

The Use of Bed Levellers In Maintenance Dredging

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The bed leveller, a device that flattens peaks and valleys frequently left by dredging, is not a new development. As shown in Figure 1, the first type of bed leveller was used in 1565. Since that time, the device has undergone a number of design changes.

About 10 years ago, maintenance dredging in small harbors was often carried out by bucket dredges (Figure 2). Sea-going hopper dredges normally performed maintenance dredging in

large waterways (Figure 3).

The cost per cubic meter of maintenance dredging carried out by bucket dredge with tugboat and dumping barges is shown in Figure 4.

Changes

Ten years ago, a small, low cost trailing suction dredge for shallow waters was developed. It is possible to operate this new dredge with a crew of two or three men per shift as shown in Figures 5a, b, c, d, e.

If the cost per cubic meter for a bucket dredge is compared with the cost per cubic meter for a low cost trailer dredge, it can be seen that for a short distance between the dredging location and the dumping site, the low cost trailer is the cheapest of the two systems (Figure 6).

For longer distances, however, the trailer is not more economical since operating times between dredging and dumping locations become too great. The trailer dredge is thus too expensive for the transportation function.

One solution for long distances between dredging and dumping sites is to use barges loaded by a hopper dredge. The contents of the barges will have a higher water content than if they were loaded by a bucket dredge.

For these reasons, a bucket dredge is the preferred choice for longer distances. However, even if a trailer dredge is slightly more expensive per cubic meter than a bucket dredge, the trailer dredge is the preferred choice from a nautical point of view, as it causes less disturbance to harbor shipping movements.

Drawbacks

Trailer dredges have their disadvantages.

Trailer dredging does not give a flat bottom profile. After trailing, the surface often contains too many peaks and valleys.

There are places where it is impossible to dredge with a hopper dredge, such as corners, jetties, etc.

Areas that are inaccessible to the hopper dredge must be dredged by grab dredges or bed levellers.

The allowable variation in bed surface smoothness for bucket dredging is approximately 10 centimeters. Harbor authorities familiar with bucket dredging activities often want to obtain the same maximum bottom margin limit when maintenance dredging is carried out by trailer dredging.

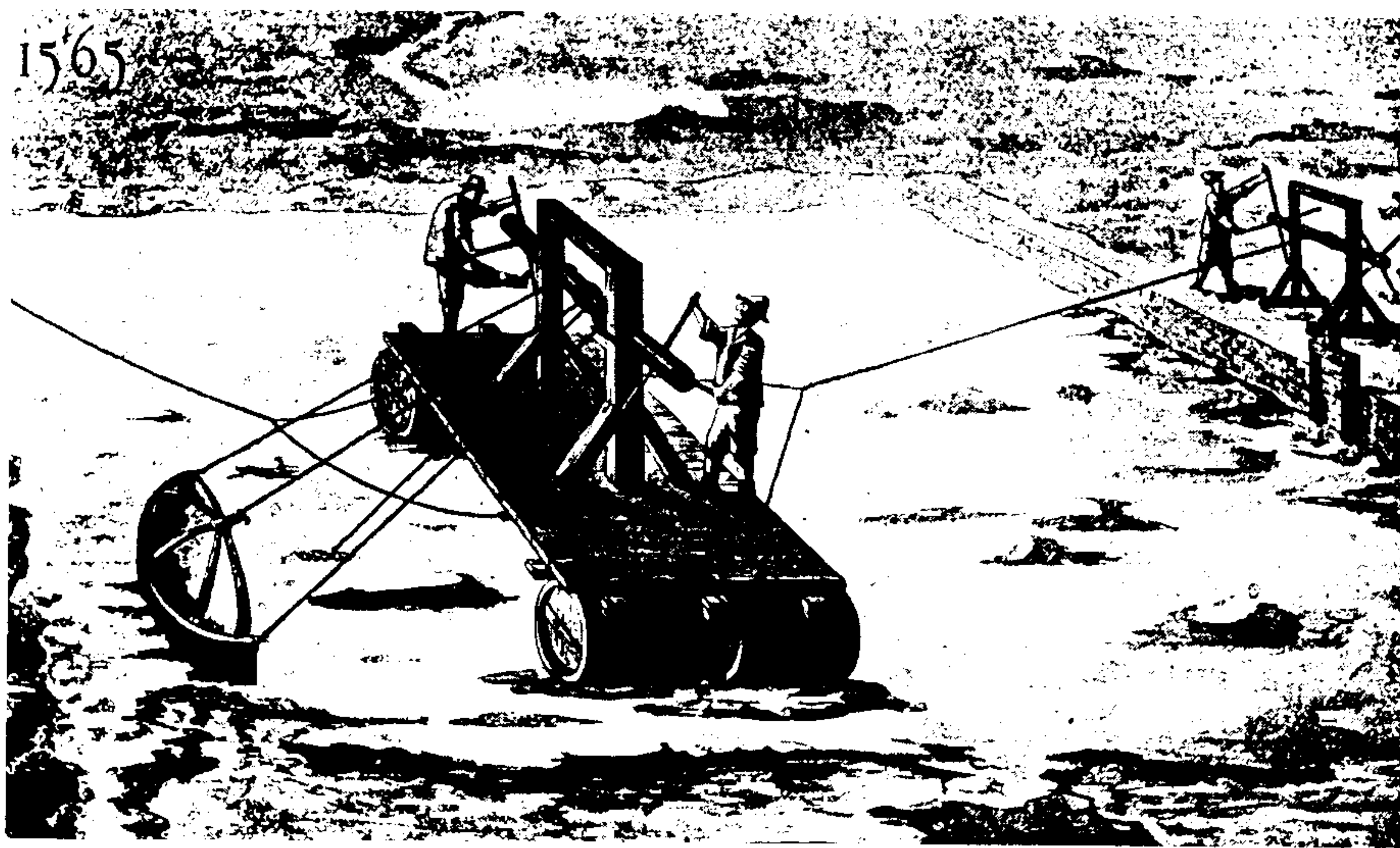


Figure 1. Sketch of an early bed leveller, first used in 1567.

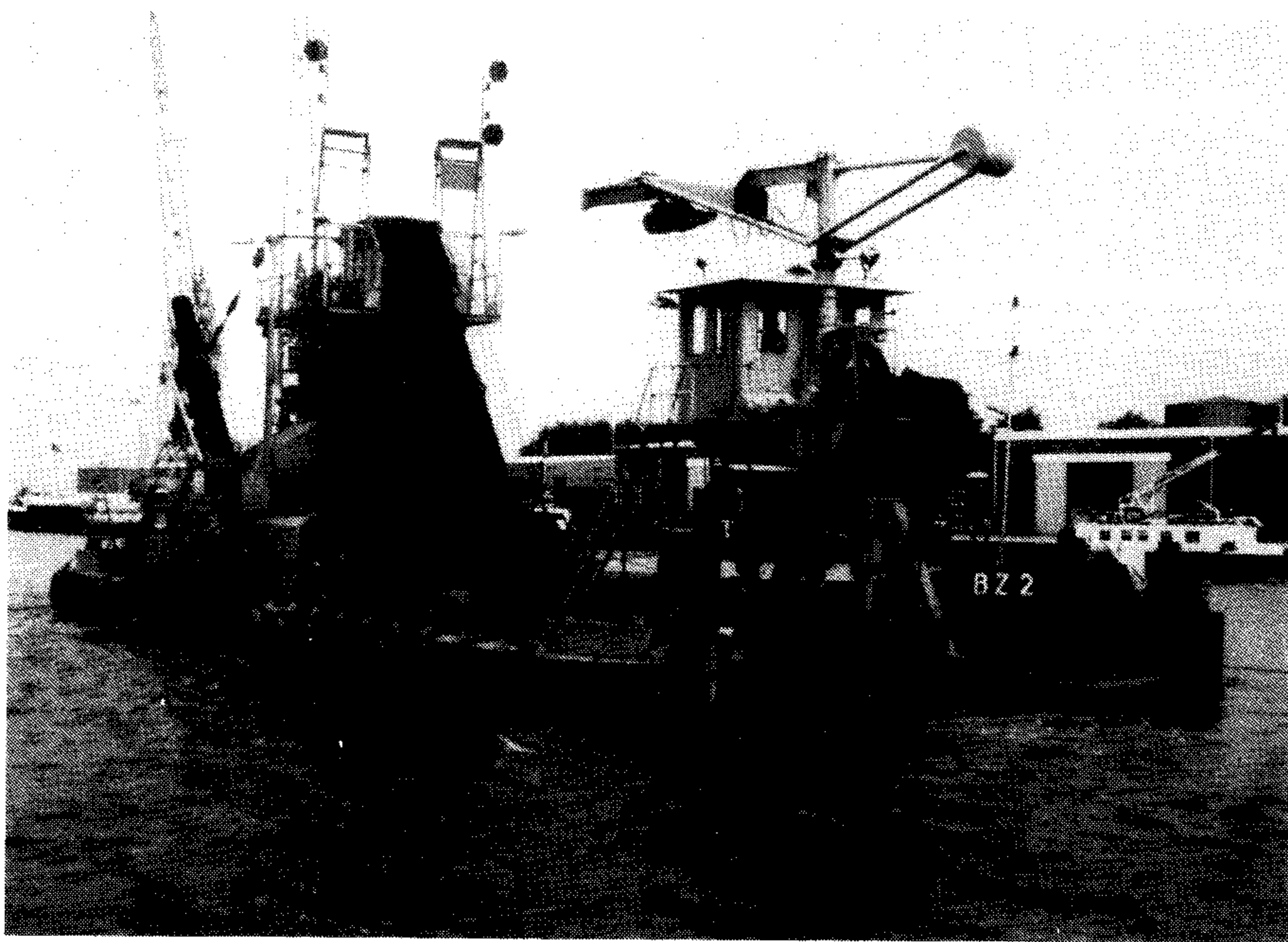


Figure 2. Bucket ladder dredge owned by Dutch Dredging B.V. used for maintenance dredging in small harbors.

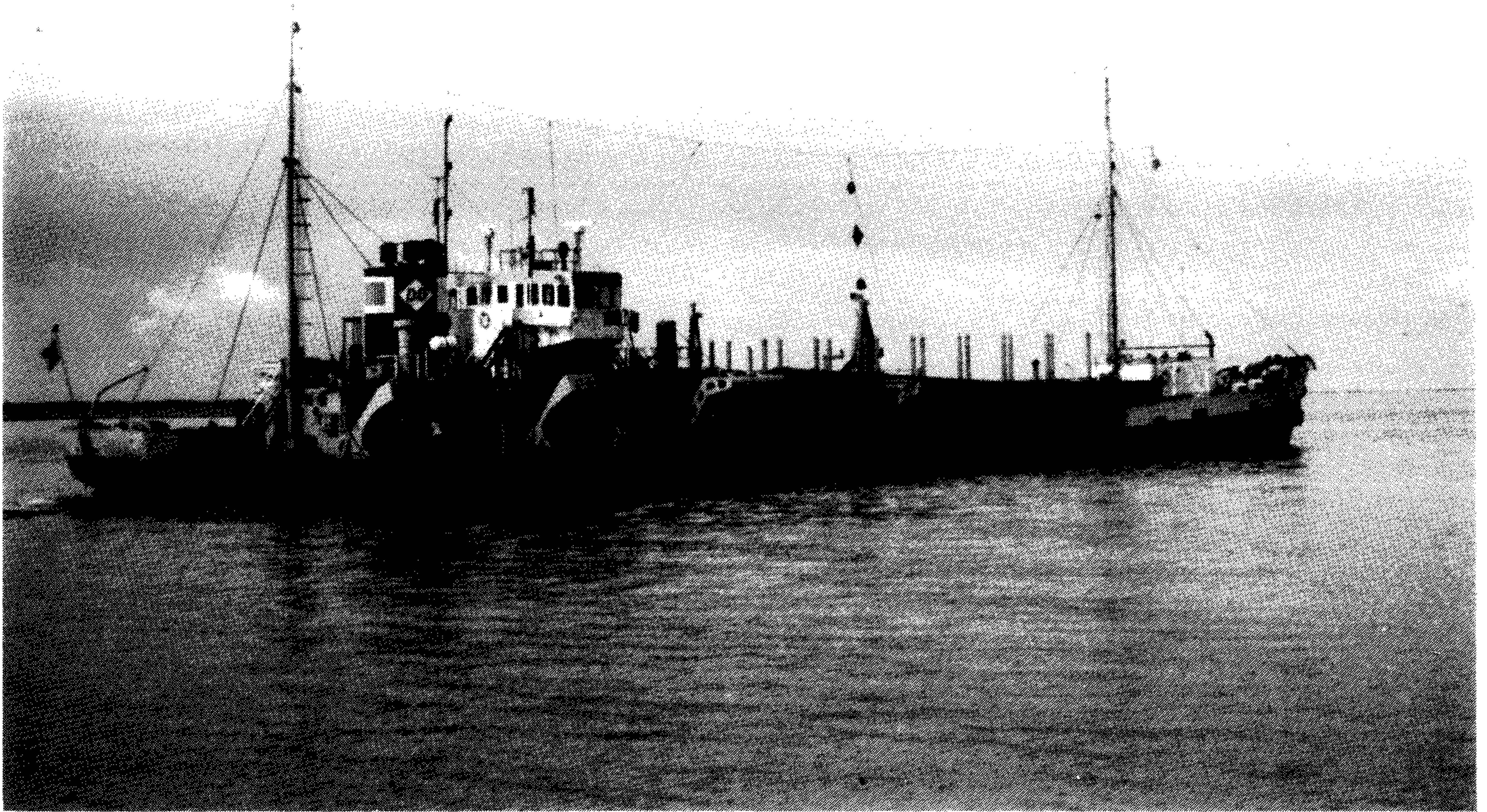


Figure 3. Sea-going hopper dredge owned by Dutch Dredging used for dredging large waterways.

When calculations are made based on pre- and post-dredge surveys, the same margin limit is used. To remain within this small bottom level margin when hopper dredging, considerable "overdredging" is necessary. This, however, often cannot be charged.

Therefore, to remain within the small bottom margin limit, a new solution had to be found which ensured that peaks were removed and deposited in the valleys to achieve a flat bottom, as shown in Figure 7.

A Solution

Bed levelling provides the solution to these problems.

When volumes are calculated based on pre- and post-dredge survey with small margin limits, a bed leveller must be used to achieve the most economical results. In addition, a bed leveller can remove and transport materials from corners, close to quay walls, and similar locations, whereas a trailer cannot come into these sites to allow the hopper dredge to pick up material.

Bed levelling during hopper dredging also has the advantage that material from peaks is transported to the valleys. This ensures that the drag head is always fully in the bed material, thus giving a higher efficiency for trailer dredging.

The influence on the price per cubic yard for maintenance dredging using a hopper dredge in combination with a bed leveller is shown given in Figure 6.

Economy

For maintenance dredging, the low

cost trailer in combination with a bed leveller is more economical than the bucket dredge; especially for short distances between dredging and dumping locations. Even for large trailer dredging projects, it is advantageous to use a bed

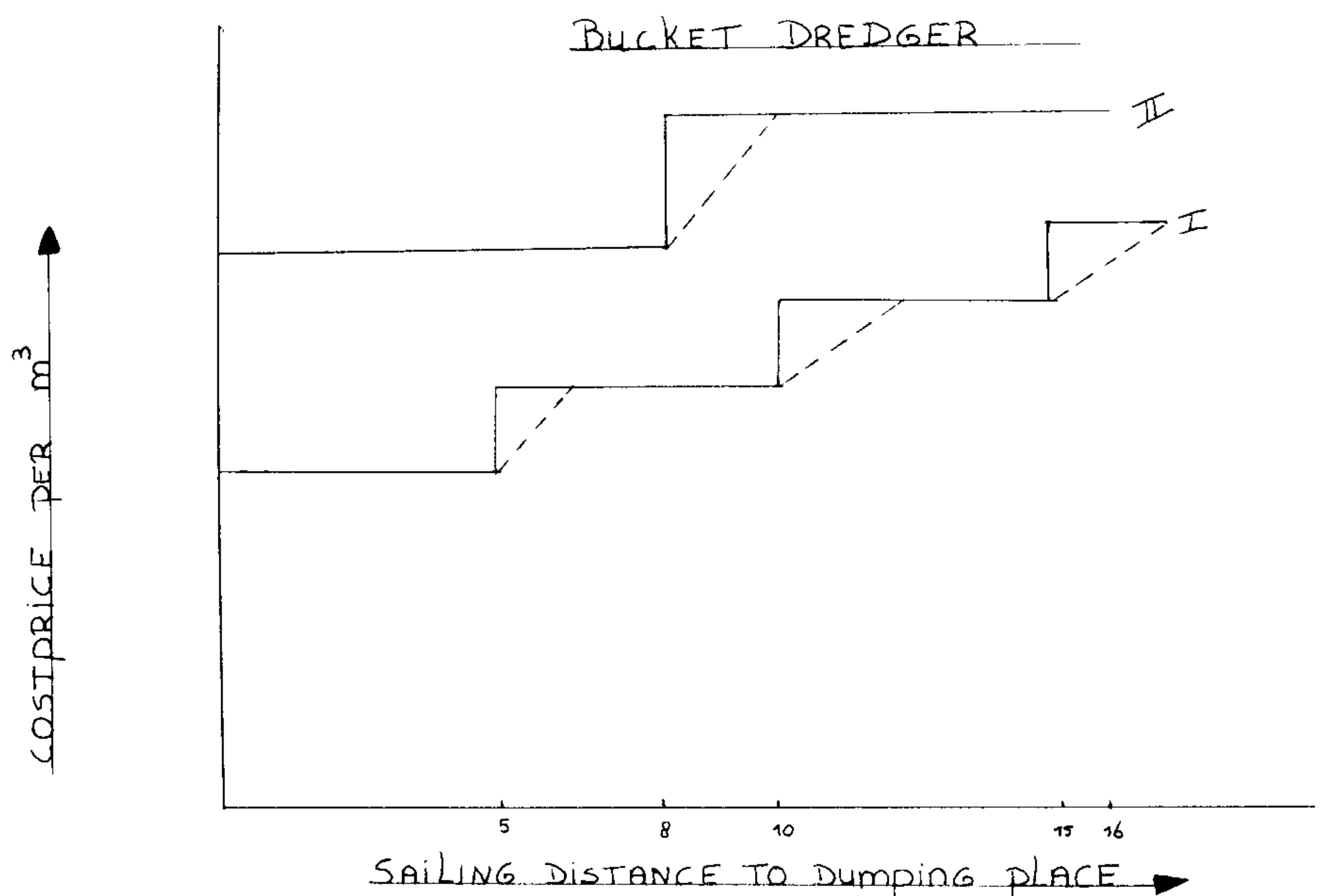


Figure 4. Cost per cubic meter for maintenance dredging by bucket dredge with tugboat and dumping barge, in relation to the distance between dredging and dumping sites.

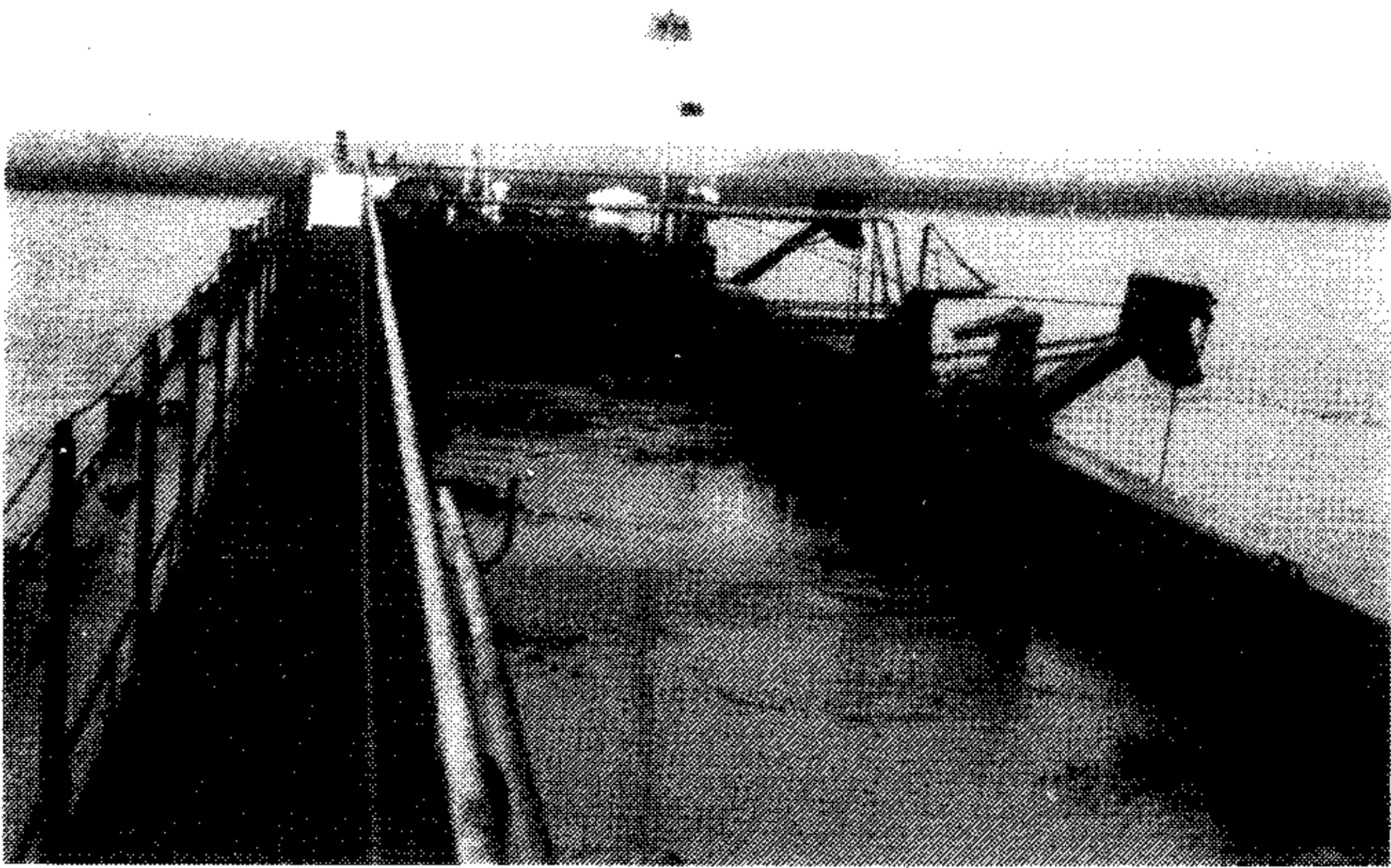


Figure 5a. Hopper of the "Adelaar" fills during dredging operations.

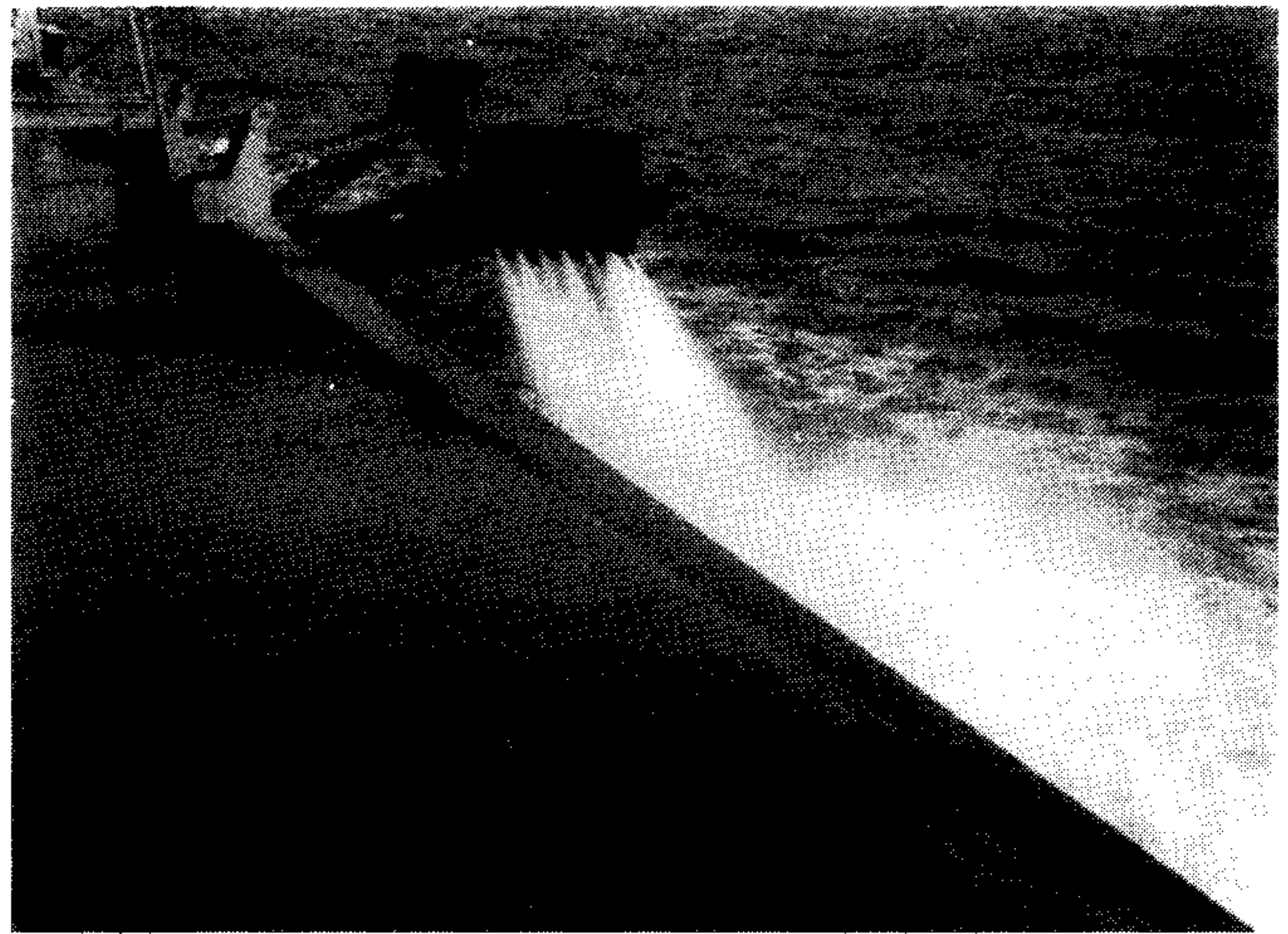


Figure 5b. Its hopper full, the draghead of the "Adelaar" is raised from the water.

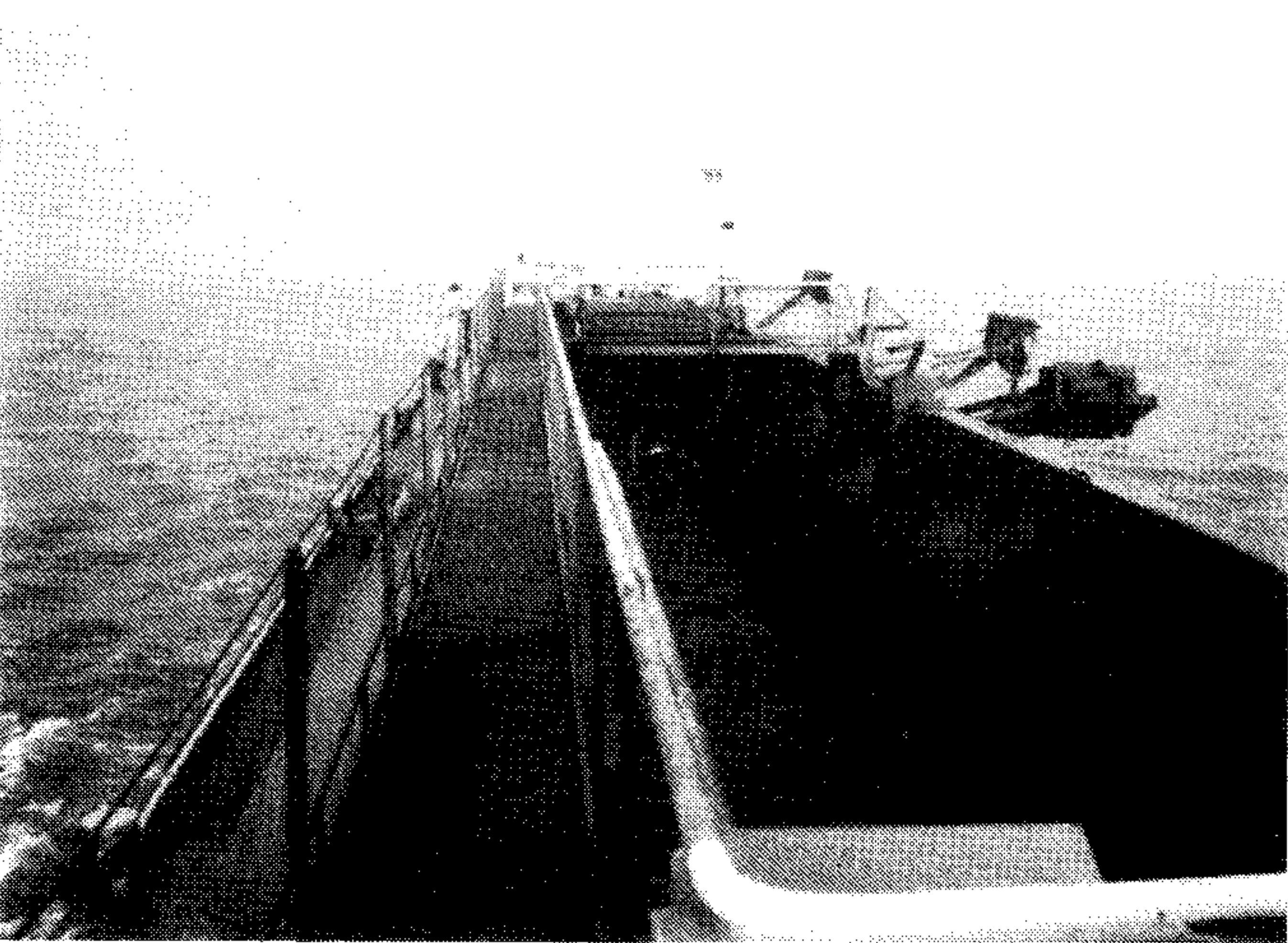


Figure 5c. Spoil is dumped at sea.



Figure 5d. Dredgemaster keeps an eye on dredge progress from the controls of Dutch Dredging's "Adelaar".

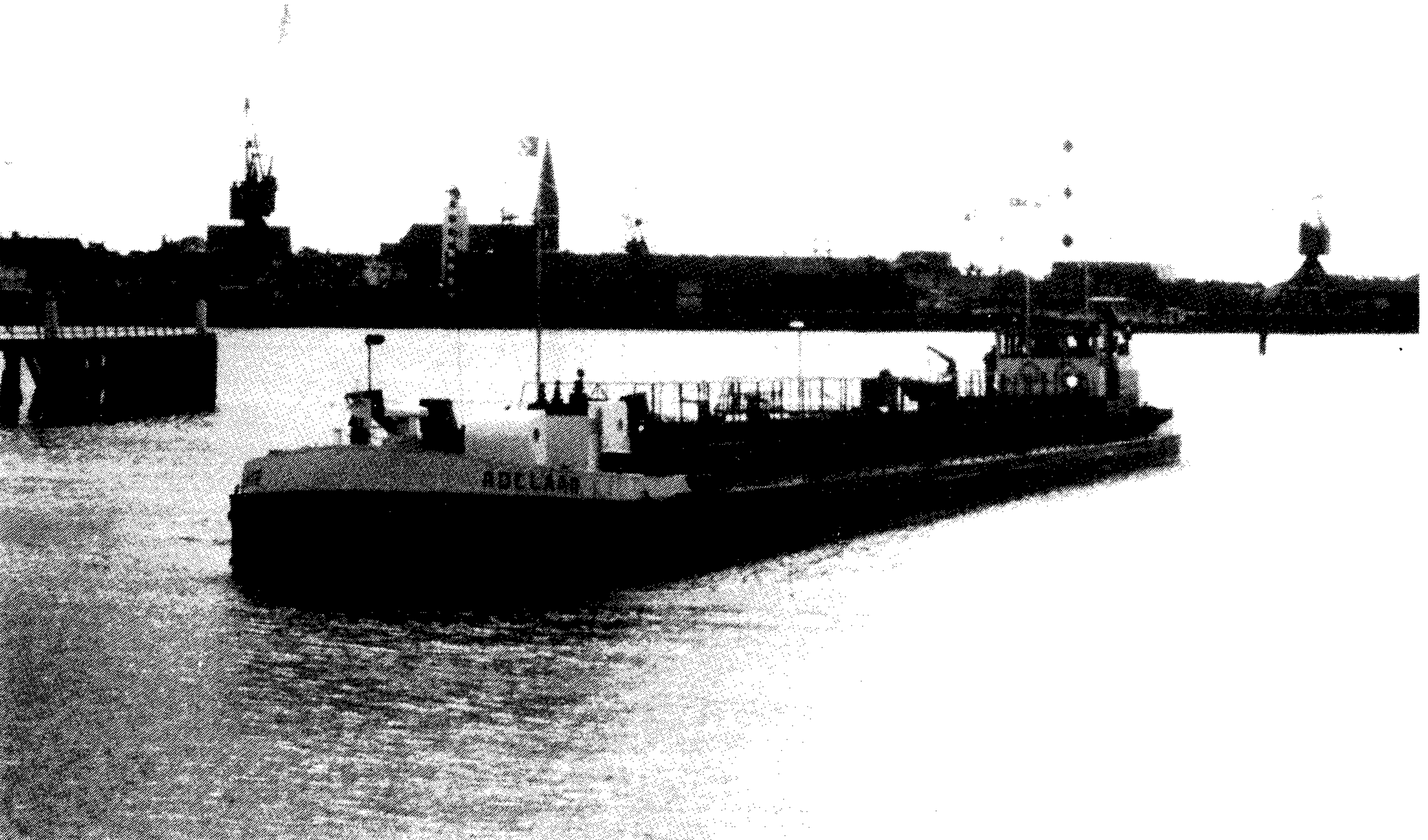


Figure 5e. The "Adelaar", a small trailing suction hopper dredge owned by Dutch Dredging B.V.



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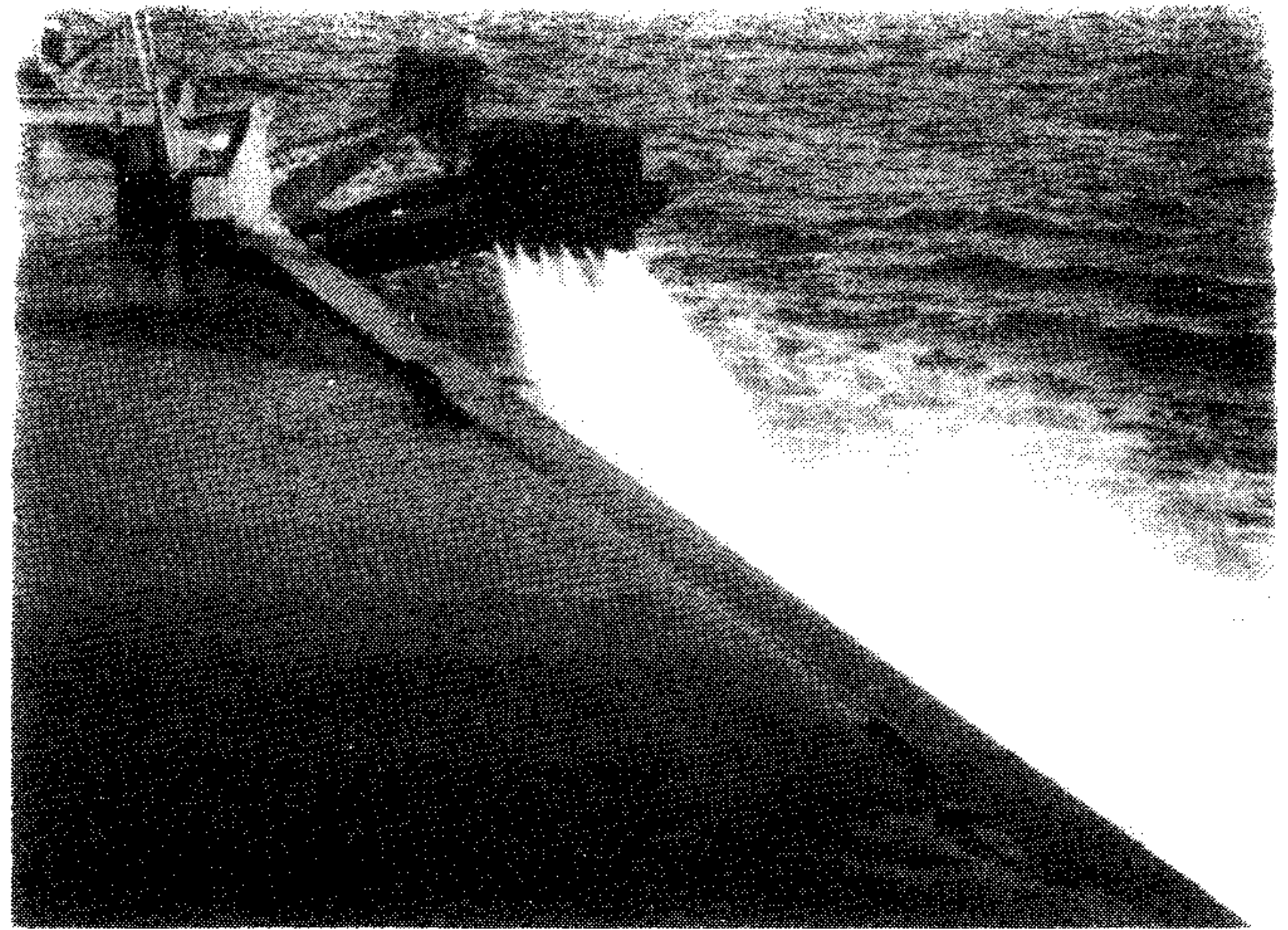


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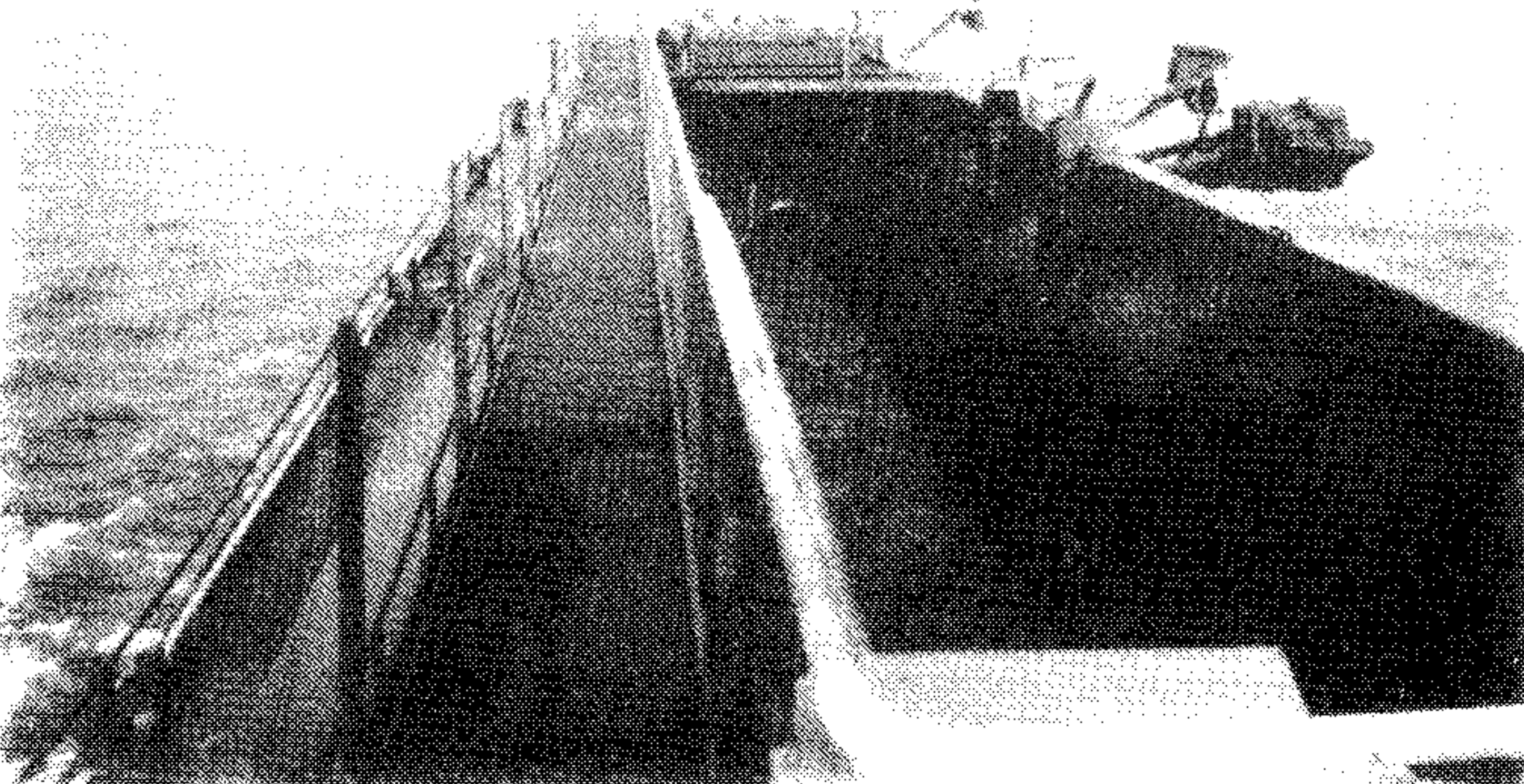


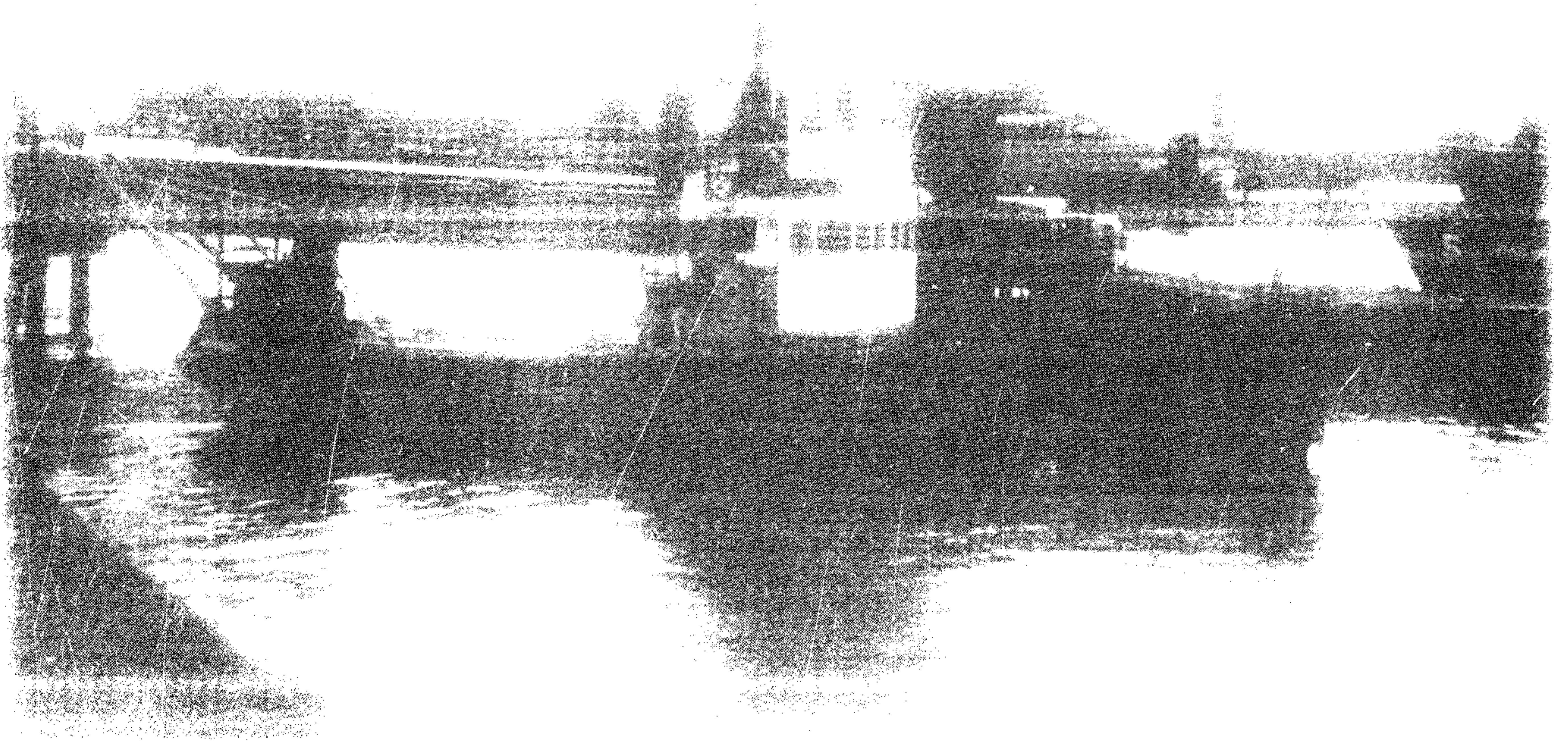
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with a motor. The engine is connected to the pump and the pump is connected to the dredger. The dredger is connected to the hopper and the hopper is connected to the conveyor. The conveyor is connected to the barge. The barge is connected to the harbor. The harbor is connected to the sea.

- The hull structure
- The steel frame
- The diesel engine
- The hydraulic pump
- The hydromotor and winch with gear
- The electrical hydraulic control system providing remote control from the bridge or wheelhouse
- Two towing chains and two towing winches

Bulldozer

The bulldozer is a tracked vehicle used for moving earth and rock. It is used in construction and mining. It is a heavy-duty machine with a large blade at the front.

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Figure 6. The influence of sailing distance between dredging and dumping sites on the cost per cubic meter of dredging of a hopper dredge, a hopper dredge equipped with a bed leveller, and a bucket dredge



Figure 7. The bottom profile left by a hopper dredge (top), compared with the bottom profile left by a hopper dredge and a bed leveller (below)

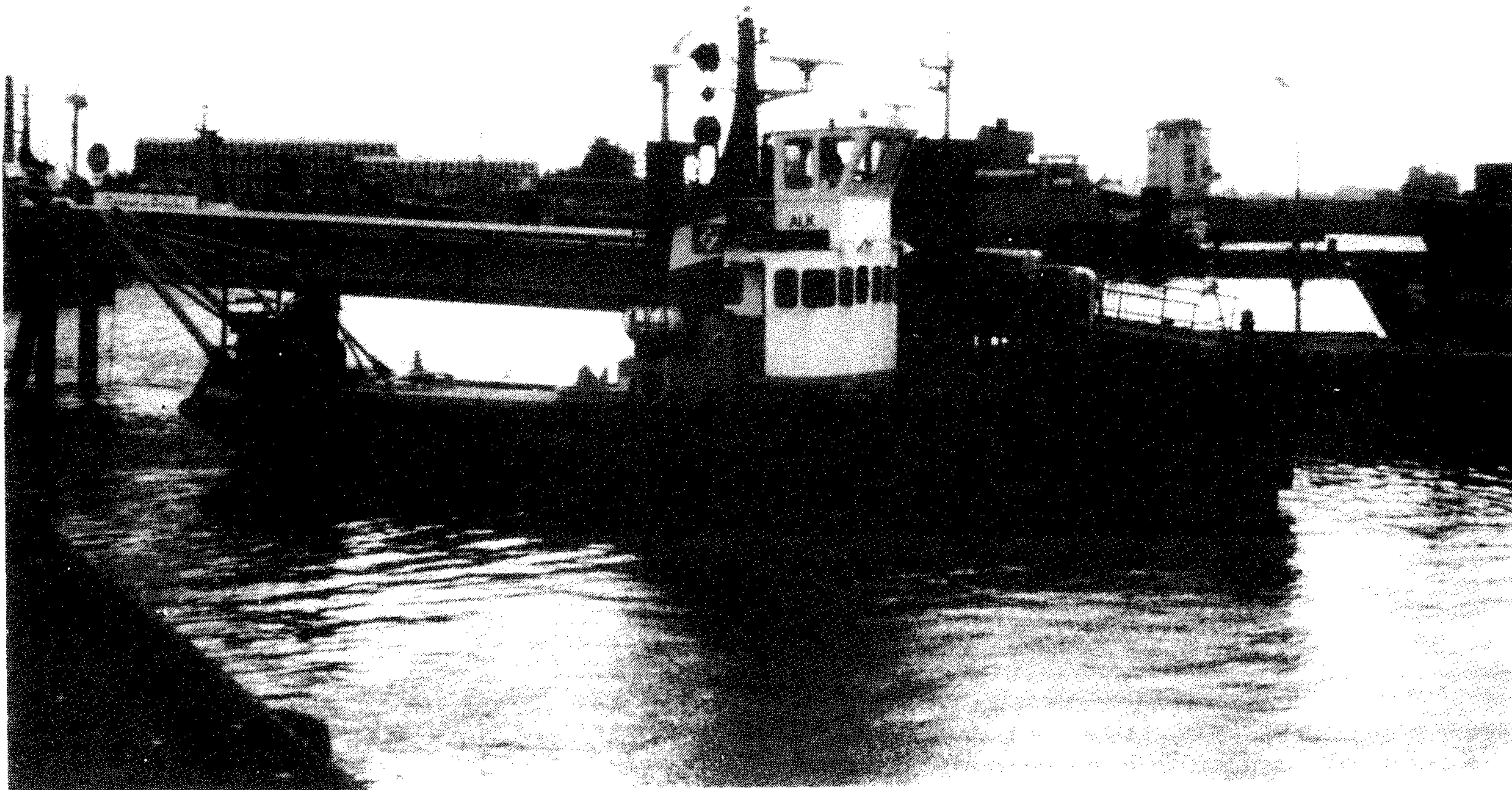


Figure 8. Vessel owned by Dutch Dredging B.V. equipped with a bed leveller. Survey boats can be fitted with a bed leveller and can undertake bottom levelling while the wider dredge is idle

leveller to achieve the most economical results.

It is always necessary to employ a survey or supply boat for large trailing dredging activities. If such a vessel is equipped with a bed leveller, it can carry out bottom levelling work during idle periods (for the dredge). A tug boat equipped with a bed leveller, is shown in Figure 8.

A complete bed levelling system consists of the following components:

- The bed leveller
- The steel A-frame
- The diesel engine
- The hydraulic pump
- The hydromotor and winch with hoisting wire
- The electrical/hydraulic controls system, providing remote control from the bridge or wheelhouse.
- Two towing chains and two towing cables.

Bulldozer

A bed leveller can be said to have the same function as a bulldozer, but operating under water. In many developing countries it is economical to carry out required maintenance dredging activities using bed levellers.

Cost per cubic meter, excluding mobilization and demobilization, are perhaps more expensive. However, when mobilization and demobilization are included it can be a more economical solution than a trailer dredge, especially in small harbors since it is hardly impos-

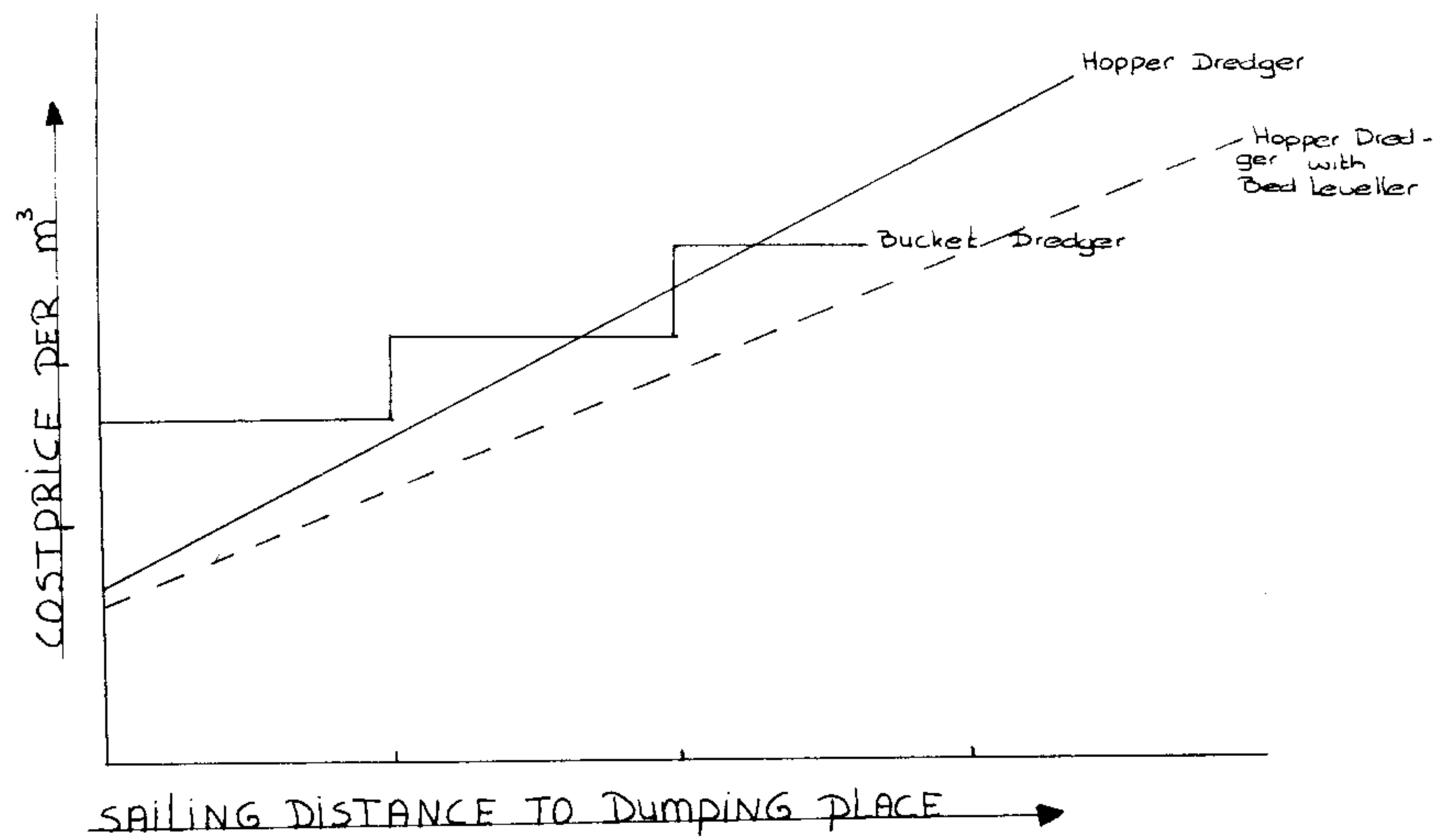


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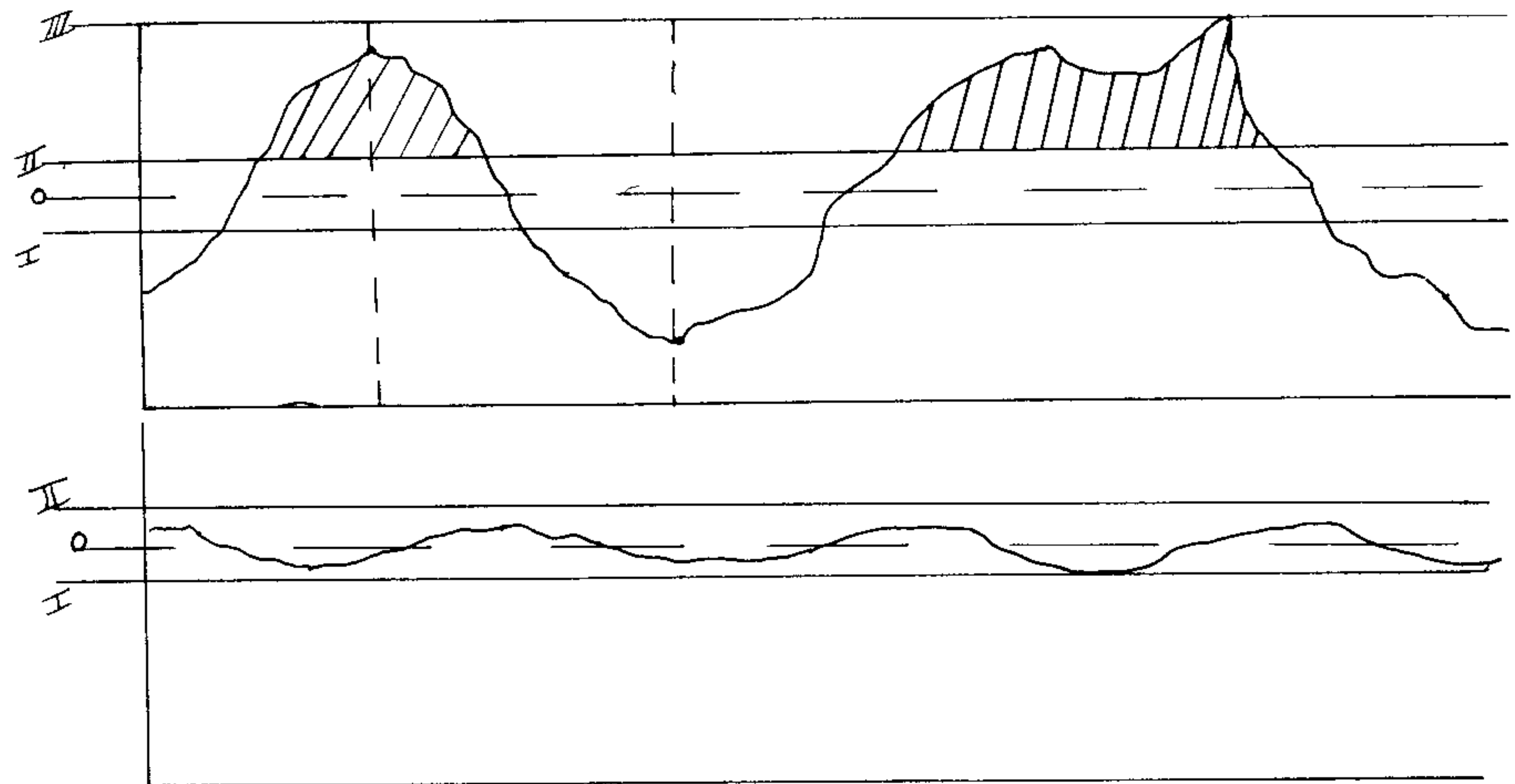


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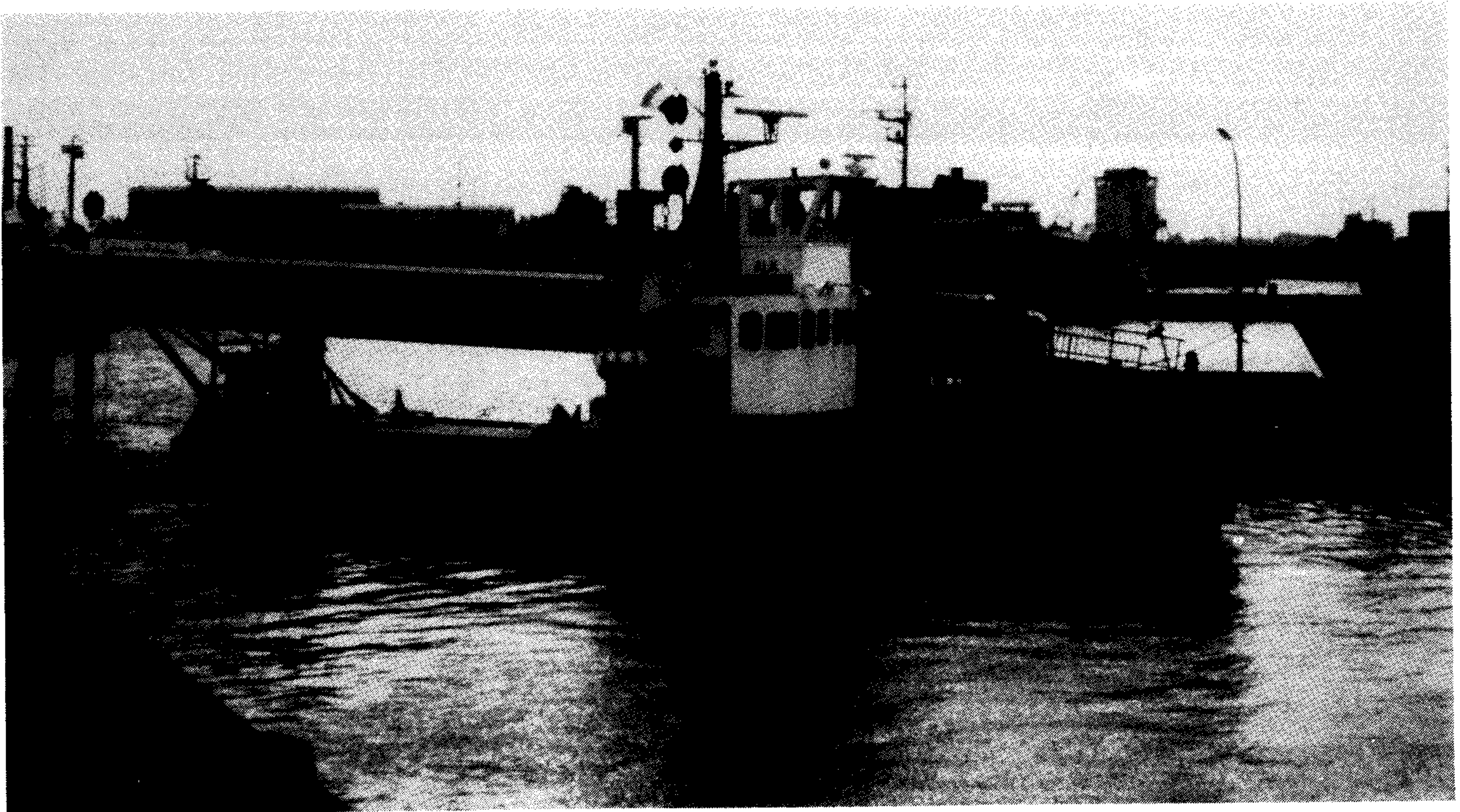


Figure 8. Vessel owned by Dutch Dredging B.V., equipped with a bed leveller. Survey boats can be fitted with a bed leveller and can undertake bottom levelling while the actual dredge is idle.

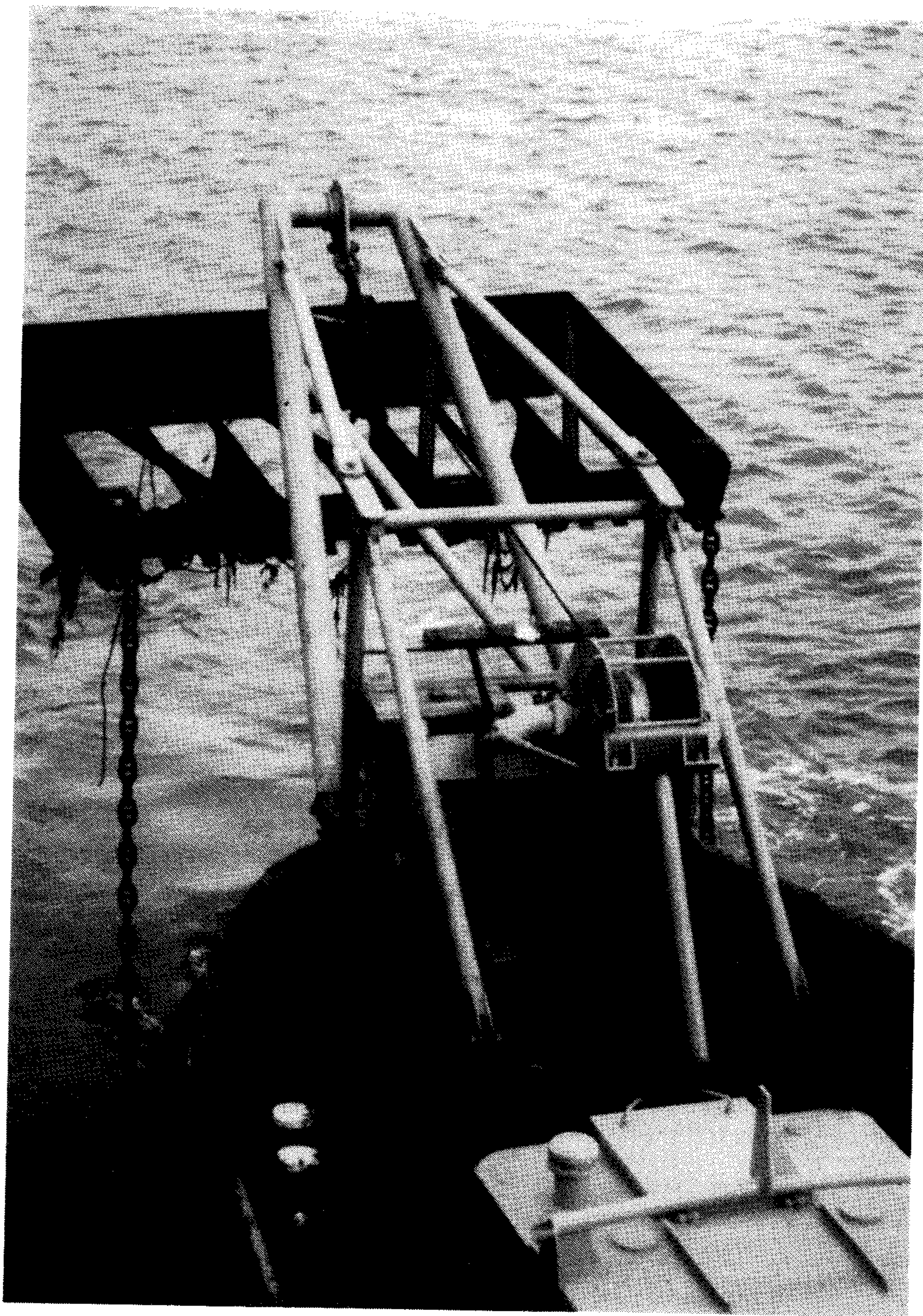


Figure 9. The bed leveller performs the same function as a bulldozer. Here, the leveller is shown raised from the water.

sible to dredge at such locations even using a small trailer.

Depending on the type of material to be dredged and the current in the harbor, it is also possible to perform agitation dredging with the leveller. The bed leveller is equipped with water jets and compressed air. The water jets break material into small particles and the compressed air is used to move this to the surface. Depending upon circumstances, it is possible that the harbor water will naturally remove the material during an ebb tide.

Hidden Debris

When maintenance dredging is carried out by bucket dredges, obstacles such as cables, engine blocks, bicycles, and such lying on the bottom, are removed during dredging. However, when this type of activity is carried out using a trailer dredging system, many obstacles remain on the bottom. It is thus necessary to remove such obstacles from the bottom every 5 years; otherwise hopper dredges have too much outfall and consequently low profitability.

It is possible to clean a harbor every five years by using a bucket dredge, or using special device known as the CAT bottom cleaner (CBC). This bottom cleaner is used behind a tugboat in the same way as a bed leveller. When the bottom cleaner is full with such obstacles it is hoisted, and the obstacles are then dumped in a small barge. This barge then dumps the obstacles at the dumping location, the bottom cleaner is again lowered to the cleaning site, and the process is repeated. A CAT bottom cleaner is shown in Figure 11. ■

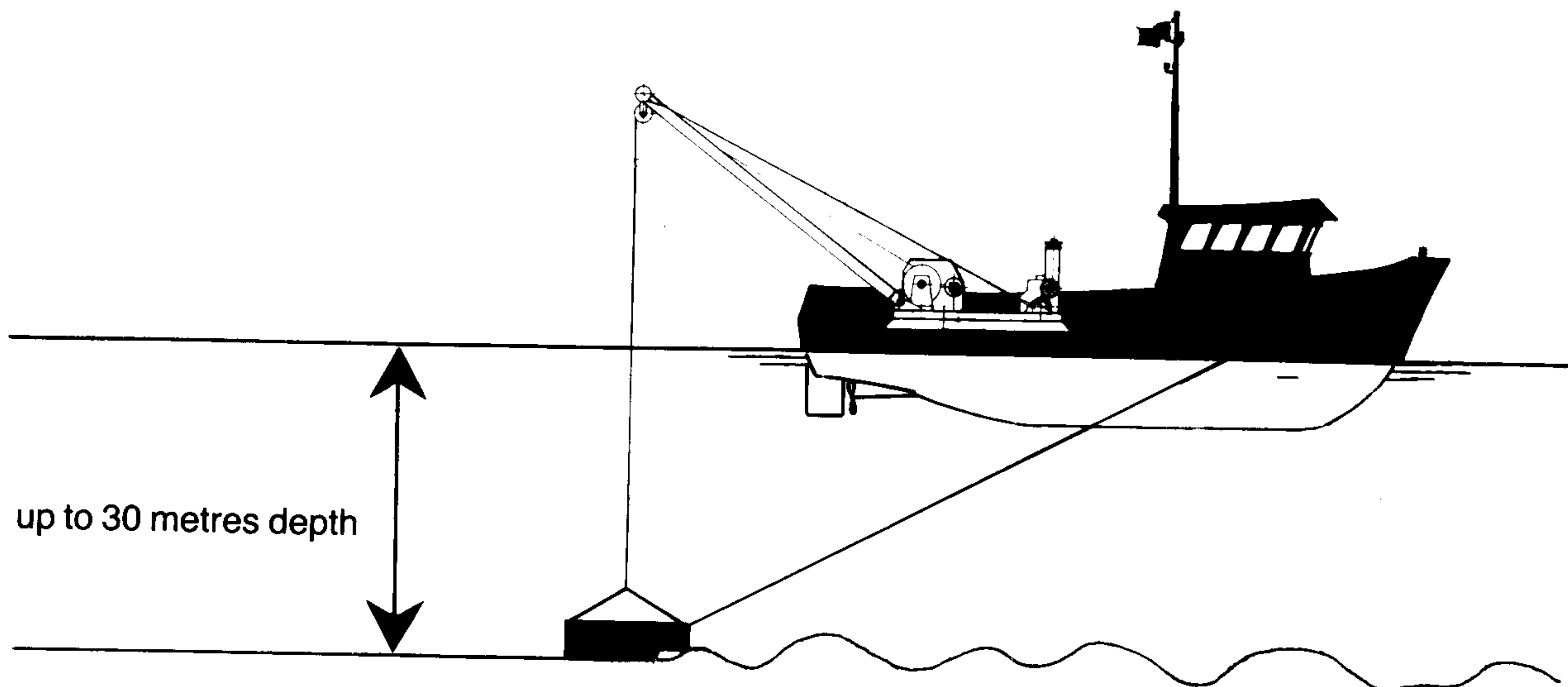


Figure 10. Sketch of vessel fitted with leveller flattening a dredged surface.