Cockle Dredging

Improved Performance Using a Solids Pump

MAFF Commission
Technical Report No. 348
November 1988

MAFF R&D Commission 1988/89

SEA FISH INDUSTRY AUTHORITY
Industrial Development Unit

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Seafish Report No. 348
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Project Code IAG16

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SUMMARY

This report describes the development of an improved cockle dredging system for the small (about 12 metres) vessels in the U.K. fleet carried out under the MAFF R&D Commission 1988/89, Project Code IAG16.

The major change was to use a solids handling pump for pumping water and cockles from the dredge head as opposed to the former method of a water jet pump incorporated within the dredge, which was the principle of the WFA cockle dredge developed in the 1960's.

Four different solids pumps were shore tested and three found to give satisfactory performance running at a restricted speed. The dredge head design was altered to resemble a smaller version of the standard Dutch suction dredge which has incorporated the solids pump principle for some years. The Dutch dredgers, however, are much larger than those in the U.K. and for this reason it was not possible to transfer the technology from one fishery to the other.

Two separate shipboard installations were completed at Kings Lynn and subsequent trials in the Wash were most successful.

The catch rates of the solids pump dredge were an unexpected bonus. They were effectively double those of the water jet type and this when coupled with the lower damage rate makes the system very attactive. The higher catch rates would permit profitable working on lower density cockle beds. The new pumps gave no mechanical difficulty but some cure has to be exercised with the under deck components as such a large volume of water spilling into the ship could be very dangerous to the vessel.

The solids pump system will cost more but the higher catch rates could result in a pay back of the extra investment within a season.

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1 INTRODUCTION

In the 1960's the White Fish Authority developed a method of dredging for cockles using a jet pump to lift the cockles from the dredge head. This system is satisfactory in its ability to lift cockles but has the disadvantage that in all but ideal circumstances the damage to the cockle shells is very high. This leads to a loss in the yield of meats and difficulty in removing sand and grit from the meats. Information and reports on the original dredge are listed in the Reference section of this report.

Since the work originally done by the W.F.A. the Dutch have further developed the suction dredging system using a solids handling pump. The W.F.A. dredge uses a jet pump in the dredge head to lift the cockles from the sea bed. Dutch engineers replaced the jet pump with a deck or ship board mounted solids handling pump which sucks the cockles from the dredge head. The dredge head was also developed in that a high velocity water jet is used to do most of the digging rather than the blade of the dredge. It was thought that this new technology could be advantageously applied to the U.K. cockle dredgers.

Seafish to find a suction pump suitable for pumping cockles and develop a dredge based on the Dutch principles, but for the smaller class of vessel more commonly found in the British cockle fishery.

2 OBJECTIVES

2.1 The prime objectives were to establish the solids handling pump dredging technique on a scale suitable for the U.K. cockle dredging vessels.

A solids handling pump of the type used in the Dutch cockle industry was to be procured and tested plus as large a range of solids handling pumps of U.K. manufacturer as could be tested within the limits of available time and finance.

2.2 Modifications were to be made to the jet pump type dredge to allow it to be used with a solids handling pump.

2.3 Having established which pumps would be suitable for pumping cockles, the pumps and system were to be installed on one of the vessels owned by Beachcomber Foods and sea trials performed under commercial dredging conditions.

3 THE PUMPS

3.1 The pump which has become the standard for the Dutch cockle industry is the German manufactured KSB single vane pump (Fig. 5a). The size of pumps used in Holland are in line with the scale of operations there and are the KRPEX 200-500 or the 250-500 pumps. These pumps are very large and would present problems of installation on the U.K. size of vessel. A single vane pump was selected using the total flow performance of the Authority jet pump system as the performance criterion. It was known that the pump speed had a critical effect on the damage to the cockles and should be kept as low as possible. The performance parameters decided on were 100-150m^3/hour flow with a head of 3-5m at 500-750 r.p.m.

3.2 K.S.B. Manufacturing Company Limited agreed to supply on a hire basis a KRPEX 150-400 Pump Fig. 5a for tests on pumping cockles. This pump is a 6in version of the 8in and 10in pumps used by the Dutch cockle industry. The performance fell within the limits defined above.

3.3 A second pump was made available by Weir Pumps for trials. The pump initially chosen was a Swallowglide SRAM-125. The pump is a 5in open impeller solids handling pump (Fig. 5b). After trials with this pump a 6in version of the pump, an SRAM-150, was supplied for further testing.

3.4 A third pump was made available by Egger Turo Pumps (U.K.) Ltd. This was their T8-150-HP8. The pump is different from the KSB and Weir pumps in its basic design (Fig. 6) - being of the recessed impeller or vortex type. The impeller is recessed in the backplate of the pump and develops a swirling vortex in the incoming fluid which causes the flow of fluid. The vast majority of solids in the fluid flow should not contact the impeller. This pump is manufactured in Switzerland but had the advantage of being readily available in the U.K. It was thought that having proved the suitability of centrifugal recessed impeller type pumps, other manufacturers' pumps operating on this principle would also be suitable.

3.5 Specifications of Pumps

3.5.1

Manufacturer	: K.S.B. Pumps Ltd
Address	: Thameside House, Grove Rd, Northfleet, Kent, DA11 9AX.
Telephone Number	: 0474 564359
Type	: Centrifugal Single Vane Impeller KRPEX 150-400.
Suction Flange	: DIN2533 PN16 150mm
Delivery Flange	: DIN2533 PN16 150mm
Case Material	: Cast Iron
Impeller Material	: Cast Iron
Shaft Material	: Steel
Impeller Diameter	: 407mm
Pump Weight	: 340kg

3.5.2

Manufacturer	: Weir Pumps Ltd
Address	: Units 6/7 Cromwell Trading Est, Cromwell Rd, Bredbury, Stockport, SK6 2RA.
Telephone Number	: 061-430-4285/6/7
Type	: Centrifugal, 2 Passage Open Impeller SRAM125 and SRAM150.
Suction Flange	: SRAM125 - BS4504 Table 10 125mm SRAM150 - BS4504 Table 10 150mm
Delivery Flange	: SRAM125 - BS4504 Table 10 125mm SRAM150 - BS4504 Table 10 150mm
Case Material	: Cast Iron
Impeller Material	: Cast Iron
Shaft Material	: 316 Stainless Steel
Impeller Diameter	: SRAM125 - 245mm SRAM150 - 315mm
Pump Weight	: SRAM125 - 475kg SRAM150 - 549kg

3.5.3	Manufacturer	: Egger-Turo Pumps (U.K.) Ltd
	Address	: Unit 3, Fountain House, Cleeve Rd, Leatherhead, Surrey, KT22 7NH.
	Telephone Number	: 0372-377688
	Type	: Centrifugal Recessed Impeller T8-150HP8
	Suction Flange	: BS4504 Table 10 150mm
	Delivery Flange	: BS4504 Table 10 150mm
	Case Material	: Cast Iron
	Impeller Material	: Cast Iron Rubber Lined
	Shaft Material	: Steel
	Impeller Diameter	: 335mm
	Pump Weight	: 255kg

4 METHODS OF TESTING - WORKSHOP TRIALS

The pumps were mounted on a bed plate (Figs. 7 & 8) and driven by a Lister SR2 diesel engine producing 13 h.p. (9.7kw) at 2000 r.p.m. Each pump was belt driven with a speed reduction 2.63:1 giving a speed at the pump of 350-750 r.p.m. Water flow through the pumps was measured with a Platon flow controls SUGV150 orifice type flow meter. Pump speeds (r.p.m.) were measured with a Smiths ATH6 hand tachometer. Fig. 7 shows the arrangement of the test equipment used for testing the KSB KRPE-150-400 and the Weir SRAM125 Pumps. Fig. 8 shows the arrangement used for the Weir SRAM and the Turo T8-150HP8.

Each pump was run in 50 r.p.m. steps through its r.p.m. range and the flow measured at each speed, thus calibrating the pump on the test rig.

After the calibration each pump was tested for its cockle pumping ability by passing 25kg batches of hand picked cockles with less than 1% chipped shells through the pump. Other debris - old mussel and cockle shells - were also allowed to pass through the pump in order that actual pumping conditions could be simulated. The cockles were fed into the suction box at a rate approximating to a catch rate of 5-6 tons/hr. After being pumped a damage count was done on each batch (Fig. 11 and Table 1).

5 COCKLE PUMPING TEST RESULTS

5.1 The K.S.B. 150-400 pump test results are shown in Table 1 and Figs. 11 and 12. The pump was set up for testing as shown in Fig. 7. The pump produced flow rates of 80m^3/hr at 400 r.p.m. which was quite sufficient to move the cockles. The damage rate above 500 r.p.m became excessive, over 15% total damage, which sets a maximum operating speed of 500 r.p.m.

5.2 The first Weir pump tested - the SRAM125 - had to be run at speeds above 700 r.p.m. in order to generate sufficient flow of 60m^3/hr to move the cockles. At this pump speed the damage rates were unacceptably high - 20% total damage.

It was considered that the larger version of this pump with its improved flow performance at lower speeds would perform satisfactorily. Weir were good enough to provide a SRAM150 pump for further trials. The pump was set up for testing as shown in Fig. 8. The facilities used for the tests shown in Fig. 7 were no longer available and the arrangement shown in Fig. 8 was used. This is representative of a below deck mounting of the pump. The results are shown in Figs. 10 and 11. The flow performance of this pump was found to be adequate and the damage rates although showing more scatter than the K.S.B. pump were considered acceptable if the speed is limited to 450 r.p.m. The pump delivers 120m^3/hr at this speed which is adequate to move the cockles.

5.3 The Turo T8-150HP8 pump was tested in the set-up shown in Fig.8. This pump has a pumping performance similar to the Weir 6in pump. The damage rates were quite acceptable provided the speeds were kept below 500 r.p.m.

6 THE DREDGE HEAD

The original objective was to use a modified W.F.A. dredge head with the suction pump but circumstances did not permit this. A scaled down version of a Dutch dredge (Fig. 3) was built for Beachcomber Foods based on information supplied by the skipper of a Dutch cockle dredger.

There are two main differences in the design of the Dutch and W.F.A. dredge considering only the dredging function. The Dutch dredge (Fig.3) uses a single large fantail digging jet, instead of the two spray pipes used in the W.F.A. dredge (Fig. 4). This large digging jet does most of the digging, the blade only guides the cockles into the suction box. In the case of the Authority dredge the blade does most of the digging.

The collector box of the Dutch dredge is in the form of an open cage with the cockles being lifted from the top of the cage via a bellmouth at the end of the suction pipe. The Authority dredge lifts the cockles from an enclosed sheet metal box at the back of the dredge. The open cage construction of the Dutch dredge makes it less susceptible to clogging with mud and other materials. A proportion of the spat and undersize cockles are also passed back onto the sand.

The Dutch dredge requires a large volume of low pressure water ($150m^3/hr$ at 18-20m head) rather than the high pressure and low volume of the W.F.A. dredge. Construction details for the Dutch dredge are given on Seafish Drawing No. M8662A3.

7 SEA TRIALS ON F.V. "LUCKY LUKE" AND F.V. "LEIGH DAVID"

7.1 Installation "Lucky Luke"

The K.S.B. pump used for the tests was purchased by Beachcomber Foods and used to fit out the "Lucky Luke" for suction dredging. The "Lucky Luke" is a Cygnus GM36 G.R.P. vessel. The main engine is a 760AEC 190 h.p. diesel. The vessel was fitted out as shown in Fig. 1.

The original pressure pump, a Weir 125-100-315 Isoglide pump engine driven by a Perkins T6-354 diesel (producing 120 h.p. at 2200 r.p.m.), used on the W.F.A. dredge previously used, were retained and used to power the new system. The full flow of the Weir Isoglide pump was used to supply the digging jet of the Dutch-style dredge head.

A hydraulic pump was driven directly off the engine and used to power the suction pump. This was done as shown in Fig. 9. The flow divider was used to limit the suction pump speed to 500 r.p.m. The suction pump was mounted on the starboard foredeck. The digging jet pump was piped up in such a way that its full output could be used to prime the suction pump.

After initial problems with priming were traced to an air leak in the suction pipe work, no further problems were experienced priming the suction pump. The 6in and 8in diameter flexible hoses used were Cre-a-flex P.V.C. suction hose and the 4in diameter pressure hose was Gaciord multi-purpose delivery hose.

7.2 Dredging Trial

The first days dredging was done on the 20th February 1988 on Tofts Sand. Extra weight of 457kg (9cwts) was added to the dredge. Experience with the W.F.A. dredge indicated that this amount of ballast would be adequate. The dredge was lowered to just below the surface. The pumping engine started, the suction pump was primed and the dredge lowered to the sea bed.

The tow was then started. Immediately the cockles being discharged from the riddle were seen to have a low damage rate. The damage rate was checked at intervals through the tow and recorded in Table 2. The towing speed was checked at 3.5 knots on the navigator.

Two tides were dredged during the day. The blade was lowered by 6mm, otherwise no changes were made and no problems were encountered. 7.1 tonnes of cockles were dredged for the day.

The author accompanied the vessel on 22nd and 23rd February. On 22nd February 5 tonnes of cockles were dredged, no problems were encountered and no changes were made. On 23rd February no dredging was done due to bad weather making the gear dangerous to handle.

Further damage information was gathered on 21st March when MAFF scientists were invited to observe the operation and gather information on the effects of the dredge on the cockle beds. Their findings are in the MAFF Field Trip Report titled : F.V. "Lucky Luke" 21st March 1988.

7.3 Installation "Leigh David"

Beachcomber Foods bought a second K.S.B. pump and used it for converting the "Leigh David" for suction dredging.

The "Leigh David" is a converted 15m steel work boat. It has a wheelhouse forward layout (Fig. 2) and a large amount of below deck space. This allowed the K.S.B. pump to be fitted below the deck in the hold. A Perkins T6-354M diesel engine drives a hydraulic pump supplying the power for the winch. The hydraulic pump had plenty of spare capacity which was utilised to drive the suction pump. The below deck mounting of the suction pump is the main difference between the "Lucky Luke" and the "Leigh David". This arrangement allows the suction pump to be kept permanently full of water thus simplifying the priming. This also has the advantage of keeping the suction pump and its hydraulics out of the weather and keeping the deck clear for working and storing the catch.

However, with this arrangement integrity of all below deck pipework must be kept sound and in good condition as a leak below deck with such a high capacity pump would rapidly flood the pump room.

7.4 Dredging Trial

The author accompanied the "Leigh David" on the 25th May 1988. The dredge being used was basically the same as that used on the "Lucky Luke". The method of setting the digging jet height and angle had been simplified. Approximately 180kg (4cwts) of extra weight were added to the dredge. The system worked without any problems throughout the trip. The catch and damage rates are shown in Table 3. The dredge was towed at between 2-3 knots and the digging jet nozzle pressure maintained at 17.5m head (25lb/in^2).

8 DISCUSSION AND CONCLUSIONS

8.1 A very large and unexpected benefit of the suction pump system is the increase in catch rates as can be seen in Fig. 13. This effect is due to the change in the work load on the dredge from the blade to the digging jet. As the blade is no longer cutting a slice of sand and cockles from the sea bed but only directing a mixture of sand, cockles and water into the suction box. This reduces the drag on the dredge and allows the vessel to tow faster. The increased towing speed does not increase the damage due to cockles contacting the blade. This increased towing speed allows a greater ground coverage and increased catch rate.

For the period covered by the graph in Fig. 11 the "Lucky Luke" with a suction dredge has a catch rate on average 116% higher than the "Leigh David" with the old Authority dredge. Even considering the differences due to different fishing grounds and the size of cockles caught, this represents a substantial increase in catch rate.

A secondary effect of the increased towing speed is that beds with a lower cockle density can be effectively dredged. Cockle densities of $16/m^2$ giving catch rates of 1 tonne/hr. This is quite an acceptable commercial catch rate (see MAFF Field Trip Report F.V. "Lucky Luke", 21st March 1988).

8.2 Table 2 and 3 show the sea trials damage rates. It can be seen that total damage rates of under 10% can be achieved, on a regular basis. Unfortunately, due to the loss of records in an office fire at Beachcomber Foods very little evidence is available on the effect of reduced damage on the yields. Yield from the cockles is influenced by several factors. The size of cockles has a large effect on the yields, and the physical condition also has a large influence on the yield. The limited data available and the impressions of the processors are that the suction dredged cockles have a 10% greater yield than the cockles dredged with the W.F.A. dredge.

The cockles processed by Beachcomber Foods are cooked almost immediately after landing. If a processor stores cockles for 24-48 hours the effect of damage on the yield will be greater due to spoilage of the cockles with shell damage.

Another aspect of the reduced damage rate is the reduced grit in the cockles, as any broken shell will allow the ingress of grit into the shell which will be carried on into the cooking process, thus contaminating the final product.

8.3 On all the voyages in which the author accompanied the vessels with suction pump systems, no mechanical or operating problems were encountered. The only area where problems occur is with the 6in diameter flexible hose between the dredge and the pump. Cre-a-flex P.V.C. suction hose had the best performance of the hoses tried.

The suction pump is very lightly loaded and only absorbs some 7kw (9.4h.p.). The low rotational speeds should ensure long bearing life and low water velocities which should reduce the effects of sand abrasion on the pump intervals. The digging jet supply pump has the most work to do absorbing 38kw (50h.p.). This pump has a large volume of water to move. The Weir Isoglide 125-100-315 pumps being used on both boats for this job have given no problems and are cheap to replace if problems do occur.

8.4 The two major benefits of the suction pump system, reduced damage and increased catch rates have been proved by the trials. The cost of an installation will be in the range of £4,000 to £7,000 depending on the vessels existing equipment. If the installation cost is £7,000, on a vessel working on average 4 days a week with an average landing of 100 bags per day and the price of an average bag of cockles as £3.00 the vessel will earn £4,800 per month. If the new system increases the catch rate to 150 bags per day, the monthly earnings will increase to £7,200. Thus the increase of £2,400 per month earnings will pay for the new system in 3 months. Not taking into account the increase in yield and the higher price that can be demanded for a better looking product, the system remains economically viable.

9 FURTHER WORK

Suction dredging is used in Holland and has been used in North Wales for harvesting and re-seeding mussels. Work should be done to investigate the effect of suction pumping on mussels. If mussels can be pumped it would have the benefit of increasing the versatility of the boats.

The reduction of sand or grit in the cockles to a level comparable with that of hand picked cockles needs to be examined.

There is a substantial cockle fishery at Leigh-on-Sea which at present is unable to justify the change to the new system. The Leigh fishermen have the unusual problem that the sands they dredge are also used by the military as a firing range. Hence they catch large quantities of shrapnel (up to 100kg in a days fishing). Work needs to be done to find the effect of the shrapnel on the suction pumps or to find a method of filtering it out.

10 REFERENCE

1. Seafish Technical Report No. 333. Updated handbook on the WFA cockle dredge of 1968.

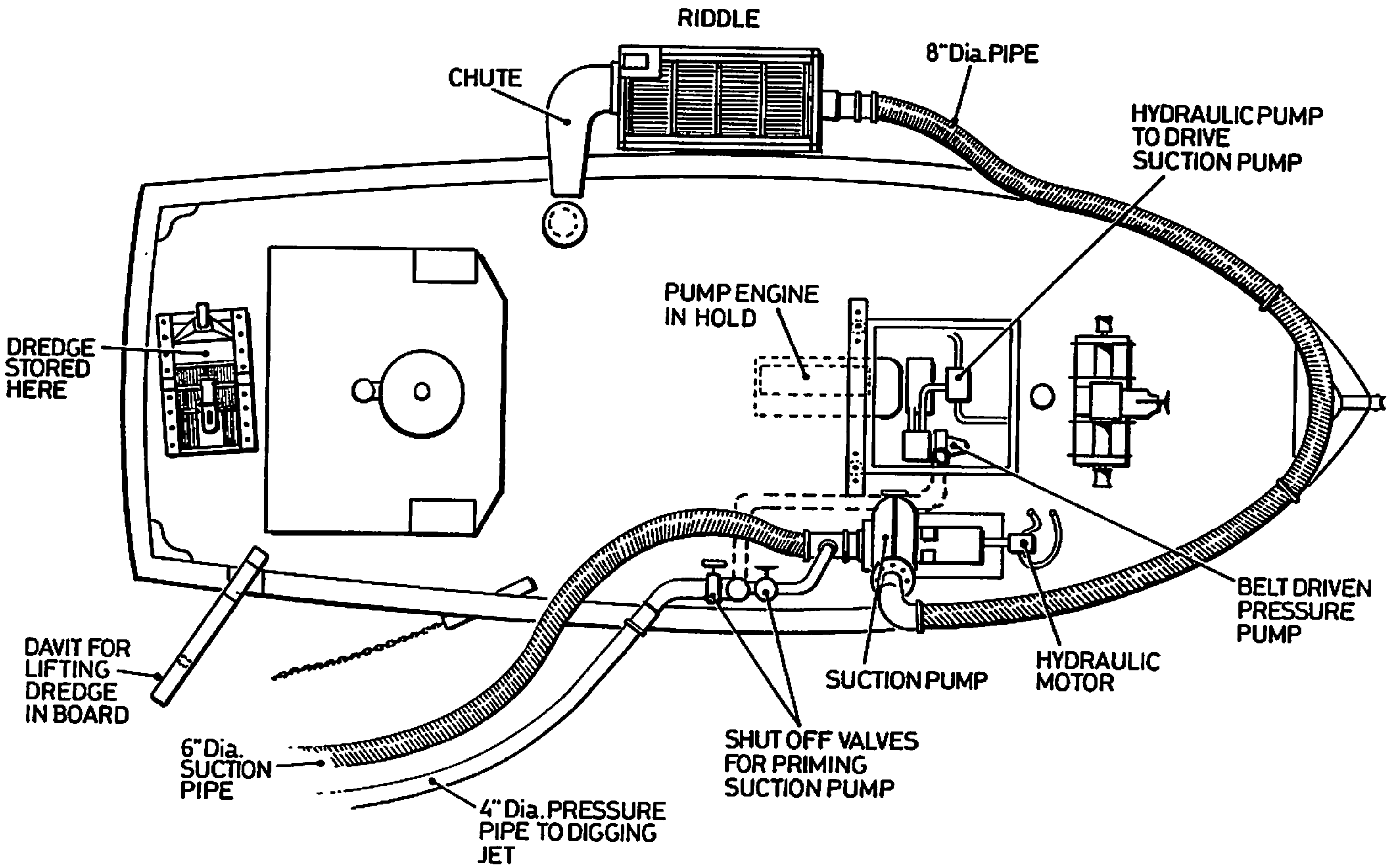
2. Seafish Internal Report No. 1305. Observations on the operation of a Dutch cockle dredger.

3. MAFF Field Trip Report F.V. "Lucky Luke" 21st March 1988.

4. Seafish Internal Report No. 1315. Cockle survey using hydraulic dredge on the Buxey and Dengie Flats.

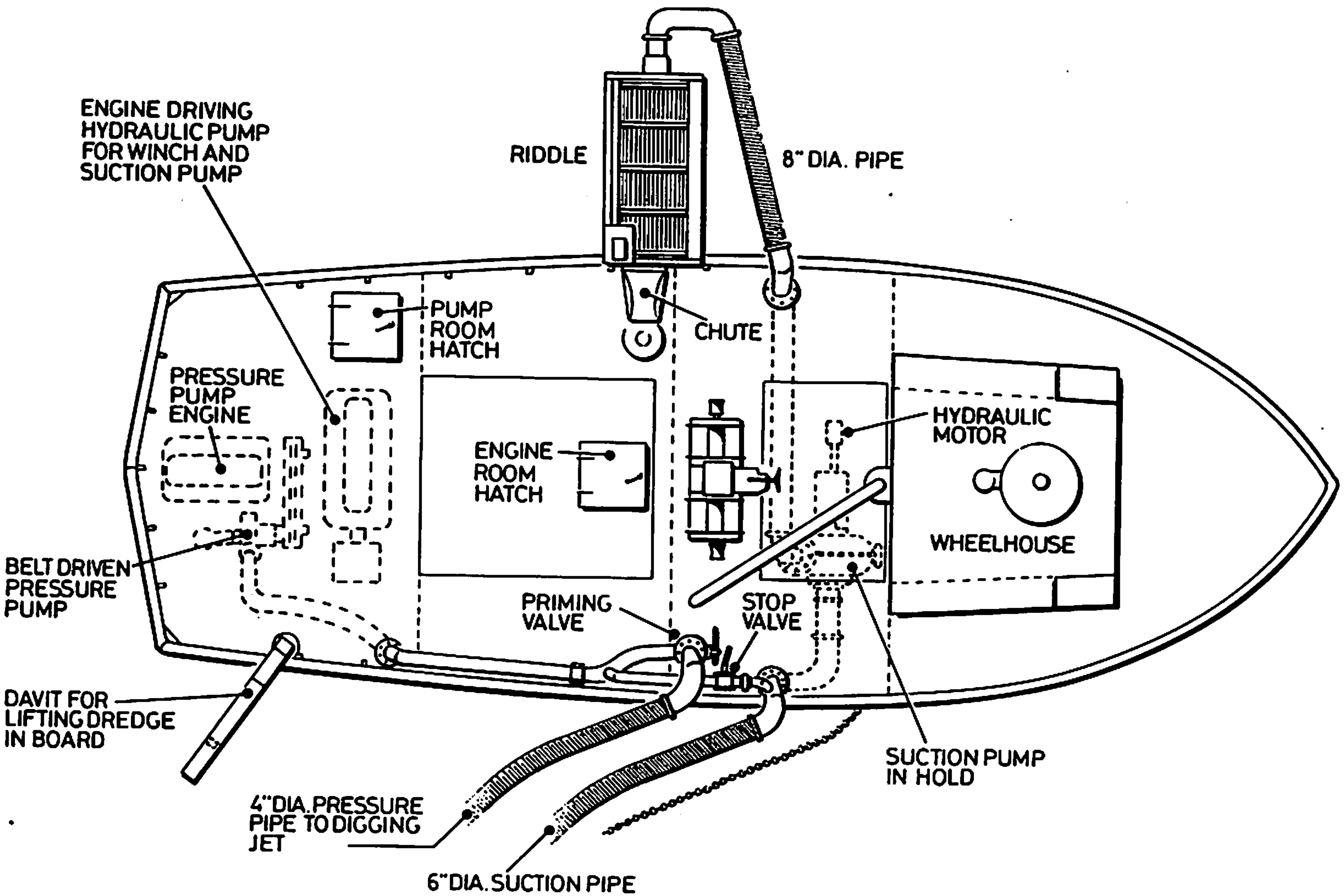
5. Seafish Internal Report No. 1369. Hydraulic cockle dredge pumping performance tests on jet pump used on Kings Lynn and Leigh-on-Sea vessels.

FIGURES AND TABLES



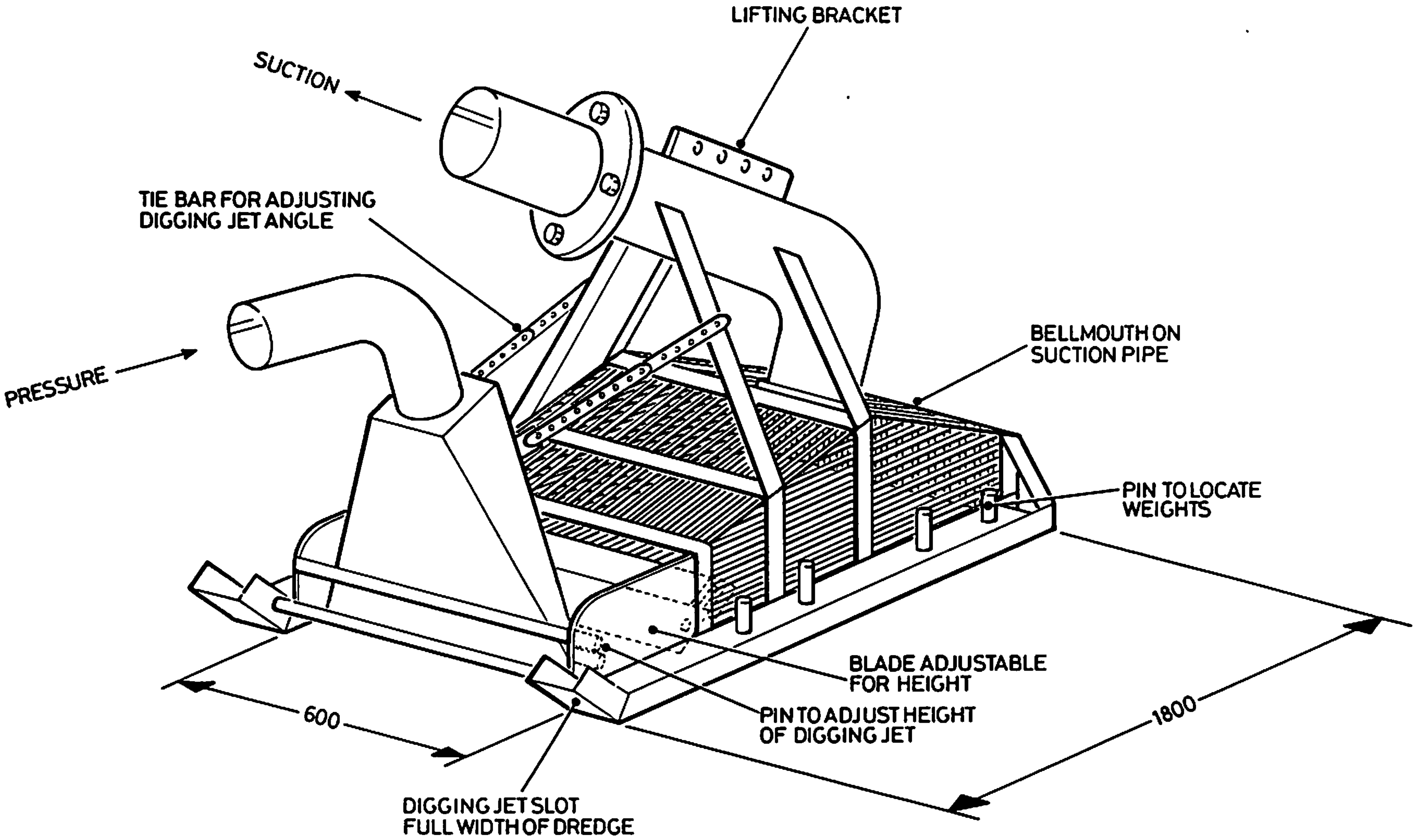
Suction Pump Installation on "Lucky Luke"

Fig.1



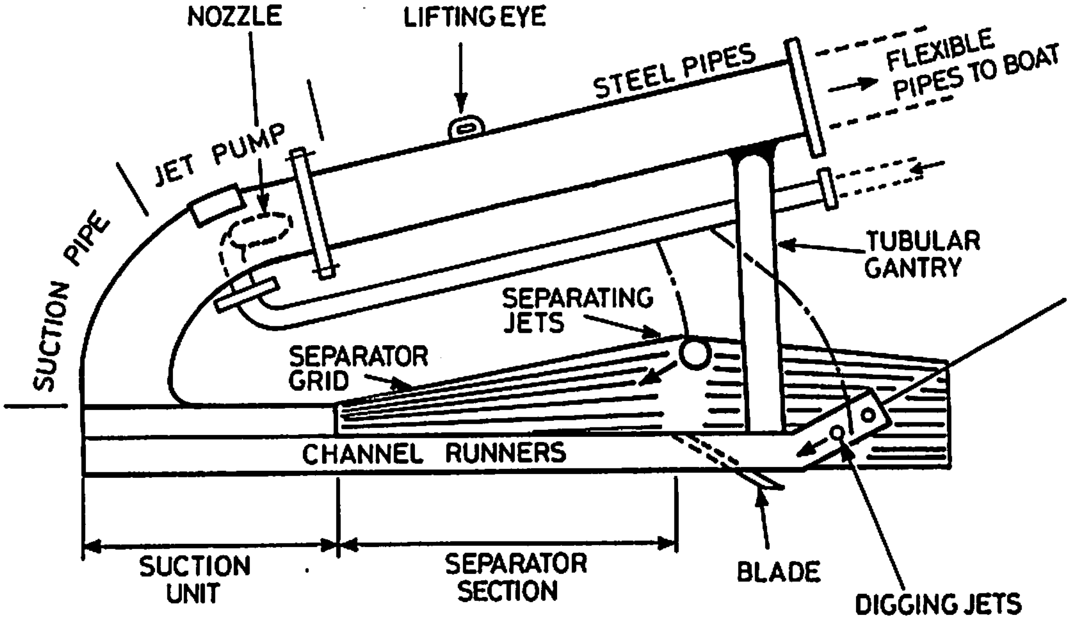
Suction Pump Installation on "Leigh David"

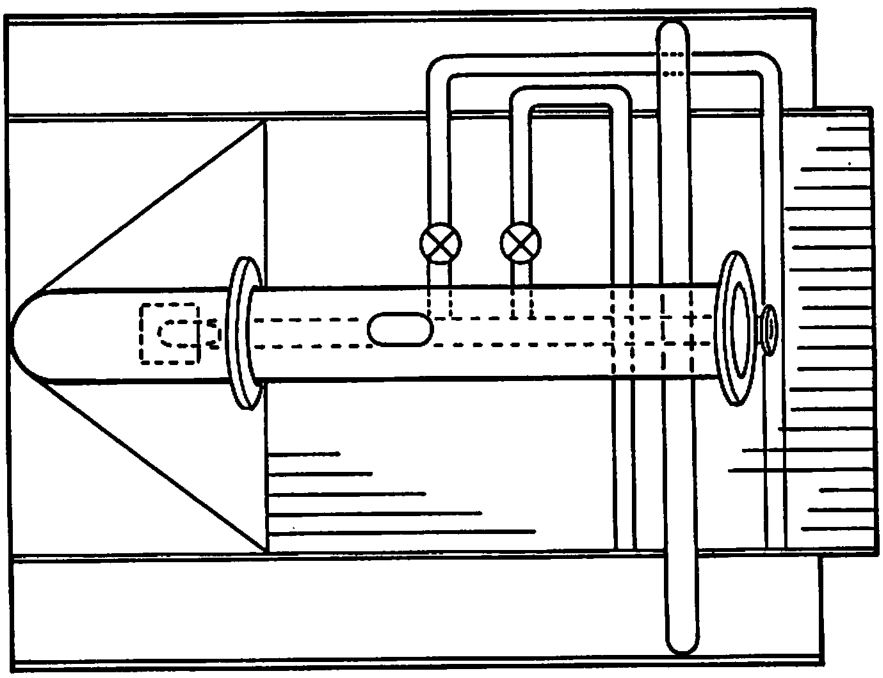
Fig. 2



Dutch Type Cockle Dredge

Fig.3

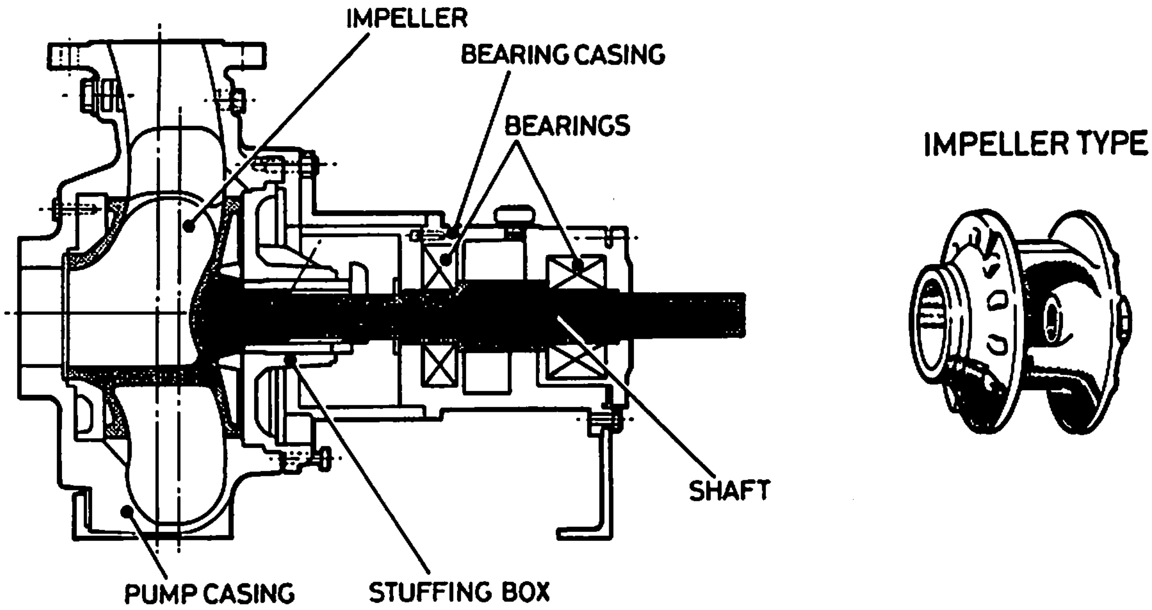




WFA Dredge

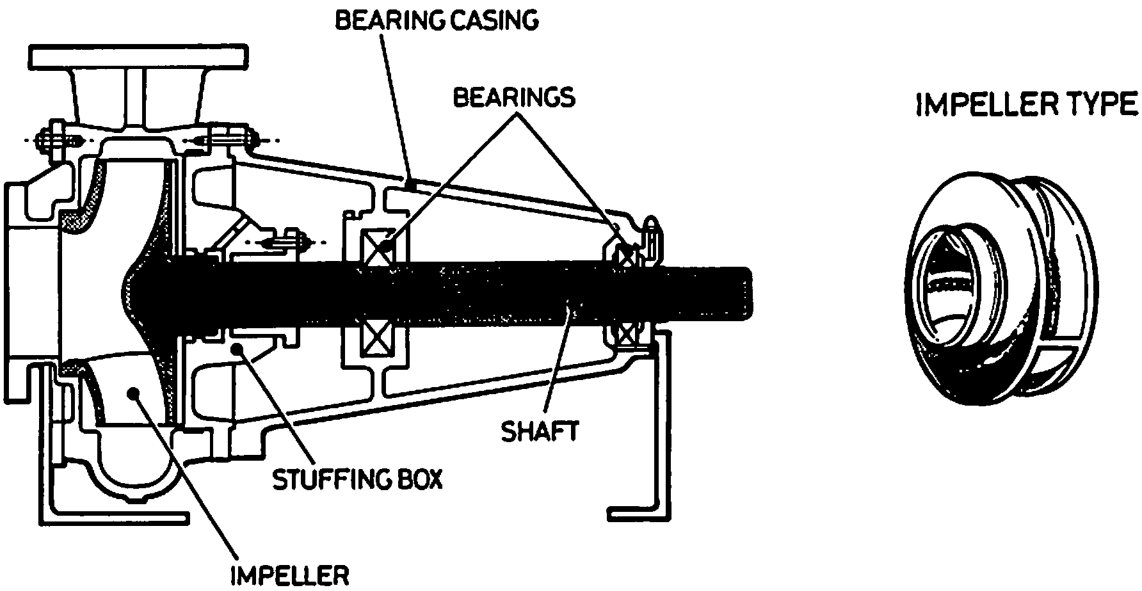
Fig.4

K.S.B. KRPEX 150-400 PUMP



(a)

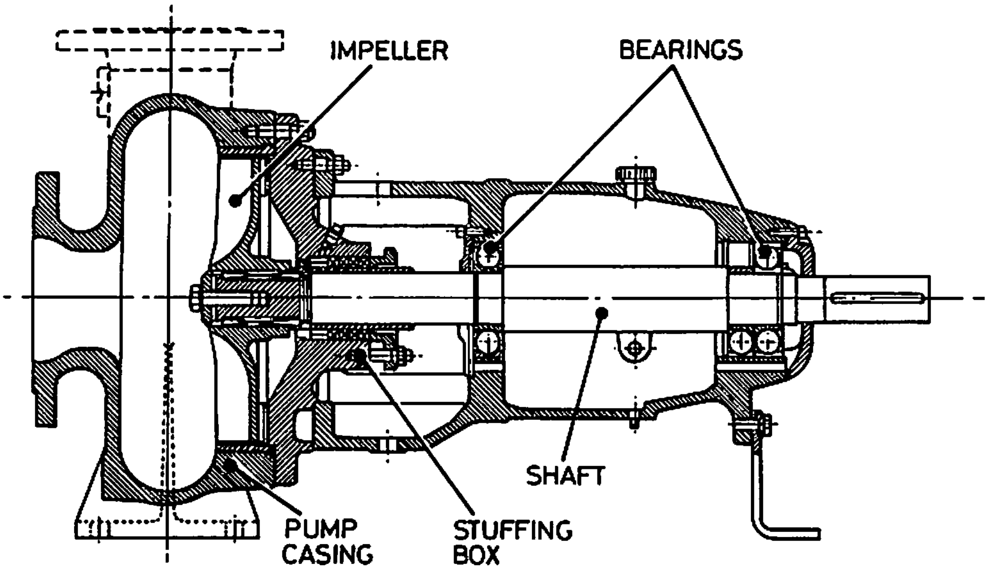
WEIR SRAM 125 & 150 PUMP

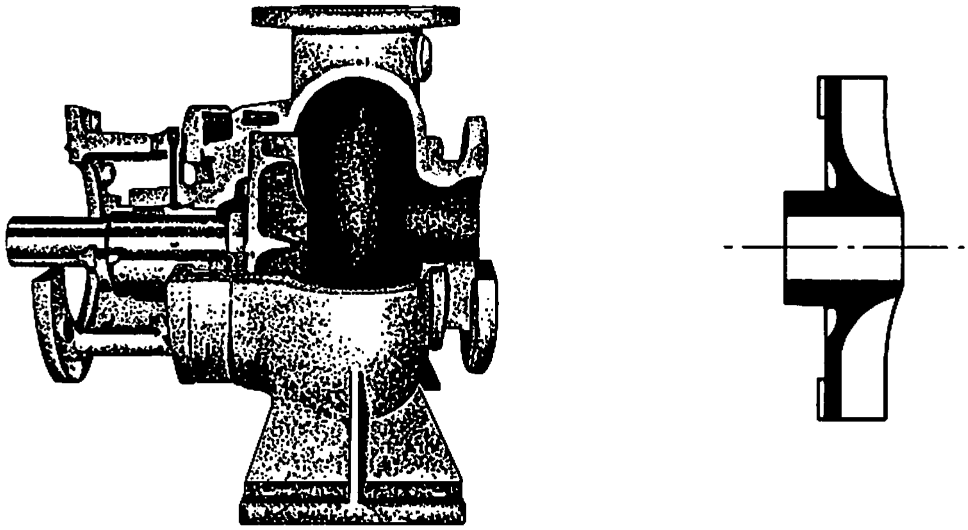


(b)

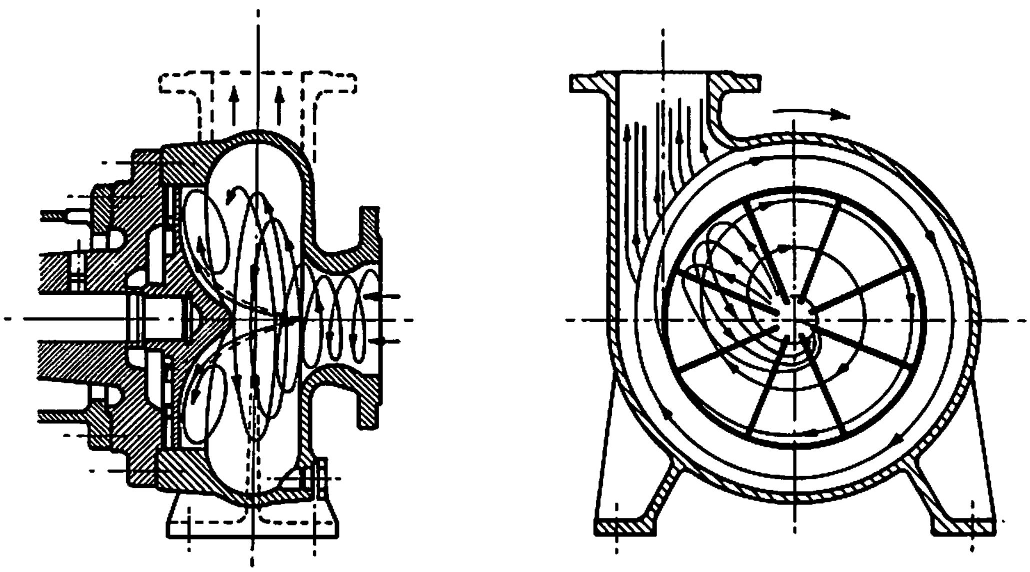
Types of Pump Tested

Fig.5



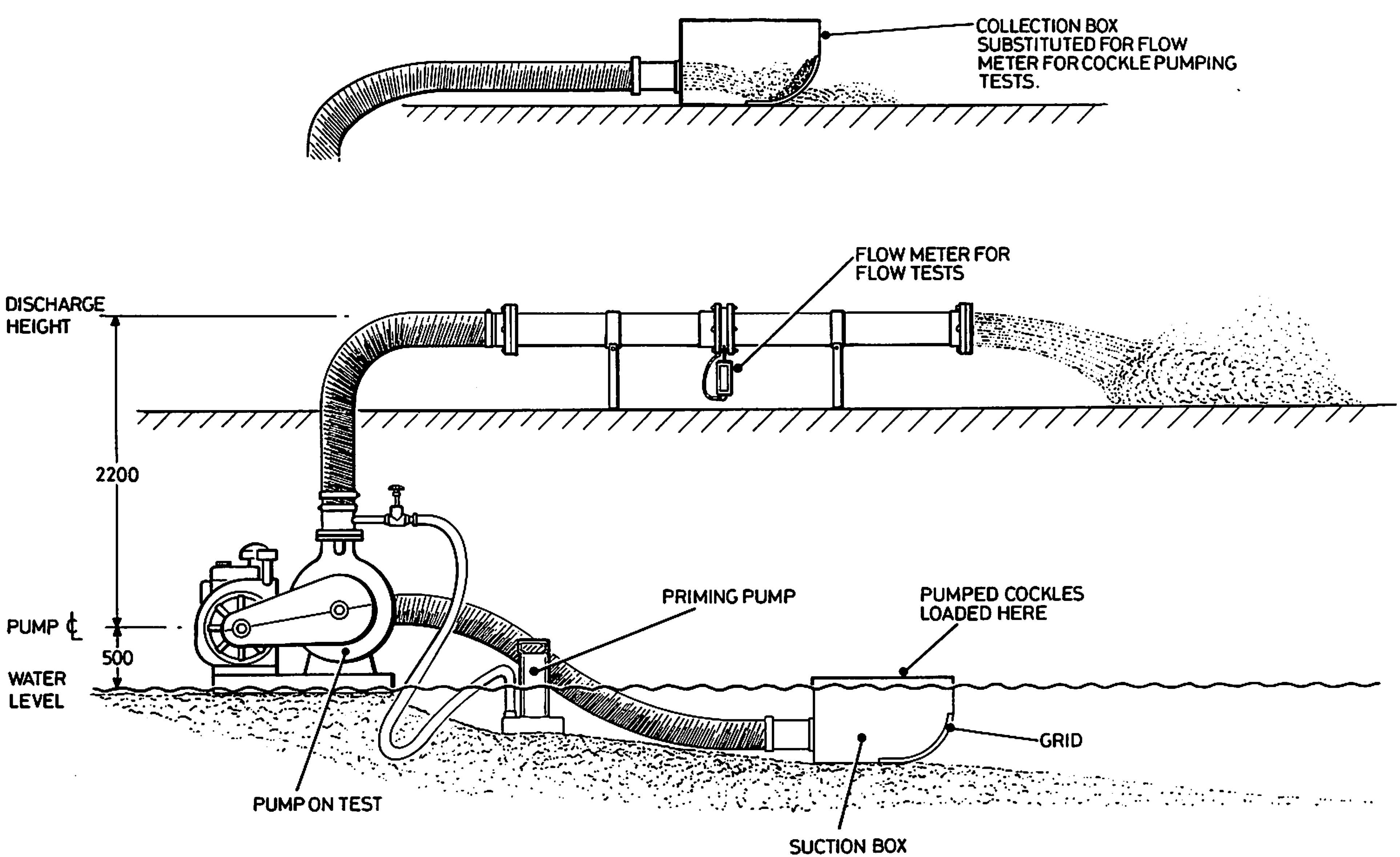


IMPELLER AND PUMP CONSTRUCTION



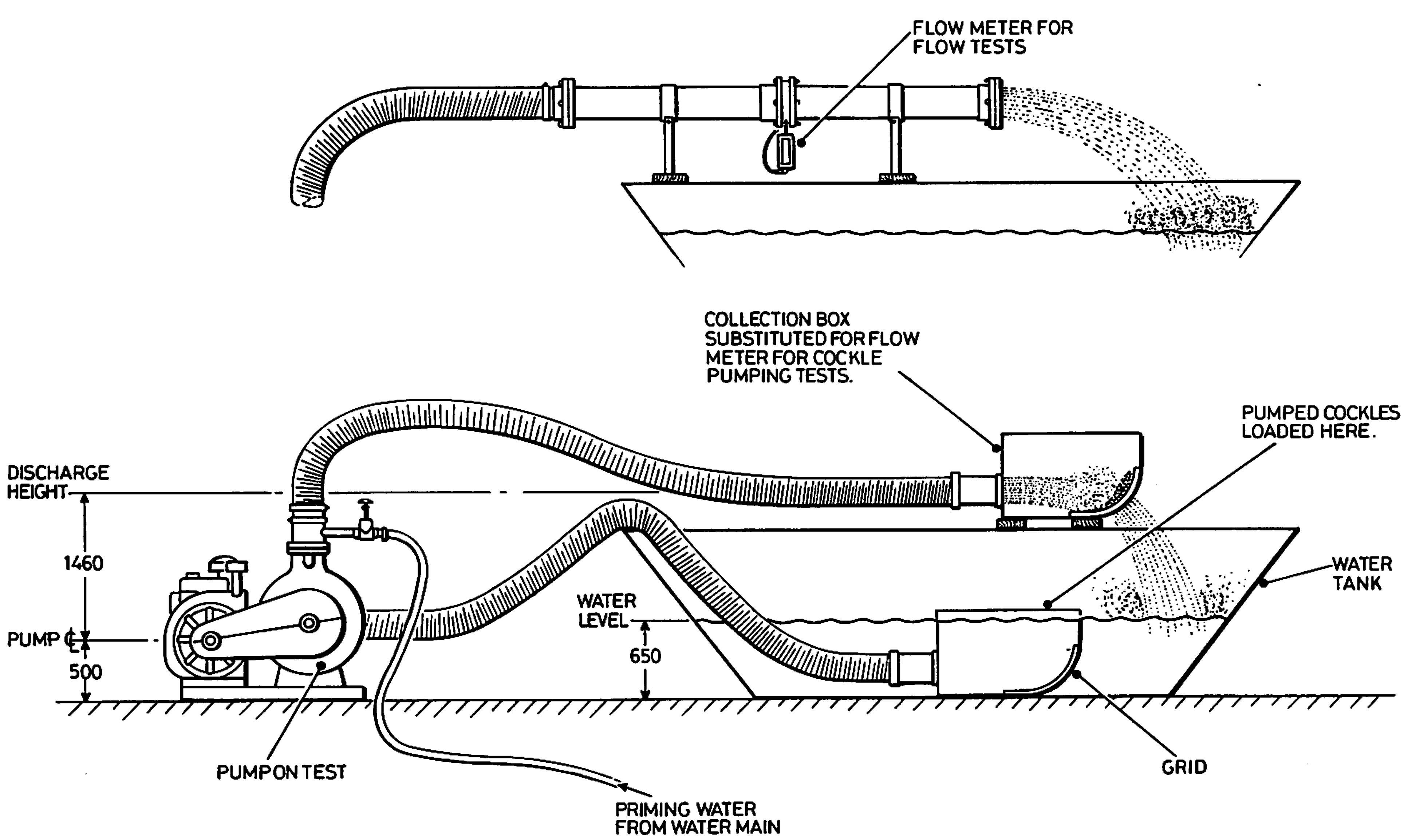
PRINCIPAL OF OPERATION

Egger Turo T8-150-HP8 Fig.6



Pump Test Arrangement for KSB and Wier 125 Pumps

Fig.7



Pump Test Arrangement for Weir 150 and Turo T8 150 HRS Pumps

Fig.8

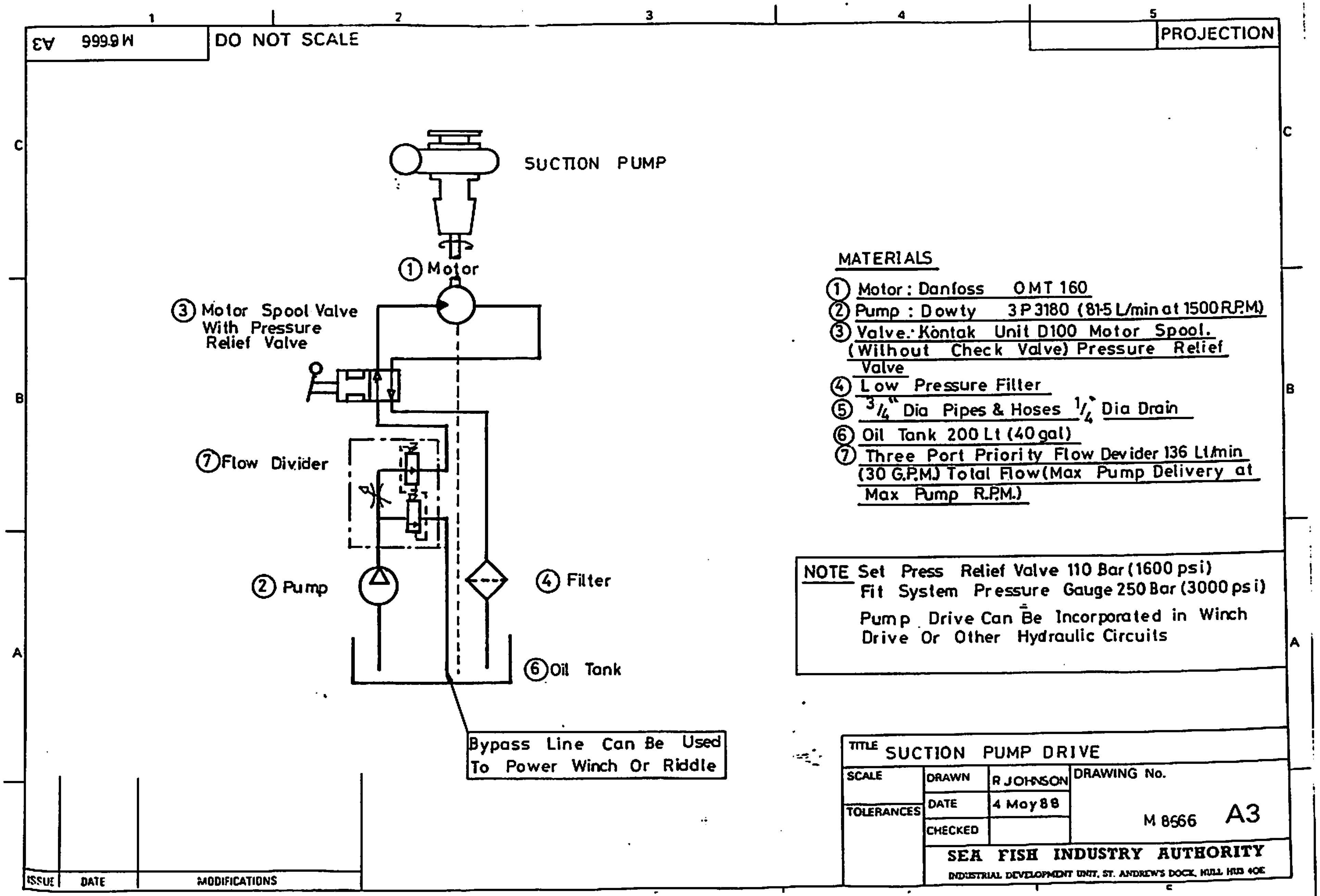
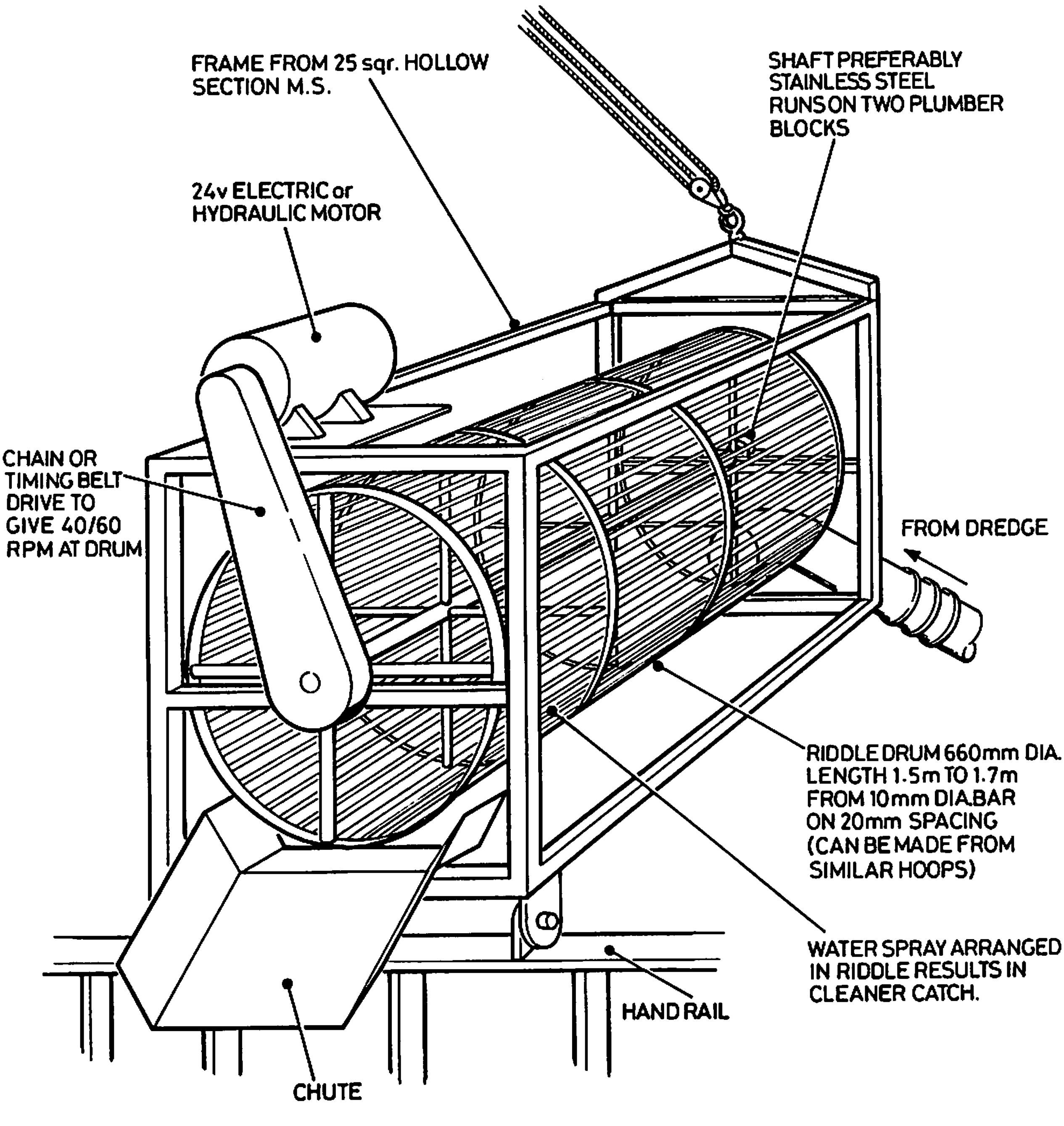
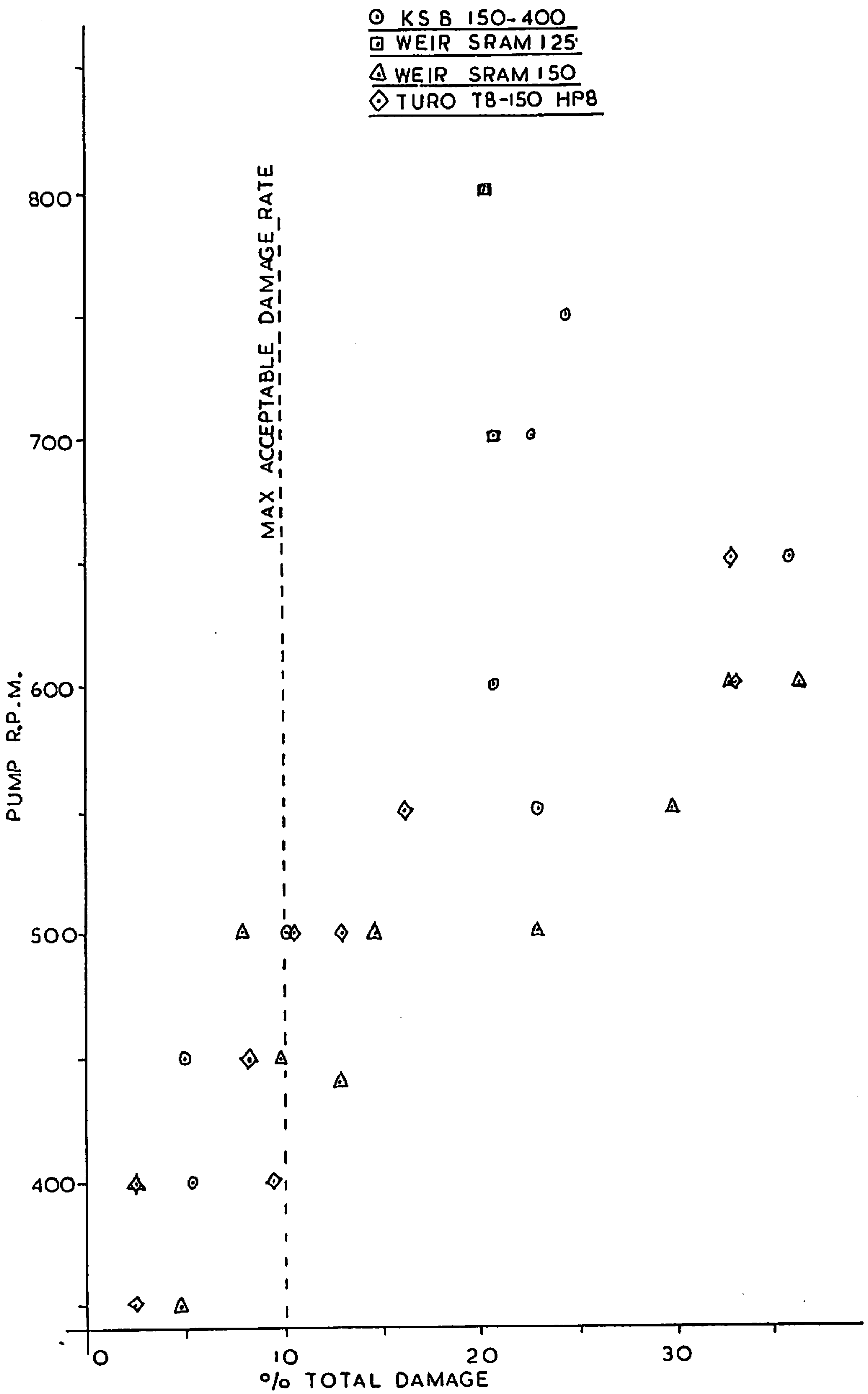


Fig.9 Hydraulic Drive for Suction Pump



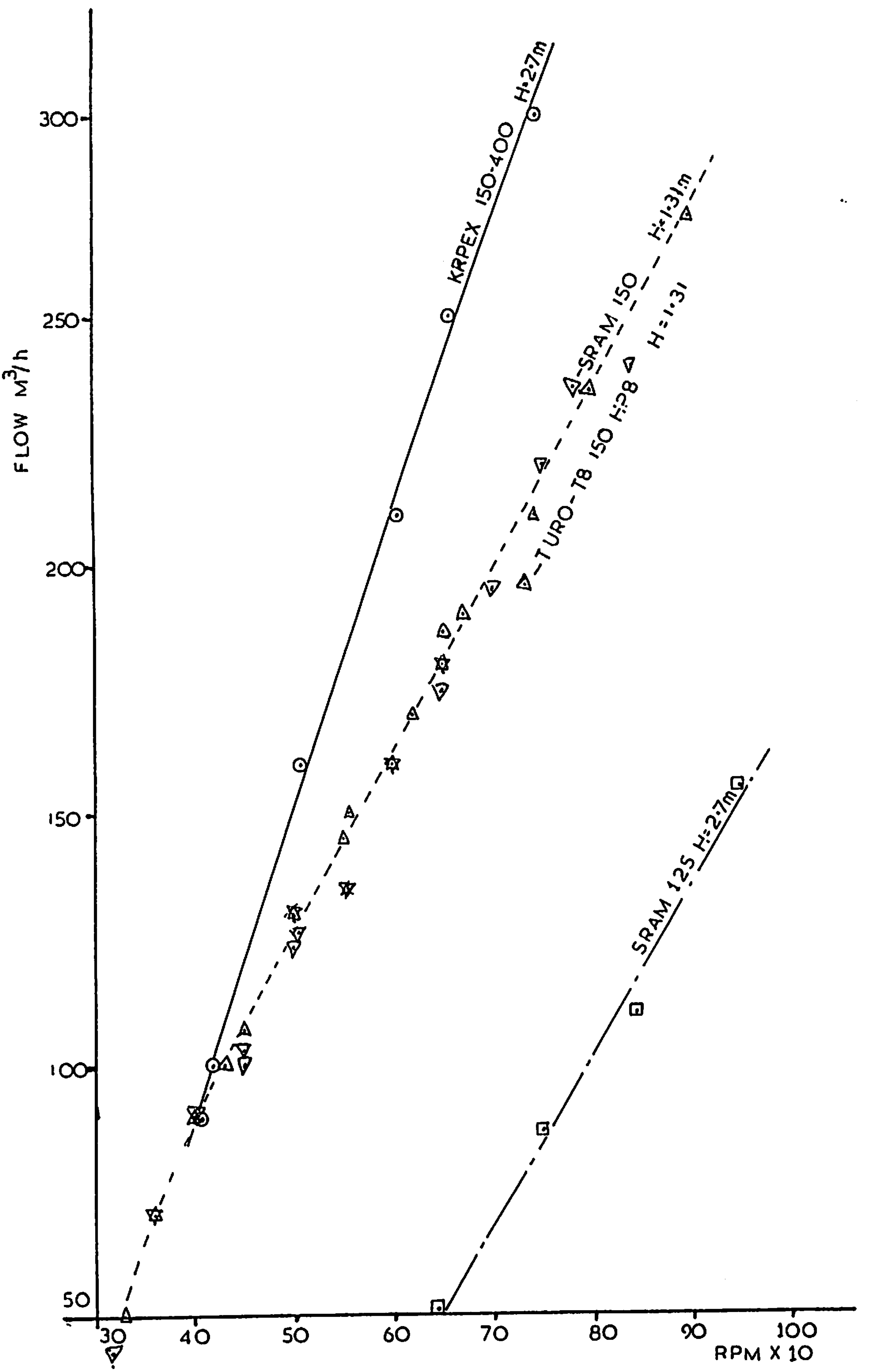
Rotary Riddle

Fig.10



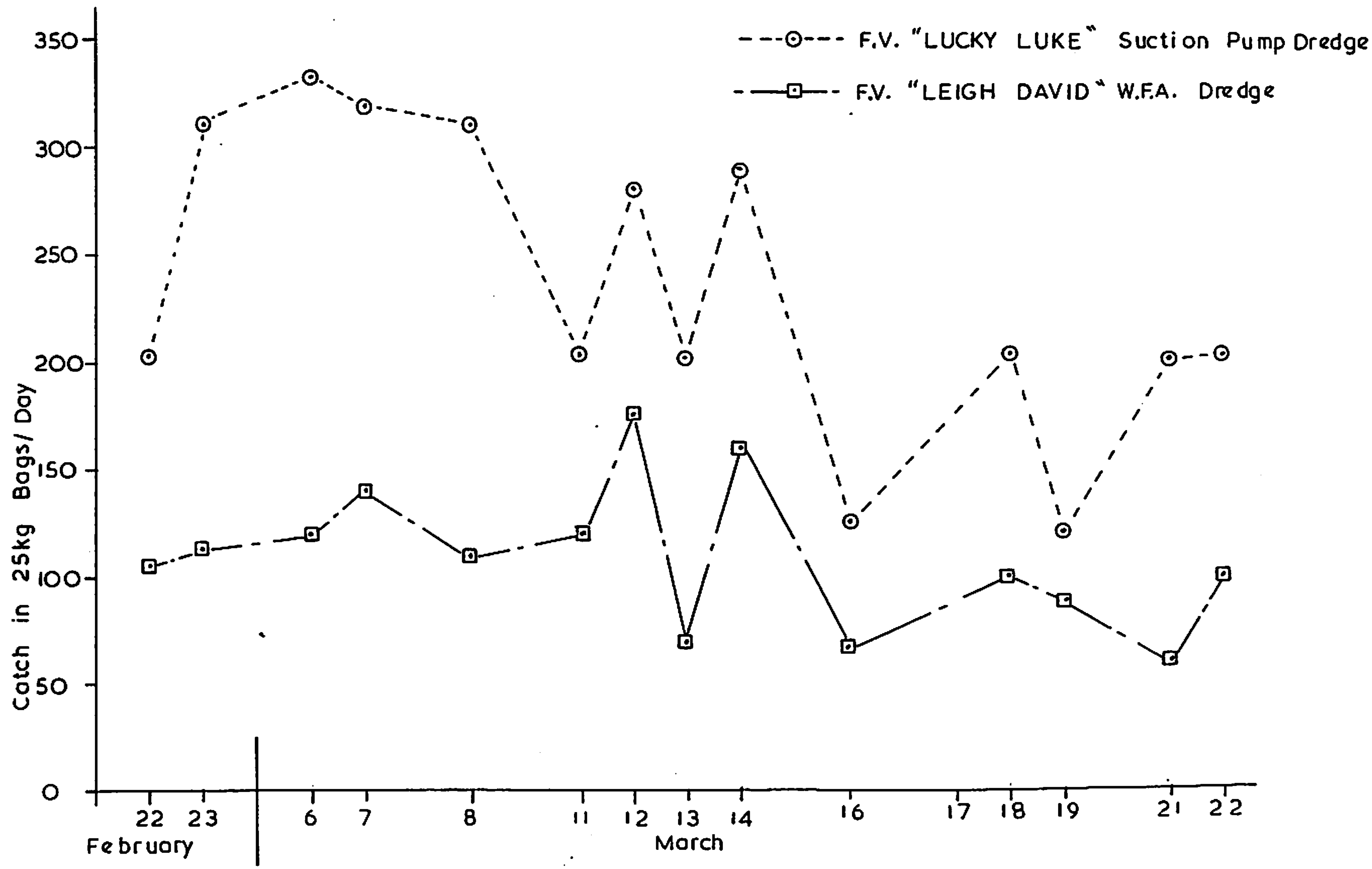
Suction Pump Damage Rates / RPM

Fig.11



Pump Flows on Test Rig

Fig. 12



Comparative Catch Rates

Fig.13

SUCTION PUMP DAMAGE TESTS Table No 1

R.P.M.	%Chipped	% Smashed	% Total Damaged
PUMP	K.S.P. 150-400		
750	15.8	8.5	24.4
700	15.6	7.5	23.1
650	21.5	15.7	37.2
600	12.7	8.8	21.5
550	14.4	9.5	23.6
500	7.9	2.2	10.1
500	4.4.	5.9	10.3
450	1.4	3.6	5
400	2	3.6	5.6
PUMP	WEIR SRAM 125		
900	22.4	13.8	36.2
800	13.2	7.6	20.8
700	13.1	8.1	21.9
PUMP	WEIR SRAM 150		
350	4.9	0	4.9
400	2.5	0	2.5
440	13.3	0	13.3
450	9.7	0	9.7
500	13.7	0.7	14.6
500	21.7	1.7	23.4
500	7.4	0.7	8.1
550	27.7	1.9	29.7
600	28.4	4.2	32.7
600	31.3	6.4	37.7
PUMP TURO	T8-150 HP8		
450	7.8	1	8.8
400	2.5	0	2.5
650	25.2	7.9	33.1
600	28.3	5.2	33.6
500	9.8	0.9	10.7
550	15.4	2.1	17.5
350	1.4	0.8	2.2
300	1	0.2	1.2
450	8.7	0.4	9.1
500	12.8	0.6	13.4

SEA TRIAL DAMAGE RATES Table No 2

Boat "LUCKY LUKE"	Date 20 Feb 88	Area "Tofts Sand"		
Time	% chipped	%Smashed	% Total Damaged	Catch Rate
9.35	6.3	1.4	7.7	1.73 T/h
9.5	6.5	0.5	7.1	1.5 T/h
10.28	3.7	0	3.7	1.28T/h
11.08	5.7	0	5.7	1.7T/h
11.38	5	1.8	6.8	1.55T/h
	9.4	2.7	11.6	1.34T/h
17	2.3	0	2.3	3.6T/h
1800	9.1	0.5	9.6	
18.5	3.2	0	3.2	
TOTAL CATCH	285 25Kg Bags	7.1 Tonns		
Boat"LUCKY LUKE"	Date22 Feb 88	Area"Tofts Sands"		
	2.9	1.4	4.3	1.7T/h
10.45	3.4	1.8	5.3	
11.15	4.5	0.6	5.1	
11.5	1.2	0.8	2	3.6T/h
19.14	2.6	0.5	3.1	2.25T/h
19.51	4.2	0.5	4.7	1.8T/h
TOTAL CATCH	203 25Kg Bags	5Tonnes		
Boat "LUCKY LUKE"	Date 21 March 88	Area "Trial Bank"		
8.2	1	10	11	
8.45	8.9	0	8.9	
9.57	13.2	2.1	15.9	
11	8.2	1.1	9.3	
18.32	9.1	0.2	9.3	
TOTAL CATCH	200 25Kg Bags	5 Tonnes		
Average Catch Rates	1.1 T/h Estimated	Cockle adensity	1.1 Tonnes/m2	

SEA TRIAL DAMAGE RATES Table No 3

Boat 'Leigh David"	Date 2 May 88	Area Black Sand/	Daesle Sand	
TIME	% CHIPPED	%SMASHED	%TOTAL DAMAGED	CATCH RATE T/h
04;00	6.3	1.4	7.8	1.04
04;45	2.5	0.6	2.4	2.57
05;10	10.2	1	11.2	3
10;57	11.4	.2.1	13.5	0.79
11;33	8.8	1.5	10.3	0.94
12;.6	7.6	0.7	8.3	1.4
12;42	12.5	0	12.5	1.7
13;06	5.7	0.8	6.6	2.8
Total Catch 201 25	Kg Bags	(5 Tonnes)		

COMPARATIV DAMAGE RATES. SUCTION PUMP/W.F.A.DREDGE Table No 4

Vessel	Dredge Pump Type	%	Shell Damage	
		CHIPPED	SMASHED	TOTAL
LUCKY LUKE	JET	20	20	40
LUCKY LUKE	SUCTION	10	1	11
LEIGH DAVID	JET	35	15	50
LEIGHT DAVID	SUCTION	8.1	1	9.2
LANGSTONE				
STAR	JET	41	23	64
LIBERATOR	JET	31	10	41
DUTCH				
DREDGER	SUCTION	10/15	5	20