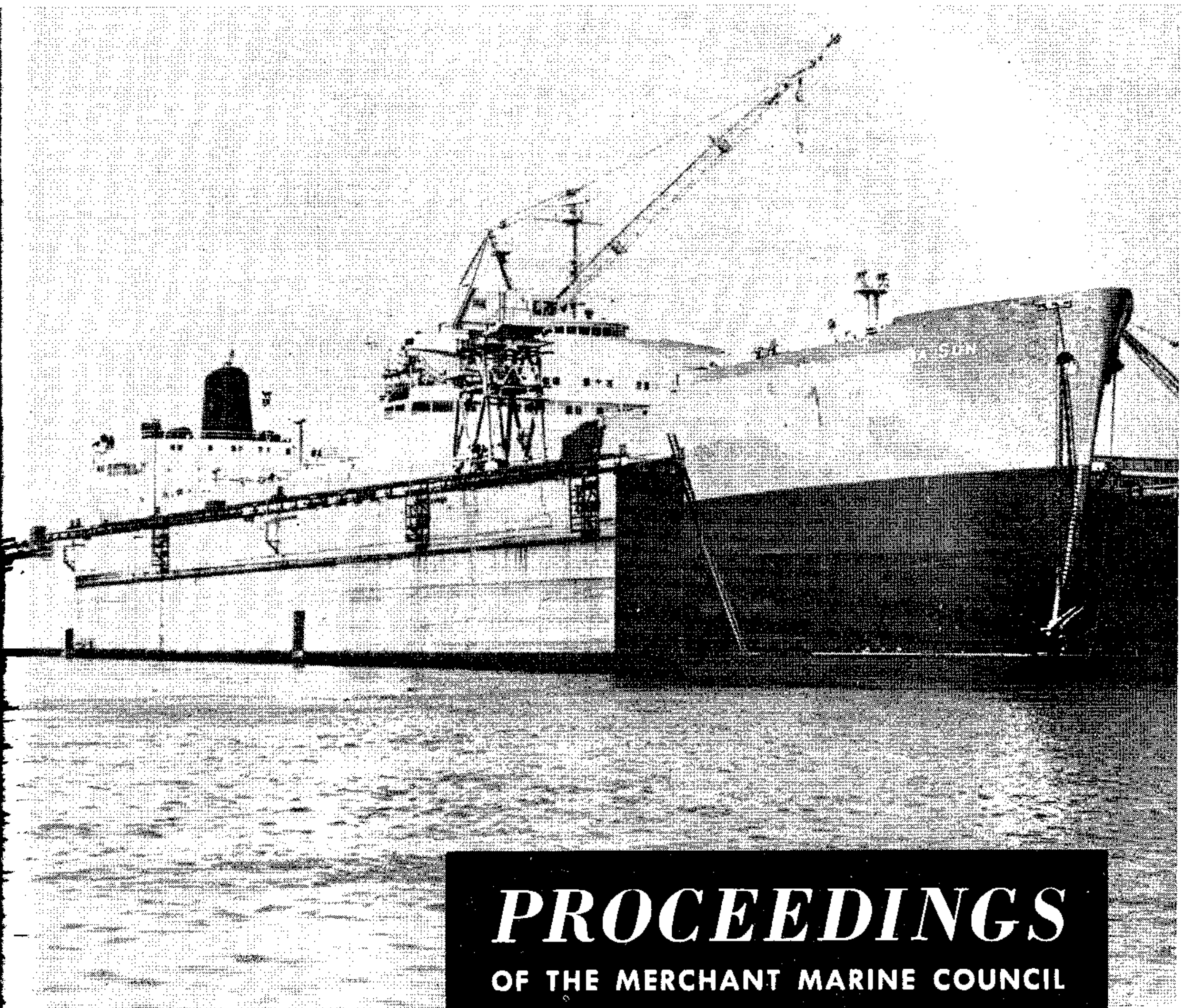
Features

LICENSED OFFICERS IN THE COAST GUARD

CORROSION OF TIN BASE BABBITT BEARINGS IN MARINE STEAM TURBINES



PROCEEDINGS

OF THE MERCHANT MARINE COUNCIL

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PROCEEDINGS

OF THE

MERCHANT MARINE COUNCIL

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CONTENTS

INTERNATIONAL LIFEBOAT RACE

OARSMEN FROM THE Norwegian liner *Stavangerfjord* won the 22d running of the International Lifeboat Race, held in the Narrows of New York Harbor last May.

The Norwegians, rowing with their customary snap and precision, covered the distance of 1 nautical mile in 10 minutes 47 seconds, some 4 boat lengths and 19 seconds ahead of their nearest competitor.

Second place went to the crew from the Esso *Baltimore*. Although last to get underway at the start, the *Baltimore* entry under the guidance of Coxswain Mike Sharik "leaned on their oars" and finished in fine style.

Third place went to the MSTS *Geiger* entry, followed by the Norwegian freighter *Havik* and the crew of the Islandic freighter *Dettifoss* in that order.

The Dutch *Westerdam* and the German *Berlin* were eliminated in qualifying races, and the *Black Heron* was unable to make port in time for the race.

Ansgar Johansen, winning coxswain, was ceremoniously tossed into the water by his victorious crew after crossing the finish line. This came as no surprise to Mr. Johansen who trained and coxswained winning crews in the 1953, 1957, 1959, and 1960 races.

In other events, a race between merchant marine academy crews went to the New York State Maritime College, with the U.S. Merchant Marine Academy second, and the Maine Maritime Academy third. Deck, engineroom, and steward's department crews from the New York City schoolship *John W. Brown* competed in a special ½-mile lifeboat race, with the deck department triumphing over their classmates.

The *Stavangerfjord* crew has gained one leg of the three needed for permanent possession of the Joseph W. Powell trophy which has been replaced as the perpetual symbol of victory by the second Millard G. Gamble trophy, a 37-inch-high silver cup.

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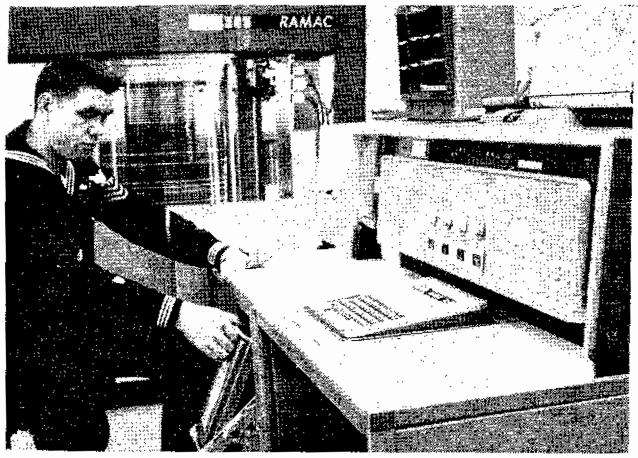
THE ROLE OF THE ELECTRONIC COMPUTER IN SAR

PHOTOGRAPH of the Rescue Coordination Center, New York. The magnetic wall chart is shown in the background.



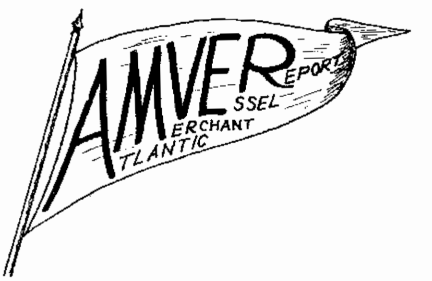
PHOTOGRAPH of the operator's console of the IBM 305 RAMAC electronic data processing machine in the AMVER Center, New York. The magnetic memory unit is shown in the background.

It is virtually certain that the complicated and sometimes hazardous job of retrieving persons from peril at sea will not be done by machines in the foreseeable future. However, the electronic computer does have a role to play in SAR—in fact, one type is now in regular use in the AMVER system. To understand its application one must first know the functions of the Coast Guard Rescue Coordination Centers.

The Rescue Coordination Centers were established by the U.S. Coast Guard to meet certain problems connected with action in emergencies. In particular, these Centers consolidate reports received from a great many sources by many different means of communications. The Centers have, for example, special telephones, teletype instruments with distant as well as local circuits, status boards, special charts on which to keep progress of action in SAR cases, and rapid communications with a Coast Guard radio station able to contact ships at sea as well as other Coast Guard units. The Centers as well as radio stations are manned on a 24 hour basis so that action in event of report of emergency will not be delayed. A Search and Rescue operation usually requires that a number of individuals and units be informed. The immense communications potential of a Rescue Coordination Center and the qualifications of its personnel make the Center far better adapted for rapid dissemination of accurate information than a ship already busy in rescue action.

Part of the Rescue Coordination Center function is to keep itself informed of the resources which may be available for assistance in emergency. Such resources include Coast Guard cutters and Coast Guard aircraft, and vessels and aircraft of other activities, often separated geographically and administratively. The information needed includes not merely numbers and types, but current status and current means of making contact without undue delay. For offshore emergencies, the assistance potential of merchant vessels already underway in the vicinity is extremely important, but due to the everchanging picture the potential is difficult to assess at the instant of a distress report. Here is a task which can be performed by electronic machines which have the capacity to produce selected portions of a tremendous data storage quickly.

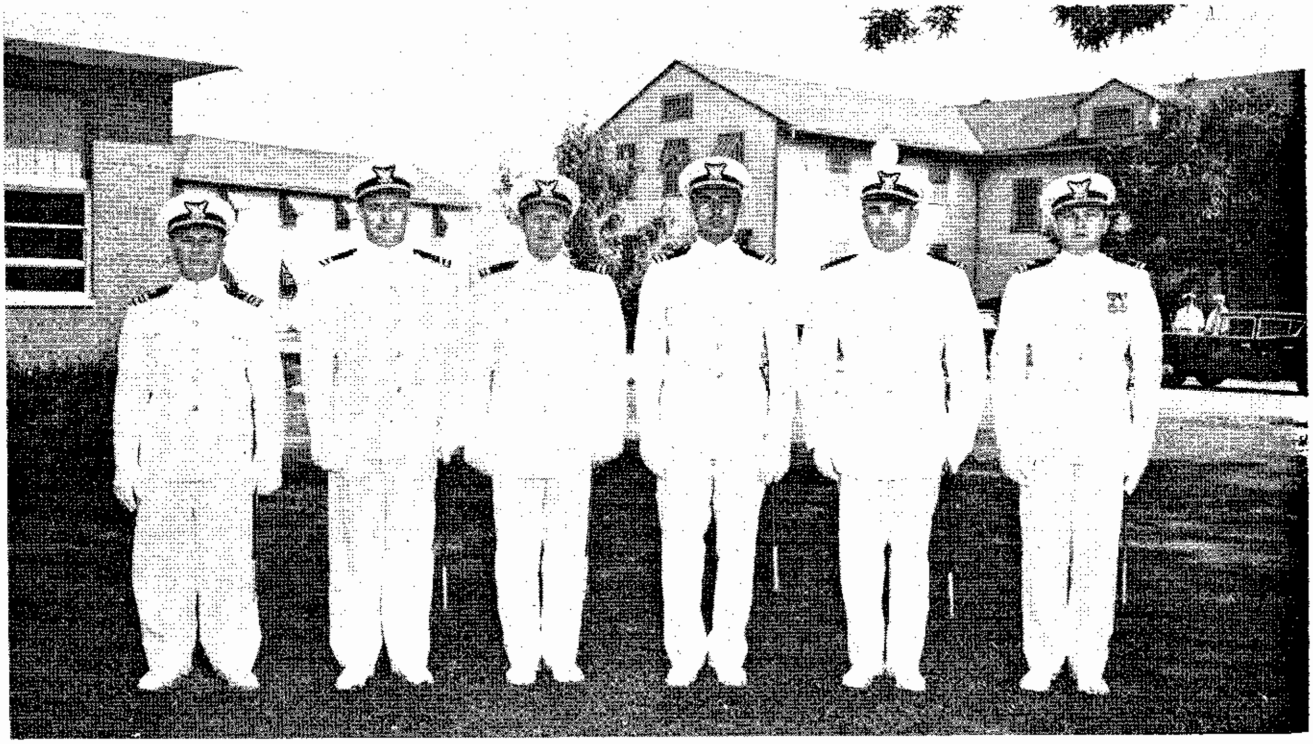
The computer in the AMVER Center in New York is an IBM 305 RAMAC which is well adapted to operational data processing. At this writing, some 16 items of probable interest in SAR for over 10,000 merchant vessels—160,000 items of information—are stored ready for instant access if needed. This data is collected from many sources and is continually brought up to date as new information is received. In addition, by means of movement reports voluntarily sent by thousands of merchant vessels when underway in the North Atlantic, the computer keeps current positions on nearly 800 different vessels underway at any time. The machine produces the identity by name and call sign, position, course and speed of merchant vessels in a selected area in minutes. By means of existing landline circuits this information can be delivered to any of five Rescue Coordination Centers from Boston to New Orleans as produced. Only a few more minutes are needed to pass such a listing to Rescue Coordination Centers in Newfoundland, Halifax, Bermuda and Puerto Rico.



As an example of the scope of machine operation in the AMVER Center, in one month the computer will hold plots on about 2200 separate vessels making 5000 passages. AMVER messages usually average about 320 daily with plots on some 750 to 800 vessels underway on the high seas. Approximately 50 vessels a month send AMVER for their first time. The total number of vessels having sent AMVER messages since July, 1958, when AMVER started, is nearly 6000. This is estimated to be about 60 to 65% of the actual traffic.

LICENSED OFFICERS IN THE COAST GUARD

(Public Law 219 Program)



A GROUP OF Coast Guard Officers who recently completed the Merchant Marine Safety Indoctrination course at Yorktown, Va. These officers entered the service from the Merchant Marine and hold licenses as indicated.

Left to right: LCDR A. T. Durgin (Ch. Engr.), LT H. B. Summey (Master), LT W. H. Simpson (Master), LT E. J. Sullivan, Jr. (Master), LTJG J. J. Wicks (Ch. Mate), and LTJG H. A. Rowe (Master).

Licensed deck and engineering officers of the U.S. merchant marine may qualify for appointment to and active duty in the U.S. Coast Guard as commissioned officers under the provisions of 14 U.S.C. 225(a)(5). This program was initiated, upon passage of Public Law 219 by the 80th Congress, on July 23, 1947.

Appointments are presently offered in the grades of lieutenant (junior grade) and lieutenant. Applicants must be male citizens of the United States, at least 21 years of age, in sound physical condition, and have served at least 4 years' sea time as a licensed officer, at least 3 years of which must have been served aboard commercial merchant vessels of the United States.

Grade determination is based upon age, license, and experience as follows:

● LIEUTENANT (Junior Grade)

Age—Must not reach 32d birthday in the calendar year in which application is accepted.

License—Chief Mate (unlimited): Oceans or coastwise; Master and First Class Pilot (unlimited): Great Lakes, western rivers, or other inland waters; or Second Assistant Engineer (5,000-or-more horsepower); First Assistant Engineer (2,000-or-more horsepower).

Experience—Four or more years' service aboard a vessel of the United States in the capacity of a licensed officer. Of this service, at least 3 years must have been served aboard commercial merchant vessels of the United States. Credit for up to 1 year may be given for service aboard public vessels of the United States. Service aboard public vessels, however, must meet the Coast Guard equivalency standards used to determine eligibility for a merchant marine license or a raise of grade.

● LIEUTENANT

Age—Must not reach 38th birthday in the calendar year in which application is accepted.

License—Chief Mate (unlimited): Oceans or coastwise; Master and First Class Pilot (unlimited): Great Lakes, western rivers, or other inland waters: or First Assistant Engineer (5,000-or-more horsepower); Chief Engineer (2,000-or-more horsepower).

Experience—Six or more years' service aboard a vessel of the United States in the capacity of a licensed officer, of which not less than 1 year must have been served as Chief Mate or First Assistant Engineer.

Two years of the six required may have been served aboard public vessels. Service aboard public vessels, however, must meet the Coast Guard equivalency standards used to determine eligibility for a merchant marine license or for a raise of grade.

An applicant who holds a degree from an accredited college, or who is a graduate of a Federal or State maritime academy, may substitute his degree, diploma, or certificate of completion for 1 year of the required 6.

Experience ashore as assistant port captain, assistant port engineer, marine surveyor, or comparable position may be substituted equally for up to 1 years of the required 6.

A combination of substitutions of education credit and experience ashore cannot serve to reduce actual sea service below the 4 years required by law. Credit for service aboard public vessels cannot reduce the required sea service aboard commercial merchant vessels below 3 years. Substitution cannot be made for the required 1 year's service as Chief Mate or First Assistant Engineer.

Applicants who fulfill the age, service, and license requirements are authorized to sit for a 3-day examination. An aptitude, psychological, English, and general examination covering the laws and regulations pertaining to the U.S. Merchant Marine plus ship construction) are required of all applicants. Deck officers are also examined in navigation and seamanship, while engineering officers are examined in marine and electrical engineering. These examinations are given at the larger Coast Guard Marine Inspection Offices on any 3 consecutive week days between 1 January and 30 September. A physical examination and personal interview before three Coast Guard officers usually is arranged at the time of the examination.

Completed applications are forwarded to Coast Guard Headquarters where a Permanent Examining Board selects qualified applicants three times a year, in April, July, and October. Successful applicants are normally tendered commissions shortly before the January convening date of the General Service School which is now located at Yorktown, Va. The purpose of this school is to train officers, commissioned from the U.S. merchant marine, in the basic elements necessary to perform duty as commissioned officers of the Coast Guard. The following topics are among those considered during 12 weeks of classroom instruction: Coast Guard orientation, navigation, communications, antisubmarine warfare, damage control, and Coast Guard engineering.

A tour of about 1 year sea duty aboard a major cutter follows this school. Coast Guard officers commissioned from the merchant marine find this sea duty invaluable in providing a sound foundation for their new career. It acquaints them with Coast Guard organization and administration; it familiarizes them with Coast Guard operations, communications, and supply; it teaches them Coast Guard customs, traditions, and usage. In short, this tour of sea duty provides an understanding of the Coast Guard as a whole which could not otherwise be obtained in so short a time.

Returning ashore, the next assignment is to a 3-month Merchant Marine Safety School, also located at Yorktown. The objective of this school is to train officers in the basic elements necessary for assignment to duty in a Marine Inspection Office. Classroom instruction includes the following topics: Marine inspection history and laws, merchant marine investigation and revocation proceedings, licensing and certificating of merchant marine personnel, passenger vessel regulations, tank and cargo vessels regulations, marine and electrical engineering regulations. Approximately 26 hours of practical hull and boiler vessel inspection procedures are scheduled.

Upon completion of this training, assignment is made to one of the larger Marine Inspection Offices. As general duty officers, men commissioned from the merchant marine may expect assignment to both sea and shore duty. However, a majority of all assignments may be expected to be within the field of merchant marine safety: Material inspection, licensing and certificating of merchant marine personnel, shipment and discharge of seamen, and investigations of merchant marine personnel and marine casualties.

A brief sketch of the Coast Guard careers of two former merchant marine officers, one deck and one engineering, depicts some of the typical training and duty officers appointed under this program may expect.

CAREER I

Upon graduation from the U.S. Merchant Marine Academy, Kings Point, N.Y., in 1947, this officer served 6 years on his license. Although eventually holding a master's license, his most senior experience was as a chief mate. At the age of 26 he applied for a commission in the Coast Guard under the provisions of 14 U.S.C. 225(a)(5) and was appointed as a lieutenant, junior grade, in 1953.

Initial assignment was to the General Service School, then located at New London, Conn. Upon completion of the course, he was then assigned to the Coast Guard cutter *Mendota* out of Wilmington, N.C. During his brief 10 months on the *Mendota*, he served as operations officer and navigator while the ship manned four Atlantic Ocean stations. Before being rotated ashore, he served as acting executive officer for 2 months and accompanied the ship to the Coast Guard yard and underway training in Chesapeake Bay.

While awaiting assignment to Merchant Marine Safety School, he spent 2 months in the district office in Norfolk where he was briefly instructed in various Coast Guard duties. At the school, a review of Federal regulations concerning merchant ship construction, licensing and document requirements, and other regulations enforced by the Coast Guard were studied in preparation to assignment in the field of marine inspection. Orders were received directing him to the Marine Inspection Office, Philadelphia, where he remained about 6 years. The first 2 months were spent in a commercial yard as a hull inspector, followed by a year and a half in licensing and examining at the Marine Inspection Office. He returned to the waterfront as hull inspector and was then assigned to marine investigation duties. This officer is currently assigned to duty at Coast Guard Headquarters in Washington, D.C., where his work involves the development of a new series of license examinations for the merchant marine.

CAREER II

Having served in the merchant marine service for almost 16 years, 11 of these as a licensed officer, this officer held a license as chief engineer when he entered the Coast Guard as a lieutenant in 1956.

After the initial assignment to the General Service School (where he became acquainted with Coast Guard organization, duties, law enforcement, communications, seamanship, and navigation), he was assigned to the Coast Guard cutter *Pontchartrain* out of Long Beach, Calif., where he served as assistant engineer and damage control officer. His first feeling was that this assignment was "ridiculous" after 11 years service as a licensed engineer, but he now looks back on those 9 months as being by far the best way to learn the Coast Guard system of operations and organization. While attached to the *Pontchartrain* he was boat officer, in charge of the boat which rescued survivors from a ditched airliner. A brief 2 weeks' assignment at the district office in Long Beach preceded attendance at the Merchant Marine Safety school. He looks back on this school as having provided excellent instruction, particularly in those areas which were relatively unfamiliar to a licensed engineer.

This officer was also assigned to the Philadelphia Marine Inspection Office, and spent 2 years on shipyard, waterfront, and factory inspection duty. His third year at Philadelphia involved investigation work prior to his transfer to Washington, D.C., and further duty related to merchant marine inspection.

Both officers are now married and have young children. In discussing

(*Continued on page 198*)

CORROSION OF TIN BASE BABBITT BEARINGS IN MARINE STEAM TURBINES

By J. B. BRYCE and T. G. ROEHNER

DEFINITION OF THE PROBLEM

EARLY IN 1957, in the course of a routine survey of a main engine of a large passenger liner, turbine and gearcase bearings were inspected and it was noted that the majority were covered with a hard black scalelike substance which had in some cases broken away leaving a patchy appearance. It was decided to remetal all the affected bearings and section samples were obtained for detailed examination. Some 12 months previously the main thrust bearing on this engine had failed at sea, the reason not being ascertained; its failure and the conditions subsequently found on the engine bearings were not connected at this time.

The changed nature of the bearing surface was not immediately identified, but preliminary investigation on a sample of the metal showed that the working surface was approximately seven times harder than that of the reverse side; a Vickers hardness number of 210 being found as compared with a Vickers hardness number of 33. Industrial experience suggests it is not possible to work-harden white metal to this extent.

The composition of the metal in use was stated to be 85.5 percent tin, 6 percent copper, and 8.5 percent antimony, although subsequent analysis showed the copper content to be 8.05 percent, antimony 8.5 percent, and the balance tin.

The Chemical Engineering Department of the Imperial College of Science and Technology and the Tin Research Institute were consulted. The Imperial College expressed the opinion that of the known constituents of the alloy, the only substance likely to be present that could give such a high degree of hardness would be tin oxide. Subsequently they and others confirmed the presence of stannic and stannous oxide by X-ray diffraction techniques. The Tin Research Institute expressed the opinion that the presence of water was essential for this form of corrosion. Figure 1 shows a photomicrograph illustrating that the tin oxide layer is of the order of 0.010 to 0 012 inch thick, and it should be noted that this is not simply built up on the bearing surface, but also reflects a penetration of the white metal by the corrosive attack.

Mr. Bryce is Chief Engineer, Marine Trade Department, Mobile Oil Co., Ltd. Mr. Roehner is Manager, Technical Service Division, Research Dept., Socony Mobile Oil Co. This article is extracted from a joint paper presented by these gentlemen before a recent meeting of the Institute of Marine Engineers in London, and is reprinted in the Proceedings because of its informative value for marine engineers. Due to space limitations several graphs and pictures present in the original paper, together with a comprehensive description of the tests employed, are omitted. It is hoped that this will not materially diminish the reader's appreciation of this work.—Ed.

Also, only the tin-rich matrix of the white metal is attacked, the other alloy constituents (SnSb cuboids—Cu_6Sn_5 particles) being unaffected, their distribution in the attacked layer being virtually the same as in the base metal.

In 1958 the main thrust bearing of another engine on board this particular vessel failed at sea. It was then considered as probable that the presence of tin oxide on the bearing surface was connected with these failures, the theory being that patches of tin oxide broke away from the face of the thrust pads, became trapped in the lubricating oil wedges, and thereby caused overheating leading to failure. All evidence was naturally destroyed in the failed bearing as the white metal was completely run out but subsequent examination of other bearings in this engine showed them all to be affected and obviously a full-scale investigation was required if the phenomenon was to be understood and corrective measures taken. This necessitated:

1. The establishment of significant and repeatable laboratory test procedures to study the factors involved in the formation of tin oxides.
2. An appraisal of operating methods and practices on board a wide selection of ships. To this end a questionnaire was drawn up covering methods of operation and details of ships' lubricating oil systems.
3. A survey to determine the extent to which this problem was of consequence.

PRELIMINARY INVESTIGATION

Investigations were begun, and as far as laboratory corrosion tests were concerned, it quickly became apparent that there were considerable difficulties in producing significant and repeatable patterns of corrosion, as seen on affected bearings, in a reasonable period of time. Ship examina-

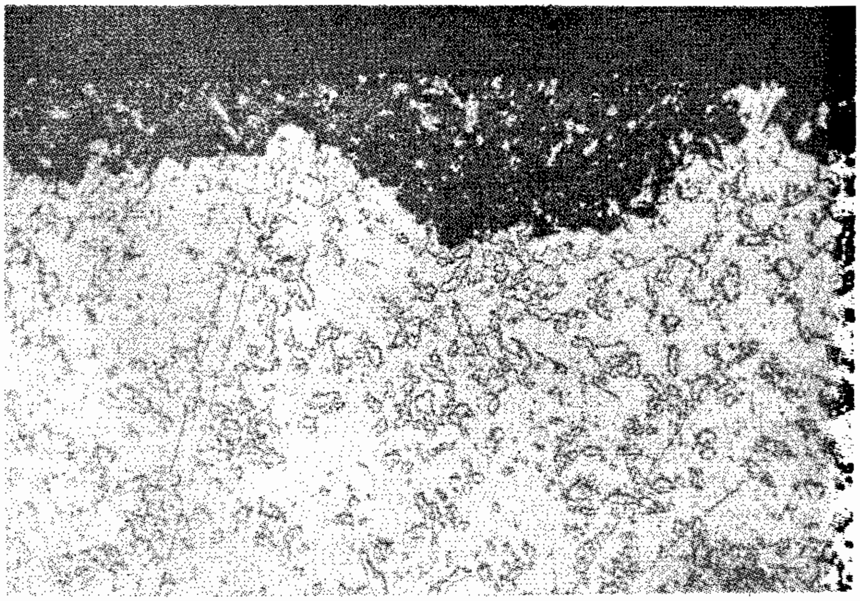


Figure 1.—Section through a typical corroded bearing (× 100 magnification).

Figure 2.—Sludge deposits in pipelines.

ons and reports indicated that only very small percentage of vessels ere affected and that the phenomeon was not confined to any one type f vessel, service, or lubricant. In all ases the ordinary routine laboratory ests on oil samples from the lubriation systems of affected vessels howed no unusual characteristics.

From these examinations varying egrees of corrosive attack were idenfied. In the early stages the bearngs affected lost their normal sheen nd a matt appearance developed. ubsequently spots or bands, brown r gray in color, were observed which entually became black, spreading the entire surface of the bearing. t later stages metal flaking occurred, hich gave rise to the patchy apearance referred to earlier. Isolated atches are first observed generally n the relieved portions of the bearing t the horns or grooves, and only after he corrosion has developed and pread through the unloaded area is he loaded portion finally affected. imilarly, in thrust pads it has been oted that corrosion commences from he leading edge. Corrosion can be onfirmed in a practical way by its haracteristic of being difficult to enetrate or cut with a knife. In all stances the steel journals and thrust ollars were smooth and completely naffected.

In the course of the ship investigaon, a failed bearing from an induced raught fan, where failure was due oil starvation, was experienced. l circulation was by a pump driven the unit itself, resulting in boundr lubrication conditions during artup and shutdown. Laboratory examination confirmed that the hard blackened areas on the white metal were stannic oxide, this being of interest for it is known that stannic oxide may be formed by direct oxidation at high temperatures as obtained under boundary lubrication conditions.

Complementary to the ship investigation, efforts were made to determine whether corrosion of tin babbitt bearings had been encountered in areas other than the marine turbine field. In this connection, bearings of seven large steam turbine generators in six generating stations using oils of the same family as the affected ships, chosen for their proximity to coastal and estuarine waters, were examined but none showed any evidence of corrosion. At a later date it was found that corrosion had taken place in a few land power stations with which the authors' company had not been concerned.

Of the 900 steamships lubricated by the particular family of oils with which this paper is concerned, only 4 cases of corrosive attack which necessitated replacing bearings were observed. Forty-eight vessels, 30 passenger or cargo, and 18 tankers were selected and critically examined, and 16 were found affected in varying degree. In addition, corrosion has been noted on 14 vessels with which the company is not associated. There can be no doubt, therefore, that this is an overall industry problem.

In two vessels examined, the main thrust block was independently lubricated and the thrust pads in each case were entirely free of any attack, while corrosion was noted in the main engine systems.

Tunnel bearings which are lubricated by ring oilers from their own sumps use in certain cases used oil drawn from the main engine circulating system. On examination such bearings showed no evidence of corrosion.

Therefore, it is evident that corrosive conditions are contained within the limits of the main engine circulating systems.

Four oils are considered; a 400-second dual-inhibited turbine oil, a 600-second dual-inhibited turbine oil where the high-temperature oxidation inhibitor is used in five times the concentration of oil A, a 400-second dual-inhibited turbine oil with the addition of an extreme pressure additive and a 300-second oil to the same formula as the first oil. There was no correlation between the incidence of corrosion and these oil types.

OPERATING PROCEDURES ARE IMPORTANT

The importance of operating and maintenance procedures is to be noted. Tankers which, except for survey periods, normally maintain their lubricating oil in continuous circulation with the centrifuge always in operation, do not appear to be as prone to corrosion. In no case was it necessary to replace any bearings apart from one selected for laboratory examination. Of the 18 tankers examined, only 4 showed corrosion as against 15 out of 30 passenger and cargo ships.

The indications are that when corrosion conditions exist, thrust bearings are attacked before turbine journal and gearcase bearings. Referring to 40 of the ships which had both thrust and journal bearings examined, it was found that 10 showed thrusts affected with journal bearings normal, 10 showed both thrust and journal bearings affected, and 20 showed both thrust and journal bearings normal.

While no direct correlation can be claimed between these failures and the problem under discussion, it is noted that thrust bearings are more prone to failure than journal bearings, and that the incidence of bearing failure at sea for unknown causes is very low. Within the authors' knowledge there has been no bearing failure at sea directly attributable to this type of bearing corrosion, the two main thrust failures mentioned earlier, where all evidence was destroyed, being the only cases where it was conjectured that this had occurred.

THEORIES AS TO CAUSE OF CORROSION

This problem gave rise to many and varied opinions and theories as to its probable cause. It may, therefore, be

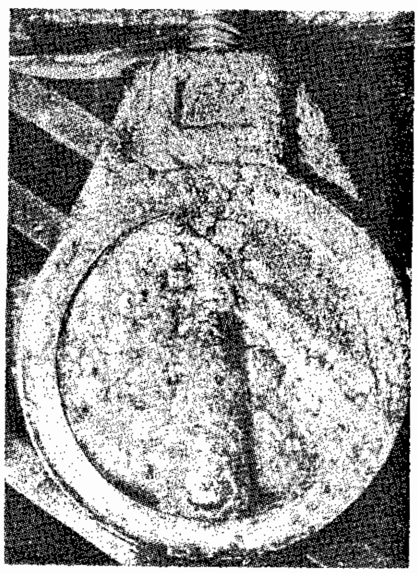


Figure 3.—Sludge deposits in oil cooler valves.

of interest in this section to deal with those which were answered as data were gathered from the ship investigations.

As in one large liner, corrosion was noted in the bearings of an auxiliary turbogenerator where the steam system was common with the main engines, but with the lubricating oil supplied from another source, steam conditions were considered. Firstly, the possible effects of ferric chloride when used in conjunction with sea water evaporation was investigated, but the chances of this material being carried over through feed water and steam and eventually reaching the bearings were remote and the idea discounted. The nature of this material is such that had carryover occurred, other metallurgical problems would undoubtedly have arisen and no trace of ferric chloride was ever found. The materials used for boiler water treatment were so common among ships which were not experiencing any difficulties that this factor was also discounted.

No significant difference in ship operating procedures was revealed between affected and unaffected ships. However, from observations it became apparent that in a number of cases, lubricating oil centrifuge treatment was not being carried out correctly, varying from treatment at too low a temperature and at too high a rate to, in an extreme instance, reluctance to operate the centrifuge at all except while in a terminal port.

Another aspect considered was the influence of soakback heat, particularly after shutdown in port when oil circulation is stopped. It was evident that as corrosion occurred in main thrusts which were not in any way involved in high-temperature soakback, corrosion as a result of temperature alone could not be considered.

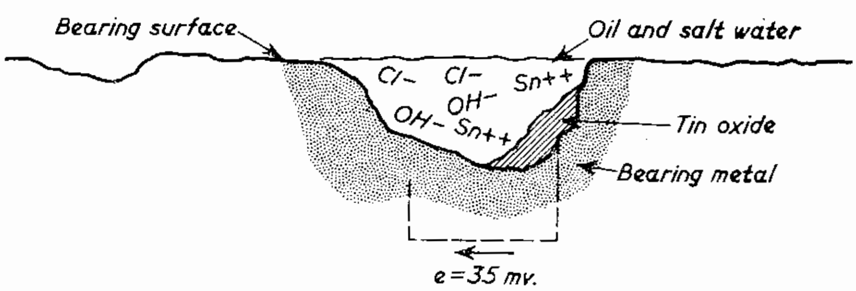
In passing it should be pointed out that with the trend to increased steam temperatures and pressures, longer periods of oil circulation after machinery is shut down are becoming increasingly necessary.

The theory was advanced that due to soakback heat, acidic vapors were formed in the bearing clearance spaces with resultant metallic attack, as the observed pattern had indicated that the part of the bearing last to be affected was that shielded from the gaseous phase. Therefore, samples of vapor were drawn from a gearcase in one of the affected vessels almost immediately after the ship had docked. Gas chromatography and infrared analysis failed to reveal the presence of low-molecular-weight organic acids, and hydrogen sulfide also appeared to be absent. This work also discounted a theory that the ingress of sulfur dioxide from funnel gases drawn into the engineroom was significant.

Specific measurements were made for stray currents in the engineroom of a large passenger liner during a routine voyage, but these were found to be nonexistent.

Tests were made for the presence of bacteria in samples of lubricating oil from an affected vessel and these were negative.

While samples of lubricating oil obtained from all the ships under review had consistently showed no abnormal variations, it was surprising to note the condition of the lubricating oil system in several cases after examinations had been carried out at the owners' suggestion and the authors' presence. On the older ships, considerable amounts of sludge were evident, particularly in areas where the oil changed direction and in some of the larger diameter circulation pipes. Sludge is an emulsion consisting of chemical salts, iron oxides, oxidized turbine oil, and water, and there is a normal inherent variation in its composition. Examples of such deposits can be seen in figures 2 and 3. These deposits were viewed with considerable suspicion as there appeared to be a direct correlation between the amount present and the intensity of the attack.



The electro-chemical action is expressed by

$$(Sn^{++}) + (OH^{-}) + (Cl^{-}) \rightarrow (Sn)(OH)(Cl) \rightarrow SnO$$

Figure 4.—Corrosion of tin-babbitt bearings.

LABORATORY INVESTIGATIONS

Answers were sought to the fundamental processes involved in the corrosion of tin by the formation of stannous and stannic oxides, and the importance of various factors and theories posed by the marine industry and the authors' company which may be summarized in the following questions:

1. Does the composition of the tin-base babbitt have any effect?
2. Are modern refinery techniques, specifically solvent extraction of lubricating oil stocks, responsible? This question was raised because it was considered that changes in the manufacture of the base stocks, as well as the inclusion of additives, differentiated present oils from conventionally refined straight mineral oil.
3. Are the lubricating oil additives the cause? This question was posed because it was believed that no similar trouble had been experienced when using nonadditive oils.
4. Are sludge, rust, and water, particularly sea water, the cause? The status of water washing of turbine oils, operation of centrifuges, and related procedures were directly involved in this question.
5. Are stray currents or electrolysis the cause?
6. Are high-bearing temperatures the cause?

CHEMISTRY OF TIN AND ITS OXIDES

Knowledge of the fundamental reactions of tin is essential to the understanding of the corrosion mechanism of bearing white metal, which is composed of some 85 percent tin, with the balance consisting of copper and antimony. In metallurgical terms the matrix is composed of tin in which are embedded intermetallic compounds of antimony-tin and copper-tin. These can be readily defined and identified by metallographic and X-ray examinations.

In aqueous media containing salt or suitable electrolyte, tin is capable of forming tin ions in solution. Water and dissolved oxygen provide a source of the hydroxyl radical. Likewise, a salt solution is always ionized to give sodium and chloride ions. Finally, tin is normally reactive to oxygen and forms oxides in the form of very thin surface films that are difficult to detect by X-ray. However, a heavy layer can form under high-temperature conditions. Tin ions can readily react with hydroxyl or chloride ions leading to the formation of tin oxides by one of several processes.

ELECTROCHEMICAL CORROSION MECHANISM

These equations are simplified, yet are basic in defining the step-by-step formation of a corroded bearing surface. The following concepts are also of importance:

1. Tin oxide is always present on the surface or in microscopic interstices of the bearing from thin film oxidation.
2. Tin as the matrix compound is present.
3. Tin is anodic to tin oxide, and with an electrolyte present, tin will corrode preferentially to tin oxide with the resultant depletion of tin from the matrix as tin ions, and the sustained release of electrons. Laboratory experiments have confirmed this information and a measured potential of 35 mv was obtained. This electron flow is the driving force for sustaining the ionization of tin.
4. In a dynamic bearing system, microscopic surface deformation can provide localized areas where the corrosion reaction can proceed, as depicted by the schematic diagram, figure 4.
5. The factors which contribute to these phenomena and primarily control the rate of reaction are as follows:
    a. Surface discontinuity;
    b. Concentration of electrolyte;
    c. Temperature; and
    d. Stresses within the bearing metal.

The mechanism described in the preceding discussion should have the following results:

a. Tin is depleted from the bearing metal matrix, leaving the intermetallic compounds relatively unaffected.

b. Oxides of tin are formed.

c. Oxides of tin and other debris (some bearings showing a considerable amount of iron oxide embedded) are compacted into pits, resulting in a thin, hard film.

d. When this film reaches a critical thickness, which will vary according to bearing dimensions, it will crack and break away and general disruption of the bearing surface occurs.

X-ray diagrams show the substantial depletion of tin from the surface, the presence of stannous and stannic oxides, the intermetallic compounds unchanged in composition, and the absence of other reaction products of the bearing metal. These points are representative of numerous X-ray patterns obtained on the corroded or surface-hardened bearings available from ship investigation. The only additional material identified in the X-ray analysis was iron oxide in the case of bearings which had developed a notable, black scale and progressed to the flaking or peeling stage. The iron oxide, from migrating sludge, has apparently been compacted into the bearing surface, along with tin oxides, since no evidence of shaft pitting or rusting was found.

X-ray diffraction patterns on a typical affected ships' bearing show a major loss of tin, large amounts of tin oxides, and large residual amounts of unattacked copper-tin and antimony-tin intermetallic compounds in the effected areas, which appeared uniformly darkened and hard to a knife blade. In the soft, i.e., normal, babbitt surface areas of the same bearing there was only a very slight indication of tin depletion from the surface and no more than a minute trace of tin oxides.

A diligent search failed to disclose any appreciable information on the corrosion of tin in an oil medium. Available information deals practically entirely with aqueous corrosion and can be summarized as follows:

Although theoretically from its position in the electromotive series, tin should be an active metal, practically, it appears to be highly resistant to corrosion. This is explained by the fact that a thin, mono-molecular layer of tin oxide rapidly forms on the surface, and since it is quite adherent and inactive, it effectively prevents any further corrosion as long as its continuity is not chemically or mechanically disturbed. Oil by itself is not corrosive to tin, and corrosion can only occur in the presence of water. Temperature, presence of oxygen, various salts, and acids all accelerate the rate of corrosion.

Therefore, in devising static and dynamic corrosion tests for lubricating oils, it was necessary to assure the presence of moisture and adopt temperatures and oxidation conditions that would be reasonable as compared to turbine operation. At the same time, conditions had to be severe enough to give some acceleration to the mechanism, but not so severe as to introduce side reactions not pertinent. In addition, it was felt necessary to investigate the corrison in both the liquid and vapor phases. Further, since it could be expected that some of the corrosion reactions might form products other than tin oxides, which could cause darkened surfaces, it was decided that X-ray analyses must be used to verify the end product on the babbitt test coupons and thus keep the investigation in the areas indicated by the condition found on ships' bearings.

Tests which did show some babbitt surface reaction, but did not duplicate the tin depletion and tin oxide make, without appreciable attack on the intermetallic compounds characteristic of the phenomenon, were quickly discarded.

EFFECT OF BEARING ALLOY COMPOSITION

Metallurgical studies of the composition of the tin babbitt alloys involved, and metallographic studies of the structure of bearing metal matrix, failed to show that either the type of alloy used or its specific structure are major factors in this problem.

EFFECT OF LUBRICATING OIL

The belief was expressed that this bearing problem was related to modern methods of refining and stock oils. A particular effort, therefore, was made to determine the behavior of representative mineral oil stocks. As a result of extensive testing and analysis, it was indicated that oil composition and additive treatment can have an appreciable influence on the oxide make in an accelerated laboratory test.

INFLUENCE OF ADDITIVES

The utilization of a high-temperature antioxidant was the cause of considerable concern and question. As a result of tests and correlation of data therefrom, it was noted that while this additive did not promote or accelerate corrosion, neither did it wholly prevent corrosion and these test results indicate that it has some ability to protect tin from corrosion.

An investigation of the effect of inhibitors in oil indicates that neither the rust inhibitor, the low-temperature oxidation inhibitor, nor the complete additive mixtures promotes the formation of tin oxide, even at 10 times their normal concentration.

EFFECT OF WATER, PARTICULARLY SEA WATER, AND RUST

Testing to confirm the influence of sea water on babbitt corrosion showed that increasing concentrations of sea water produce increasing rates of corrosion.

Corrosion also occurred when a slurry of rust and distilled water was tested, the action of the rust in accelerating the attack on tin being quite marked. Rust is a major constituent of sludge in a ship's system arising from, among other sources, moisture condensation on areas not swept or covered by the oil.

Several of the affected bearings had shown the presence of iron oxides which had evidently been carried in the lubricant stream, deposited and

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compacted into the bearing surface. This rust, in contact with bearing metal, would increase the oxidation of tin and thus the formation of tin oxides.

There are indications that rust can function as a donor of oxygen to tin in acidic conditions, and thus promote corrosion. Further, rust acts as a colloid which binds water and holds various electrolytes by absorption. Thus it serves to bring such corrosive elements in close and prolonged contact with tin and be at least partly responsible for the destructive action of sludge on the bearing matrix.

WATER CONTAMINATION

Consideration was therefore given to the whole background of water contamination of marine turbine lubricants.

In prewar steam turbine installations, gland-sealing arrangements were such that considerable amounts of condensate contaminated the lubricant, thus having an involuntary water washing effect; many ships operated with appreciable amounts of water in the lubricating oil charge. In addition, prior to the introduction of additive-type turbine lubricants, water washing at the centrifuge was a general marine industry practice. It was necessary to water-wash these straight mineral oils to avoid the presence of water-soluble organic acidity and the attendant problem of attack on metals in the systems.

During the last war and immediately afterwards, there was a rapid change in the service conditions imposed on the lubricating oil by improved turbine design, due to the increase in steam temperatures and pressures and also by the more common use of pressure lubricating oil systems. In the latter regard, the consequent reduction of the quantity of oil in circulation, taken with the fact that a turbine oil broadly acts 75 percent as a coolant, led to an increase in the severity of heat/oxidation conditions imposed upon the oil. As the oxidation rate of a hydrocarbon oil doubles for each rise of approximately 18° F., it became necessary to increase the stability of the lubricant by improvement of the base oil specifically by solvent extraction and the introduction of oxidation and rust inhibitors. In the laboratory and on board ship, evaluation of the new oils showed that the formation of organic acidity could be regarded as virtually eliminated as far as the oil was concerned for the lifetime of the turbine. Experience confirmed that this was due not only to the action of the inhibitors but also to the enhanced stability of the solvent extracted base oil. The rust inhibitor functions by preferential absorption on the metal surfaces, and by its nature also has an affinity for water-oil interfaces. These factors were appreciated and led to the recommendation to discontinue water washing, a decision adopted and recommended by ASTM after extensive field and laboratory experience.

It has been suggested that these new additive oils do not separate so completely and as readily from water as the older straight mineral turbine oils. Under certain laboratory test conditions developed for use with the older oils, this may occur on samples of used oil from ships' systems. However, in recognition of the limitations of these test methods, it should be pointed out that it is now an accepted practice not to demand or expect equivalent demulsibility test results on used oil as compared to new. There has been no experience of any evidence of an oil of the group under discussion ever forming a stable emulsion in service.

During the immediate postwar period, improvements to turbine gland design, together with the introduction of gland steam evacuation (some older ships being modified in this regard), considerably reduced the ingress of condensate and thus incidental water washing was minimized. In addition, because of a ship's environment, from time to time inadvertent contamination of the lubricating oil with sea water could be anticipated.

WATER WASHING

A question that naturally arises when water washing is advocated, is the possible depletion of the rust inhibitor. From past and current work, the authors incline to the view that additive depletion by water washing is not so rapid as heretofore believed. Water washing with the addition of 5 percent of the total centrifuge throughput at 50 percent of its rated capacity which is enough for the removal of electrolytes, should remove so little additive that normal makeup would maintain an adequate balance in a lubricating oil system. This assumes that excessive water contamination does not occur and that the system is free from accumulations of sludge and rust which would absorb the inhibitor.

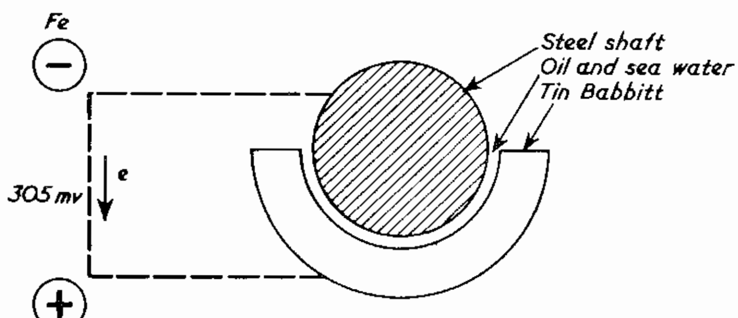
A laboratory study to reassess the effect of water washing on the rate of additive removal was undertaken and is summarized as follows:

In one series of tests, consecutive batch contacts were made at 180° F. with 5 percent and also with 50 percent of water, with representative areas of clean steel, copper wool, and rusted steel wool.

In another test designed to simulate actual operation, water was continually added to 400-second dual-inhibited oil in a Vickers pump circulation system and a portion of the oil/water mixture bypassed through a De Laval centrifuge. Before centrifuging, additional water was added at the rate of 5 percent of the flow through the centrifuge.

a. After some 50 extractions with 5 percent water, sufficient rust inhibitor was removed so that the oil failed in the ASTM rust test using synthetic sea water. After 40 extractions with 50 percent water, failure occurred in the less severe distilled water version of the ASTM rust test.

b. Virtually all of the inhibitor must be removed before failure occurs in the ASTM rust test with distilled water. In the Vickers pump test, which is a continuous purification test, borderline failures began to ap-



The corrosive action is expressed by

$$Fe \rightarrow Fe^{++} + 2e,\ O_2 + H_2O + 4e \rightarrow 4OH,\ Fe^{++} + 2OH \rightarrow FeO + H_2O$$

Figure 5.—Iron anodic to tin.

pear at a point approximately equivalent to 300 contacts with 5 percent water, and the margin of failure was not appreciably greater when the test was extended to 1,500 contacts.

EFFECT OF SLUDGE

Demonstrations in other laboratories than those of the authors' company pointed to the critical role which sludge plays in babbitt corrosion. Its use as a contaminant in some of the tests outlined confirmed this work.

EFFECT OF STRAY CURRENTS

Investigation on some affected ships showed the turbines were safely grounded, with no indication of stray currents. However, questions regarding the possibility of electrolysis having been raised, a review of the pertinent literature and previous experience with electrolysis in lubricant systems was made.

Studies have been made concerning the influence that equilibrium potentials of iron and tin may have on the corrosion phenomena. In this regard, iron is anodic to tin and, as a result, iron will corrode as illustrated by schematic bearing drawing, figure 5. In the event of stray currents, where iron remains anodic to tin, the same reactions will occur at an accelerated rate. In such a situation, the shaft would show pits from corrosion, which, however, have not been observed and this possibility must be discounted.

It is possible to have a reversed potential where tin is anodic to iron which causes the situation depicted in figure 6 if the following conditions are satisfied:

The normal iron-tin potential be reversed by an applied electric voltage which must be greater than 305 mv to sustain the electron flow counter to the normal potential. If this occurs, then tin ions are formed, with the subsequent formation of tin oxide, and these conditions also lead to pitting of the shaft. Further, this situation leads to a characteristic pitting of the tin babbitt which it is stated is easily recognized by the pits formed having a smooth, shiny, melted appearance.

As previously stated, actual stray current measurements made on board ship have all been one-tenth or less of the voltage required to sustain the reaction shown in figure 6, and since no conditions as described have been observed, it is thus concluded that it is not a part of the problem.

The electrolytic mechanism was investigated in the laboratory using tin babbitt-iron cells with sea water and with water-oil emulsions. With and

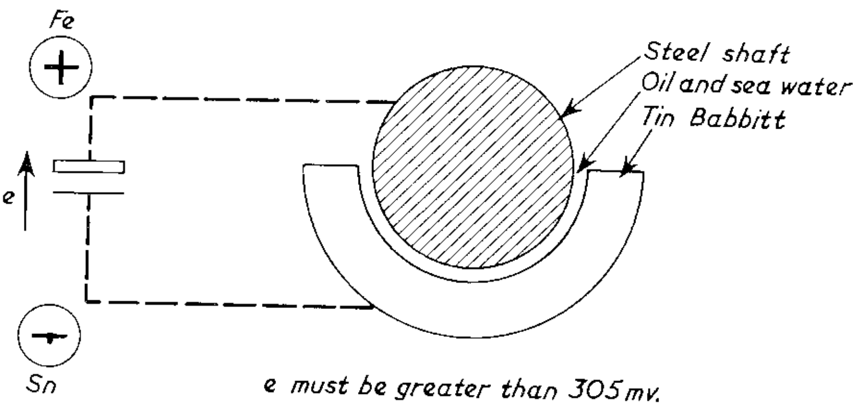


Figure 6.—Tin anodic to iron.

without impressed voltage, the reactions went exactly as outlined. These experiments were made with simple cells as well as electrified bench tests such as the 10-drop test and the dynamic corrosion test. It is also significant that in all cases of electrolytic corrosion where tin was made anodic by impressed voltage, the oxide formed was predominantly stannous, with very little stannic oxide. Examination of ship bearings revealed the reverse; that is, stannic oxide predominated.

INFLUENCE OF HIGH BEARING TEMPERATURES

Earlier, equations are given showing that tin will react directly with oxygen to form stannous and stannic oxides. In a laboratory test, when a steel shaft was run on a babbitt bearing without lubricant, large amounts of tin oxide were easily formed, due to the excessively high local temperatures evolved. Similar conditions may prevail under boundary lubricating conditions which may be momentarily encountered on startup and shutdown of turbine machinery, and in other cases, more frequently, as discussed in relation to the bearing failure, on the induced draught fan where the unit drove its oil circulation pump. It is well known that any increase in temperature will increase the rate of electrochemical reactions and, therefore, high temperatures will increase the rate of tin oxide formation.

SHIP RESEARCH PROGRAM

As a result of this laboratory work and ship investigation, the authors had now arrived at the following interim conclusion.

Tin babbitt corrosion was considerably influenced by three things—water, dissolved salts in the water; i.e., electrolytes, and sludge. Therefore, as a next step at the beginning of 1960, a research program covering five ships, the first four of which were experiencing bearing corrosion, was initiated. The program called for periodic bearing inspections and analyses of samples of oil, water, and sludge from the lubricating oil systems, and study of the effect of water washing the lubricating oil at the centrifuges.

Reference bearings were selected and examined initially, and at subsequent reexaminations during the year it was observed that there had been a pronounced improvement in surface cleanliness as well as the absence of any indication of further corrosion.

Water washing had commenced on test ship 1 in one engineroom in February 1960 and throughout ship 2, in mid-1959. On these vessels corrosion of the bearings has been arrested, but the significant improvement noted should also be related to the cleaning of the systems and recharging with fresh oil, as a similar improved situation was apparent in the after engineroom of ship 1 where water washing was not practiced. This latter case led the authors to believe that the overall improvement was influenced by the removal of sludge deposits in the system. On ship 2, samples of the lubricating oil obtained before water washing was introduced and samples of the same charge taken 4 months after water washing had begun, in both cases before the system had been cleaned, were compared with laboratory test results. This confirmed the improvement on board ship due to water washing alone.

Samples drawn from ships 1 and 2 show no change in additive concentration, in the period under review, so while, as has been shown, water washing under the severe laboratory conditions of mixing indicates some removal of additive, normal makeup causes the practical loss to be negligible.

It is estimated that the charge in each system of these ships passes through the centrifuge about 50 times each month. Thus, there is a reasonable degree of correlation between laboratory test procedures and ship operation. Therefore, normal lubricating oil makeup should compensate for losses under controlled water washing and provide adequate protection.

However, excessive water washing or contamination, ingress of sea water or sea salts, and the presence of accumulations of rust and sludge in the system, all influence rust inhibitor life and under such abnormal conditions further measures may be necessary.

Many analyses of lubricating oil samples were made covering color, appearance, water content, sediment, neutralization value, and viscosity.

Samples of the centrifuge discharge water from ships 1 and 2 were examined for dissolved solids, chlorides, sulfates, pH, and were also tested for corrosive tendencies.

The incidence of corrosive samples of sludge from the ships practicing water washing was much lower as the program progressed.

Because of the normal inherent variation in the composition of sludge, not all sludge samples taken from a given ship's system can be expected to promote corrosion. Investigation of the samples showed no correlation between any of the chemical properties of a sludge and its corrosive tendencies. It was not possible to carry out any statistical assessment in view of the relatively small number of samples involved.

CONCLUSIONS

X-ray diffraction analysis of the surface of ship bearings and laboratory corrosion test coupons is a reliable and reproducible method of assessing the condition of ship bearings, interpreting the results of, and guiding laboratory corrosion studies. We cannot stress too strongly the value and versatility of the resulting characteristic patterns in illustrating the basic chemistry involved in this corrosive attack.

The hard film of tin oxide found on the surface of high tin base babbitt bearings is the result of an electrochemical reaction. Such a reaction can only proceed in an aqueous media when electrolytes are present, hence water is an essential factor and is invariably present. It is to be noted that the reaction cannot occur in a dry state and more importantly that abundant fresh water will reduce the electrolyte concentration to such an extent that the rate of corrosion will be negligible.

CONTAMINANTS

Contaminants commonly present in turbine lubricating oil systems act as electrolytes. Because of the environment in which they operate, ships' systems are prone to contamination with sea water through atmospheric condensation and on occasions through leakage. Dissolved salts, particularly sodium chloride from sea water, accelerate the electrochemical reaction and, hence, the rate of corrosion. Oxides of iron in the presence of moisture also initiate the reaction by donating oxygen to tin, resulting in the formation of the oxide. The time, temperature, and frequency of exposure of the bearing surface to the components necessary for the electrochemical reaction will, of course, determine the rate of corrosion.

SLUDGE

Sludge in the turbine system is an active promoter of corrosion, both by itself and by its property of acting as a retention agent or "sponge" when it maintains reactive materials on the bearing surfaces.

Turbine oil by itself does not cause or support corrosion. As has been shown, neither the base stock nor the additives used are contributory factors to the problem. As a matter of demonstrated fact, the additives offer some degree of protection against electrochemical corrosion.

The materials necessary for the electrochemical action to occur are generally present in a lubricating system, but not always in the concentration required to promote corrosion. As has been shown, evidence points to the attack first taking place on main and turbine thrust bearings rather than on journal bearings. In considering main thrust bearings, in addition to the influence of higher loading with its consequent effect on interfacial temperatures, the design of the bearing housing is such that after shutting down water, electrolytes and rust settle out, and over a period accumulate. Under momentary boundary conditions during startup, temperatures are undoubtedly high and such elevated temperatures with the contaminants present would further accelerate electrochemical reaction. Turbine thrust bearings can be similarly affected. Attack of journal bearings is a later development as the concentration of water and electrolytes increases throughout the system and the onset of corrosion becomes more general affecting turbine journals and the gearcase bearings. The initial appearance of hardening and gummy film on the bearing horns is due to deposits of sludge and rust engendered in other parts of the system, and these may initiate the reaction at these points on the bearing.

CONTINUOUS CENTRIFUGING ADVOCATED

Continuous centrifuging with water washing under controlled conditions should be practiced at all times as this will dissolve and remove the salts entering the system as well as diluting their concentration. Satisfactory water washing can be obtained with 5 percent of water, i.e., an oil-to-water ratio of 20:1, and 10 percent of water is the maximum that should ever be employed. Centrifuging should be carried out with both the oil and water between 160° and 180° F. Fresh water, and this should be either drinking water (which should not be supplied from tanks previously used for sea water ballast), or condensate should be injected into the oil supply line to the centrifuge in a countercurrent direction. It should not be injected in the form of low-pressure steam because the resultant dispersion of water is so fine that usually the centrifuge is unable to separate it completely and the oil tends to remain cloudy.

To assist intimate contact, a baffle chamber at the point of water injection would be helpful. Complete clarification of the oil returned to the system is the most important criterion and is best accomplished by reducing the flow through the centrifuge to approximately 50 percent of its rated capacity. Observation of the treated oil, which should be clear and bright, will enable the final adjustments to be made, a cloudy appearance signifying that water is present. Under ideal conditions all oil in the system should be centrifuged every 24 hours and additional refinements such as metering of the water and lubricant supply should be contemplated so that operating personnel can maintain adequate control.

MAINTAIN LUBE OIL CLEANLINESS

Cleanliness of the lubricating oil system should be maintained by periodically cleaning storage tanks, drain tanks, and gravity tanks. The system should be viewed critically and with the cooperation of the lubricant supplier; assessment made of those points in the system which may be subject to deposits such as the larger bore pipes, branch pieces, oil coolers, and valves, and these areas also inspected and, if necessary, cleaned. Periodic tests of sludge deposits from the centrifuge bowl and of centrifuge water discharge should be made by the techniques detailed in this paper.

Finally, recognizing that in spite of the precautions proposed, prevention is better than cure, the company's laboratories have worked on the selection and testing of other additives which could be employed to supply an increased factor of protection against corrosion. Lubricants containing these additives have been tested in the laboratories where it has been shown they have the abilty to inhibit babbitt bearing corrosion. At the present time products containing these additives are being tested in the company's tanker fleet in order to evaluate their performance as turbine lubricants.

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NAVIGATION AND VESSEL INSPECTION CIRCULAR NO. 9–61

AUGUST 9, 1961

Subj: Valves employing resilient material

PURPOSE

The purpose of this circular is to clarify the use of valves employing resilient materials on vessels subject to Coast Guard inspection.

BACKGROUND

During the last few years, valves employing resilient material have received increasing acceptance by industry and Government agencies for use in various systems and under various service conditions. This has led to an increasing number of resquests for the use of these valves on vessels subject to Coast Guard inspection.

DISCUSSION

The use of resilient material in a valve may result in tighter closures under normal service conditions, but it also may result in a valve that is less resistant to fire damage.

a. Definitions:

(1) For the purpose of this circular, resilient material is considered to be any nonmetallic material.

(2) A valve employing resilient material is defined as any valve in which the closure is accomplished by resilient material instead of a metal to metal seat.

b. *Valve designations:* The various types of valves employing resilient material can be divided into two general categories:

(1) Category A. Valves that could continue to provide effective, although not necessarily leakproof, closure of the line and would not allow appreciable leakage out of the valve if the resilient material were damaged or destroyed. An example of a valve in this category would be a resilient-seated butterfly valve.

(2) Category B. Valves that could not provide effective closure of the line or would permit appreciable leakage out of the valve if the resilient material were damaged or destroyed. An example of a valve in this category would be a packless diaphragm valve.

VALVE INSTALLATIONS

The use of valves employing resilient material shall be governed by the following:

a. The design, construction, and material shall meet the applicable requirements of the Marine Engineering Regulations and Material Specifications, CG–115.

b. The manufacturer's temperature, pressure, and service limitations for the valve shall be observed.

c. Valves in Categories A and B may normally be used in any piping system, except as the positive shutoff valves required by 46 CFR 55.10–35(d) for systems subject to internal head pressure from tanks containing inflammable or combustible liquids. In addition, valves in Category B may not be used—

(1) at any location in a firemain system;

(2) at any location in the bilge system;

(3) as the positive closure for any opening in the shell of the vessel.

d. For the special case of deep tanks for grade E combustible liquids located in a pipe tunnel or shaft alley, valves in either Category A or B may be installed at the tank in lieu of the positive shutoff valves required by 46 CFR 55.10–35(d). However, if the fuel or cargo oil system is led from the tank to the machinery space, a metal-to-metal seated valve shall be installed in the line at the machinery space side of the bulkhead.

ACTION

a. The manufacturers of valves employing resilient materials shall have filed a Manufacturer's Affidavit, Form CG–935A, in accordance with 46 CFR 55.01–15. The limitations currently contained in the notes to the listing of acceptable manufacturers of valves employing resilient material in the Equipment Lists, CG–190, are no longer in effect and will be deleted at the next printing.

b. The Officer in Charge, Marine Inspection, shall be guided by this circular in the acceptance of valves employing resilient materials. Any further questions concerning these valves should be directed to the Commandant (MMT).

Effective date. Upon receipt.

MARITIME SIDELIGHTS

Striking of the ship's bell originated in the days of the half hour glass. It was then the duty of the ship's boy to turn the glass at the end of every half hour. To show that he was doing his duty, he was required to give the bell on the quarterdeck a lusty swing every time he turned the glass.

Later, ship quartermasters discovered that this was an excellent method for indicating the passage of a watch and calling the next watch.

To make it simpler, they began having the bells tolled in increasing numbers as the watch progressed. One bell denoted the first half hour of a watch; at the end of the second half hour of the same watch there would be an additional toll of the bell, and so on, until eight bells had been sounded. At the beginning of each watch the bell would be tolled anew.

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Dry-cargo vessels of 12 additional countries are to follow Britain's example in banning discharge of oil-contaminated ballast water into "prohibited zones" of the sea. The prohibition will apply except when ships are going to a port which has no facilities to receive their oily residues.

Under the International Convention for the Prevention of Pollution of the Sea by Oil, 1954, "prohibited zones" for dry-cargo ships extend generally for 50 miles from all coasts, but around the United Kingdom and certain neighbouring countries they stretch out to 100 miles from land.

Up to now, "prohibited zones" have had to be observed only by United Kingdom registered dry-cargo vessels, and by tankers registered in the countries which have accepted the Convention—Mexico, Sweden, the Federal Republic of Germany, Denmark, Canada, Norway, the Republic of Ireland, Belgium, France, the Netherlands, Finland, the Republic of Poland and the United Kingdom.

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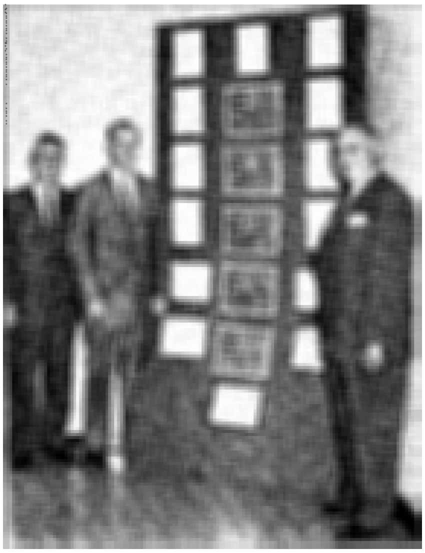
Oceanographers began probing the sea near Bethany Beach, Del., last August to learn more about the origin and behavior of the mysterious sand waves that intersect the U.S. coastline in many areas from Cape Hatteras to New York.

SAFETY AWARDS



A TOTAL OF 19 SAFETY AWARDS were recently presented to ships of the Lykes Line fleet. Joseph W. Simon, Jr., right, president of the Metropolitan New Orleans Safety Council, is shown making the presentation. Receiving the awards in behalf of the company were Capt. James B. Rucker, left, manager of Lykes' safety division, and Joseph T. Lykes, Jr., senior vice president of the company.

Mr. Simon made the presentations in behalf of the National Safety Council, Chicago, and the American Merchant Marine Institute, New York.

The NSC's Certificate of Commendation Plaque and the AMMI's Jones F. Devlin Award were won by five ships of the Lykes fleet, each having a record free of lost-time injuries dating back more than 2 years. They are the vessels *Aimee Lykes, Charlotte Lykes, Genevieve Lykes, Harry Culbreath,* and the *Virginia Lykes*.

Nine other ships were awarded the NSC's Presidential Letter Award. They were the *Kendall Fish, Eugene Lykes, Mason Lykes, Shirley Lykes, Brinton Lykes, Dick Lykes, Ruth Lykes, Solon Turman,* and *Velma Lykes*.

In addition to winning the NSC and AMMI awards, the *Harry Culbreath* also won the coveted top fleet award offered by Lykes annually for the safest ship engaged in the company's worldwide operations. The *Harry Culbreath* completed a 3-year record without any lost-time injuries.

The first of a series of twin-container barges is to be placed into service on the Mississippi River in the near future. These barges have two container sections, an inner section with 3 individual compartments and an outer section with 6 individual compartments.

This design will permit the use of one container section on an outgoing trip, and the use of the other section on the return trip, thereby eliminating the necessity of cleaning the barge before taking on a return-trip cargo.

The liquid cargoes, that will be carried in the new barges—petroleum, lubricating oils, molasses and edible oil—can be loaded in either the three inner compartments or the six outer compartments. Both the inner and the outer containers have heating coils and pump equipment, and the smooth sides of the inner container make possible thorough cleaning at comparatively low costs.

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The Tradition of the Sea Award was presented in absentia recently to the master of the tanker *Mary Ellen Conway* for an outstanding sea rescue. The presentation was made during observance of Kings Point Day of World Trade Week at the United States Merchant Marine Academy at Kings Point. Capt. G. Zvelich of Genoa, Italy was named winner of the sixth annual award for his rescue of 48 crew members of the oil-ore carrier *Sinclair Petrolore*, on Dec. 6, 1960. He was cited for his rescue of all but two of the crewmen on the vessel after it exploded off the coast of Brazil.

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The annual report of the Safety Bureau of the New York Shipping Association indicates waterfront accidents during 1960 were at the lowest level of the last 5 years.

Alexander P. Chopin, chairman of harbor employers' organization, said that in the past 3 years alone, there has been a 15-percent decline. The rate last year was 70.3 accidents for each million man-hours worked, he said.

nautical queries

Q. (a) What is quadrantal deviation?

(b) By what is it caused?

(c) How is it compensated for?

A. Quadrantal deviation is caused by the magnetism induced in horizontal soft iron by the horizontal component of the earth's total force. It is zero at the cardinal points, maximum at intercardinal points, and its direction is opposite in successive quardants. It is compensated for by hollow soft iron spheres on opposite sides of the compass.

E'ly dev. on NE & SW, move balls in.

W'ly dev. on NW & SE, move balls in.

Q. (a) Do the meridians of longitude appear as vertical straight lines on a polyconic chart? Explain in your answer.

(b) The distance between two points on a polyconic chart of the Great Lakes is 150 *statute miles.* If a vessel makes a speed of 10 *knots,* how long will it take her to traverse this distance?

A. (a) The meridians of longitude converge towards the pole on a polyconic chart. Only the central meridian is vertical.

(b) $\frac{150 \times 5\,280}{10 \times 6{,}076} = 13.031$ hrs.

ANSWER: 13 hours 1.8 minutes.

Q. What depth of water would you expect at 1 p.m. in a locality where the chart showed a depth of 5 fathoms at mean low water, the tide tables showed the duration of rise to be 6 hours, range 6 feet, and low water occurred at 11 a.m. with a height of 1.5 feet?

Note: Tide Tables to be used.

A. Duration 6 hours Difference 2 hours Range 6 feet	Correction to height, table 3, = 1.5 feet

	Feet
Charted depth	30
L.W. height	1.5
Correction to height	1.5
Depth of water at 1 p.m.	33.0

Q. If a vessel is required to draw mean draft of 21'–06'' in sea water, the density of which is 1,026 ounces, what must she be loaded to in water of 1,002-ounce density?

A. 1,026 : 1,002 :: X : 21.5'

$$X = \frac{1{,}026 \times 21.5}{1{,}002} = 22.01' \text{ or}$$

22'–00'' in F.W.

Load to 22'–00''

Q. A steam engine develops 37 IHP with a mean effective pressure on piston of 40 lbs. per sq. in., length of stroke 18 ins., number of revolutions per minute 60, find the diameter of the cylinder.

A. $\text{I.H.P.} = \frac{\text{PLAN}}{33000}$

wherein $D^2 \times .7854 = A$

$$D^2 = \frac{33000 \times 37}{40 \times 1.5 \times .7854 \times 120} = 216$$

and $D = \sqrt{216} = 14.7$ inches answer

Q. A vessel steams 700 miles on 560 barrels of fuel at a speed of 10 knots. Having left only 400 barrels of fuel and 800 miles to go, what speed must she make to reach port?

A. Co : Cn : : $So^2 \times d : Sn^2 \times d$

$560 : 400 : : 10^2 \times 700 : x^2 \times 800$

$$x^2 = \frac{400 \times 10^2 \times 700}{560 \times 800} = 62.5$$

$x = 7.905$ knots

Q. (a) What is the purpose of the telemotor equalizing valve and bypass valve in the wheelhouse on vessels fitted with this type steering apparatus?

(b) What methods other than telemotors are used to control steering engines from remote stations such as the pilot house?

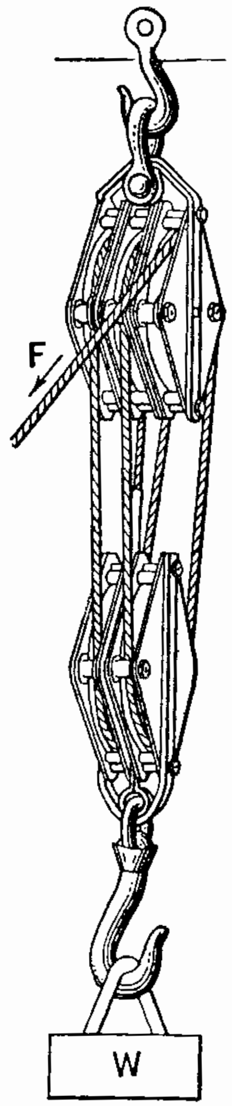
A. (a) A telemotor equalizing valve is used to equalize the amount of fluid on the two sides of a telemotor pump and lines in the pilot house when the wheel is in the midships position. If the wheel is used constantly in one direction or if held hard over on one side, fluid may leak through the piston rings, leaving more fluid on one side than the other. The equalizer is used to remedy this situation. It and the bypass valve should be open when the telemotor is not being used, such as when the vessel is not under way, or when the vessel is underway and an alternate steering engine control method is being employed.

(b) Vessels employ electric steering controls and direct shafting controls as well as telemotor.

BLOCKS AND TACKLES

Q. (a) What is the mechanical advantage, disregarding friction, of the tackle below?

(b) What would be the mechanical advantage, disregarding friction, if the position of the blocks were reversed so that the hauling part was at the weight?

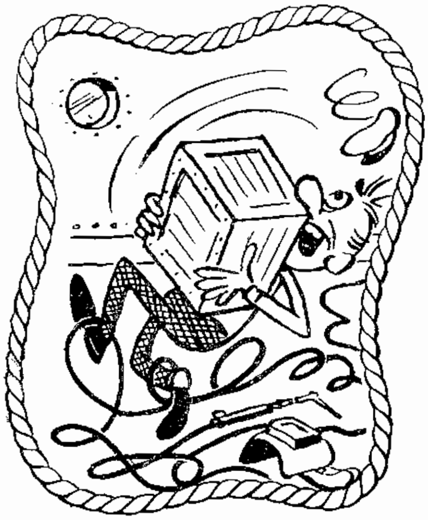


A. (a) Disregarding friction, the ratio is $\frac{F}{W} = 1/5$ or $F = 1/5$ W or the mechanical advantage is 5.

(b) Disregarding friction, the ratio would be $\frac{F}{W} = 1/6$ or $F = 1/6$ W or the mechanical advantage would be 6.

HOW'D YOU LIKE YOUR TRIP?

By Arthur E. Wills



No, we're not talking about that cruise to Japan, but the one you took to hospital when you failed to "pick 'em up and lay 'em down" and landed on your profile as a result. Of course, you had lots of company in "tripping," for there are plenty of things around a ship's deck to stumble and fall over. Below decks, the list is multiplied.

Such tripping hazards aboard ship fall into three general classes. The first are those which are part of the ship's structure and about which all you can do is to keep them well painted, white or yellow, and remember to pick up your feet. Such hazards include padeyes, cleats, bitts, ground tackle, deck straps, hatch and door coamings, deck cargo lashings, etc.

Then there are the million and one items which contribute to bad housekeeping—shipkeeping if you prefer—that provide tripping hazards for unwary feet. Loose dunnage, separation paper, hatch boards and beams, hatch pontoons, loose mooring lines, loose boom falls, junk from below; all these and more take their toll. The cure is obvious—keep the vessel shipshape.

Finally, there are the tripping hazards which are present necessarily but whose stay is temporary, usually while the ship is in port. These can be aggravated greatly if cargo operations and ship repairs are going on at the same time. This category includes welding cables, oxygen and acetylene hoses, air hoses, etc. Cables and hose may be running across decks, through doors, up and down ladders, passageways—most everywhere. Sometimes, on safety-conscious ships, these cables and hoses are triced up overhead in passageways and doors.

As a rule, the welding machines, with their air compressors and gas bottles, are located on the pier near the ship's gangway to avoid interference with cargo operations and minimize the length of hose and cable leads. If repairs are scheduled for the machinery spaces or other midshiphouse areas, the leads usually pass up from the pier, across the main deck, through a passageway access door, down a passageway, and thence through the casing door, which has to be left open. A lot of foot traffic flows by and over such gear.

A safer lead is from pier to boat deck and down to machinery spaces via the casing emergency door. If the boat deck is fitted with awning stanchions, spars and spreaders, the leads can be lashed overhead to them. If the ship has no emergency casing door, the cables and hoses can be led from the pier to the bridge deck and then down to the machinery spaces through the engineroom skylight. Repair contractors may resist such leads because of the extra length of cables and hoses required. It is up to the ship to maintain strict supervision and to insist upon maximum safety for installation and operation.

One of the our safety engineers, Mr. George Kroh, reports having seen a few ships where a 6-inch nipple was installed in way of the superstructure bulkhead plating directly above the passageway access doors. Similar 6-inch nipples pierced the machinery casing over the access doors and several loop-type brackets were located overhead in the passageways. Cables and hoses led from the pier to the main deck where they were secured to an overhead bracket, then through access nipples to the machinery spaces, leaving passageways and doors clear for foot traffic. When not in use, the nipples were closed with pipe caps.

On another ship, holes were cut in the main deck adjacent to the sheer strake, port and starboard, and 6-inch nipples were installed. Welding cables and hoses were led through these nipples to the second deck storeroom area and thence to the machinery spaces. Nipples were capped when not in use, but presumably authority for such deck piercing would be required from the vessel's Classification Society.

This discussion of welding cable and hose leads has been concerned with rigging for repairs in machinery spaces, but the same principles apply to any other area on a ship in which repairs are in progress. The main requirements are strict supervision and insistence on respect for safety considerations while repair gear is rigged. If a lot of "trips" can be saved, it's well worth it. And if you want to ship out on the next trip, take a tip and DON'T BE TRIPPED!

Courtesy the United States P. & I. Agency

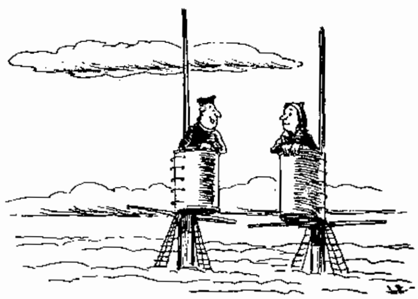
BRAGGING DOES NOT PAY

A merchant seaman was recently sentenced to 90 days in jail by a U.S. District Court judge for willfully, unlawfully, feloniously, and without authority attempting to alter a U.S. Coast Guard license—a violation of Title 18, USC, Section 2197.

The seaman, who held a merchant seaman's document with the rating of cook, was not employed aboard ship at the time of his offense. His reputation was that of a braggart who told friends that he possessed a license as Master. When his bluff was called, he tried to produce.

The would-be Master was arrested by an FBI agent. He offered no explanation or denial of the fact that he tried to have the license of a deceased officer altered, but pleaded guilty after an indictment was returned against him.

There was no indication that the seaman considered further fraud or actual illegal use of the document, nor belief that his attempt could have been successful. Tampering with a Coast Guard license, whether it be for fraudulent use or to inflate one's ego, is a serious offense.



Quite a fog layer, isn't it? Did you hear a heckuva crash a few minutes ago?

Courtesy of Shipping Register & Shipbuilder

UNITED STATES COAST GUARD

ADDRESS REPLY TO:
COMMANDANT
U. S. COAST GUARD
HEADQUARTERS
WASHINGTON 25, D. C.

MVI
8 May 1961

Commandant's Action on
Marine Board of Investigation; explosion and fire on board the M/V *S–21* on 21 September 1960, with loss of life

The record of the Marine Board of Investigation convened to investigate subject casualty together with its Findings of Fact, Opinions and Recommendations has been reviewed.

The self-propelled, oil well drill tender *S–21*, formerly the LST *769*, was moored bow to the California Company drilling platform *7–X* which is located in Block 26, Grand Isle area, Gulf of Mexico. While attending the drilling platform, where the plugging of a gas well by "cementing" or "killing" was in progress, an explosion and fire occurred at about 1822 CST on 21 September 1960 involving the vessel's pumproom and adjoining spaces. Of the 11 crew members and approximately 43 oil workers aboard the vessel, one crew member was killed and two crew members were injured and six oil workers were injured. Damage to property was estimated at $12,500.

The pumproom is a compartment located on the centerline of the 3d deck in the after half of the vessel. Integral mud pits are constructed at the forward end of the pumproom. The deckhouse with its quarters and messing facilities is on the main deck over the after third of the compartment. The vessel's dry storage area, including the reefer space, is located immediately aft on the 3d deck. At the time of the casualty, the watertight door between the dry storage area and the pumproom was secured, although a circulation of air between these two spaces existed through open watertight closures to and through the machinery spaces in the hold directly below. The pumproom ventilation was provided by an exhaust fan that vented on the boat deck and its ducting that extended into the pumproom at about the 2d deck level. In addition, a hatch, located over the forward half of the pumproom, was partially opened.

Mud pumping equipment that belongs to the Halliburton and Noble Companies, subcontractors for the California Company, is located in the pumproom and is used exclusively in well drilling and production operations. These pumping units are temporarily installed in the pumproom for the period of the contract. Since this equipment is used exclusively in the drilling for, and the production of oil, gas, petroleum and other subsoil minerals, it is exempted from inspection by the Coast Guard.

The Halliburton unit is mounted on a skid and consists of two high pressure pumps, their diesel engines, and measuring tanks. This unit is located on the port side aft in the pumproom. The Noble pump with its engine is placed forward of the Halliburton unit and is used to supply mud from the vessels mud pits to the measuring tanks on the Halliburton unit. A discharge line from each Halliburton pump joins in a "T" or "Y" arrangement, and the common line runs through and on the ship to the bow and then to the "Christmas Tree" on the platform. The "Chirstmas Tree" consists of a group of valves at the top of the well. Except for a manual discharge valve at each pump, there are no other valves in the line between the pumps and the "Christmas Tree." At the time of the casualty, the No. 2 Halliburton pump was inoperative due to a broken thrust bearing. This pump's discharge valve was in a closed position and its release line, which emptied into the measuring tanks, had two manually operated valves both of which were open.

At approximately 1810, the Halliburton operator, using pump No. 1, began pumping mud to the wellhead. His helper and the Noble pump operator were in the pumproom with him. When the mud line pressure was built up to 5,000 psi, the "Christmas Tree" was opened permitting the mud and the gas from the well to meet. After about 2 barrels of mud were forced into the system, mud began to blow violently from the open measuring tank that was not in immediate use. Suspecting that gas was blowing from the measuring tank and not knowing how it was escaping, the operator idled his pump and left the pumproom in order to telephone the platform and was followed by his assistant. The Noble operator shut his pump off and started to leave the pumproom when the explosion occurred. The valve on the "Christmas Tree" was closed at about the same time.

According to the Noble operator, the explosion, a loud booming report, seemed to occur at the Halliburton unit. Unassisted, he made his way to the main deck after the explosion. The Halliburton helper had just stepped on the main deck at the time of the explosion, and saw the pumproom hatch being blown off. A flash followed by flames erupted from the open hatch and black smoke poured out of the galley doors at the after end of the deckhouse. The fire was brought under control at approximately 2000. Examination after the casualty disclosed that flame or fire damages were mainly confined to the pumproom and machinery spaces, dry storage and reefer area, and crew's quarters on the 2d deck. Smoke damage extended to living spaces around and above the fire area. Flame damage in the pumproom had apparently been most intense in the area of the Halliburton unit, but the dry storage area, which contained many combustible items appeared to suffer the greatest damage. The watertight door opening into the pumproom from the dry storage and reefer area was bulged forward into the pumproom.

The body of the deceased oiler was located on the reefer flat after the explosion. Injuries were sustained by the Noble operator and seven others who were in the vicinity of the deckhouse at the time. One of these men jumped overboard and was later recovered.

After the casualty, an investigation by personnel on the vessel revealed that the discharge valve on the inoperative pump, although closed, had a scored or cutout seat.

REMARKS

Concurring with the Board, it is considered that the explosion was due to a large amount of gas from the well passing through the faulty discharge valve on the inoperative Halliburton pump, then through the release line of the same pump, then into the pumproom through the mud measuring tank, and from the pumproom into adjoining spaces. Although the source of ignition was not determined, there were numerous possibilities, such as electrical equipment in any of the gas contaminated spaces, or even the lighting of a cigarette.

As further concluded by the Board, it would appear that the release of the gas might have been prevented if the Halliburton unit had been operated differently and if, for example, either or both valves on the release line of the inoperative pump had been closed. In addition, it would appear that an adequate check valve in the mud line might have prevented this casualty. In any event, however, the cause is considered to have occurred strictly within the scope of the specialized, oil well equipment operation.

This casualty supports the desirability of isolating the pumproom, to the extent practicable, from living, working, and machinery spaces. Watertight closures to the pumproom spaces should always be closed when the vessel is connected by piping to an oil or gas well. The master's responsibility for the safety of his vessel dictates that he keep himself informed of any operation which may affect the safety of his vessel so that he may take all reasonable and timely precautions to safeguard the vessel and those on board.

Since the possibility of gases backing up into the pumproom is always present, despite precautions, efforts should also be made to guard against or minimize all sources of ignition within the pumproom. Unless such precautions are taken, isolating the pumproom will not prevent a repetition of this or a similar accident.

The Board's conclusion that the system of ventilation provided in the pumproom space was inadequate is concurred in. The presently installed system would not prevent the collection of vapors in the lower layers of the compartment. Although it is recognized that this deficiency cannot be considered as contributing to this casualty (because of the high rate at which the gas escaped), the Board's recommendation concerning an adequate ventilating system is approved.

Subject to the foregoing remarks, the record of the Marine Board of Investigation is approved.

J. A. HIRSHFIELD,
Vice Admiral, U.S. Coast Guard,
Acting Commandant.

LICENSED OFFICERS

(*Continued from page 185*)

why they decided to apply for Coast Guard commissions and their intention of remaining in the service, the officers considered the desire for financial stability, the chance to establish one's self in a community, and the opportunity to spend more time with their family as important reasons. Medical care, commissary privileges, and low insurance rates were also mentioned as advantages. Retirement benefits received a special word of praise.

Complete details of the program, eligibility requirements, scope of professional examination, and other pertinent details are included in the publication, CG-231, which is available in any marine inspection office. Persons who consider themselves eligible and wish to apply for an appointment as a commissioned officer should address a letter to Commandant (PTP), U.S. Coast Guard, Washington 25, D.C.

HANDLE POLYPROPYLENE LINES CORRECTLY TO AVOID INJURY

Most of us are well aware of the fact that the possibility of injury increases when any type of equipment is handled incorrectly. And, most of us fully realize that in order to eliminate the possibility of injury when using any type of equipment, we should be thoroughly familiar with it and what might possibly go wrong.

A recent injury was the result of either not knowing or not guarding against the possibility of injury when letting go a polypropylene line which has a strain on it.

The accident occurred when an AB was letting go the last line—the port stern line—which had a heavy strain on it. The remaining three turns suddenly paid out and the slack end hit the AB on the back of the right hand, breaking a bone in the hand.

The one feature that must be taken into account when using polypropylene is that it has a much surer grip

on bitts and gypsy head. Extreme care must be taken when surging or letting a line go with a strain on it. Any strain will tend to fuse the line to the chock or bitts and, of course, the fusing increases in proportion to the strain. When letting go or surging a line with a strain on it, the turns should not be thrown off the bitts. Instead, they should be slackened until the fuse is broken sufficiently to surge the line safely. If too many turns are taken off the bitts, the fusing releases suddenly, allowing the line to "go on the run."

Courtesy The Marine News

EQUIPMENT APPROVED BY THE COMMANDANT

[EDITOR'S NOTE.—Due to space limitations, it is not possible to publish the documents regarding approvals and terminations of approvals of equipment published in the Federal Register dated August 16, 1961 (CGFR 61-30), Federal Register dated August 29, 1961 (CGFR 61-32), and Federal Register dated August 31, 1961 (CGFR 61-34). Copies of these documents may be obtained from the Superintendent of Documents, Washington 25, D.C.]

AFFIDAVITS

The following affidavits were accepted during the period from 15 July 1961 to 15 August 1961:

Dresser Manufacturing Division. Dresser (Great Britain) Ltd., 197 Knightsbridge, London S.W. 7, FITTINGS.

Sealol, Inc., P.O. Box 2158, Providence 5, R.I., VALVES & FITTINGS.

Commercial Shearing & Stamping Co., P.O. Box 239, Youngstown 1, Ohio, VALVES.

Elkins Flange Manufacturing Co., The Benson, Jenkintown, Pa., FLANGES.

Sorensen Industries, Inc., foot of Fifth St., Darby, Pa., CASTINGS.

MERCHANT MARINE SAFETY PUBLICATIONS

The following publications that are directly applicable to the Merchant Marine are available and may be obtained upon request from the nearest Marine Inspection Office of the United States Coast Guard. The date of each publication is indicated in parenthesis following its title. The dates of the Federal Registers affecting each publication are noted after the date of each edition.

CG No.	TITLE OF PUBLICATION
101	Specimen Examination for Merchant Marine Deck Officers (7–1–58).
108	Rules and Regulations for Military Explosives and Hazardous Munitions (8–1–58).
115	Marine Engineering Regulations and Material Specifications (2–1–61).
123	Rules and Regulations for Tank Vessels (12–1–59). F.R. 3–30–60, 10–25–60, 11–5–60, 12–8–60, 7–4–61.
129	Proceedings of the Merchant Marine Council (Monthly).
169	Rules of the Road—International—Inland (5–1–59). F.R. 5–21–59, 6–6–59, 5–20–60, 9–21–60, 4–14–61, 4–25–61.
172	Rules of the Road—Great Lakes (5–1–59). F.R. 1–7–60, 3–17–60, 5–20–60, 9–21–60.
174	A Manual for the Safe Handling of Inflammable and Combustible Liquids (7–2–51).
175	Manual for Lifeboatmen, Able Seamen, and qualified Members of Engine Department (9–1–60).
176	Load Line Regulation (9–2–58). F.R. 9–5–59, 8–2–60, 11–17–60.
182	Specimen Examinations for Merchant Marine Engineer Licenses (12–1–59).
184	Rules of the Road—Western Rivers (5–1–59). F.R. 6–6–59, 5–20–60, 9–21–60, 10–8–60, 12–23–60, 4–14–61, 4–25–61.
190	Equipment Lists (4–1–60). F.R. 6–21–60, 8–16–60, 8–25–60, 8–31–60, 9–21–60, 9–28–60, 10–25–60, 11–17–60, 12–23–60, 12–24–60, 5–2–61, 6–2–61, 6–8–61, 7–21–61, 7–27–61, 8–16–61, 8–29–61, 8–31–61.
191	Rules and Regulations for Licensing and Certificating of Merchant Marine Personnel (11–1–60). F.R. 11–30–60, 1–4–61, 4–19–61.
200	Marine Investigation Regulations and Suspension and Revocation Proceedings (7–1–58). F.R. 3–30–60, 5–6–60, 12–8–60, 7–4–61.
220	Specimen Examination Questions for Licenses as Master, Mate, and Pilot of Central Western Rivers Vessels (4–1–57).
227	Laws Governing Marine Inspection (7–3–50).
239	Security of Vessels and Waterfront Facilities (8–1–61).
249	Merchant Marine Council Public Hearing Agenda (Annually).
256	Rules and Regulations for Passenger Vessels (3–2–59). F.R. 4–25–59, 6–18–59, 6–20–59, 7–9–59, 7–21–59, 9–5–59, 1–8–60, 5–6–60, 8–18–60, 10–25–60, 11–5–60, 11–17–60, 12–8–60, 12–24–60, 12–29–60, 4–19–61, 7–4–61.
257	Rules and Regulations for Cargo and Miscellaneous Vessels (3–2–59). F.R. 4–25–59, 6–18–59, 6–20–59, 7–9–59, 7–21–59, 9–5–59, 5–6–60, 5–12–60, 10–25–60, 11–5–60, 11–17–60, 12–8–60, 12–24–60, 7–4–61.
259	Electrical Engineering Regulations (12–1–60).
266	Rules and Regulations for Bulk Grain Cargoes (5–1–59).
268	Rules and Regulations for Manning of Vessels (9–1–60). F.R. 5–5–61, 6–28–61.
269	Rules and Regulations for Nautical Schools (3–1–60). F.R. 3–30–60, 8–18–60, 11–5–60, 7–4–61.
270	Rules and Regulations for Marine Engineering Installations Contracted for Prior to July 1, 1935 (11–19–52). F.R. 12–5–53, 12–28–55, 6–20–59, 3–17–60.
293	Miscellaneous Electrical Equipment List (3–7–60).
320	Rules and Regulations for Artificial Islands and Fixed Structures on the Outer Continental Shelf (10–1–59). F.R. 10–25–60.
323	Rules and Regulations for Small Passenger Vessels (Not More than 65 feet in Length) (7–1–61).
329	Fire Fighting Manual for Tank Vessels (4–1–58).

Official changes in rules and regulations are published in the Federal Register, which is printed daily except Sunday, Monday, and days following holidays. The Federal Register is a sales publication and may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C. It is furnished by mail to subscribers for $1.50 per month or $15 per year, payable in advance. Individual copies desired may be purchased as long as they are available. The charge for individual copies of the Federal Register varies in proportion to the size of the issue and will be 15 cents unless otherwise noted in the table of changes below.

CHANGES PUBLISHED DURING AUGUST 1961

The following have been modified by Federal Registers:

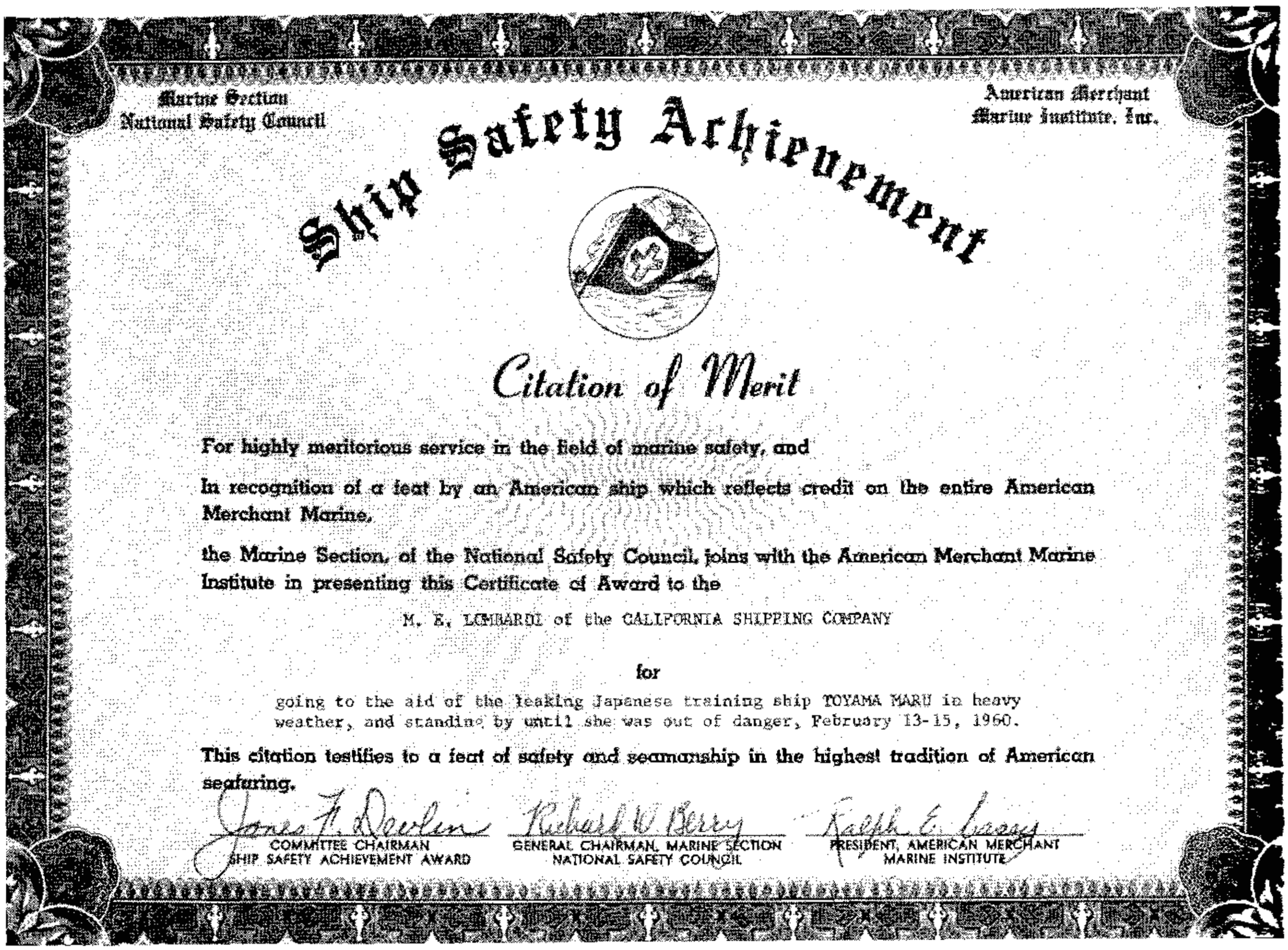
CG–190 Federal Registers, August 16, 1961 (25 cents), August 29, 1961, and August 31, 1961 (20 cents).

SHIP SAFETY ACHIEVEMENT CITATION

The steamship *M. E. Lombardi* of the California Shipping Company's tanker fleet recently received the Ship Safety Achievement Citation of Merit for an outstanding display of seamanship and safety at sea. This award, jointly sponsored by the American Merchant Marine Institute and the Marine Section, National Safety Council, was presented to Captain Clayton Hiller, former master of the tanker, by Rear Admiral Allen Winbeck, USCG, Commander, 12th Coast Guard District.

On February 13, 1960, the *Lombardi*, under Captain Hiller's command, went to the assistance of the Japanese training ship *Toyama Maru*, apparently sinking in the Pacific Ocean as a result of a serious leak. Under dangerous sea conditions, a boat was launched and the master of the training vessel brought aboard for consultation. When it was decided that the *Toyama Maru* might be repaired, the *Lombardi* furnished needed materials, ferried them to the ship, and stood by until a U.S. Coast Guard cutter arrived.

Left to right—Captain Clayton Hiller holding citation just presented by Rear Admiral Allen Winbeck USCG, Iver Larson, National Safety Council and L. C. Fleming, Pacific Coast Director, Maritime Administration. The group are inspecting an aerial photograph taken by the Coast Guard of the *M. E. Lombardi* standing by the stricken Japanese training ship *Toyama Maru*. In the lower foreground one of the Lombardi's boats is retrieving a gasoline pump dropped by the Coast Guard plane that took this photo.



Marine Section
National Safety Council

American Merchant
Marine Institute, Inc.

Ship Safety Achievement

Citation of Merit

For highly meritorious service in the field of marine safety, and

In recognition of a feat by an American ship which reflects credit on the entire American Merchant Marine,

the Marine Section, of the National Safety Council, joins with the American Merchant Marine Institute in presenting this Certificate of Award to the

M. E. LOMBARDI of the CALIFORNIA SHIPPING COMPANY

for

going to the aid of the leaking Japanese training ship TOYAMA MARU in heavy weather, and standing by until she was out of danger, February 13-15, 1960.

This citation testifies to a feat of safety and seamanship in the highest tradition of American seafaring.

COMMITTEE CHAIRMAN
SHIP SAFETY ACHIEVEMENT AWARD

GENERAL CHAIRMAN, MARINE SECTION
NATIONAL SAFETY COUNCIL

PRESIDENT, AMERICAN MERCHANT
MARINE INSTITUTE

U.S. GOVERNMENT PRINTING OFFICE: 1961