

**SEA FISH INDUSTRY AUTHORITY**  
**Industrial Development Unit**

**MECHANISATION OF LONGLINING**

**AUTOCLIP SYSTEM ON MFV SARAH 'H'**

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Internal Report No. 1307  
MAFF R&D Commission 1986/87  
Project Code IBA 16(b)

A. J. Dean  
March 1987

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**SUMMARY**

Following a request from the industry the Autoclip System was installed aboard the Grimsby vessel SARAH 'H' for trials to assess its commercial performance using small illex squid as bait. The profitability of lining has been much improved by the adoption of small squid as bait and it was considered that mechanised lining would now be viable and beneficial.

Development work was required to enable the baiting mechanism to handle the squid but although the system functioned well, the fishing performance was poor due to the loss of bait from the hooks.

It is concluded that the lack of mechanical strength of small illex squid render it unsuitable for mechanised baiting.

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1 **INTRODUCTION**

The trials and work described in this report were carried out as part of MAFF Commission 1986/87 Project Ref. IBA 16(b).

Throughout the development of the Autoclip system, the trials aboard the Lowestoft vessel, the Alison Jane, had resulted in a high level of interest from skippers both in Lowestoft and Grimsby; several, actively considering buying the system.

In 1982, consideration of the commercial price of £35,000 for the system plus the limited profitability of the fishery necessitated suspending further development until the profitability of the fishery improved.

In 1984 the system was loaned to a fisherman in Anglesey who was very keen to use it for the dog fishery, which was just beginning

to develop there. Vessel management problems plus some technical problems resulted in the system being removed after some six months of limited use.

In 1985 Seafish was approached by two skippers from Grimsby and Lowestoft with the request that we re-consider further trials with the system. The profitability of the fishery had improved immensely through the adoption of small illex squid as bait. Vessel earnings had hitherto been largely dependant on the summer dog fishery but with the squid bait, the winter cod fishery was now as profitable as the summer. With all the year round profitability, mechanised lining systems were now affordable and advantageous in view of the problems of hand baiting with frozen squid.

Thus as a result of the request from the industry it was agreed to carry out development work on the mechanical baiter to make it suitable for handling small squid and if successful to install the Autoclip system on the Grimsby vessel the SARAH 'H', skippered by John Hancock, for assessment trials.

This report describes the work on the Sarah 'H'. Full details of the Autoclip system are given in Field Report No. 1052.

2            VESSEL DESCRIPTION

Name SARAH 'H' - Reg. GY 377.

The vessel is a 15.25m (50 ft) wooden built vessel of a class commonly known as a "snibby". She has been extensively refitted and has a half shelterdeck which extends from the fully covered fo'c'sle head along the port side. A high filled in stern rail has been fitted and this incorporates a stainless steel sheetmetal fairlead for shooting longline gear.

The main engine is a Gardner 6LX 150 bhp. Hydraulics driven off the main engine operate a Spencer Carter line hauler, a pot hauler and an unloading winch.

Wheelhouse equipment is comprehensive with the usual range of radars, sounders, radios, etc. The vessel also has autopilot steering.

3            NARRATIVE

3.1        Preparation

Aside from the general refurbishing of the various items of equipment and the make-up of new snood assemblies, it was necessary to develop the baiter to handle the small squid bait. The original baiter had been designed for use with mackerel and large squid, with which it was very effective, but tests with the small squid were totally unsuccessful. After experimenting with various packing pieces a 32mm diameter tube was used to contain the squid. Spring loaded feeder teeth project through a slot along the length of the tube and transport the bait down to the cutting knife. In modifying the baiter it was possible to make the tube a removal insert which enables the baiter to be quickly converted to mackerel or large squid.

A modification was also made to the hauling rig to speed up the hauling rate. Quite often, when hauling lines, the snood clips can be orientated into the correct position for removal simply by the operator pulling the snood horizontal. If the mechanism then directly pressed the clip off the line instead of firstly rotating to orientate the clip, faster hauling could be achieved. Originally, the design of the rig had included this direct "hammer only" feature but the valve used to interchange the servo-heads to achieve this would only accept pressure in one direction and hence the feature was not available during previous trials.

A spool valve, pilot operated by the original 'D' section valve was fitted to overcome the problem, enabling full clip orientation or "hammer only" to be selected.

Electrically, the whole machine was thoroughly checked. The shooting rig was rewired and the on/off switches were replaced and mounted on the sides since the top mounted switch had in the past

always suffered from ingress of moisture. The control boxes were tested and any suspect components were replaced.

### 3.2 Installation

Although originally planned to take place during April 1986 the installation had to be postponed owing to the long delivery on a tandem hydraulic pump unit. The pneumatic compressor required with the Autoclip system is driven hydraulically and since it was not possible to arrange a belt drive to a pump to drive the compressor; the vessel's existing hydraulic pump was replaced with a tandem pump, one section powering the vessel's hydraulics, the other section the compressor.

The compressor was installed on the vessel during July but the rest of the installation was delayed until September to take advantage of the vessel's three week refit period.

As shown in Fig. 1 the shooting rig was mounted at the stern but due to the lack of deck space it was fitted on a track on the port side of the wheelhouse casing so that it could be moved to project over the stern rail for operation but also retracted to avoid damage when the vessel was moored up. The vessel's line hauler was moved to the port side and the Autoclip fairlead mounted in the place of the line hauler on the stbd rail. The hauling rig was positioned in line with the fairlead and mounted close to the hauler to leave sufficient room clear of the hatch for the operator. Hand rails were installed at the hatch sides to carry a removable pound board across the forward edge of the hatch in order that the operator could stand securely with his back resting on the board. The line drum was mounted midships, between the hatch and the wheelhouse casing and was positioned to face the port side where a pulley, mounted on the rail, guided the line aft for shooting, or forwards to receive line from the hauler when



hauling. A guard frame was mounted around the line drum in the interest of safety.

In order to maintain the vessels ability to use the traditional gear the following work was carried out.

A hinge was added to the stand of the hauling rig to enable it to hinge over forwards to be clear of the line hauler. A fish stripper was fabricated to mount in the lower half of the hauling rig stand such that the line could be hauled over the fairlead on the stbd. rail, through the stripper and around the hauler. To re-coil the line into a bath ("backing-in") the crew man stands just aft of the hauler with a bath to the right of his feet. It was found necessary, after an initial trial, to add a steel chute between the hauler and stripper to contain the hooks and prevent them from snagging on the line hauler knife mounting bracket.

A wooden tray was also made to fit between the fairlead and the stripper so that dogfish could roll directly off the tray and via a chute, down the hatch when stripped off the hooks.

Installation of the shooting rig at the stern necessitated removing most of the high stern rail and also the shooting fairlead which was integral with the rail. A new hand rail section was made which left sufficient room for attachment of anchors when shooting with the Autoclip and this was mounted such that it slotted onto brackets and was quickly removable. The shooting fairlead was modified such that it could quickly be positioned on the same brackets as the hand rail section. Thus the vessel can quickly change to working traditional gear.

### 3.3 Sea Trials

The vessel was chartered by Seafish for one week for crew training and familiarisation with the equipment. Since one of the crew members had previously been with the Alison Jane and was very familiar with the operation of the system, the crew quickly adapted to the new method of working.

The dog season had virtually finished and the cod had yet to arrive, hence it was a particularly poor fishing period.

#### Wednesday October 1st

Steamed 2½ hours off. Worked 4 feelers but only 3 or 4 fish on each. Disregarding the lack of fish, 1000 hooks were shot with the Autoclip. Baiting started off being very good but the baiter rapidly stopped feeding the bait. The squid was jammed as a solid mass inside the tube and had to be cleared by physically pushing it through. This occurred several times during the shoot and resulted in approximately 50% baiting. The attachment of hooks was problem free as was the run of line and the attachment of anchors.

Hauling was good, the hammer only facility enabling a fast hauling rate of 20 hooks per minute.

More feelers were worked and on achieving 8 fish on a feeler, 6 packs (1200 hooks) of their own gear were shot. Shooting presented no problems but hauling was difficult due to persistent snagging of the hooks on the line hauler knife bracket. The knife had been re-positioned to allow for the new angle of wrap of the line with the Autoclip system and it was found that having only 90° of wrap it was not gripping their line sufficiently and snoods were jamming in the knife. Only ½ a kit of fish was taken.

#### Thursday 2nd and Friday 3rd October

Consideration was given to the problems with the baiter. The bait had been in a very soft condition and it was concluded that if the bait was firmly frozen it would feed down the baiter tube without jamming.

The line hauler sheaves were machined to increase their grip on the lines and a steel chute was constructed to contain the hooks between the stripper and hauler to prevent snagging.

#### Saturday 4th and Sunday 5th October

The vessel steamed 6 hours off in the hope of finding fish. The whole weekend was spent shooting feelers with no success. The Autoclip system was not used.

#### Monday 6th October

The Skipper felt that the line hauler was running slower than prior to the installation, this he judged from the speed of hauling of their own gear.

To gain speed the hydraulic flow, by-passed by the flow splitter controlling the compressor, was directed to the line hauler circuit. This gave a 20% increase in speed.

Using local shipwrights, a wooded tray structure was installed along the port rail under the shelter deck to properly stow the hook racks for the Autoclip. Since the vessel was carrying both traditional and mechanised gear little space was available and proper stowage of the racks was essential to avoid damage to them.

#### Tuesday 7th October

The vessel worked inshore just clear of the River Humber. With the bait in a frozen condition the baiting was initially very good

but after 200 hooks the baiter jammed. On being cleared, good baiting was achieved for a 100 hooks or so but it inevitably became choked with bait again.

Examining the bait in the tube showed that the feeder teeth had cut a groove in the bait and were not feeding it down to the knife. The possibilities of re-designing the bait feed mechanism were discussed along with the concept of the vessel using large squid for several weeks whilst a new design was built.

#### Wednesday 8th October

On considering the baiting problem it became apparent that the problem was not one of insufficient grip to feed the bait but was due to over-feeding. The depth of bait required to be fed for each bait is 20mm but the feeder teeth stroke 35mm to allow for slip between the teeth and the bait. The feeder rack is pushed up by an air cylinder and is powered down, on the feeding stroke, by springs which theoretically should feed the bait as far as is required. However, because of the very soft nature of the squid the excess travel available was progressively compressing the bait into a solid mass.

In order to solve this problem a simple spacer was made to limit the stroke of the feeder rack.

#### Thursday 9th October

Tested the baiter at sea. Despite the baiter jamming on a couple of occasions, 90% baiting was achieved. It was found essential to exercise great care feeding the baiter. One had to hold the bait until the teeth take the bait, pressing the bait into the tube resulted in choking.

Two shoots of 2000 hooks were made with a baiting performance of 90-95%. Hauling was trouble free but few, if any baits were returned. This was not necessarily disturbing since baits are not always returned due to starfish, crabs etc. and strong tides.

Since satisfactory baiting performance had now been achieved and the whole system was functioning well no further Seafish manning was required.

#### 3.4 Commercial Fishing Trips

As previously stated, fishing was particularly poor at the time; all vessels were searching for fish and failing to make a 'trip'.

The Sarah 'H' made three trips with no success, as did other vessels. On the third trip feelers for dogs were not worked, instead, the vessel made two shoots of 2000 hooks hoping for cod. Each shoot caught approximately one kit. A shoot of 2000 hooks using the vessels own traditional gear in a slightly different area yielded 5 kit.

Baiting with the Autoclip was reported, by the Skipper to be extremely good; 98% but he was becoming increasingly concerned about the catching ability. The snood length, he felt, may be too short and the mono-filament nylon snoods may be too resilient to fish as well as the traditional gear. Few, if any baits were being returned and although this often is the case with strong tides, it raised serious doubts about the baiting.

A fourth trip was made this time fishing alongside another vessel. Although the system performed extremely well and the baiting, observed as the hooks left the vessel, was again around 95%, the catch was very poor. The Sarah 'H' took 1 kit of fish compared with the 10 kit of the vessel alongside.

Faced with the evidence of this trip the Skipper requested that we should consider removing the system. A full discussion was held on the vessel to explore any possible improvements which could be made but the mutually agreed decision was that there was no alternative but to remove the equipment. The compressor and hydraulics were left aboard the vessel in the event that a solution to the fishing performance was found within a month or so thereby, enabling quick re-installation of the system.

## 4 DISCUSSION

### 4.1 Fishing Performance

Trials with the Autoclip over the years have totalled 2-3 years of commercial fishing mostly on the Alison Jane. Throughout the trials fishing performance has always been considered as being equal to traditional gear, both when fishing for dogs and cod. David Hunt, Skipper of the 'Alison Jane' was always happy that, hook for hook, he fished as well as the next boat. Technical problems and shortage of gear resulted in the Alison Jane losing some trips but often she out-fished other vessels. John Hancock, Skipper of the Sarah 'H' was keen to use the Autoclip since he had seen its fishing performance and felt that, if reliability could be achieved, the system would be very beneficial, particularly in view of the increased profitability of the fishery.

Since the fishing gear, the line, snoods and hooks have not been changed the poor fishing performance can only be due to baiting. Baiting performance, with the small squid, as observed as the hooks entered the water, was extremely good, hence, the baits must be lost off the hooks whilst in the water. The lack of returned baits is evidence of this.

Prior to proceeding with the installation on the Sarah 'H' it was appreciated that baiting with the small illex squid would be a problem. The squid is 100-150mm long and approximately 30mm across the tube section of the body. A special insert had to be made to contain the squid in the baiter feed tube and shore tests were carried out to assess baiting performance. Within the limitations of shore testing, the bait was considered to be reasonably securely hooked, although it was impossible to achieve the double hooking as per hand baiting. The baiting mechanism attempts to roll the bait around the bend of the hook. The hook

point penetrates the bait and as the bait is drawn along, by the hook, a spring loaded tension arm rolls the bait backwards around the bend of the hook such that the point eventually just projects out of the bait. With mackerel, the hook is around the back-bone and gives very secure hooking. With the larger loligo squid, the size and the mechanical toughness of the squid also results in secure hooking. However, the small section and the softness of texture of the illex squid make it difficult to mechanically manipulate it on to the hook.

The bait is supplied frozen and is used in a semi-frozen condition, when the bait is just slightly flexible. The knife of the baiter cuts a section of bait 20mm long. Since the squid's body is tubular, the cut bait is annular in form but, lacking any substance in the centre, the ring of bait is flattened by the side holding lever of the baiter into an oval section approximately 30mm x 8mm. The hook point penetrates the end of the oval and carries the section of bait to the tension arm at which point it is just clear of the side holding lever. The tension arm causes the bait to distort in the opposite plane and the point of the hook pierces through the opposite side of the bait. See Fig. 2. Thus the hook passes right through the bait which is carried on the bend of the hook. As can be seen in Fig. 3 the double hooking, achieved with manual baiting, provides more support for the bait.

The preliminary shore based tests had included leaving the bait to thaw and soaking the baited hook in water for a long period. The Skipper and crew of the Sarah 'H' were consulted for their opinion on the baiting quality and in view of the concensus of opinion, that the baiting quality was adequate, the installation on the vessel was made.



The sea trials took place at a time when fairly strong tides were being experienced and this coupled with the lack of fish in the area make it hard to be totally conclusive about fishing performance. However, John Hancock is a very experienced skipper who is not normally outfished by other vessels and his opinion, after trying for 5 weeks with the system was that the gear was not fishing, presumably due to bait loss off the hooks. The vessel was not under charter and could no longer afford to persist with the equipment.

#### 4.2 Mechanical Performance

The mechanical performance of the system was pleasingly good, there were no snags with either the shooting or the hauling operation.

Shooting, in the past, had sometimes been marred by hooks running foul on the hook track. The hook pressure plate was modified during the Anglesey trials and before the installation on the Sarah 'H', the whole hook track assembly was re-aligned. As a result, every hook passed through the mechanism smoothly. Slight problems were experienced due to moulding 'flashes' on the new snood clips. Occasionally the clips would lock together and prevent the hammer mechanism from carrying a clip from the clip feed to press it onto the line. This was a minor problem which would cease when the 'newness' had been "worn off" the clips.

Hauling was much improved. The modification to the hauling rig, to give hammer only facility, enabled a fast hauling rate of 25 hooks per minute to be achieved with minimal practise by the crew. Replacing the snoods on the racks was made easier by the crew rigging a wire to carry a buffer store of snoods.

The man at the hauling rig simply hung each snood on the wire by its hook and the man loading the racks took the snoods from the wire. The benefit of this was that the hauling rig operator was not waiting for the loading man to take the snood from him and the loading man was not pressured to keep absolute pace with the hauling rig.

The compressor installation performed well, the hydraulic drive with flow control, which permits constant compressor speed regardless of main engine revs, provides a good solution to obtaining a constant air supply. Equally, the electric and electronics used with the Autoclip system were all totally reliable.

Considerable trouble was experienced with snoods and the line jamming in the line hauler sheaves. A vee section knife is situated between the sheaves to peel out the line which, being gripped in the vee of the sheaves, would otherwise be carried right around the hauler. With the Autoclip system the knife had to be repositioned and this, coupled with the reduced angle of wrap of the line around the hauler, gave problems of snoods jamming and insufficient grip. New sheaves and a knife assembly eventually solved all the problems.

## 5 CONCLUSIONS

### 5.1

The Autoclip system on the Sarah 'H' was not successful due to the inability to securely bait the hooks with small illex squid.

### 5.2

Baiting performance i.e. the percentage of hooks entering the water carrying a bait was high, 90-95%. However, mechanised baiting (single hooking) is not sufficient to securely hold illex squid and manual baiting using a double hooking technique is required.

### 5.3

The size, structure and lack of mechanical strength of small illex squid make it doubtful that any mechanised baiting system will be totally successful in achieving secure baiting with it.

### 5.4

Mechanical performance of the Autoclip system was proven to be good. Shooting and hauling operations were efficient and no reliability problems were experienced. The improvements made to the hook track, the hauling rig and the electronics have enhanced the system's reliability.

### 5.4

In view of the good mechanical and baiting performance, the Autoclip is a viable system provided that mackerel or the larger loligo squid is used as bait.

CONCLUSIONS

2.1

The automatic system on the bench was not successful due to the inability to accurately place the books with small tolerances.

2.2

During performance tests, the percentage of books entering the water container was high, 90-95%. However, mechanical binding (single binding) is not sufficient to securely hold files and manual binding using a double binding technique is required.

2.3

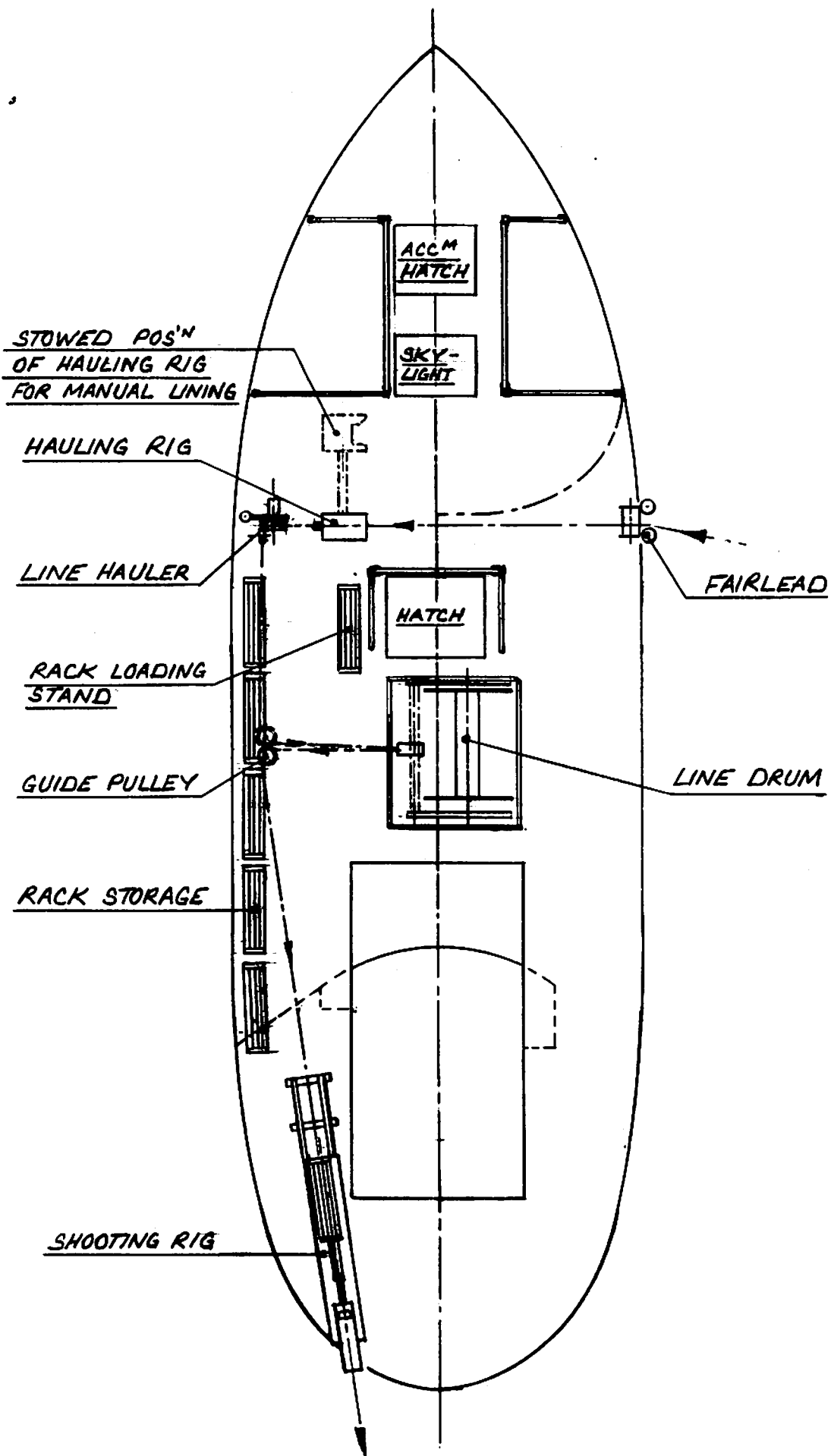
The cause of the failure to place the books accurately was the lack of a mechanical stop on the automatic binding system which would be totally successful in achieving accurate binding with it.

2.4

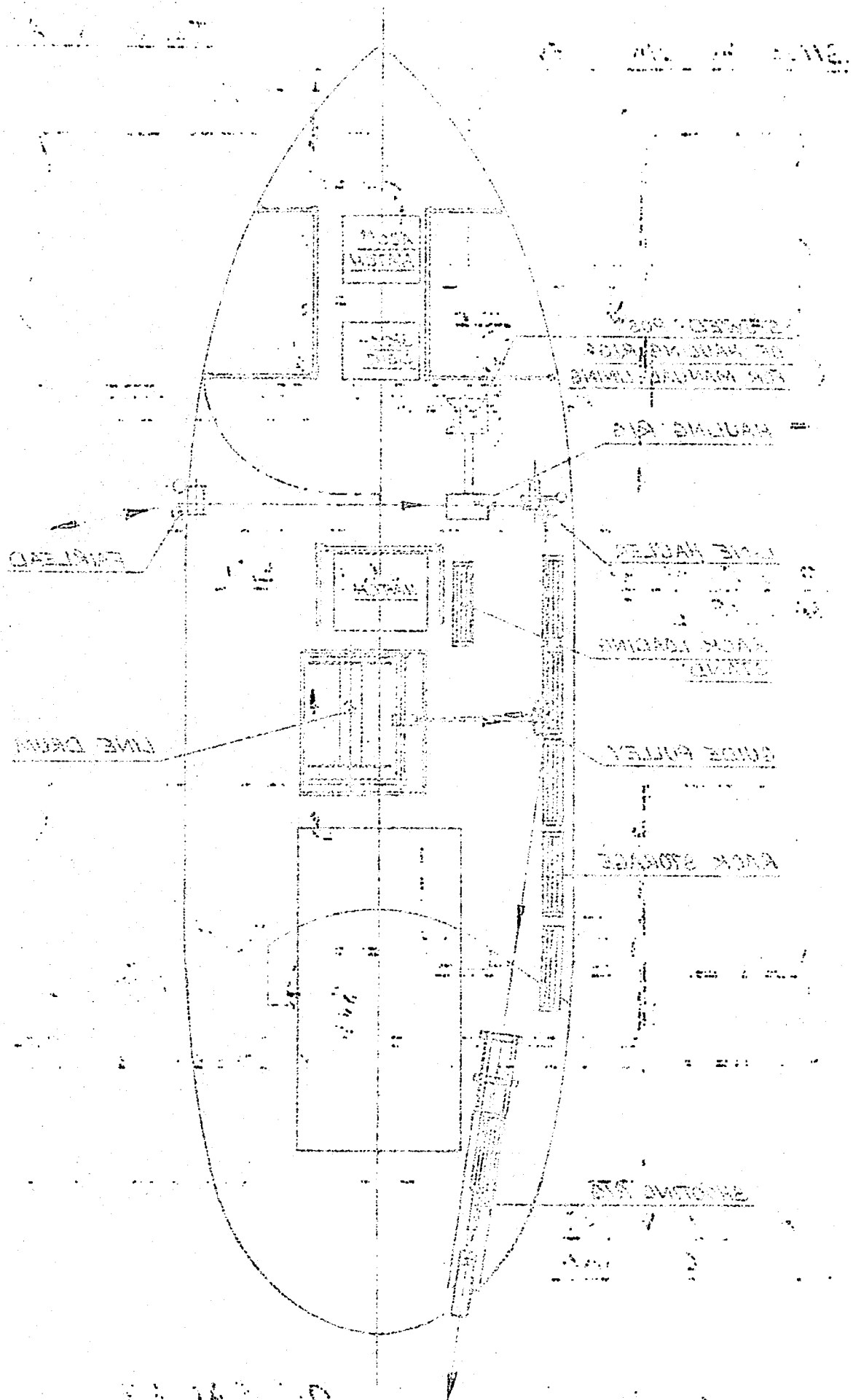
Technical performance of the automatic system was proved to be good. Binding and handling operations were efficient and no reliability problems were experienced. The improvements made to the book track, the binding rig and the electronics have enhanced the system's reliability.

2.5

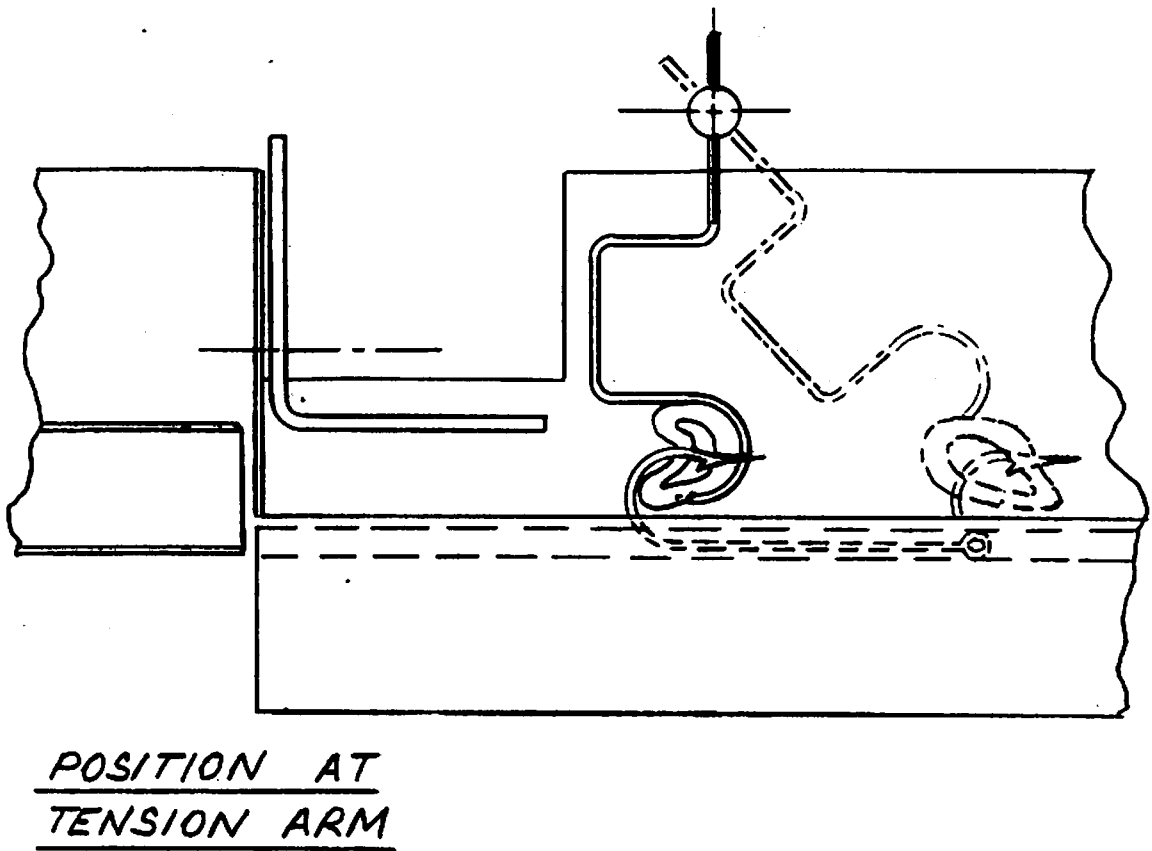
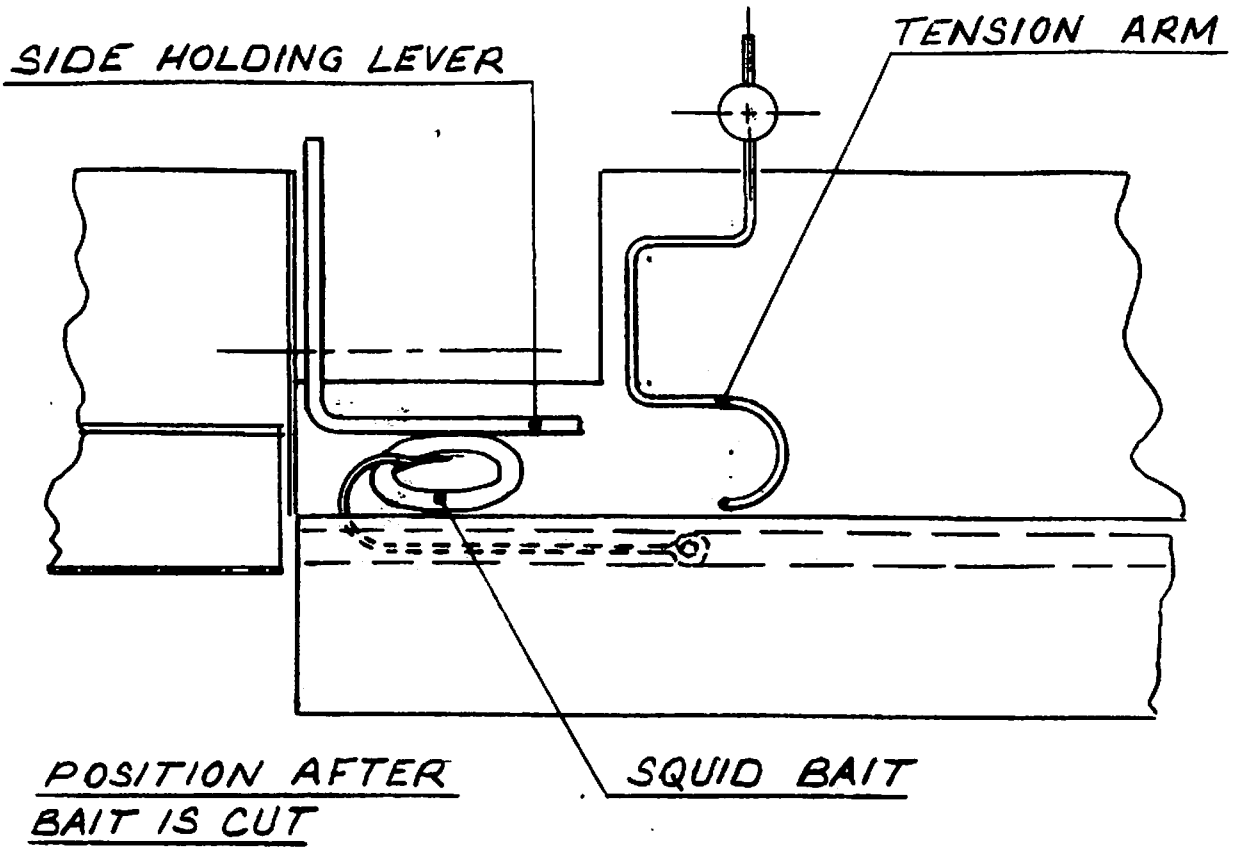
In view of the good mechanical and binding performance, the automatic system provided that material or the paper binding should be used as a final step.



AUTOCLIP SYSTEM LAYOUT  
ON MFV SARAH 'H'



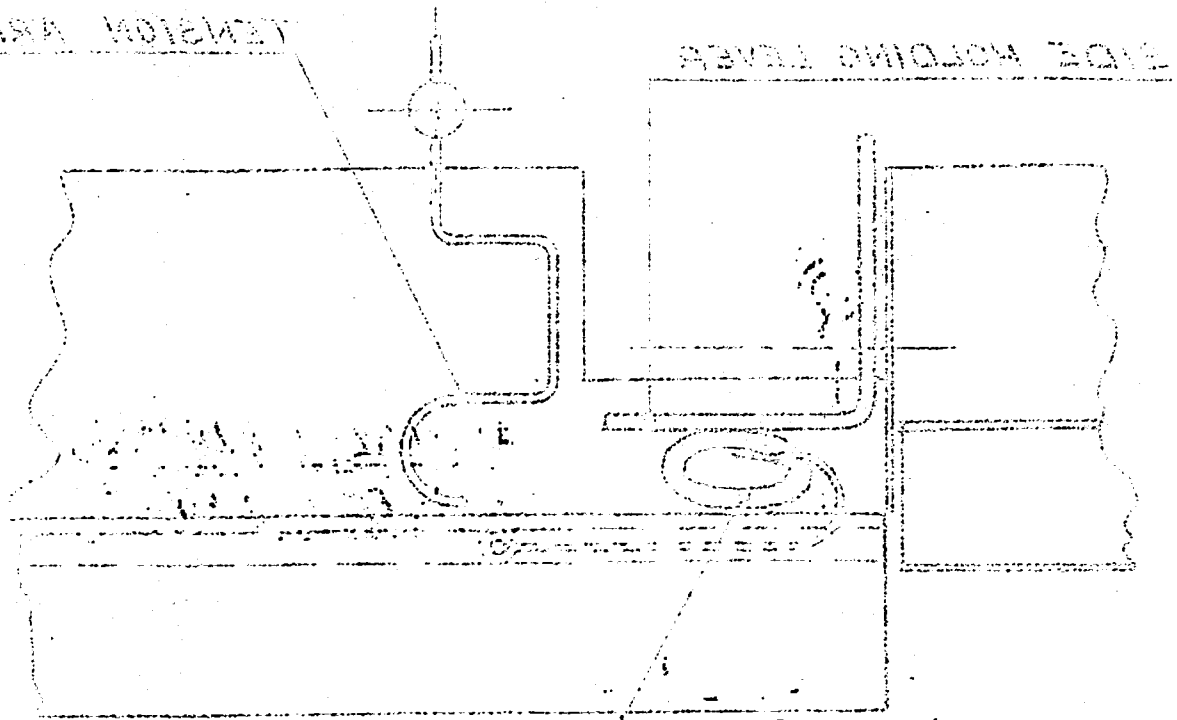
ON MAY 28 1944  
 AUTOCIP SYSTEM LAYOUT  
 H. SARAH W.



HOOKING ACTION OF BAITER AUTOCLIP SYSTEM

TENSION ARM

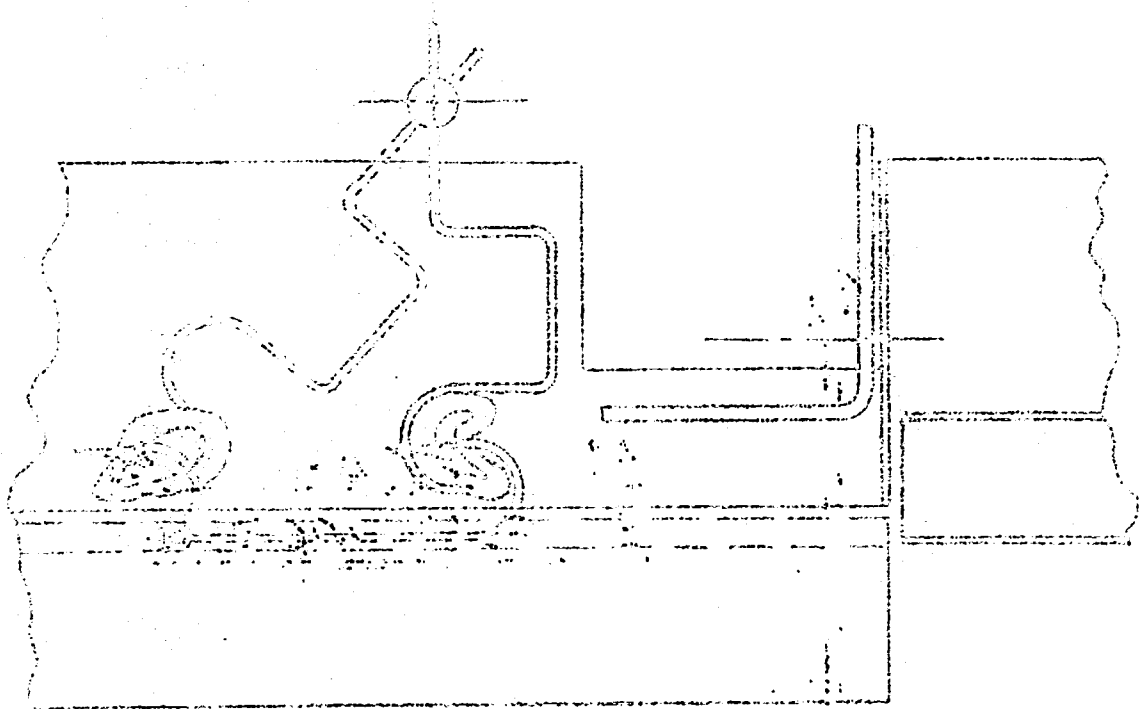
SLIDE HOLDING LEVER



SLIDE BAIT

POSITION AFTER

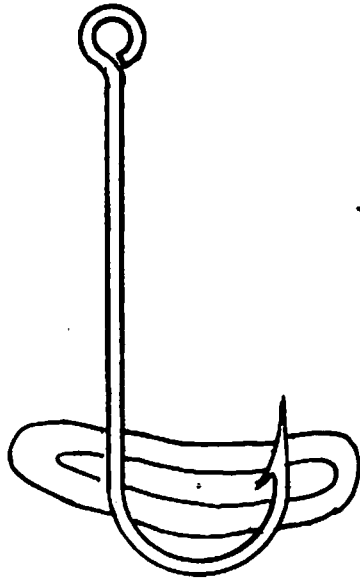
BAIT IS CUT



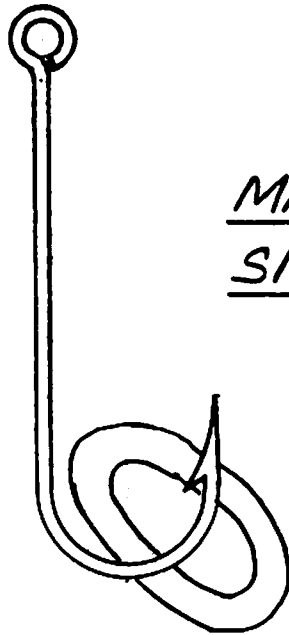
TENSION ARM  
POSITION AT

AUTOCLIP SYSTEM  
HOOKING ACTION OF BAIT





MANUAL BAITING  
DOUBLE HOOKING



MACHINE BAITING  
SINGLE HOOKING