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A NEW METHOD OF HANDLING LONG-LINE GEAR USING A ROTATING TUB

By Herbert J. Mann*

CONTENTS

ABSTRACT

A considerable savings in manpower may be effected by operating tuna long-line gear from a rotating tub rather than by handling it in the conventional manner. Instead of using individual baskets of line which must be separated and joined together for each day's fishing, a continuous mainline is set from, and hauled into a wooden storage drum. Conventional gear requires but few changes to fit it for the new method of operation.

INTRODUCTION

This is the third report on the construction and operation of the long-line gear used by the Pacific Oceanic Fishery Investigations (POFI), U. S. Fish and Wildlife Service, in a program of exploratory tuna fishing in central Pacific waters. It describes a new technique for handling long-line gear called the "tub" method, which saves manpower as compared with conventional long-line fishing methods. Earlier descriptions of the design and operation of long line, as developed at POFI, were given by Niska (1953) and Mann (1955).

In this report, "long-lining" refers to the set-line method of fishing used in the Japanese and Hawaiian high-seas fisheries for tunas and spearfishes. The gear is constructed so that a series of baited hook droppers is suspended from a long mainline, usually several miles in length; the mainline is buoyed up at regular intervals by buoys and floatlines. Unanchored, the gear drifts with wind and current with the hooks fishing at 100 to 500 feet below the surface.

The Japanese have found long-lining to be an effective way of harvesting tuna, and a large part of the Japanese commercial tuna catch is taken by this means. The long line, however, is not utilized to any great extent by United States fishermen. Two major drawbacks to this method of fishing, as now practiced, have prevented its general acceptance by the American industry. First, the method is nonselective, as far as catch is concerned, so that fish of various species and sizes are taken on the gear. This presents no hindrance in a fresh-fish economy such as Japan possesses, in which there is a steady market demand for fresh fish of all types, but it does present some problems to the United States canning industry accustomed to dealing with fish of uniform size and species. Secondly, a comparatively

*Fishery Methods and Equipment Specialist, Pacific Oceanic Fishery Investigations, U. S. Bureau of Commercial Fisheries, Honolulu, T. H.

large number of men are required for long-lining. The relatively low concentration of tuna in most regions of the open sea makes it necessary to set a large amount of gear over a wide area in order to insure a commercial return. Japanese vessels, fishing from 1,200 to 1,500 hooks a day, require more than 20 men for assembling, baiting, setting, hauling, and restowing the gear. An American purse seiner or live-bait vessel of comparable tonnage usually has a crew of about 12 men..

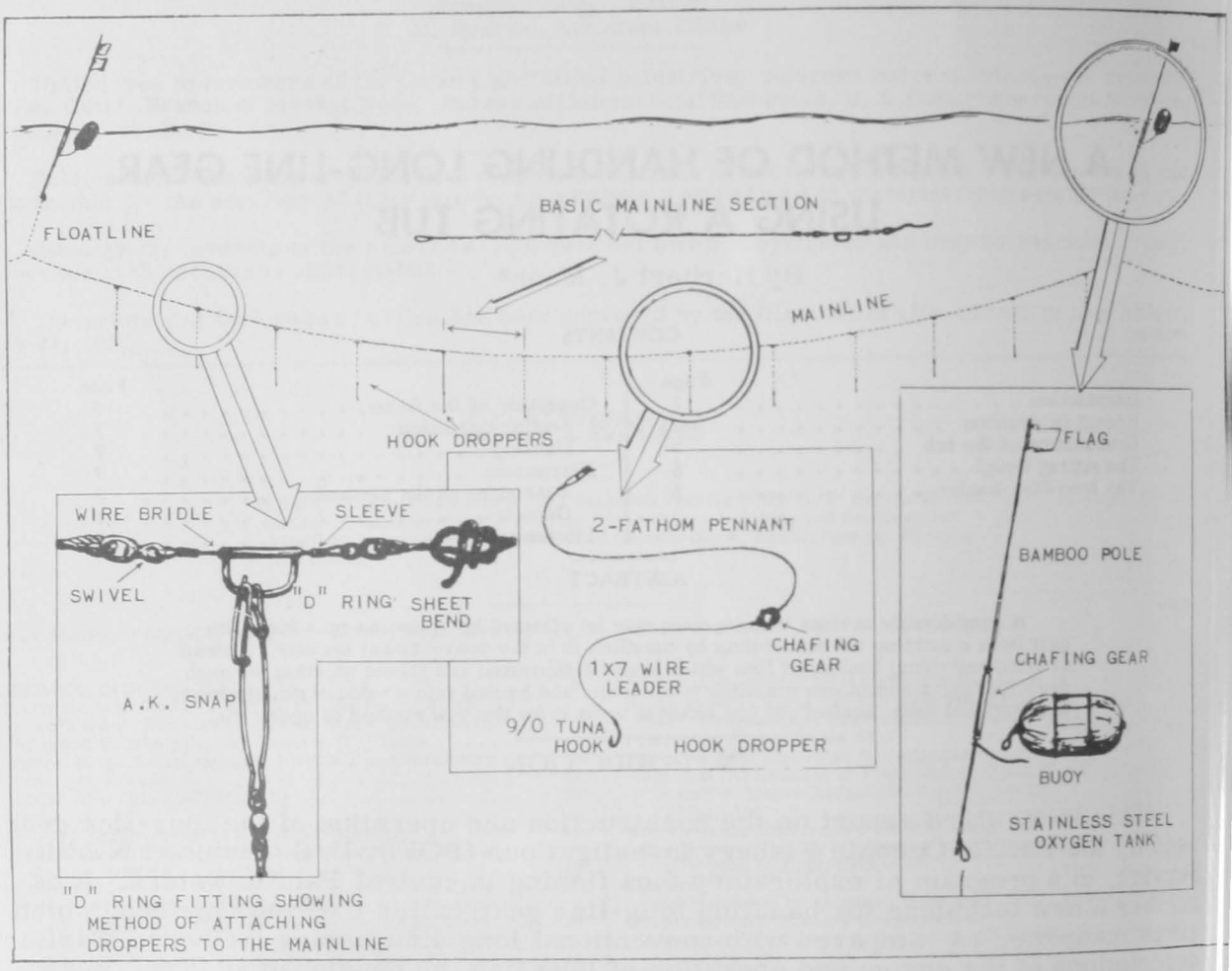

Fig. 1 - Schematic diagram of one basket of tub gear.

POFI has made several attempts to modify the long line so as to reduce the number of men necessary to operate the gear. For example, a "drum line," which consisted of a mainline in one continuous length reeled on a wooden drum instead of being broken down into separate units was tried experimentally. In another scheme wire rope was substituted for cotton twine for the mainline, and high-speed multiple-drum winches were used to set and retrieve the gear. In both of these methods difficulty was experienced with winch inertia problems and with the devices for attaching droppers to the mainline in the setting operation. Neither scheme offered enough promise to justify the continuation of its development.

RECENT INNOVATIONS

The latest modification of tuna long-lining, the tub method described here, has proven successful in experimental fishing. With this method, the mainline, in one continuous length, is set from, and hauled into the wooden storage tub that gives this method its name. The droppers and floatlines are detachable and are removed from the mainline during hauling operations and reattached during the setting proces

By eliminating the handling of the mainline, a considerable saving in labor is effected. Fishing cruises aboard the Bureau's research vessels John R. Manning and Commonwealth, during which the new method and the conventional method of handling gear were compared, showed that the usual POFI set of from 60 to 100 baskets of gear could be made by 5 men, or less, using the tub method, whereas, the full crew of 11 men was necessary to operate conventional gear.

Shown in figure 1 is a schematic representation of one basket of POFI experimental long line. Except for the "D" ring (shown in the insert, lower left), the gear is of the standard POFI design described in detail in a previous report (Mann 1955). The "D" ring, a nonstandard fitting designed by POFI, is also a new development. Its function is to provide free-swivelling action between dropper and mainline at any

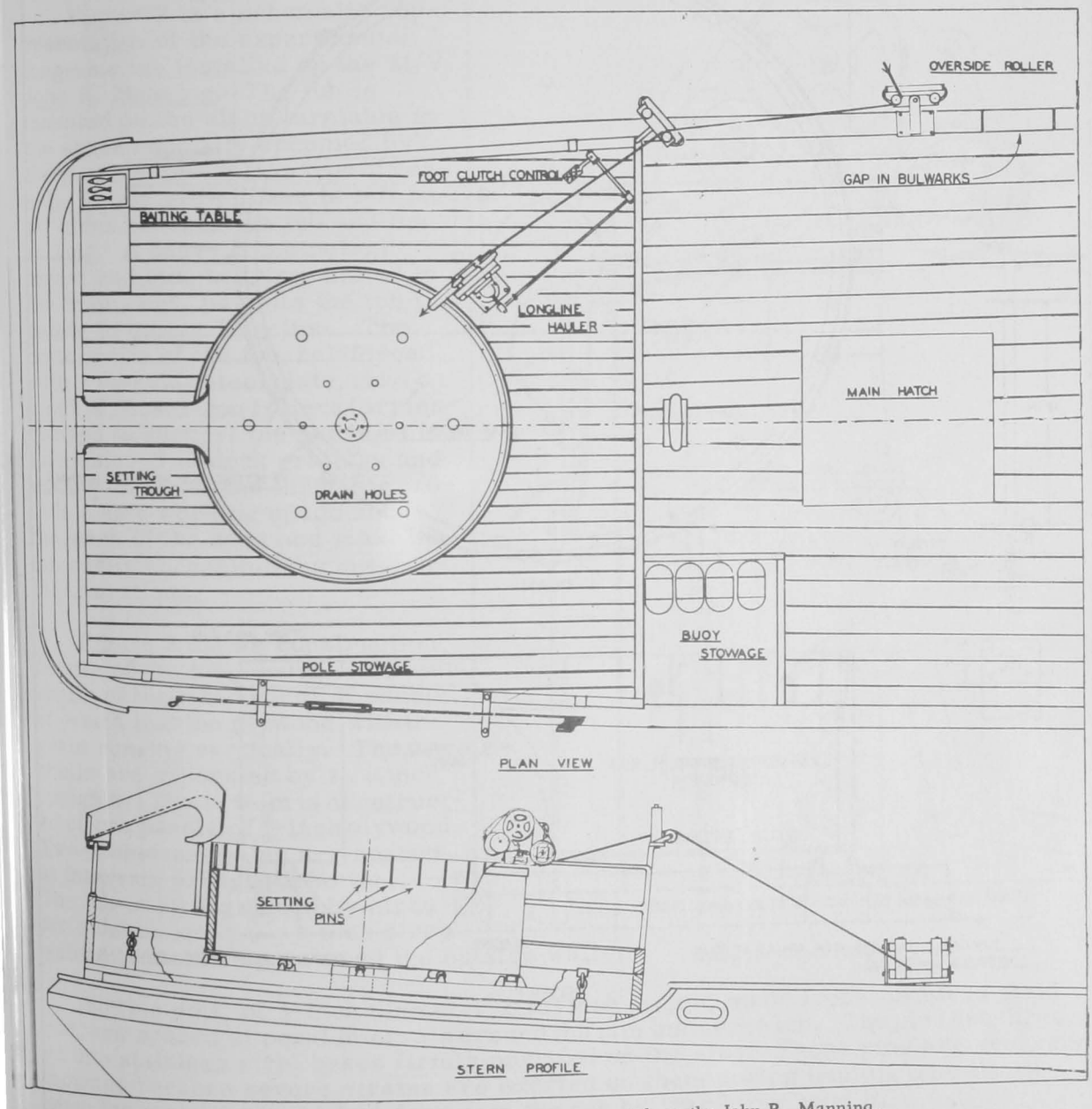

Fig. 2 - Installation of the line-stowage tub on the John R. Manning.

angle of pull. Formerly the AK snaps were clipped directly to the wire bridle. This means of attachment ordinarily permitted the dropper to swivel around the mainline and thus prevented tangles of dropper and mainline, when the gear was being hauled

aboard the vessel, but it frequently failed to function properly when large fish pulled the dropper parallel to the mainline. At acute angles under strong tension, the snap ceased to have any swivelling action and sometimes was pulled out of shape or broken.

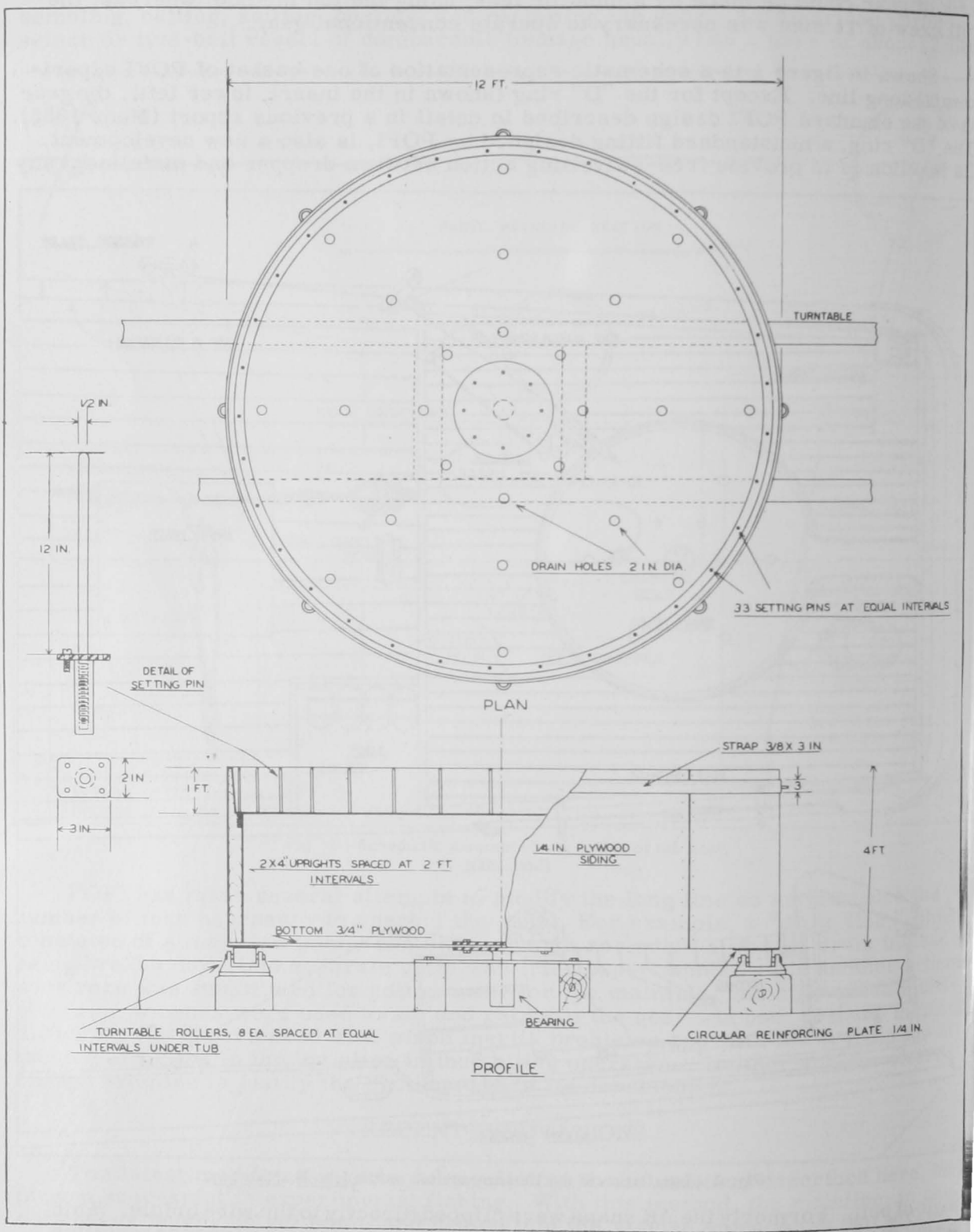

Fig. 3 - Construction details of line storage tub.

The new "D" ring maintains proper swivelling action with the dropper leading in any direction. The rings are fabricated from a section of stainless steel tubing $\frac{5}{16}$-inch outside diameter and $\frac{3}{32}$-inch inside diameter. The lower section of $\frac{3}{16}$-inch diameter stock is formed in a U-shape and welded to the tube section. The rings are threaded on a wire bridle made up of a 6-inch length of $\frac{3}{32}$-inch diameter 7 x 7 stainless steel wire rope. Wire loops holding brass swivels at each end of the bridle are made by pressing Nicopress fittings on the wire with a hand tool. Swivels are used to relieve torque which develops while the long line is being brought in by the hauler.

CONSTRUCTION OF THE TUB

Figure 2 is a schematic representation of the experimental long-line tub installed on the M/V John R. Manning. The tub is mounted on the stern turntable in the space normally occupied by the purse seine on this type of vessel. Ample work space is left on all sides between the tub and the railing. A heavy combination thrust and side bearing, bolted to the main deck, permits the tub to rotate in either direction. The bottom rim of the tub, reinforced with a circular steel plate, runs on a set of 8 cast-iron rollers formerly used to support the purse-seine turntable. The deck gratings and railing on top of the turntable provide a safe working space above the wash of the seas and make the tub easily accessible during fishing operations.

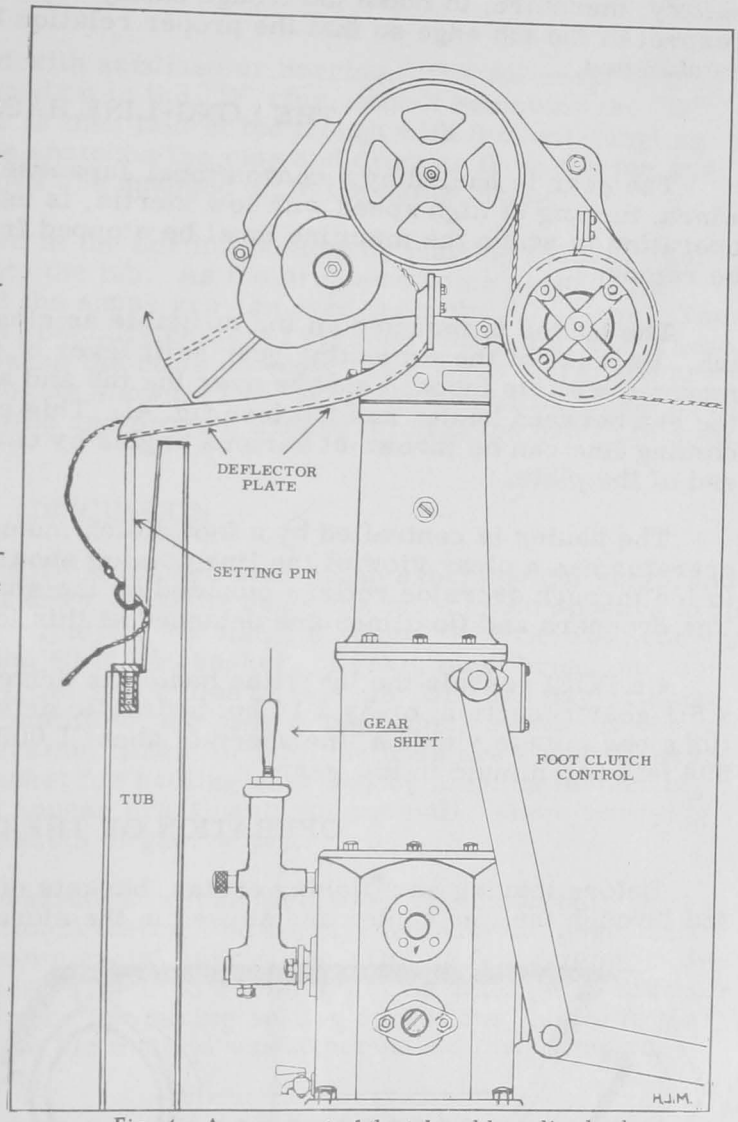

Fig. 4 - Arrangement of the tub and long-line hauler.

Figure 3 shows construction details of the tub. Inner and outer shells of the tub consist of panels of $\frac{1}{4}$-inch marine plywood with the grain running vertically. The two shells are separated by 2 x 4-inch uprights. The bottom is constructed of two panels of $\frac{3}{4}$-inch plywood. Two-inch drain holes are spaced at intervals around the bottom. The tub is strengthened by circular steel bands of $\frac{3}{8}$- x 3-inch strap welded to form rings around the outside walls.

Setting pins, of $\frac{1}{2}$-inch diameter x 12-inch length, made from stainless steel rod, are spaced at equal intervals around the rim inside the tub. The pins are threaded into stainless steel bases firmly mounted on the step. These pins are securely mounted because severe strains are exerted on them during hauling operations when the mainline is packed down into the tub by trampling upon it.

The tub on the John R. Manning is $11\frac{1}{2}$ feet inside diameter and 4 feet in height. This size allows for storage of 100 baskets of POFI mainline gear. The tub, as presently designed, is rotated by hand. If large amounts of long-line gear are to be fished commercially, some system of turning the tub by power is desirable.

THE SETTING TROUGH

The setting trough (fig. 2) is a demountable sheet metal form used to confine and guide the outgoing mainline during the setting process. In general appearance it is similar to the type used in the halibut fishery of the eastern North Pacific. The inboard lip of the trough is mounted above the tub edge and slightly inboard of the setting pins. In the original installation, some difficulty was experienced in getting the "D" rings to lift smoothly from their setting pins. It was necessary, therefore, to make the trough easily adjustable in height and distance in respect to the tub edge so that the proper relation between pin and trough could be established.

THE LONG-LINE HAULER

The gear is hauled by a conventional Japanese long-line hauler. This type of winch, turning at high speed with low inertia, is especially adapted to the long-line operation in which the mainline must be stopped frequently so that droppers can be removed.

The hauler is mounted on the turntable as close as possible to the edge of the tub. Because of the projecting gear shift lever of the winch, the hauler cannot be mounted with its inboard sheave over the tub and a deflector plate is used to bridge the gap between hauler and tub (see fig. 4). This plate is adjustable so that the incoming line can be thrown at various angles by changing the height of the inboard end of the plate.

The hauler is controlled by a foot clutch mounted at the rail, so that the winch operator has a clear view of the line coming aboard. To aid in landing fish, the line is led through overside rollers mounted on the starboard side of the main deck. The droppers and floatlines are detached at this lower level.

On POFI vessels the long-line hauler is driven by a 3 hp. electric motor through a 5:1 gear reduction, or by a 14 hp. hydraulic drive. An input speed of 300 revolutions per minute yields a line speed of about 1,000 feet per minute in high gear and 500 feet per minute in low gear.

OPERATION OF THE GEAR

Before leaving on a fishing cruise, baskets of mainline are knotted together and fed through the line hauler and stowed in the storage tub. No attempt is made to coil the line down uniformly but it is distributed on the bottom of the tub by changing the angle of the deflector plate from time to time so that line is thrown from one side of the tub to the other.

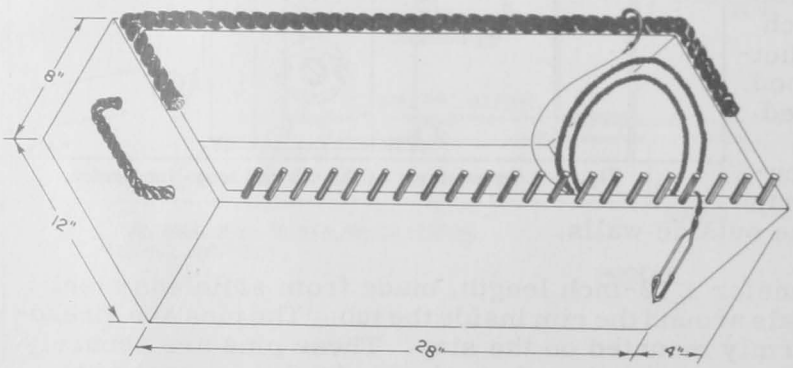

Fig. 5 - Dropper stowage box.

As the "D" rings pass through the hauler they are caught by one fisherman and threaded on the setting pin nearest the winch (see fig. 4). All rings for one basket are placed on a single pin and the cloverleaf knot marking the end of the basket is looped on top. The tub is then turned by hand until an alternate pin comes in line with the winch. (Rings of successive baskets are threaded on alternate pins to prevent lines from piling up too much in one place.) After the tub has made one complete revolution the process is

repeated until three layers of 33 baskets each are in place. The tub is covered by a tarpaulin to keep the line from being disarranged before setting.

SETTING OPERATION: When setting the gear, the vessel is steered on a desired course at speeds up to nine knots. The tub is turned until the setting pin of the top basket lines up with the center of the setting trough. The end of the mainline is led through the setting trough. The floatline and buoy with pole are attached and the assembly is thrown overboard. Thereafter the drag of the end basket pulls the mainline from the tub.

The hook droppers are baited with sardines or herring. The AK snap, at the upper end of the dropper, is snapped on to the "D" ring without removing the "D" ring from its pin, and the dropper is then laid in the trough with the bait dangling overboard. The outgoing mainline snatches the ring and dropper from the pin and carries them overboard. Floatlines are snapped on in the same manner.

HAULING: The gear is hauled in the normal fashion by running the mainline through the longline hauler and into the tub. As the droppers come aboard, the winch is stopped momentarily and the snaps are removed from the "D" rings. The droppers are coiled and packed in specially designed plywood boxes (fig. 5). These have sloping ends to facilitate stowing the coils on edge. The hooks and snaps are secured to opposite sides of the box as shown. The "D" rings are threaded on pins as described before. Fish are gaffed and brought aboard through the gap in the rail shown in figure 2.

DISCUSSION

EVALUATION OF THE METHOD: Although still in the experimental stage, and with a great deal of developmental work yet to be done, the tub method appears to be commercially practicable. When employing the usual methods, POFI crews, consisting ordinarily of 11 men, fishing 60 to 100 baskets of gear, must break out, assemble, disassemble, and restow from 1 to 2 tons of wet line for each day's fishing. By eliminating the handling of the mainline, the size of the fishing crews may be reduced by more than one-half. Operation times for both methods are about the same, averaging about $3\frac{1}{2}$ minutes per basket for hauling gear and $2\frac{1}{2}$ minutes for setting. Thus, by this new method it would appear practicable for a small vessel, carrying 4 or 5 men, to fish 100 or more baskets of gear a day.

DEFECTS: It should be emphasized, however, that the method has only been tried experimentally and that additional testing and experience with the gear are necessary to insure satisfactory commercial application. Only a few defects in design have been noted so far, but these appear to be minor. One anticipated difficulty, that of fouling of the mainline in the tub during setting operations, failed to materialize. Indeed, less fouling by the tub method was experienced than when assembling and setting baskets by hand.

The most serious drawback noted so far is the excessive wear and tear on the mainline at the bridles caused by the impact of the "D" rings on rollers and longline hauler during hauling operations. In an effort to overcome this, the rollers have been made larger in diameter and the "D" rings have been reduced in size. To eliminate the difficulty altogether, a method of joining the droppers to the mainline by a system which swivels as freely as the "D" ring method, but which has less bulk, is needed.

Another defect of the present gear is that the knots which join the mainline sections abrade rapidly by passage through the haulers, so that the line at the knots needs recutting and splicing before the mainline itself is worn out.

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NUMBER OF TAGGED HADDOCK CAUGHT MORE THAN ONCE

In the July 1958 issue (p. 18) of Commercial Fisheries Review appeared a report of a tagged skipjack tuna caught three times within 16 days. Two biologists of the North Atlantic Fisheries Investigations, U. S. Bureau of Commercial Fisheries, Woods Hole, Mass., report two similar experiences with tagged haddock.

One haddock was originally tagged June 30, 1956, from one of the Bureau's research vessels about 85 miles off the Massachusetts coast, near Cashes Ledge. It was one of 250 haddock tagged at that location as part of a study of the definition of stocks and migrations of the species. Long-line gear was used to capture the fish.

On November 2, 1957, the same haddock was again captured, this time in the otter trawl of the Bureau's research vessel Albatross III, but still in the same area near Cashes Ledge. The fish was measured and released.

The fish was captured for the third and final time by the Boston commercial otter trawler Arlington on June 15, 1958, about 95 miles south of the Cashes Ledge area on the western side of Georges Bank. In the two years that had elapsed from the original tagging to its capture by the M/V Arlington, the haddock had grown in length a total of 6.2 centimeters (2.4 inches) in spite of his hazardous existence.

Also a cod tagged from the commercial line trawler Alice and Nancy on the Pollock Rip grounds on March 5 was captured a second time on March 11 by the same boat. The skipper, familiar by now with tagging operations, re-released the fish after noting the tag number. The cod was taken for the third and last time by another line trawler in the same general area on April 4. The cod had taken the hook three times in just one month.

The biologists report that they have recorded many similar experiences with tagged fish.