled tightly by fishtailing the stern so that successive wraps are evenly stowed.



6. Shackle connections between pennants should always be inserted as shown. Pin facing outboard



5. Barge cranes can often help out due to their head height. The crane picks up bight of a 30 or 40 metre pennant and lowers it to the boat.

g. Work wires — length and amount in/out

Keeping track of how much wire has been deployed or run out is critical in judging the proper amount of work wire to deploy when running and retrieving anchors using permanent chain chasing gear.

Knowing the length of work wire also enables to boat captain to judge his position in relation to the permanent chaser at all times.

If the work wire is supplied in one piece. With drum end attached and knowing the distance from winch drum to roller and length of work wire fleet a bight aft to the guide pins so that you have one deck length from winch drum to pins. If the work wire is 600 feet long paint 5 stripes on the wire 100 feet aft of the winch drum. Spool up wire until first set of stripes is on the drum and then paint 4 stripes 100 feet aft of the drum. Repeat process as you spool up ending with 1 stripe 100 feet from the outboard end. Knowing the length of the pennant on the chaser and keeping a careful check of the stripes as you pull in or slack out gives a pretty good guide as to the position of the chaser in relation to the stern roller.

Anchor chasing diagram/fishing diagram

At what **radar range** will boat be at the anchor during **chase out.**

Given	Anchor chain out — fairlead to anchor	3800 feet
	Water depth	350 feet
	Pennant length to be used at roller	700 feet
	Distance radar scanner to stern roller	170 feet

Steps

1. Work out horizontal distance — stern roller to seabed

$$\sqrt[2]{700^2 - 350^2} = 606 \text{ feet}$$

2. Stern roller to radar scanner ..... + 170 feet

776 feet

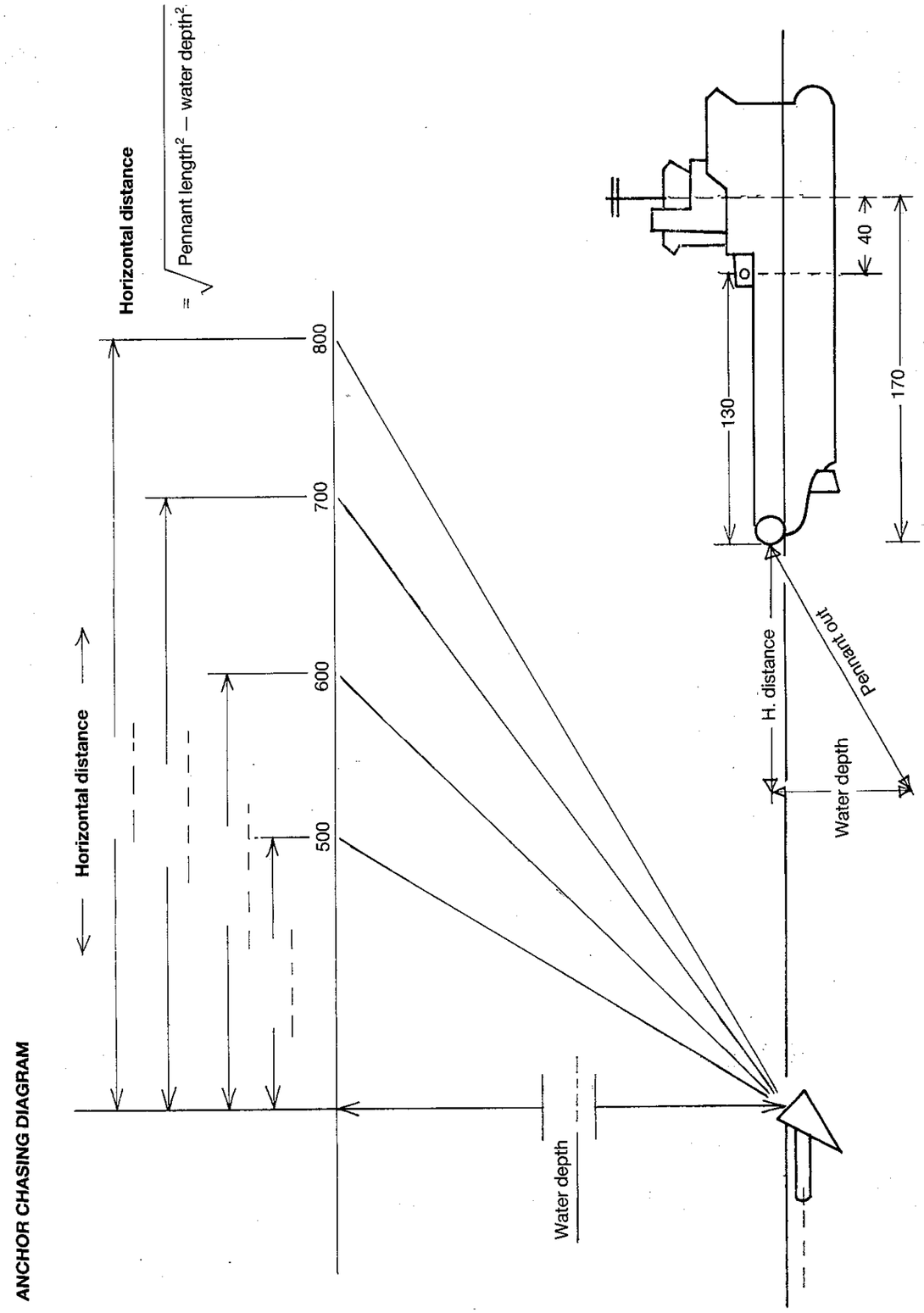
3. Anchor to fairlead ..... + 3800 feet

4. Radar distance ..... 4576 feet

5. Divided by 6080 ..... = 0.75 miles

6. **Set variable range marker on 0.75**

Note: Actual distance will be somewhat **less** due to rig mooring line catenary.
See catenary notes/calculations.
But using 10/15% less than calculated would be pretty close for practical work.



ANCHOR CHASING DIAGRAM

h. Pulling power of winches
The ability (power) of a winch is described in terms of tonnes pull on first layer (or wrap) and then at full drum, that is with maximum number of layers of wire properly stowed on the drum.

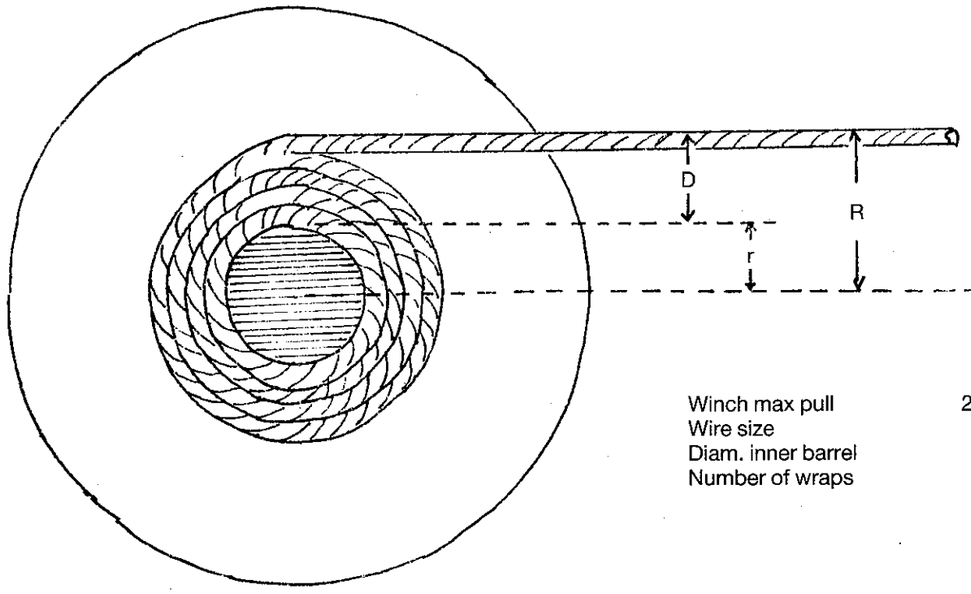
The more wire that is spooled up on the drum the lower is the winch's pulling power because the wraps create a lever arm which reduces the actual force applied on the rope.

Some winch makers provide useful charts showing the remaining pulling power with successive layers of various diameter wires. The ratio is linear and a chart or graph is easily constructed provided the following is known.

1. The diameter of the winch inner barrel.
2. The maximum pull of winch on the first layer.
3. The diameter of the wire being spooled up
4. The number of wraps (or turns) actually on the drum.

See example below.

PULLING POWER OF WINCHES



Winch max pull	250 tonne
Wire size	70mm
Diam. inner barrel	150cm
Number of wraps	5

$$\text{Remaining pull} = \frac{\text{max. pull} \times r}{R}$$

$$= \frac{250 \times 75}{110}$$

Pull **170 tonnes**

$R = D + r$

$R = 5 \times 70 + 75$ cm

$R = 110$

PART 4. RUNNING AND RETRIEVING ANCHORS

a. Permanent chain chaser (PCC) systems — operational notes
The use of this system of deploying and retrieving barge anchors imposes very much higher strains on pennants and work wires than for normal bouyed systems.

In general it can be said that the chasing pennants for anchors in the 15 to 20 tonne weight range should be fitted with 76mm diameter pennants and the boat's work wire should be of at least 70/72mm diameter.

When rigging up the work drums for PCC systems the use of several pennants to make up the working wire should be avoided. For example say the boat's own work wires are 65 metres long and anchor work is to take place in 600 feet (200 metres) water depth. A work wire would ideally be made up of 3 x 500 feet pennants. In North Europe pennants generally come in standard lengths of 100, 200 and 500 feet using 3 x 500 feet lengths plus the boats work wire and the chaser pennant, usually 150 feet allows the boat at all times to place maximum forces on the wire without a connection being at the roller. Similarly as there are only four connections in the system careful spool up will allow the work wire to the first 500 feet connection and that between the two 500 feet lengths to lie at one side of the work drum clear of the bulk of the wire and thus avoiding jamming of connections and damage to wires when pulling hard at break out.

b. Running out to anchor
Prior to running the chaser out to the anchor a careful boat captain will carry out the following:

1. Work out the radar distance from barge to anchor plus the amount of work wire deployed.

2. When lining up the boat to commence running observe the gyro repeater/bearing and compare it with the bearing given to him by the barge. It always makes it easier if the line of the barge mooring can be observed.

3. Take careful note of current set and wind strength direction which might set the boat off the line of the chain.

4. Always know how much wire he has deployed.

5. Pre-calculate the amount of wire to have out for that water depth to achieve the correct w/wire length of 1½ to twice water depth.

6. Find out from the barge what type of anchors are in use.

7. Find out from the barge the bottom type and if the anchors have achieved full test tension. Also how long the anchors have been in the ground.

b. Operational notes — permanent chasers

Permanent chasers come in a variety of shapes and sizes. They are not always correctly matched to the anchors. The result is that the chaser collar may not go fully up the anchor shank and this makes break out difficult.

On the other hand the collar may jam on the shank wedging itself hard between shank and flukes, the result is that the anchor may be pulled out of the ground during the "strip off" manoeuvre. LWT and Danforth anchors are frequent culprits.

Chasing collars are still found where the pennant is shackled directly to the collar without a short length of chain. For the boat captain the lack of the chain presents two very distinct dangers.

If he has to deck the anchor, very high bending loads are imposed on the chaser pennant mechanical splice next to the chaser connection just as the anchor is coming over the roller. Frequent pennant breakages occur as a result. The only way to cope with this problem is to get the anchor orientation correct for boarding (see sketch) to ensure that as little chain weight as possible exists and bring the anchor aboard in one smooth slow pull without stops or jerking on the winch.

Secondly the options for double securing the anchor prior to running out are also reduced without the chaser tail chain. That has to be boarded.

Anchor and anchor buoy rigging

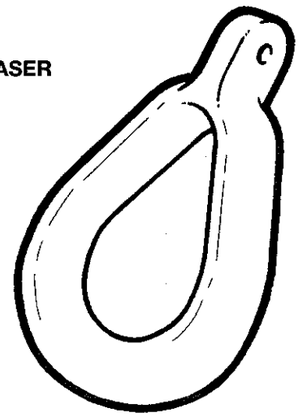
Stevin Mk 3 high holding power anchor
14 tonne weight. A very efficient general purpose anchor. If properly deployed should hold up to at least 10-12 times its own weight in sands and muds.

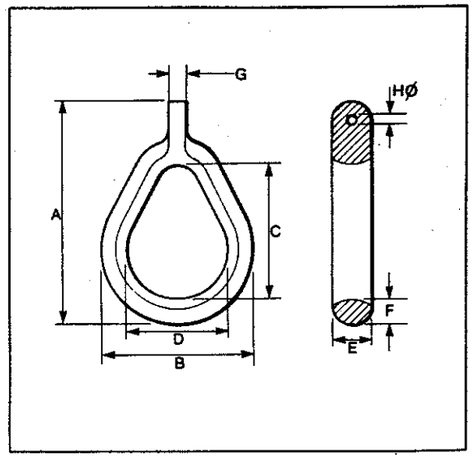
b. Anchor and anchor buoy rigging

Anchor buoy rigging
This buoy, soft type, is fitted with chain tail and nylon strop (pigtail). This unusual arrangement is used on construction barges and other specialised craft.

b. Chain chasers

PERMANENT CHAIN CHASER



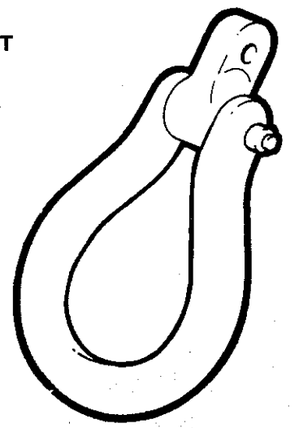


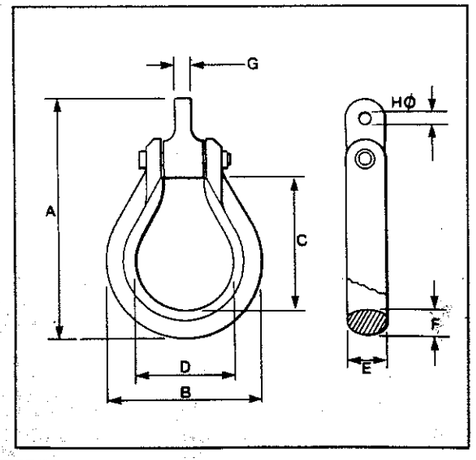
Type	S.W.L. Tonnes	Proof Test Tonnes	Weight kg	Weight lb		A	B	C	D	E	F	G	H
BEL 102	100	250	1088	2400	in	65.25	45.00	39.00	30.00	12.00	7.50	4.88	3.38
					mm	1657	1143	991	762	305	191	124	86
BEL 106	130	250	1451	3200	in	67.00	46.00	39.00	30.00	15.00	8.00	5.13	3.88
					mm	1702	1168	991	762	381	203	130	99
BEL 110	130	250	1433	3160	in	73.50	49.00	44.50	33.00	13.00	8.00	5.13	3.88
					mm	1867	1245	1130	838	330	203	130	99

Material: BS 2789 GRADE 420/12

Lifting eye dimensions shown are standard for each type. Specials can be made to suit customer's requirements.

DETACHABLE PERMANENT CHAIN CHASER



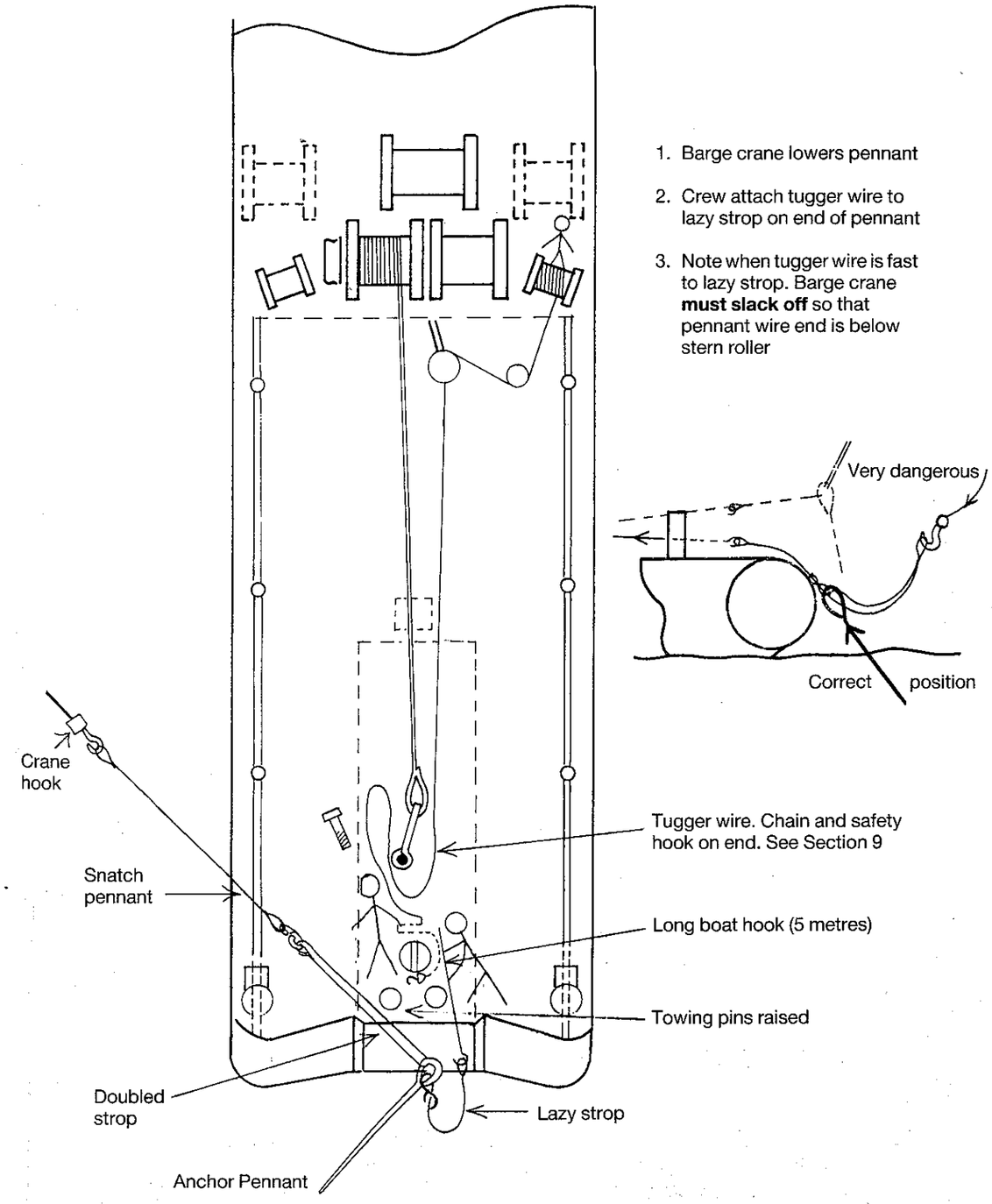


Type	S.W.L. Tonnes	Proof Test Tonnes	Weight kg	Weight lb		A	B	C	D	E	F	G	H
BEL 107	100	250	1238	2730	in	74.25	45.00	42.50	30.00	12.00	7.50	4.88	3.38
					mm	1886	1143	1080	762	305	191	124	86
BEL 108	130	250	1656	3650	in	76.00	46.00	42.00	30.00	15.00	8.00	5.13	3.88
					mm	1931	1168	1067	762	381	203	130	99
BEL 111	130	250	1742	3840	in	78.50	49.00	44.50	33.00	13.00	8.00	5.13	3.88
					mm	1994	1245	1130	838	330	203	130	99

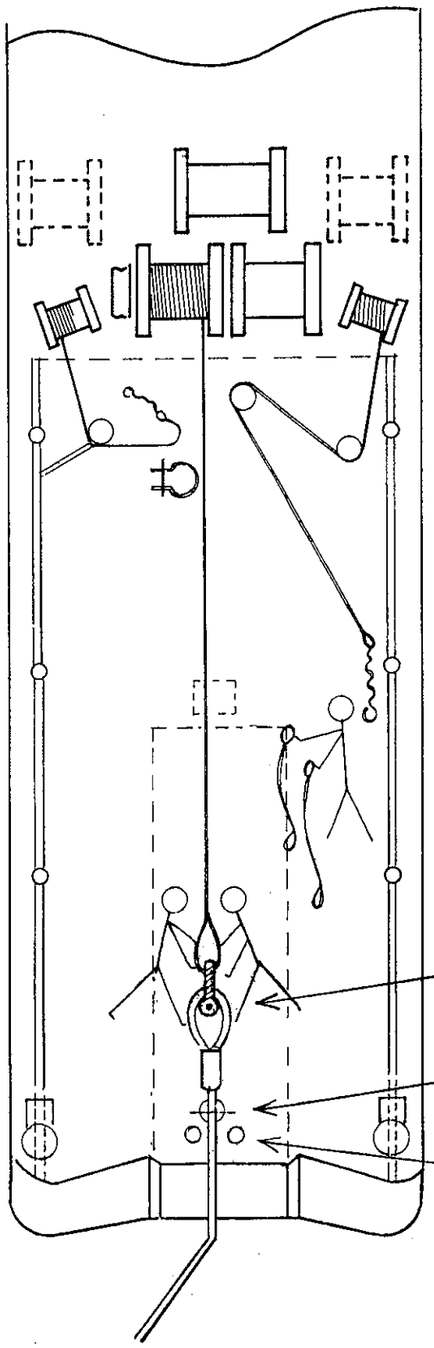
Materials: Body and eye piece — BS 2789 GRADE 420/12 ASTM A 536 GRADE 65/45/12
Hinge Bolt — NI-CR-MO Steel
Nut — Stainless Steel

Lifting eye dimensions shown are standard for each type. Specials can be made to suit customer's requirements.

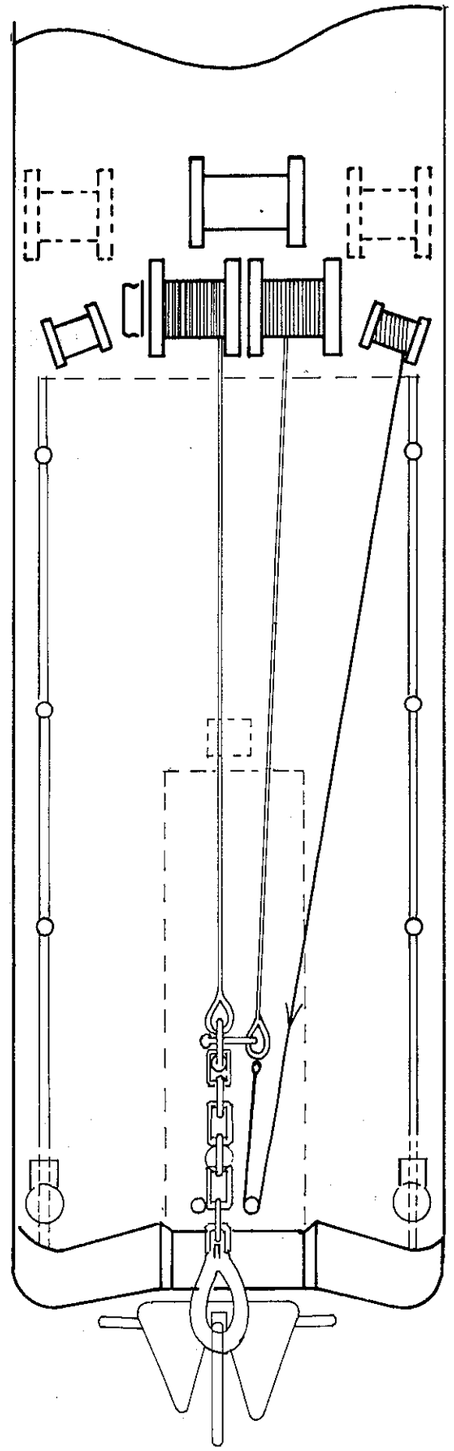
Diag 1. DECK READY TO RECEIVE PENNANT FROM BARGE



Diag 2. PREPARE TO HEAVE UP PENNANT



Diag 3. ANCHOR HOVE UP TO ROLLER AND DOUBLE SECURED



Once the anchor has been hove up hard against the roller there are a number of options for securing it.

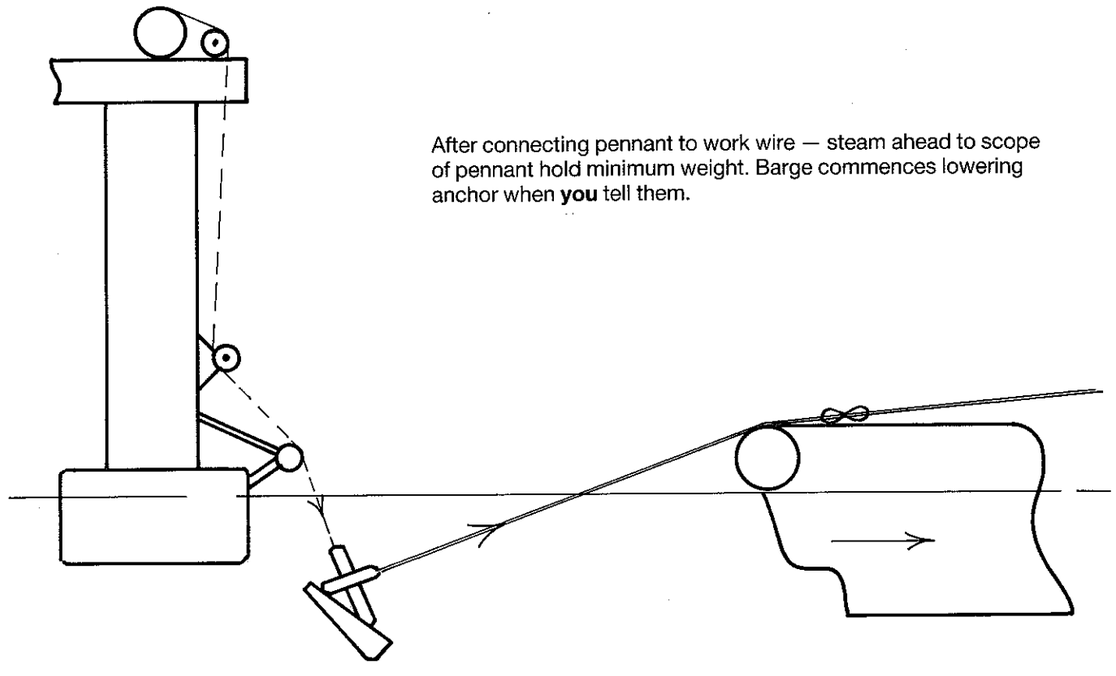
Method 1
Hold it on the pennant wire with brake and clutch of anchor handling winch applied

Method 2
If the chaser ring has a tail chain long enough raise shark jaw and take some weight on the jaw

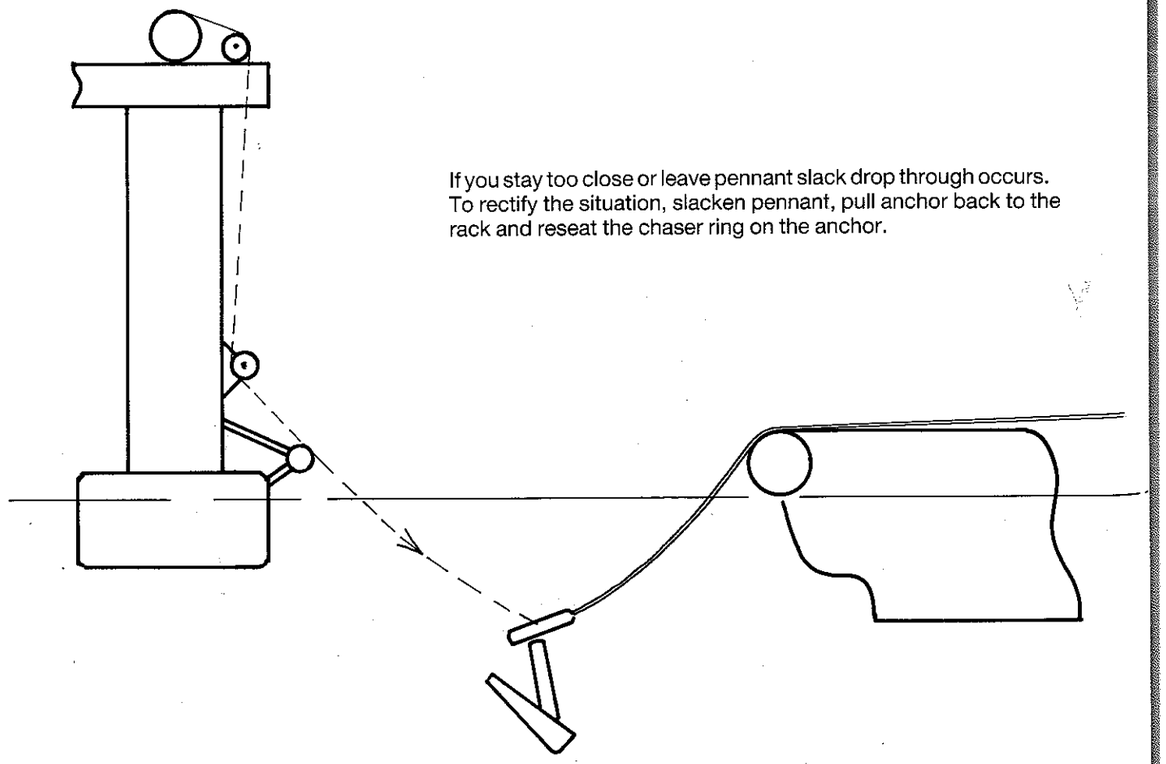
Method 3 — as shown
If tail chain fitted run out tow wire or second work wire and shackle it in behind the pennant.

Note: run the anchor to location with towing pins raised.

Diag 4. PREPARING TO RUN ANCHORS — PERMANENT CHAIN CHASING (PCC) SYSTEM

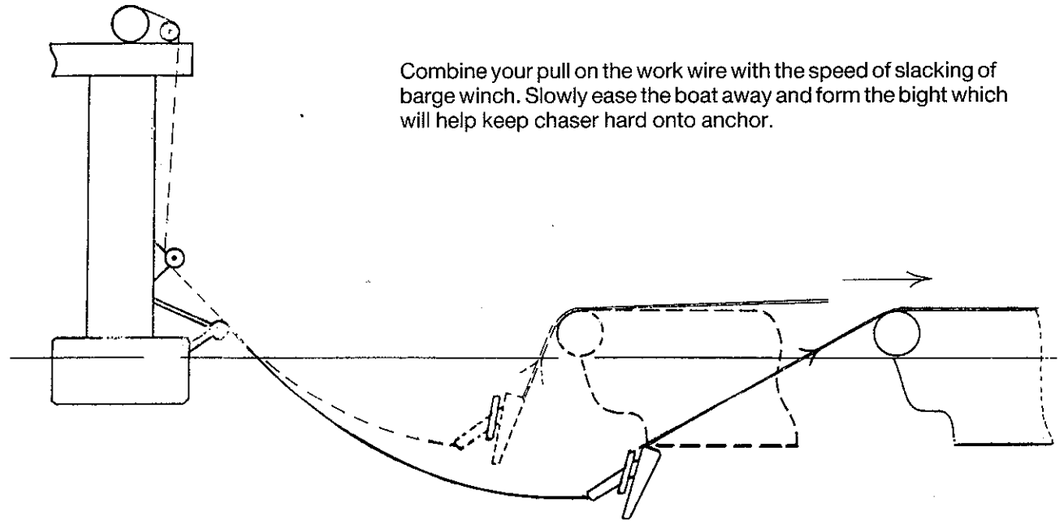


After connecting pennant to work wire — steam ahead to scope of pennant hold minimum weight. Barge commences lowering anchor when **you** tell them.

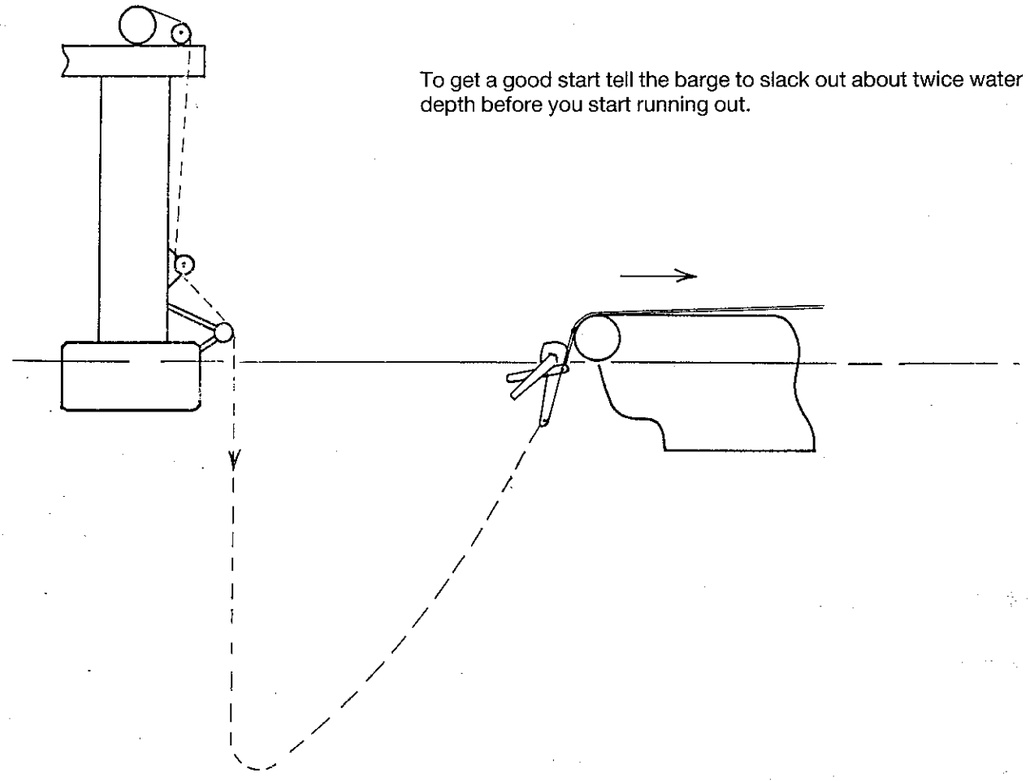


If you stay too close or leave pennant slack drop through occurs. To rectify the situation, slacken pennant, pull anchor back to the rack and reseat the chaser ring on the anchor.

Diag 5. PREPARING TO RUN ANCHORS — PERMANENT CHAIN CHASING (PCC) SYSTEM



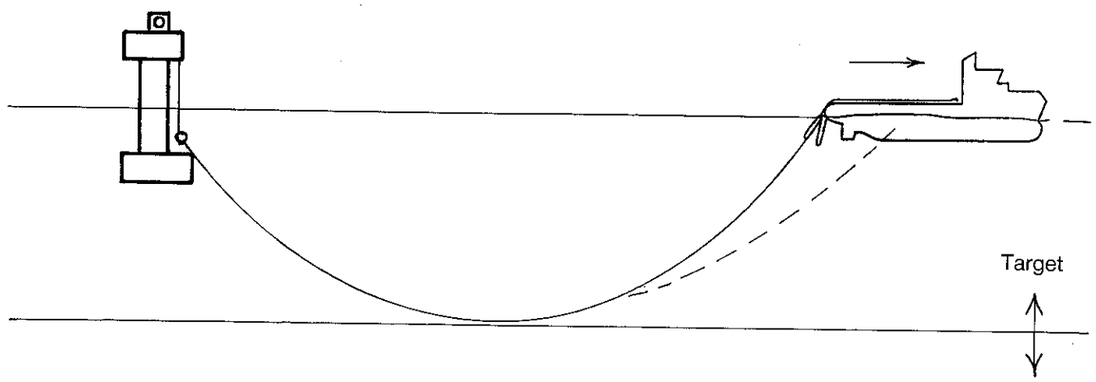
Combine your pull on the work wire with the speed of slacking of barge winch. Slowly ease the boat away and form the bight which will help keep chaser hard onto anchor.



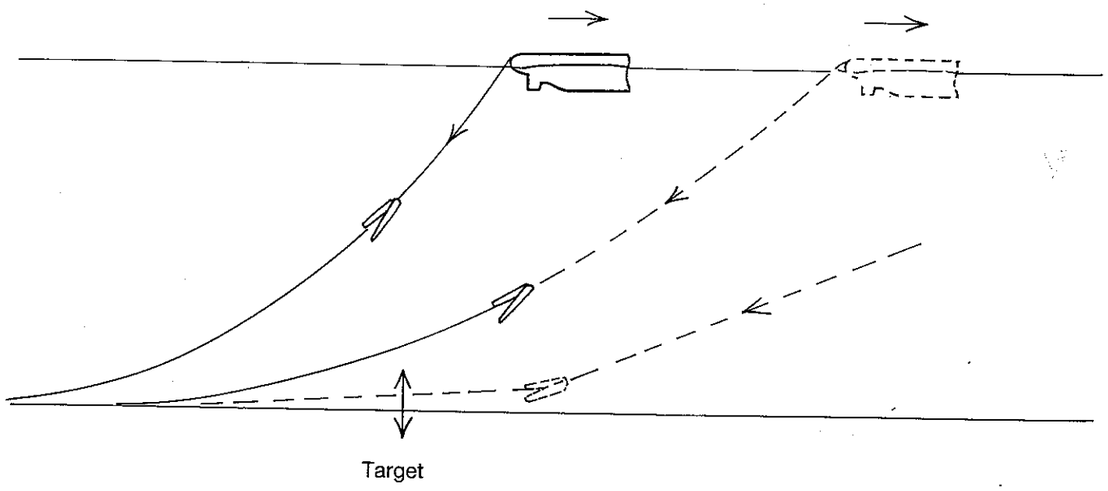
To get a good start tell the barge to slack out about twice water depth before you start running out.

Diag 6. RUNNING TO LOCATION — PERMANENT CHAIN CHASING (PCC) SYSTEM (cont'd)

When you have reached the target position ease down power as barge brakes the chain and commence slacking after **stretching** chain.



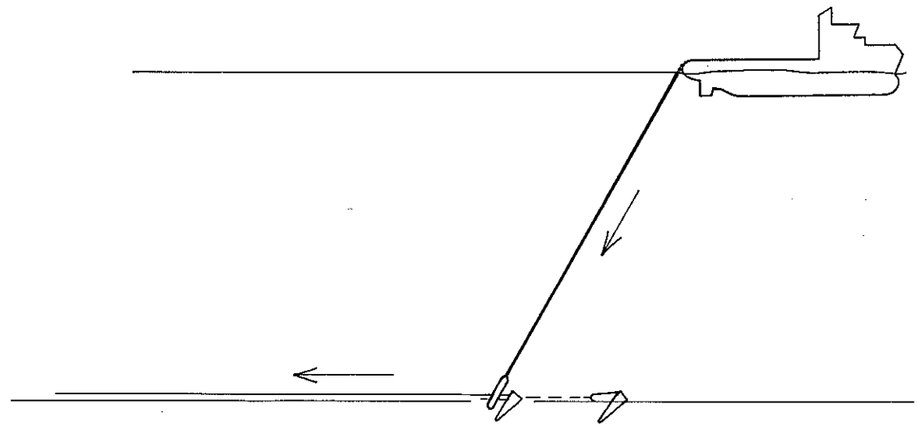
Keep steaming slowly ahead and land the anchor on the seabed **under tension** with between 1½ and 2 times water depth of work wire deployed.



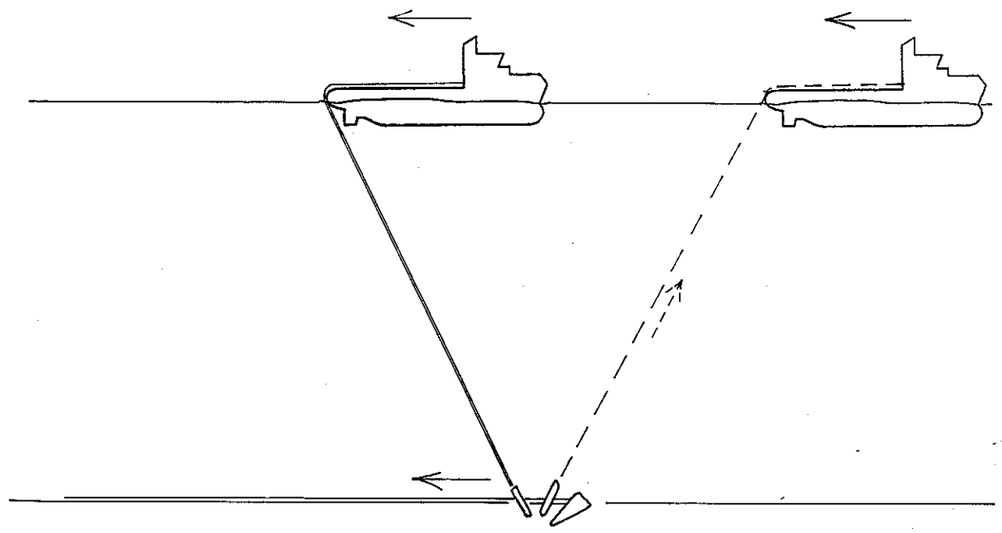
Diag 7. STRIPPING OFF CHASER MANOEUVRE METHOD I — PCC SYSTEM

After anchor is landed ease off power and ask barge to tension up to about ⅓ test tension.

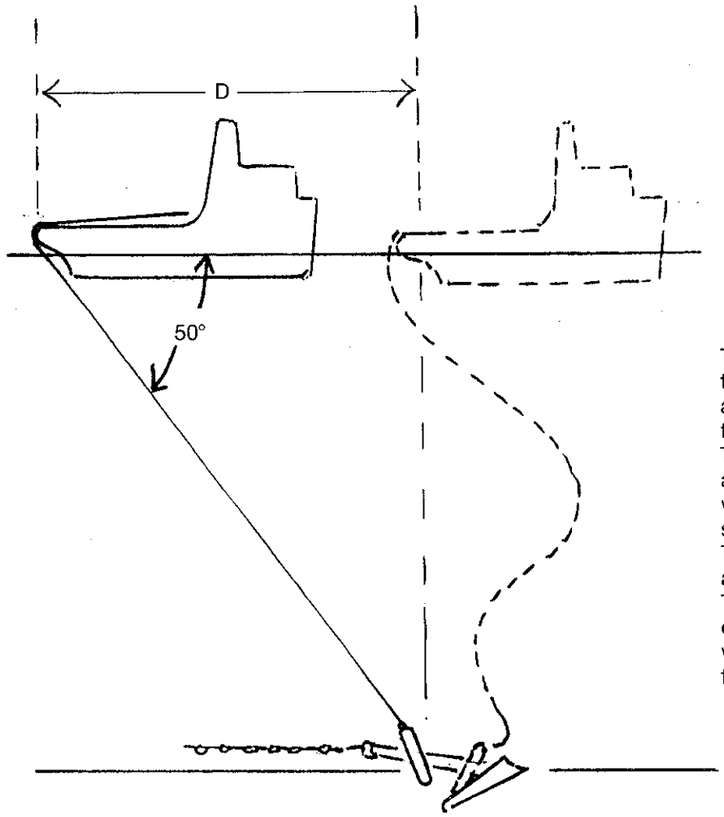
Note: Unless the chain is moderately tensioned you will pick up bights



Heave in work wire to about 1½ times water depth.
Come astern on both engines slowly and keep boat on the same heading as the chain. Don't let boat slide off to port or starboard.

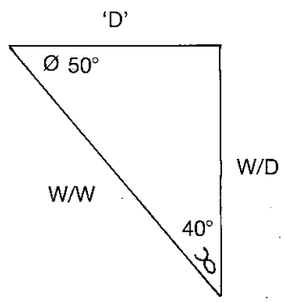


Diag 8. STRIPPING OFF CHASER MANOEUVRE METHOD I (cont'd) — WALSH



To strip off the chaser you need to come astern a distance approximately equivalent to 'D' for most boats.
This works out to an acceptable angle of about 55° before the wire will foul anything under the stern.
To work out how much to come astern proceed as follows.
The known factors will be water depth and max angle of work wire under boat allowed before fouling (see example).

Example



Adjacent D = $\frac{\text{Water depth}}{\text{Tangent } Ø}$

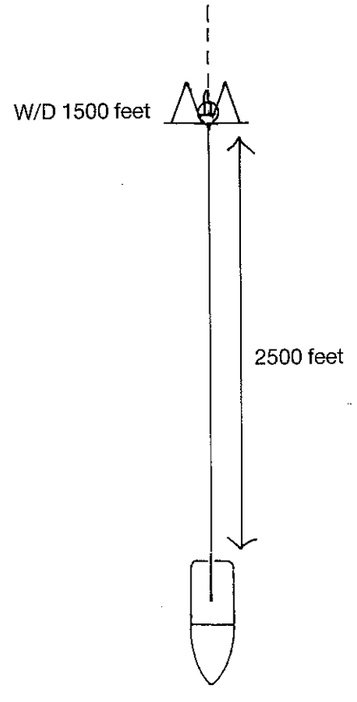
Water depth **600 feet**

Angle for this boat **50°**
Therefore amount of **wire out** when you strip off will be

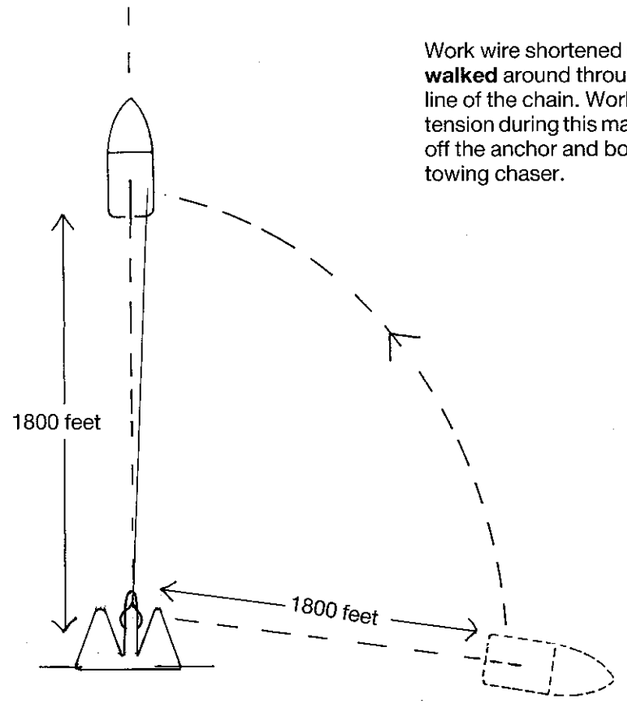
W/Wire (work wire) = $\frac{\text{Water depth}}{\textbf{Cosine} \propto 40°}$ = **783 feet**

D = distance $\frac{\text{Water depth}}{\text{Tan ø } 50°}$ = **503 feet**

Diag 9. STRIPPING OFF MANOEUVRE METHOD II — JORGA

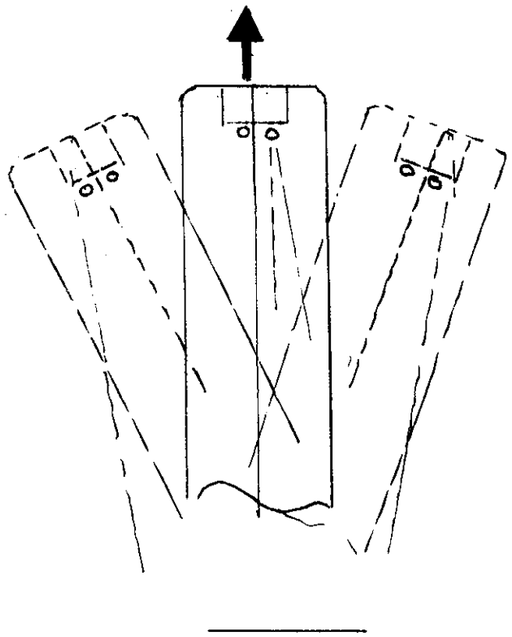


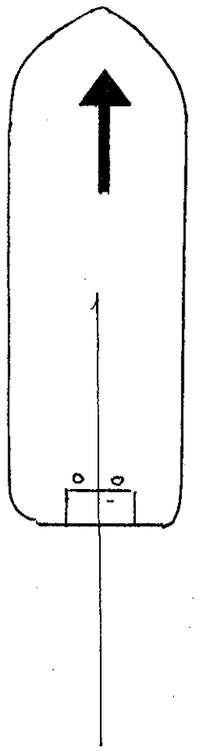
Anchor put on bottom after running 5000 feet chain in 1500 feet water. Anchor put on bottom with 2500 feet work wire out.



Work wire shortened up to 1800 feet and boat **walked** around through 180° and exactly back over line of the chain. Work wire kept under very low tension during this manoeuvre. Chaser is now pulled off the anchor and boat moves towards barge towing chaser.

Diag 10. RUNNING BACK TO BARGE





The chaser can be **felt** when its clear of anchor by the following

a. Very low work wire tension — steady

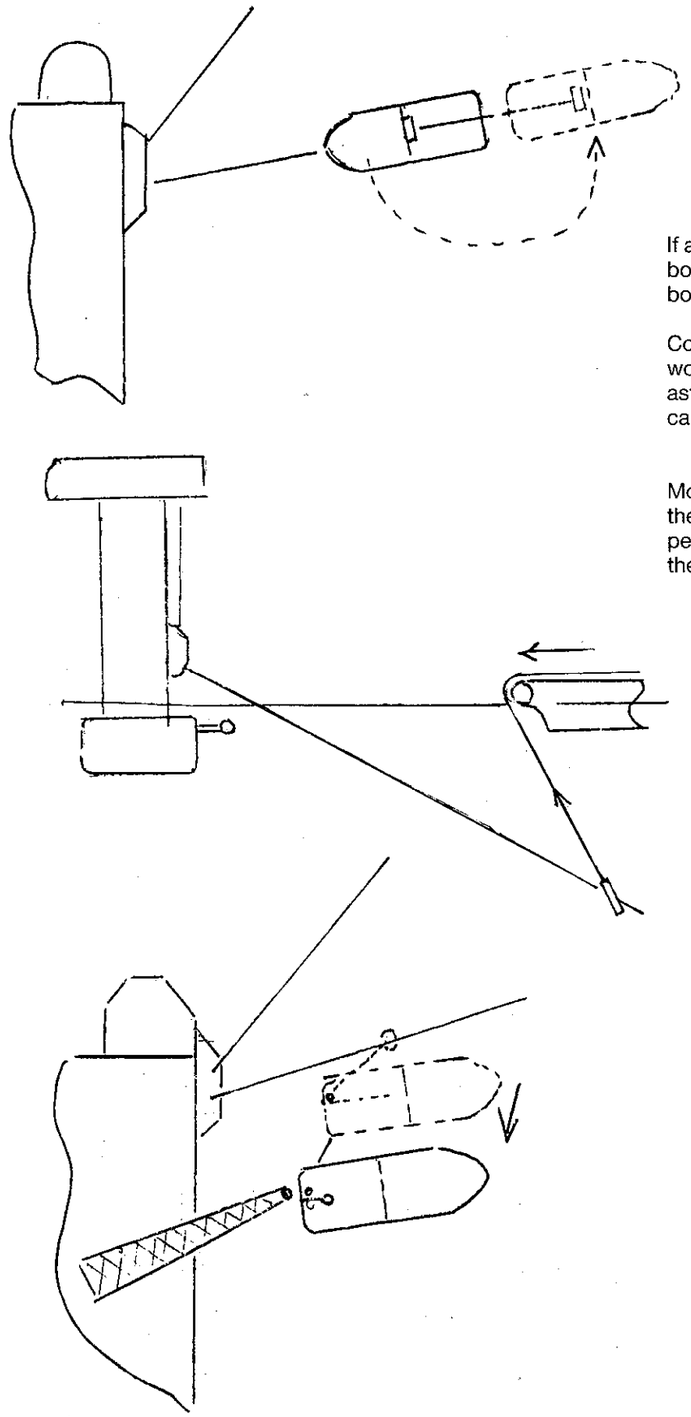
b. Barge reports steady tension on anchor line — no reduction

c. When chaser is on the chain and moving freely the work wire will 'jump' in a rythmic motion as the chaser is towed along. The winch operator on the barge may **'feel'** the chaser moving on the chain.

Towing back can be done stern first as in A or bow first as in B.

In each case use about 1½ times water depth work wire.

Diag 11. PASSING PENNANT BACK TO THE BARGE

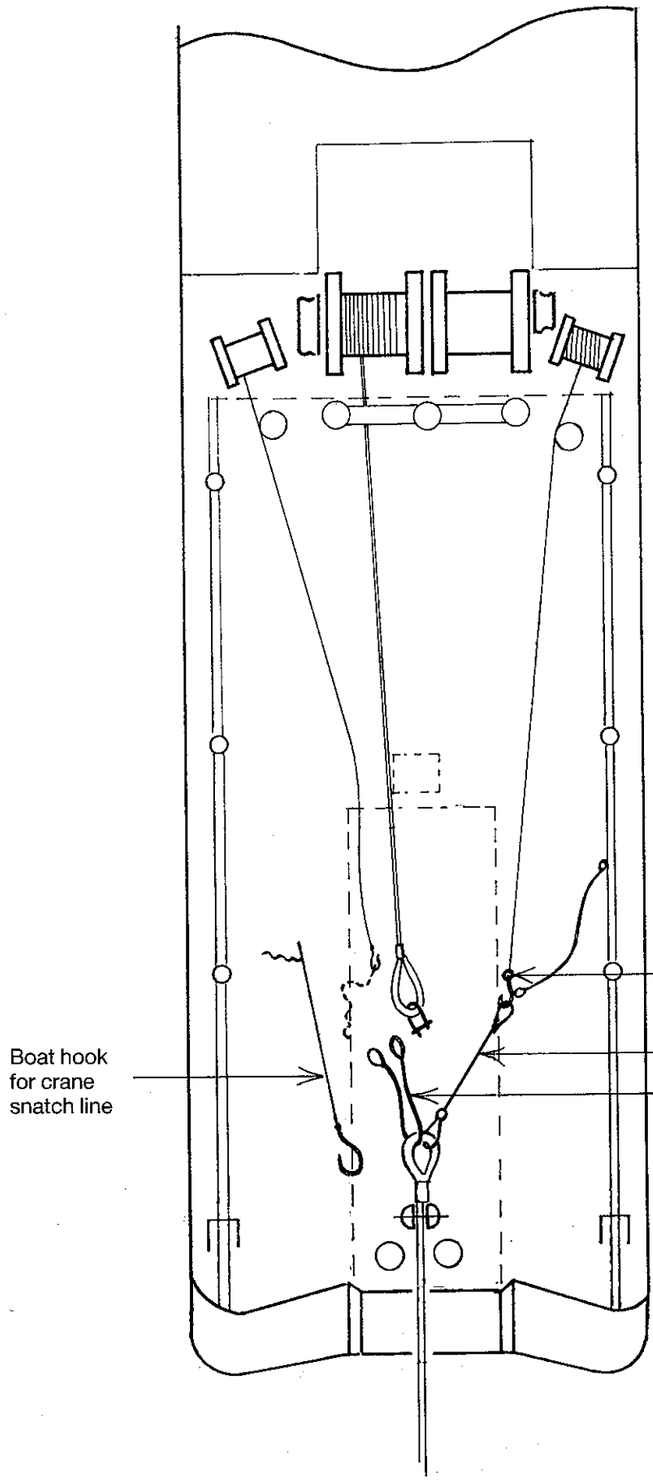


If approaching bow on, turn the boat through 180° when about 3 boat lengths off.

Commence shortening in the work wire and continue coming astern in line with the anchor cable

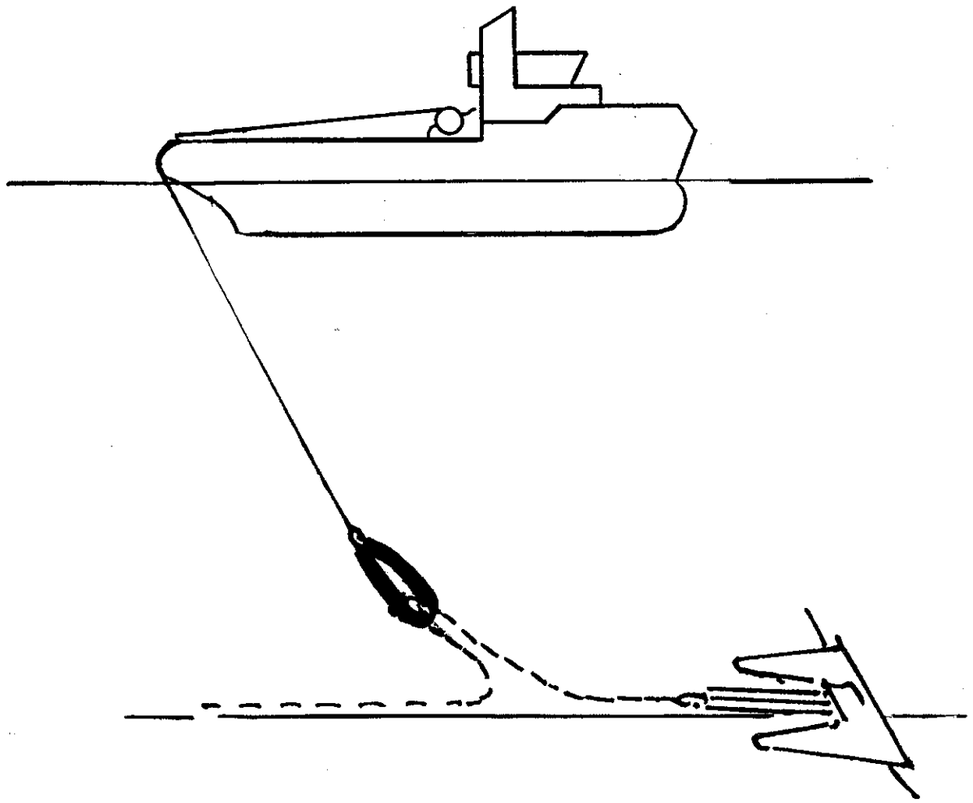
Move the boat sideways clear of the anchor cable towards the pennant pick up position under the barge crane.

Diag 12. PASSING BACK PENNANT WIRE — DECK LAYOUT



Deck rigging pennant ready to pass back after disconnecting work wire

Diag 13. PCC SYSTEM PROBLEMS — CATCHING A BIGHT



If the work wire is too short during "strip off" or the chain is not sufficiently tensioned prior to stripping back to the barge **this happens.**

High tension on the work wire is a common symptom.

Solution

1. Slack off on work wire to 1½/2 times water depth.
2. Tension up fully on barge chain.
3. Strip out to anchor.
4. Check with barge if anchor needs to be redeployed.
5. If yes — pull to target and re-strip.

c. Retrieval — Operational Notes
Running out to anchor PCC system

Parameters

Boat	8000 hp	Chain	76mm
Bollard pull	100 tonnes	Anchors	20 tonnes
Work wire	68mm	Water depth	450 feet
Winch (pull)	250 tonnes		

Many modern anchor handlers have drag brakes fitted to their winches. The drag brake is used to adjust brake tension such that at a given pulling force the winch drum will pay out to prevent overpull and parting of tow lines and work wires. This facility can be used with success when running out to retrieve anchors using permanent chain chasers.

The difficulty is to judge when the chaser is actually at the anchor.

Proceed as follows.

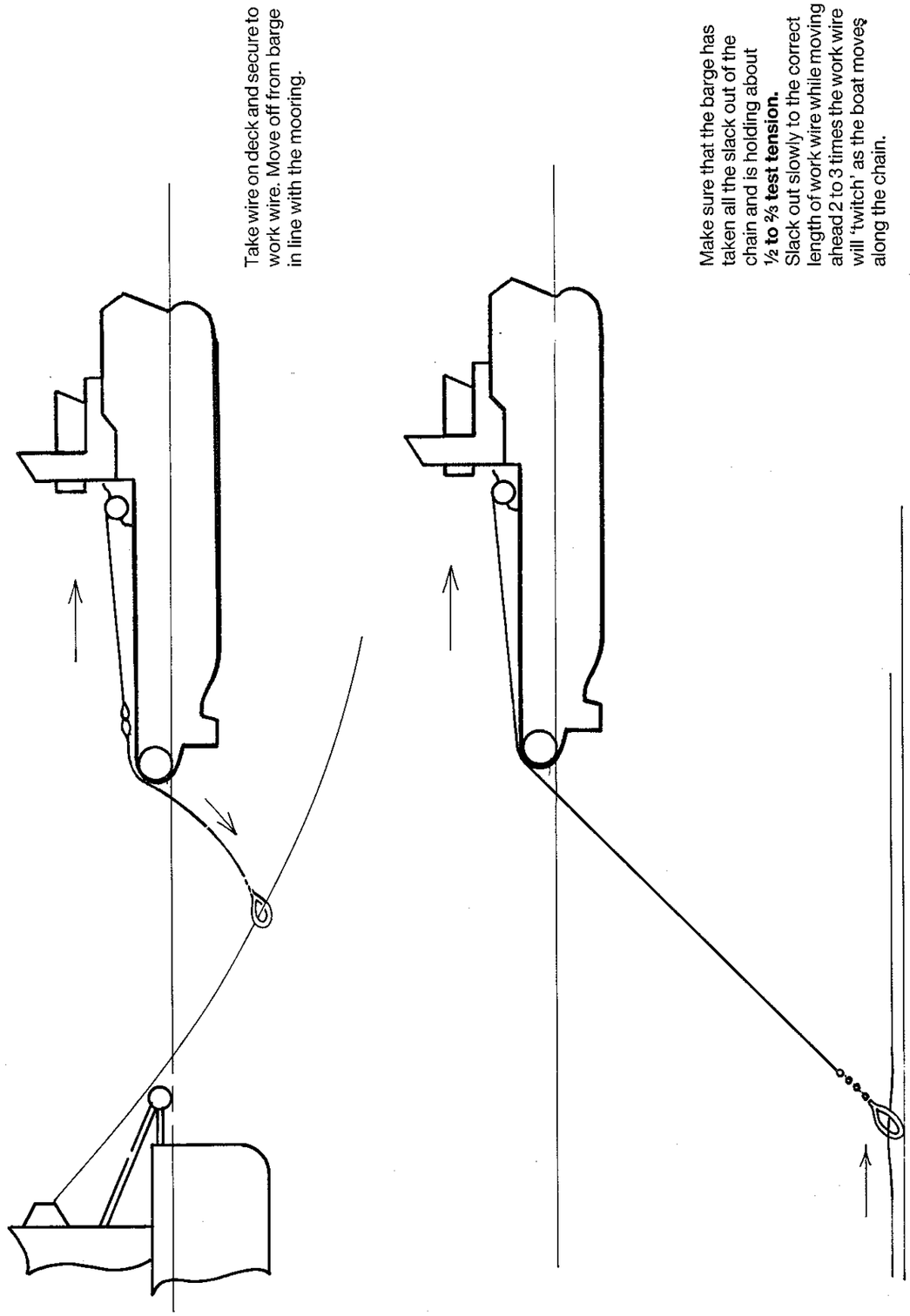
1. Line up on the bearing of the mooring chain.

2. Start off the run out deploying full scope of work wire.

3. DeClutch anchor handling winch and set the drag brake at about 10/15% of maximum. Leave at least ten turns of work wire on the drum. Steam at about 3/4 knots.

4. When the chaser hits the anchor, winch will start to pay out, apply full brake pressure keeping steaming at about ½ power.

5. Clutch in winch and commence heave up using 40% pitch and heaving with 50/60 tonnes, pull. When tension reaches 100 tonnes, stop heaving, keep steaming, attempting at regular intervals to pull on winch.

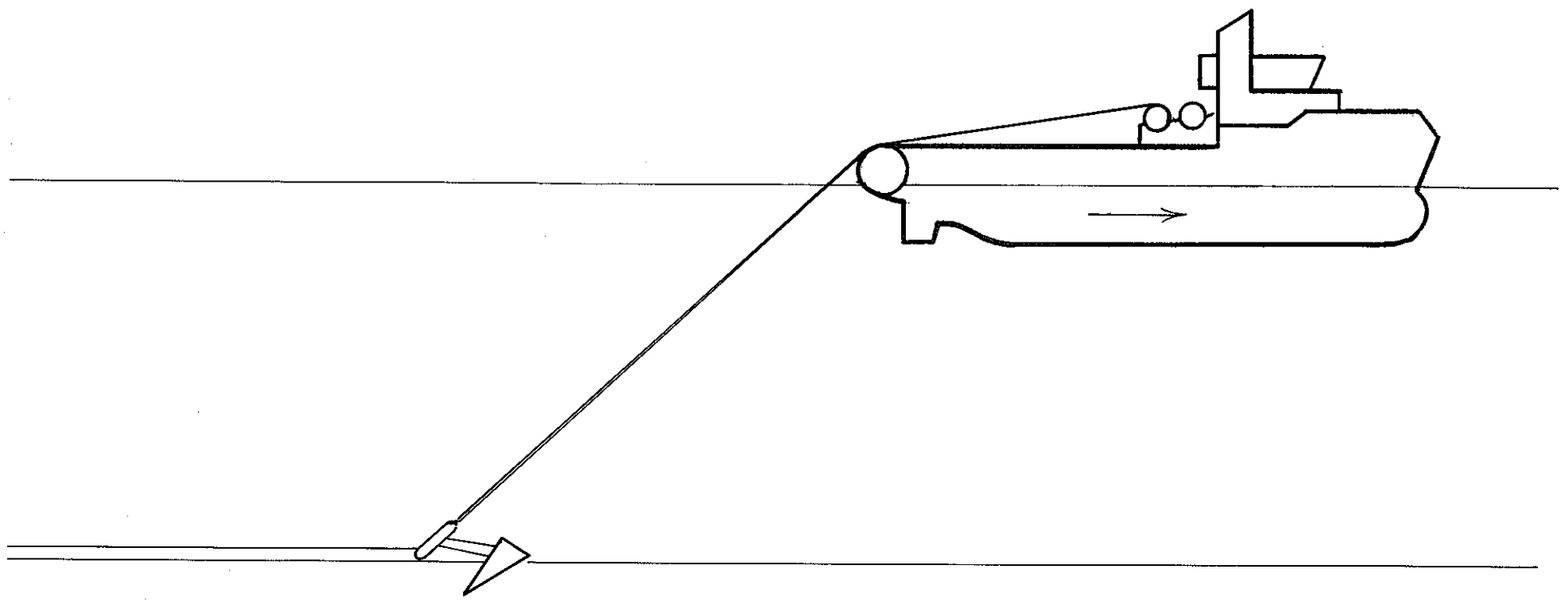


Diag 14. RUNNING OUT TO ANCHOR — PCC SYSTEM

Diag 15. AT THE ANCHOR

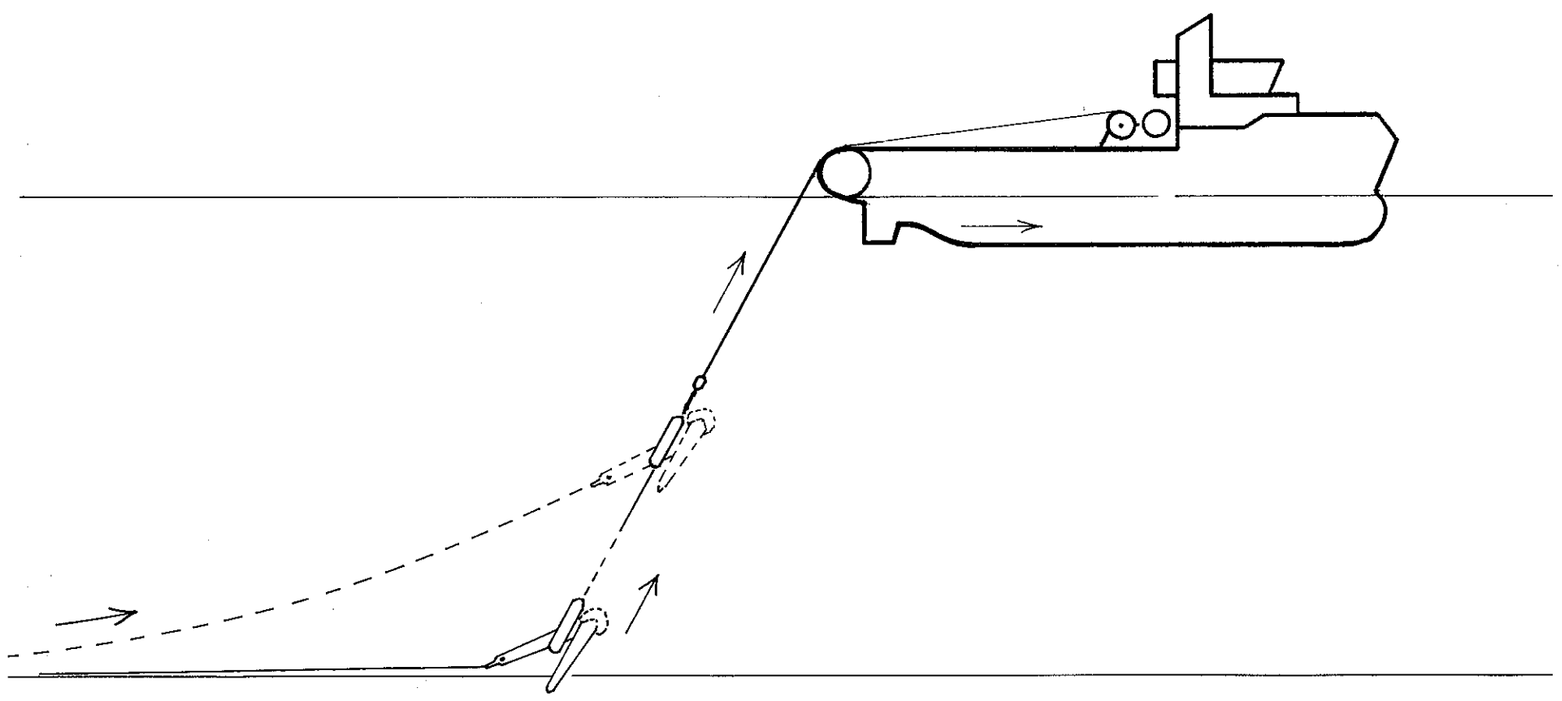
Watch radar EBL setting carefully and the winch tension. As the boat approaches the distance calculated (using the following known factors) chain length from barge to anchor, water depth, work wire length (see operational notes) be ready to ease down on the power.

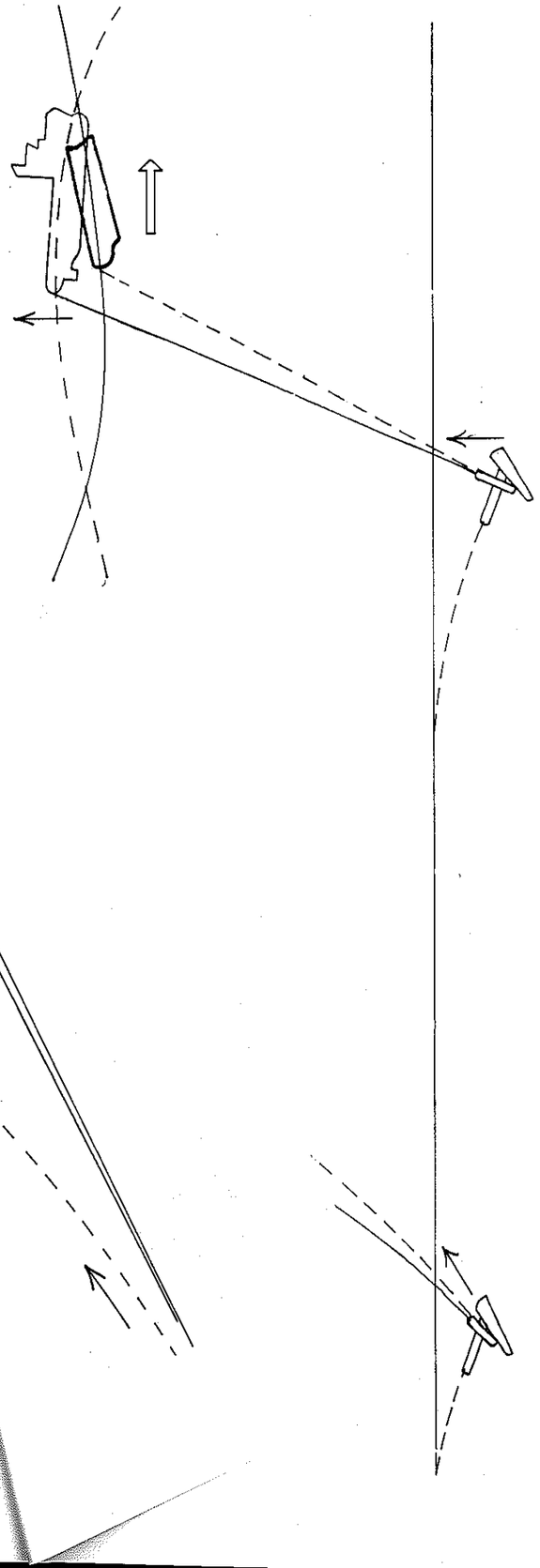
Work wire will stop twitching when anchor is reached and chaser comes onto anchor. Watch for high tension on the winch and keep the boat on the line of the chain.



Diag 16. BREAKING OUT THE ANCHOR — RETRIEVAL WITH PCC SYSTEM

Shorten in the work wire to between 1½/2 times water depth. Keep steaming slow ahead, tell barge to slack off tension on the mooring line, slacking about 50 feet. When the barge has reported that they have slacked off increase the power to about 50%. Observe winch tension. When the tension drops the anchor is out of the ground.





Diag 15. AT THE ANCHOR

Watch radar EBL setting carefully and the winch tension. As the boat approaches the distance calculated (using the following known factors) chain length from barge to anchor, water depth, work wire length (see operational notes) be ready to ease down on the power.

Work wire will stop twitching when anchor is reached and chaser comes onto anchor. Watch for high tension on the winch and keep the boat on the line of pull.

d. Breaking out the anchor — operational notes

Breaking high holding power (HH) anchors out of the ground is one of the most hazardous and skillful parts of the anchor handlers work.

Large forces are involved and patience rather than bruteforce isthe essence.

Generalisations

If the particular anchors to be retrieved have been subjected to large forces and have not slipped they are likely to be deeply buried and more force will be needed to break them out.

Pulling vertically upwards on the pennant wire of a deeply buried anchor will more usually part the wire before the anchor breaks out.

Soil volume on the flukes and the suction or under pressure below the flukes, work against trying to lift the anchor vertically.

For most types of barge anchors the following guide is useful:

a. In sandy soil the break out force will be between 12 and 17% of the anchor's test load.

b. In clay soil the percentage would be about 60%.

c. In sticky soft soils it can exceed 100%.

As the typical test tension is around ⅓ break strain of the chain or cable in use, the following table is a summary of the forces.

Table of break out forces — metric tonnes

For a large deeply buried anchor it would not be unusual to apply 80 tonnes of bollard pull and 200 tonnes of winch tension sustained over some time, say 30 minutes, in order to break out the anchor.

These forces might be considerably increased if there is significant swell as the boat heaves up and down (see diagrams on previous page).

The aim is to slide the anchor backwards and upwards along the path it made when burying itself.

Prior to attempting to break out an anchor which you suspect will require very high forces make sure that the pennants and work wires are in very good order. Too much impatience will most certainly lead to broken wires.

Chain Type	⅓ Breakload	Sand 17%	Clay 60%	Soft soils 100%
76mm ORQ	159	27	95	159+
76mm K4	205	35	125	205
102mm K4	345	59	207	345

Diag 18. RACKING THE ANCHOR

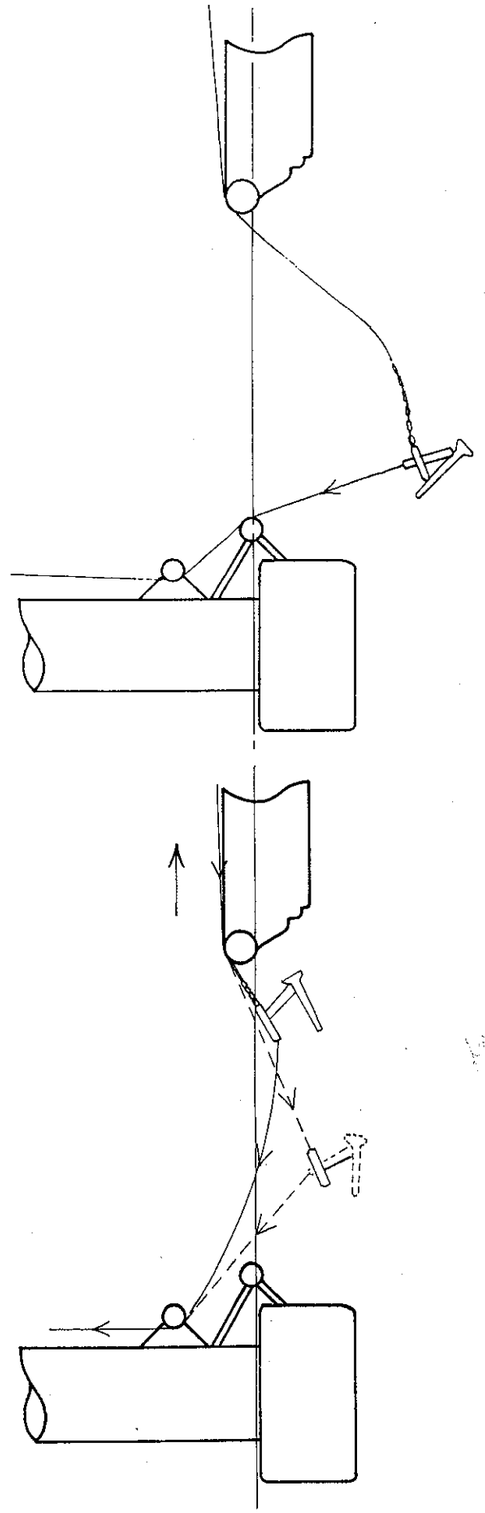
Back in until about 150 metres off. Hold position — barge keeps heaving on chain.

Slack away on the work wire at same speed as the barge is heaving in chain — "float" anchor to the rack.

If the boat is too close or work wire is not kept taut the chaser will slip off the anchor.

The aim is to rack the anchor with the chaser correctly positioned on the shank.

Note: To pass back pennant move the boat sideways to a position below barge crane (see diagram 11 in section 4b).



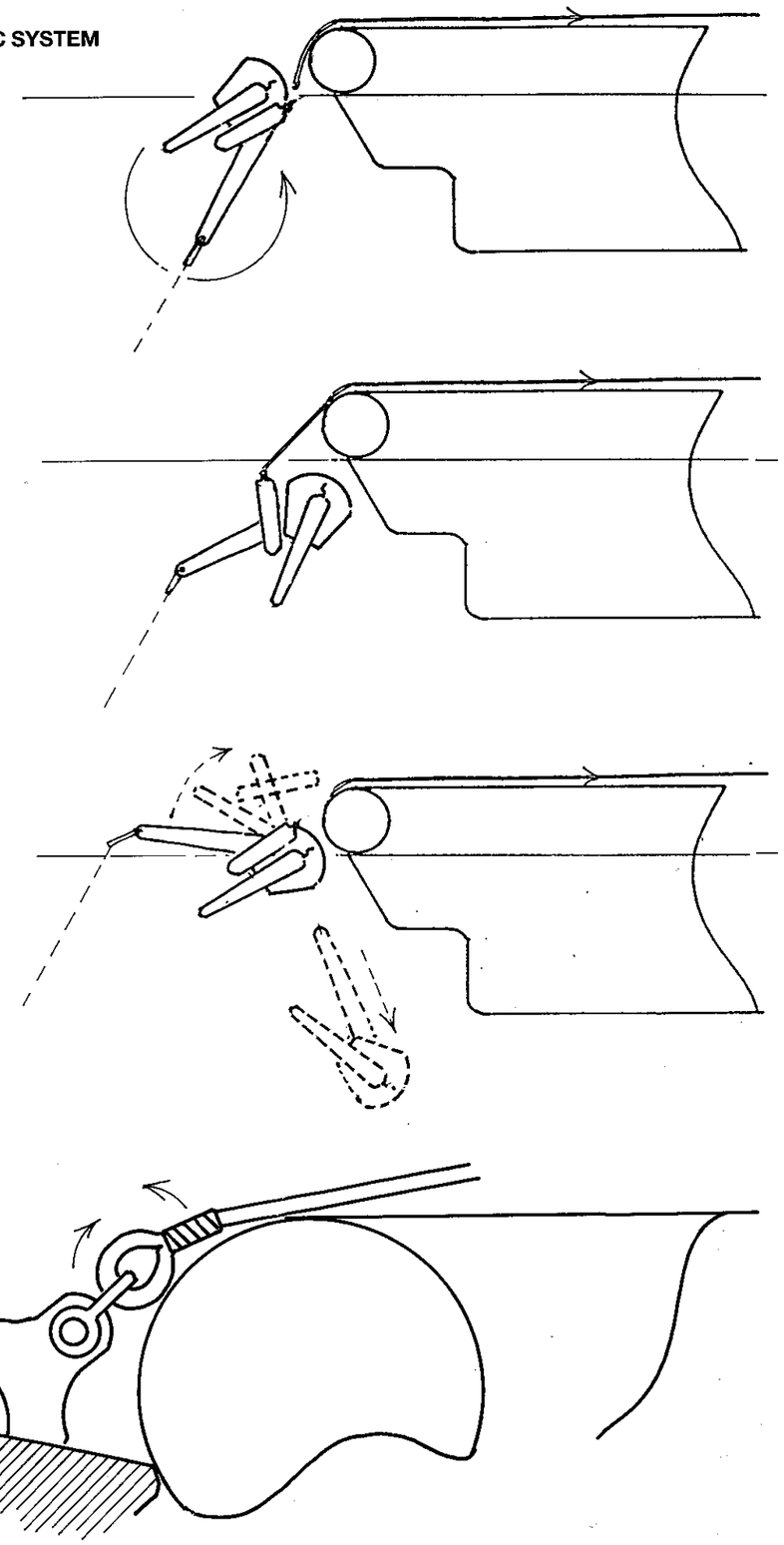
Diag 19. DECKING ANCHOR — PCC SYSTEM

Anchor at roller — chain leading astern.
As the anchor comes up it will invariably spin.

You now have the anchor under the roller in this orientation.

If you heave it up in this position you risk parting the pennant with the very heavy strain required to pull anchor on deck, or anchor might drop through chase ring.

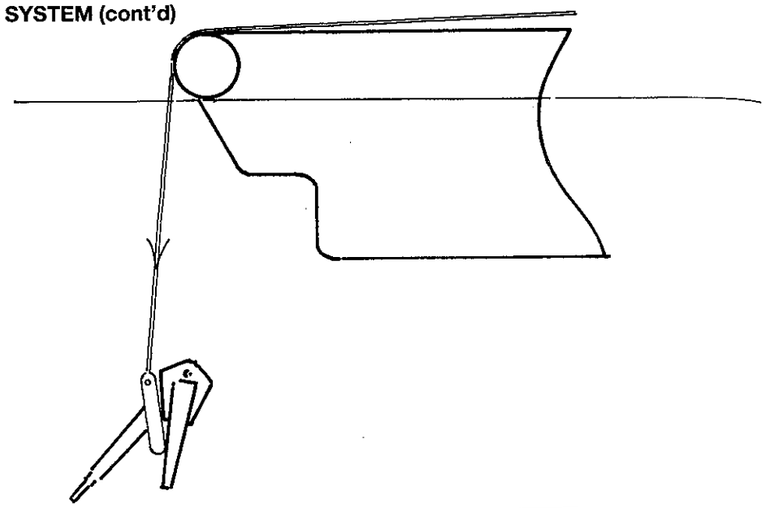
Pennant sockets are very liable to split open if subjected to over stress like this.



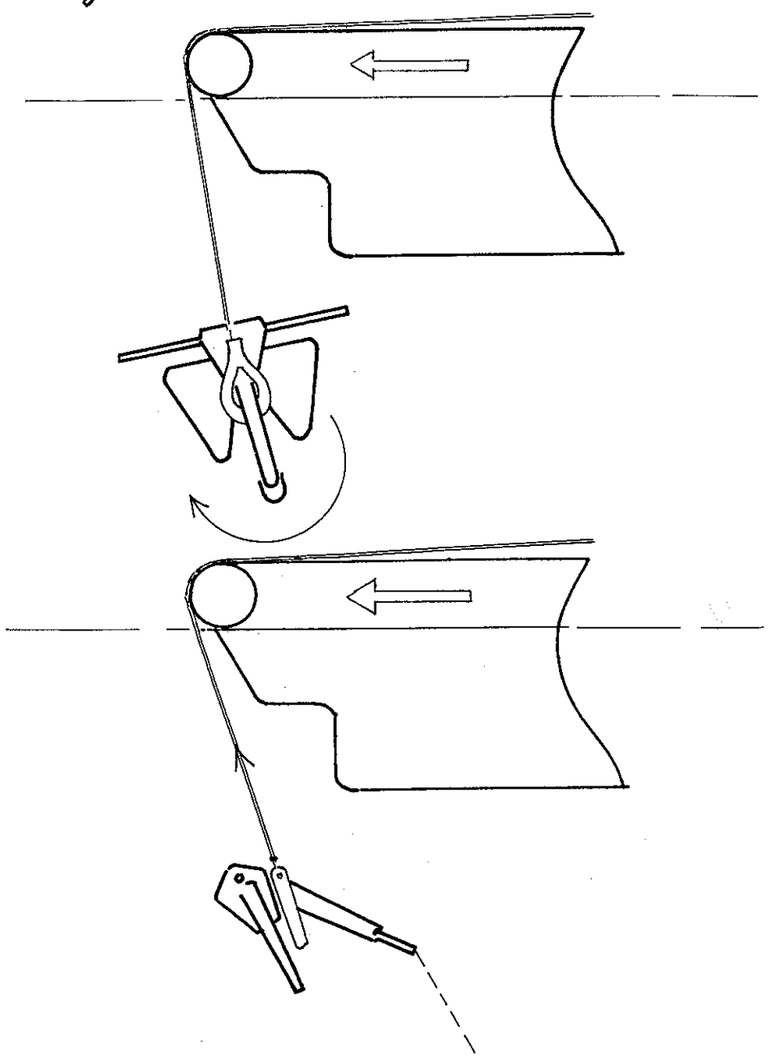
Diag 20. DECKING ANCHOR — PCC SYSTEM (cont'd)

Lower anchor below the roller — say 10 to 15 metres.

Ask the barge to give more slack if necessary or possible.



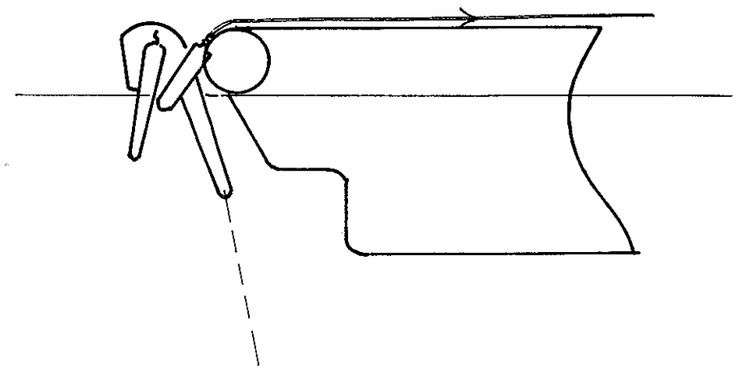
Steam astern and get anchor and chain in this position, anchor should swivel.



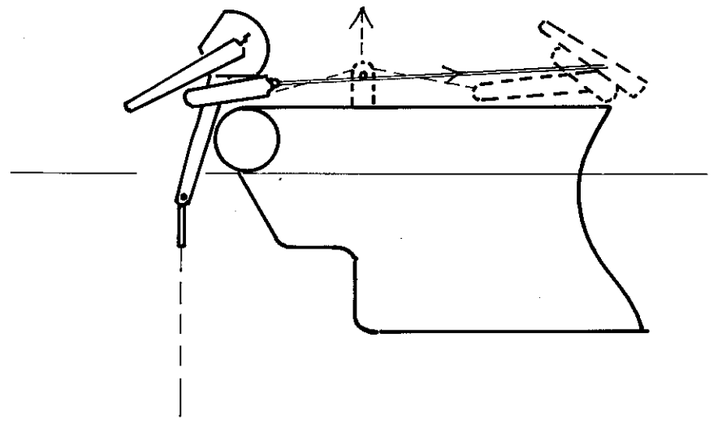
Stop coming astern. Heave up on pennent.

Diag 21. DECKING ANCHOR — PCC SYSTEM (cont'd)

Check orientation correct as shown. All stop on winch.



If correct, heave on winch and bring anchor on board. Secure chain in shark jaw/fork.



f. Running and retrieving anchors — two boats

In very deep water, very shallow water or in particularly sticky ground it may be that one vessel alone has insufficient power to deploy the desired amount of mooring line. Similarly it may be that only low horse power vessels are available and one boat has insufficient power to deploy the required scope.

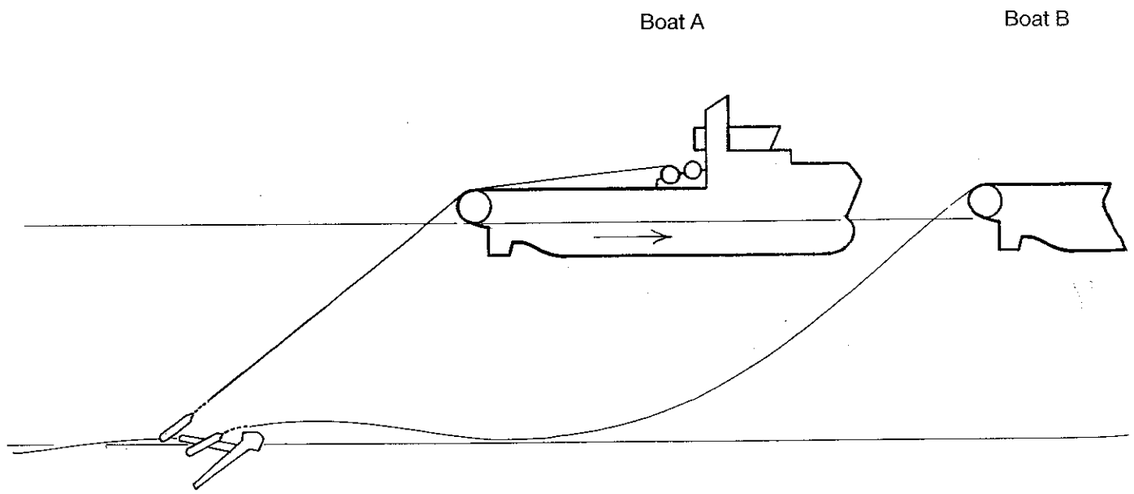
This problem can be overcome by using a J-chaser and fishing up a bight of chain. The other boat handles the anchor in the normal way.

During deployment the distance between the boats is usually about ⅓ of the required total scope.

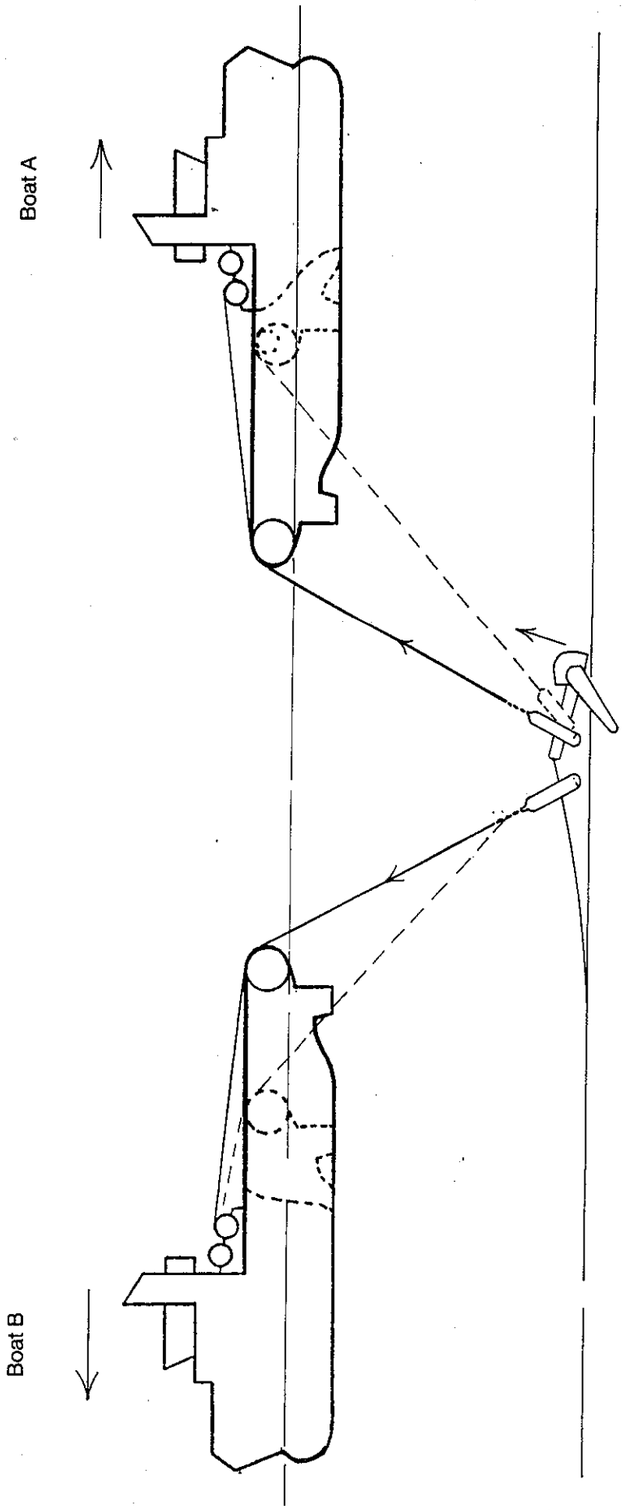
The reverse procedure can be used to break out mooring chains and retrieve them.

When running out mooring chains using two boats a J-lock chaser can be useful. This type of chaser will slide over a chain in one direction only and lock in the opposite direction. When carrying very heavy long chains such as in permanent moorings for SBM's etc this device can be particularly useful (see drawings).

Diag 22. RUNNING AND RETRIEVING ANCHORS USING A J-LOCK CHASER



Boat A at anchor. Unable to break it out of ground.
Boat B sweeps chain with J-lock chaser and runs out to anchor with about 2 x water depth work wire.



Boats A and B apply maximum tension on their work wires to break anchor out of ground. When the anchor is clear and hoves up "B" eases tension and boat A heaves anchor to stern. J-lock chaser may drop clear or have to be cleared by decking anchor on "A".

Boat A reapplies tension. Boat B turns towards barge, shortens to about 1½ times water depth and then applies tension to lock chaser. Barge slacks off all tension.

Diag 23. USE OF A J/LOCK CHASER (cont'd)

g. Buoyed mooring systems — components
The following sequence of events is the normal procedure when **running anchors** with **buoyed systems.**

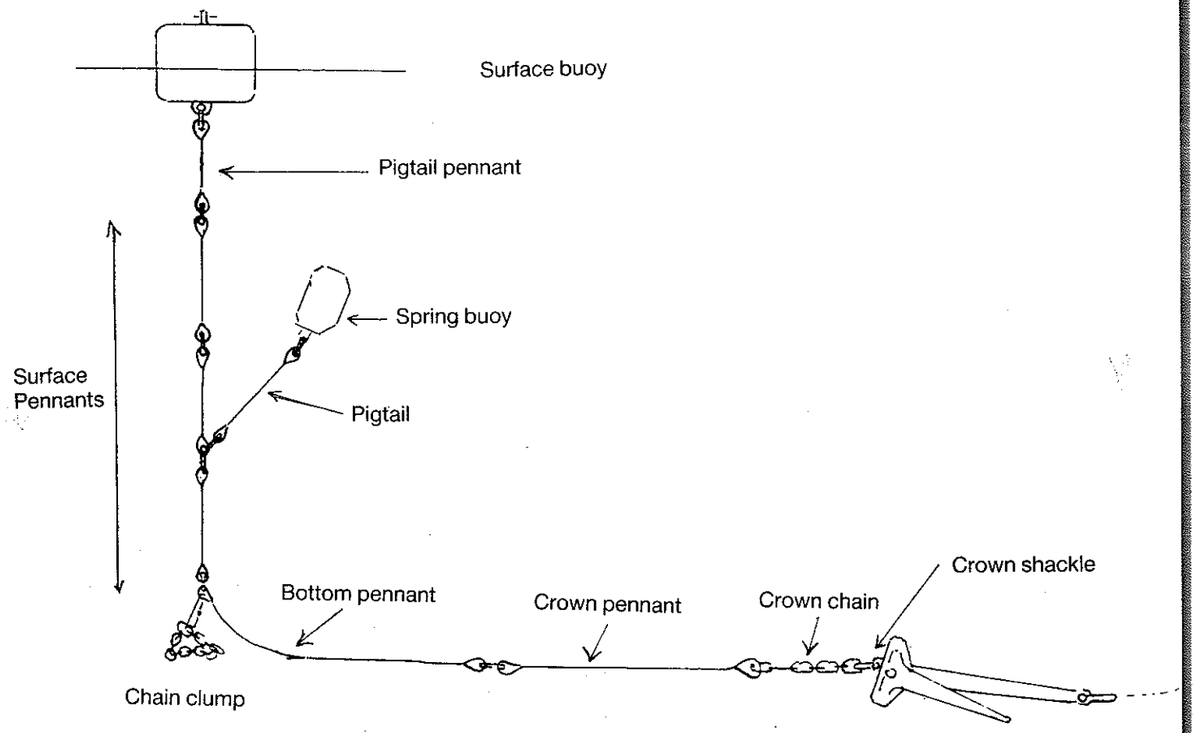
1. The AHT organises its work drums so that the surface rig up, that is the pennants from the crown pennant to surface buoy, are currently spooled up in the order directed by the barge master.

2. The AHT proceeds to the designated anchor rack position and takes the pennant wire.

3. With the pennant wire made fast to the work wire/pennant string the anchor is walked off the rack and the AHT hauls the anchor to the roller. The AHT may be directed to "deck" and secure the anchor or simply run it snugged up under the roller.

4. The anchor is then "run" to the designated location, stretched and put on bottom.

5. The barge then tensions up to about ⅓ test tension and if satisfied, the boat runs the remaining surface pennants and attaches buoy which is then launched.



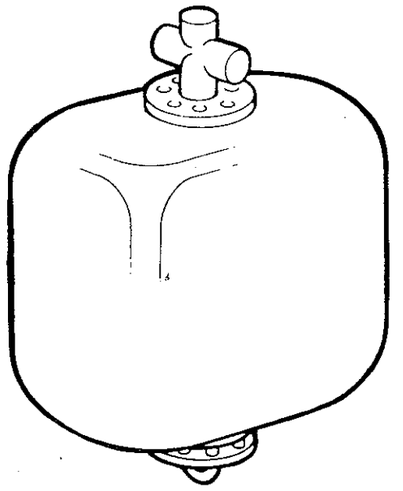
h. Buoys — general information
Buoy sizes are usually stated in terms of the buoy's physical dimensions and reserve buoyancy. The reserve buoyancy is the weight of water displaced by the buoy when fully immersed minus the buoy's weight in air.

Steel is the most common material used in buoy construction with GRP, pneumatic rubber and foam filled plastic buoys also available. Steel buoys have advantages in strength and resistance to damage when pulled under the water. They are, however, affected by sea water corrosion and can be dangerous to small vessels if drifting free.

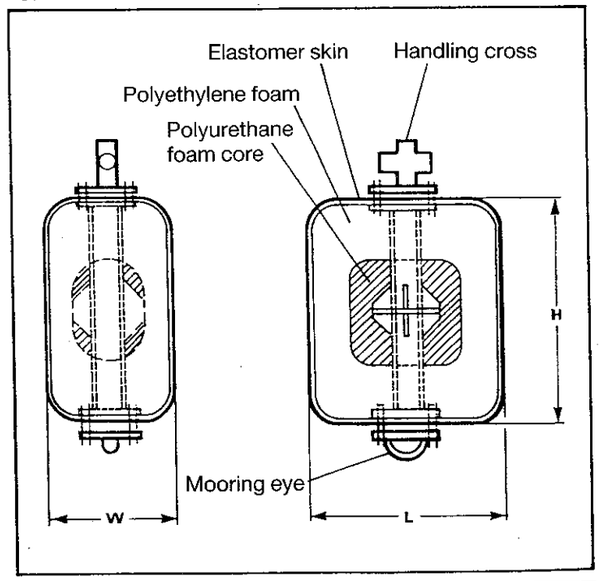
Buoys in GRP are lightweight and strong but susceptible to fracture on impact. Pneumatic rubber buoys are medium weight, reasonably easy to handle but are susceptible to abrasion and puncture by sharp objects. Foam filled plastic buoys are lightweight, impact absorbent and easy to handle but are susceptible to damage from sharp objects and tend to be expensive.

The selection of buoys must involve consideration of the buoy's capability to support loads (its reserve buoyancy); its ability to resist tensile and bending forces; its shape and materials of construction. If the buoy is lighted, additional considerations include the light range and colour, signal characteristics and the power source.

Impact absorbent buoys
These buoys are designed to be unsinkable, robust, lightweight and maintenance free. The buoys are manufactured with a core of rigid foam built around heavy duty steel work to provide structural strength. The rigid foam is covered with an energy absorbing flexible foam which is coated with a flexible polyurethane material.

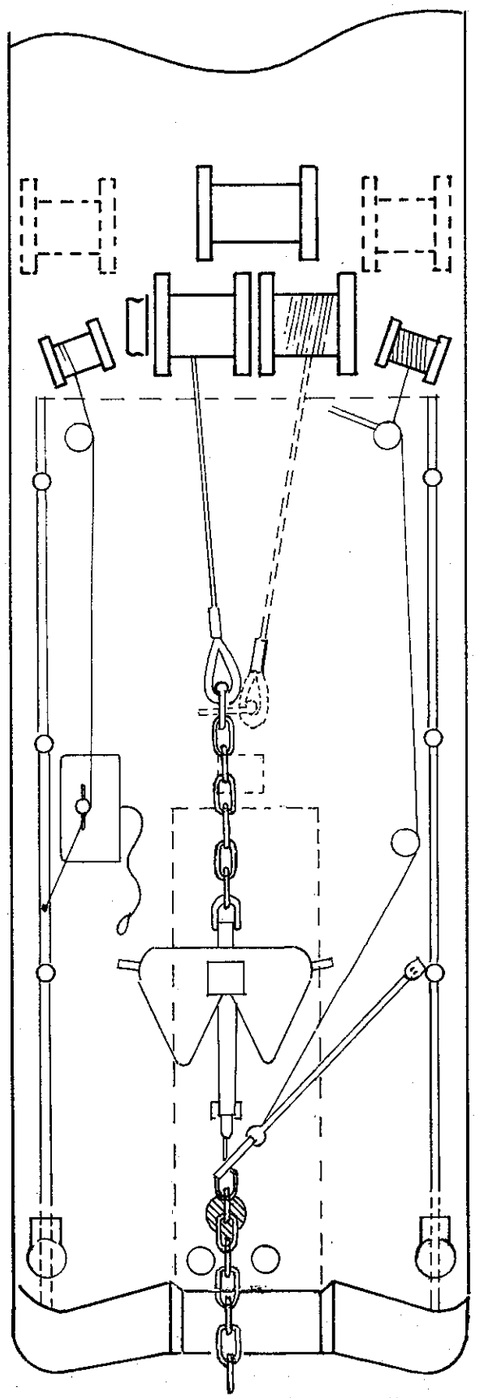


Drawing courtesy of Seafast



Type	Reserve Buoyancy		Width (W)		Height (H)		Length (L)		Weight	
	kg	lb	mm	in	mm	in	mm	in	kg	lb
APB 4	4000	8820	1400	55	2000	78¾	1910	75	910	2007
APB 6	6000	13230	1400	55	2000	78¾	2665	105	1050	2315
APB 8	8000	17640	1750	70	2500	98½	2200	86½	1220	2690
APB10	10000	22050	1750	70	2550	98½	2690	106	1370	3021

Diag 24. RUNNING TO LOCATION BUOYED MOORINGS — ANCHOR DOUBLE SECURED

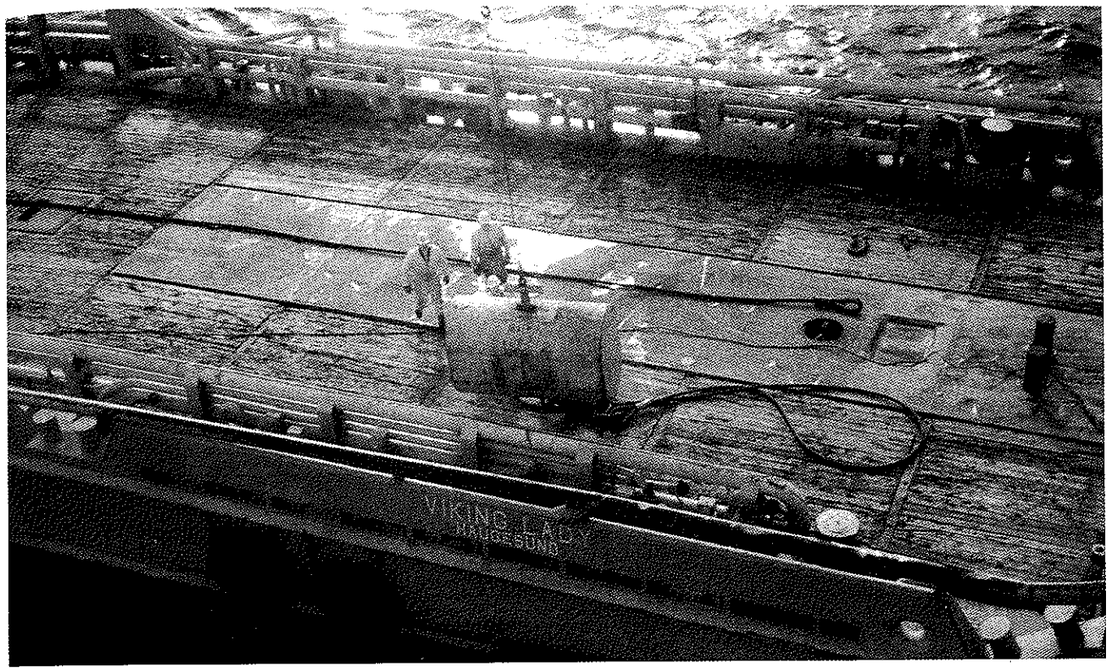


When running anchors in locations where pipelines/ wellheads or other obstructions exist a boat will be instructed to run the **anchor on deck — double secured.**

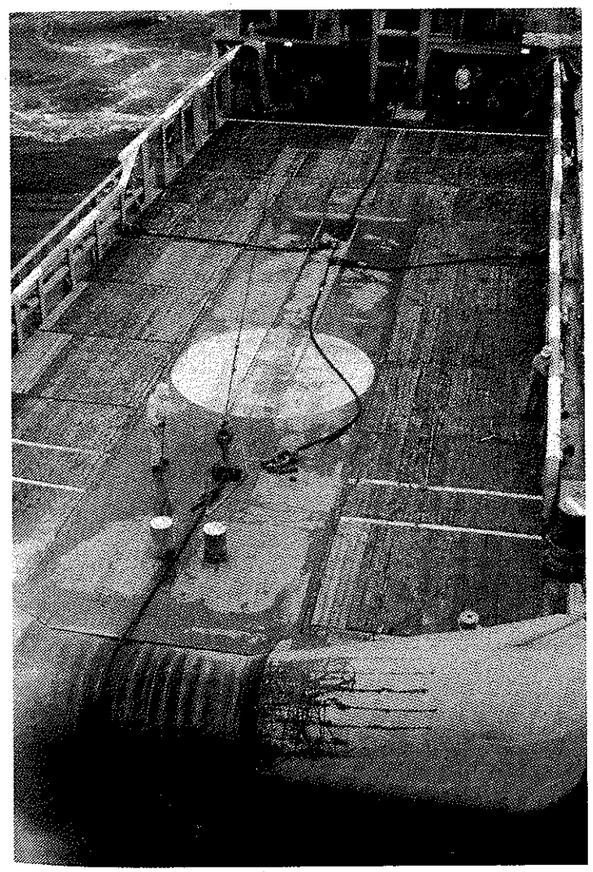
Method 1
Heave anchor on deck and secure main chain in shark jaw.

Method 2
Heave anchor on deck and attach 2nd work wire.

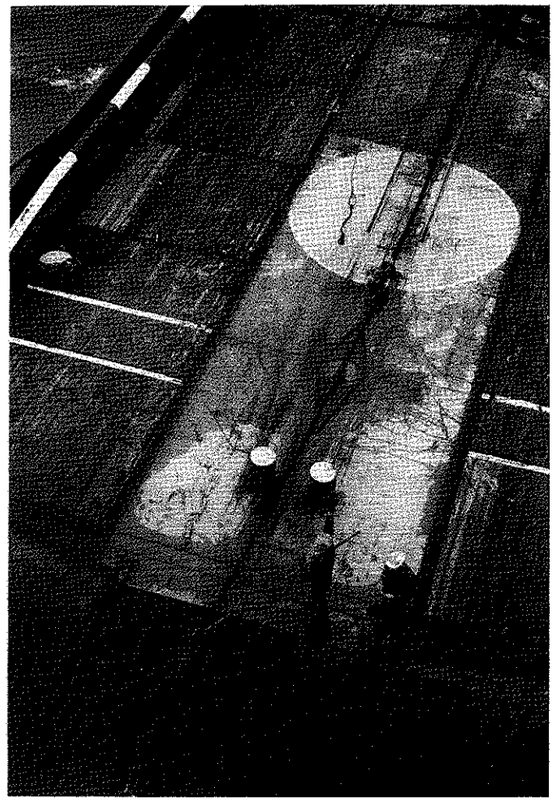
Method 3
Heave anchor on deck and use pelican hook on main chain.



Above: Buoy lowered to boat — buoy pennants already spooled up.

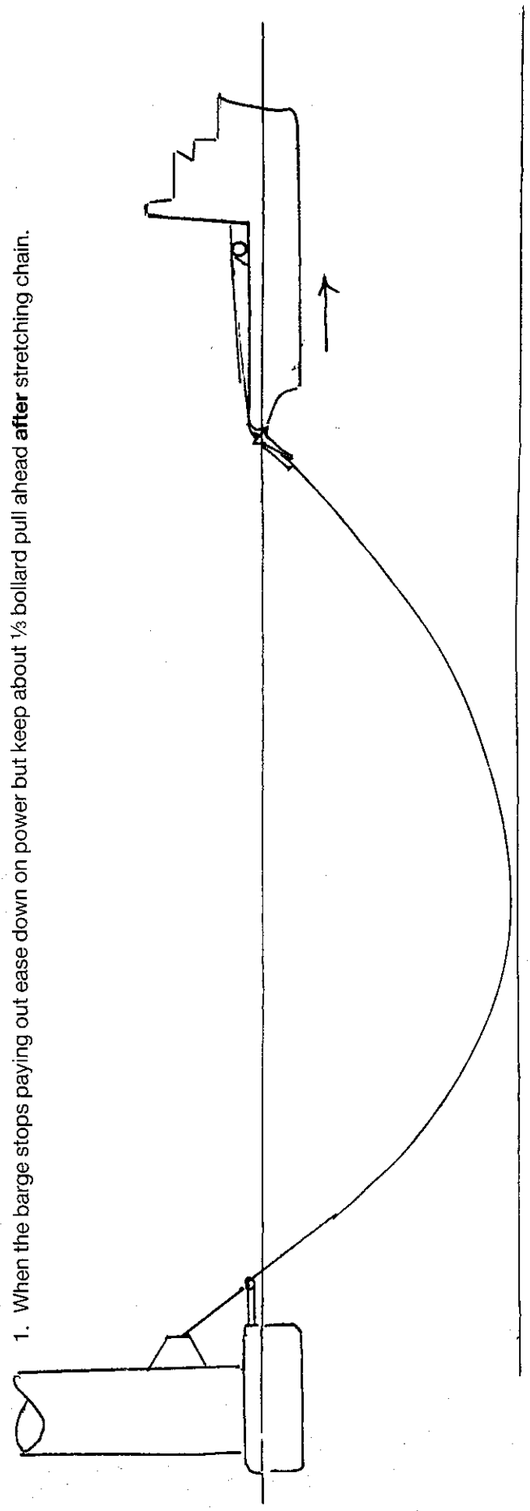


Left: 1) Anchor crown pennants passed to boat. 2) Pennant attached to tugger launch and hauled up to stopper. 3) Stopper just engaging pennant and work pennant ready to connect.



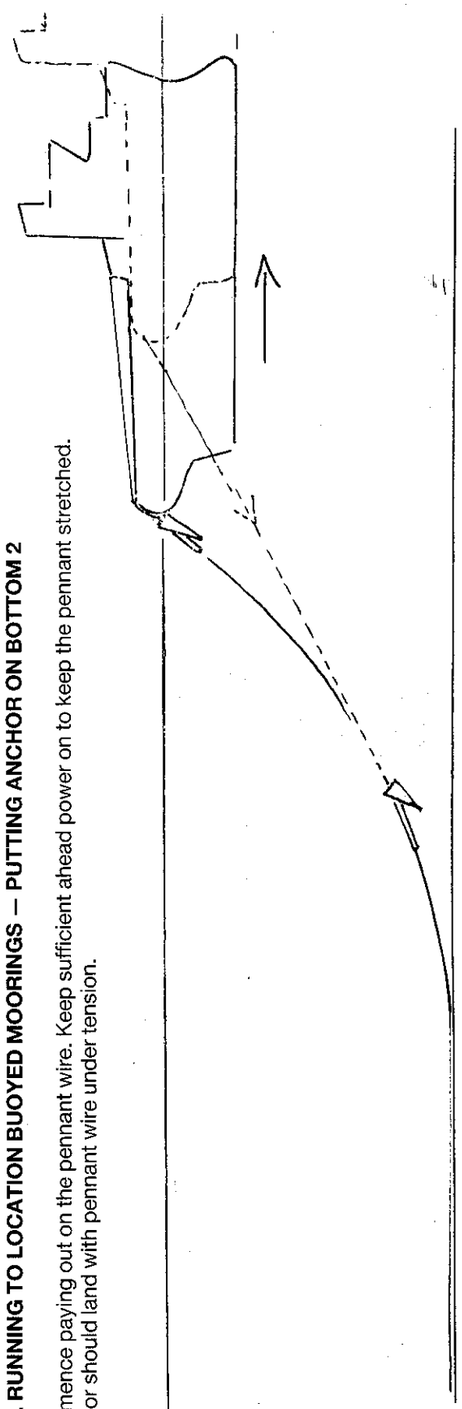
Pennants connected, boat taking up slack.

Boat commences hauling on pennant while barge slacks off on anchor line



Diag 25. RUNNING TO LOCATION BUOYED MOORINGS — PUTTING ANCHOR ON BOTTOM 1

1. When the barge stops paying out ease down on power but keep about ⅓ bollard pull ahead **after** stretching chain.



Diag 26. RUNNING TO LOCATION BUOYED MOORINGS — PUTTING ANCHOR ON BOTTOM 2

2. Commence paying out on the pennant wire. Keep sufficient ahead power on to keep the pennant stretched. Anchor should land with pennant wire under tension.

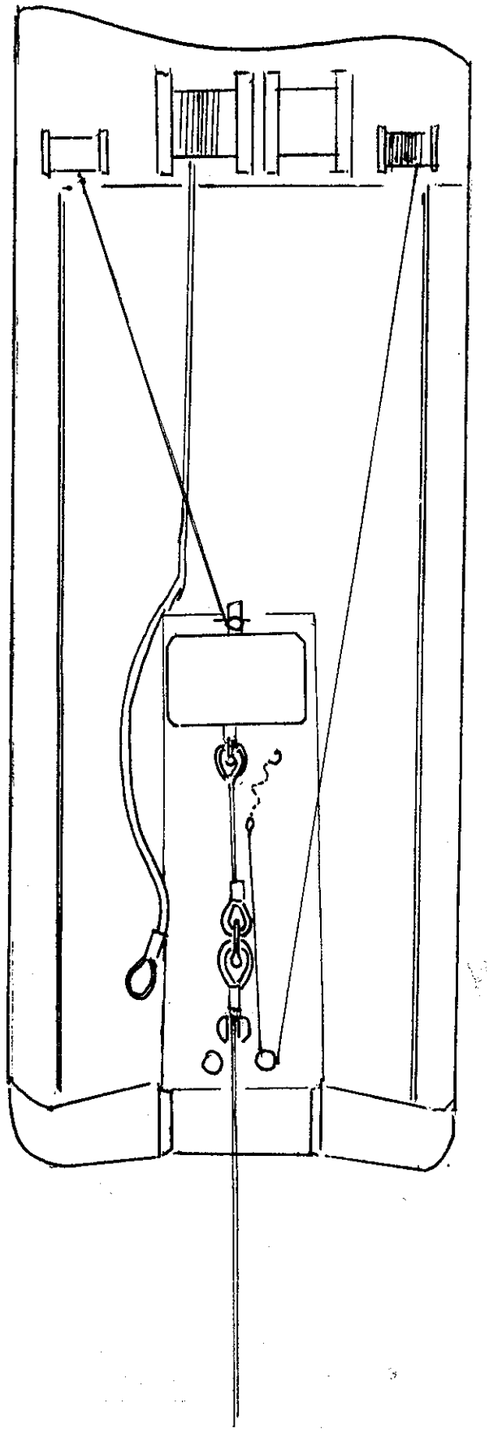
Diag 27. RUNNING TO LOCATION BUOYED MOORINGS — BUOY LAUNCH

3. After the barge has taken initial tension, ease down on power and slack out all the buoy support pennant string.

   Secure top pennant eye in the shark jaw and connect up the surface buoy.

   Clear deck of gear. Lower guide pins and lower the jaws. Launch buoy.

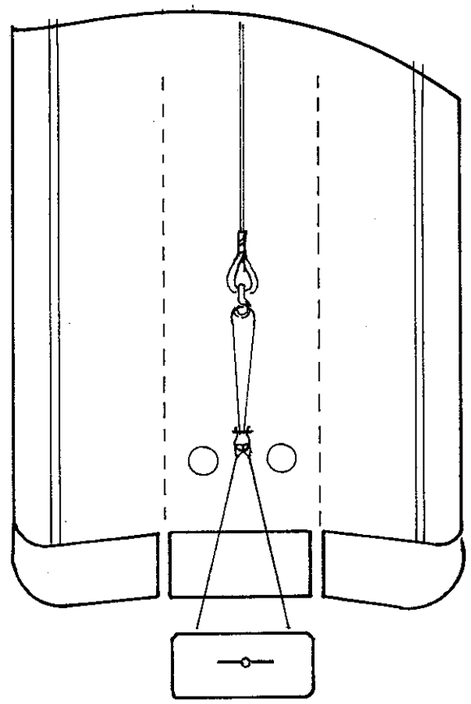
   Note:
   If using chain clump attach this to the crown pennant eye when lowering anchor to bottom.



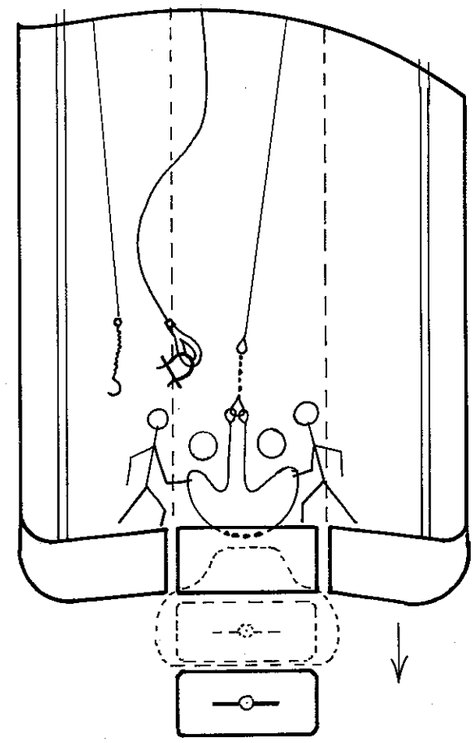
j. Retrieving anchors — buoyed mooring systems notes
The AHT will have organised the winch drums such that at least one drum is cleared of all pennants other than the work wire.

1. The boat proceeds to the designated anchor buoy. Catches and decks the buoy.
2. The buoy is disconnected from the surface pennants and the surface pennant is connected into the work wire and initial tension applied.
3. Barge slacks off the chain/wire and the AHT breaks the anchor out of the ground, heaving it to the roller where the anchor is checked for damage or tangled pennants.
4. The barge then hauls the mooring line in and on close approach to the barge the AHT slacks off on the surface pennant until the anchor is housed on the rack.
5. The AHT then disconnects the surface pennant from the pennant string and passes it to the barge via the barge's crane.

Diag 28. BUOYED SYSTEM — CATCHING THE BUOY

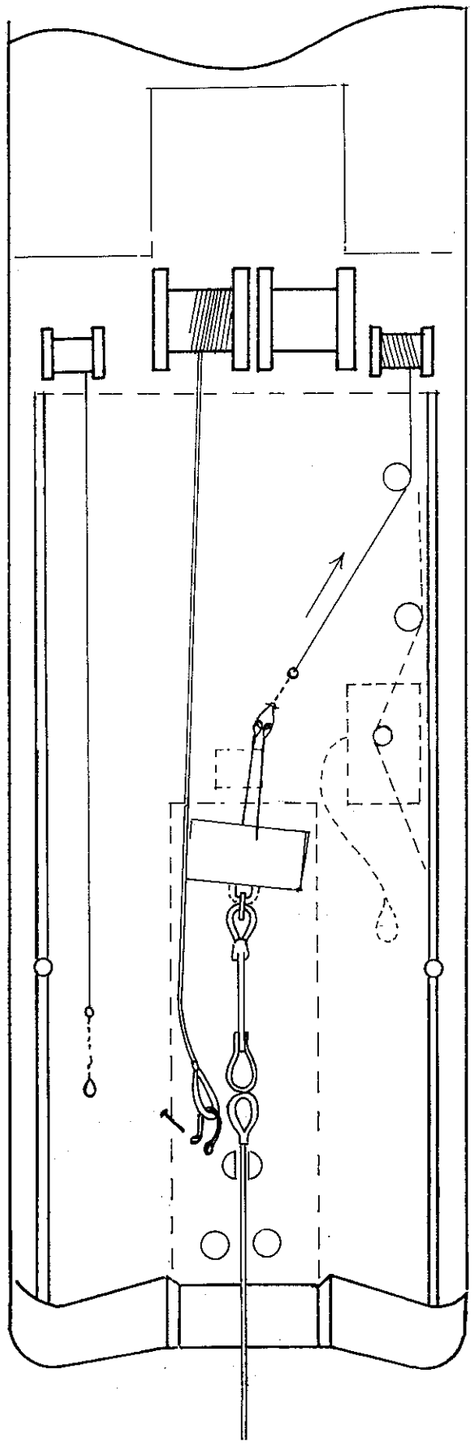


If the buoy is very large and heavy use the work wire to heave the buoy on deck.
Jaw off the buoy pennant (pigtail) and secure one tugger to the buoy crusiform.



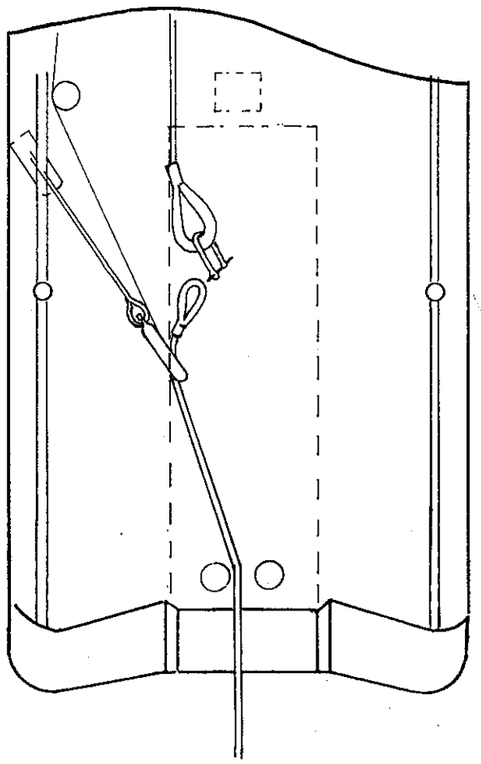
Prepare deck and lasso buoy with crew deployed as shown.

Diag 29. BUOYED SYSTEM — DISCONNECTING THE BUOY AND RIGGING THE WORK WIRE

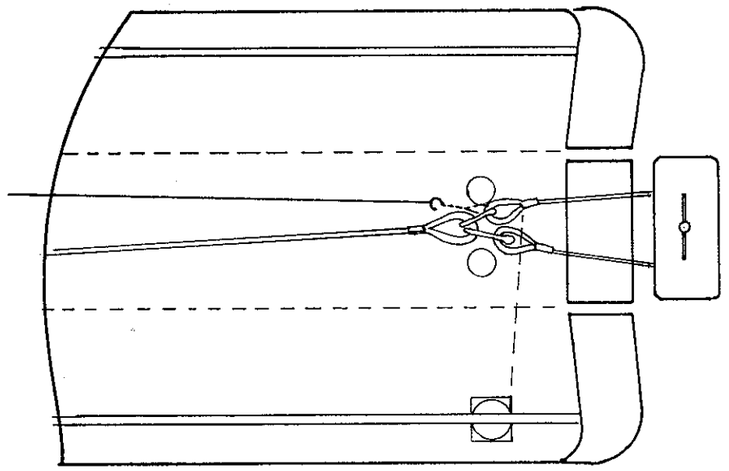


Left: Disconnect the buoy, pull it to one side and secure it against crash rail. Connect work wire to the anchor pennant string. Prepare to break out anchor when barge has taken off all line tension.

Below: Use pelican hook as shown if the shark jaws are defective.



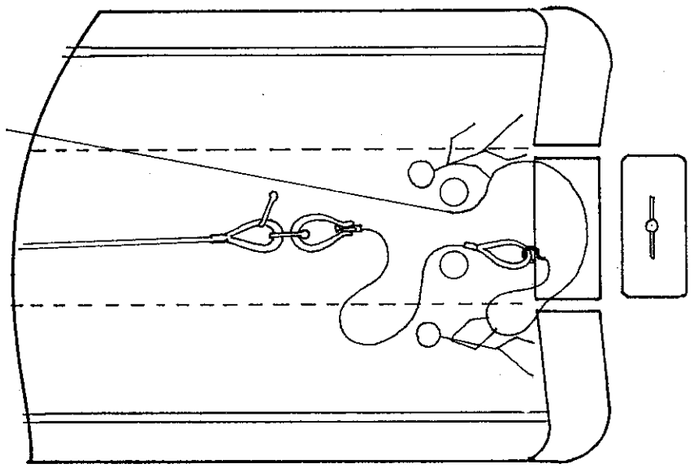
3. Heave up on the work wire to bring the buoy on board. Jaw off the anchor pennant. Clear away buoy and heavy pennant. Attach work wire and commence anchor retrieval.



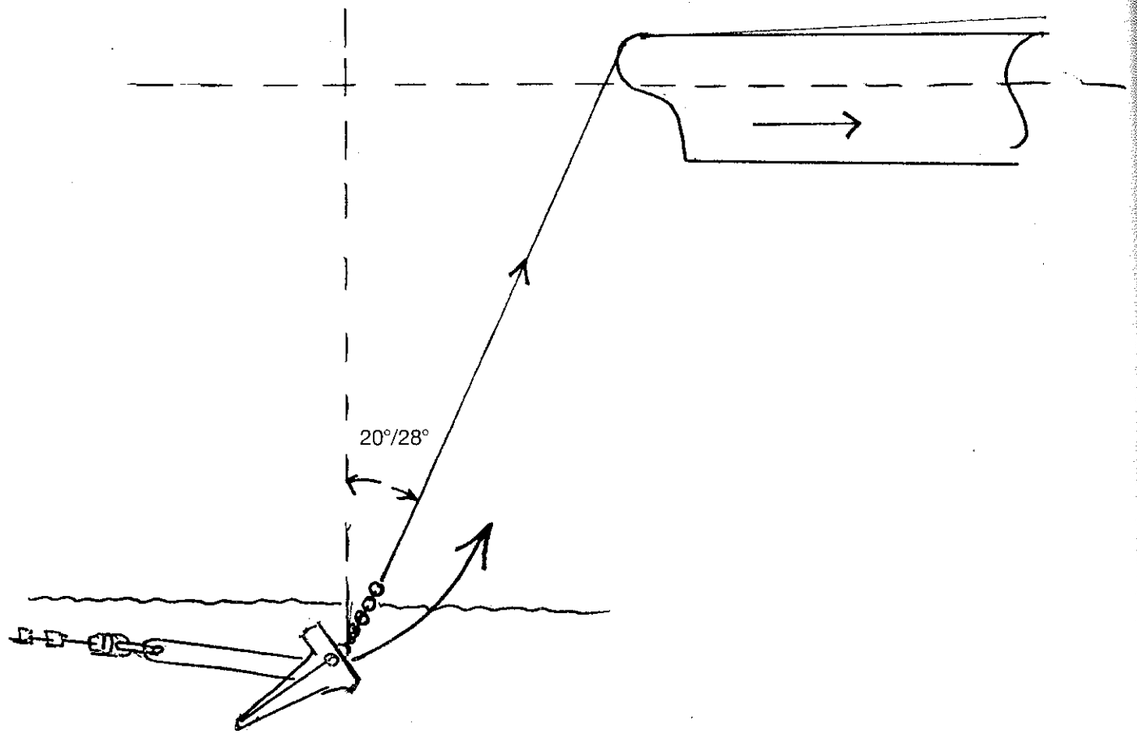
Diag 30. BUOYED SYSTEMS — CLEARING FOULED PENNANTS

1. Run work wire down to stern. Attach 25 foot pigtail pennant as shown and tugger wire rigged with throwing bight.

2. Throw bight of tugger wire over the buoy. Heave up on tugger and bring eye of the short pennant on board. Connect it up. **Note: If no short pennant** is available the work wire end can be used but the sharp nip may damage the wire.



Diag 31. BUOYED SYSTEM — BREAKING OUT ANCHORS METHOD I

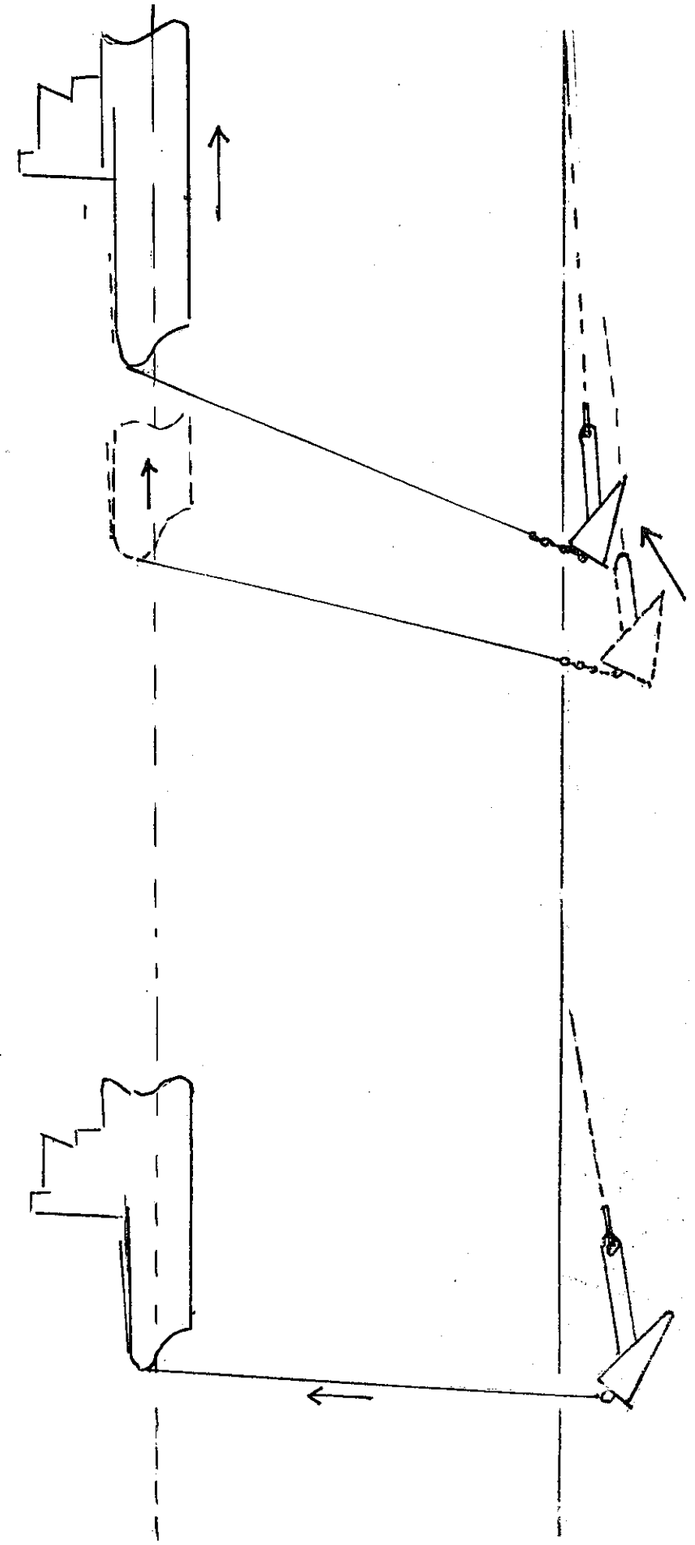


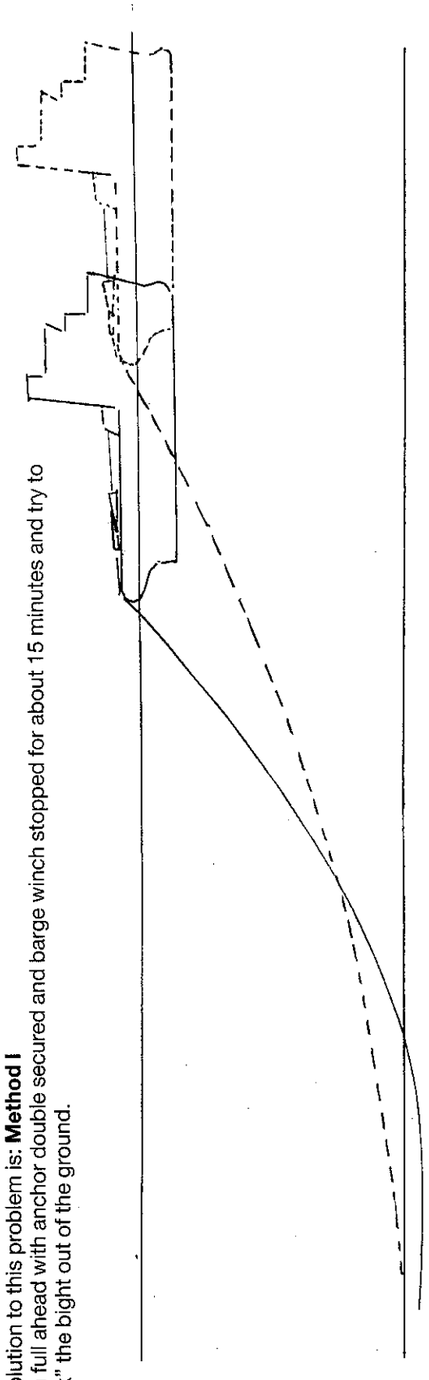
Break Out Sequence

1. Barge slacks off about 100 feet on mooring chain. No tension.
2. Shorten work wire to about water depth +10/15% to make angle with vertical of about 20°/28°.
3. Steam ahead maintaining constant distance off barge and commence heaving on winch pulling anchor out at an **angle** not vertically.
4. In heavy seas use more wire length and ease up on winch, watching peak tensions carefully.

Diag 32. BUOYED SYSTEM — BREAKING OUT ANCHORS METHOD II

1. **Shorten right up** on the work wire.
2. Turn and head towards the barge in line with the anchor chain.
3. With the anchor chain slack heave up as much as you can on the winch.
4. Slack 5-6 metres work wire head for barge under full power.
5. Tell barge to tension up anchor chain to about 80 tons (40 tons if wire mooring).
6. When barge reports tension falling anchor is out of ground — ease power.
7. Turn 180° and heave anchor to roller.

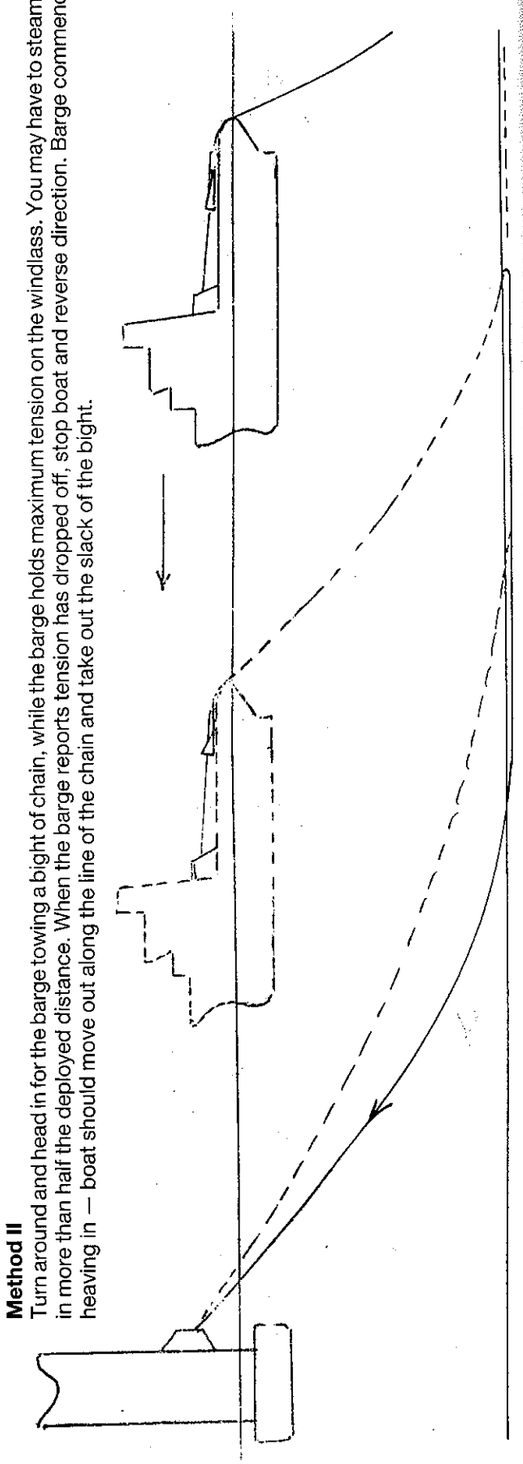




Diag 33. BUOYED SYSTEM — RETRIEVING ANCHORS FROM STICKY GROUND METHOD I

The anchor chain may be difficult to haul in if the ground is particularly sticky. The barge usually reports that it cannot heave any more even though the anchor has been unseated and hove up behind the boat.

The solution to this problem is: **Method I**
Steam full ahead with anchor double secured and barge winch stopped for about 15 minutes and try to "break" the bight out of the ground.



Diag 34. BUOYED SYSTEM — RETRIEVING ANCHORS FROM STICKY GROUND METHOD II

Method II
Turn around and head in for the barge towing a bight of chain, while the barge holds maximum tension on the windlass. You may have to steam in more than half the deployed distance. When the barge reports tension has dropped off, stop boat and reverse direction. Barge commences heaving in — boat should move out along the line of the chain and take out the slack of the bight.

PART 5. LAYBARGE ANCHOR WORK

a. Characteristics of laybarge anchor work

Pipelaying is a more or less continuous process which means that the anchor spread is constantly adjusted as the pipelay barge moves along the route.

Typically for a large laybarge three AHT's will be used to work a spread of ten to twelve anchors. The tugs work as a team directed by the "tower foreman" and they are expected to respond rapidly to his directions. The work may spread over days or even weeks and the tugs must be so manned that the fatigue element of both deck crews and officers is taken into consideration.

This is often achieved by having extra personnel on both bridge and deck. Neglect of the fatigue element can have serious safety and efficiency implications.

Laybarge anchor work has its own peculiar dialogue which may require some explanation if tug personnel are not to be confused.

Tower order	**Translation**
Pick it up	Lift the anchor off bottom
Put it down	Put anchor on bottom
Take off	Run the anchor in direction indicated
Live anchor	Tug holds anchor under roller and remains pulling in the direction and at power setting indicated
Run the Yokahama	Attach the Yokahama fender on the anchor wire where ordered
DMA system/buoy	Dead man anchor A set of anchors and buoys laid at the beginning of a pipelay sequence
A and R system/buoy	A buoy system used when the pipeline end is placed on the seabed and buoyed off.