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FIGURE 16. SECOND METHOD OF DEPLOYMENT AND RECOVERY OF THE CHUTE TRIALED ON F.V. *ATU S*.

The chute was labelled along its length at 0.5 metre intervals, from 3 m above the end of the chute, where the bait exits, to 6 m along its length. From observing which of these labels was at the water line at any given moment, it was possible to determine how deep the chute was delivering the bait. For example, if the first label, at 3 m, was at the water line, it meant that a bait leaving the chute at that moment would be 1.4 m under the water. These depths and related labels on the chute are shown in Table 9.

TABLE 9. BAIT DELIVERY DEPTHS OF CHUTE RELATED TO LABELS ON IT.

Distance (m) from bottom of chute	Label on chute	Depth of bait delivery (m)
3	1	1.4
3.5	2	1.75
4	3	2.1
4.5	4	2.6
5	5	3.2
5.5	6	3.8
6	7	4.7

TABLE 10. LOCATION OF TRIALS, THIRD TRIP F.V. *ATU S.*

Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
34° 25' S 174° 09' E	34° 14' S 174° 54' E	34° 26' S 175° 15' E	35° 08' S 175° 69' E	Not recorded

The chute's setting depth was monitored three times in each setting operation. This was done by noting the label closest to the water at five second intervals for a period of five minutes. This gave fifteen minutes of monitoring during each set to determine where the most common setting depth was.

Results

The new system was tested five times, four times in an actual line setting operation and once while steaming. The trials were conducted off the north-east coast of New Zealand; their location is given in Table 10.

The conditions were mild for all four fishing sets, and the fifth trial during normal steaming. For all the shots the swell was never above 1 m and the wind always from 10 to 15 knots. The vessel speed was always between 8 and 9 knots.

The chute delivered 5270 baited hooks without entanglements during the four sets.

The elasticity of the Forsheda mooring compensator deteriorated over the four sets and this reduced the setting angle and depth of the chute. On the first set the bait exit point was consistently deeper than 3 metres, but by the fourth set the depth of the bait exit point had reduced to around 2 metres.

Discussion

The chute met the requirements for number of hooks delivered without the entanglement problems of previous trials. One or two light sticks caused minor entanglements, but this was soon rectified by placing the light stick further up the branch line so that it did not come into contact with the chute. The operators of the chute found it simple to use.

However, the chute did not meet its requirement for setting hooks at a depth of 3 m. Initially the setting depth was mainly in excess of 3 m, but by the fifth set more than half of the hooks were being set at a depth less than 3 m. This is most probably due to a stretching of the rubber strop used to govern the setting depth, as it was noticed by the third day that the chute was riding higher in the water because of this. Given the mild conditions in which testing was performed, the crew of the vessel and the observer believed that under strong conditions the rubber would have snapped.

Conclusion

A stronger and more reliable measure for governing the setting depth was required. The skipper suggested that a strong steel spring in place of the rubber would be more effective.

Addendum

Since this trial a new method for controlling the setting depth on the chute has been developed and trialed. This system involves a caged spring which is strong enough to withstand the considerable pressures placed upon it by the chute, while still maintaining the required setting depth (Figure 17). Observations over a ten day period during setting confirmed a constant setting depth in excess of three metres.

The spring shock absorber is connected to the chute by a double hook that fits either side of the keel of the chute and over a 20 mm pin which is fitted permanently through the keel section (Figure 18). The weight of the spring and chain and the size of the RHS (square hollow steel tube) that the keel is welded to prevents the hook disengaging while the chute is deployed.

The double hook is designed to be able to pass completely through the roller carriage, and is connected and disconnected with a steel gaff while above it.

This hook can only be connected or disconnected when the chute is in the half deployed or half recovered position. All connection and disconnection operations are done safely without the operator having to lean over the side or the stern.

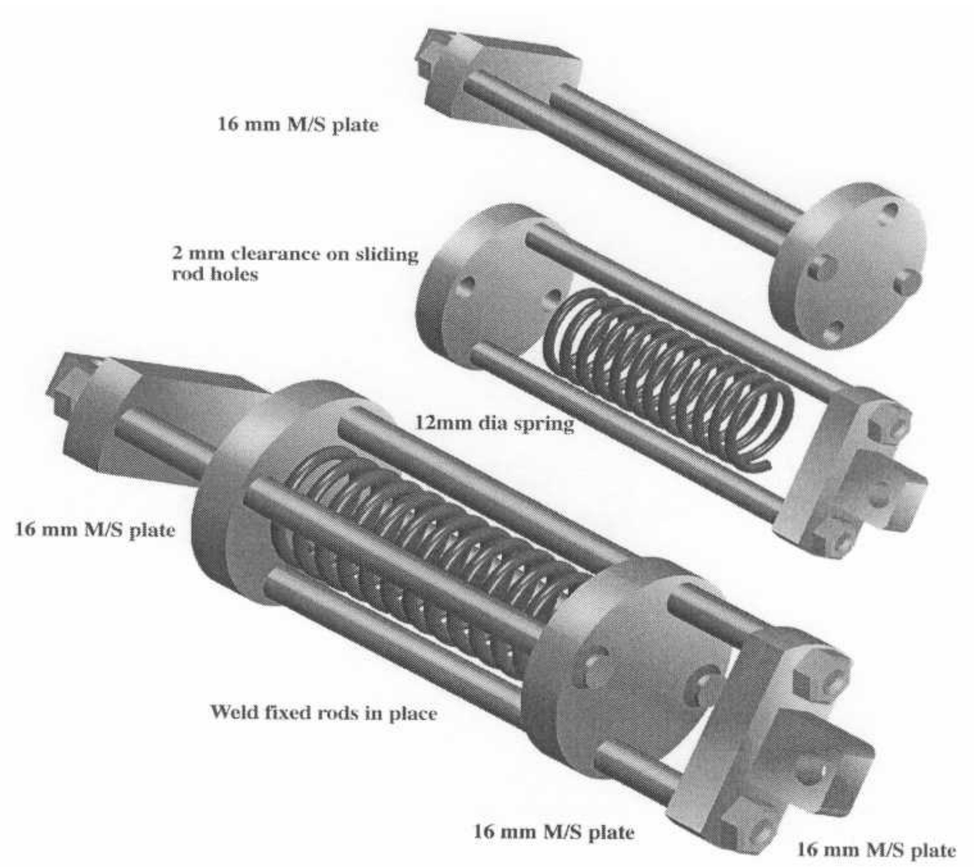

FIGURE 17. IMPROVED SHOCK ABSORBER USING A STEEL SPRING.

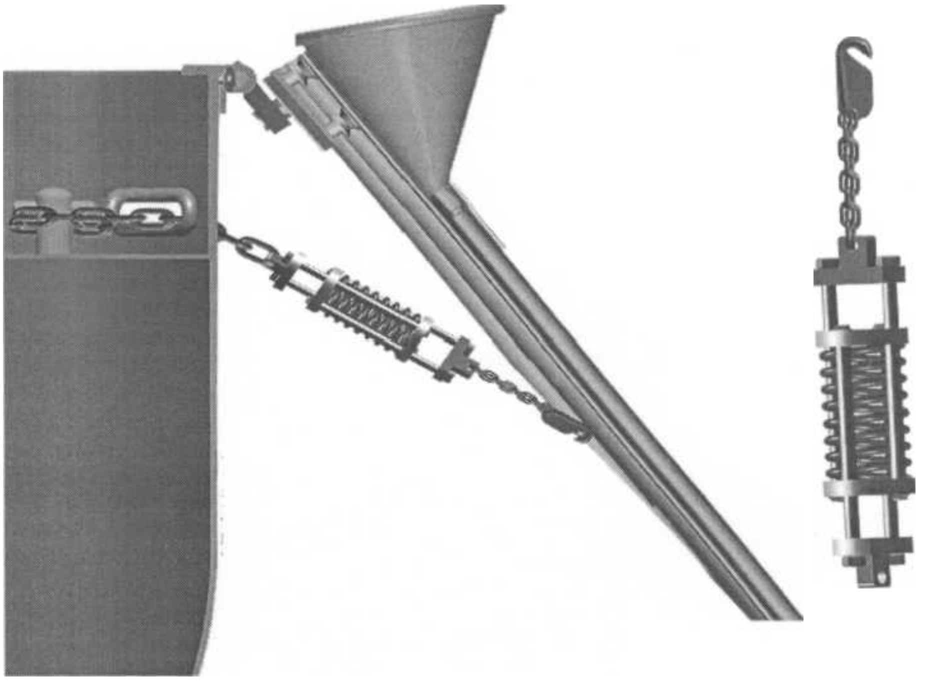

FIGURE 18. SPRING SHOCK ABSORBER CONNECTED TO THE CHUTE.

3.5 BAIT SETTING TIMES

by K. Walsbe

An important operating standard for the chute is speed with which baits can be fed into it. New Zealand vessels set one baited hook between every 7 and 9 seconds. A number of timing experiments were carried out on the various models, and the results are summarised in Table 11.

TABLE 11. RUN TIMES FOR VARIOUS TYPES OF BAIT AND VARIOUS TUBE LENGTHS.

LENGTH OF TUBE	VESSEL SPEED (KNOTS)	BAIT	NUMBER OF TRIALS	MEAN (SD) OF RUN TIMES (SECONDS)
6	6.5-7.5	sanmar (50 g)	23	4.49 (0.57)
6	6.5-7.5	squid (20-30 count)	54	3.93 (0.53)
6	6.5-7.5	squid (40-60 count)	56	4.08 (0.44)
6	6.5-7.5	sanmar (50 g)	49	3.40 (0.27)
6	6.5-7.5	squid (20-30 count)	46	3.16 (0.39)
7	6.5-7.5	sanmar (50 g)	50	3.52 (0.97)
7	6.5-7.5	squid (20-30 count)	50	3.35 (0.42)
9	6.5-7.5	sanmar (50 g)	7	4.01 (0.28)
9	6.5-7.5	squid (20-30 count)	29	4.05 (0.67)

4. Conclusions from all commercial trials

4.1 CHUTE CONFIGURATIONS

The configurations on three commercial vessels reflected both the incremental design changes from the experience gained during the trial process and requirements of individual vessel layout, fishing practices and skipper/crew requirements. Although the basic design concept remained unchanged, each vessel had unique requirements. If the chute is used widely in the fishery it is likely that a range of options will be necessary to tailor it to each vessel's requirements.

Setting tube

The setting tube operated in a range of setting depths from three to seven metres. As the length of the tube increases, so do the weight and strengthening required. Figures 19 and 20 outline some of the modifications in tube design and material under consideration for the development of a 12 metre chute for a 50 metre tuna vessel. As the weight increases, other aspects of the chute (such as the carriage and deployment and retrieval system) will require strengthening as well.

On several trials problems occurred where the snood was pulled out of the setting tube before the baited hook had left the base of the tube. The use of brushes at the top of the tube has overcome this problem.

Cross-section

To reduce the tension on the connection between the vessel and chute, it may be advantageous to streamline the underwater cross-section of the chute. A 12.5 m 180 mm D section steel device has been tested behind the DOC vessel M.V. Hauturu. Because of the low freeboard on this vessel, the setting depth was in excess of 7 m. Despite the additional drag on the chute due to the excessive length of the setting tube, a setting angle of about 45 degrees was achieved. This has led to concerns that the 180 mm configuration may be too heavy.

It is proposed that the section be trimmed back to 120 mm as in Figure 20 and re-tested on the same vessel.

It may be economically viable to extrude the device from aluminium (Figure 20). A stainless steel liner could be used to protect the inside of the setting tube from the points of the hooks, and lead weights could be used to adjust the setting angle.

Bait trough

The major design requirement for the trough was to ensure adequate and even flushing of the water over the trough surface and the smooth passage of water to the mouth of the setting tube. The devices with multiple water outlets at the top of the trough provided adequate flushing.

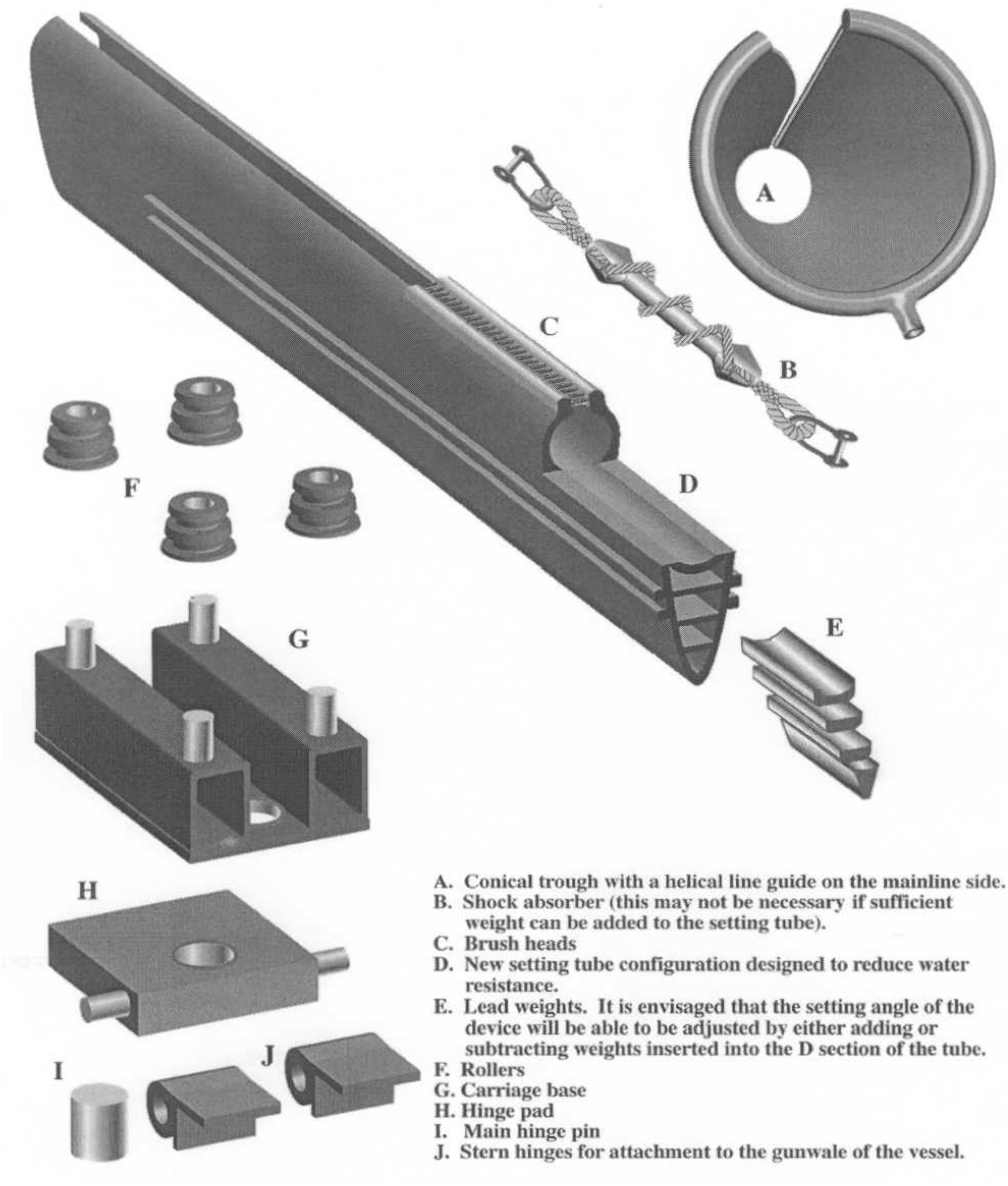

FIGURE 19. PROPOSED DESIGN OF A CHUTE, USING EXPERIENCE GAINED FROM SEA-GOING TRIALS.

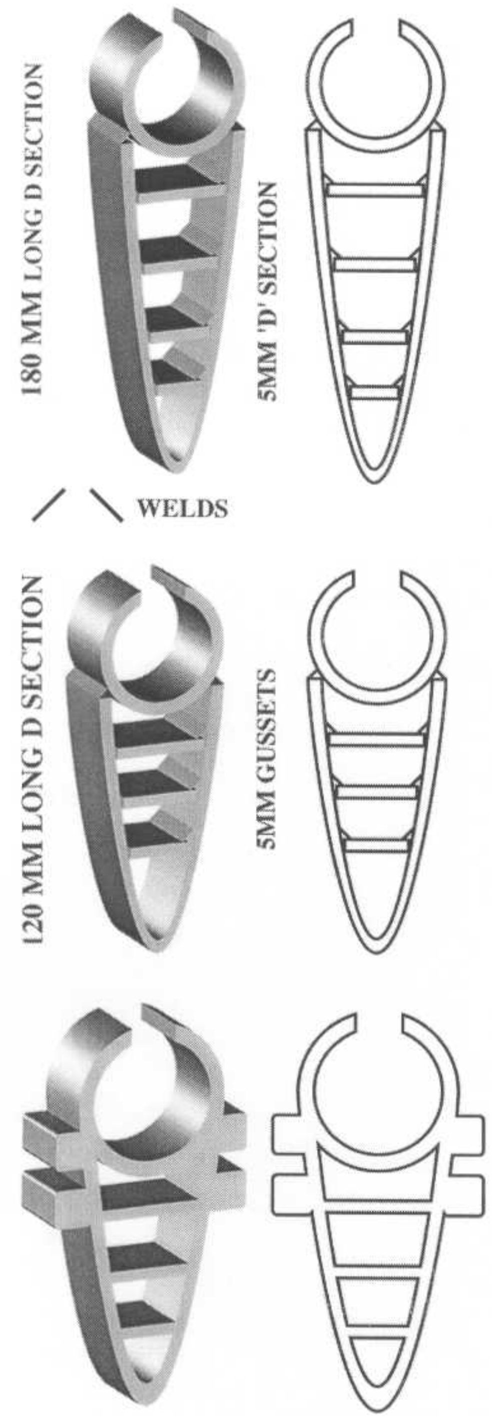

FIGURE 20.PROPOSED IMPROVED CROSS-SECTIONS TO THE CHUTE.

Hinge assembly

The basic hinge assembly with the use of shock absorbers performed effectively in all trials.

Carriage system

Problems occurred in moving the tube into and out of the setting position during the trials with both F.V. *Daniel Solander* and F.V. *Brenda Kay*. An improved roller carriage design used on the F.V. *Atu S* second trial has overcome this problem. For the larger 50 metre vessels a hydraulic lift may be necessary because of the increased length and weight of the chute.

Setting angle devices

Paravanes

When paravanes were trialed in the open sea by tuna fishing vessels significant problems occurred. The commercial trials identified three drawbacks in using the paravanes.

1. The paravanes made setting the chute difficult in rough seas. Once the paravane was in the water it created a strong downward force, making retrieval of the device from the water a slow and arduous process. Setting tubes fitted with paravanes were also difficult to deploy and retrieve, particularly in adverse conditions.

2. Larger vessels with vastly greater propeller wash turbulence experienced problems with two of the paravane types, being unable to hold the minimum setting angle required. Although the Arrowhead paravane had the smallest surface area of any of those trialed, it was by far the most powerful and the only one that achieved a correct setting angle when trialed from the F.V. *Daniel Solander* in the Southern Ocean.

3. During the setting process, hooks and snoods were occasionally caught in the paravane, causing delays in the longline setting operation while the chute was retrieved and hooks/snoods removed. Potential causes considered for the problem ranged from operator error to a backwash phenomenon behind the vessel.

Shock absorbers

The shock absorber method of angle setting has successfully operated in rough seas over several trips on a 30 metre tuna vessel. The use of a Forsheda mooring compensator may be appropriate for smaller (10-15 metre) vessels, but larger vessels will require a spring shock absorber (see Figures 15 and 18).

Weighted tube

An alternative to the shock absorber method may be to add weight to the tube to set the angle of the setting tube. Weights could be added or subtracted to adjust for varying setting speeds and propeller wash conditions (see Figure 19E).

Recovery and deployment devices

The optimal angle for deploying and retrieving the chute is the angle of set when the device is fishing (40 to 50 degrees). Because of vessel configurations, none of the trials was able to deploy and retrieve at this angle. The vertical deployment and recovery device (as used on the first F.V. *Atu S* trial) was the least effective method and potentially the most hazardous if the chute (when vertical) had broken loose from the mounting in a rough sea.

The need for up to five crew to deploy and retrieve the chute (as occurred on the F.V. *Daniel Solander* trial) can be overcome by the use of a modified carriage system (see Figure 19) and a hydraulic retrieval and deployment device. For vessels up to 30 metres in length, a simple block and tackle pulley system would be sufficient to deploy and retrieve the chute.

Safety issues

The early commercial trials identified a number of safety issues related to the operation of the chute. Modifications made for the F.V. *Atu S* second trial ensured adequate safety of the crew during the deployment, retrieval and fishing stages. These modifications included removing the paravanes, reducing the friction of the setting tube on the carriage system, changes in the securing system for the device when not in use, and changing the deployment and recovery system so that crew did not have to lean out over the stern of the vessel.

5. Acknowledgements

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