ENGINE BEDS FOR SMALL FISHING BOATS

by

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ABSTRACT

The paper outlines problems connected with engine installation in small boats, describes methods of construction of engine beds and submits recommendations applicable to the design and construction of small wooden fishing craft.

INTRODUCTION

The performance of small fishing boats combines three main factors, namely, easy operation, safety and economy. *Easy operation* has always first claim of place on board, and seakindliness. *Safety* requires the consideration of scantlings, construction, stability and manoeuverability, etc. The question of *economy* is divided up into components such as speed, lifetime and building costs. These factors are inter-related but can be contradictory. They are also influenced by special circumstances, namely local building possibilities, an eventual Government loan scheme arrangement which can limit the size of the boat, lack of foreign currency and so on.

This paper is intended to show the important contribution made by good engine installation towards satisfying the above mentioned factors.

To obtain the best performance from a boat, the space taken up by the engine should be as small as possible, to allow more working area for the fishermen and the maximum space for fishing gear and catch. This often means that the engine is fitted in the aft end of the boat, where, however, it is difficult to find space for a well developed engine installation.

The propulsion machinery in a fishing boat consists of the engine, the stern gear, and the propeller. They should all be built into one common foundation system. This presumes that the keel, the shaft log and the engine foundation are built as one rigid unit. One of the most common causes of engine troubles in small fishing boats is the poor installation of these three components, which results in vibration. The compact arrangement of outboard engines causes few installation troubles and must be one of the reasons for their popularity.

VIBRATIONS

Vibration in a boat is caused by the following factors: (A) engine vibration, (B) vibration in the propellers, and (C) vibration in the shaft.

The main reasons are the following:

(A) Vibration in the *engine*, (properly fitted and properly working) occurs for two main reasons:

(a) unbalanced quantities;

(b) the pressure when the piston is moving down during the expansion stroke. In a well balanced engine this factor is by far the strongest. This pressure will affect one engine bearer more than the other, and will give the engine a slight tendency to go out of alignment for a moment.

(B) Vibration in the *propeller* occurs from:

(a) unbalanced quantities or shape, and/or;

(b) the wake behind the stern post. Therefore the stern post has to be "streamlined" as much as possible and the propeller bearings outside the stern tube should project more than 4 in. beyond the shaft log, to give the water a better flow.

(C) Vibration in the *shaft* is caused by:

(a) taking up vibrations described in A and/or B, and

(b) misaligment of the shaft, especially if there are more than 2 bearings between propeller and engine. The shaft may be misaligned when a dry boat is launched, and a slight deformation occurs in the shape of the boat.

(c) If the shaft is bent or underdimensioned or the engine beds are wrongly designed, there will be vibration in the hull.

THE ENGINE BEDS

To eliminate engine vibration it is necessary to connect the two main engine bearers through a rigid system of floors to the keel. The engine bearers should be long, about 2½ times the length of the engine. The floors supporting the engine bearers should be made in one piece with the bearers bolted well to the floors. It is considered unnecessary and undesirable to cut the engine bearers so that they follow and touch the planking. The propeller thrust can normally be ignored.

In wooden boat building the principle applied when connecting members is, that the friction occuring between these members from the pressure of a bolt, screw or other securing means should "glue" or "weld" them together into a solid unit. The bolting has therefore to be arranged with this objective.

AN EXAMPLE OR ENGINE INSTALLATION

To illustrate what has been said above, the 27½ ft. fishing boat developed in Ceylon for net fishing and longlining can be studied. The boat is designed to carry a maximum of 50 drift nets. The size of the boat was limited by the conditions of the Government's loan scheme. Space in the boat was therefore very restricted and the engine had to be put as much as possible in the rear. Working conditions are in many ways very hard, since the fishermen have to go over shallows and reefs where the boat touches the bottom in the breakers. This will lead to a misalignment of the engine and stern gear if they are not built as a "compact unit" on a common foundation. The general arrangement of the boat is shown in Fig. 1.

Figs. 1 and 2 show how the engine beds are arranged. The main engine bearers are not parallel, permitting a closer connection to the floors in the rear part of the boat. At the same time the "parallelogram effect" disappears. These main engine bearers overlap the shaft log, thus making a rigid connection between engine and stern gear. The shaft angle is between 6 and 7½ degrees depending on engine make. The distance between the inside of the shaft log and the engine flange is only 15 ins. As this is a question of the mass production of boats where several types of engines will be built in, the engine beds have been arranged so that the engine rests on separate seats, which are well connected to the engine bearers, and are through-bolted to the floors. The engine beds are common to all makes of engines and are therefore built in before the planking of the boat. Only the engine seats are put in afterwards to fit different makes.

This type of engine bed has another advantage, namely, that if the engine foundation is fairly narrow and the flywheel in the fore end of the engine has a large diameter, as for instance in some of the Japanese engines, this will not cut off the main engine bearers. A disadvantage is that for re-alignment of the engine it has sometimes to be lifted fairly high to get the necessary shims underneath, as the main engine bearers protrude above the level of the seats.

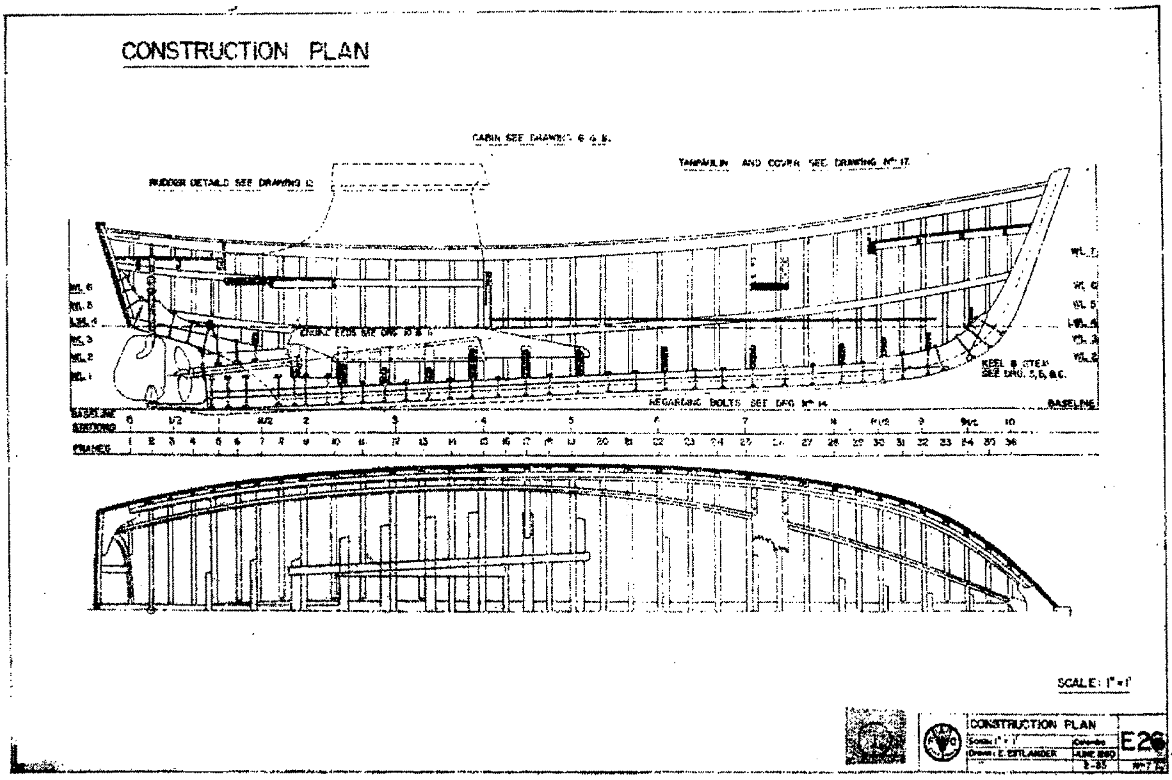
CONSTRUCTION PLAN
TARPAULIN AND COVER SEE DRAWING Nº 17
KEEL & STEM SEE DRG. 5, 6, & C.
BASELINE
STATIONS
FRAMES
SCALE: 1"=1'
CONSTRUCTION PLAN
E26

FIG. 1.

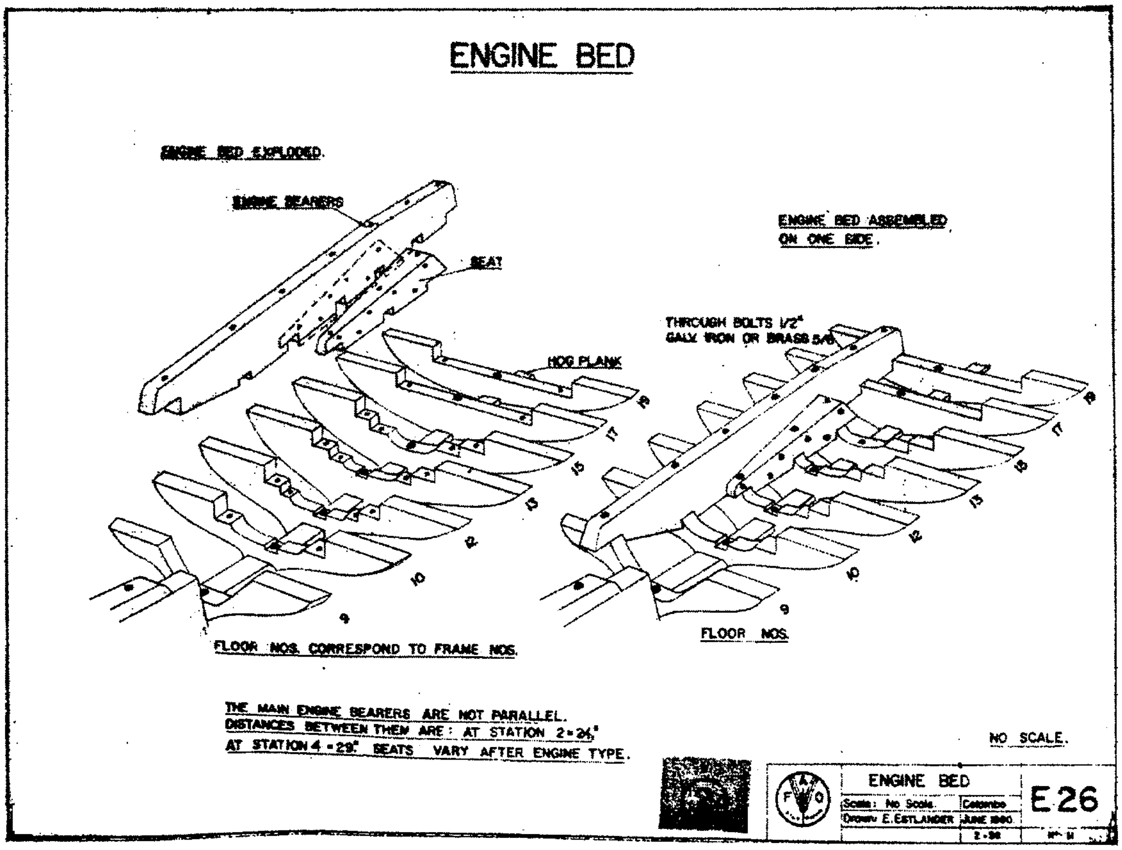
ENGINE BED
ENGINE BED EXPLODED.
ENGINE BEARERS
SEAT
HOG PLANK
ENGINE BED ASSEMBLED ON ONE SIDE.
THROUGH BOLTS 1/2" GALV. IRON OR BRASS 5/8"
FLOOR NOS. CORRESPOND TO FRAME NOS.
FLOOR NOS.
THE MAIN ENGINE BEARERS ARE NOT PARALLEL.
DISTANCES BETWEEN THEM ARE: AT STATION 2 = 26"
AT STATION 4 = 29". SEATS VARY AFTER ENGINE TYPE.
NO SCALE.
ENGINE BED
Scale: No Scale.
Colombo
Drawn E. ESTLANDER
JUNE 1960
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FIG. 2.

INCONVENIENCES IN ENGINE DESIGN

Another problem to which the engine manufacturers do not seem to give full attention is that an engine has often to be installed in the aft end of the boat, where the space is very narrow. If the feet on which the engine rests are low, they will in reality leave little or no wood for the engine beds or seats. In extreme cases the engine has been taken farther forward to get them built in, thereby reducing fishing space. Fig. 3 and 4 show random examples of how different engines fit into these engine beds, approximately at station 3, where the aft engine feet are usually situated. Many more examples could be given. The feet of some engine types must be turned upside down to get more clearance aft for the engine seat. Sometimes completely new feet for the engines have to be made locally. The correct feet arrangement on engines is to have the aft feet higher up than those in the fore-end thus giving more wood for the engine seat. Many American petrol engines designed for planing hulls, have the engine feet arranged at an angle of about 6 to 9 degrees to the crank shaft. This can be very easily realised for many engines if the aft feet are loose pieces fitted to the engine by bolts.

Important pieces of engine equipment such as strainers for the cooling water, oil filters, dynamos etc. should be arranged so that they can be easily installed or removed without cutting pieces from the seats or main engine bearers. For engines fitted in the center or fore end of the boat there are no such engine bed problems, as there is plenty of space to develop a system of longitudinal and transversal members. The problem in such cases is to get the engine bearers connected to the shaft log so that misalignment does not occur due to rough handling of the boat, when going through breakers.

STERNGEAR

One further problem when building in engines in the aft end of small boats is that the distances between propeller bearing or sterntube inner bearing and the engine is so short that the slightest misalignment will cause big stresses on the sterntube inner bearing and propeller bearing.

If the distance between propeller bearing and the engine aft bearing is so short, no bearing in between is necessary, and therefore the sterngear inner-bearing should be left out and replaced by a flexible stuffing box. Fig 5.

RECOMMENDATIONS

1. When designing small fishing boats, the engine beds, including shaft log, have to be incorporated into the backbone of the boat at an early stage, since they are important members in the backbone construction of the boat.
2. The engine manufacturers should agree upon a standardizing of marine engine foundations for engines of the same size along the following lines:
   - (a) The engines should not have more than 2 pairs of feet, one at the very fore end of the engine, and the other just after the last cylinder, not fixed to the gear box. It is not advisable to have the transversal combustion pressure delivered to the engine beds via the gear box. In small fishing boats engines have often to be installed or realigned under unfavourable circumstances, and it will be easier to align two pairs of feet rather than three.
   - (b) The level of the feet or foundation should be 2 or 3 in. over the propeller shaft level, but will depend on whether the engines have reduction gear or not.
   - (c) If the gear feet are separate pieces bolted on to the crank case, feet with a 4 in. higher level can be delivered as an optional extra to fit an engine built into the aft of the boat.
   - (d) A guide to the distance between fastening bolts for 1 and 2 cylinder engines with an output of 8-12 h.p. per cylinder and r.p.m. 1500-1800 (covering a wide rang of makes) is :

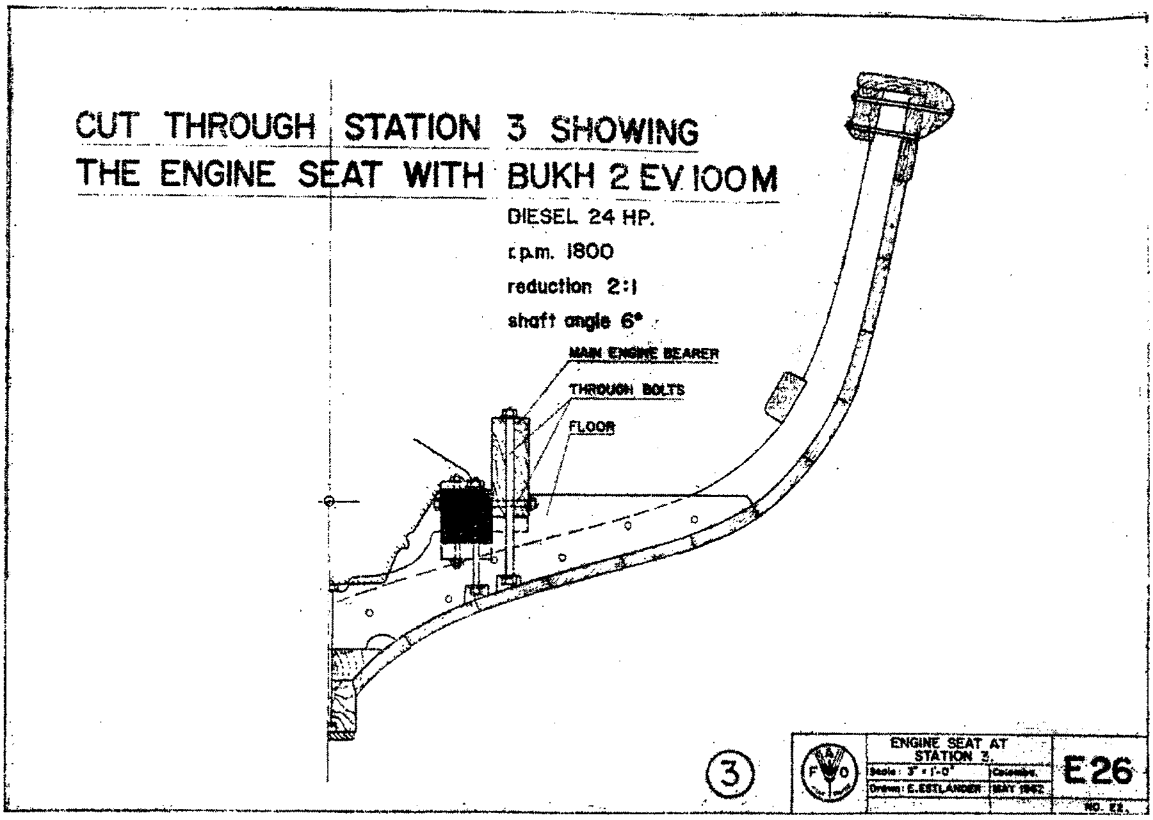
CUT THROUGH STATION 3 SHOWING
THE ENGINE SEAT WITH BUKH 2 EV 100M
DIESEL 24 HP.
r.p.m. 1800
reduction 2:1
shaft angle 6°
MAIN ENGINE BEARER
THROUGH BOLTS
FLOOR
3
ENGINE SEAT AT STATION 3.
E26

FIG. 3.

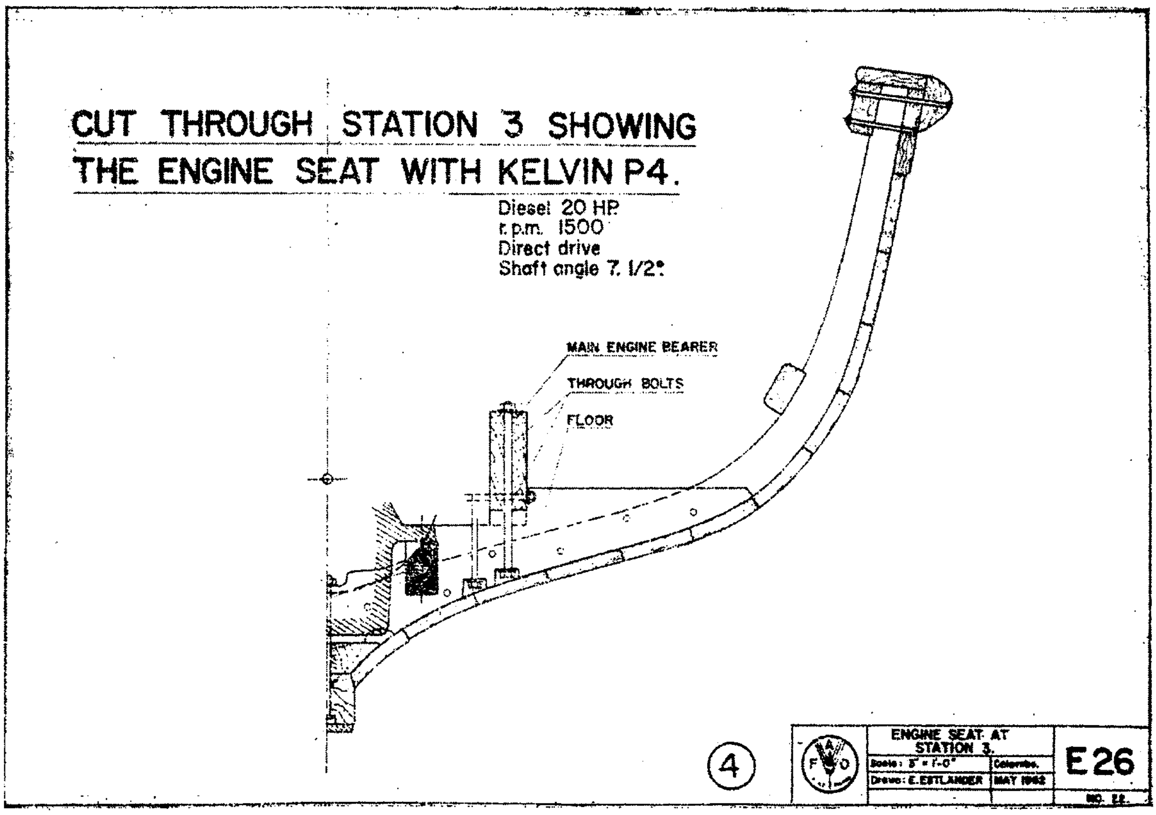
CUT THROUGH STATION 3 SHOWING
THE ENGINE SEAT WITH KELVIN P4.
Diesel 20 HP.
r.p.m. 1500
Direct drive
Shaft angle 7. 1/2°
MAIN ENGINE BEARER
THROUGH BOLTS
FLOOR
4
ENGINE SEAT AT STATION 3.
E26

FIG. 4.

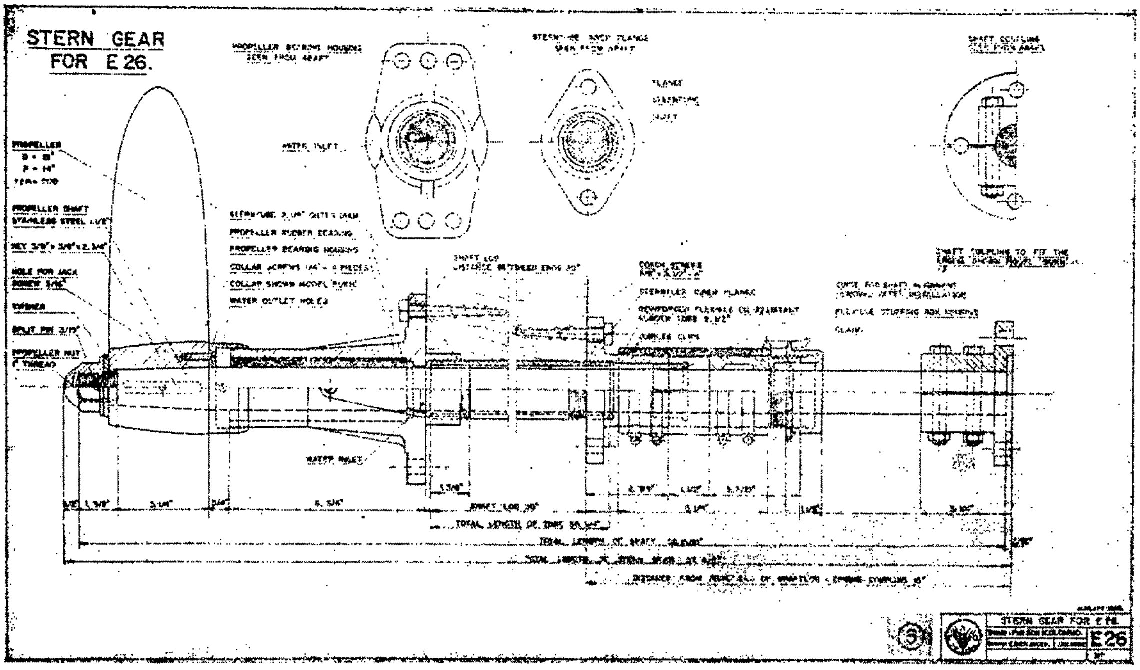

FIG. 5.

transversal		20 in., maximum 22 in.
longitudinal	1 cyl.	12 in., maximum 16 in.
	2 cyl.	18 in., maximum 22 in.

(e) Instruments and equipment should be so fitted to the engines, that they can be removed or handled without having to cut higher engine beds, since they are members in the longitudinal stiffening system of the boat. Bolts, and not studs, should be used for the fastenings.

(f) Arrangements for remote control, especially for the gear box should be standardised and simplified.

(g) It should be possible to start the engine at both ends. This is essential for engines built in aft in small fishing boats, as a live bait tank, a closed fishhold, etc., have to be built just in front of the engine. If the engine is built in the middle or fore end of the boat the engines have mostly to be started at the fore end, depending on accommodation arrangements.

3. (a) The diameter of the propeller should not be too big. Small fishing boats often operate in shallow water which limits the space for the propeller. If the pitch/diameter ratio for engines with a reduction 1:2 is taken to 0.6-0.7 it also covers special cases where the water is very shallow, while still allowing work with an economical efficiency.

(b) The propeller bearing should be shaped so that it projects well behind the deadwood to produce ample clearance between the deadwood and the propeller.

(c) Rubber bearings have shown good results in sandy waters provided they are well flushed with clean water, and should be considered as standard fitments.