REPORT OF THE INVESTIGATION

INTO THE LIFEBOAT ACCIDENT ON BOARD

mv HOEGH DUKE

AT SURABAYA, SUMATRA

ON 20 AUGUST 1992

London: HMSO

The accident was investigated by the United Kingdom Marine Accident Investigation Branch (MAIB) on behalf of the Cayman Islands Authorities. This report is published also on their behalf.

INDEX

1. SUMMARY

The starboard lifeboat with 12 persons on board was being lowered into the water when the aft hook slipped off its davit fall lifting ring. Consequently the lifeboat swung about the forward hook before free-falling upside down into the water. Six seamen were killed and six others hospitalised. At the time of the accident the crew were undergoing a routine lifeboat muster drill.

The Cayman Islands Administration requested MAIB to investigate the cause and circumstances of the accident and report any lessons learned. The immediate cause of the accident was unintentional release of the "on-load" release aft hook on the starboard lifeboat due to a defective release mechanism which was prevented from being reset in the locked position. The defects were due to neglected maintenance and lack of understanding of safe operation of the mechanism.

The inherent dangers with "on-load" release mechanisms have been recognised for some time by the international shipping community. The SOLAS 1974 Convention requires regular routine attention to be paid to maintenance and service of this equipment. These requirements are reflected in United Kingdom and Cayman Islands Merchant Shipping legislation.

The Managers of the mv HOEGH DUKE manage three vessels all carrying lifeboats equipped with "on-load" release mechanisms. There was a total lack of care in operation and maintenance of this equipment fitted on board mv HOEGH DUKE. Because of the possibility of a similar situation existing on other vessels, as a matter of urgency, interim recommendations were directed to the Managers, Leif Hoegh & Co A/S, advising a safety audit of the equipment, a programme of servicing and maintenance of "on-load" release mechanisms and a training programme using the advice of persons with specialised knowledge of the equipment.

Poor maintenance and lack of training and knowledge have been significant common causal factors in a series of fatal accidents involving the inadvertent release of various types of "on-load" release hooks. It is considered that the designs of these hooks are complicated and ambiguous requiring a high degree of specialised skills, not normally associated with ships' crews, in order to ensure that the mechanisms are properly maintained and serviced. For this reason and the fact that they are exposed to the harsh conditions of a marine environment, their continued use should be questioned.

PART I FACTUAL ACCOUNT

2. PARTICULARS OF THE SHIP AND CREW

2.1 Description of vessel

Name	:	HOEGH DUKE
Official No	:	705628
Registered	:	George Town, Cayman Islands
Built	:	Swan Hunter Shipbuilders Ltd, Wallsend
Keel Laid	:	1982
Gross Tonnage	:	30061 tons
Length overall	:	648.36 feet
Beam	:	105.84 feet
Draft	:	29.99 feet
Manager	:	Leif Hoegh (UK) Ltd
Classification	:	Lloyd's Register of Shipping +100A1 Bulk Carrier,+LMC,UMS,Ice Class 3

Life-Saving Appliances include two 40-person capacity totally enclosed, self-righting lifeboats, manufactured under licence from Watercraft (UK) by Jorgensen & Vik A/S, Norway. The lifeboat davits are Watercraft pivot type WP/8.0 MXL/3800 equipped with Watercraft Colts MW/7500 winches.

The vessel is also equipped with four 20-person and one 6-person throw overboard liferafts, 8 lifebuoys and 40 life-jackets.

At the time of the accident all required convention certificates were on board, in date and valid. In particular the Cargo Ship Safety Equipment renewal survey was completed on 19 March 1992. The certificate was issued by the Cayman Islands Administration on 31 March 1992 valid until 18 March 1993.

2.2 Crew

The ship carried a total complement of 26: the Master, four deck officers, one radio officer, four engineer officers, one electrical officer, eleven deck ratings, three engine room ratings and a Chief Cook.

The vessel was crewed in accordance with the Safe Manning Certificate and officers and seamen were qualified in accordance with the Cayman Islands qualification requirements which are the same as those of the United Kingdom.

The Master, Chief Officer, Chief Engineer Officer and Second Engineer Officer had a significant number of years experience at sea in their designated rank. The Master and Chief Officer had 18 months and 4 years service respectively on the HOEGH DUKE. The Chief Officer is British and the other three senior officers are Norwegian.

Junior officers and other ranks come from the Philippines with the exception of the Electrical Officer who originates from Yugoslavia. These crewmen were contracted to the vessel for 10 months. At the time of the accident some of them had recently joined the vessel, but others had nearly completed their contracted service on the vessel.

3. NARRATIVE

The starboard lifeboat with 12 persons on board was being lowered into the water when the aft hook slipped off its davit fall lifting ring. Consequently the lifeboat swung about the forward hook before free falling upside down into the water. Six seamen were killed and six others hospitalised.

The accident occurred in the afternoon of 20 August 1992 during a routine lifeboat muster drill with the vessel berthed alongside in Surabaya, Indonesia. Under the direction of the Master, the Chief Officer ordered the lifeboat to be lowered from the stowed to the embarkation position. Twelve crew members, including the Second Officer in charge of the lifeboat and his designated assistant, the Third Officer, embarked the lifeboat held in by the tricing pendants.

Both officers were qualified in operation and handling of survival craft in accordance with the provisions of the 1978 Convention on Standards of Training, Certification and Watch-keeping for Seafarers, (STCW), and all participants in the exercise wore standard SOLAS life-jackets and safety helmets.

Subsequent to release of the slip ring of each tricing pendant by two men positioned in the forward and aft hatchways, the lifeboat swung out to the lowering plumb position. All hatch doors were then closed and the lifeboat was ready for lowering. The bowsing tackle, although available, was not used in this exercise.

At approximately 1545 hours, using two-way radio telephone, the command was given to lower the boat. Subsequent to operating the winch brake locally at the winch position and as the lifeboat started to lower the aft lifeboat hook released from the lifting ring. The lifeboat swung downwards pivoting about its forward hook which also released. The lifeboat fell approximately 35 feet upside down into the water remaining afloat in that position.

The upturned boat drifted forward along the side of the ship. To effect a rescue attempt the Chief Officer was lowered by a deck slewing crane before jumping into the sea to swim to the boat. He was followed by the Bosun and messman who were also lowered into the sea by another slewing crane.

The Second Officer and a seaman emerged from under the boat and were picked up by a passing launch. The same launch towed the lifeboat to within reach of the most forward deck slewing crane. Using this crane a sling and shackle were lowered and attached around the lifeboat rudder stock. The lifeboat was partially lifted out of the water by the stern. With the help of the attending Bosun and the messman, at 1600 hours the Chief Officer entered the upturned lifeboat to evacuate survivors and bodies, and at 1630 hours he declared the lifeboat empty. The evacuation was assisted by volunteer craft which happened to be in the area at the time.

By 1800 hours the lifeboat was recovered by a cargo crane and landed on top of a cargo hatch.

PART II CONSIDERATION OF POSSIBLE FACTORS

4. THE "ON-LOAD" RELEASE HOOK AND CONTROL MECHANISM FITTED TO THE LIFEBOATS

The hook assembly fitted to the lifeboats is the Mills Titan "on-load" quick release suspension mechanism manufactured in the United Kingdom by William Mills (Marine) Ltd. It is of a type for davit launched survival craft complying with the requirements of the Regulation (41.7.6.2.1), 1983 Amendments to Chapter 111 of the SOLAS Convention 1974 and approved by a number of Administrations including that of the United Kingdom. The mechanism is designed to enable simultaneous release of the hooks from each fall while the lifeboat is either fully waterborne, (normal operation), or fully suspended on the hooks, (emergency procedure).

The hook assemblies were manufactured in 1983 and had been satisfactorily proof tested to 2.5 safe working load (12.5 tonne) in accordance with Department of Transport requirements and in compliance with the 1974 SOLAS Convention.

The general arrangement of the release mechanism assembly is shown in Figure 1. To release the hooks from the fall wires, the release handle of the release handle assembly, which is situated at the coxswain position inside the enclosed lifeboat, is pulled aft to operate the forward and aft morse cables simultaneously causing the hooks to swivel into the open position. The release hook assembly is shown at Figure 2.

The release handle assembly illustrated in Figure 3 incorporates three safety devices to prevent inadvertent release of the hook.

1. A hydrostatic release interlock device prevents movement of the two operating quadrants and therefore the release handle until the lifeboat is waterborne. A manually operated hydrostatic release override lever is installed behind a glass panel, and should the hydrostatic mechanism fail to operate, the quadrants may be freed by operation of this lever.

2. A Tee-headed safety pin fitted to the release handle assembly preventing inadvertent movement of the release handle which, like the hydrostatic interlock, prevents movement of the operating quadrants. This pin should be removed once the lifeboat is waterborne. To operate the release handle, the pin has first to be removed.

3. The release handle is lifted up against a spring force constraining the handle tang in slots on the side plates of the release handle assembly.

Once the above three safety devices have been operated manually, or in the case of the hydrostatic release, automatically, the release handle may be moved in the aft direction bearing the tang A onto the quadrants, and pulling the operating cables which in turn pull on the respective cam arm operating lever of each release hook assembly (Figures 2 and 4). Rotation of the half-moon face of the cam by the cam lever frees the tip of the hook, resulting in the release of the hook from the lifting ring.

To reset the hook, the release handle is moved to the locked position, but the handle tangs will not at this stage drop into the side plate slots due to the position of the operating quadrants. At each hook assembly, the hook is swung back and held closed. The re-cocking lever, which is connected to the cam spindle, is lifted upwards to return the cam and the two quadrants to the reset position. The hook is now locked in position, with face to face contact between the hook tail and the half-moon cam face, and the two quadrants reset with the release handle tang A fully housed in the side plate slots. The Tee-headed safety pin can now be inserted in the release handle assembly to lock the two quadrants in position.

A feature of the release mechanism is that with correct adjustment of the operating cable face to face contact is made between the hook tail and the half-moon cam face when the hook is under load and the interlocks are in place. If this contact is not achieved the two faces are not parallel and the operating cable may be placed under compression (Figure 5). However, cable movement will be prevented if the operating quadrants are in the reset position. If, however, the quadrants have not moved over fully to this position the hook will remain closed until load on the hook is sufficient to overcome the effect of friction in the release mechanism causing the hook to open. The effectiveness of the constraining influence of this face to face contact is tested in the statutory 2.5 safe working load proving tests on the hook assembly, which is undertaken without the operating cables attached. This test not only proves the strength of the hook and the cam spindle, but also demonstrates that the cam does not rotate under load when in face to face contact with the hook tail.

Chevron Tankship Company of San Francisco commissioned a comprehensive investigation into the mechanics of this type of release mechanism as a result of a similar accident on the CHEVRON PERTH in 1991. It was found that the compressive load on the operating cable increased in proportion to the cam angle with respect to the hook tail (Figure 5).

Details of the geometric relationship between the tip of the hook and the half-moon cam which constrains it in the locked position are illustrated in Figure 4. Key dimensions are the gap between the hook and cam (in the open position), eccentricity of the cam, and the radius of the tip of the hook. These dimensions control the nature of the interaction forces between the hook and the cam (Figure 5).

Small misalignments between the half-moon cam face and the hook tail can cause loss of face to face contact, thus placing a compressive load on the operating cable with a tendency for the hook to open if the cable is not restrained. This misalignment may be caused by a number of reasons, for example, wear on the hook tail end causing the radius F (Figure 4) to increase, wear on the hook swivel pin and bushes and on the half-moon cam face and incorrect adjustment of the operating cable. Misalignment reduces the constraining effect of friction between the contact faces of the hook tail and half-moon cam, and increases the moment acting to turn out the cam to the release position.

The reliability and maintenance of the operating cable is discussed later in the report. However it is convenient at this juncture to describe the cable in some detail.

The make of the operating cable for the hooks and the hydrostatic interlock was not positively identified. The manufacturer of the cable was not established but the cable was similar in appearance to a standard Morse 64C cable manufactured by Teleflex Morse Ltd. This is a standard type of cable fitted to Mills Titan release mechanisms and is commonly used in a wide variety of applications such as aeronautical control engineering. Each end of the cable is fitted with a U-shaped clevis pin which is screwed onto a stainless steel end rod and attached to the stranded inner operating cable. This cable runs in a teflon plastic inner liner designed to give low friction qualities which is itself surrounded by a conduit strand covered by a red plastic outer sleeve. The sealing arrangement to prevent ingress of foreign deposits into the running part of the assembly consists of a stainless steel support tube attached to the outer sleeve by a mild steel crimp connection. Plastic seals cover the interfaces between the end rod (wiper seal) and support tube, and between the support tube and the crimped fitting. The cable is intended to operate with it securely clamped on fixed mountings with minimum bend radii.

5. INSPECTION OF THE "ON-LOAD" RELEASE ASSEMBLY

The Inspector commenced his inspection and interview of witnesses on 28 August 1992, when the HOEGH DUKE arrived at Singapore, her next port of call.

The "on-load" release assembly was inspected as found in the lifeboat at Singapore and later after it was detached from the lifeboat and transported to William Mills Marine in Manchester, England for further examination and tests.

Observations:

1. In Singapore, the aft hook half-moon cam release spindle was found to be set horizontal to the hook tail in the release position.

2. No sign of wear or damage was found on the tail of the aft hook and the geometrical dimensions of the hook assembly and the lifting ring were found to be within the maker's specification.

3. There was evidence of hammer marks on the aft hook operating quadrant and on the hand re-cocking lever of the aft hook assembly indicating previous difficulty in resetting the aft hook release mechanism.

4. It was found in Singapore and later confirmed in Manchester that undue force was necessary to reset the hook. In Manchester, the aft hook assembly and the release handle unit were set up to facilitate operation. By applying reasonable effort to the cam re-cocking lever the aft operating quadrant moved over towards the locked position, but it was not possible to push the quadrant fully home so as to engage the release handle tang in the side plate slots. Because of the position of the aft operating quadrant, the Tee-headed safety pin could not be completely inserted through both side plates to lock the quadrant in position. The hydrostatic interlock lever would not drop in front of the quadrant to prevent its movement. With the aft quadrant in this position, the hook tail and half-moon cam were not in flat contact but lay at an angle to each other with a maximum gap of 10 mm. A wear mark across the face of the cam indicated that the two faces had been set in this open position during previous service.

5. A number of tests were carried out at the maker's works in Manchester which included the setting up of the aft hook assembly on a tensile test machine with the release handle unit nearby. The two units were connected using the original operating cable. The cable and the aft quadrant were adjusted to replicate the supposed position of the aft half-moon cam prior to the accident with its face open to the tail of the hook and the release handle unit locking devices ineffective in locking the quadrant in position. A static load was applied to the hook and the hook lifting ring was hammered to simulate an imposition of a vibrating load on the already loaded hook. This simulation is not a normal method of

testing, but it gave an insight into the effect these loads had on the ability of the hook to remain in the locked position. The test was repeated for different values of static load up to and beyond the safe working load of the hook. In each case, when the lifting ring was hammered, the half-moon cam rotated towards the release position. In one of the tests the hook finally released. The tests were repeated with the release handle unit set in the locked position. In each of these tests the half-moon cam moved slightly away from the face to face contact between it and the hook tail, the degree of movement of which appeared always to be the same. The Inspector concluded that the possible reason for this movement was the effect of interaction of the tail edge of the hook and the wear mark across the face of the cam preventing face to face contact so resulting in a residual moment on the cam face.

6. The "Morse" operating cable connecting the release handle to the aft hook was slightly bent at the screwed rod indicating that an undue compressive force had acted on the cable at some stage, (Figure 6). The inner operating cable was partially seized in its sleeve. The reason for seizure was investigated by consultants employed by Leif Hoegh who found that at the hook end section of the cable, the crimped mild steel end fitting and the clevis fork were heavily corroded, with a tendency to cracking of the former. It was confirmed using a stereo microscope that deposits consisting of a mixture of salt and corrosion products were present on the inner operating cable, inside the support tube and inner plastic liner. Pitting corrosion on the inner cable was evident but considered negligible. Tests confirmed that the cable was made of authentic stainless steel.

It is probable that sea water leaked into the cable when the lifeboat was upside down in the water, but it is equally likely that contamination took place during service. This end of the cable is exposed to the marine environment and continually subjected to a salt water laden atmosphere. In order to protect against such conditions, the suppliers of Morse cables, Teleflex Morse Ltd, recommended to Watercraft and the Department of Transport in 1980 that cable ends should be well coated with grease for protection. Neither the aft nor forward cable at each hook assembly were lubricated. However, at the release handle assembly end the cables were well covered in grease.

The aft re-cocking lever was found to be unreasonably stiff.

The cable installation was found to be securely restrained in the lifeboat: bend radii of the cables appeared to accord with manufacturer's recommendations and the fore and aft cable clamps at the underside of both hook assemblies were tight.

7. The forward half-moon cam spindle was found in the release position with the respective operating quadrant moved over but not to the full extent of the release position. The operating cable was severely bent in way of the cam operating lever. The condition of the cable prior to the accident could not be confirmed because of this damage and further damage as a consequence of removal of the hook assembly from the lifeboat in readiness for transportation to the United Kingdom.

On examination of the forward hook assembly in Manchester, it was observed that the working parts of the assembly moved as they should, albeit with a certain stiffness due to lack of maintenance. The unit had not been maltreated in the same way as the aft hook assembly in that hammer marks were not present to indicate forcible attempts at resetting. This finding seemed to indicate that the operating cable had not seized to the same degree as the aft unit.

8. In Singapore, the Tee-headed safety stop pin on the release handle unit was found to be fully housed and undamaged, but it was deduced that because of the relative position of the pin and operating quadrants the pin could only have been partially inserted before the accident, removed subsequent to it and then later re-inserted fully. Pin removal probably took place during the inspection in Surabaya (Figure 7).

9. A bracket in the release handle assembly fixing the hydrostatic unit cable was distorted so that the manual release lever of the hydrostatic interlock was in the open and unlocked position. It is considered that this damage took place as a result of the accident. The glass access cover was in place and undamaged indicating that the manual override had not been used. The hydrostatic actuating diaphragm unit of the interlock was free to move and undamaged.

10. In the light of what was found on the starboard lifeboat, the condition of the "on-load" release hooks of the port lifeboat were examined. The release mechanism on this lifeboat was found to be unsafe so that the lifeboat had to be taken out of service. The Lloyd's Register Surveyor representing the Cayman Islands Administration agreed to temporary installation of liferafts in lieu of both the starboard and port lifeboats.

6. RELEASE OF THE AFT "ON-LOAD" RELEASE HOOK

6.1 Cause

Inspection of the aft hook "on-load" release mechanism confirmed that because of stiffness in the aft operating cable and cam spindle the aft quadrant was not in the full reset position, so that the faces of the cam and the hook tail were not in flat contact. Because the aft quadrant was improperly reset, the three safety devices in the release handle assembly were ineffective in locking the quadrant in position. It is considered that the forward quadrant was in the full reset position but with the Tee-headed safety pin only partially inserted to lock only this quadrant in place.

The accident occurred subsequent to the start of the lowering operation.

Because the aft quadrant was not in the reset position the face of the half-moon cam was at an angle to the hook tail, so that the tail tended to lever on the face of the cam, resulting in a compressive load being applied to the operating cable. From the results of the hammer induced release testing carried out in Manchester, it is considered that the combined compressive load in the cable and the vibration from the falls was sufficient to overcome the friction in the cable and in the hook assembly release mechanism. Because interlocking devices were not in place to prevent movement of the operating quadrant, the half-moon cam spindle rotated to release the aft hook into the open position.

As the lifeboat swung about the forward hook subsequent to release from the aft hook, the load exerted on it caused the keel lifting bar to rip through the stem of the lifeboat. As a result the operating cable distorted, forcing the cam spindle lever to rotate the half-moon cam to release the hook.

It is considered that at the time of the accident the "on-load" release hook mechanism was in an unsafe condition. It could not be properly reset because of the seized condition of the aft operating cable and stiffness of the re-cocking lever. The seizure of the cable was due to contamination of the inner sleeve by salt and corrosion deposits.

The general poor condition of the mechanism in this boat and in the port lifeboat indicated serious neglect of maintenance and ignorance of safe operation of the equipment.

6.2 Maintenance and Operation of the release mechanism

The possibility of unsafe operation of "on-load" release mechanisms has been recognised for over a decade. SOLAS 1974 Convention requirements provide for regular weekly and one monthly inspections of lifeboats and equipment in addition to three monthly lifeboat manoeuvres in the water which necessitate release of the boat from the falls. The Convention also provides for training manuals and on board maintenance instruction on lifesaving equipment which specifically includes launching appliance release mechanisms. The United Kingdom Merchant Shipping (Musters and Training) Regulations 1986 which are mirrored in Cayman Islands legislation, require that the equipment must be adjusted and maintained in strict accordance with maker's instructions.

Regular three monthly lifeboat drills were carried out on both the starboard and port lifeboats. The lifeboats were placed in the water and the hooks released on every occasion. The starboard lifeboat drill which preceded the accident took place on the 5 June 1992. The release mechanism must have been incorrectly set during this drill and before recovery of the lifeboat from the water. Because of the friction effect of stiffness in the aft operating cable and its respective half-moon cam spindle, the aft hook was prevented from releasing during the recovery operation.

The last Safety Equipment Renewal survey was held at Jeddah on 18 - 19 March 1992 by an exclusive surveyor of Lloyd's Register of Shipping. On this occasion the starboard lifeboat was lowered and the hooks released. The Society expects the surveyor at each survey, when the vessel is in service, to visually examine the mechanism in association with other components of the launching appliance. For those boats which are lowered and released from the falls under survey, the operation of the mechanism is directly verified. It is unclear if, on this occasion, the release mechanism was examined in accordance with Lloyd's Register requirements and confirmed to be safe.

The unsafe condition of the release mechanism could have been avoided by a programme of maintenance and regular servicing in accordance with the maker's instruction and maintenance manual. A planned maintenance and records system was in operation on board, which included regular checks and servicing of the lifeboat and its launching system. However, the system did not account for the lifeboat "on-load" release mechanism. There were neither records on the ship nor with management ashore indicating work carried out on the release mechanisms, nor evidence of any spare parts being ordered or supplied. No maker's "on-load" release mechanism instruction and maintenance manual was provided to the ship, although such a manual has been available to industry since 1985. In the light of operating experience this manual has been revised seven times. The crew were unaware of the manual's existence.

As advised in the manual the HOEGH DUKE lifeboats were fitted with instruction labels at the release handle position indicating the dangers of inappropriate operation of the hydrostatic release interlock. However the manual also advises a warning label instructing correct resetting of the release mechanism before recovery of the lifeboat. This label was not fitted in the boats.

In addition to installation checks and operational instructions, the manual advises weekly visual checks followed by more rigorous monthly and twelve monthly inspections. These inspections require the boat to be hung on a maintenance pendant in order to test the mechanism and to check for stiffness and wear. There was no maintenance pendant on board the vessel. The "on-load" release hook is designed to close engineering tolerances and any changes to these tolerances may render the hooks unsafe to operate. The manual, for example, specifies that a maximum allowable wear on the hook tail edge radius should be no greater than 1mm. Given the working conditions on board, it is considered unreasonable to rely on obtaining a true measurement of this tolerance. Any wear indicated on the tail of the hook, whether it be at the tip edge or on the contact face, should be considered unacceptable requiring immediate hook replacement.

However, the required tolerances of the hook assembly which ensure adequate face to face contact between the hook tail and the half-moon cam face are not confined to just wear on the hook tail. For example, wear on the half-moon cam face and its spindle, and on the hook pin can have a detrimental effect. The manual should be explicit in describing the importance of checking and maintaining all hook assembly tolerances that affect face to face contact.

It is considered that inspection of the hooks can only be carried out effectively by personnel specially trained in the maintenance and operation of this kind of hook. This inspection requires that the lifeboat is out of service for the duration of the inspection. The down time of the lifeboat should inevitably be extended where these tolerances are outside maker's specification, in order to enable necessary repairs. The required tolerances of the hook assembly are not fully specified in the manual, making it incomplete.

The condition of the aft operating cable was a primary factor in preventing correct resetting of the release mechanism. The manual advises installation and adjustment procedures for operating cables. Further, lubricating procedures advocate that the cable end assemblies are kept clean using paraffin based products and that they are coated sparingly with a thin film of grease. The manual notes that the control cables are lubricated on assembly and additional lubrication should not be required for the average installation. However, it goes on to say that if site conditions warrant, ie excessive heat, complete lubrication kits are available from Morse controls. The subjective term, "excessive heat", is not explained. The manual advises that if cables are still found to be stiff after all the above procedures, they should be replaced.

This advice is considered to be flawed. Complete lubrication kits were obtainable until three years ago, when they were withdrawn due to lack of demand. William Mills are amending their Manuals to reflect this. Also the inner operating cable member is surrounded by a plastic liner which acts as a self lubricated bearing surface which is not designed to be lubricated by application of grease or oil. Indeed, hydrocarbon based lubricants may have a detrimental effect on the plastic liner. The recommended application of oil to the end fittings of the cable is meant to protect the seal and end rod from the effect of a salt laden atmosphere, thereby possibly reducing the risk of seal breakdown and the ingress of salt and corrosion deposits. The operating cables presently used cannot be effectively repaired once seized. Faulty cables render the lifeboat unsafe to use so that the cables must be replaced immediately if the lifeboat is to remain in service. The manual should clearly reflect this requirement as well as the necessity of carrying suitable spare cables.

6.3 Comments on the use of "On-Load" release hooks in general

There have been a number of previous accidents involving "on-load" release hooks. In September 1985, a 58-person Watercraft America lifeboat fitted with Mills Titan "on-load" release hooks had been re-stowed after sea trials when the forward hook inadvertently released. Investigation into the accident found that the operating quadrants had not been fully reset so that the Tee-headed safety pin was improperly inserted with the release tang not located in the side plate slots. As a result of this finding, Watercraft UK and its associated company, Watercraft America, advised customers to make modification to existing release handle assemblies by relocating the Tee-headed safety pin so that the new position would not allow the pin to be inserted until the operating quadrants are in the fully reset position and the release handle tang is fully dropped back into the slots. Subsequent to this accident, the modification was incorporated in all new Mills Titan installations (Figure 8). The Department of Transport was advised of the modification.

The Mills Titan "on-load" release hook is one of a number of types presently in use which satisfy the requirements of the 1974 SOLAS Convention. At least seven types are known to MAIB and each one depends on close engineering tolerances requiring extensive and precise maintenance to assure their security. As such, their use in the marine environment where conditions are not ideal should be questioned. During the course of this investigation and that of other investigations this lack of understanding was found to be not just confined to ships' crews, but extended to shore management, surveyors and service personnel.

Although poor maintenance and lack of training is a significant causative factor in this and other similar accidents, the man-machine interface and existing personnel conditions must be considered in the setting of regulatory requirements if they are to be successful. If, through IMO, the international community are to insist on requirements for "on-load" release systems, they should require the systems to be designed and constructed so as to be fully reliable given no more than a realistic degree of maintenance. The criteria set should allow both for the effects of the maritime environment and the fact of limited crews without specialist knowledge of the equipment. It is considered that "on-load" release hooks in use at present do not meet such a criterion.

PART III CONCLUSIONS

7. FINDINGS OF THE INVESTIGATION

Immediate cause of the accident was:

7.1 Improper resetting of the "on-load" release hook mechanism in the starboard lifeboat.

7.2 During lowering of the lifeboat into the water the aft hook released as load on it applied a moment to the half-moon cam face. The resulting compressive force in the operating cable overcame the constraint of friction in the cable and in the cam spindle, resulting in rotation of the spindle and release of the hook.

Principal contributory factors were:

7.3 Stiffness of the cam spindle was due to lack of lubrication of its bearing. The self lubricating property of the operating cable was lost due to salt and rust deposits in the inner sleeve at the hook end section of the cable resulting in its seizure.

7.4 Neglected maintenance of the release mechanism.

7.5 Lack of understanding by the ship's officers of the safe operation of the mechanism.

Probable contributory factors were:

7.6 Unavailability of the maker's maintenance and instruction manual.

7.7 The design of the release mechanism, in so far that with load on the hook and with the cam and hook tail not in face to face contact, it will release when the operating cable is unrestrained.

7.8 The recommended modification to the position of the Tee-headed safety pin ensures that the release handle and the operating quadrants are fully reset before the pin can be inserted to lock the quadrants in position. The effectiveness of the locking device is clearly visible to the operator. This modification was not carried out on the release mechanisms of the HOEGH DUKE lifeboats.

7.9 The currently accepted design criteria for "on-load" release systems do not require the provision of a simple and unambiguous operation which is fully reliable given a realistic degree of maintenance.

PART IV RECOMMENDATIONS

The following recommendations were directed to the Cayman Islands Administration and to member countries of the Red Ensign Group.

1. In the light of this incident and other recorded incidents, it is recommended that all ships belonging to the Red Ensign Group and fitted with "on-load" release equipment, are surveyed in detail at the next due renewal survey of the Safety Equipment Certificate and any deficiencies reported.

2. Attention to the incident should be brought to the IMO Secretariat with the recommendation that similar surveys should be made by all Flag States to identify and report deficiencies to the Secretariat.

3. A research project should be initiated which takes account of this incident and other recorded incidents and reported deficiencies, to reconsider the designs of "on-load" release mechanisms and possibly the need for such equipment.

4. Guidance to surveyors delegated to survey Red Ensign Group vessels for the purpose of issue of the SOLAS Safety Equipment Certificate should be issued, so that the requirements for the SOLAS 1974, 1983 Amendments relating to operational readiness, maintenance and inspection of on board training and instruction in the use of "on-load" lifeboat release mechanisms are satisfied. In particular:

    1. A suitable training, operation and maintenance manual for the "on-load" release hook mechanisms is on board and available to all crew members.

    2. The shipboard check list for use for carrying out inspections of lifesaving equipment includes details of lifeboat "on-load" release mechanisms.

    3. A list of replaceable parts for the lifeboat release mechanisms and the source of these parts is available on board.

    4. A log for the records of inspections and maintenance of the lifeboat "on-load" release mechanism is on board.

    5. Lifeboats equipped with "on-load" release mechanisms are fitted with instruction labels as advised by the manufacturers.

    6. On-board crew training in the use of ships life-saving appliances includes safe operational use of lifeboat release mechanisms.

    7. The surveyors should be satisfied that the "on-load" lifeboat release mechanisms are maintained in accordance with manufacturer's instructions.

    8. Suitable maintenance pendants are on board.

5. The requirement should be considered for every safety manual etc to be "in a language and form which will be understood at least by the officer in charge of the equipment to which it relates", with the onus placed on the Owners to ensure compliance. This should give the option of either having the manuals translated or ensuring that at least senior officers have adequate command of the English language.

The following recommendations were directed to Leif Hoegh & Co A/S:

6. In accordance with the requirements of PART VII, Schedule 1 to the Merchant Shipping (Life Saving Appliances) Regulations 1986, regulations which are reflected in Cayman Islands legislation, Leif Hoegh should ensure that instruction plates indicating the method of resetting and operating the lifeboat release mechanisms of the HOEGH DUKE are in accordance with the advice in the William Mills (Marine) Ltd manual number 01, revision 7. The Company should also check to ensure that similar notices are in place in lifeboats of other vessels in their fleet equipped with "on-load" release mechanisms.

7. Leif Hoegh should ensure that respective vessels are supplied with suitable maintenance pendants.

8. Leif Hoegh should ensure that vessels in their fleet fully comply with the Regulations 18, 19, 51 and 52 of Chapter III of the 1983 Amendments to the 1974 SOLAS Convention.

9. Leif Hoegh should consider for all their vessels a requirement for every safety manual etc. to be "in a language and form which will be understood at least by the officer in charge of the equipment to which it relates".

The following recommendations were directed to William Mills:

10. William Mills should review their instruction manual entitled: "Instruction and Maintenance Manual, Titan "on-load" Release Suspension Gear Fitted with Hydrostatic Interlock" Number 01 revision 07 January 1992 with the view to amending sections:

8.4. ii) The required tolerances of the hook assembly to ensure adequate face to face contact between the hook tail and the cam face are not confined to just wear on the hook tail. The manual should be explicit in describing the importance of checking and maintaining all hook assembly tolerances to within the manufacturer's requirements.

10.0 The note in this section referring to the lubrication kits for the operating cables should be deleted.

Further, it is considered that the manual should advise that operating cables cannot be effectively repaired once seized up. Faulty cables render the lifeboat unsafe to use and must be replaced immediately if the lifeboat is to remain in service. It should also recommend that suitable replacement operating cables are carried on board at all times.

It is considered that operating cable and hydrostatic cable attachment and adjustment, pre-operational and monthly and annual maintenance checks must only be carried out by fully trained and qualified safety officers. This point should be more clearly emphasised in the manual.

11. William Mills should also define the level of knowledge, experience and competence required of personnel employed to maintain the "on-load" release mechanism. They should re-emphasise the importance of regular servicing by qualified personnel.

12. William Mills should consider the fitting of grease points (nipples) as an aid to lubrication of the cam release spindle of the hook assembly.

13. William Mills should investigate a means of eliminating the possibility of inadvertently placing a compressive load on the operating cable with a tendency for the hook to open if the cam is unrestrained.

Marine Accident Investigation Branch
October 1994

ADDENDUM

ACTION TAKEN BY WILLIAM MILLS (MARINE) LTD TO PREVENT RECURRENCE

William Mills intend to consider amendments to the instruction manual entitled: "Instruction and Maintenance Manual, Titan "on-load" Release Suspension Gear Fitted with Hydrostatic Interlock". It is agreed that reference to the lubrication kits for the cable should be deleted. They advise that the operating cables cannot be effectively repaired once seized up. Faulty cables render the lifeboat unsafe to use and must be replaced immediately if the lifeboat is to remain in service. Suitable cables should be on board at all times.

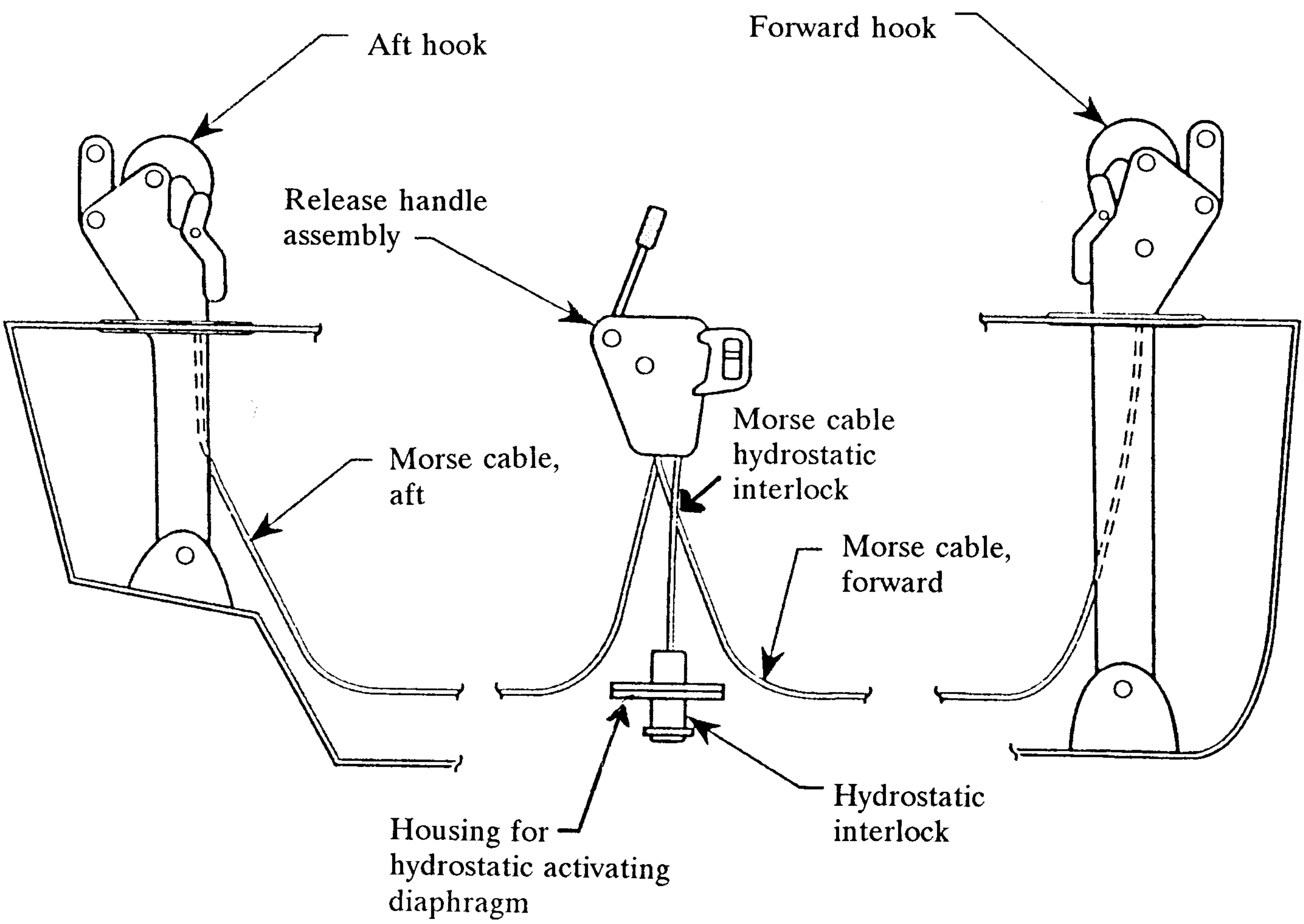
William Mills (Marine) Ltd intend to investigate the possibility of fitting grease points to the cam release spindle.

As a designer and manufacturer of Lifeboat Release Equipment, William Mills (Marine) Ltd have become increasingly concerned at the level of incidents and reported accidents which refer to lack of operator understanding and incorrect maintenance of release equipment as a main contributing factor.

Raising awareness of the high safety standards demanded by the industry is essential and both these important aspects need to be fully understood and effectively controlled. To assist, the Company are introducing two comprehensive Maintenance and Personnel Training Courses on Mills Release Equipment: one for Operational Training and the other for Maintenance and Operational training. Where maintenance is not carried out by William Mills (Marine) Ltd, it is their intention to recommend that customers use only companies with Approved/Certificated Engineers.

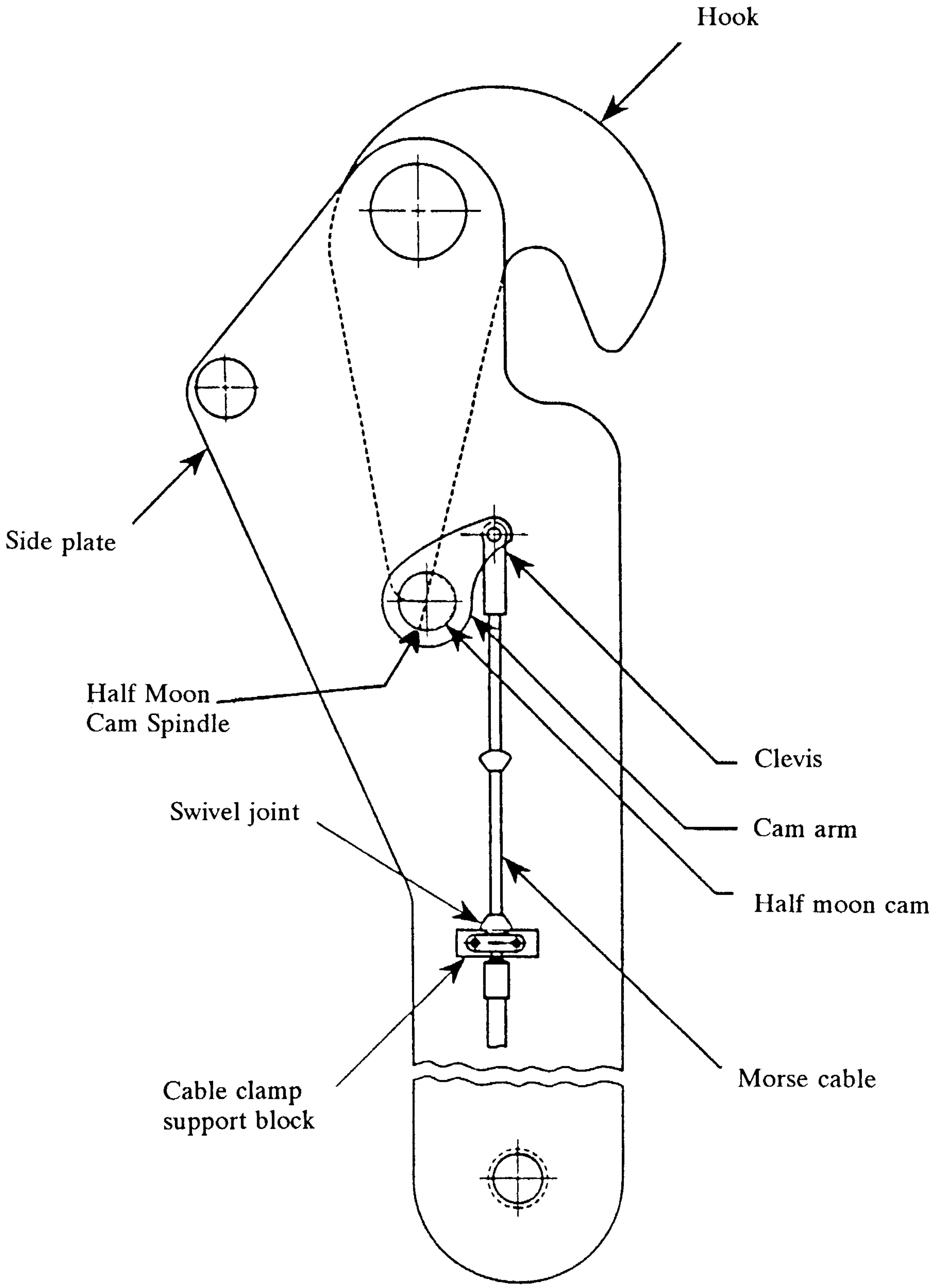
William Mills are confident these Courses will provide operators with valuable information to raise and clarify safety standards and, in turn, reduce the level of accidents.

FIGURE 1



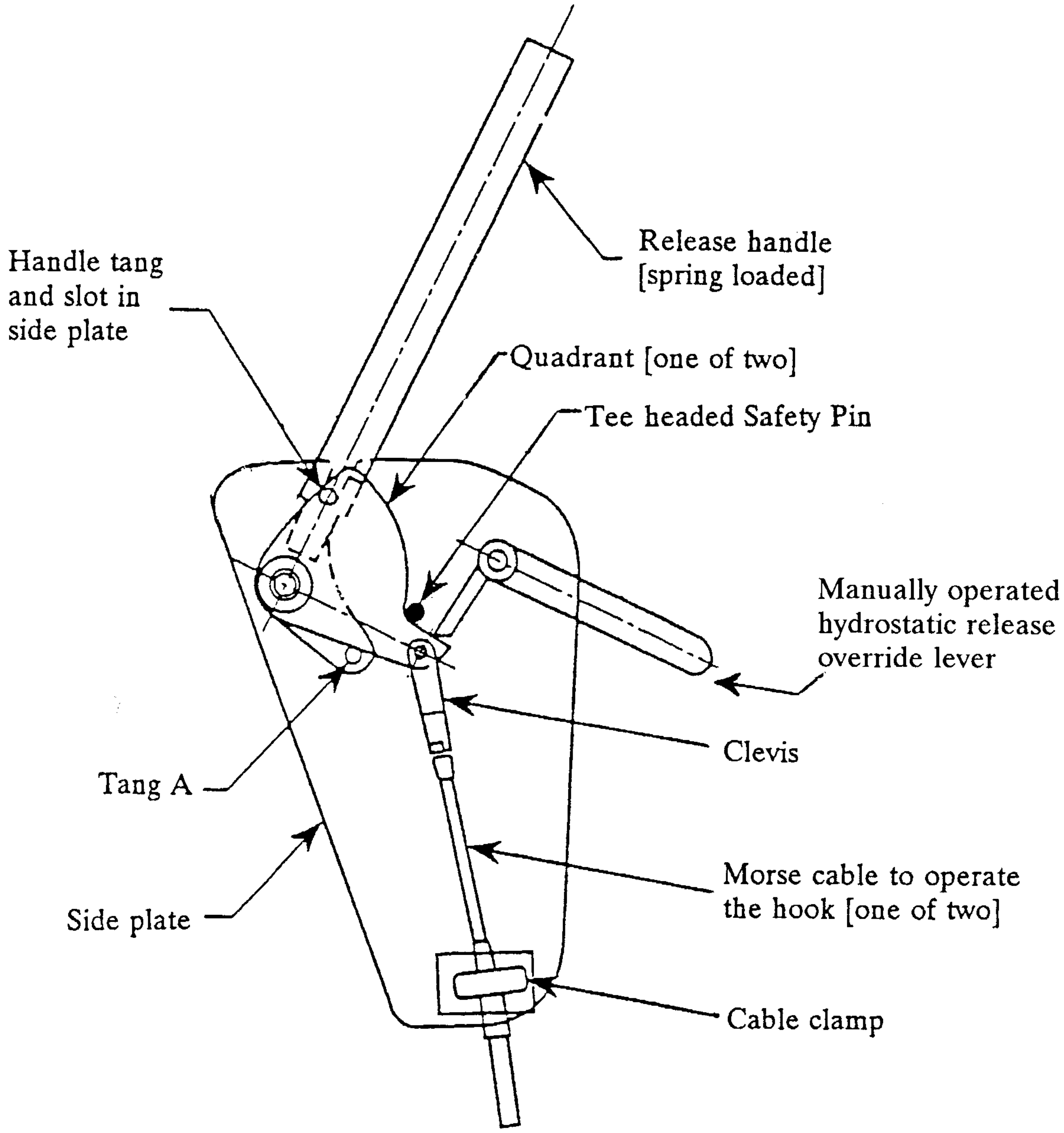
Release mechanism general assembly

FIGURE 2



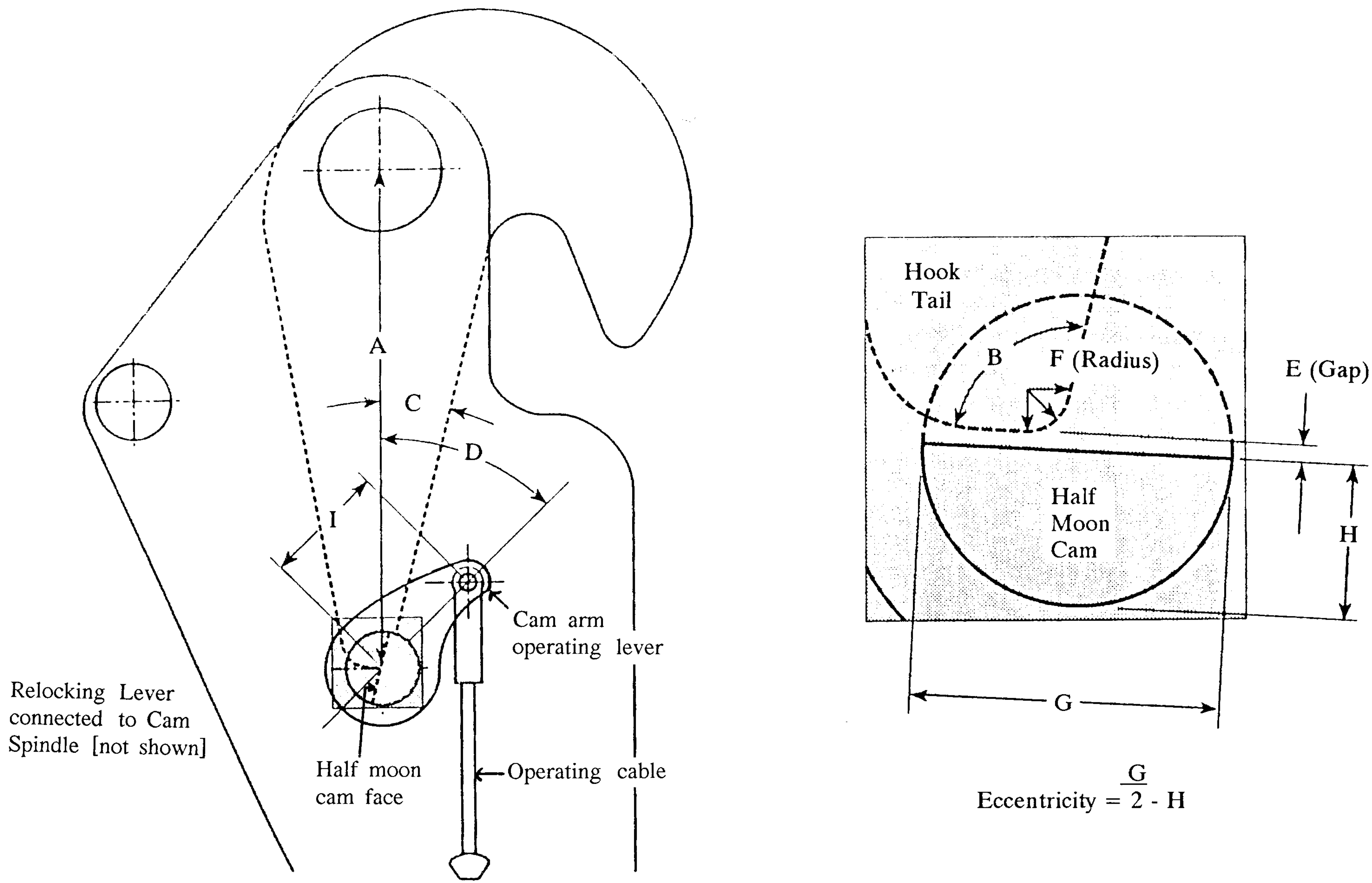
Release hook assembly

FIGURE 3



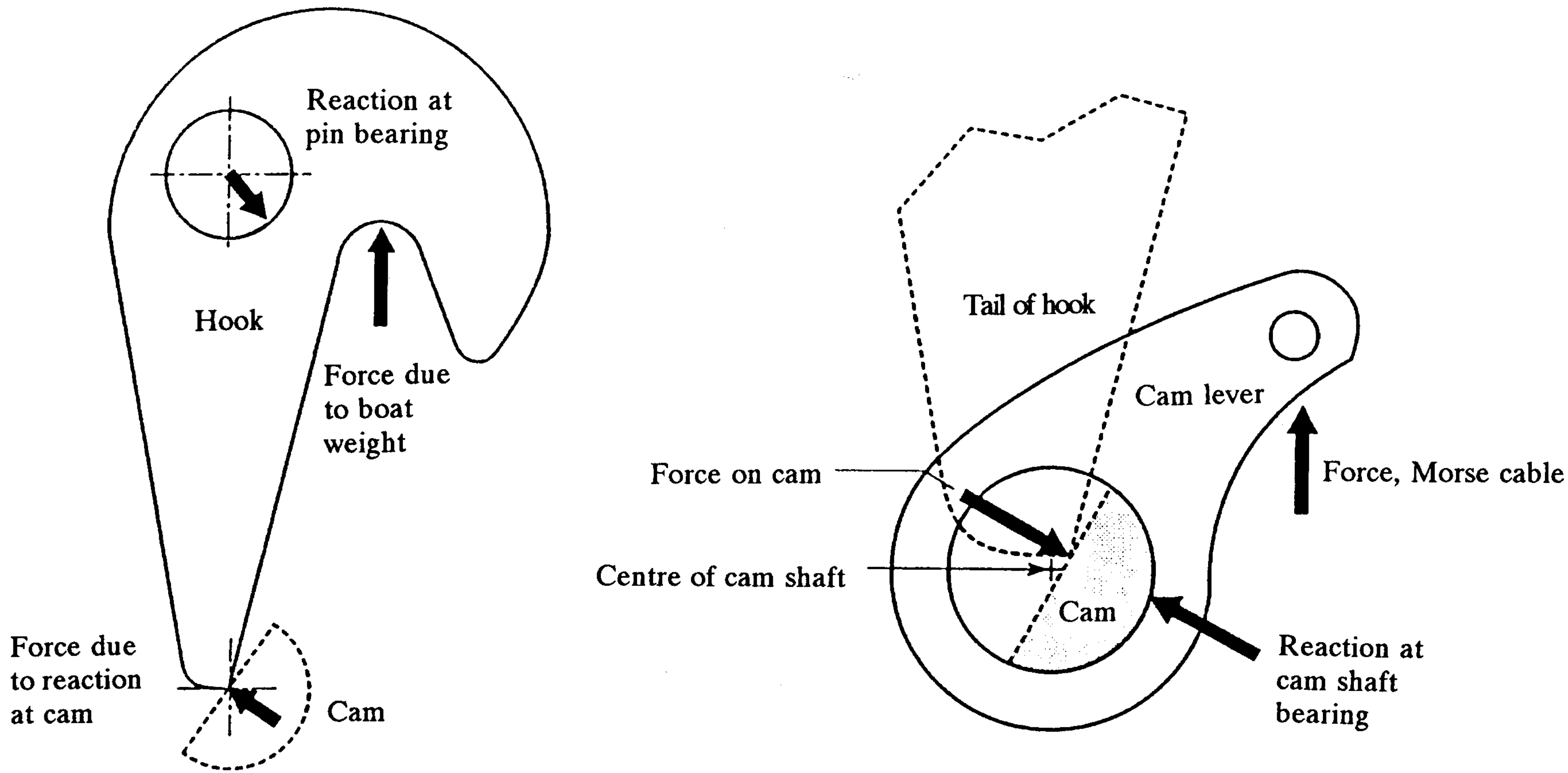
Release handle assembly with safety pin location

FIGURE 4



Release hook dimensions

FIGURE 5



Free body diagrams of release hook and half moon cam, shaft, and lever

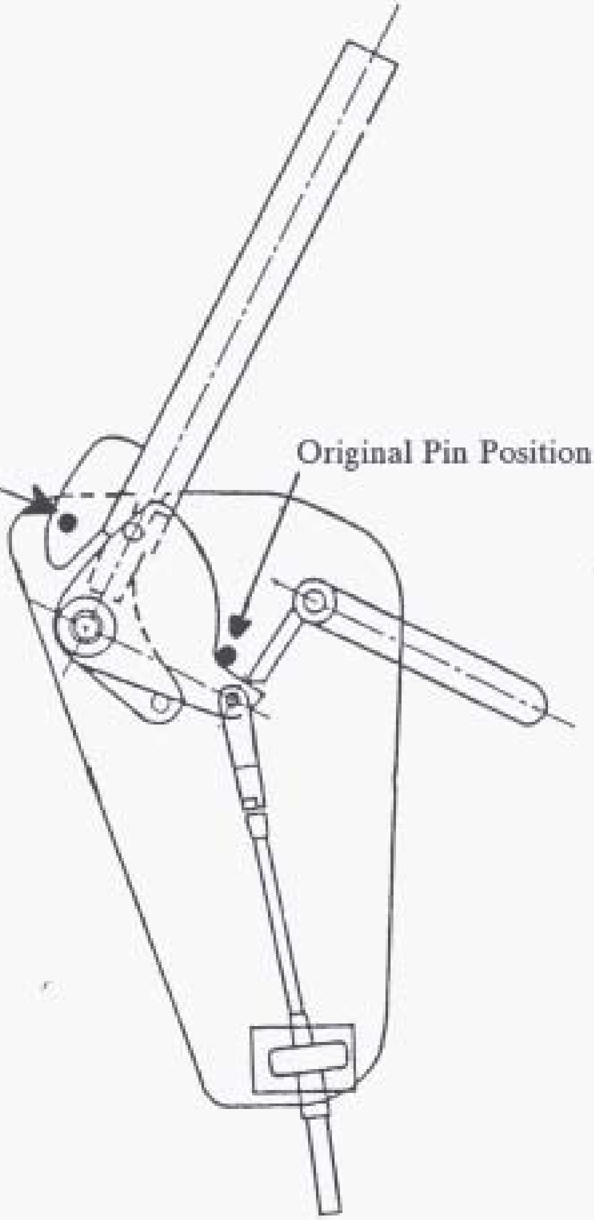
FIGURE 6

Aft hook side view cock position 90°

FIGURE 7

Release handle assembly pin fully home
(as found by Inspector)

FIGURE 8



Release handle assembly with modified safety pin location

Printed in the United Kingdom for HMSO
Dd300086 12/94 C4 G3397 10170