Updated Handbook on the W.F.A. Cockle Dredge of 1968

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SEA FISH INDUSTRY AUTHORITY
Industrial Development Unit

UPDATED HANDBOOK ON THE W.F.A. COCKLE DREDGE OF 1968

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SUMMARY

This handbook was originally written in 1968.

Since that time, the design has changed only marginally and most of the information is still valid for this type of dredge.

The handbook has been up-dated to include known improvements and experience and based on recent trials of pumping rates from this dredge (reference 2103 14th Oct. 1987).

It is important to note that this handbook refers to the "HYDRAULIC LIFT" or "JET PUMP" cockle dredge.

During 1987 the Seafish Industry Authority, with M.A.F.F. funding, embarked on a project to design an improved cockle dredge system to reduce shell damage and improve dredging rates. This project has been very successful with the resulting system being known as the "SOLIDS PUMP" cockle dredge.

The two main changes are that the "JET PUMP" has been replaced by a solids handling pump onboard and all the water from the pressure pump is used in digging jet(s) at the front of the dredge.

This "SOLIDS PUMP" system is superior to the original dredge in several ways and is likely to supercede it. The system is more expensive initially but the rewards make it economic. Details of the new system will be available from Seafish, Hull mid-1988.

The new dredge system is presently in use on a Kings Lynn vessel and its performance is exceeding expections.

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Updated by SEAFISH 1988

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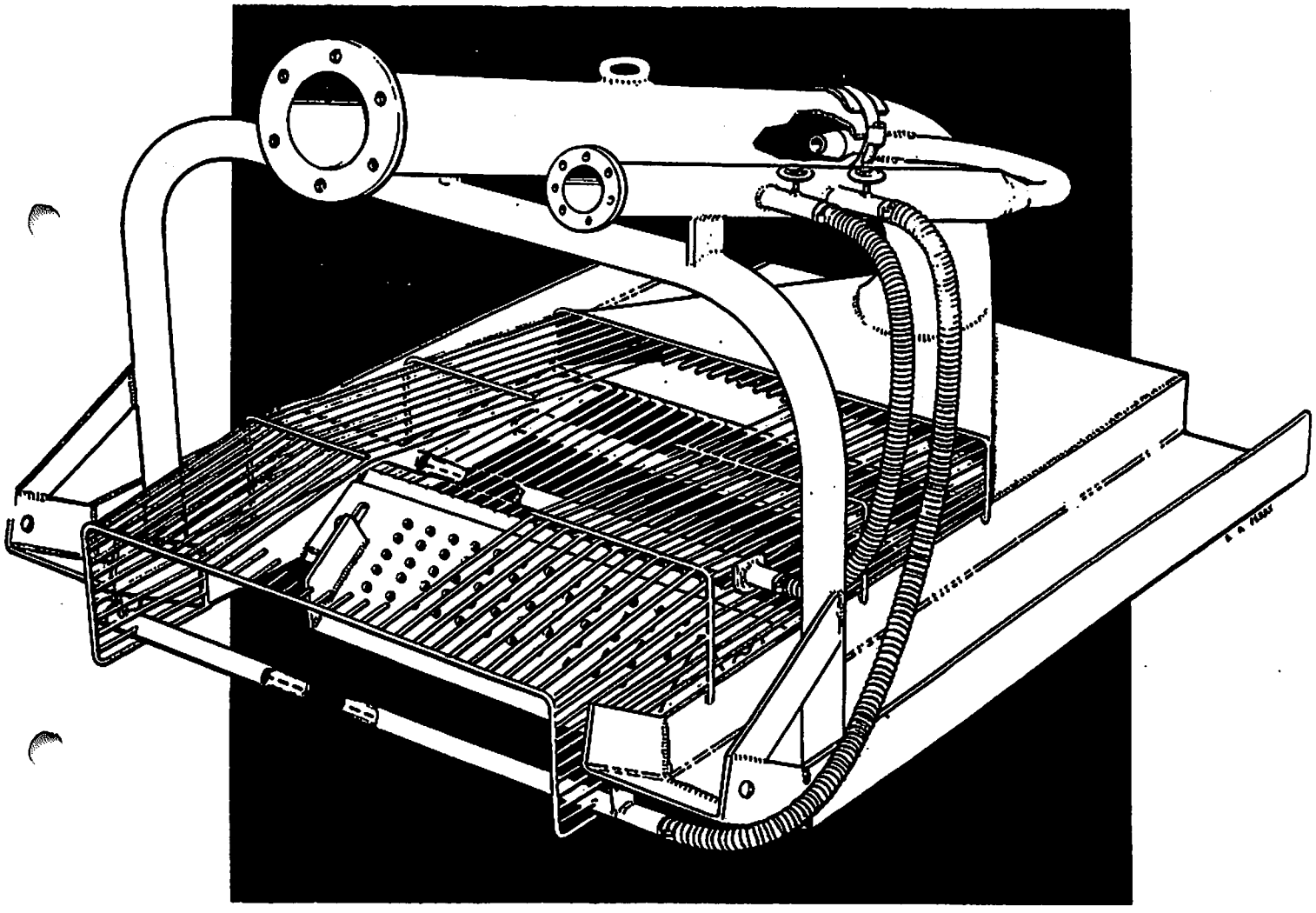

Hydraulic Lift Cockle Dredging Equipment

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1. INTRODUCTION

Designed and developed by the White Fish Authority in conjunction with the Severnside Oyster Company (Bangor) Limited, the hydraulic-lift cockle dredge continuously delivers cockles on deck without the need to lift the dredge from the sea-bed.

Extensive trials have shown that the dredge harvests between 80% and 100% of the marketable cockles in its path and at the same time separates out undersize cockles which resettle readily with indications of only 5% mortality. The dredge tracks are soon repopulated by cockles migrating from the surrounding area.

Harvesting rate in terms of weight per hour is dependent on the cockle population density and dredge size. It has been as high as 6.1 tonnes (6 tons) per hour on very dense beds with a 610mm (24in) wide dredge blade. Results over several months from trials in the Thames Estuary with a 300mm (12") wide dredge blade gave an average harvesting rate of 1000-1250kg (20-25kg) per hour mainly on beds of small cockles too thinly populated for hand picking. On occasions 1780kg (35cwt) per hour has been achieved on higher density beds and on very low density beds the delivery has been as low as 760kg (15cwt) per hour. The 610mm (24in) wide dredge and blade is now in general use.

2. PRINCIPLE OF OPERATION OF DREDGE

The dredge takes continuous slice of sand and cockles from the sea-bed. After separating out some sand and undersize cockles it delivers sandy water and cockles to deck level where they are discharged onto a rotary riddle. The riddle allows sand, water and undersize cockles to fall overboard leaving only marketable cockles to be directed into bags or into the hold.

The dredge (Figure 1) is towed by chain along the sea-bed. A series of holes in the digging jet pipe provides jets of water to fluidise the sand in front of the blade which takes the cut of sand and cockles. Forward motion of the dredge forces the sand and cockles up the slope of the blade and onto the separator screen. Here the separator jets break the sand from the cockles, force sand, shell and undersize cockles throught the bottom grid and push marketable cockles towards the back of the dredge. At the back of the dredge, suction created by a powerful jet of water in the jet pump section, lifts and transports the cockles in water through a large flexible pipe and onto the riddle. This allows unwanted water, undersize cockles and old shells to fall overboard whilst only the marketable cockles are directed inboard to be bagged or channelled into the hold space.

3. DESCRIPTION OF THE DREDGE AND RIDDLE

3.1. Dredge

Construction details are given on up-dated Seafish Authority Drawing No. M 8660A1 which can be purchased. The basic construction of the dredge is shown in Figure 2 and Figure 3.

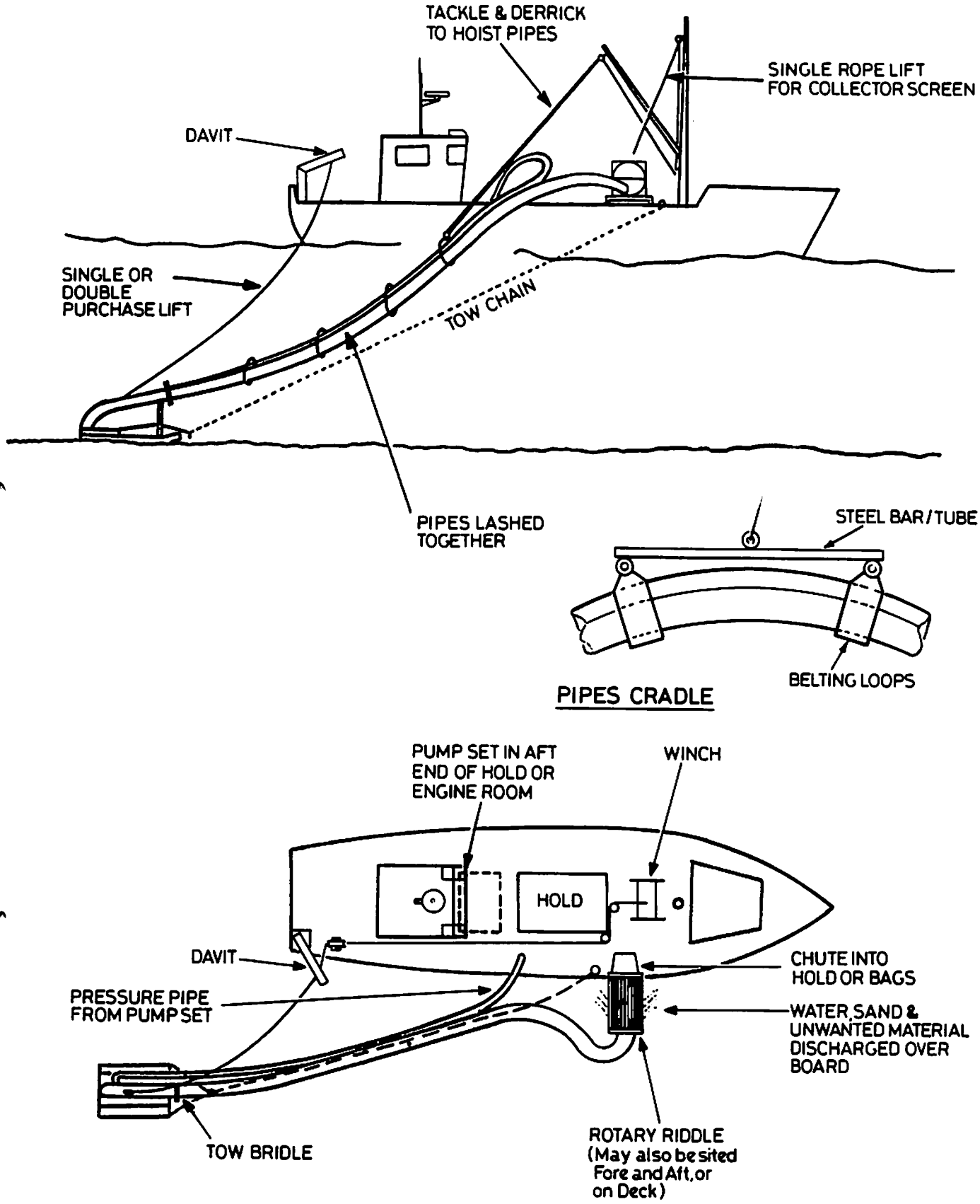
The dredge is of mild steel construction throughout with the exception of the blade which is usually of tougher composition. The digging jet pipe is situated across the front of the runners just above the level of the underside of the runners and directs one set of jets downwards in front of the blade, and a second set backwards

on to the blade. The blade which is adjustable for depth of cut is supported between two channel section runners and slopes upwards and backwards until it joins the separator screen. The separator screen extends horizontally backwards to the suction unit. Situated across and over the separator screen is the separator jet pipe in which the jets are angled backwards. The separator screen is totally enclosed by a grid above the jet pipe and this is extended forward to include the digging jet pipe. At the back of the dredge a solid plate triangular suction unit is formed which leads up to the jet pump via a suction pipe.

The jet pump, of which the suction pipe is an integral part, extends from the back of the suction unit to a tubular gantry at the front of the dredge. It is secured to the gantry and a flange is provided for the connection of the flexible delivery pipe. The jet pump consists of a pipe of uniform diameter and a nozzle which is let into the bottom of the pipe and directed towards the flexible pipe connection. The nozzle is mounted on a bolt or flange to allow alignment of the jet and nozzle replacement. High pressure water is supplied to the nozzle by a steel pressure pipe which is also connected at the gantry to a flexible pressure pipe. Valve connections are provided on this pressure pipe to supply the separating and digging jets.

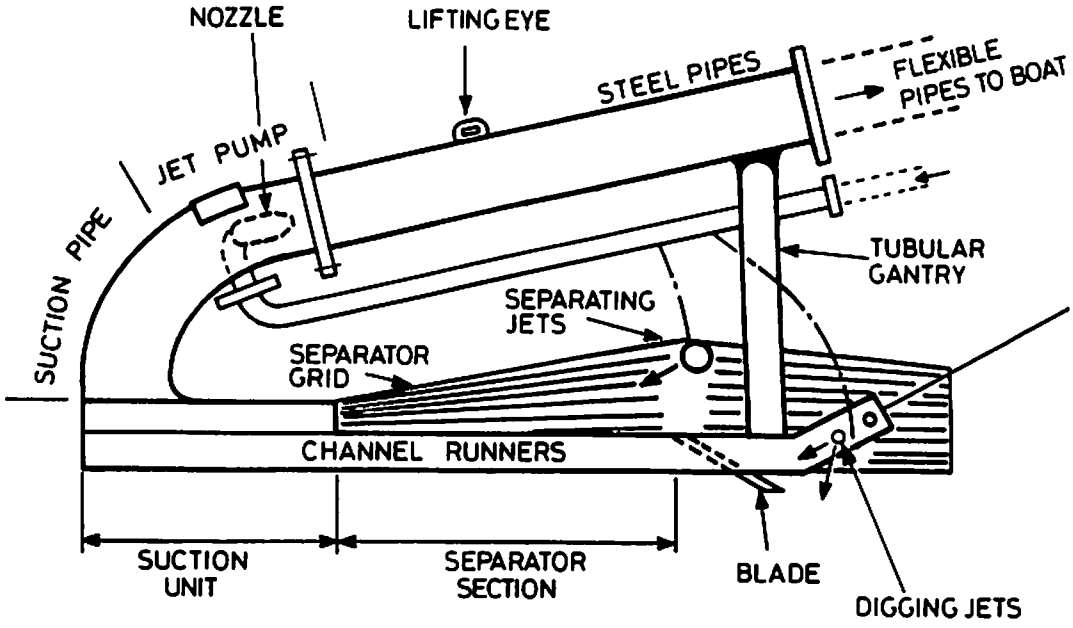
A lifting eye is welded to the jet pump pipe. Towing is by a chain bridle from the front of the runners.

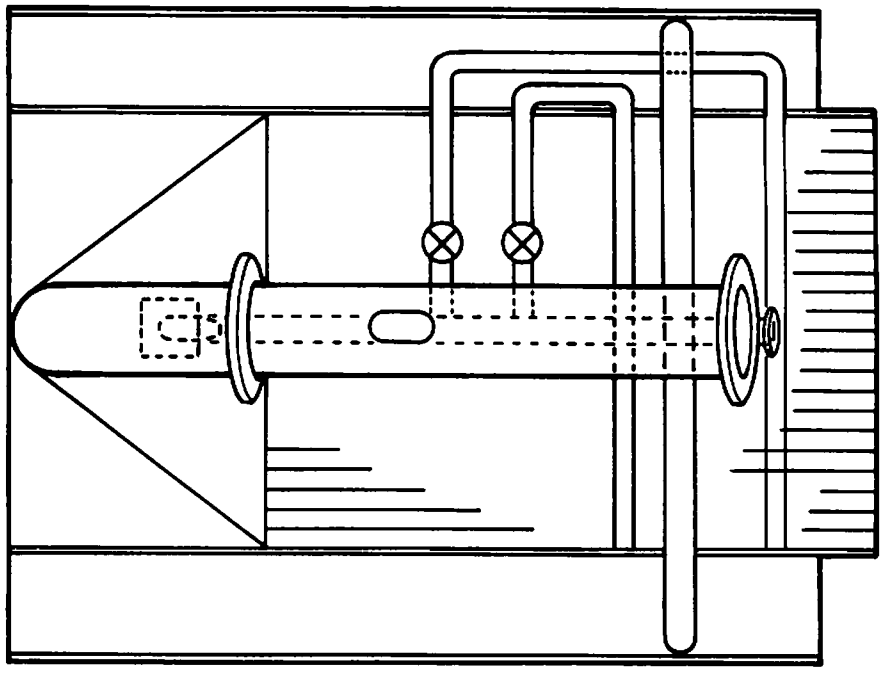
3.2 **Riddle** - This has superceded the original static screen.
The riddle (Figure 4) is a rotating drum formed from mild steel bars which may run axially or be in the form of hoops. The spacing of the bars should be such that the undersize cockles will pass through. The drum can be driven by an electric or hydraulic motor which ever is the most convenient at approximately 40/60rpm.



Dredging Equipment

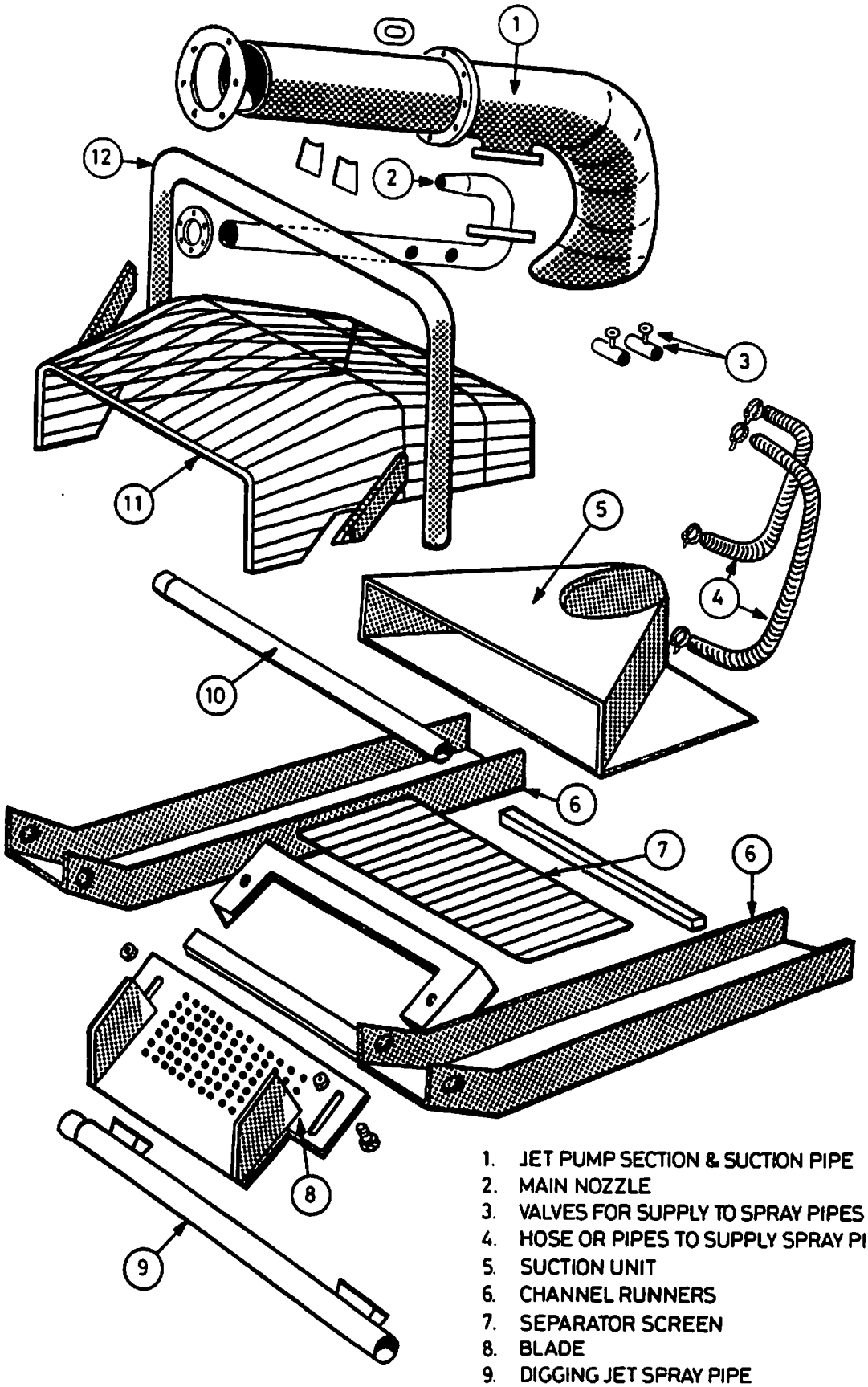
Fig.1





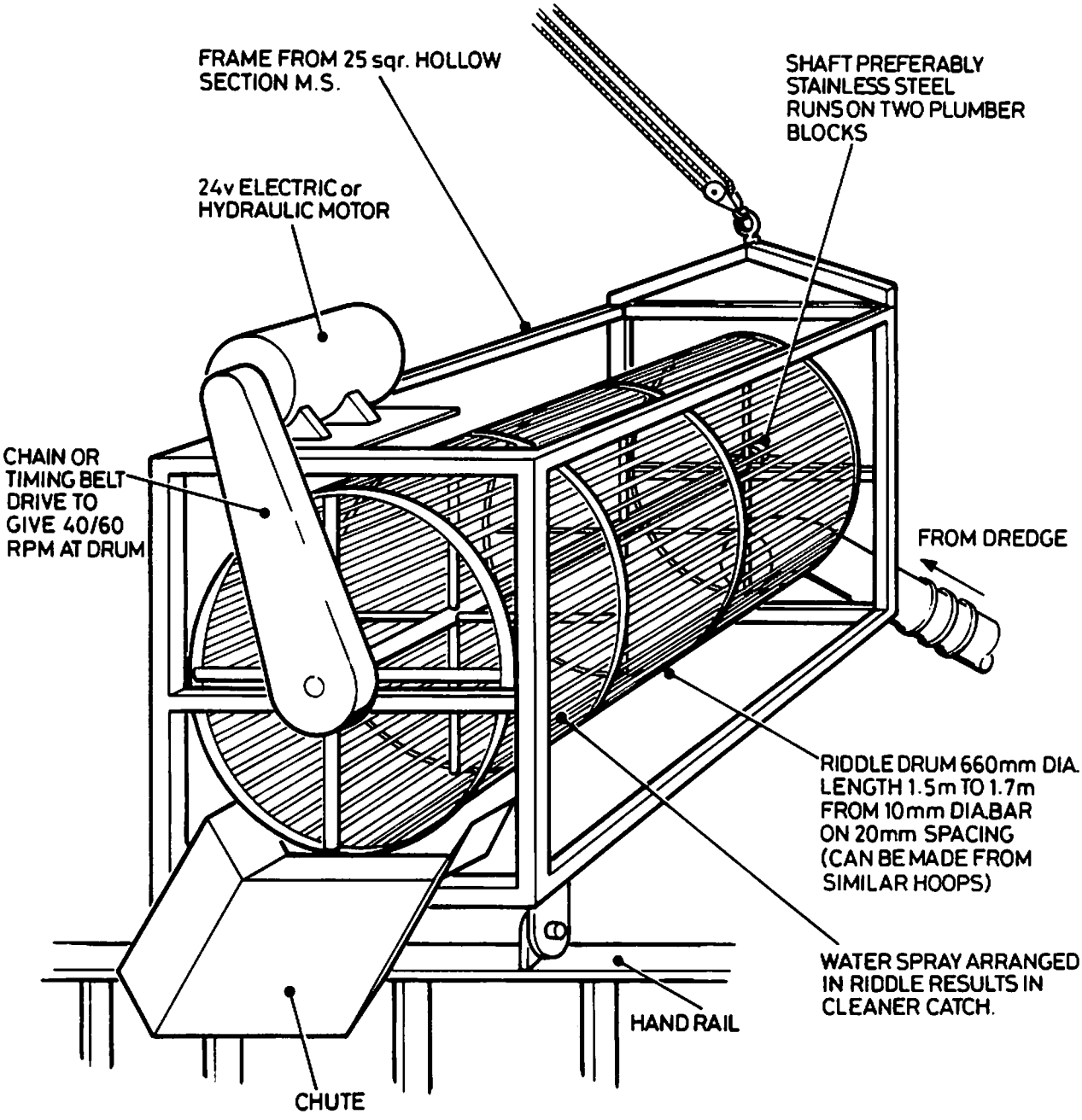
The Dredge

Fig.2



1. JET PUMP SECTION & SUCTION PIPE
2. MAIN NOZZLE
3. VALVES FOR SUPPLY TO SPRAY PIPES
4. HOSE OR PIPES TO SUPPLY SPRAY PIPES
5. SUCTION UNIT
6. CHANNEL RUNNERS
7. SEPARATOR SCREEN
8. BLADE
9. DIGGING JET SPRAY PIPE
10. SEPARATING JET SPRAY PIPE
11. TOP AND SIDE SECTION OVER SEPARATOR SCREEN & BLADE
12. TUBULAR GANTRY

Dredge Components Fig.3



Rotary Riddle

Fig.4

The drum is carried in a square tube frame and can be mounted over the side of the vessel, or on the deck. If the riddle is deck mounted adequate arrangements must be made for clearing the water from the deck.

4. LIST AND SPECIFICATION OF EQUIPMENT REQUIRED FOR DREDGING

4.1 Vessel

A shallow draft vessel of adequate hold capacity, over 10.7m (35ft) long and having a free running speed of at least 6 knots. Two men, or one and youth, are required to work the equipment.

4.2 Dredge

As described in Paragraph 3.1. Of welded mild steel construction to Seafish Authority drawing No. M.8660A1 (original drawing was I.D.U. 2116).

4.3 Riddle

As described in Paragraph 3.2. Of welded mild steel construction. Hydraulic or Electric drive.

4.4 Pumping Set

To deliver high pressure water supply to the dredge.

For a 610mm (24in) dredge 30 litres/sec (400gpm) at 100lb/in^2(7kg/cm^2) pump delivery pressure is required.

For an 460mm (18in) dredge 22 litres/sec (300gpm) at 100lb/in^2 (7kg/cm^2) pump delivery pressure is required.

On both sizes of dredge the blade width may have to be reduced on muddy or silty grounds.

A pressure gauge connection should be fitted at the pump outlet.

Full details and specification for a pumping set is shown in Appendix 1.

4.5 Winch

To hoist dredge from the sea-bed and if two-barrelled may be used to hoist pipes. The winch should be capable of a 10cwt (500kg) lift at a speed of 60ft/min (18m/min). This speed however is not critical because of the very short lift.

5. SPARE EQUIPMENT AND REPAIRS AT SEA

There are times when some repairs must be carried out at sea and if suitable tools and spares are on board a trip back to port may be avoided.

Based on experience to date is recommended that the following items should be carried:-

5.1 Pressure Hose

A full spare length is desirable but at the very least some short lengths to make up in the event of a burst.

5.2 Delivery Hose

Failure normally occurs next to pressure pump and the short damage section can be cut out. Thus it is not really necessary to carry a spare length of this hose but one should be readily available ashore.

5.3 Hose Fittings

It is essential that connections and clips for both hose sizes are on board to enable split sections to be cut out and the cut ends to be remade. Connectors should be sized such that they are easily pushed into the flexible pipes. Brass nuts or 316 stainless and bolts are

recommended for flanged joints as steel nuts and bolts quickly sieze up unless regularly removed and greased. Suitable spanners for these nuts and bolts should be carried and a hacksaw with spare blades is useful for cutting pipes.

5.4 Separating and Digging Jet Pipes

The digging jet pipe wears quickly due to its proximity to the sand and will require regular replacement.

6. MAINTENANCE

6.1 Pump Set

Comply with manufacturer's instructions.

6.2 Dredge

1) Keep all water passages clear. Check that digging jets and separating jets are facing in the correct direction.
2) Check the blade depth - to re-adjust for wear, trim the cutting edge when worn.
3) Clean the grid screens of wedged cockles, weed, etc.
4) Check flexible pipes for cracking. The main pipe usually goes at the dredge end or at the riddle. The pressure pipe goes at the pump delivery end. Check pipe clips and couplings.
5) Check the towing bridle.
6) Check the steel delivery pipe downstream of the main jet for leaks. The pipe can be eroded by sand in the vicinity of the jet. Cut out the eroded section and weld in a new piece if necessary.

6.2.2 Damaged Cockles

Even when the dredge is functioning correctly, many cockles delivered have chipped shells. The proportion affected is generally between 5% to 35% but varies from ground to ground and depending on the cockle

population density and the quality of their shells. Almost all of the cockles which are damaged have slight chipping in the region of the hinge which does not affect the cooked meats, this damage is cause by collisions between cockles as they pass throught the jet pump.

If badly smashed cockles are appearing an any quantity, it is probably due to one of the reasons in Table 1.

6.3 Davit or Gallows

To handle and stow dredge. To be designed so that the dredge is stowed inboard when not in use and be capable of allowing the dredge to be lifted and lowered clear out over the ship's side.

6.4 Derrick

To handle pipes and, if required, riddle. It should have a minimum S.W.L. of 5cwt (250kg) with the outer end approximately 12ft (3.6m) above the deck in way of the riddle. Lifting by hand rope tackle or warp from winch if available.

6.5 Propeller Guard

To prevent fouling of the propeller with pipes or dredge lifting warp. A successful method has been to form a rigid circular band of mild steel of section 3/8in. x 2in. and of a suitable diameter to clear propeller blade tips and rigidly fastened to the hull.

6.6 Towing Chain

To take the weight of the dredge when towing. 9-11m (30-36ft) of chain with a breaking strain of 3 ton is required. A sheathing of old rubber hose on the tow chain will prevent scuffing on the side of the vessel.

6.7 High Pressure Pipe

To convey water from pumping set to dredge.

Braided canvas reinforced smooth bore rubber hose with a quoted working pressure of at least 10.5Kg/cm^2/150lb/in^2 is required. Various other types of hose have been used but all had a very limited life because of the arduous duty. 9-12m (30-40ft) of 76mm (3in) bore for the 610mm (24in) dredge and 63mm (2½in) bore for an 460mm (18in) dredge.

6.8 Delivery Pipe

To convey cockles, water and sand from dredge to riddle at deck level. It is essential that the hose be smooth bore, non kinking and with a good abrasion resistance. Fully filled P.V.C. reinforced hose has been found suitable although inclined to be stiff at low temperatures. A rubber hose is also suitable for this duty but has the disadvantage of being very expensive and the couplings or fittings are often difficult to make.

9m (30ft) of 150mm (6in) bore is required for the 610mm (24in) dredge and 130mm (5in) bore is adequate for the 460mm (18in) dredge.

A cradle is required at the lifting point on this pipe to prevent excessive kinking when lifting and to keep the pipe within the recommended minimum bending radius.

7 RECOMMENDED ARRANGEMENT OF DREDGING GEAR

7.1 Layout of Equipment

This depends on the vessel used. In general the dredge is stowed and secured on the davit or gallows structure. The pipes are stowed along the deck with the towing chain, from the dredge to the riddle which is sited forward. In some cases where the distance between the dredge and riddle is insufficient the pipes may have to be looped on the deck. The anchor point for the towing chain, i.e. the towing point, should be well forward. Preferably the pumping set should be

sited below deck. If an existing winch is employed its position is fixed and extra fairleads have to be provided. If it is necessary to fit a winch or hoisting device it is best situated in way of the davit, but many other variations of hoisting arrangement are possible.

A typical layout of dredging equipment is illustrated in Figure 1. The gear can be arranged to fit whichever side of the vessel is desirable.

7.2 Working Depth

With the length of delivery pipe at 9m (30ft) or thereabouts dredging is limited to 4.6m (15ft) below the surface with dredging efficiency starting to fall off at about 3.6m (12ft). This however, depends on the strength of the tide, at slack tide dredging has been carried out at 5m (16-17ft).

7.3 Length of Pipes and Tow Chain

Relative lengths of the large delivery pipe and towing chain are very important. There should be a small amount of slack on the large pipe at 4.5m (15ft) depth so that the towing chain takes the weight of the tow. This setting should then be satisfactory for dredging at lesser depths. Experience suggests the towing chain should be 1m (3ft) shorter than the large pipe, assuming that the tow point on the vessel is in line with the end of this pipe (with the gear in the dredging position). In practice the tow point is usually about 1.2m (4ft) forward of this position and the towing chain would thus be approximately 0.3m (1ft) longer than the large pipe. If the large pipe is shortened, perhaps to re-make a connection, then the towing chain length should also be shortened by the same amount.

The small or pressure pipe length will depend on the position of the pumping set and is usually 9-12m (30-40ft) but should be of

sufficient length to enable hoisting of the pipes without any strain.

7.4 Jet Pipes

Slots and holes should be to the recommended sizes and direction. (See section 9 and drawing M8660A1). These openings should be checked daily when dredging and cleared if necessary as only slight blockages can upset the efficiency of the jets. This also applies to the blade if it is perforated.

After a lengthy period of operation the slots may become enlarged. This will starve the main jet pump nozzle of pressure and a fall-off in efficiency will result. If, due to this reason, the pressure cannot be maintained the jet pipes should be renewed.

7.5 Blade Depth Setting

This blade is adjustable over the range 0-55mm (0-2¼in) depth of cut. Broadly speaking the blade depth should be set to the same dimensions as the length of the cockles being dredged. However, the setting does depend on the type of bottom, for hard sand a little deeper and on soft muddy or silty grounds a little less. Summer and Winter seasons also have their effects on the setting of the blade. In most cases the best setting is only found by experience. Too shallow a cut results in cockles being smashed open and too deep a cut results in lifting too much dead shell. It is thus best to adjust the blade to give a minimum of smashed shells with little or no dead half shells. Excessive delivery of dead shell occurs occasionally when patches of old shell are encountered but this condition is readily recognised as there are no live cockles delivered and often indicates the limit of the bed.

8 SHOOTING AND HAULING THE DREDGE

Some duties preparatory to shooting can be performed whilst on passage to

the beds, duties such as arranging chutes in hold, checking fastenings and rigging etc.

8.1 Shooting

1) Arrange screen in working position and clip in delivery pipe if possible.
2) Start and prime pump set.
3) Hoist dredge outboard but do not lower, lift pipes up to derrick.
4) Open valve or speed up pump set to supply water to the dredge. Check the digging and separating jets are operating. Dredge may be lowered just below surface to prevent excessive splash but care must be taken to ensure that the end of delivery pipe is discharging overboard.
5) Manually lift towing chain overboard.
6) Lower away dredge and pipes together until both the hoisting warp and pipe lift are slack and the towing chain is taut.
7) Adjust pump delivery pressure to maintain a good flow from the large delivery pipe, depending on pipe length and size, may be from 4.2-6.3kg/cm^2(60-90lb/in^2). Pressure required at the main nozzle on the dredge is between 3.5-4.5kg/cm^2(50-65lb/in^2) with both jet pipes turned on.
8) Adjust the angle of the riddle if necessary.

Note:- Dredge should never dropped onto the sea bed before water is applied because it may choke up with sand initially and impair performance.

Dredging can then be carried out continuously as long as cockles are being delivered and everything appears in order. See Section 9.2 and Tables 1 & 2 for faulty operation.

8.2 Hauling

On completion of dredging the hauling procedure is as follows:-

1) Hoist dredge and pipes together taking care not to put excessive lift on the pipes.
2) Shut-off water to dredge and stop pumping set.
3) Lift towing chain inboard.
4) Stow dredge and pipes along deck.
5) Swing or lift riddle inboard and secure.

If hoisting warp is powered from pumping set then it may be necessary to delay the stopping of the engine and to do so when convenient.

9 WORKING THE DREDGING EQUIPMENT

9.1 Normal Working

When dredging, the towing chain should be kept taut at all times, thus showing that the dredge is being towed properly from the front of the runners.

For efficient dredging it is important to tow the dredge at the correct speed, which should not exceed 1½ knots over the ground, nor fall below 1 knot.

Manoeuvres are best made to the same side that the dredge is towed so that the gear does not pass under the boat and risk fouling the propeller with the pipe. However, providing there is sufficient water under the boat, turns can be made to the opposite direction.

When towing in a straight line the simplest way to control the boat is to keep the towing chain just clear of the line of the side of the vessel. When towing in a curve, or turning, the dredge will swing relatively further away from the vessel.

On the muddier and silty grounds the dredge performs better by towing against the current. This is because the water streaming past the dredge assists in clearing the mud by flowing throught the front of the dredge and washing out of the top and sides of the grid section. On weedy grounds towing against the tide has the same benefits.

9.2 Malfunctionion of the Dredge

9.2.1 Delivery from Dredge

The colour of the water and the cockle delivery from the large pipe is a good indication of whether the dredge is working correctly. The delivery should appear muddy or coffee coloured. A light colour or clear delivery generally associated with reduction in cockle delivery rate, indicates malfunctioning of the dredge which can be due to one or more of the reasons in Table 1 and 2.

10 EQUIPMENT COMMONLY USED

10.1 Pressure Pump

WEIR ISOGLIDE 125-100-315

SPP UNISTREAM 80/32

10.2 Pressure Pipe - see section 6.8

10.3 Delivery Pipe - see section 6.9

TABLE 1

DAMAGE TO COCKLES

	REASON FOR EXCESSIVE DAMAGE TO COCKLES	CORRECTIVE ACTION
1	Incorrect depth of cut or malfunctions 4, 5, 6, Table 2.	Increase blade depth setting or correct faults 4, 5, 6, (Table 2.)
2	Falling too far into the hold and striking floor	Instal simple chute to channel the cockles into the hold.
3	Pressure too high at pump delivery creating too much turbulence.	Check that pump outlet pressure is normal. If damage persists and excessive chipping is also present check that sufficient water is escaping from digging and separating jets.
4	Pressure too low at dredge allowing cockles to build up in the dredge or pipe-work.	

TABLE 2

MALFUNCTION OF DREDGE

	MALFUNCTION	CORRECTIVE ACTION
1	Tipped over on side	Raise of bottom and drop, or raise to deck level and check for faults 2 and 3.
2	Suction unit blocked.	Raise to deck level and check for weed, driftwood, bottles, stones, polythene sheet, etc.
3	Choked with sand or mud.	Raise and check. The trouble has often cleared by the time the dredge reaches the surface. Check blade depth is not excessive, the pump pressure is adequate and the jet pipes are in order.
4	Lifting off bottom as a result of excessive depth or towing too fast especially against strong tide.	Reduce towing speed. If trouble persists check depth of water. If over 4.5m (15ft) it is unlikely that dredging can be continued. However, a slower towing speed and weights on dredge may improve efficiency.
5	Towing light at front end and not taking full depth of cut.	Raise and examine shine on bottom of runners. If balance of dredge has altered add weights to front of dredge. If not, condition caused by onset of fault 4.
6	Partially towed by pipes. Rear-end raised.	Raise and examine for shine at front end of runners. This indicates pipe lengths too short for chain length. Correct by shortening the towing chain.