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Technical Report 135

Mechanical Discharge of Wet Fish Trawlers at Tidal Ports

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SUMMARY

This report describes trials held between 1973 and 1975 of a new method of discharging wet fish trawlers at a tidal port, in this case Aberdeen. The principle was that of a vertical lift from a high speed winch discharging on to a boom conveyor cantilevered from the quay with the whole unit being independent of the vessel. This technique was unaffected by tidal variations during the landing period.

The prototype equipment functioned well and was easily operated by the fish porters and could increase productivity by around 20%. Because of the recession in landings at Aberdeen the system was not subsequently adopted. However as the equipment is versatile in its ability to discharge wet fish vessels from 20m upwards at all quaysides with sufficient headroom whether tidal or gated and with vessels moored bow in or alongside, recommendations for future commercial development are given.

1. Introduction

1.1 Since the early 1950's, traditional methods of landing wet fish from trawlers have come under much criticism, directed mainly at the slowness of discharge and the high labour cost. The introduction of mechanised systems, which would operate satisfactorily in the conditions at the ports and fit in with the practices of the trade, particularly those of the auction sales, was more difficult than first considered.

1.2 In 1970/71 the White Fish Authority demonstrated at Grimsby a fast and efficient system for landing boxed fish (Appendix 1), which was adapted from a method of discharging frozen fish. About the same time a mechanical system for landing wet fish in bulk was introduced at Hull. (Appendix 1) Both these systems consist of elevators placed in the trawler's fishroom, feeding a conveyor carrying the boxes or fish from deck level to quay. With built in adjustments for height this arrangement was not difficult in conditions of a closed dock where during the course of one discharge operation, there was little variation between the level of the deck and the quay.

1.3 Tidal ports, however, present greater and continuous problems of height adjustment. For example, in Aberdeen, the largest fully tidal port, the tidal variation is between 2.4m (8ft) and 3.6m (12ft). A four hour landing time frequently means that there is a variation of 2.4m in the height of the deck of the vessel between the start and end of the landing. In the early 1970's at ports other than distant water ports, there was a much wider size range of vessels and catches and the limitation in berthing space meant that several catches had to be landed in succession at the same berth. A quick turnround and flexibility were essential. The unproductive installation and dismantling time associated with the elevator systems (Appendix 1) were unacceptable in these circumstances. It should be noted that in Aberdeen the vessels berth with the bow quarter to the quay, and not alongside as in most ports. This required a longer cantilever to reach over the vessel's hatch.

1.4 Although the 'whip' derrick method, long in use at Aberdeen was faster and showed a better labour productivity than the Grimsby "Gilson Pulley" (Appendix 1) it was considered that substantial improvements could be made by mechanisation. The objective of this project was thus to develop in prototype a mechanical discharge system, capable of meeting the requirements of trawlers landing at Aberdeen. Such a system would obviously be suitable for other ports with a restricted tidal range.

At the start of the reconstruction of Aberdeen Market in 1969 no provision was made for installing mechanised discharge. Therefore the project was undertaken in consultation and with the full co-operation of the Aberdeen Fishing Vessel Owners' Association, who were in a position to influence the market redesign if the need arose.

2. Conditions to be met by the System

2.1 In order to meet the needs of the industry at Aberdeen the system was required to meet the following conditions.

i) Be capable of handling both boxed and shelved fish without detriment to quality.

ii) Operate in conditions of up to 3.65m variation between high and low water.

iii) Be able to discharge trawlers currently fishing from Aberdeen.

iv) Continue to operate safely with vessels "ranging", due to movement within the harbour basin.

v) Have sufficient mobility and ease of installation to enable the equipment to be used for discharging several vessels in succession.

vi) Allow the same high degree of grading of fish for size for the auction practiced at Aberdeen.

3. Selection of System

3.1 After a survey in 1971 of U.K. and a number of continental ports, (Appendix 1) no existing system was found which met all these requirements. Features of several systems, however were considered capable of adaption. The most flexible systems were traditional winch systems. Of these the fastest and most efficient in terms of weight landed per man hour was the 'whip' derrick system at Aberdeen. The labour productivity of this system compared favourably even with some bulk handling systems, and only with the WFA/Goss box landing system and the Granton system of landing boxed fish by crane were higher weights landed per man hour observed. Most mechanised systems employed a conveyor to transport the fish from the trawler's hatch to the quay. It was decided therefore to combine the flexibility of a winch and derrick lift through the hatch with the speed of a shore mounted boom conveyor.

3.2 The traditional method of landing loose fish at Aberdeen was in wicker baskets with a discharge rate of 180 baskets per hour. Thrown from quay to deck and from deck to hold, the baskets were filled in the hold then slung ashore to be barrowed across the market and tipped into boxes for the auction. In 1966 a series of trials by the A.F.V.O.A. with assitance from the W.F.A. (Ref MAS 3) demonstrated clearly that tapered plastic boxes could be filled in the fishroom in place of the wicker baskets and there after the landing could be treated as a boxed landing. The trials in 1966 also involved weighing of each box and agreement on an appropriate manning scale was not reached, so that the practice of filling boxes in the fishroom was never adopted. The new design of nest/stack box introduced by the A.F.V.O.A. in 1973 was considered ideal for this method of landing and it was proposed to adopt this principle for handling loose fish.

4. Prototype Equipment

4.1 Constraints

With the rebuilding of the Aberdeen fish quay in progress it was uncertain where the trial landings could be carried out. The prototype equipment therefore had to be free standing. It was not possible to incorporate any form of mounting on the quay which might be employed in a final design. The counter balancing of the cantilevered conveyor added considerably to the overall weight. For economy, any form of self propulsion was also excluded. It had to be accepted that the manoeuverability of the prototype would be restricted and that there could be no real test of installation and dismantling time.

4.2 Basic Design

The new system made up of two basic components (see Figures 1 and 2 in Appendix 2);

i) an electrically driven hydraulic winch with a $\frac{1}{4}$" diameter wire rope and a fixed jib,

ii) a boom gravity roller conveyor with operating position

An operating platform was fitted to the side of the conveyor with the winch control at the outer end. In operation, the jib was vertically above the trawler's hatch so that only a vertical lift was required to bring the load to the level of the outer end of conveyor and the operator was in a position to see through the hatch into the fishroom.

4.3 The engineering of the chosen design was carried out by C.F. Wilson Ltd of Aberdeen who built the prototype. Their solution to the weight and mbility problem was to split the unit into two components; i) the jib section with winch and hydraulic pack

ii) the conveyor section with the operating platform reached by a walkway.

Each was mounted on its own independent carriage. The coupling of the two components was designed so that the hydraulic pack only functioned when the unit was securely locked together.

5. Method of Operation

5.1 The jib section was wheeled into position with the lifting hook "plumbing" the centre of the hatch. The unit was then anchored by means of screw jacks. The conveyor section was wheeled into position over the jib section, finishing up with the operating platform above but slightly short of the hatch. Again screw jacks were put down to hold the position. The hydraulic couplings were made, enabling the hydraulic winch to be operated from the operating platform by means of lever operated valve. The sling used was the conventional model, which allowed either one or two boxes to be lifted at once. The operator raised the box through the hatch, stopping the winch when the box was slightly higher than the end of the conveyor. He then pulled the box in towards the conveyor, while at the same time lowering it so that it landed on the conveyor. The sling was uncoupled and lowered back down through the hatch and the box was given a push to start it down the roller conveyor.

6. Initial Trials

6.1 Initial trials were carried out at Peterhead, where it was possible to avoid the pressures associated with landing to a tight schedule for an auction. These trials showed that under real conditions the method of manually landing boxes on the conveyor was not satisfactory. It was possible for the box to be landed insecurely on the end of the conveyor, so that the weight of the box could be taken up sufficiently for the sling to slacken and one or both hooks fall free. There was a danger of boxes falling back through the hatch. It became clear also that the operator's workload was too heavy and would have to be reduced. Several other mechanical problems arose which had to be rectified.

7. Modifications after Initial Trials

7.1 The manual transfer of the boxes from the sling to the conveyor was eliminated by fitting a powered extension to the conveyor. This extension consisted of a carriage running on rails carrying a roller platform with a front guard rail. The carriage was extended or retracted by a hydraulic ram. A limit switch attached over the winch cable was triggered by the relief of pressure, when the lifting hook reached a pre-set height and activated the ram to extend the carriage under the load. The boxes were lowered onto the conveyor by means of the winch; the operator released the slings and retracted the carriage by means of a manual switch, while the front guard rail engaged with the lower box to prevent it falling off the roller platform. The momentum of the retraction stroke was sufficient to start the boxes down the gravity roller conveyor.

7.2 Foot pedals were fitted to the hydraulic winch control valve in place of the hand lever, leaving the operator's hand free to guide the box sling.

7.3 A "counter-balance" valve was introduced into the hydraulic system to counter the possibility of boxes running back down in the event of a power failure. This unfortunately had the effect of slowing the descent rate of the empty sling.

7.4 The new sequence of operation of the modified unit was as follows;

i) the hook with sling was lowered into the fishroom;
ii) the two boxes were raised from the fishroom;
iii) the limit switch stopped the lift at the required height and activated the ram extending the landing platform under the boxes;
iv) the boxes were lowered on to the extension and the hooks removed manually by the operator;

v) the retraction button was pressed by the operator and the extension retracted;

vi) the boxes were carried by momentum on to the roller conveyor and thence into the market;

vii) the cycle was repeated.

8. Trials at Aberdeen

8.1 The first trial on Aberdeen Market, arranged with the full co-operation of the A.F.V.O.A. and the Aberdeen Fishmarket Porters, took place in February 1974. The trial was successful and the equipment operated as designed. The contribution of the fishmarket porters to the project was gratifying. Six of the 13 man squad, manning the trial landing were drawn from the porters' industrial relations committee and the remainder were volunteers. It was emphasised that safe working was the most important consideration in the trial.

8.2 One hundred boxes were landed from a Polish trawler, the catch of which had been boxed at sea in inshore type wooden boxes. The last one hundred boxes were left in the bottom of the fishroom after the main part of the shot had been landed. The vessel was discharged at the "Yawl Market" and the boxes stacked opposite the vessel.

8.3 The "Yawl Market" provided very poor conditions for manoeuvring the landing equipment into position, since the floor of the market was cobbled and the concrete apron of the dock was badly pitted and pot holed, both conditions making the movement of the unit on small solid castors, difficult. With the full squad of porters, the derrick unit was aligned over the main hatch (approx 1.8m x 1.2m) very quickly and the conveyor unit pushed into position, located and connected up without much difficulty. The installation was completed in approximately fifteen minutes. The tidal conditions were ideal, the vessels' bulwarks were a little lower than the dock level.

8.4 The winch operators' only previous experience of the controls was a few minutes in the manufacturer's yard. He very quickly learned to operate the winch and after landing a few boxes singly, soon started landing the boxes in pairs as intended. Under the test conditions, the porters very quickly adapted to the system and experienced no great difficulty and for periods were landing boxes at the equivalent rate of 360 per hour.

8.5 Minor Modifications

Several minor modifications were agreed by representatives of the fishmarket porters following a second trial. The stability of the conveyor unit was improved by the addition of a retractable front support incorporating a jacking device. The winch control was improved by modifying the hydraulic system.

9. Final Trials

9.1 The programme of trials was interrupted at this point for a long period owing to the congestion on the Aberdeen Market as result of the reconstruction work and other factors outwith the control of the Authority. The final trial in February 1975 was carried out at the "New Market" i.e. the section which had been reconstructed. This site had two advantages over the "Yawl Market" in that the apron was 4.5m wide and the floor overall was smooth concrete. Once again the vessel selected was a Polish side trawler landing fish under contract to a large processor and therefore were not going through the process of the auction sale, but this time there were two hundred boxes left for the trial.

9.2 Once again the trial was carried out with a different man in the operating platform but clearly the crew proved that if allowed time to become accustomed to the unit, they very quickly developed a good working momentum. In this trial the hatch man on the vessel's deck, controlled the box by means of a rope attached to the hook ring. This not only helped control the ascent but turned the boxes to the correct orientation for landing on the rollers. During this trial a discharge rate of 350 - 400 boxes per hour was achieved.

10. Discussion of System tested

10.1 Mobility of Equipment

Although the restrictions to the mobility of the prototype equipment are noted in paragraph 4.1., the importance of providing equipment easily manoeuverable and self propelled was underlined by the trials.

10.2 Winch Operator

The winch operator was the key man in the discharge team. Pedal control of the winch was shown to be both necessary and possible. It was considered that the system could be further improved by replacing the gravity track with a powered conveyor. The use of a powered conveyor, adjustable for height, to place the operator close to the vessel's hatch, would minimise height of lift, reduce the cycle time, and increase the confidence of the winch operator.

10.3 Hatch Man

It was demonstrated from the first Aberdeen trial that only one man was required at the hatch instead of two under the traditional system. In the first trial, the hatch man kept the cable clear of the hatch in the traditional way, leaning on it with a gloved hand. In the later trials the winch cable was controlled by a rope attached to the hook swivel.

The porters considered that the winch operation should be sufficiently flexible to allow boxes to be lifted from the wings of the hold as well as directly below the hatch. This was achieved in later trials and did not result in an increased landing rate but in fact presented problems by causing the wire rope to foul the height cut-out mechanism.

10.4 Boxes

There was one unfortunate consequence of choosing the Polish vessel's for the trials. The boxes they used were wooden "inshore type" and in many cases were in a poor state of repair. This led to problems of lifting broken boxes and getting them to run smoothly on the conveyor. No such trouble had been experienced during preliminary tests using plastic boxes.

Throughout the trials only boxes filled at sea were discharged. The alternative, method of filling boxes in the fish-room was not employed, but this has not reduced confidence in the principle.

10.5 Delivery of Boxes into the Market

Extension gravity roller track carried the boxes into the centre of the market reducing the distance which the boxes required to be transported to the display position for the sale. This probably reduced the manning requirement by one, compared with the traditional 'whip' derrick system. Weighing could easily have been incorporated at the end of the gravity track, as it was in the 1966 trials, but in the interest of speed in completing the final unloading trials, this was omitted.

11. Development of Commercial System

From the trials with the prototype it is possible to specify the requirements of a commercial version. These are summarised in Appendix 3 and the alterations from the prototype system are discussed below.

11.1 Development of conveyor unit

The landing cycle time could be further reduced if the landing platform was maintained in a position as close to the hatch as possible. This could be achieved (10.2) by using a powered conveyor mounted on an adjustable frame which could be raised or lowered as required from the winch control position. The winch operator would thus be placed very close to the hatch. The lift would be confined to about 2m more than the height of the fishroom, the winch operator's confidence would be increased, and it would be possible to discharge without a man at the hatch. In the case of shelved catches, the former hatch man's function would be changed to passing boxes to fishroom and handling pound boards. The landing platform, extending once per cycle as before, could be improved by fitting a powered conveyor or powered rollers which would be activated only on the completion of the retraction stroke. The whole conveyor unit would be retracted on to the quay for transfer to other trawlers.

11.2 Automatic height cut out

This would be fixed at a constant distance from the landing platform.

11.3 Multiple units

For discharge of the larger vessels two or more unloading units would be required to work from the same vessel. The overall width of the commercial units would be reduced to allow working of two from one large hatch or two small adjacent hatches (say 1.5m apart).

11.4 Mobility of units

To allow greater utilisation of the equipment, each unit would be movable along a quayside for a distance to cover the berthing of two to four vessels. A rail system with self propulsion seems preferable.

11.5 Sequence of Discharge

The introduction of heavier landing equipment would entail a change in the traditional sequence of discharge. At present vessels are discharged and catches are sold in the order in which they docked. To obviate leap-frogging of equipment the landing company requires to station a large number of winches along the length of the quay. These are brought into action as required and derricks rigged.

High capital cost equipment must clearly be used more efficiently. Preplanning however should enable the allocation of sufficient rail mounted units to all sections of the market to allow each section to complete unloading by a given time. The sales could then still take place in the order in which the vessels dock.

Conclusions

12.1 A practical mechanical landing system for a tidal port was demonstrated by combining a high speed winch with a boom conveyor.

12.2 A fully developed system incorporating a quay mounted and powered propelled unit could achieve worth while benefits;

i) a faster rate of discharge,

ii) reduced manning, at the hatch and on the quay.

12.3 The type of winch foot control tested could be easily operated by any winch operator.

APPENDIX 1

Mechanised Discharge Systems at U.K. and European Ports
A Study carried out in 1971

1. Hull - Bucket Elevator System

This system discharged wet fish trawlers at Hull where a number of units had been installed. The fish were conveyed in loose form from shelved or bulk stowed catches.

The Equipment consisted of the following:

i) Permanently fitted in each vessel:-
   (a) slat conveyor down the centre of the fishroom floor.

ii) Installed prior to the landing at a service quay:-
   (a) bucket elevator resting on the floor of the fishroom and clamped to the hatch.

iii) A trough belt from deck to quay.

iv) An ice separator.

v) A selecting belt.

System

Fish and ice were shovelled into the central slat conveyor and carried in bulk up the elevator to the quay where much of the ice fell through the separator. Fish were selected by lumpers from the conveyor on the quay into kits. There were only two selections of each species. An attempt was made to discharge only one species at a time but it was impossible to identify fish by freshness without slowing down the system very greatly.

Rate of Discharge

The rate appeared to vary throughout the landing. Large quantities of cod or haddock could be discharged quite fast. The start tended to be slow until the staging was cleared and all the fishroom gang were able to load the conveyor.

Reported maximum rate 875 cwt per hour
" average " 500 cwt per hour
Manning scale 50
Average labour productivity; 10 cwts per man hour
Estimated labour productivity with existing system at Aberdeen; 10.8 cwts per man hour.

Specification

Elevator weight; $1\frac{1}{2}$ tons
Minimum hatch size; 3'3" x 3'
Height of conveyor from fishroom floor; 1'6"

Application to Aberdeen

It is considered that an elevator could be adapted with no great difficulty for mounting in the fishroom of most Aberdeen trawlers. Few Aberdeen trawlers, however have fishrooms large enough to allow for a conveyor to be mounted permanently down the centre of the hold. At low tide the level of trawler decks can be twelve feet below quay level and for all but stern trawlers with a factory deck, a more sophisticated conveyor or elevator would be needed from ship to shore.

Conclusion

The system is mechanically sound and the damage caused to fish is not excessive. For trawlers with a large hatch it is quite easy to install. Judging by the discharge rates achieved to date the system has very little to offer in terms of improved discharge rate and labour productivity compared with the present system at Aberdeen. The system also has very definite disadvantages in terms of size grading and difficulty of identification of freshness, damage to a proportion of the fish and capital cost. This system is also not really practical for Aberdeen since it is impossible to transfer the elevator quickly from one vessel to another. The introduction of such a system at Aberdeen could have an adverse effect on quality and increase the cost of landing.

2. Grimsby

Grimsby differed from Aberdeen and Granton in that ships operating from there were much larger and the fish dock itself was locked part of the day so that there was a tidal fall of only 1.5m. Like Aberdeen the methods of stowing catches were mixed, so provision had been made for operating both shelved and boxed fish. The system used for shelved fish was somewhat similar to Aberdeen except that no derricks were used but blocks were suspended above the hatch by means of a "Gilson" wire fitted with rings, and a support structure was built on the trawler deck with a broad wooden boards between this support structure and the quay. The fish were discharged in baskets, being lifted from the fishroom and landed on to this board, then slid down the board to the quay.

There were two new systems tested in Grimsby, one for shelve fish and one for boxed fish.

Shelved Fish

Instead of the wooden support structure a platform built up from pre-cut scaffolding was arranged on the trawler deck and a gravity roller track was run from this down to the quay.

Boxed fish - W.F.A. Elevator

This system was manufactured by George Orton, Sons and Spooner Limited to the specification of the W.F.A. I.D.U. and had been tested at Grimsby over a period of 6 months. The equipment was an adaptation of the vertiflow elevator and horizontal conveyor installed by G.O.S.S. for discharging frozen blocks at North Shields and was designed to handle fish boxed in any boxes similar to the Warwick aluminium boxes or the Stromberg 90 litre plastic box. Most of the trials had been of discharging Stromberg boxes.

Description

The discharge system comprised 4 sections:

i) Roller conveyors in the hold
ii) Feed unit
iii) Vertical elevator
iv) Ship to shore conveyor.

Boxes were fed into the vertical elevator and delivered to the quay automatically.

Rigging

The installation of the equipment on the vessel required the use of a mobile crane. There were no facilities at the fish market at Grimsby for rigging the vessel and was necessary to carry this out at an open berth and subsequently move the trawler to the market. For dismantling the vessel had to return to the open berth. A clear area was required in the fishroom to allow the elevator to be lowered by the mobile crane into the hold, where it was secured to a base pad, forming part of the hold deck, on which the elevator stood. The discharge conveyors were also rigged at the open berth. When the vessel arrived at the market section the gravity roller conveyors were connected to the slat conveyor to carry the boxes into the market. Rigging time varied very much with different vessels and the experience of the operators in rigging the particular vessel. Representative times might be expected to be, rigging one hour, dismantling 45 minutes.

Operation

The elevator was loaded manually in the fishroom. In vessels which were fully boxed, light sections of roller conveyors were used to transport boxes from the stoppage position to the elevator.

Each box was lifted by a series of fingers (or a fork) mounted on a bar which carried the box to the top of the elevator and deposited it on a skate wheel discharge. Guide rollers and cam rails rotated the carried into a vertical position for return and further cam rollers at the base turned the carriers back to the horizontal position.

Rates of Discharge

The elevator tower was designed to operate at a rate of 960 carriers per hour but it was found impossible to load at this rate except for very short periods. The control factors appeared to be (a) the rate at which the elevator could be loaded in the fishroom and (b) the rate at which a conveyor could be cleared in the market. It was reported that the equipment had operated for periods at a rate of 700 boxes per hour but the overall rate had been about 450 boxes per hour.

Manning

The manning had varied but this appeared to have settled down to the following; fishroom 9, quay side 9. It was suggested that it may be necessary to increase the quay numbers to clear the conveyors more quickly.

Conclusion

This was a fast efficient system for unloading large shots of boxed fish. The principle drawback was the time required and the cost of rigging and dismantling the equipment. This made it impossible to transfer the elevator quickly from one vessel to another and could thus only be used for discharging one trawler in 24 hours. At Grimsby it had been found that the system greatly increased the labour productivity in terms of cwts landed per man hour and potentially substantial savings in labour cost could be achieved. These savings however had to be set against the additional cost of rigging and there were insufficient large boxed shots at Aberdeen to consider the installation there of this system.

3. Granton - Mobile Cranes

System

All Granton trawlers box their whole catch. Mobile cranes are employed to land the boxes with loads of from 10 to 12 boxes at a lift. Granton harbour was not congested and vessels could lie along side the quays, which at high tide were above the level of the trawler bulwarks. All fish landed at Granton was consigned by road, some to the local market a little over a mile distance and the bulk to more distant markets at Glasgow, Hull etc. The landings took place at any convenient time during the day and the fish consigned for the next morning's sale at different markets. There were no dockers at Granton and the landing was performed by casual labour with some crew members.

Equipment

Several berths were equipped with rail mounted travelling cranes. On the North quay however a Jones 44 mobile crane was used with a similar capacity.

Rates of Landing

Landing 10 boxes per skid; 420 boxes per hour
" 12 " " "; 500 " " "

Conclusion

This was a fast, flexible and inexpensive system for landing a boxed catch. The Jones 44 cranes could be operated without difficulty on the 15 foot wide apron of the reconstructed section of the market. An additional advantage of the cranes were that they could be used for re-boxing the trawlers and with 20 boxes at a lift this could be very fast.

The system was however not so suitable for landing shelved fish. Even if boxes were supplied to the fishroom, the space required to stack boxes on the crane pallets might make working difficult. The apron on the older Aberdeen fish quays was too narrow for crane operation and probably could not support a crane.

4. Continental Ports

Mechanisation of discharge systems for fresh fish had not yet been widely developed on the continent. The majority of continental trawlers appeared to stow their catch in bulk and discharge by means of winch and baskets or plastic tubs. No system in operation on the continent complied with the specification thought necessary for an improved system at Aberdeen, but there were, however some facets of continental practices which might be incorporated with advantage.

At Bremerhaven, Cuxhaven and Schevenigen winch systems were used in conjunction with over head gin pulleys rather similar to the practice at Grimsby. At Cuxhaven landing boards were used rather like Grimsby but at Bremerhaven a chute was employed which carried plastic tubs from the hatch to the quay a second chute carrying the empty tubs from the quay to the hatch. Bremerhaven had however a tide free harbour with dock gates. Cantilever roller conveyors were employed at Scheveningen for the same purpose. These were mobile boom conveyors with a pulpit mounted at the outer end and were wheeled into position so that the pulpit was directly over the vessels hatch. A catcher stood in the pulpit and guided the baskets on to the rollers, released the hooks and allowed the basket to pass down the rollers into the market. In this last method the conveyor system, being mounted on the quay was quite independant of the trawler and could operate satisfactorily as long as the conveyor cleared the bulwark of the vessel. Higher conveyors had in fact been introduced for discharging stern trawlers.

Perhaps the most sophisticated system in concept was the installation at Hamburg Altona. This had not been seen in use and as the port only had 4 trawlers it was not used very often. The Hamburg system consisted of a belt conveyor mounted on a very substantial structure running on rails along the front of the quay. The conveyor along with operator's pulpit could be raised to a vertical position while the vessel came along side and then lowered over the hatch. The actual unloading was also carried out with plastic tubs and these were emptied on to the belt conveyor. The fish and ice pass over a series of belts which included an ice riddle, the fish continued to fall into boxes at a weigh point and the ice being returned to the harbour. The whole system was massive and was thought to be far more complex and costly than necessary.

5. Lowestoft - Deck to quay conveyor

Trials had been carried out in Lowestoft by I.D.U. in conjunction with the L.F.V.O.A. of a trough belt conveyor to carry loose fish from the deck of trawlers to the quay. This conveyor was similar in design to the 'Fyson' trough belt conveyors used in Aberdeen to ice trawlers.

It was understood that fish were lifted in baskets by winch and gin wheel from the fishroom in the normal way. The loose fish were then tipped on to the trough belt conveyor, carried ashore and deposited on a horizontal belt conveyor for selection. The trials are reported to have demonstrated that fish could be landed in this way. Flat fish were conveyed at an angle of 45° without difficulty.

Conclusion

The system introduced additional handling operations, which could be detrimental to quality. There was a possible increase in discharge rate but none in manual operations since the system transfers the selection operations from fishroom to quay. The difficulty of identification of freshness, referred to in the section on the bucket elevator at Hull also arose here. It was doubtful whether the system had any advantages over the existing system at Aberdeen and could have an adverse effect on quality.

6. Grimsby - Overhead conveyor

This system had not been examined but from press and other reports appeared to consist of a means of transferring baskets of fish from deck to inside the fish market by means of carriers running on an overhead track. The estimated landing rate of 120 baskets per hour compared unfavourably with the present performance at Aberdeen as did estimates in labour productivity.

APPENDIX 2

Outline specification for Production model

As a result of the trials of the prototype landing unit it is possible to define an outline specification for a production model. A sketch of the proposed general design is shown in figure 3.

Mobile Carriage

The unit would consist of a retractable, derrick and conveyor, mounted on a mobile carriage, running on permanent channel tracks tied into the quay. The unit would be self propelled and anchor points would be provided in the market floor securing the unit when the derrick and conveyor are extended.

Conveyor

The conveyor would be a powered belt, with flights fitted to an adjustable frame carrying the landing platform at its outer end.

The extendable landing platform would be fitted with powered rollers and link mounted so that the platform remained level whatever the altitude of the conveyor. An operating platform would be attached beside the landing platform, with access from the vessels deck and fitted with foot pedal winch controls. The extension of the landing platform would be operated by the tripping of a switch at a fixed height above the conveyor and the retraction by a manual start button in the operating platform. Maximum out reach would be 5m and the variation in height would be from 1.5m above quay height to 2.5m below quay height: maximum discharge load would be 300kg, but for safety the system should support twice this load to cater for the case of the previous load not being cleared before the weight of the second is taken. The conveyor would deliver to extension gravity roller track leading into the market. Raising, lowering and retracting the conveyor would be controlled from one of two positions, the operating platform or on the mobile carriage.

Derrick

The derrick would have a maximum out reach of 5m and be fully retractable, controlled either from the operating platform or from the carriage.

Winch

A high speed electrically controlled hydraulic winch, having a maximum loading 250kg at a maximum rope speed 2.5/sec, and fitted with an overlead cut out, automatic fail-safe braking, and an automatic over-run control. The light-hook speed in reverse for returning the sling to the fishroom should be as near "free fall" as possible without eliminating control.

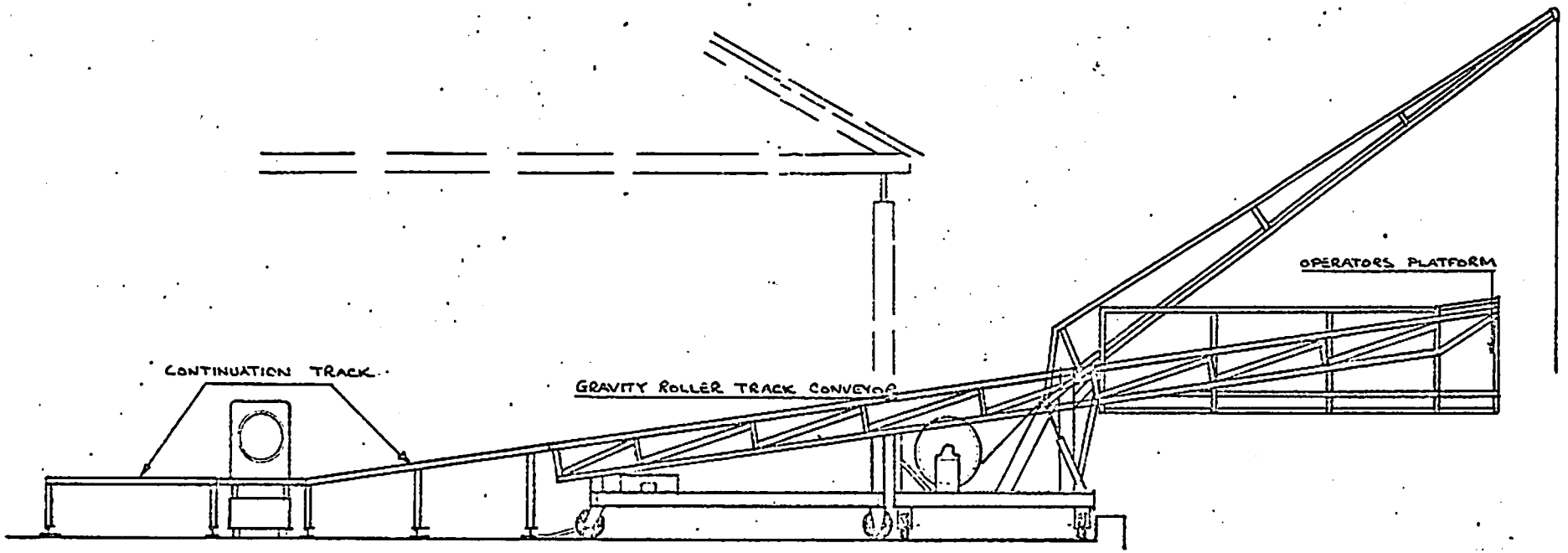
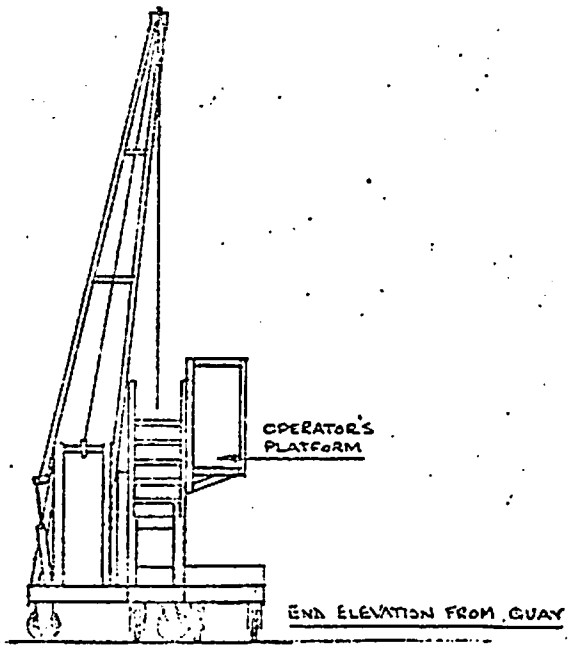


FIG. 1. SECTION

PROTOTYPE SYSTEM



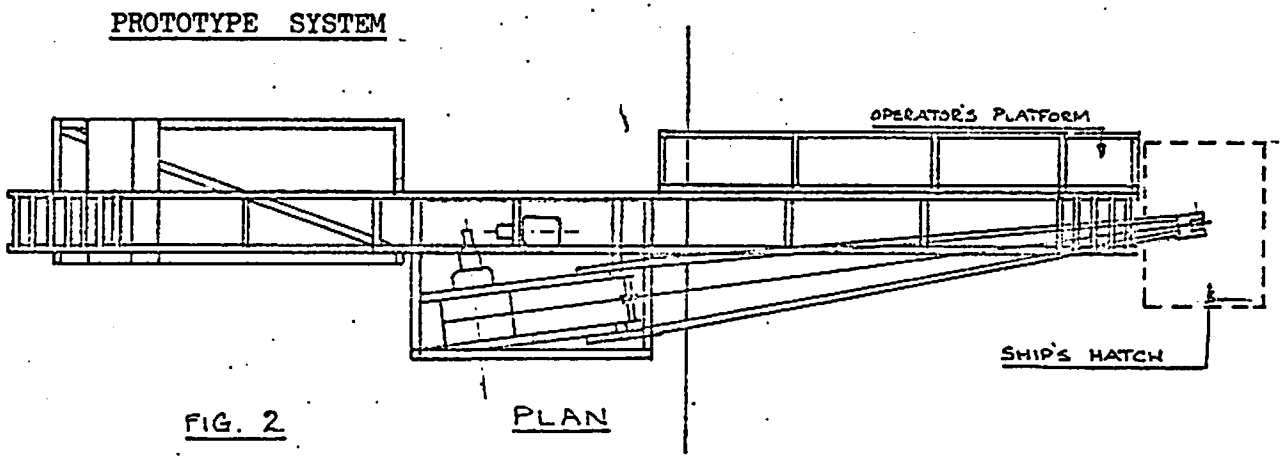


FIG. 2 PLAN

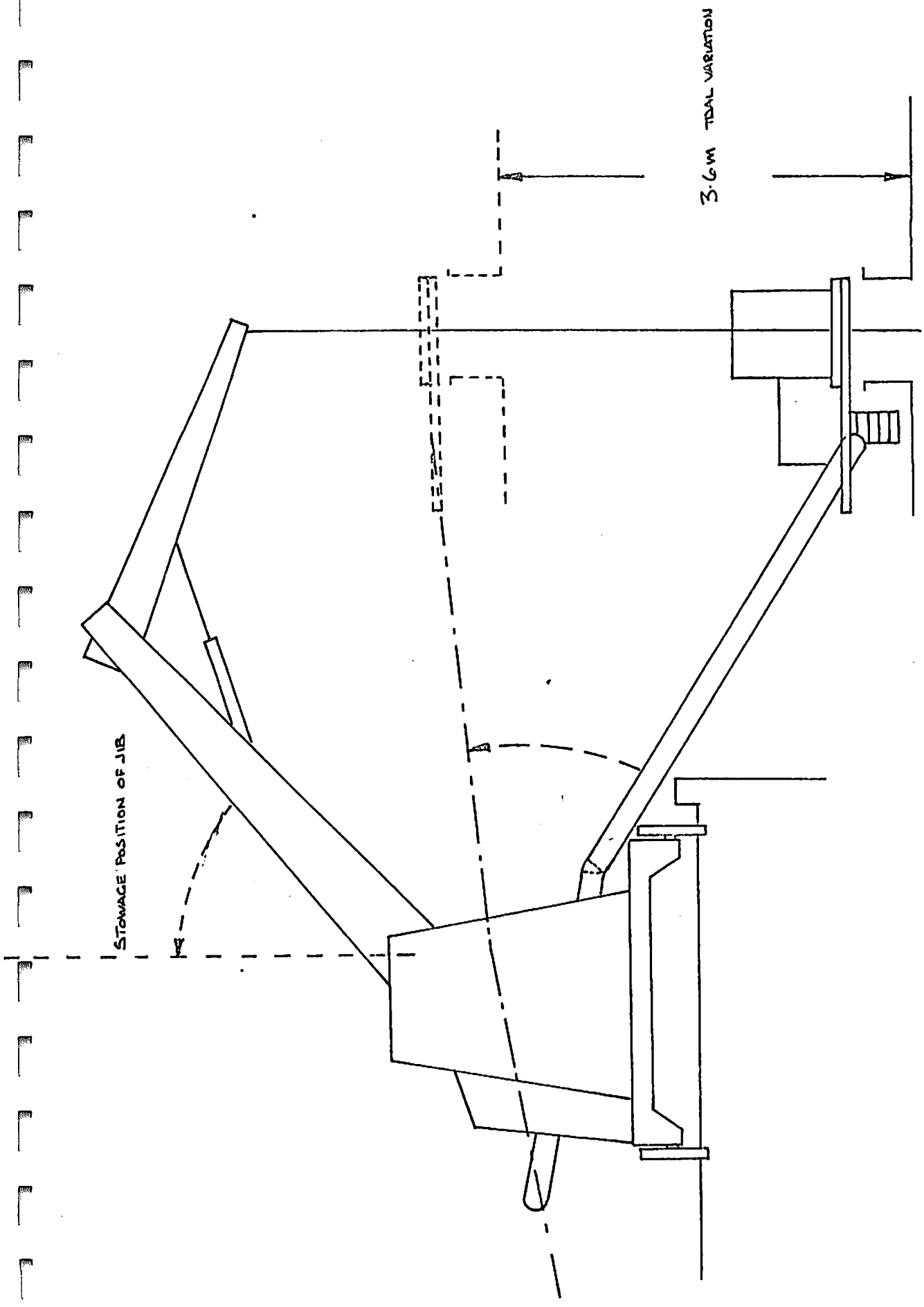


Figure 3 Proposed General Design

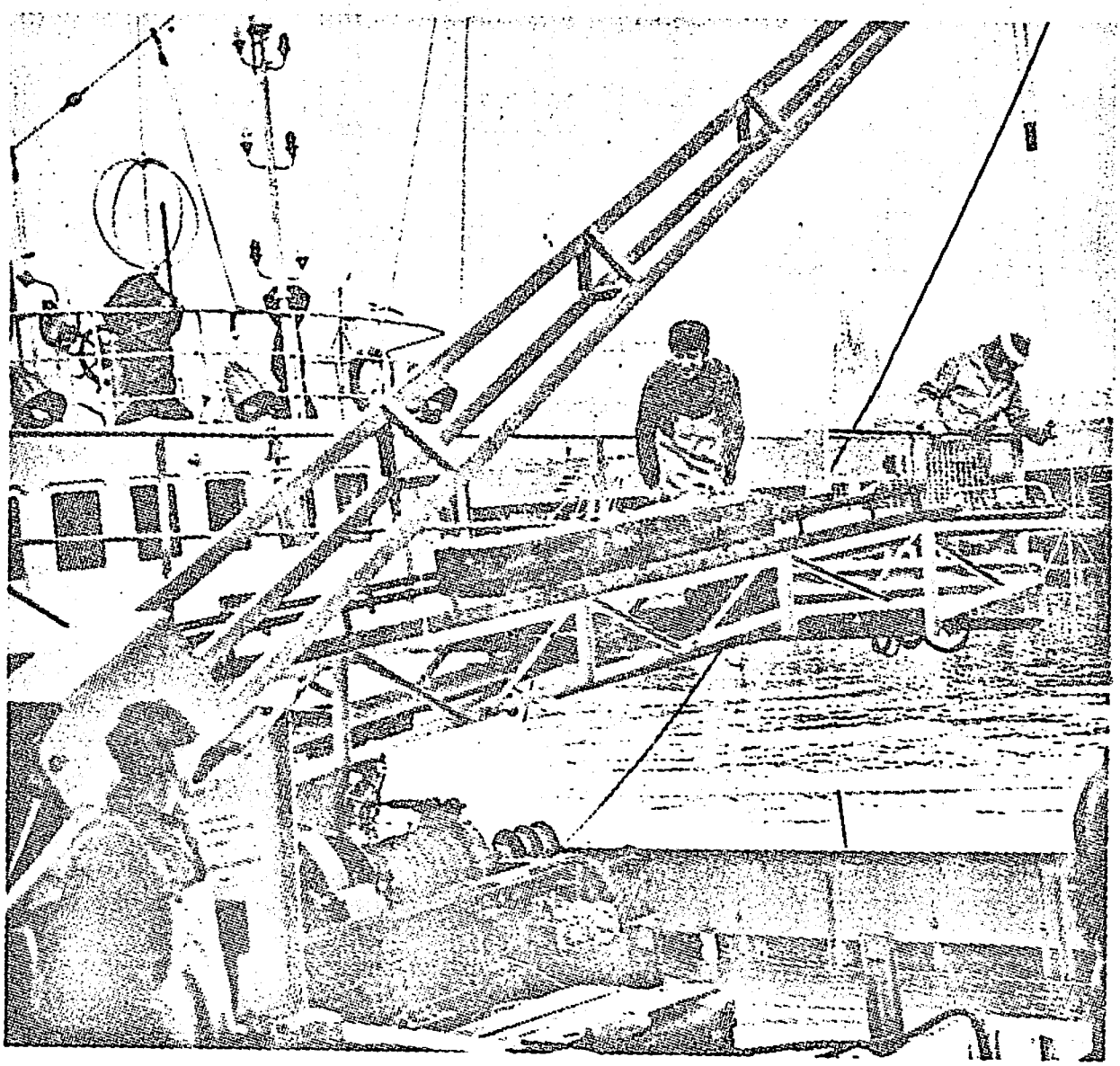


Figure 4 First trials of modified machine

(The second man on the walkway was only necessary because of the very poor condition of the boxes (10.4))

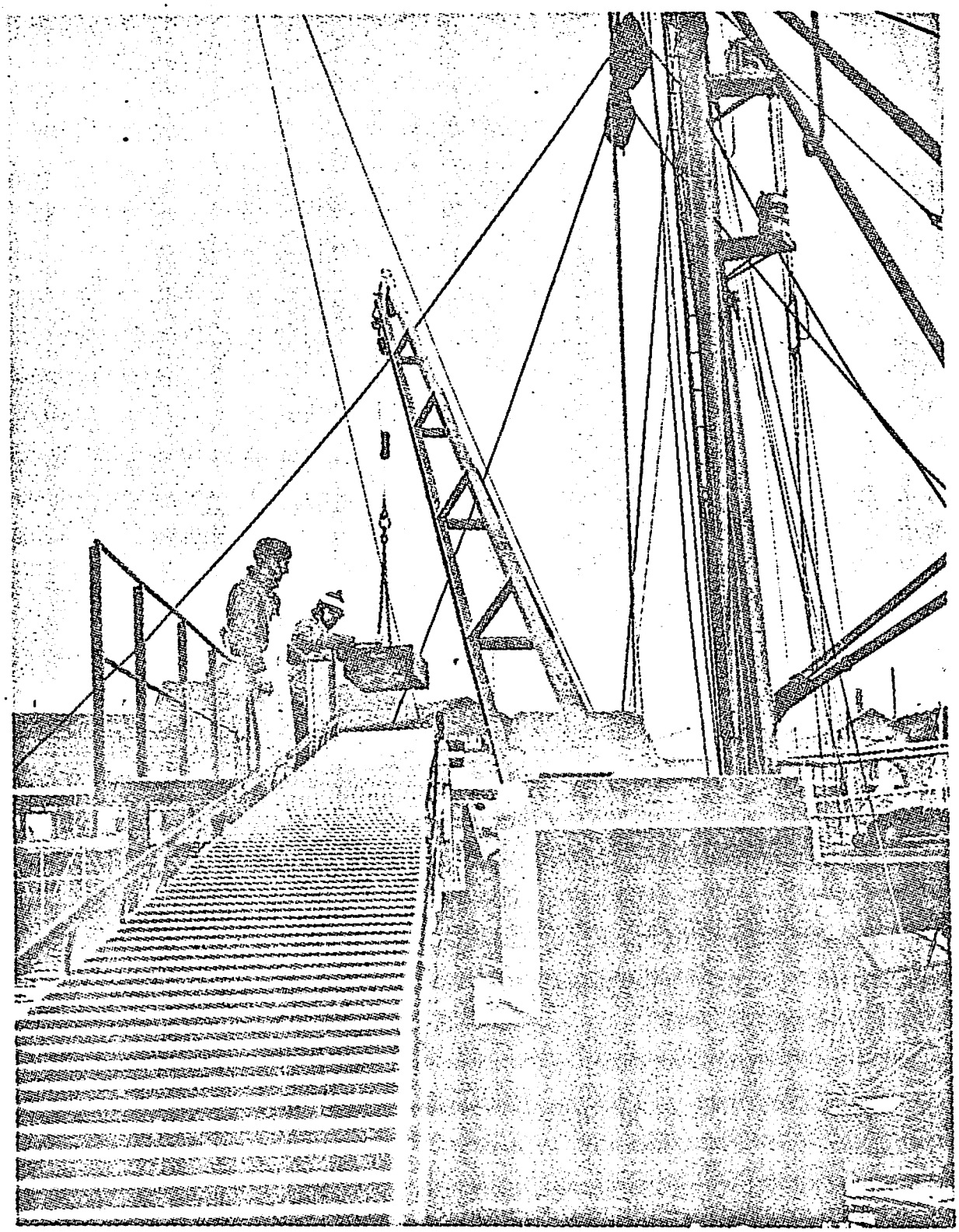


Figure 5 First trials of modified machine