PROCEEDINGS OF THE
MERCHANT MARINE COUNCIL

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UNITED STATES COAST GUARD

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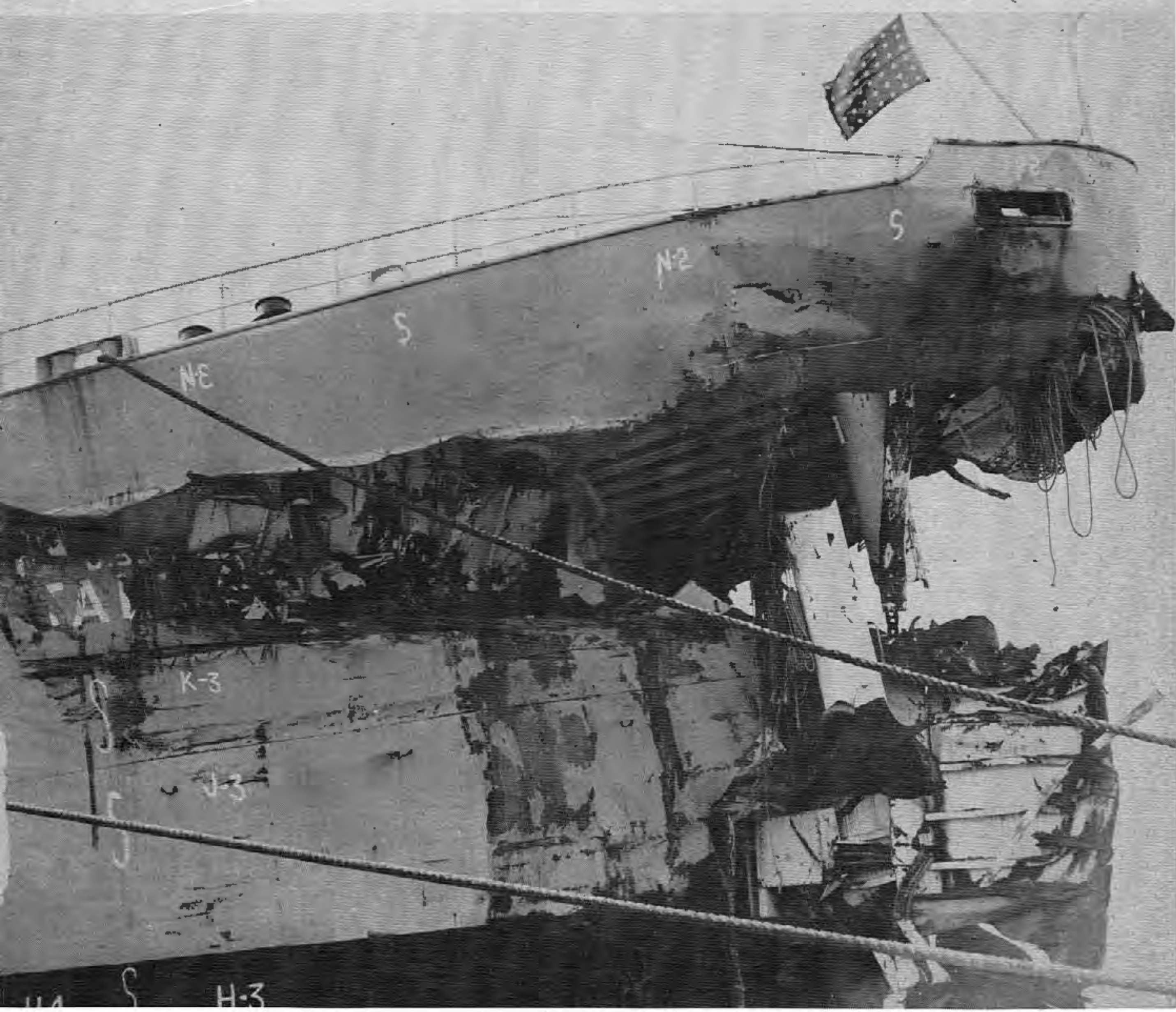

Proceedings of the

MERCHANT MARINE COUNCIL

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The Merchant Marine Council of the United States Coast Guard

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The bow of the USNS *Tallulah* following a collision with the SS *Orion Planet* off the California coast February 13, 1955. U. S. Navy photo.

BACK COVER

The SS *Olympic* aground near Bombay Harbor July 24, 1951. Photo credit to Mr. T. W. Truxillo, First Assistant Engineer in the vessel.

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LESSONS FROM CASUALTIES

THE *Proceedings of the Merchant Marine Council* has been published since January 1944. Beginning with the first edition, *Lessons from Casualties* have been printed each month. In 1948 Capt. Schuyler F. Cumings, Senior Marine Superintendent of the United States Lines, suggested that a special *Lessons from Casualties* issue be published. In accord with his very worthy suggestion, the January 1949 issue was so published. It has now been seven years since a select compilation has been made and, accordingly, this issue will be devoted solely to *Lessons from Casualties*.

The *Lessons* selected for reprint are believed to be representative of some of the more common and more serious types of casualties.

A study of these casualties and of the lessons pointed out should be made by the men of the merchant marine with the object of avoiding the serious consequences others have experienced. It is the Council's hope that personnel of the ships reading this issue will keep the copies in circulation so that as many officers and men as possible may profit from the unfortunate mishaps of others.

SEAMANSHIP

CRACKED SHIP AND IRON MEN

By CDR. William C. Foster, USCG

ON THE evening of November 16, 1954 the SS *P & T Trader*, a C–3 type cargo vessel, was eastbound towards Coos Bay, Oreg., from the port of Yokohama, Japan, approximately 600 miles from her destination. The vessel was light, drawing 8 feet forward and 17 feet 6 inches aft, and had been averaging about 14 knots with following winds and seas during the voyage.

At 6 p. m. the wind shifted from the southwest to east southeast and the sea began to build up from an easterly direction. Moderate pitching was experienced from this easterly sea and at 10:30 p. m. the vessel commenced to pitch heavily. At 10:50 p. m. the vessel, while making approximately 70 r. p. m., pounded heavily into a large head sea and a loud report was heard throughout the vessel.

The speed was immediately reduced to 45 r. p. m. and the vessel was brought around away from the wind and sea. The Master and Chief Engineer made an immediate inspection in the driving rain and rising wind and discovered that the main deck was cracked from the vicinity of the after port corner of No. 3 hatch over to the sheer strake. The crack ran slightly aft as it went outboard. With the aid of a flashlight the Master was able to determine that the crack extended down the vessel's side through three shell plates. The strengthening strap on the sheer strake was buckled outboard and was cracked approximately one-third of the way through. Several rows of rivets on either side of the crack had been sheared and others had been started.

The crack worked with every roll and pitch of the ship and it was apparent that the situation could worsen with little or no warning. An emergency message was sent to the Commander, 13th Coast Guard District, in Seattle, advising of the vessel's predicament, but it was up to the crew to remedy the situation. All hands were called out and under the direction of the Chief Engineer preparation was made to commence emergency repairs.

After the first hurried inspection, a complete inspection of the forward end of the vessel was made. It was discovered that in addition to the main deck and shell plate fractures, there was a small crack at the forward starboard corner of No. 3 hatch on the main deck and a small secondary crack leading off at a 45° angle, tending aft, one-third of the way to the sheer strake from the after port corner of No. 3 hatch. In the lower 'tween deck it was found that the shell plating crack had ruptured frame No. 92. It was also found that in the upper 'tween deck there was a crack at the after port corner of No. 3 hold.

As the most serious crack appeared to be the one on the port side of the main deck leading away from No. 3 hatch, emergency repairs were started there. On either side of the crack, near the port bulwark, was located a heavy bitt and chock. Two 300-foot winch falls, 8 x 19 steel wire, were lashed tightly around this bitt and chock. On the starboard side, in a similar manner, the 1½-inch insurance cable was lashed around the bitt and chock located there. This lashing was set up as tightly as possible and was held fast by means of an after deck winch.

In addition, various lengths of cargo deck lashing chain were made fast on either side of the crack and set up by means of turnbuckles. Around No. 3 hatch coaming was wrapped a length of five-eighths inch steel wire. This was done to prevent the diagonal hatch corners on the port side aft and the starboard side forward from opening further than they had.

The emergency equipment drill was used to drill the ends of the main deck crack both in the hatch coaming and in the shell plating. Holes were also drilled at the ends of the smaller cracks in the 'tween deck, on the main deck, and at the forward starboard corner of the hatch. *With one exception, none of the cracks extended beyond the drilled holes.* The exception was the crack in the upper 'tween deck plating at the port after corner of No. 3 hatch. The first hole was drilled approximately 4 inches from the corner and after the crack continued to run, a second one was drilled approximately 7 inches from the corner. The crack did not extend beyond the second hole.

The Chief Engineer, Mr. Charles T. Schonbeck, who had been aboard the vessel since it was received from the United States Navy in 1947, had burning and welding outfits complete with 200 cubic feet of acetylene gas and 244 cubic feet of oxygen. He also had an ample supply of welding rods which were used in normal operation to weld deck cargo lashing pads on deck since the vessel frequently carried large deck cargoes of lumber.

It was decided to weld several plates over the main deck crack and to install strengthening angle bars over the shell plating crack. Five steel blank flange plates from the No. 2 deep tank bilge wells were removed for this purpose. These plates were 25 inches by 18 inches by ⅝ inch. These plates were fairly evenly spaced over the crack and were welded in place. (*See Figure 1.*) Difficulty was experienced at first in making the weld hold since the crack was working approximately three-eighths of an inch, but, upon tightening the winch falls, the amount of movement was materially reduced.

In the upper 'tween deck level, four tie bars, which were fabricated from

1¼-inch diameter steel rod and threaded on both ends, were inserted and bolted to frames 91 and 92. Holes were cut in the frames for this purpose. Seven cargo deck lashing chains of seven-eighths inch pear-shaped links were brought up tight with turnbuckles between deep web beams 90 and 95. The jumbo boom turnbuckle was also installed between these web beams. Holes were burned in the beam flanges and the turnbuckle shackles were bolted to the beams. (*See Figure 2.*)

In the lower 'tween deck, five angle bars which were obtained by cutting up a deep tank ladder, were welded across the crack. Three tie bars were also installed between frames 91 and 92 for additional reinforcement. In addition, short sections of angle bar were welded around the end of the crack to prevent spreading.

The foregoing repair job was completed 42 hours after the casualty occurred. The Chief Engineer stated that he had nothing but praise for the manner in which the crew, regardless of department, turned to and carried out his instructions. A constant watch was kept on the cracks after the repairs were completed and careful attention was given to the vessel's course and speed. On November 22, 1954, the vessel arrived safely in inland waters off British Columbia and continued on to Seattle.

In conclusion, it is believed that this emergency repair job, which was done with limited equipment and under difficult conditions was most commendable and reflects a high standard of leadership and ability on the part of the officers and crew of the SS *P & T Trader*. These emergency repairs may well have prevented the ship from breaking in two with possible large loss of life. Congratulations to Capt. Douglas E. Wilson, Chief Engineer Charles T. Schonbeck, and the crew of the SS *P & T Trader* for an outstanding exhibition of good seamanship.

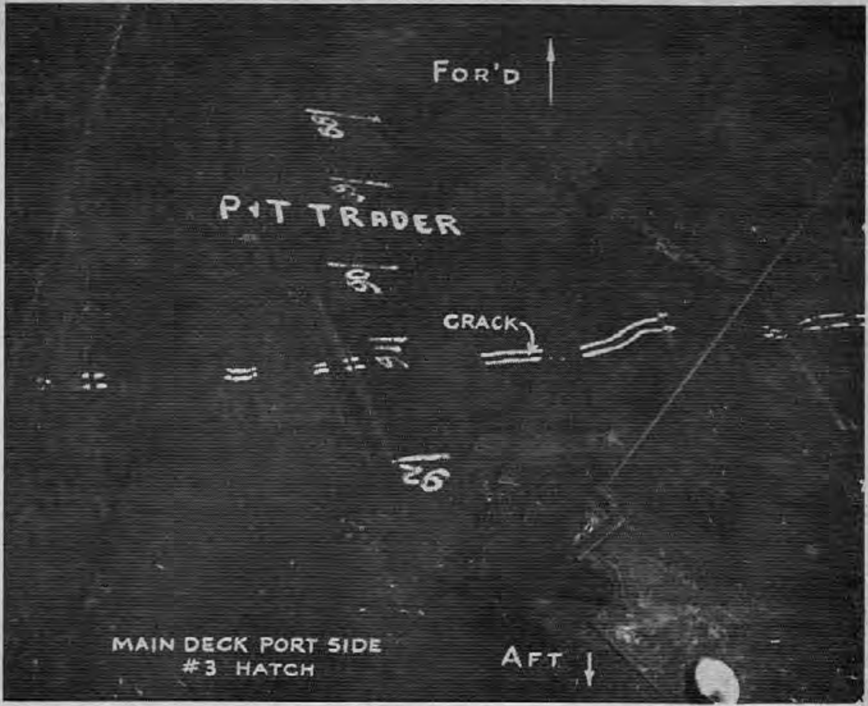

Figure 1. **Looking forward on port side main deck of SS *P & T Trader* showing crack and emergency welding repairs.**

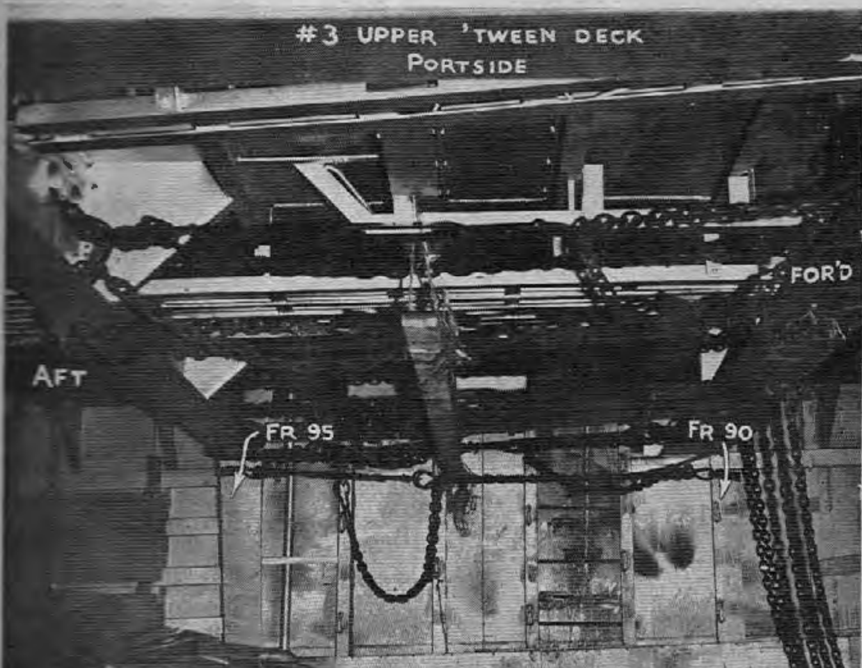

Figure 2. **Looking outboard from port side upper 'tween deck showing turnbuckle arrangement.**

RED HOT DECK

The officers and crew of the SS *Neva West* recently handled a shipboard emergency with commendable efficiency and inventiveness. A fire at sea which could have endangered the entire ship and its complement was extinguished in a few hours with minimum damage. To get at the seat of the fire, a hole was cut through the deck plating using an improvised electric welding rig.

The *Neva West*, a victory-type freighter, operated by Bloomfield Steamship Company, was enroute from New Orleans to Bremerhaven with a cargo of baled cotton, grain, and general cargo. Five days after sailing, with the ship well out in the Atlantic, fire broke out in No. 1 hold. At 5:18 a. m., the helmsman called the second mate's attention to what appeared to be smoke issuing from No. 1 hold. The mate immediately sent him forward to investigate, and called the Master, chief mate, and Chief Engineer. Black smoke by now was visible pouring from the windlass control box and the *Neva West* was quickly turned and headed downwind at slow speed.

Upon arriving at the scene, the Master, Oran L. Snodgrass, assumed charge of the fire-fighting operations. All vent covers for No. 1 hold were left intact and the hatch covers were left in place. The steam smothering line was opened and the hold flooded with steam for two hours. An attempt to enter the hold by way of the forward masthouse to ascertain the extent of the fire was unsuccessful because of the heavy smoke and heat. Then, it was noted that one section of the main deck just forward of the starboard corner of the hatch was heated more than any other portion, and was becoming red. Seeing that, the Master ordered a hole cut in the deck for the admission of a fire hose.

First the deck was cooled by a hose stream; then, using a length of welding conductor some workman had accidentally left aboard at the last shipyard visit, the Chief Engineer, Harry O. Gwin, and the ship's electrician, Edward G. Keagy, rigged up a welding circuit from the main power supply panel at the anchor windlass resistor box. A piece of metal rod was cut in the shape of a welding electrode. With a heavy current and the electric arc from the electrode, it was possible to fuse the metal of the deck plating enough to burn a hole through and then enlarge it.

Within 11 minutes a hole was cut large enough to allow a solid stream of water from a $2\frac{1}{2}$-inch fire hose to be directed on the seat of the fire. Within a short time it was under control. Then, the pontoons were removed from the hatch and the crew turned to, removing the smoldering cargo. By noon there were no longer any traces of fire. Damage to the vessel was small. Some cargo had been damaged by fire and water but the total damage was insignificant compared to the value of the entire ship and its cargo, to say nothing of the lives of all aboard—all of which had been saved from the possibility of an overwhelming inferno by the plucky and intelligent efforts of the officers and crew.

The source of ignition of the fire could not be definitely ascertained. There were indications of overheating in one electrical circuit which passed through No. 1 hold, but this point was 11 feet from the origin of the fire. Spontaneous heating of the cotton was a strong possibility but could not be verified.

The problem of burning a hole through a steel plate may sound like a simple detail. However, when your ship is at sea and you have a fire smoldering under your feet and no oxy-acetylene torch aboard with which to cut a hole to get at it, the problem of making a little hole becomes a big problem. The personnel of the *Neva West*, especially the electrician, deserve praise for the efficient manner in which they coped with a shipboard emergency.

Cutting or burning metal by the use of an electric arc is an industrial process with many applications where the cut does not have to be particularly smooth or clean. During an emergency at sea when it is necessary to cut into a deck plate or sever an anchor chain, the arc cutting process could be worth its weight in gold. Materials necessary for this operation would be: Heavy conductors equivalent to No. 0000 wire (or the heaviest you can find) long enough to reach from the power source to the cutting point, an electrode, and a non-conducting handle to hold the electrode.

On a vessel fitted with DC electric auxiliaries, the most practical electrode would be a carbon rod. If the vessel is equipped with carbon-arc searchlights, rods from these searchlights would serve well. Any stick of carbon will function as an electrode. The center pole electrode from the interior of a dry cell (especially the larger No. 6 size cell) has been used successfully for arc cutting.

If no carbon rod is available, the most practicable makeshift electrode would be a piece of steel rod of about $\frac{1}{4}''$ diameter and $18''$ long. If no steel rod is available, steel pipe of about the same cross-sectional area would be useable. Using steel, it will be well to have spare electrodes on hand, as the steel electrode will fuse and melt away readily as the steel is being cut.

The conductor must be secured to one end of the electrode with a screw clip or heavy electrical clamp and the return conductor secured to the metal to be cut a few feet from the cutting point. In addition, there must be some manner of holding and manipulating the electrode so that the person is absolutely insulated from it. Pieces of rubber hose would be useful for such insulation.

With an electrode of approximately $\frac{1}{4}''$ diameter, an electrical current of about 300 amperes is necessary to obtain enough heat for fusion. Therefore, the source of power should be one of the ship's main feeders, such as the power supply line to the anchor windlass or the deck winches, so that a heavy current can flow through this circuit without dangerous overheating.

However, since the contact of the electrode with the metal to be cut in striking the original arc would create practically a dead short back through the line to the generator, it is necessary to include sufficient resistance in the line to limit the current to 300 to 350 amperes. By connecting the conductor to one side of the power supply in series with the resistors installed in the starter circuits of most heavy duty DC motors, such as the anchor windlass or deck winch motors, sufficient resistance can be obtained. The return conductor, grounded near the cutting point, should be connected to the other side of the power supply circuit.

It may be necessary to bypass or install jumpers across the fuses and circuit breakers in the power supply line. Rendering safety devices inoperative or badly overheating circuits in this manner are not justified, of course, unless a true emergency exists, in which case they are fully justified.

Before attempting to make the cut, the operator should provide himself with a rubber mat on which to stand, thus insulating himself from the steel deck. If cutting is attempted on an anchor chain, care should be taken that no person is touching it while current is flowing.

To cut the metal, the operator strikes an arc by touching the end of the electrode lightly to the base metal, quickly withdrawing it approximately $\frac{1}{4}$ inch, then holding the electrode at just enough distance from the base metal so that the electric current continues to flow. As the end of the electrode fuses and melts, the electrode is moved closer to maintain the proper arcing distance. By holding the arc at one point on the base metal, the fusing process will gradually continue into and finally penetrate through the base metal.

On vertical work, the molten metal will tend to flow down and away from the cutting point, thus enabling the fusing process to penetrate through the metal more quickly. On horizontal work, the molten metal will tend to collect around the arc and remain in a puddle, complete penetration thus requiring more time. In any event, the operator should take extreme care not to touch the electrode or connection to the conductor with any part of his body, or a lethal shock may result.

Most U. S. merchant vessels built since World War II and many tankers built before or during the war are fitted with AC power for auxiliaries. On an AC ship, the improvised arc cutting method should probably not be attempted unless an experienced electrician is available, because the inclusion of proper resistance in the makeshift burning circuit from AC equipment may be considerably more complicated.

Since the molten metal running from this cutting process could be the source of additional fire, or the overheating of a ship's circuit carrying this heavy current could result in permanent damage to the circuit or even an additional fire, such risks must be carefully weighed against the exigencies of the situation. If there is really an emergency, and a hole or cut is badly needed, these risks will be small compared to the risk to the whole ship. The improvised arc cutting method may help to save *your* ship, someday.

POOR JUDGMENT

A merchant ship loaded to her marks arrived off a foreign port after sunset and during bad weather. The wind was blowing a gale directly on shore with heavy rain squalls in which the wind reached force 8. The anchorage was congested due to the presence of a number of other vessels, many of which were experiencing difficulty in holding, even with two anchors down.

The master ordered the anchor "let go" and almost immediately it began to drag. He hove up and proceeded farther off shore and again anchored with 90 fathoms of chain out. He again began to drag despite the use of his engines to ease the strain on his ground tackle. After about an hour he again hove up and steamed off shore at slow speed.

At about 0400, the night dark and the wind still of gale force and a heavy swell setting in, he ran back for the anchorage. His lookout was stationed on the bridge because of the seas that had been coming over the bow while heading into the wind. After about half an hour, when he concluded he was close enough to the beach to anchor—no soundings had been taken at any time—he discovered that he was well into the congested anchorage and was dangerously close to the beach. Full use of engines and rudder were insufficient to extricate the ship from this position due in part probably to the shallowness of the water in which she then was. Both anchors were let go but the vessel lay in the trough of the sea and drifted broadside onto the beach.

A tug was dispatched to her assistance but could not get close enough to pass a line in the shallow water and the heavy seas. The ship was pounding heavily and after about an hour and a half broke in two. Lifeboats and life rafts were launched and a part of the crew reached the beach although one man was swept off his life raft and drowned and the first lifeboat was capsized in the surf. The remainder of the crew stayed by the wreck and were taken off the following day.

The master was charged with inattention to duty and unskillfulness and after a full hearing was found guilty and his license suspended for a period of 6 months. The conclusion was inescapable that after anchoring in a dangerously congested area under conditions which showed that the vessel's ground tackle would not hold, the master had properly gotten under way and had gained sea room where he could lie to or hold his position with the use of his engines. A short time thereafter he re-entered this congested anchorage under conditions which placed him in greater peril than at the time when he first anchored. Inadequate precautions as to lookouts and soundings were taken with the result that he overran his estimated position and caused the total loss of a valuable cargo vessel and the death of one of his seamen.

NAVIGATION

OVERTAKING IN NARROW WATERS

THE SUCTION effect of two ships passing close aboard each other at other than very slow speeds has long been recognized. It was the subject of exhaustive study in the collision between H. M. S. *Hawke* and the S. S. *Olympic* in British waters in 1911.

Less appreciated, perhaps, is the extent of water displacement and disturbance well ahead of a vessel moving at speed, particularly if that vessel is of a full form. This displacement is exaggerated if the vessel is moving in a confined waterway or channel. It can be noticed in any jetty-protected entrance by observing that the water level rises on the jetty at any point well in advance of the passage of that point by the vessel's bow.

In other words, a full-bodied vessel, such as most cargo ships, tends to push ahead of her a small hill of water, sometimes as much as a foot high and extending in a semicircle around her stem. The actual extent depends on the vessel's lines, her speed, and the nature of the channel. The fact that a certain amount of water is pushed bodily ahead, before it can slip past the bows, tends also to cause a hollow or trough somewhere amidships of the vessel.

In the case of two steamers passing on opposite parallel courses these displaced waters act to some degree to keep the ships apart: the bow of each tends to be deflected away by the mound of water created by the movement of the other. But where two vessels are not passing bow to bow the effect may be very different and should be given careful consideration by the master of the burdened vessel.

A clear example of the need for care is given in a collision case occurring in the Delaware River some years ago. Two full-bodied cargo steamers were proceeding down river, the leading one at a speed of about 9 knots while the second was overtaking her at about 12 knots. Weather conditions were clear, with no wind. It was shortly after nightfall.

The overtaking vessel blew two blasts, and was answered by the leading ship which was keeping well to the right-hand side of the channel. At that particular point the river is quite wide, giving the illusion of ample sea room, but actually the ships were obliged to pass in a narrow (300-foot) dredged channel. The sum of their cross-sectional areas amounted to almost 20 percent of the area of the channel prism.

When the overtaking vessel's bow had drawn abreast the stern of the other, the latter took a rank sheer to port, across the bow of the overtaking ship. That vessel backed hard with full left rudder, but collision was unavoidable. Fortunately, enough change of direction and loss of headway was produced by the overtaking vessel so that the contact was broadside to, and comparatively minor damage was suffered.

In the investigation the burdened vessel claimed that, after passing signals were exchanged, the overtaken ship had failed to maintain course and speed, but instead had altered course under circumstances which rendered the collision inevitable. The overtaken vessel denied altering her rudder and claimed that the sheer taken was due to suction of the overtaking ship.

Actually, of course, this was the case, although it was water displacement rather than suction which caused the sheer. The two vessels were occupying a substantial amount of the cross section of the channel. As they drew abreast the displaced waters were further restricted. That pushed ahead of the overtaking vessel impinged upon the port quarter of the overtaken ship sufficiently to throw her stern to starboard.

An example of the opposite effect of displaced waters is found in a similar case where the overtaking steamer sheered into the leading vessel. This occurred in a 30-foot dredged channel with a bottom width of 150 feet. The overtaken vessel was of 60-foot beam and was drawing 28 feet. The vessel coming up astern was of 40-foot beam and 17-foot draft. It will be noted that not only was the larger vessel clearing bottom by only 2 feet, but that the cross-sectional area of the two accounted for almost 40 percent of the channel prism. In this case the bow wave of the burdened vessel was insufficient to affect the much larger leader, but when the bow of the former came about amidships of the overtaken vessel the suction of her trough caused the smaller craft to swing sharply into her, seriously damaging both vessels.

The obvious answer in such casualties is to avoid overtaking in a narrow waterway unless it can be done at a very slow speed. When a large vessel is overtaking a smaller one, both steaming at practically full speeds for their respective hulls, the water disturbance, not to mention the tendency to "smell" bottom, renders the steering of both vessels subject to serious aberration.

RELIABLE ARE THE RULES

The editor of *THE LOG* has suggested that the term "target", in speaking of radar images, be avoided, as all to often a radar observed object unfortunately becomes a target. Call them what you will, radar images, with a frequency that belies the present degree of perfection of radar installations, continue to become tangible objects impeding the movement of ships (at full speed) in fog.

The fault lies not in the design, construction, or operation of the radar installation, but in the attitude of those who con the ships so equipped. This fact has been presented many times in many publications, including radar manufacturers' instruction books, textbooks, trade magazines and other maritime media. Radar was designed to give the operator an instantaneous range and bearing of an object; nothing more.

If the object be another vessel, a rock or point of land, a buoy, an iceberg or rain squall, all that can be expected of the radar set is a reasonably accurate range and bearing. An experienced operator may be able to identify the various objects sighted, particularly if the operator is familiar with the land masses and aids to navigation in the vicinity of his vessel. Radar then becomes invaluable in piloting in poor visibility. One range and bearing of a known fixed object provides the information necessary to set a proper course.

However, collision-avoiding action requires more information than a range and bearing. Knowing a vessel's position with respect to yours at a particular instant does not preclude the possibility of collision. The other vessel may be approaching, going away, or crossing. It may be going around in circles or drifting. It may alter course and speed radically; who knows? You need several ranges and bearings to determine what the other vessel is doing, but even this information is no guarantee as to what the other vessel will eventually do.

At this point, let us leave the general discussion and proceed to a spot on the western shore of Chesapeake Bay at Point Lookout where we may assume our radar set is in operation

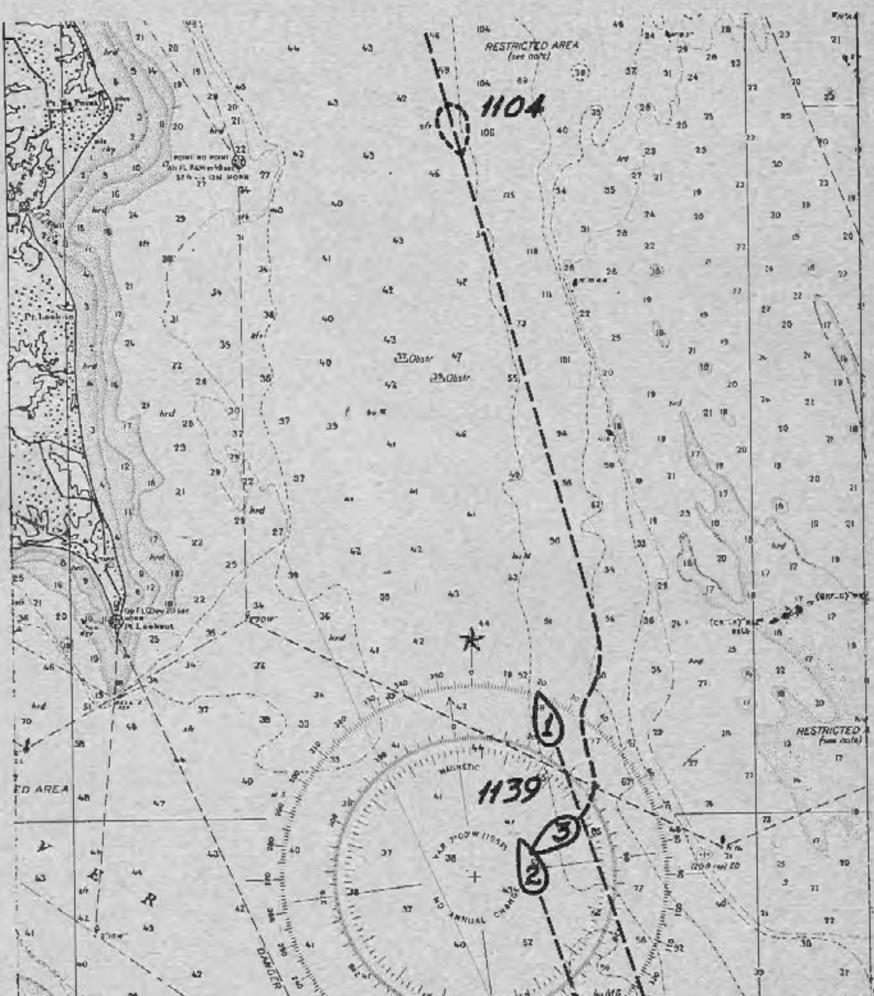

Figure 1. **Chart showing Point Lookout vicinity of Chesapeake Bay where collision occurred.**

during an actual casualty. A scene from real life is taking place. If we keep our eyes and ears open, we may pick up a few pointers in connection with the use of radar. (*See Figure 1.*)

In addition to the contour of the bay and the mouth of the Potomac River, we can spot quite clearly Smith Point Lighthouse at a distance of approximately 12 miles, bearing SE x S (146° T), and Pt. No Point Lighthouse at a distance of 5½ miles, bearing roughly N x E (015° T). Note that the time is 1040 when we sight an object—no, two objects—on the scope in the vicinity of Smith Point Lighthouse. Watching the two objects from our fixed position and in relation to Smith Point Lighthouse, without actually making a plot, we can determine that they are vessels underway, heading up the bay probably toward Baltimore. The after vessel is slowly overtaking the forward vessel.

For the purpose of future reference let us tag the overtaking vessel No. 1 and the vessel about to be overtaken, No. 2.

Now at 1104 a third object appears, coming in strong, heading down the bay opposite Pt. No Point Lighthouse. This vessel, No. 3, is really making time. Perhaps it isn't as thick out there as it is at our vantage point. The situation as it now stands consists of two elements: one, an overtaking situation, and the other, a meeting situation. Nothing unusual, except that one or more of the ships will have to alter course before the passing can be executed.

The situation is developing fast now. It's a shame there isn't some way we could warn No. 3 of the presence of the two oncoming ships, or vice versa.

Figure 2. Starboard bow of upbound vessel following collision.

At 1135 No. 1 has completely overhauled No. 2, having passed close aboard to starboard. But, No. 3 is bearing down and won't clear No. 1 by very far. Look! No. 3 is coming right, right into the path of No. 1. The two radar images are merging into a great blob.

Evidently it was just a close call for, although No. 1 appears to be dead in the water or nearly so, No. 3 is continuing her swing to the right. It looks like No. 3, having missed the first vessel, is trying for the second, and it looks like she'll make it.

1139. She did! The blob is back on the scope, this time consisting of Nos. 2 and 3. No. 1 is maneuvering, cautiously approaching the scene undoubtedly to render assistance.

What really happened? What would an investigation of this collision disclose? Departing our vantage point, let us consider the facts, amplifying what we have seen and already know.

To begin with, vessel No. 3 was equipped with radar which was in good condition and in operation. It was being used for piloting and for detecting other vessels. Vessel No. 1 was also radar equipped and its radar was in operation. Vessel No. 2 was not radar equipped.

Vessel No. 1 was proceeding up Chesapeake Bay in the fog on reduced speed of 12 knots sounding regulation fog signals. (If you care to call 12 knots reduced speed when the visibility is about a ship's length.) Vessel No. 1 correctly and quickly appraised the first object presented in her radar scope as a vessel underway on approximately a parallel course—an overtaking situation. This vessel, vessel No. 2, was overtaken properly. The other object, vessel No. 3, appeared to be approaching in such a manner as to pass safely down the starboard side, but the radar did not indicate that No. 3 would come right, practically into the jaws of collision. Timely evasive action by both vessels prevented a disaster at this time.

Vessel No. 2, also heading for Baltimore, was proceeding at a speed slightly less than eight knots, sounding regulation fog signals. Fog signals from a vessel astern indicated that an overtaking situation was progressing nicely. Later, the overtaking vessel could be seen through the fog, distant about 300 ft. After this vessel had gone on ahead, her fog signals still being heard, signals from another vessel ahead, apparently approaching, were picked up. Vessel No. 2 immediately stopped her engines as required by Article 16, Pilot Rules for Inland Waters. When the second fog signal from the approaching vessel was heard, the engines of vessel No. 2 were put full speed astern. And, when this unseen vessel finally broke through the fog at a distance estimated to be about 1,000 yds., about four points on the starboard bow, she was seen to be swinging right and pushing a high bow wave. Two emergency full astern signals were given on No. 2, and at the moment of impact she was actually making sternway.

Vessel No. 3 departed Baltimore early in the morning, and after passing Fort Carroll at 0620, her engine revolutions were increased to full speed. The weather at this time: overcast, light northerly winds, visibility about 2 miles. She pursued the normal bay course at full speed passing Cove Point one mile off at 1000. From Cove Point she made good her course and at 1104 passed Pt. No Point one mile off. Due to fog, these distances were established by radar. She then overhauled a small vessel, seen only by radar, about a half mile to westward of the course line. Following the course change at Pt. No Point, two objects were picked up on the three mile range of the radar scope. These targets were ahead, one favoring the starboard bow. After determining that they were inbound vessels, it was decided to put the "targets" on the port bow and a course change to the right was ordered. Also, it was decided to be a *good idea* to commence fog signals, the visibility now being somewhat less than one mile. Change of course to the right was ordered in 5° increments when fog signals off the port bow were heard. As the approaching vessel's fog signal appeared to be closing in, hard right rudder was ordered.

While vessel No. 3 was swinging to the right, a deeply-laden vessel (vessel No. 1) broke through the fog about a shiplength off the port bow. In order to clear this vessel, hard left rudder was ordered followed by hard right as the approaching vessel passed the bow of No. 3. Shortly after clearing this vessel, the fog signal of the second target was heard. This signal was answered by vessel No. 3 continuing her swing to the right with no reduction in speed. At about 1138½, when the second target broke through the fog bearing three to four points off the port bow, distant a half mile, the engine of vessel No. 3 was put full astern. This maneuver was neither timely nor sufficient under the circumstances to prevent collision. The vessels collided at 1139, with the bow of No. 3 slicing through the forecastle deck, forepeak, boatswain's stores and chain locker of the other vessel, from starboard to port, in a knifelike fashion. The illustrations attest to the damage sustained and to the force of impact.

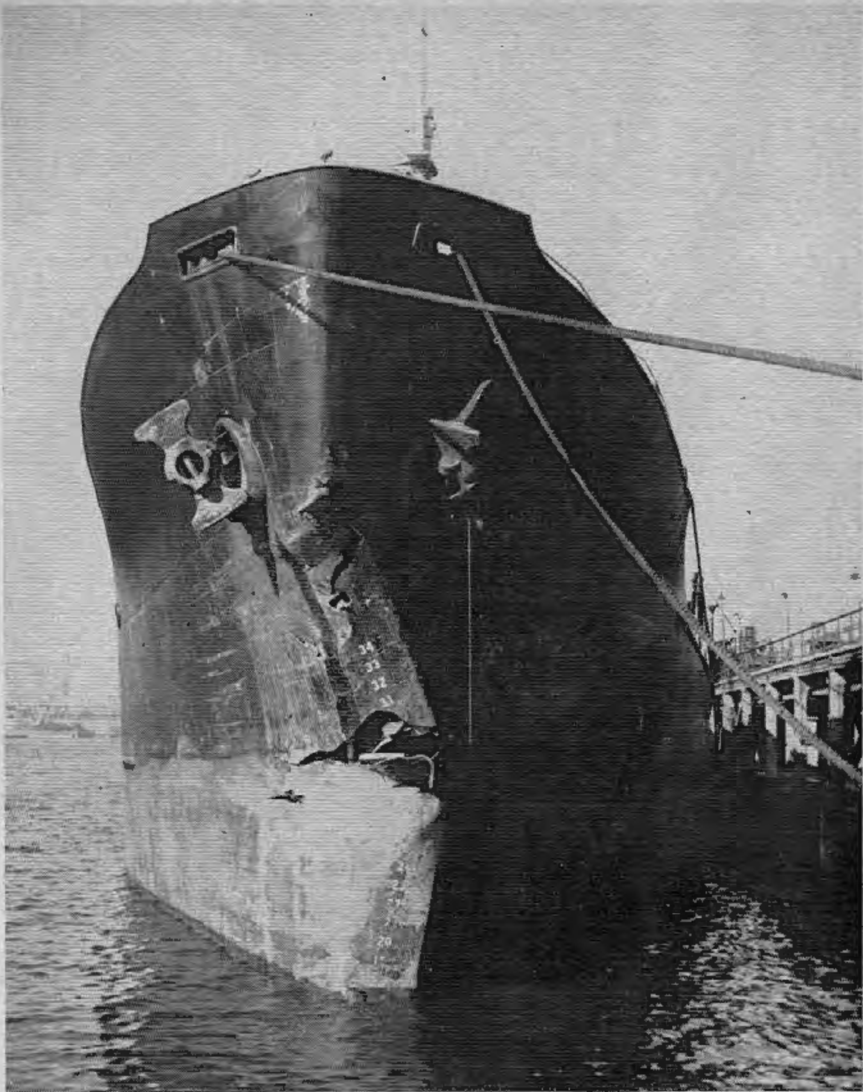

Figure 3. **Bow of downbound vessel following collision.**

So end the facts. What was originally said has been borne out. Moreover, the following is obvious:

(1) That the vessel tagged "No. 3" was navigated at an uncontrollable speed of 14½–15 knots during a period of visibility ranging from 500 feet to a half mile.

(2) That after hearing apparently forward of the beam the fog signal of an approaching vessel the position of which was not ascertained, the person in charge of the con of vessel No. 3 failed to stop the engines and navigate with caution until danger of collision was over.

(3) That the person in charge of the con of vessel No. 3, with full knowledge of the presence of an approaching vessel, actually altered course in the direction of the course line of the approaching vessel without definitely establishing her position.

(4) That, although vessel No. 3 had the advantage of radar, the information elicited therefrom was misinterpreted.

(5) That the Rules to Prevent Collisions of Vessels continue to be the most reliable rules to follow in fog, and that these Rules when properly used in conjunction with further information obtainable from the radar scope may become virtually infallible.

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RADAR PLOTTING

A number of articles have appeared in these "Proceedings" on the subject of radar. In these there was mention of the necessity of using the information furnished by the radar to make a plot to determine the track of the target. Because it seemed obvious that how to make such a plot would be within the knowledge of any officer on a bridge watch no discussion on this point was made.

However, the fact that there are on record several collisions in fog in which one of the ships had a radar in use leaves us no other impression than that there is a need for education on the matter.

Two of these fog collisions were meeting situations and two others were crossing cases. If these approaches had been made in broad daylight the officer on watch would have had little difficulty in estimating the situation. It might take him some time to determine if a vessel sighted dead ahead, hull down, involved a meeting or an overtaking situation, but in time he would have the answer. By taking bearings during the approach he could have determined if there was risk of collision.

Everything he could have done with his naked eye the radar can do, but better. Can he fix the speed of the other vessel? Can he accurately determine its course? Can he accurately determine the distance off? No, but the radar can supply the information which will enable him to do so IF he knows how.

The radar will, in addition to a bearing, supply the range. A series of such ranges and bearings will, if properly plotted (taking into account the movement of your own vessel during the intervals), tell you the course and speed of the vessel. Knowing this you know whether the approach is one of meeting, crossing, or overtaking. With this knowledge you are in a position to decide how to avoid that vessel.

Let us assume you are on watch on the high seas on a ship in a pea-soup fog (and don't forget to sound that whistle every 2 minutes even though you do have your radar in operation). Let us also assume the ship is making 15 knots, which is a moderate speed only as long as there is no collision. You or someone else is looking at the radar scope periodically or maybe continuously, and if it is periodically it should be much oftener than every 10 minutes. The radar is working beautifully and eventually a target is picked up dead ahead distant 10 miles.

Now if it were a clear day there would be no difficulty. There should be none with the radar supplying information. Your main concern is to determine whether you are in a meeting, crossing, or overtaking situation. Assuming that the bearing remains constant, you know that you are either overtaking or meeting the other vessel. A little thought on the matter will give you the answer. You know your speed is 15 knots and that you travel a mile every 4 minutes. If the target is a lightship on station your ship will close it at the rate of her own speed, that is, every 4 minutes the radar range will be 1 mile less. If it takes more than 4 minutes for the range to decrease 1 mile, you should know that you are overtaking. Let us say it takes 6 minutes, you know then that the relative speed is 10 knots. With your speed of 15 knots you are gaining only at the rate of 10 knots, obviously the other vessel is making 5 knots on the same course. Conversely, if the range decreases 1 mile in less than 4 minutes, the two vessels are approaching on reverse courses. If she is making 5 knots, the relative speed of approach is 20 knots and the range should drop a mile every 3 minutes.

Having made the determination whether it is a meeting or overtaking situation you are in a position to take avoiding action. Take it early, give the other vessel a wide berth, and in the meantime keep her under observation in the radar scope for any possible changes in speed or course. After all, she might have a radar too and might have taken avoiding action also.

Let us take the crossing situation. Suppose you pick up a target three points on the starboard bow. If it were in sight, you would step to the pelorus and take a few bearings to see if the bearing changed. The same thing can be done with the radar. In addition to the bearings it will also give you the ranges. If the bearings change rapidly, the chances are good the vessels are going to pass well clear of each other. If the bearings do not change, or only slightly, the vessels are on collision courses and something has to be done. Here again, get your information early, decide what best need be done and then do it early, keep the vessel under observation in the radar for any changes she might make which could nullify the action you took.

To make the plot, previously referred to, in order to determine the course and speed of the target is a simple matter. Suppose you are making 15 knots on a course north true and a target is picked up bearing 50° true at a distance of 10 miles. Take a piece of paper, or a plotting sheet, or a mooring and maneuvering board (H. O. 2665), or if the second mate does not object use the chart and run off a line indicating your course of north true. Then from a point on this line run off a line 50° true and at a point 10 miles to scale on this line plot the position of the target. Six minutes later the range and bearing is 8¾ miles on a bearing of 55°. During this time you have moved ahead 1½ miles. Plot this point and from there run off a line bearing 55° and mark a point 8¾ miles from your position. Draw a line joining the two positions of the target and extend it until it crosses your track. With the parallel rulers run this line down to the compass rose and you will find that the vessel is on a course of 282° true. Then with your dividers determine the distance between points. You will find that during the 6 minutes the vessel has moved a half mile, therefore her speed must be 5 knots.

The point at which the two lines cross is 8.1 miles from your position at time of the first bearing and is 7.8 miles from the first position of the target. If both vessels maintain their courses and speeds your vessel will arrive at the point in 32 minutes while it will take the other vessel 1 hour and 34 minutes.

Don't be satisfied with only two bearings. In the instant case the target vessel might have increased speed to 15 knots right after the second bearing, thus changing the situation as to involve risk of collision. Unless a continuing plot is made any change in the situation would not be detected.

The vessel picked up by radar has been referred to here as the target. This is a poor selection of words as a target is usually thought of as something to hit. This is one case where in missing the target you get satisfaction.

"OUT HERE, — THE SKIPPER'S WORD IS LAW!"

(Courtesy Maritime Reporter)

AN EXIGENCE OF OXYGEN

A CASUALTY occurred two years ago on an ocean-going freighter in which the outcome was considerably happier than could have been expected. This casualty was highlighted by the efficient operation of the Master, officers, and crew under the stress of fire at sea.

A fire of terrific intensity which was being fed by pure oxygen was extinguished; a crew member who had leaped overboard with clothes aflame was recovered by the ships boat crew; and nine passengers and fifty-two crew members were brought safely to shore. This fortunate outcome of a situation fraught with peril, and which could well have resulted in the loss of the ship with great loss of life, was due in large measure to the courageous, intelligent, and persevering efforts of the officers and crew.

The ship involved in this modern saga of the sea was the SS *President Pierce*, under the command of Captain Frederick P. Willarts. She was underway in the Western Pacific bound for Yokohama when the fire occurred.

A few minutes before 1 p. m., on February 13, 1954, the third mate was standing watch in the wheelhouse. Suddenly, the quiet was shattered by the ring of the alarm bell on the fire-detecting system. As the mate turned to check the smoke detecting box, the helmsman shouted: "There's a fire at No. 3 hatch!" Turning to look out the forward wheelhouse windows, the third mate was greeted by a blast which shattered the windows. The wheelhouse was immediately filled with smoke and flame. Three more explosions followed in rapid succession. As soon as the smoke cleared the third mate ran to call the Master, and the helmsman ran for the nearest fire extinguisher.

Prior to this, the chief mate had been sitting in his room preparing voyage reports. A knock at the door brought the news from the refrigeration engineer that smoke was pouring from No. 3 upper 'tween decks into the midships shelter deck area. The two men ran forward, were met by another wave of white smoke, and shouted for the boatswain and deck crew. At this moment the first explosion shook the quarters and the passageways were filled with smoke and flame as the first blast was followed by three more.

Sitting at the desk in his office, the Master, alerted by the first explosion, leaped into action. He gathered the passengers, seven women and two men, from adjoining staterooms as quickly as possible and directed them to assemble near the stern. He then took charge of fire-fighting activities.

As the crew led out hoses in the midships area, they noticed that all the hatch boards and four hatch beams had been blown off No. 3 hatch; there was fire throughout No. 3 hold; and the forward end of the midships house, pilothouse, and adjoining deck area were aflame.

Within three minutes of the first detection of smoke, *there were eight fire hoses in play*.

Fires on the midships house and pilothouse were extinguished first.

Suddenly, the chief mate noticed a man with clothing aflame leap overboard. He informed the Master who ordered a boat crew to their stations. Within five minutes, a lifeboat was launched with an eight-man crew, to try to recover the man who had jumped overboard.

Soon thereafter, the fire on deck and in the quarters was quickly brought under control. As the wind was broad on the bow, the Master changed course to bring the wind on the stern and reduced speed to that of the wind in order to get a dead calm. The fixed CO_2 system was discharged into No. 3 hold and the adjoining spaces at intervals as a preventive measure.

An SOS was broadcast advising that the vessel was afire. Inasmuch as her position was only a few miles from port, several vessels immediately prepared to get underway.

Forty minutes after launching the lifeboat, the man who had jumped overboard, a messman, was hauled from the water badly burned and suffering from shock and exposure, but alive. Needless to say, he will never forget the eternity of those forty minutes of anguish from the pain of burns and the shock of immersion, panic as the vessel steamed away, and of hope and jubilation as the lifeboat bore down upon him.

Fire was still burning fiercely in No. 3 hold, but was kept from spreading by the hose streams of the fire-fighters. Within an hour a Naval transport arrived at the scene. Whereupon, all passengers and four crew members who had suffered burns were transferred to the transport.

By this time the fire in No. 3 hold appeared to be under control, so the Master decided to head for a safe harbor. Following the Naval transport, since all navigational instruments were inoperable, the seared ship reached port in three hours, the crew still fighting the fire.

The burning cargo in the wings of No. 3 hold could not be reached from the hatch, so holes were cut in the deck with burning equipment available on board and hoses were inserted through the holes. Upon arriving at the anchorage, fire-fighting crews from Navy and Army vessels came aboard and relieved the now-exhausted crew. Debris was removed from No. 3 hold and thrown overboard. Longshoremen commenced discharging cargo from other holds to lighters.

The vessel now had a 13-degree list to starboard due to accumulated water, and tugs came alongside to assist in pumping out pockets of water in No. 3 hold. The list was rapidly reduced.

Early on the morning of the second day the vessel was shifted to a mooring buoy in the inner harbor, and No. 3 hold was completely discharged, with no further outbreaks.

An examination of the cargo plan shows that in the square of No. 3 upper 'tween deck oxygen cylinders had been stowed, four piles in all. These cylinders were ICC-approved, appropriately marked with green labels, and stowed in accordance with Coast Guard regulations. These regulations require the cylinders to be secured against shifting or working. It was found that several oxygen cylinders had burst which accounted for the four separate explosions.

Practically all the cargo in No. 3 hold was lost or severely damaged. The cost of repairs and cargo damage was approximately half a million dollars.

Fire had apparently originated in the after section of No. 3 upper 'tween deck and spread to the lower 'tween deck and lower hold. The fire in the midships passageways had apparently spread from No. 3 upper 'tween deck through vertical battens running into the midships shelter deck area, as well as through open ports and doors at the forward end of the midships house.

While the source of ignition may never be known, it was the conclusion of the investigating authorities that one of the oxygen cylinders must have come loose due to the working of the ship and cargo and developed a leak—and that the escaping oxygen contributed directly to the source of ignition in one of three ways:

(a) If pure oxygen flowed onto some substance which was already subject to spontaneous heating, such as rags or other debris which contained traces of oil, the rapid oxygenation resulting therefrom quickly spurred the spontaneous heating process to the ignition temperature.

(b) If spontaneous heating of a nearby substance had already created ignition, however small, or metallic materials in contact had caused a spark, the escaping pure oxygen immediately engendered a conflagration. As soon as oxygen cylinders started to rupture, the escaping gas then immediately propagated combustion with terrific intensity, propelling fire throughout the cargo hold.

(c) There are also cases on record of fires occurring in cylinder fittings where minute quantities of oil were injected into the cylinder by the compressor during the charging operation. When minute droplets of oil are vaporized by the escaping oxygen, ignition and sometimes explosion occur.

It appears then that the primary cause of the casualty was some minor flaw in the stowage and securing of the oxygen cylinders, or in the construction of one of the cylinders, which allowed a leak to develop. The ship's officer's main concern must be for tight and secure stowage of the cylinders to guard against shifting.

The regulation governing the stowage of oxygen cylinders is 46 CFR 146.24–50 and can be found in CG–187 *Explosives or Other Dangerous Articles on Board Vessels:*

(a) Cylinders of compressed gas stowed on their sides shall be dunnaged under the first tier so that they will not rest directly on a steel or iron deck. Each additional tier shall be stowed in the cantlines of the lower tier and in no case shall cylinders be stowed bilge to bilge or directly on top of one another. The tiers may be stepped back and the ends alternated in order to clear the flange. Suitable lashing shall be provided to prevent movement in any direction.

(b) When cylinders are stowed in a vertical position they shall be stowed in a block, cribbed or boxed in with suitable sound lumber and the box or crib dunnaged at least 4 inches off the steel or iron deck. The cylinders in the box or crib shall be braced to prevent any movement. The box or crib shall be securely chocked and lashed to prevent movement in any direction.

(c) Lashings in all cases shall be secured to padeyes or other permanent structural parts of the vessel. Pipe rails shall not be used to secure lashings.

While individual members of the crew could not each receive specific citation, each must indeed have felt proud of his part in warding off disaster, and lucky that the leadership, organization, and training needed so desperately in the face of the holocaust were there for the payoff.

On April 1, 1953, Captain Willarts was officially commended by the Commandant of the U. S. Coast Guard for his exemplary conduct in keeping with the highest traditions of the U. S. Merchant Marine.

TRIAL BY FIRE

A grim reminder of the terrible consequences of failing to have a crew trained to cope with emergencies occurred a few months ago when a foreign combination passenger-freight vessel burned at night in an American port. *See Figure 1.*) The deaths of eight passengers and three crew members were directly attributable to the breakdown of the smooth functioning of the crew when it was presented with a disastrous situation for which it had been poorly trained.

The fire apparently started amidst a maze of electrical wiring located behind overhead paneling. Smoke was detected issuing from the paneling; the master was notified; but, no general fire alarm was rung or any positive action taken for several minutes. Consequently, dense smoke and darkness caused by the failure of several lighting circuits hampered subsequent fire-fighting efforts. Eventually fire hoses were run out and streams of water were played on the general overhead area.

Fortunately the passengers were aroused and directed to assemble on the upper deck. By this time dense clouds of smoke had engulfed the entire midships area. Realizing that conditions were beyond control, the Master ordered abandon ship.

While lowering lifeboat No. 4, the after end was dropped, and the boat ended up hanging vertically with two of the crew clinging to the thwarts. When it was finally lowered, the boat partially filled with water, however, some passengers managed to climb down and board the boat.

An attempt was made to lower a liferaft, but it was dropped and lost. Due to the flames the crew was only able to lower two of the six lifeboats. However, they did manage to lower away two small dinghies off the stern.

The chief mate blew a distress signal on the ship's whistle. Fortunately, due to the nearby presence of service installations, this signal was heard and answered. Within fifteen minutes a Navy fireboat and a Coast Guard picketboat were alongside searching for and picking up survivors. All those who were in sight in the water, on the burning ship, or in lifeboats or dinghies were safely transported to shore. However, the final count of survivors revealed three crew members and eight passengers missing.

With the arrival of two Coast Guard cutters on the scene, efforts to combat the fire were intensified, but it was impossible to get into the areas below decks where the fire was raging. Several days later, when it was possible to enter the midship area, the

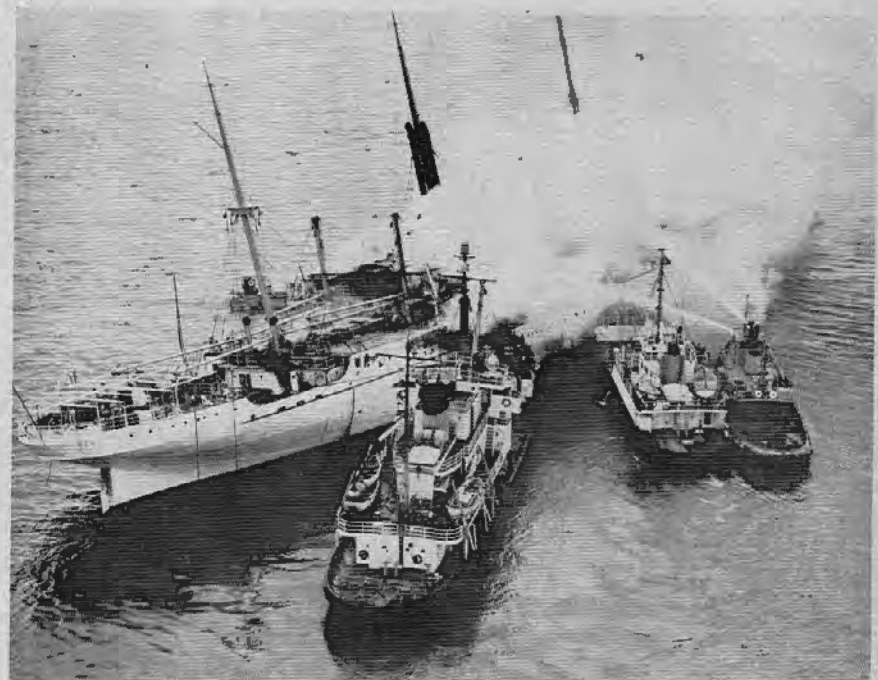


Figure 1. **Coast Guard and Navy vessels fight fire on foreign passenger ship.**

eight passengers were found in a sitting position in the lounge, apparently asphyxiated by smoke, and the three crew members were found burned to death in the crew quarters.

Investigation of this tragic casualty pointed up the deficiencies in the training of the crew to meet emergencies. Effective organization, instruction, and drilling of the crew had not been established or carried out. Many of the crew had not been thoroughly acquainted with their duties for emergencies.

There was no procedure by which the crew could be informed when the emergency organization should change from fire-fighting to abandon ship. There was no effective plan by which the passengers could be warned. Abandon ship was a fiasco. Such organization as had existed vanished in the holocaust of flame and smoke.

The three stark words FIRE AT SEA must ever remain indelibly imprinted on the subconscious minds of mariners, not as an omen of fear, but as a finger of warning.

BLUE CHRISTMAS

It was three days before Christmas. The seven men in the clean-up gang on the barge went busily about their task of preparing her for a "clean" cargo, scraping, shovelling, wiping, hoisting, and climbing, each man preoccupied with thoughts of the happy holiday which was just around the corner. At 9:42 a. m. the foreman left to go to the plant storeroom for additional cleaning rags. At 9:45 a. m. there was an ear-shattering blast! Large sections of steel, structural parts, electrical wires, cleaning gear, and men's bodies flew through the air. When the smoke had cleared, Christmas was forever gone for six men, and but a sorrowful memory for five widows and six children.

The 726-ton tank barge had arrived at the yard December 20th with a load of low pressure distillate, a highly volatile inflammable product with a flash point of less than 50° F. After unloading, orders were passed to clean out all tanks, eight in number, and prepare for a cargo of menthol. The cleaning process consisted of removing all residue of the previous cargo by means of wiping down the tanks with rags, scooping up all accumulated sludge, scale, and product with metallic scoops, and hoisting such accumulation from the tanks by means of wooden hand buckets. Upon removal from the cargo tanks, all residue was deposited in large steel boxes on deck for later removal from the barge by power crane. Before the clean-out gang boarded the barge, certain precautions were taken.

It seems that this load of distillate, which is often cut with light hydrocarbons and used as jet fuel, was the first such cargo to be handled at this yard. Nobody connected with the unloading or stripping-cleaning process seemed to know exactly what the product was or what precautions were required.

The services of two industrial chemists were obtained. Without making any chemical analysis, the chemists decided that the product looked and smelled like kerosene or a mixture of kerosene and diesel oil and that the smell also somewhat resembled gasoline. Wisely, they decided to treat the product and take all precautions indicated as if it were gasoline. This information was passed on to the cleaning gang and they undertook normal precautions necessary for working with a dangerous product involving explosive hazards. Men working down in the tanks wore air line respirators of a type designed to guard against asphyxiation due to lack of oxygen or inhalation of toxic petroleum vapors.

These respirators consisted of close-fitting face masks supplied with air by means of rubber hoses through an air manifold on the deck of the barge and through one or more reducing valves. No smoking or open flames were permitted on or near the barge. Portable electric lights used in the tanks were installed by the yard electricians using explosion-proof lights, wiring, and receptacles, the lighting receptacle stand being installed temporarily on deck. All lighting equipment was grounded by a third wire conductor to the shore.

Nevertheless, there were several weak points in the safety standards employed for working with explosive hazards. While yard standards called for the use of aluminum non-sparking scoops by the clean-up gang, at least one galvanized steel scoop was used. Some of the men were wearing ordinary working shoes which probably contained steel nails. The portable drop lights were not secured carefully in place while in use but the cords were merely draped over convenient angle irons where they could be easily dislodged. No attempts were made to gas free any of the compartments of the barge following the discharge of cargo and before sludge and scale cleaning operations were begun.

Coast Guard regulations require the compartments of any tank vessel or tank barge to be certified as safe by a gas chemist whenever riveting, welding, burning, or like operations ("hot" work) are to be undertaken within or on the boundaries of such spaces or adjacent spaces. The regulations do not specifically require any such formal "gas free" certification to be made prior to an activity which involves no "hot" work. Such a requirement, while desirable from the over-all standpoint of safety, would be impracticable and almost impossible to enforce due to the many thousands of such situations that occur daily.

In the above case gas freeing of the cargo compartments was not re-

Figure 2. Main deck of tank barge showing effects of vapor explosion.

quired. However, the preliminary work of cleaning out and removing the sludge at the bottom of the cargo tanks was a part of the process of gas freeing.

Cleaning operations were begun the morning of December 21 and continued on the following morning. No. 3 tanks, port and starboard, and No. 4 tanks, port and starboard had been completed. Work was underway on tanks No. 1 and 2, starboard. Two men were in No. 2 starboard wearing the air respirator masks and engaged in scooping sludge into the wooden buckets. A third man stood at the edge of the cargo hatch to tend the air lines to the masks and to hoist the wooden sludge buckets as they were filled. Two men were preparing to enter No. 1 starboard with the sixth member of the gang standing by to tend their lines. The foreman of the gang departed to go for additional rags. All hatches were open. Four compartments were completed. No compressed air was flowing except to the respirator masks in use. No pumps or motors were running aboard the barge. All seemed normal.

At 9:45 a. m. without warning, the barge trembled and there were two devastating explosions almost simultaneously. All six men of the cleaning gang were killed so it was impossible to ascertain any of the last minute details of exactly what each man was doing, moving, or touching, when ignition occurred. Bodies of the two men cleaning in No. 2 starboard were found in that tank. One body was found on the main deck near No. 1 hatch, pinned beneath one of the heavy steel sludge boxes. Three bodies were later recovered from the river.

Examination of the barge and analysis of the evidence indicated that the first explosion occurred in No. 1 starboard. A second explosion immediately occurred in No. 1 port, No. 2 port and starboard, and No. 4 port. The deck of the barge was buckled upward as much as 4 feet in places. (*See Figure* 2.) A large section of deck plating 30 feet by 10 feet was blown 200 feet up on the shore, striking a locomotive crane and concrete mixing truck with considerable damage. (*See Figure 3.*) It was of small comfort to the families of the workmen to know that the explosion was so violent and destructive that the deceased undoubtedly died almost instantly.

The setting for the explosion was clear. Steel tanks enclosing an air-vapor mixture from a highly volatile petroleum product provided the loaded gun and the ammunition. Potential sources of ignition existing in or near the movements of the cleaning gang provided the primer. But who pulled the trigger? The death of all eye-witnesses of the actual triggering rendered doubly difficult a true solution of the above question. Only the conclusion that ignition was provided by one of several logical circumstances could be made. The Marine Board of Investigation on this tragic casualty scrutinized four reasonable factors which could well have triggered the detonation. These were:

(a) The dropping and breaking of a portable electric light globe from a suspended position from which it could be easily dislodged.

(b) Ignition by flash fire of inflammable vapors which could have drifted down to the proximity of the steam boiler on a derrick barge which was moored to downwind end of the tank barge.

(c) Friction sparks generated in the striking of the galvanized steel scoop against the barge.

(d) Friction sparks generated by metal in the shoes of the workmen striking the barge.

It was impossible to narrow the possibilities down to one potential source as more likely than the others. Since the cleaning was being performed by a group of experienced workmen all of whom had been employed by the company for several years, it is unlikely that the casualty was caused by any careless or foolish act. More likely, the explosion was triggered by one of the above-stated factors which had probably existed time and again on various cleaning jobs at that yard and which had become tolerated due to habit and usage. Unfortunately the slow dulling process in the awareness of explosive hazards had not been accompanied by any dulling of the explosive hazards themselves.

HIGH OCTANE

A small tanker met disaster last year in an East Coast port when three cargo tanks which had contained high octane Avgas exploded with terrific force, damaging the work barge alongside, injuring three men, and immediately sinking the vessel in badly damaged condition. (*See Figure 1.*) That there was no deaths was due only to the most fortunate of circumstances, as sheets of steel decking and other structural parts flew through the air, striking the work barge, and landing in the nearby street and on the adjacent harbor surface.

This tanker, a small coastal type of about 800 gross tons, was fitted with 4 cargo tanks, each divided longitudinally on the centerline by a tight bulkhead, the effect being the creation of 8 separate cargo tanks. Aft of No. 4 tank was the raised superstructure and navigating bridge.

On the day of the explosion the vessel arrived at her home port and was tied up alongside a work barge which contained a machine shop, welding, burning, and other repair equipment, for the purpose of renewing and fairing a section of plating on the forward bulwark of the port wing of the bridge.

Figure 3. **Portion of deck plating hurled 200 feet by force of explosion.**

A day before, a cargo of 110/145 octane aviation gasoline had been discharged from all four cargo tanks at a nearby port. However, none of the tanks had been gas freed before repair work was started. While en route to the home port, the cargo tanks were rinsed out with cold salt water, but none of the tanks were more than partially filled with water before they were pumped dry. The sides of the tanks were not washed down.

Before beginning repair work, No. 4 cargo tanks, the one nearest the bridge bulwark to be repaired, was completely filled with sea water on orders from the Marine Superintendent. After this tank was filled to overflowing, all tank domes were dogged down hand tight and all valves on connecting pipelines were checked for tight closure. Nos. 1, 2, and 3 cargo tanks remained as they were, not gas free and obviously gaseous from high octane aviation gasoline. There were, however, two vertical noncargo spaces between the site of repairs and the nearest cargo space.

No notification was made to the local Officer in Charge of Marine Inspection that alterations or repairs were to be undertaken, as required by 46 CFR 30.01-10. An inspection to ascertain whether "hot work" could be accomplished safely in spaces adjacent to bulk cargo spaces, as required by 46 CFR 35.01-1, was not made.

On the morning of the disastrous day, staging and ladders were set up on the port side of the bridge and oxy-acetylene burning and electric welding equipment was placed on the bridge. Oxy-acetylene hoses led to the bridge from bottles on the barge. The welding cable (hot wire) led to the bridge from the generator on the barge but this cable came aboard the tanker in the vicinity of No. 1 cargo tank, port, and there were several points on it where the insulation was questionable and had been taped. The ground wire of the welding circuit was secured by a C-clamp to a stanchion socket near the after part of No. 2 port cargo tank and thence led to a ground strap installed all around the work barge, to which the welding generator was grounded.

As a security measure the port wing of the bridge was wet down and a fresh water hose was kept running on deck in the vicinity of No. 4 tank, where hot sparks might be expected to fly from the repair work. At the time there was a fresh breeze of 25 to 35 m. p. h. blowing approximately onto the vessel's port beam.

About mid-morning a damaged section of plating on the port wing of the bridge was cut out with the oxy-acetylene torch. During the early afternoon, while a new piece of plating was being shaped for installation, a vertical piece of angle iron was tack-welded on the corner of the port wing.

At mid-afternoon two men were working on the port wing, the master was in the machine shop of the barge alongside; and the chief mate and another man were in the office at the after end of the barge. Suddenly a terrific blast rent the air, followed closely by two more detonations. The tank vessel seemed to expand like a balloon. Pieces of deck plating flew in all directions. The vessel's sides were sprung out and she quickly filled with water and sank, in shallow water, fortunately.

A section of 8" rubber discharge hose flew over and landed on the after end of the work barge, crushing the office space and seriously injuring the chief mate and a shore worker. One of the men on the wing of the bridge was thrown down by the blast and received a badly lacerated face and punctures about the face from flying scale. The barge did not sink and the after superstructure of the tanker remained above water, so that rescue of the wounded men took place at once. It was indeed a blessing that there was no fire following the blasts.

As closely as could be determined upon later analysis, the initial detonation took place in either port No. 3 tank or port No. 1 tank, followed closely by detonations in No. 2 port and starboard, and there was no actual burning or welding carried on for approximately 15 minutes before

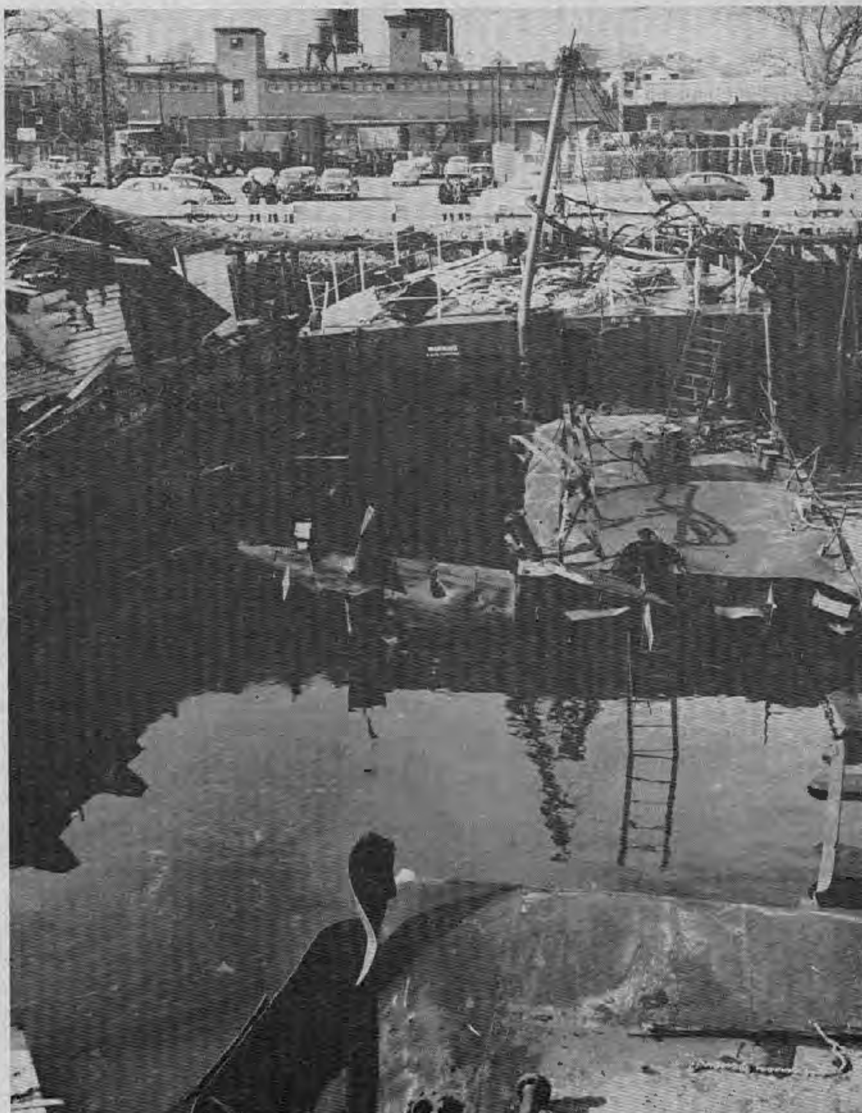


Figure 1. **Looking forward from bridge of a harbor tanker following explosion.**

the explosion. However, smoking and other spark-producing activities took place on the work barge alongside, which was to windward on that day. The fresh breeze sweeping across the decks of the tanker from the port beam, while it probably prevented the accumulation of any gaseous fumes on deck, could easily have carried a spark of some sort aboard from the barge to lodge in some spot where it would reach an explosive mixture.

It was developed that the ship's pressure vacuum relief valves had not been regularly inspected by the ship's force. A broken or defective relief valve on No. 1, 2, or 3 tank could have been the avenue of a spark to explosive fumes.

The nature of the repair operations underway leads to the conclusion that ignition was caused by one of these operations. However, no sparks were noticed by any one as far forward as No. 3 tank and the prevailing breeze, plus the time interval of 15 minutes, plus the stream of water on deck, would tend to rule out this source. A more likely point of ignition would seem to be the defective hot welding lead coming aboard near No. 2 tank.

Although there were no witnesses to prove it, a spark resulting from contact of a bare spot on this cable with any of the metallic ship's structure could well have provided the source of ignition. Three other less likely but possible sources of ignition also existed. These were:

(1) a carelessly tossed cigarette which could have been carried aboard by the prevailing breeze from the shore near the ship;

(2) sparks due to the loosening of the C-clamp at the vessel's connection with the welding ground cable; and

(3) a spark caused by friction of metallic parts such as a gusset or other member carrying away in an empty tank, as the vessel was then surging in the gusts of wind.

The exact cause of ignition will probably never be known.

The failure of the Master and/or the owners to carry out the provisions of 46 CFR 30.01–10 in notifying the Officer in Charge of Marine Inspection of the proposed repair work was a technical violation of regulations which did not actually contribute to the causes of the casualty. Action was taken against the license of the Master for failing to have an inspection made to determine whether the repair operations could be safely undertaken, as required by 46 CFR 35.01–1, but this action was later reversed upon the decision that, since there were two vertical noncargo spaces between the port wing of the bridge and the boundary of No. 4 tank, the port wing should not have been construed as *"adjacent"* to any cargo space.

It is clear that the basic errors leading to the casualty were not in noncompliance with law or regulation but in misconception of the entire problem of "hot work" on a nongas free tankship. Obviously it was not safe to perform "hot work" on this vessel. Measures taken in partially washing out Nos. 1, 2, and 3 tanks and in filling No. 4 tank with water were entirely inadequate. All tank domes should have been dogged down hand tight and set up with nonsparking wrenches. Leading welding cables aboard in the vicinity of nongas free tanks when they could have been led aboard near the stern was inviting disaster.

It goes without saying that continued neglect of the vessel's pressure vacuum relief valves would sooner or later have led to grief.

Just prior to the explosion, the above tanker was indeed like a loaded gun with numerous fingers tickling the trigger. The element of doubt as to the loaded gun going off was not whether, but when.

ENGINEROOM

BOILER NEGLIGENCE

AN 8,000-ton, C–3, cargo vessel suffered casualties to both boilers which required her to return to port for extensive repairs. Examination disclosed damage to the boiler casings, insulation, and economizer assemblies on both boilers. Cost of repairs was $30,000, and the vessel was delayed in port eight days.

This vessel departed New York on an east bound round the world voyage. The chief engineer was satisfied with the condition of the plant upon departure and no unusual difficulty was experienced until the vessel was one day out of Honolulu two months later, when a hot spot approximately two feet in diameter was discovered on the bottom of the starboard boiler furnace.

Speed was reduced immediately, and the vessel returned to Honolulu for repairs. Repairs consisted of: complete removal of the economizer banks of the port and starboard boilers; complete renewal of all brickwork; renewal of port boiler, sidewalls, flooring, and partial backwall; renewal of the starboard boiler slope brickpan; and renewal of the front casing of the port boiler in and around the superheater door.

Investigation disclosed that the plant had been operated during the voyage on 21 nozzles, except for the time the vessel was maneuvering, and that number 43 burner tips were used to maintain the steam pressure for operating main and auxiliary machinery.

The engineroom log book disclosed that the tubes were blown daily on the morning 4 to 8 watch and the evening 8 to 12 watch. However, both economizer banks were plugged solid with soot.

It was established that during the course of the voyage neither the Chief Engineer nor the second assistant engineer had entered the fire sides of either boiler to determine the condition of the brickwork and tubes. During the course of the voyage the vessel had made stops at 11 ports. The average length of stay in these ports was three days, during which cargo was worked and only one boiler operated.

The obvious lack of inspection and proper maintenance of the boilers by the responsible engineering personnel appeared to be the major factor in this casualty. The Chief Engineer and the second assistant engineer, who were charged with responsibility of maintenance, should have made periodic inspections of the boilers. If they had, preventive measures could have been taken earlier to cope with the extensive deterioration discovered on inspection of the boilers.

DANGER—MAN IN DRUM!

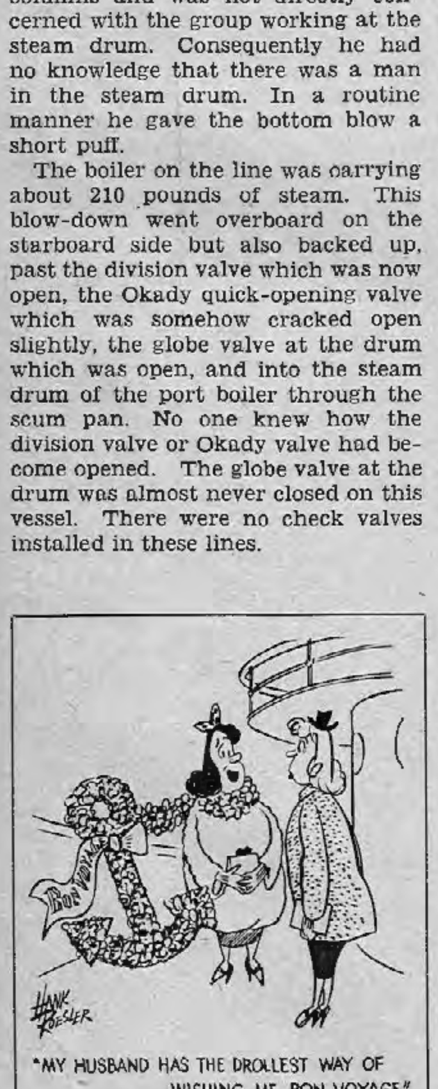
A fireman serving on a freighter equipped with sectional header water tube boilers suffered painful burns when a puff of live steam accidentally entered a steam drum in which the fireman was working. The steam followed a path from another boiler which was steaming on the line through at least three valves which should have been closed but were not, due to carelessness and neglect.

In the process of preparing the vessel to be laid up for a period of months the port boiler was being cleaned to prepare for annual inspection. It was taken off the line and allowed to cool for three days. The boiler was secured; the division valve between the blow-down lines from both boilers was closed; signs were posted on feed steam valves; blind joints were placed in the main and auxiliary steam lines and the principal valves closed on the boiler.

Under the supervision of the first assistant engineer, the boiler was dumped and the manhole cover removed on the steam drum. The first assistant entered the steam drum with an extension light and determined that the drum should be hosed out with fresh water to remove mud and sediment. This job was assigned to the fireman who was the smallest man in the work group.

It was a matter of established routine on this vessel for the fireman on watch to give the bottom blow on the boiler or boilers on the line a puff on the blow-down valves, once each watch. The fireman on watch at the time of this accident was working with a second assistant on the water columns and was not directly concerned with the group working at the steam drum. Consequently he had no knowledge that there was a man in the steam drum. In a routine manner he gave the bottom blow a short puff.

The boiler on the line was carrying about 210 pounds of steam. This blow-down went overboard on the starboard side but also backed up, past the division valve which was now open, the Okady quick-opening valve which was somehow cracked open slightly, the globe valve at the drum which was open, and into the steam drum of the port boiler through the scum pan. No one knew how the division valve or Okady valve had become opened. The globe valve at the drum was almost never closed on this vessel. There were no check valves installed in these lines.



"MY HUSBAND HAS THE DROLLEST WAY OF WISHING ME BON VOYAGE."

(Courtesy Maritime Reporter)

At this moment the fireman was inside the drum beyond the scum pan and thus trapped with no escape except through the incoming steam and hot water. In desperation he sheltered himself as best he could, which was not very well, due to the cramped position, until he was able to crawl out of the drum when the hot geyser subsided. He was severely and painfully scalded on his body, particularly on his face, left side and arm. The engineering personnel rendered such first aid as they were able and took him to the hospital where he was given inpatient treatment for 23 days.

This painful injury was caused by the neglect to carry out precautions required by good engineering principles before allowing a man to work inside a boiler which is connected in any way with a steaming boiler. Three valves which were open or partially opened should have been closed. All licensed engineers are required to demonstrate their knowledge of such safety precautions in examinations given as a prerequisite to the issuance of their licenses. Before a man is allowed to work in such a boiler all steam connections should be securely closed and lashed, safety valves checked to see that they are seated, a sign hung near steam valves on the dead boiler that men are working inside, the boiler cool enough to enter safely, and burners or other sources of combustion completely removed.

The first assistant and second assistant engineers in this case both received official admonitions for negligence in failing to ascertain that all steam valves were securely closed before allowing a man to enter the steam drum.

In the above casualty the division valve in the cross line to the skin valves should have been closed and lashed. The Okady quick-acting valve should have been closed and lashed. The surface blow globe valve right at the steam drum should have been closed and lashed.

Article 55.10–15 (a) of the Marine Engineering Regulations requires that, where blowoff valves are connected to a common discharge from two or more boilers, a nonreturn or check valve shall be provided in the line from each boiler to prevent accidental blowback in the event that the boiler blowoff valve is left open. While this requirement applies to vessels the construction of which or the alteration of which was contracted for on or after 19 November 1952 and does not apply to the vessel involved in this casualty, the principle of safety in this requirement is equally applicable to all marine steam installations, and would have prevented this injury if such check valves had been installed.

The installation of such nonreturn or check valves where not now so equipped is highly recommended. The regulations require that, when vessels built prior to 19 November 1952 are reboilered, the blowoff valve and fittings shall be renewed in accordance with requirements in existence at the time of the reboilering. Thus a nonreturn valve must be installed under these circumstances. However, in accomplishing any repairs or alterations to the boiler blowoff system, the installations of nonreturn or check valves is urgently recommended. The correction of a situation which may involve painful or fatal injury to engineering personnel is worthy of very serious consideration by marine engineers and marine superintendents.

ANOTHER BOILER CASUALTY

There occurred recently a boiler casualty which illustrates some points of interest to fireroom operating crews. The vessel was on an intercoastal voyage.

The fuel supplied to the vessel in question was a very heavy variety of oil which required heating to a temperature of 228° F. in order to reduce the viscosity to 150 seconds Saybolt Universal. The latter is considered the optimum viscosity for the proper atomization of the fuel oil in the ordinary mechanical burner.

On the westward voyage, it was found that the proper atomizing temperature of 228° F. could not be attained with the equipment on board and by the time the Panama Canal was reached, the air pressure in the furnaces had increased considerably and the superheater temperature had commenced to drop. This indicated that the gas passages were restricted, and, accordingly, permission was requested, after leaving the Canal, to clean the fireside of each boiler in turn.

Upon opening the boilers a considerable yellowish deposit was discovered on the tubes. This deposit was assumed to be sulfur. The firesides of both boilers were scaled and waterwashed and the vessel then proceeded to San Pedro, Calif. Smokeless combustion was maintained in spite of the difficulty in obtaining the proper temperature of the fuel oil, by feeding in excess air and cutting down the power developed by the boilers.

On the return trip combustion was maintained in the manner described above and the trip was otherwise uneventful until the vessel cleared the Panama Canal for New York. Soon after leaving the Canal heavy weather was encountered with wind varying from force four to nine. Shortly thereafter it was discovered that the boiler casings in several spots had been overheated and buckled. Precautionary measures were thereupon taken consistent with the safety of the vessel. Upon the conclusion of the voyage, an examination revealed that parts of the boiler casings and refractories were considerably damaged and one 4-inch side waterwall tube was damaged sufficiently to warrant its removal. The cost of repairs was approximately $12,000.

The use of excess air invariably results in an over-all lowering of furnace temperature. At first glance it would seem that this statement is inconsistent with the fact that localized overheating of the boiler demonstrably took place. However, the inconsistency is more apparent than real. What probably happened is that the deposit on the tubes noted by the chief engineer, and which was undoubtedly due to poor combustion, increased to the point where the gas passages were cut down markedly. This then directed the products of combustion toward the sides of the boiler instead of the uptakes. This, in turn, produced a "torching action" or a concentration of heating in one locality instead of throughout the furnace generally which resulted in overheating in specific localities.

It is thought that the engineering force of the vessel concentrated on correcting the results of the poor combustion experienced (plugging of the gas passages) instead of the cause thereof (inability to raise the temperature of the fuel oil to that necessary to reach the correct viscosity for proper atomization). It is evident that the tubes of the fuel oil heaters were coated with a deposit from the heavy fuel oil supplied on the voyage in question, or possibly from oil burned on previous voyages, to the extent that the rate of heat transfer between the steam and the fuel was dangerously reduced.

It appears to the Coast Guard that the proper approach to a solution of the problem encountered by this vessel would have been to clean the fuel-oil heaters, or attempt in other ways to obtain the proper temperature. The cleaning of the boiler tubes was necessary, of course, but as shown by subsequent events would have had no effect on the poor combustion which could and did result in replugging of the gas passages.

There are several methods which have been successfully used in cleaning fuel-oil heaters. The commonest and quickest, although possibly not the most efficient, would be to isolate one of the heaters, break the fuel oil connections, and blow steam through the coils. If the deposits were not too firmly baked on, this method would probably do the trick. Another method which demands slightly more elaborate equipment would be to isolate one of the heaters as before and circulate some fuel-oil solvent, such as kerosene or one of the new cleaning compounds, through the heater until the tubes were clean.

If, in spite of these measures, it still appeared impossible to reach the desired temperature, the oil in the settling tanks could have been heated by means of the tank heating coils to a temperature such that the fuel heaters could have raised it the remainder of the way to 228° F.

The oil supplied this vessel was undoubtedly such that some ingenuity was necessary in burning it safely and economically. However, it is thought that by application of one or the other of the measures described in the preceding paragraph a proper atomization temperature could have been attained. What actually happened, of course, was that the engineering force tackled the result of the trouble rather than the cause.

ASPHYXIATION

FUNEREAL FUMES

TWO TRAGIC cases of death due to asphyxiation by toxic fumes and lack of oxygen on two tankers have recently been reported. Death in each case was facilitated by ignorance, carelessness, misconception, and a complete disregard of basic rules of safety and common sense. The scene of the fatality in each case was the after pumproom of a T-2 tanker. On one the cargo being pumped was jet fuel and on the other, grade B gasoline. *In each case the man who died was working in intense fumes without any breathing apparatus.*

On the first tanker, discharging jet fuel, all three cargo pumps were in operation. The cargo pump shaft glands had been slackened at the beginning of the operation to allow for normal expansion as they heated up, and a slight trickle of cargo from these glands was noticed, but considered normal. The pumproom ventilation system was in operation and both doors to the main deck were open, but the pumproom skylight was closed.

After two or three hours of operation, the chief pumpman noticed that gland leakage was increasing, and he attempted to tighten the glands and reduce leakage, but was unsuccessful. Upon leaving the pumproom, meeting the second pumpman on deck and talking over the situation with him, both men decided to return to the pumps and again attempt to stop the leakage.

They descended into the pumproom without stopping the cargo pumps and without notifying any of the vessel's officers. While the chief pumpman was rigging a chainfall on an upper level, the second pumpman went below and worked on the pump glands. Neither man was wearing a breathing apparatus. In a few minutes the chief pumpman descended to the pumps and found the second pumpman on the verge of collapse. Within seconds the second pumpman fell, his body becoming lodged between piping and a bulkhead. The chief pumpman hurried out on deck and called for help.

Standing on deck amidships, the second mate heard the call for help and was immediately apprised of the situation. He sent for the master and instructed a seaman to don the fresh air breathing apparatus. The chief pumpman, second mate, and seaman went below to attempt to remove the inert man. Since the unconscious victim weighed about 200 pounds, and was lodged in an awkward position, it was extremely difficult to move him. The rescue crew finally secured a lifesaving belt on the man and, with assistance from crew members above, pulled him up on deck. He was found to have been wearing a paint sprayer's mask.

The local fire department had arrived in the meantime and immediately attempted to revive the victim with an inhalator. He was carried from the vessel and promptly removed to a hospital where oxygen was administered for one-half hour, but he was pronounced dead at that time. The second mate and chief pumpman were both nearly overcome, but neither suffered ill effects other than nausea. The seaman who had been wearing the fresh air breathing apparatus suffered no effects at all.

About two hours later, examination of the pumproom disclosed 3 feet of cargo in the bilges and the pump glands still leaking badly. All pumping was then ordered stopped until the cargo in the bilges was removed, the compartment gas freed, and all cargo pump shaft glands repacked. The venting system was found to be in good condition.

On the second tanker, gasoline was being discharged with all cargo pumps operating. About one hour after discharge started, the second assistant engineer descended into the pumproom to check the pumps. He found No. 1 pump to be leaking badly and returned to the deck to notify the first assistant and the chief engineer.

The second assistant returned to the pumproom, followed by the chief engineer and the chief mate. The latter two soon came out as they were becoming affected by the heavy concentration of gasoline fumes. They told the second mate to watch the engineer in the pumproom below.

Twenty minutes later the second mate saw the engineer collapse on the floor plates, and he immediately sent for the fresh air breathing apparatus. The Chief Engineer, chief mate, and second mate descended into the pumproom and attempted to carry out the unconscious man. They were joined by the first assistant. Due to the weight of the overcome man and the growing effects of the fumes on the rescue party, they could not remove the victim and they all climbed out on deck where the chief engineer blacked out.

Upon being notified of the casualty, the master immediately donned a fresh air breathing apparatus and descended into the pumproom where he attached a leather rescue harness to the unconscious man on the floor plates. After two attempts with the leather harness, which slipped badly on the sweaty body of the victim, he was hauled out on deck 40 minutes after he had passed out. The master, while working in the pumproom, did not notice the figure of the first assistant, who by this time had collapsed. Emergency first aid treatment and oxygen was immediately given to the man who had been removed, by a local rescue squad.

It was at this point that the master was told by the chief mate, whose wits had been somewhat affected by his "gassing," that the first assistant was still in the lower pumproom. As the master was nearly exhausted and the chief mate feeling better, the chief mate then donned the fresh air breathing apparatus and descended into the pumproom. He found the first assistant's body wedged between a heavy valve and a bulkhead in such a manner that he could not move him. Two seamen, both wearing breathing apparatus furnished by the local rescue squad, now went down into the pumproom, secured a line around the first assistant's body, and guided him as he was lifted out on deck, also about 40 minutes after he had been overcome.

The first assistant's body was blue when removed from the pumproom and in spite of all efforts by the local rescue squad, he was soon pronounced dead by a doctor who had been summoned. The man who had been first overcome regained consciousness at the hospital and gradually recovered.

Only 12 days later under almost similar circumstances, a pumpman on the same vessel was overcome by fumes in the same pumproom. He had made several trips down into the after pumproom attempting to tighten the packing on No. 3 pump gland, not wearing a breathing apparatus or safety line, and with gasoline fumes present in strong concentrations.

However, on this occasion a seaman posted to watch him detected his dilemma almost immediately. *The same master went immediately to the pumproom and, disregarding his own safety instructions which he had promulgated aboard the ship, descended into the pumproom without a breathing apparatus or safety line.* Fortunately the chief mate had put on a breathing apparatus and came down to help remove the overcome man. They were able to secure a line around the pumpman and the crew above hauled him out on deck. The Master was scarcely able to climb out of the pumproom. The pumpman regained consciousness before he reached the hospital and recovered.

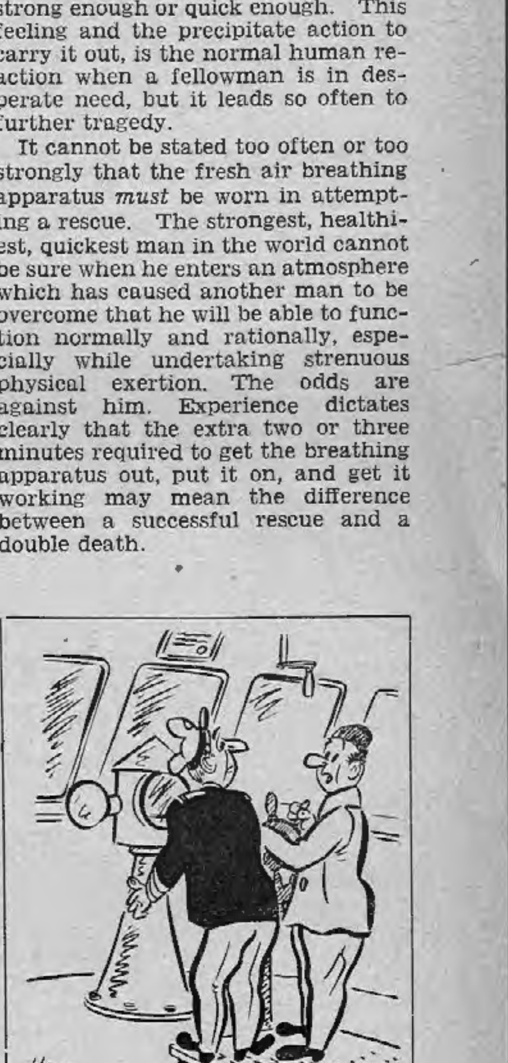
Upon investigation of the mechanical ventilation system for this pumproom, it was found that the exhaust fan was operating in the wrong direction so that both supply ventilator fans and exhaust ventilator fans were driving air into the pumproom and consequently there was little or no circulation. This difficulty was promptly remedied.

Thus the death of two professional seamen, both of whom were apparently well acquainted with the hazards of their trade, was brought about by a tragic procession of the type of errors and carelessness which do not give a second chance. In the first instance both men went below into a pumproom, where hazardous fumes were present and where there was an obvious deficiency of oxygen, without wearing a fresh air breathing apparatus or a safety line, and without posting a watchman on deck to check their safety.

Common prudence should have dictated their notifying one of the ship's officers. The wearing of a paint sprayer's mask by the deceased was a pitiable error based on ignorance and misconception. Since such a mask serves no purpose whatsoever except to filter drops of liquids or particles of solids from the air being breathed, it was useless when worn in an atmosphere deficient in oxygen and was only a hindrance.

In the second instance, disregard for ordinary safety practices when entering questionable spaces on a tanker was flagrant and widespread. Apparently a feeling or tendency persists amongst merchant marine officers, in spite of all warnings, lessons from the past, and ordinary prudence, that rescues of persons overcome in tanks or pumprooms can be accomplished by persons not wearing breathing apparatus if the rescuer is strong enough or quick enough. This feeling and the precipitate action to carry it out, is the normal human reaction when a fellowman is in desperate need, but it leads so often to further tragedy.

It cannot be stated too often or too strongly that the fresh air breathing apparatus *must* be worn in attempting a rescue. The strongest, healthiest, quickest man in the world cannot be sure when he enters an atmosphere which has caused another man to be overcome that he will be able to function normally and rationally, especially while undertaking strenuous physical exertion. The odds are against him. Experience dictates clearly that the extra two or three minutes required to get the breathing apparatus out, put it on, and get it working may mean the difference between a successful rescue and a double death.



"Compass off? Too bad we haven't got a tree. I hear moss always grows on the north side of 'em."

(*Courtesy Maritime Reporter*)

THE BREATH OF LIFE

A 25-year-old chief pumpman on a T–2 tanker died recently when a strap of the fresh air breathing apparatus he was wearing parted under strain. Neglect to keep the emergency apparatus in good condition was the direct cause of the fatal accident, although other circumstances were involved. The death certificate listed as causes of death: (a) Compound fracture of skull; (b) ruptured spleen and right kidney; (c) hemorrhage and shock; and (d) asphyxia. This gruesome combination of conditions, any one of which could have been fatal, came about through a thin trail of error, neglect, lack of foresight, and plain bad luck.

A leak in the stripping line of No. 4 center tank had been found after discharging cargo at the last port. The tanker being at sea with mild weather prevailing, it was decided to test the stripping lines with a hydrostatic pressure of 25 p. s. i. to pinpoint the leak and to carry out repairs underway in order to facilitate butterworthing of the tanks. Early in the morning the fresh air breathing apparatus was brought out and examined on deck near No. 4 tank by the chief mate, Chief Engineer, chief pumpman, bos'n, and a deck maintenance man. This included testing the face piece and hose for tightness. The chief pumpman donned the equipment and indicated it was working satisfactorily. The original black elastic fabric straps on the face piece had deteriorated and parted, but they had been replaced by heavy twine. Further tightness was accomplished with the adjustable nonelastic fabric straps around the head.

Originally the men had planned to use new equipment which had come aboard two months before, i. e., a Mine Safety Appliance Set, consisting of two face pieces with two harnesses and hoses, and a pump. Fresh air breathing apparatus had not been needed on this vessel during those two months. Upon breaking out this new set, it was discovered that there were two 25-foot sections of hose, rather than two 50-foot sections as had been ordered.

When delivery had been made to the vessel, the chief mate had signed a receipt showing a set of fresh air breathing apparatus with two 50-foot hoses, and had not actually measured the hoses. Since over 50 feet of hose was needed on this occasion, the mate decided to use one of the new face pieces with a 25-foot section of hose and, with an additional 50-foot section of old hose attached to it. It was then discovered that the fittings of the old and new hoses were not interchangeable and could not be fitted together.

At this point consideration was given to butterworthing the tank without repairing the leak in the stripping line. Unfortunately however, after a thorough examination of the old equipment, it was decided to use it and proceed with the job. The chief pumpman, who was to perform the task while wearing the equipment, indicated no apprehension as to its effectiveness. Indeed, the chief mate had used the old equipment himself in No. 4 tank four months before with no ill effects.

The tank was not gas free and contained residue of gasoline mixed with several inches of water which had leaked from the stripping lines during the hydrostatic tests. It was obvious that fumes in dangerous concentrations were to be expected in the tank and that the use of breathing apparatus was absolutely necessary.

With the deck maintenance manning the airpump, the chief pumpman, wearing the old equipment, descended the ladder 43 feet to the bottom of the tank. This ladder was in two sections. The upper section lead forward and down to a landing 20 feet below the main deck, and the lower section lead aft and down from the landing to the bottom of the tank. This meant that the safety line, a new 12-thread manila line spliced to the ring of the leather harness, had to cross several metal edges in its lead from the pumpman to deck. The pumpman located the stripping line leak at a point 30 feet from the bottom of the ladder, and returned on deck for tools.

With a pipe clamp, a wrench, and a flashlight, the pumpman returned to the tank bottom. He was seen to drop his flashlight, search for it a few seconds, but then continue to the point of the leak and crouch over the pipe and fumble about for a few minutes. Suddenly he straightened up and hastened for the ladder, becoming confused and apparently losing his sense of direction. He missed the ladder, finally grasped it, then collapsed.

Seeing the pumpman in difficulty, the men on deck heaved away on the safety line to hoist him bodily from the tank. The chief mate descended about 10 feet into the tank to help clear the line and the unconscious man from several metal edges over which they must pass, especially one piece of angle iron installed as a brace to the ladder. As the chief mate started to clear the body to pass above the brace, the leather belt of the harness suddenly parted. Before the horror-stricken eyes of the men standing helplessly on deck, the pumpman's unconscious form hurtled 30 feet straight down, landing with a sickening crunch headfirst on the steel tank bottom. After a moment of awesome realization by the witnesses, one man ran to call the Master.

Using the newer breathing apparatus and the two 25-foot sections of new hose, which were barely enough to reach, the Master himself descended into the tank and tied another line around the man's body. This time the pumpman's body was hoisted and laid out on deck. Artificial respiration and the use of the respirator were continued for almost four hours. However, there was no sign of pulse, heartbeat, or breathing. The weary men finally were forced to admit the obvious, and the pumpman was pronounced dead. It is extremely likely that he died instantly after the fall, in view of the injuries listed on the death certificate.

Close examination of the leather harness which had parted showed, by rolling the leather tightly between the fingers, that there were fine hairline cracks on each side of the break, which was about in the middle of the belt and near a riveted loop. No cuts or abrasions of the belt were evident. The leather had apparently become brittle and lost considerable of its tensile strength through hardening and natural deterioration. While the indirect cause of the death was undoubtedly some leakage or other trouble with the face piece experienced by the pumpman, which allowed him to inhale toxic fumes and then forced him to hasten for the ladder, the principal cause of death was the failure of the leather harness. It is likely the pumpman would have been revived had he been successfully removed from the tank on the first try.

Another indirect cause was the insufficiency of the new breathing gear which had been aboard for two months without having been properly checked, since it was not known until too late that there were only 50 feet of hose. This necessitated using the old equipment, the condition of which was evidently questioned by the chief mate and others before it was used on the above fatal date. Indeed, it was fortunate that the pumpman had made his way to the foot of the ladder, for if he had collapsed at the point of pipe repair, other lives may have been endangered in trying to reach him, the new hose being the only other available on the vessel and being too short to reach that point.

The principal lesson from the above woeful incident is the continual need for maintenance and care of safety equipment. Had the Master or chief mate checked the new gear when it first came aboard and noticed the shortage of hose, or had they examined and tested the safety harness of the old gear periodically, or had they replaced the defective elastic straps of the old face piece when those straps first deteriorated, the 25-year-old chief pumpman might well have been hale and hearty today. Above all, had the chief mate listened to the small voice saying, "Don't!", in his subconscious mind, as the group deliberated the wisdom of attempting the repairs at all with the old breathing apparatus, the Grim Reaper might have passed up this visit.

While it was fortunate that two sets of breathing apparatus were aboard the vessel, enabling the Master to go down in the tank, nevertheless the second set would never have been needed if the first set had been properly maintained. Like life preservers, regardless of *quantity* available, when the time of need comes, it is the *quality* of the one on you that counts. The periodic testing, examination, and maintenance of fresh air breathing apparatus and other similar safety equipment is just as important a shipboard duty of the ship's officers in the eyes of the Coast Guard as any other duty stated or implied by law or regulation.

The Master and chief mate were both reported to be reliable, conscientious and capable officers, efficient and attentive to duty. Yet each, while 99 percent thorough, had allowed the 1 percent of laxity to creep in by taking too much for granted. A young man's life was snuffed out; and the Master and mate must bear this tragic mischance with them the rest of their lives. Don't let it happen to you!

DEATH FROM DRY ICE

The use of solidified carbon dioxide (dry ice) for the preservation of perishable foodstuffs has increased in recent years. Besides maintaining perishables, at a low enough temperature to insure against spoiling, the carbon dioxide gas which is evolved from the dry ice has a marked beneficial effect in that it inhibits the formation of various fungi, surface slimes, etc. Accordingly, it is used extensively in railroad refrigeration cars, highway trucks, and other vehicles used for the transportation of foodstuffs. Ordinarily, as in railroad cars and highway trucks, the carbon dioxide from the dry ice causes no harm as it is dissipated immediately in the surrounding atmosphere.

Recently, however, two trailer vans refrigerated with dry ice were loaded into the lower hold of a vessel in the late afternoon. At the close of the working day the hatches were covered as usual. The next morning when the stevedores returned to the ship the hatches were opened and the stevedores descended into the hold. During the night a large amount of carbon dioxide gas had evaporated from the dry ice in the trailers and owing to its high density (1½ times as heavy as air) filled the lower portion of the hold. Four of the stevedores were immediately overcome.

The vessel concerned was a freight vessel and at that time (1949) an oxygen breathing apparatus was not required by regulations. It so happened, however, that such an apparatus was carried on board. The chief mate donned it and attempted to rescue the four unconscious men. However, after getting one of the men out, it was discovered that the oxygen supply was exhausted. Consequently, it was necessary to await the arrival of a city fire department rescue squad before removing the other three stevedores—they died from the effects of the carbon dioxide.[1]

To digress for a minute, it was found at the inquiry that the oxygen breathing apparatus had been requisitioned by the chief engineer and was put on board by the owners. The testimony disclosed that this apparatus had been tested at each fire and boat drill *by opening the oxygen valve to observe the pressure of the oxygen.* The cumulative effects of these tests had finally resulted in the almost complete depletion of the oxygen supply.

Similar accidents resulting in loss of life have happened on at least two other occasions widely separated as to time. Carbon dioxide is regarded as a dangerous material as is shown by the fact that when it is used as a fire-extinguishing agent in the engine rooms of vessels, an alarm must be fitted which is actuated automatically before discharging the gas into these spaces. Accordingly, the Coast Guard has now established regulations governing the use and stowage of dry ice.

These regulations are contained in *Subchapter N—Explosives or Other Dangerous Articles or Substances and Combustible Liquids on Board Vessels.* In brief, dry ice cannot be stowed below decks and containers must be clearly marked to show that they contain dry ice.

[1] EDITOR'S NOTE:

One self-contained breathing apparatus is now required on all vessels over 1,000 gross tons on an international voyage. Part 96.30-10, 46 CFR.

BEFORE HIS TIME

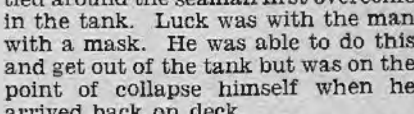
An article appeared in the June, 1954, *Proceedings* entitled "Funereal Fumes." It described the deaths of two men on two T-2 tankers due to asphyxiation while working in the pumprooms without wearing fresh air breathing apparatus. A sad sequel to these unnecessary deaths recently occurred on a foreign tanker which was preparing to load in an East Coast port. The 34-year old chief mate, a fine professional seaman, just arrived at the prime of life, died as a result of a moment's haste and carelessness.

Preparatory to loading a cargo of toluene and benzol, cargo tanks were being pumped out and washed down by hose pressure. Two seamen were detailed to hose down No. 1 port center cargo tank. One man was handling the nozzle inside the tank and one man assisting from on deck. When the job was nearly completed, the seaman on deck saw the man in the tank suddenly collapse on the bottom plates. The seaman on deck yelled to a deck boy to run and get the chief mate, while he himself ran to the deck locker to obtain two gas masks.

When the seaman returned with the masks he saw that the chief mate had already gone down into the tank and had also collapsed. Putting a gas mask on, this seaman entered the tank and succeeded in getting a line tied around the seaman first overcome in the tank. Luck was with the man with a mask. He was able to do this and get out of the tank but was on the point of collapse himself when he arrived back on deck.

At this point the third mate put on the other gas mask and started down into the tank in an attempt to get a life line around the chief mate. He was affected by the fumes immediately and just made it back to the deck, collapsing there and requiring resuscitation. Another seaman now donned one of the gas masks and managed to climb down and get a line around the chief mate but by the time he had returned to deck, he also collapsed and required resuscitation.

The group of men on deck labored frantically and managed to haul the chief mate out of the tank, but their efforts appeared hopeless as there was no sign of life. Confirming their worst fears, a doctor who was summoned aboard pronounced the chief



mate dead, principle cause of death: fractured skull. Apparently, the chief mate had been overcome by the fumes and, in falling, had struck his head a severe blow. All of the other four men who had been overcome recovered, although two of them required hospitalization.

It was determined after the series of accidents that motor benzol was being loaded in No. 2 cargo tank at the time of the casualty. Oil inspectors determined that there was a concentration of benzol vapors at the bottom of No. 1 port center tank. Evidence would indicate that these vapors resulted from seepage from the No. 2 tank. However, since the vessel sailed soon after the above misadventures, such defects in the bulkhead could not be established.

Although no description of the exact type of gas masks used could be obtained from the vessel's agent who reported the above accidents, the masks were probably of the so-called all-purpose "canister" type. This is a gas mask equipped with a filter which is useful only in that it chemically and mechanically removes certain gaseous elements and smoke from otherwise breathable atmosphere. It does *not* supply any oxygen. Unless there is at least 16½ percent of oxygen by volume in the atmosphere, the minimum necessary to sustain human life, there will be no point in using this type of mask for the wearer will be overcome by lack of oxygen and perhaps asphyxiated.

The U. S. Coast Guard *Manual for the Safe Handling of Inflammable and Combustible Liquids* contains the following statements: "Cargo tanks which are not known to be gas free should not be entered by anyone not provided with, and experienced in the use of, a fresh air (hose) mask. It should always be remembered that the usual 'canister' mask is of no use in entering oil tanks. Only two types of masks can be used—the hose mask where fresh air is pumped to the user through a hose from the deck, and the oxygen-breathing apparatus where a supply of oxygen for breathing is carried by the user. The wearer of either type of breathing apparatus should be provided with a safety belt and life line. The life line should be tended by two men from the deck above."

It is very likely that the men who were overcome in the tank suffered initially from the toxic effects of benzol fumes which would not be filtered out by a gas mask containing an all-purpose canister. Benzol is a simple aromatic hydrocarbon obtained from the distillation of coal tars. Its vapors when breathed cause headaches and vertigo in the initial stages of exposure. Advanced symptoms from prolonged exposure are: inebriation, staggering gait, twitching, convulsions, and loss of consciousness.

However, while the original toxic effects of benzol vapors may have distressed or partially disabled the men who entered the tank, it is almost certain that the real disabling factor was lack of oxygen. Since the vapors present in the tank were slightly heavier than air, they would tend to accumulate at the bottom of the tank and tend to displace the air, resulting in oxygen deficiency. Tragically, the crew of the tanker in the above case utterly failed to appreciate the real nature of their enemy in the tank, lack of oxygen. The all-purpose type gas masks they used were completely useless insofar as protecting the wearer against anoxia, or asphyxiation due to lack of oxygen.

It is difficult to explain or understand how intelligent merchant officers and seamen, in this type of emergency, can proceed, one after another, to perpetuate each other's mistakes in entering cargo tanks and being overcome.

Unfortunately, the record indicates that this phenomenon occurs from time to time on tank vessels. As mentioned in the previous article on this subject, the belief persists, in spite of all warnings and lessons to the contrary, that rescue of persons overcome in tanks or pumprooms can be accomplished by persons not wearing breathing apparatus if the rescuer is strong enough or quick enough. That this belief is dangerous and will only lead to disaster must be driven home to all tanker men, again and again.

Breathing apparatus which supplies fresh air or oxygen to the wearer independent of whatever atmosphere may exist in a cargo tank is the *only* safe device which will allow a rescue to be made and *must* be used.

ELECTRICAL

THE CONDUCTOR WAS HUMAN

DEATH by electrocution struck tragically one afternoon aboard a freighter while a routine electrical repair was being undertaken. The chief electrician, an efficient technician, made one mistake which cost him his life almost instantly. However, a major contributing factor to the casualty was a faulty installation which had been made at least two years previously and which was not too apparent to the chief electrician.

During the morning the Chief Engineer discovered a ground in the motor of a forced draft blower. He issued orders to secure this blower and place another in operation instead. When this was done, however, it was found that the second blower started to overspeed and could not be controlled by use of its rheostat. The Chief Engineer then instructed the chief electrician to disconnect this faulty rheostat and replace it with a new one. A rheostat of the exact size needed could not be located in the vessel's spare parts, so it was decided to disconnect the leads to the faulty rheostat and run these leads through the main gauge board to a smaller rheostat to be temporarily mounted on the front of the main gauge board. The Chief Engineer issued these instructions to the chief electrician about midmorning. He did not again see the chief electrician alive. The job was considered to be of a purely routine nature and not requiring further supervision by the Chief Engineer.

The gauge board was located in an athwartships position forward and slightly outboard of the port boiler. The back of this gauge board was a portion of the after boundary of the machine shop. Inside the machine shop and directly forward of the main gauge board was a work bench, the back of which was a tall tool board. The space between the back of the tool board and the back of the main gauge board was about 24 in. fore and aft and about 6 ft. athwartships.

Mounted on the back of the work bench were three field rheostats. The original handles on these resistors had been removed and a separate piece of metallic shafting had been added to the short metallic stub which originally held the rheostat handle. This shafting was extended about waist high, across the 24-in. space between the boards, and through the main gauge board, each shaft being insulated by a fibre bushing where it passed through the main board. The original rheostat handles were then attached by set screws to these shafts on the face of the main gauge board. Apparently this arrangement had been installed at some time after the original installation. The rheostats were fitted to the back of the tool board rather than the back of the main gauge board, due to the maze of piping, tubing, and wiring on the back of the main gauge board.

The first assistant engineer discussed the job of replacing the faulty rheostat with the chief electrician before the job was started. After lunch, the first assistant engineer was in the fireroom near the gauge board and was advised by the chief electrician that the job was nearing completion. The first assistant was then called away on another repair job. About two hours later he returned to the gauge board to enlist the assistance of the chief electrician in the additional repairs. When he looked behind the gauge board he found the chief electrician slumped over the rheostat shafting.

The first assistant immediately called for help, de-energized the rheostats, and removed the chief electrician's body. Although there were no signs of life, artificial respiration was begun immediately and a police emergency squad and a hospital ambulance were summoned. The doctor arriving on the ambulance pronounced the chief electrician dead. His body was removed from the vessel. Examination of the gauge board indicated that he had only to run the rheostat leads through the board itself, mount the rheostat on the face of the board, and connect up the leads to complete the job.

When the chief electrician's body was originally removed from behind the gauge board, severe burns were found on the under side of his right arm and on the left portion of his chest and on his left shoulder. These were the points where he had leaned on the metallic rheostat shafting. Following the accident, it was found that, while there was no leakage to ground in any of the three rheostat circuits, the through metallic shafts connecting the rheostats to their handles were energized with 120 volts when in use. All engineering personnel on the ship disclaimed any knowledge of this condition and had assumed that the three shafts were not subject to any voltage. The chief engineer had experienced a slight shock at some time in the past when he accidentally came in contact with one of these shafts, but he had attributed this to insulation-breakdown within the rheostat itself which would account for a slight potential on the shaft. No extensive work had been performed behind this main gauge board for at least two years previously.

Conditions in the fireroom at the time this accident occurred were very humid. At the point where the chief electrician's body was found there was condensation on the deck and the temperature was estimated to be at least 100° F.

Obviously the chief electrician was aware that there was, or could easily be, some voltage on these shafts. Since it was practically impossible to reach the rheostat on which he was working without touching one or both of the other two shafts, it is most likely that he had experienced some shock before his final accident. It is quite likely that when he began the job, with his skin relatively dry and his feet insulated from the deck by rubber-soled shoes, any shock he noticed would have been very slight.

However, as he progressed with the job, perspiring profusely, the surface resistance of his body would, due to moisture, be greatly lowered. Under these conditions any contact with the metallic shafts with moist skin and with some other part of his body grounded to the ship's structure would allow a lethal current to flow through his body, and it is believed that this is what happened.

It is known that a current above 90 milliamperes is likely to cause death, especially when the path of the current includes the area near the heart. It is also known that while the electrical resistance of dry, calloused skin, such as on the hands, may be as high as 1,000,000 ohms, when the skin is wet with salt water or salty perspiration, this electrical resistance of the skin may fall as low as 300 ohms. With a potential of 120 volts applied to such wet skin, a current of 400 milliamperes may flow.

The rheostat shaft installation as it existed at the time of the unscheduled electrocution was not in accordance with the approved practices of the Coast Guard's *Electrical Engineering Regulations*, the *National Electrical Code*, the *American Institute of Electrical Engineers' Standard No. 45*, or other recognized electrical safety codes. It is apparent that such installation was made at some time after the original construction of the vessel. It is likely that whoever ordered or made the installation with the metallic shafts extending across the 24-inch space did not realize that the small metal stub shaft upon which the operating handle was originally mounted was energized when the rheostat was in operation. Since the operating handle was insulated from this stub shaft, the above fact could have been easily overlooked. However, when the metallic shaft extensions were applied directly to the small stub shafts, the extensions themselves were automatically energized whenever the rheostats were in operation, and this dangerous condition was quite obviously overlooked by all hands from then on. It is also apparent that this arrangement of the extension shafts was made without requesting and obtaining the approval of the local Coast Guard Officer in Charge of Marine Inspection, as is required for any electrical repairs or alterations affecting the safety of the vessel.

The inherent dangers of electrical shock resulting in severe injury or death aboard ship cannot be overemphasized. Conditions of high humidity, moist skin, and the ever-present metallic structure of the ship are all too favorable for the body's conduction of electrical current when the contact with some "hot" lead or object is made. To compound these inherent hazards by allowing improper installations or alterations aboard ship is really inviting disaster.

A few simple "rules of the thumb" for safety in dealing with electrical systems aboard ship are presented here.

1. Never trust to luck with electricity. Assume that a lead or contact is "hot" unless you *know* otherwise.

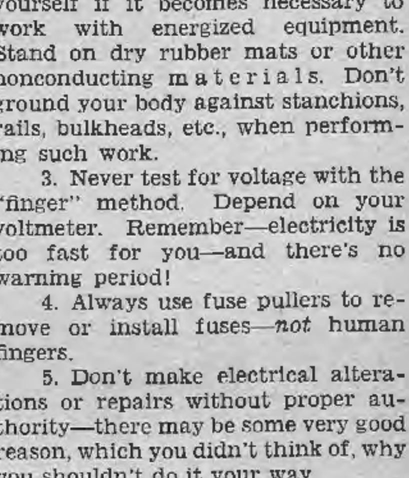
2. Guard against grounding yourself if it becomes necessary to work with energized equipment. Stand on dry rubber mats or other nonconducting materials. Don't ground your body against stanchions, rails, bulkheads, etc., when performing such work.

3. Never test for voltage with the "finger" method. Depend on your voltmeter. Remember—electricity is too fast for you—and there's no warning period!

4. Always use fuse pullers to remove or install fuses—*not* human fingers.

5. Don't make electrical alterations or repairs without proper authority—there may be some very good reason, which you didn't think of, why you shouldn't do it your way.

6. Beware of working near high voltage leads when underway at sea. Any ship afloat can take a sudden and unexpected roll or lurch.



"How perfectly adorable!—And what room is this?"

Courtesy Maritime Reporter

GROUNDS FOR LIFE

The ease with which a harmless-looking portable electric tool can deal sudden death was reemphasized this spring when a wiper aboard a steamer in a Gulf port was electrocuted so innocently and quickly that he probably never knew what had happened.

The guilty instrument of death was nothing more than an everyday household portable electric grinder designed for use with 110-volt alternating current. What happened was this: This victim's ship was in drydock for rudder stock repairs. A yard workman carried the grinder aboard to use in grinding the hub of the quadrant to fit the new stock and laid it across the top of the quadrant while he turned away to plug the cord into a shore power receptacle.

Just at this moment the wiper, who was damp from perspiration and a recent rain squall on deck, picked up the grinder, apparently to move it so he could wipe off the top of the quadrant. The yard workman upon turning saw the wiper with a painfully distorted facial expression and immediately pulled the plug and called for help. The wiper was then carried out on deck where artificial respiration was attempted. An ambulance was called for immediately, but the wiper, a healthy young man of 24, died en route to the hospital.

The subsequent examination of the grinder disclosed no apparent defect or ground within the instrument. There was no ground wire or connection therefor fitted to it. A local armature works and electrical testing company examined the grinder, disassembled the handle, checked the wiring, and advised that in their opinion "the grinder in its present condition could not have shocked anyone handling it." Nevertheless, the wiper was electrocuted handling it.

(Courtesy Maritime Reporter)

One of the common misconceptions about electrical shock concerns the relative dangers of high voltage and low voltage. While most of us maintain a healthy respect for higher voltage electrical circuits, many of us are prone to consider low voltage, such as household lighting circuits, with disdain. It is true that the higher the voltage, the greater the danger of lethal shock, but the factor principally determining damage to the body is current, or amperage. Current, for any given voltage, is determined by the electrical resistance of the body, and it is this resistance which varies so greatly for different parts of the body or under different conditions of moisture. For instance, the resistance of dry, calloused skin, such as on the hands, may be as high as 1,000,000 ohms, while the resistance of skin which is wet with salt water or perspiration may fall as low as 300 ohms. If a man, such as the unfortunate wiper mentioned above, were to be standing on a damp steel deck or with some part of his damp body well grounded against a stanchion or bulkhead, and were to reach down and pick up approximately 100 volts a. c. in the form of a harmless looking grinder, his body would receive a current of 100 volts/300 ohms or 333 milliamperes. Generally 100 milliamperes causes sufficient damage to vital organs that the victim cannot be revived. On the other hand, if another man, standing on dry or nonconductive flooring, were to pick up the 100 volts with a dry hand, his body would receive a current of 100 volts/1,000,000 ohms or 0.01 milliamperes, or just a tickle.

Unfortunately for maritime occupations, the damp or wet conditions are much more apt to prevail than the dry. Therefore, the danger that low voltages may cause electrocution is very high. In fact, as can be seen from the above calculations, electrical potentials of approximately 30 volts can, under conditions all too frequently encountered in or near ships, cause lethal body currents.

Degrees of electric shock have been tabulated, according to the amount of current passing through the body as follows: up to 0.3 milliampere: "Tap" or "Bite"; 0.3 to 1.0 milliamperes: "Pinch" (Pain); 1.0 to 3.0 milliamperes: "Grip"; 3.0 to 15.0 milliamperes: Unpleasant stimulation of the muscles; 15.0 to 19.0 milliamperes: Stimulation and paralysis begins (can't let go); 19.0 to approximately 90.0 milliamperes: Permanent nerve tissue damage; and above 90.0 milliamperes: Probable death. Damage to the body is, of course, dependent upon the path of the current—a path including the area of the heart, such as head to left leg, arm to arm, etc., is much more likely to result in death.

Damage to the body resulting from shock stems from one or both of two effects: *ventricular fibrillation,* and *respiratory-center paralysis.* The former is a condition of the heart following electrical shock paralysis in which the heart muscles respond in a haphazard fashion, the effect being a quivering and discordant contraction, which renders the ventricles incapable of supplying the oxygenated blood to the rest of the body. The latter is a temporary derangement of the functions of the medulla-oblongata portion of the hind brain which controls the normal stimulus of breathing.

For the layman, regardless of which condition may result from electrical shock, continuance of respiration in the shocked person is the prime consideration. Artificial respiration, preferably using the Holger-Nielsen [1] method, should be instituted immediately. If the *respiratory-center paralysis* can be overcome and the victim resumes normal breathing, there is a chance the heart may overcome the effects of *ventricular fibrillation* and resume its normal rhythm. If respiration is not restored within the first three or four minutes, chances of recovery are small. In an unconscious state with no heart action or respiration, death occurs in about five minutes due to lack of oxygen and consequent damage to body cells. The number of successful recoveries when artificial respiration was started *after* three minutes is small, and when started after five minutes, death was almost sure. DON'T WAIT FOR A DOCTOR! START ARTIFICIAL RESPIRATION AS SOON AS VICTIM IS RELEASED FROM ELECTRICAL CURRENT.

While the wiper who died in the above accident may have been beyond aid when released from the current, there is no good reason why the equipment should have caused the casualty in the first place. Proper grounding of all portable electrical equipment is a *must* for safety. When ordering new equipment, order proper grounding attachments. When using it, require the grounding wires to be connected. Save lives on the ground level, for the fact remains that a properly connected grounding wire would have, in all probability, saved this wiper's life.

[1] See Proceedings, December 1955.

GANGPLANK ACCIDENTS

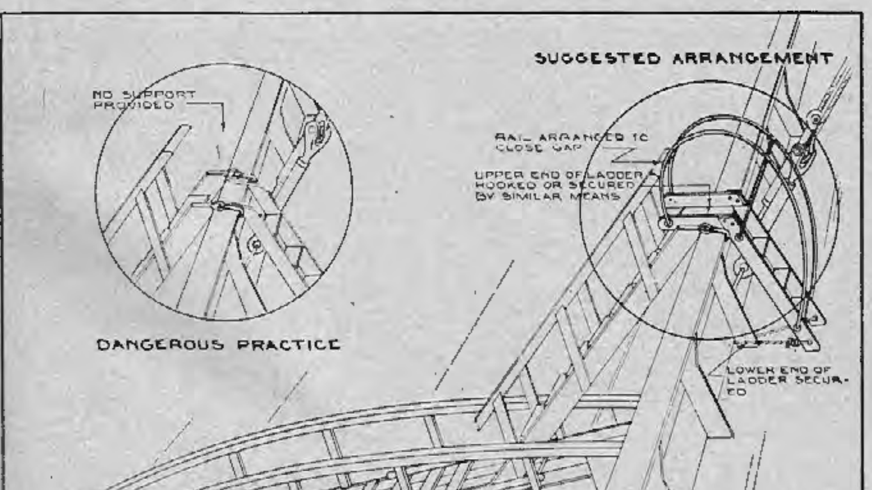
ON TOO many occasions men have lost their lives by falling from the gangplank of ships berthed alongside a pier. In each of the three cases the gangway was of the same type: A gangplank slung from the bulwark with a ladder resting upon it leading up to the rail, leaving an unprotected space between the ship's rail and the end of the handrail on the ladder. Probably all three lives might have been saved had an adequate guard rail been installed at this danger point.

In one case an oiler was boarding a ship carrying a parcel in one arm. Just as he reached the bulwark (beyond the point where there were handrails on the ladder) he slipped and fell in a sitting position; in attempting to rise, still clutching his bundle, he lost his balance and went overboard between the ship and the pier and was drowned.

In another case the gangway ladder was at the extreme angle of 75° with the ship's side, and was also slippery from a recent shower. The seaman boarding the ship slipped at the top of the ladder and, there being nothing for him to catch hold of, fell overboard to his death.

In the third case, a crew member was boarding a vessel with a package under each arm. On this ship the gangway was fitted only with a manila handrope over 3-foot stanchions instead of the customary fixed handrail. This type of rope rail is poor at best, not only because of its sag, but also because it cannot be carried out to a stanchion at the end of the ladder and is usually secured at each end to an eyebolt on the ladder itself. Here the hazard was still further increased by the fact that the seaman did not have his hands free to help himself. He asked to be given a hand as he stepped from the ladder to the rail, but no one could reach him before he toppled over. He fell from the bulwark, striking his head against the pier as he fell, and never regained consciousness.

In none of these cases was there any indication that the victim was under the influence of alcohol. Also, they all occurred either in daylight or under adequate lighting conditions. In all probability they would not have happened, even in the case of those men encumbered with packages, had some better protection been afforded at the point where a man steps from the gangway ladder to the bulwark. The accompanying sketch indicates the "danger zone," and shows a suggested installation for increased safety at the crucial spot. However, a seaman is supposed to exercise reasonable caution in dangerous places; the old maxim of "One hand for the ship and one for yourself" is still a good one. These three deaths, under similar circumstances, occurring within so short a time, indicate the need for additional safety measures and for more common sense precaution on the part of seamen.



CAUGHT IN THE BIGHT

"Eternal vigilance is the price of freedom"—from injury or death.

Handling heavy weights with cargo rigging places all hands within handshaking distance of sudden disaster, especially if there is one moment's carelessness or relaxation of vigilance. This is all the more true when the rigging is wire with heavy metal blocks and fittings.

A man's foot was amputated in a split second several months ago aboard a ship carrying a deckload of lumber because vigilance was relaxed for a moment. The wire didn't even slow up as it went through flesh and bone.

Discharging of general cargo from the holds was about finished, though some of the deckload of cargo was still on deck. Crew members were engaged in securing cargo gear, as each hold was completely discharged. Hatch beams and boards were put in place by the stevedore gang, and the crew was cradling and securing booms for sea.

In lowering the port and starboard booms at No. 2 hatch, it was necessary to work in a crouched position on the boom table, due to some of the remaining piles of lumber protruding almost across the table. Space did not allow more than one man at a time to work on the topping lift wire. Accordingly, an AB entered the available working space and passed a chain stopper onto the topping lift by taking two half hitches and then reverse wrapping the 6-thread manila tail, which was spliced on the end of the chain stopper, on the wire. He then turned this stopper over to the ill-fated seaman mentioned above, to hold, while the wire was transferred from the table cleat to a winch drum.

The weight of the boom was supported by this wire.

The stage was set.

The first seaman then started to remove turns of wire from the cleat and ease the strain onto the stopper. The stopper took the strain and held properly, but the large heavy deck fairlead block leaned over, as the strain through it relaxed, and rested against the adjacent lumber pile.

The two seamen then removed the final turns of wire from the cleat and stretched out the 30 to 35 feet of wire to clear all the kinks and turns. Next, they hauled the wire to the winch and started reaving turns on the niggerhead.

As they heaved the slack of the wire toward the winch, a slight strain on the heavy deck fairlead block toppled it against the leg of the seaman holding the stopper. No doubt this blow caused some annoyance and pain to this man, as he momentarily released his grip on the manila tail of the stopper.

As the wire began to slip through the stopper, the two men at the winch tried to hold it, but could not get a grip. They had to let go, as the wire suddenly ran with a rush, impelled by the heavy weight of the boom. The wire snapped toward the man at the stopper and, in less time than it takes to tell, a bight had encircled his right foot and amputated it clean at the ankle, the heavy fairlead block serving as the "chopping block". Other turns of wire encircled the upper parts of his body and arms inflicting painful bruises and injuries.

Several men on deck, attracted by the crash and scream, ran to assist, and in a few seconds had the wounded man disentangled from the wire and stretched out on deck. A tourniquet was rigged on the injured leg to stem the flow of blood, and an ambulance arrived a few minutes later to transfer the man to a shoreside hospital.

This serious injury was probably caused by the cramped conditions of working space around the fairlead block and chain stopper, due to the partial deckload of lumber remaining in the area. Had there been no interference, such as was caused by the bulkiness of the lumber, it is most probable that the fairlead block would not have struck the man's leg and that he would have maintained a better grip on the stopper. However, another factor which directly abetted the accident was the neglect of a principle of good seamanship in failing to apply half hitches in the tail of the stopper on the standing part of the wire. Had this been done, the momentary release of grip by the seaman when the block struck his leg would not have allowed the wire to start to slip. One law which has never been repealed or relaxed for a single moment is Newton's law of gravity. In flying a plane or in handling heavy weights, remember: The first mistake is never forgiven. Like fire, gravity is an invaluable ally, but an implacable enemy.

One man with one foot will forever remember the consequences of a slip with heavy weights. Will you?

FIRE EXTINGUISHER EXPLOSION

Recently a 35-pound carbon-dioxide fire extinguisher was removed from a vessel to a pier to be weighed. It was placed in the sun in an upright position. Due to the increase in pressure caused by the heat of the sun, it is presumed that a fracture of the control valve occurred. The carbon-dioxide was released from the heavy cylinder in such a manner that the cylinder took off as though jet propelled. The heavy cylinder traveled 115 feet, struck a piling, and was deflected, traveled another 95 feet and during the course of such travel reached a height of 30 feet before it fell. Fortunately no one was in the path of flight and the only damage done was to the pier and the fire extinguisher.

At annual inspections all carbon-dioxide cylinders, whether fixed or portable, are examined externally and checked by weighing to determine contents. When carbon-dioxide fire extinguishers are removed from a vessel for checking purposes or otherwise, every precaution should be exercised not to subject the cylinder to excessive heat from either the sun or any other source. The pressure of carbon-dioxide increases rapidly with an increase of temperature.

The moral of this accident is: DO NOT LEAVE OR STORE CARBON-DIOXIDE CYLINDERS IN THE SUN OR HEAT!

INSTRUCTION OF GREEN LOOKOUTS

The posting of a lookout at night or in low visibility is a basic safety precaution which no master neglects. But the mere stationing of a hand in the bow, or upon the bridge or elsewhere if the bow station is unsafe, is not sufficient. It is the responsibility of the officer in charge of the ship to assure himself that the lookout is, in fact, performing his duties vigilantly throughout his watch. Undoubtedly, in many instances a watch officer in a high, protected charthouse has better visibility than a lookout exposed to the weather on an open forecastle deck. But this should not allow the officer to disregard the lookout or to tolerate negligence in making reports, even though the reported object may already have been noted by the bridge.

An example of the result of such tolerance was shown in a collision occurring between two steamers on a dark night and in clear weather. The prescribed complement of one of these vessels was such that an ordinary seaman was standing lookout watch. Unfortunately, it was this seaman's first trip to sea. The two ships came together through unskillful handling on both sides. The part played by the lookout had little or no bearing on the actual collision since the lights of both vessels had been clearly visible for some time.

DANGEROUS—BEWARE LOOSE DOG!

A large modern diesel towing vessel was flooded and severely damaged last winter on one of the western rivers when she struck a submerged object. However, there is a strong presumption that the damage was caused more by the failure to control the progressive flooding which resulted after the damage, than by the initial damage. Flooding took place through at least two "watertight" doors.

On a routine trip, a strong blow was suddenly felt from the bow of the vessel. Apparently a steel object of undetermined nature had been struck. Flooding was immediately detected. The officers and crew rushed to the engineroom and saw water flowing aft into the machinery space through two "watertight" doors *which were open at the time.* They quickly closed these doors but, since the doors did not fit tightly, a large quantity of water continued to flow into the engineroom. Flooding progressed aft and the vessel was soon in a sinking condition. The captain headed his vessel for shore and beached her on a nearby mud bank. However, flooding continued and the stern sank in 17 feet of water. The extensive damage occurred to all of the machinery. Damage was estimated at over $100,000.

It was unfortunate for this vessel that the four watertight doors were not only in poor operating condition, but opened the wrong way, that is, into the engineroom. Although the vessel was salvaged and completely restored and there were no deaths or injuries, this mishap could have resulted in the complete loss of the vessel and loss of life.

While the above vessel was not required to be inspected, it is quite likely that fault could be found with the condition and use made of watertight doors and hatches on many other vessels, both inspected and uninspected.

The most important point to be remembered and acted upon is that watertight doors are installed for a specific purpose and should be kept in condition for that purpose at all times. Any factor which affects the ability of a watertight door to close a bulkhead tightly and prevent flooding is a factor which endangers the ship. Rendering a watertight door or hatch inoperative by lashing it open, obstructing its closure in any way, altering it materially so that it cannot function, or removing it should never be permitted. Any condition which temporarily affects the full usefulness of a watertight door should be remedied just as quickly as possible. The moment of greatest need may arrive sooner than you think.

Hand-operated watertight doors and hatches found on merchant vessels of the United States are usually one of two types. The type most usually found is completely manual, that is, after the door is closed, the dogs have to be closed by hand. The number of dogs vary from one to six. A door with less than six dogs is far from being an efficient watertight door.

The second type is partly automatic, that is, the action of the dogs depends upon the manual turning of a handwheel. The handwheel is mounted on both sides of the door on a common shaft and actuates all the dogs simultaneously by means of gears and eccentric levers.

Watertight doors of either type are useless unless they close tightly against the door frame. A properly designed WT door is so constructed that a continuous rubber gasket around its outer perimeter will come flush against a steel knife-edge built into the frame of the door in such a manner that this knife-edge presses tightly into the gasket and forms a seal entirely around the door.

Therefore, it is necessary to keep knife-edges clean, sharp, and true. They should not be painted and any damage must be repaired, to return them to true. The rubber gaskets must be complete, that is, full length, and kept free of paint so that the rubber will remain soft and pliable. Rubber gaskets are a favorite object to be painted by inexperienced painters, perhaps because they find these gaskets unpainted. Once such a gasket has been painted, it is usually necessary to renew it, as paint will harden and deteriorate the rubber.

Steel wedges against which the dogs tighten when they are closed have a tendency to wear, so that the door can no longer be made tight. In this case it may be necessary to build up and remachine the surface of the wedges or renew them. The dogs themselves require occasional cleaning or adjustment so that they operate freely and are positioned to engage the wedges properly. This adjustment can usually be made by using different size shims and washers. Many a WT door has been found to be "out of service" due to frozen dogs.

It is most important that the door itself be kept true and in one plane so that all of the outer surface will engage the knife-edge as it was intended to do. Constant usage, damage due to heavy weather, blows struck by machinery or other objects, and the working of the vessel may cause doors to become warped and untrue. Unless repaired and trued up, they are useless for their primary purpose. Sometimes workmen or other misguided individuals cut holes through them for strange and various reasons. The repair and permanent closure of any such holes is essential, and it is almost always too late to do this after the vessel has been damaged.

On any well-run vessel which is equipped with WT doors or hatches, they should be tested regularly to see that they function properly, and any repairs which are needed should be promptly accomplished. It should never be forgotten that a fault in such a closure may be just as drastic to the safety of the ship as a hole in the hull. A periodic test of such closures is particularly important if such closures are not used regularly; for instance, WT doors to storerooms or little-used compartments which may remain closed most of the time.

On WT doors of the quick-acting type, the actuating mechanism should be disassembled and inspected occasionally to insure that all of the parts are intact and working properly. Lubrication of the working parts at this time is highly desirable. On doors of this type, which are spring-loaded to automatically close, the spring should be closely examined to make sure it is completely operative. The actuating mechanism should never be forced open or forced closed. If it does not work easily, undue force may easily break the gears or levers inside the door and this closure is then "out of service" until repaired.

Of vital importance is the general principle that WT doors are installed in a vessel to be *used*. In general, unless it is obviously necessary to keep such a door open for some specific purpose, the door should be kept closed, so that it will not be necessary for someone to remember to close it after damage occurs. Lives have been lost due to failure to observe this principle. Lashing WT doors and hatches open for convenience, or simply because the need of the tight closure is not staring in your face, is about the same as leaving fire extinguishers and life preservers on the dock when getting underway because you do not expect to have a fire or a man overboard on that trip.

In general, WT doors and hatches are mounted so that the water pressure resulting from flooding after the most likely type of damage will help close the door. The great majority of collisions and groundings which cause flooding usually involve damage near the bow or stern. In the case of the above-mentioned towing vessel, the WT doors should have been mounted so that they opened away from the engineroom, that is, so that flooding from the bow or the stern which progressed toward the heart, or engineroom, of the vessel would help close the doors, *not* help open the doors. However, this principle of the direction in which a WT door should open is subject to considerations of other local conditions which may necessitate opening the door in the other direction, such as lack of room for the door to swing, obstruction by some important object such as a fire hydrant, etc. In addition, consideration must always be taken of the desirability of doors opening in the normal direction of *escape* for personnel.

A point of advice to be remembered in case of flooding which has been confined by a WT door—if you are uncertain whether a compartment behind a WT door is flooded and you are attempting to determine this by partially opening the door, don't try loosening the dogs on the edge away from the hinges. If you do, and there is full pressure behind the door, this pressure may burst open the door and you have lost control of the flooding. Try one of the dogs on the hinged edge. In this manner leakage will tell you if the compartment is flooded and you will *not* lose control and possibly flood another compartment, perhaps with the loss of the ship.

One common method of completely disabling a WT door which practically every vessel will encounter at some time or other is the habit of leading cables, air hoses, etc., through opened WT doors. This is usually done by shore workmen who have no appreciation of the importance of the door, and may care even less. If at all possible, do not disable your WT closures in this manner, as the only measures which can be taken in an emergency to close a door thus disabled, that is, cutting the cables and hose, etc., may lead to many unfortunate complications, and such a procedure may take too long to prevent flooding.

WANTED—SEA ROOM

ONE of the most disheartening hazards of the merchant vessel navigator is the unexpected encounter with a small pleasure craft or fishing vessel. While the navigator of a merchant vessel can reasonably expect another merchant vessel to act with reasonable prudence and skill, he can never tell exactly what the small boat is going to do. There have been several unfortunate experiences where merchant vessels collided with small boats in the last few years; some of them resulting in death. However, no matter how unreasonable, foolish, or negligent the actions of the small craft have been, there is no licensed deck officer afloat who wants to hit one of them or hurt any of the occupants. In fog or limited visibility, a small boat can loom up under the bow of a merchant vessel with terrifying suddenness and dismaying results. Apparently, the Rules of the Road for avoiding collisions are not understood by many small-boat operators.

One such collision took place last year off the East Coast. The small craft was demolished (*see Figure 1*), but fortunately no lives were lost. A foreign freighter was steaming northward approximately nine miles off shore during warm summer weather. There were scattered patches of fog with intermittent good visibility. The freighter was turning up about 14 knots and the radar had been turned off, since the mate on watch thought it would not be needed. At about 7:15 a. m., the ship was plunged into a fog bank without much warning. The mate on watch shouted to the carpenter, who was working on the fore deck, to go to the forecastle head and act as lookout. Shortly after the carpenter arrived at the bow, he turned around, shouted, and waved his arms indicating something ahead of the vessel. The Chief Mate grabbed the engineroom telegraph and threw the engines full astern. The Master came running up from his cabin.

On board the small motor craft, a party of 10 passengers and 2 crew members, having dropped the anchor in a likely spot, had started to fish. This 34-foot wooden cabin cruiser was used for sport fishing parties, and it had departed the dock early that morning. Only a few minutes after anchoring, those aboard heard a ship's whistle close by. The operator ran forward to cut the anchor line to get under way, and his assistant began to ring the boat's fog bell as hard as he could.

Before he could cut the anchor line, he glanced up and was horrified to see a freighter's sharp bow loom out of the fog. Within seconds the fishing boat was struck a death blow amidships. The tremendous force of the impact threw the occupants into the water. The wreckage settled quickly and was soon only awash. Fortunately, the operator had stowed the life preservers in an accessible location and the persons floundering in the water were able to reach them. Additional life preservers were thrown overboard from the freighter. With the aid of these, all hands were able to remain afloat until two nearby fishing boats arrived at the scene and rescued them.

The freighter launched a life boat as soon as she was able to stop her headway, but by that time the survivors had been picked up. Except for one of the crew who suffered a broken leg, no one from the fishing party was seriously injured. The wreckage was towed ashore by the Coast Guard, but was deemed a total loss.

Another more tragic encounter between a merchant vessel and a small pleasure craft occurred off the West Coast. A foreign freighter and a 50-foot auxiliary yawl came together early one spring morning with such disastrous results for the yawl that all five occupants lost their lives. The freighter's only damage was a slight bend in her jack staff.

The weather was overcast with light drizzle and a visibility of about four miles as the freighter steamed along the coast at 13.5 knots. During the midwatch, the seaman who was assigned as lookout on the foreign freighter left his station and went below to make coffee. Nobody was assigned as lookout during his absence. Suddenly, the officer on watch saw a small white light about two points on his starboard bow. Shortly afterwards, the helmsmen saw the white light and a red light. The rudder of the freighter was put hard left and standby was rung on the engineroom telegraph. This noise awakened the Master who ran up to the bridge. Before he arrived, the freighter had smashed into and steamed through the wreckage of the yawl, still going full speed ahead. By the time the freighter had stopped, turned around, and returned to the scene, nothing could be found but small bits of wreckage, which included a chunk of the stern of the yawl's dinghy.

Of the five persons known to have been on the yawl, only one body was found, but it is certain that all four of the others also perished. Since there were no survivors, it was impossible to obtain any evidence as to the yawl navigation, intentions, or actions to avoid collision.

A tragic accident occurred one evening in a West Coast harbor when the operator of a small passenger motorboat, a converted landing craft, neither heard nor saw a foreign freighter bearing down on his starboard side. The freighter, being the privileged vessel in a crossing situation, maintained her course and speed, finally blew a one-blast signal, the danger signal, and then reversed her engines and changed course hard right. Nevertheless, a collision occurred and the small boat sank, three passengers losing their lives.

Two collisions have occurred in the last two years in which small vessels, being overtaken by large merchant vessels, altered their courses suddenly or erratically and were struck and sunk by the larger ships with resulting loss of life. In the first instance, a fishing trawler was headed for her home port on the East Coast during a summer evening. A large tanker was headed for the same port and undertook to overtake and pass on the trawler's starboard side. At the worst possible moment, with the tanker's bow overlapping the trawler, the trawler suddenly altered course to her right! She was struck by the tanker and sank soon afterwards, one man from the trawler losing his life.

In the second instance, a tanker was proceeding down the main channel to sea on the West Coast at a speed of about 12 knots. A small fishing vessel was sighted about a mile and a half ahead, also proceeding down the channel. The tanker blew two blasts to the fishing vessel indicating a passing on her port side. Due to the inattention of the operator, or the noise of the diesel exhaust, this signal was not heard. Shortly thereafter, the fishing vessel made a pronounced change of course to the left and appeared to be headed across the bow of the tanker. The tanker blew a danger signal, went full speed astern and gave hard right rudder. As a result, the tanker's bow started swinging to the right and the fishing vessel appeared clear on her port bow, whereupon the tanker stopped its engine. Shortly afterwards, the fishing vessel made another sharp change in course, this time to the right, and before the tanker could take additional avoiding action, a collision had occurred! The fishing vessel sank with the loss of one man who was asleep in his bunk.

Another tragedy with needless loss of life occurred when a tug pushing a barge in an East Coast harbor struck a 30-foot yacht, on a clear summer night. The tug and yacht had been on converging courses and the tug pilot had taken avoiding action, finally backing down full. Apparently, the operator of the yacht had not seen the tug as he took no avoiding action. The yacht was sunk and one passenger lost his life.

An unexpected collision occurred one night on an East Coast river when a small tank vessel ran down a rowboat and two young men, aged 14 and 23, lost their lives. The two men had gone out on the river for a few hours of fishing—no doubt they were keeping little or no lookout for approaching vessels. About 4:00 a. m., the tanker, light and with the bow riding high, approached, making nine knots. There was no lookout posted, although the vision of the mate on watch was obscured by the high bow. Personnel on the tanker did not even know they had struck a boat until voices were heard screaming from the water. Although the tanker stopped and lowered a lifeboat, no one could be found. Both bodies were recovered at a later date.

What conclusions should be drawn from these sorrowful encounters between "the big fellow" and "the little fellow" on the waters of the United States? One obvious conclusion is that each tragedy was caused, to a large extent, by a lack of appreciation or consideration of the other fellow's problems. For instance, the small boat operator who assumes the big ship is going to keep out of his way or keep clear of him, regardless of the circumstances, is headed for trouble, in a hurry. Similarly, the big ship navigator who neglects to exercise every reasonable care and precaution toward the small boats in his vicinity is likewise headed for trouble. The old maxim: "Live and let live" is especially appropriate for application to the marine highways of the nation.

Regardless of how the small boat operator feels about the big ships hindering and interfering with his use and enjoyment of the waterways, or how the big ship navigator feels about the small boats hindering and interfering with the pursuit of commerce on the waterways, each must live with the other and each must give the other a full share of consideration. Although it is dangerous to generalize, most of these accidents can be traced to two erroneous viewpoints: (1) The large vessel navigator, who is probably proficient, does not realize or will not admit that the small boat operator may not be an expert in the Rules or the Road and may not be proficient in handling his boat or in understanding the significance of large and small vessels approaching each other. (2) The small boat operator, who thinks he has his own craft well under control, does not realize or will not admit that the large vessel is relatively unmaneuverable and restricted in movement and *may not be able* to avoid him.

That many small operators do not understand the significance of a crossing situation or the requirement that the privileged vessel hold her course and speed is unquestionable. This lack of understanding and the necessity for "extremis" avoiding action which it may entail must ever be kept in mind by the large vessel navigator.

Very broadly, advice to the two classes of navigators could be stated as follows: If you are at the conn of a merchant vessel, take care for the little fellow! Anticipate and be prepared lest he do the wrong thing at the wrong time. If you are at the wheel of a small pleasure craft or fishing vessel, keep a good lookout all around and give the big fellow plenty of room. He cannot handle his ship one-tenth as freely as you can and he will be grateful for the sea room.

Figure 1. Remains of yacht after collision with foreign freighter.

WAGES OF CARELESSNESS

All the elements necessary for a disastrous explosion were present; a hundred gallons of gasoline had leaked into the bilges; the vapors from this gasoline had spread throughout the interior of the vessel; and there was a gasoline-driven, double-duty generator on board, which, if used to pump out the bilges, offered a source of ignition to the vapors.

This was the situation faced by the captain of a yacht one recent summer morning. The gasoline he had ordered from a local dispenser of marine supplies was then being pumped on board. During the refueling operations, the dock pumpman, who had heard sounds of leakage from below, shut down the gasoline pump and went into the engineroom to investigate the cause of the apparent leak. He found the starboard tank leaking badly and, by comparing the amount of fuel he had unloaded with the amount in the tank, he estimated that at least a hundred gallons had leaked into the bilges.

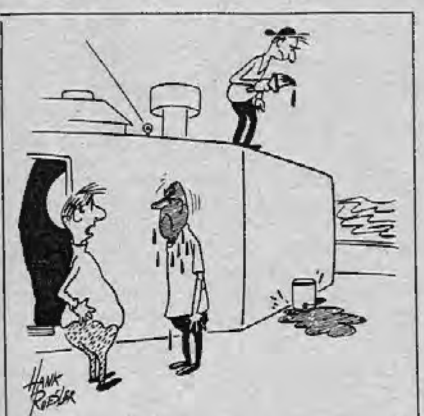
Before resuming refueling operations, the pumpman insisted to the captain that the bilges be pumped out and went on the dock to borrow a pump for that purpose. The only

pump available was an electric pump which he refused because of the danger it offered as a possible source of ignition to the gasoline vapors.

When he had left the yacht, the gasoline-driven generator was in operation at slow speed charging batteries; as he returned he observed that the captain had apparently switched the generator over and that it was now being used to pump out the bilges. Nearing the yacht he heard, in rapid sequence, the speed of the generator suddenly increase, a loud exhaust explosion followed almost instantaneously by a tremendous explosion from the interior of the yacht, and saw an immediate outburst of fire. The casualty caused fatal burns to the captain of the yacht, serious burns to two other persons on board, and complete loss of the yacht.

The course that a SAFETY MINDED, reasonable, and prudent man would take to empty the bilges would have been to shut down all machinery offering a possible source of ignition to the gasoline fumes, take necessary precautions against possible asphyxiation, and then use a hand pump to bail the gasoline out of the bilges, being careful not to provide a source of ignition to the explosive vapors. The master, by his actions in this casualty, violated the very fundamentals of the rules for the safe handling of gasoline.

Scientific studies have shown that a half pint of gasoline vaporized in a confined space may create a potential explosive power of 5 pounds of dynamite. This yacht had an estimated 100 gallons of gasoline in its bilges. No one would handle a ton and a half of dynamite in a careless manner. In this case a source of ignition was voluntarily offered to vapors rising from 100 gallons of gasoline having a potential explosive power of a large barrel of dynamite. It exploded. Very little imagination is needed to picture the havoc wreaked on this 88-foot yacht.



"Green in the face! I thought you never got seasick!"

(*Courtesy Maritime Reporter*)

The Coast Guard has repeatedly emphasized the necessity of being SAFETY MINDED when operating gasoline-propelled craft. Reports of many cases involving the explosions of gasoline vapors on board gasoline-propelled craft are received annually at Coast Guard Headquarters. The occurrence of such a large number of these accidents shows that all those who handle gasoline on vessels are not, as they should be, SAFETY MINDED.

It is hard to believe that the captain in this case was not aware of the danger involved in using the gasoline-driven generator while the gasoline vapors were so prevalent. He was a man of experience and had received several issues of a master's license. His attention had been directed to the vapors and the gasoline in the bilges.

The only conclusion that can be drawn is that he thought he could take the chance; that he could get away with it; that other ships might have explosions, but not his. This frame of mind is well suited to a soldier ordered "over the top," but even his chances are better than the man who takes his life in his own hands by voluntarily offering a source of ignition to highly explosive gasoline vapors. In the interest of their own safety and property, operators of vessels having gasoline-driven machinery are urged to follow the basic rules of safety in handling gasoline—BE SAFETY MINDED—observe the following rules:

1. Fuel tanks should be properly installed and vented.
2. Fueling should be completed before dark except in emergencies.
3. Whenever boat is moored at service station for fueling:
   A. Do not smoke, strike matches, or throw switches.
   B. Stop all engines, motors, fans, and devices liable to produce sparks.
   C. Put out all lights and galley fires.
4. Before starting to fuel:
   A. See that boat is moored securely.
   B. Close all ports, windows, doors and hatches.
   C. Ascertain definitely how much additional fuel the tanks will hold.
5. During fueling:
   A. Keep nozzle of hose, or can, on contact with fill opening to guard against possible static spark.
   B. See that no fuel spills get into hull or bilges.
6. After fueling is completed:
   A. Close fill openings.
   B. Wipe up ALL spilled fuel.
   C. Open all ports, windows, doors and hatches.
   D. Permit boat to ventilate for at least 5 minutes.
   E. See that there is no odor of gasoline in the engineroom or below decks before starting machinery or lighting fire.
   F. Be prepared to cast off moorings as soon as engine starts.

The Coast Guard has available for distribution copies of the pamphlet entitled *Motorboat Safety* which has recommended practices for the care and safe operation of motorcraft. Copies of this pamphlet can be secured at the nearest Coast Guard Marine Inspection Office or upon request from the Commandant (CMC), U. S. Coast Guard, Washington 25, D. C.

ARSON, BARRATRY, FRAUD

The temptation to attempt to collect insurance proceeds by intentionally destroying property is sometimes too great to resist, even for boat owners. The incidence of small vessels lost by sinking or fire wherein comprehensive investigation can reveal no definite or reasonable causes for their loss, especially in locations where it is known that business is not too good, is far too great for normal explanation. One recent attempt to defraud an insurance company by intentionally burning a boat ended in utter disaster for the owner.

In July 1954, the owner of a 30-foot cabin cruiser was sentenced by a District Court Judge in Jacksonville, Fla., to 4 years in Federal prison for burning his boat to collect the $6,500 insurance. Two accomplices, who pleaded guilty to the actual burning of the vessel, were each given suspended sentences and placed on 5 years' probation.

Federal statutory criminal offenses committed on the navigable waters of the United States or in the United States admiralty or maritime jurisdiction are under the original jurisdiction of Federal District Courts. Section 2271, Title 18, United States Code, CRIMES AND CRIMINAL PROCEDURES, reads as follows: "Whoever, on the high seas, or within the United States, willfully and corruptly conspires, combines, and confederates with any other person, such other person being either within or without the United States, to cast away or otherwise destroy any vessel, with intent to injure any person that may have underwritten or may thereafter underwrite any policy of insurance thereon or on goods on board thereof, or with intent to injure any person that has lent or advanced, or may lend or advance, any money on such vessel on bottomry or respondentia; or

"Whoever, within the United States, builds, or fits out any vessel to be cast away or destroyed, with like intent—

"Shall be fined not more than $10,000 or imprisoned not more than 10 years, or both." Prosecution of the owner in this case was based upon this statute and upon Sections 2272 and 2274, Title 18, United States Code, which are somewhat similar.

The incident, investigated as a marine casualty by the Office of Marine Inspection, Jacksonville, Fla., took place on May 11, 1953. At 5 p. m. on the above date the cruiser while navigating approximately one and a half miles off-shore from Jacksonville Beach caught on fire and burned to almost a total loss. During subsequent investigation, the two men who had been operating the boat stated that they took the boat from a repair yard to sea on a trial run after repairing the engine. They claimed that they had been running for three hours when the engine backfired, causing fire in the engine compartment and the fire so alarmed the men that they immediately abandoned the cruiser in a small dinghy. During interrogation of other witnesses, it become apparent that fraudulent conspiracy to destroy the property was involved.

A witness from the repair yard stated that on two previous occasions he had found a soldering iron left plugged into the electric current on board the boat. Other witnesses who were able to salvage the engine and part of the boat testified that the repairs alleged to have been made on the engine were not likely as the carbon deposits in the engine had not been disturbed and it did not appear that any of the fittings on the engine had been removed at all. One witness testified that he saw two men remove the dinghy from the top of the cabin of the cruiser and tow it astern upon leaving the yard. However, the statements of the two men who had been in the boat when it caught fire were in conflict as to where the dinghy was kept and when it was placed overboard.

Close examination of the engine and fuel connections from the salvaged portion of the boat indicated that the fuel connection from the tank at the carburetor had been tampered with and the soft gaskets had been taken out in order to allow the leakage of gasoline to the bilges. The engine was fitted with an approved type flame arrester of the up-draft type which would have prevented fire from reaching the bilges in case the engine backfired.

In view of the conflicting and condemning circumstances, the Officer in Charge of Marine Inspection, Jacksonville, Fla., contacted the United States district attorney. The Federal Bureau of Investigation was assigned to further investigate the circumstances of this case and assisted the Coast Guard's investigation as necessary.

Charges against the owner of the boat and the two men who were in it when the fire occurred were presented to the Federal grand jury which returned a true bill of indictment. The owner was charged as follows:

COUNT ONE

Beginning prior to May 6, 1953, and continuing to June 1, 1953, the owner did willfully and corruptly conspire within the United States to cast away or otherwise destroy a vessel, to wit, a 30-foot cabin cruiser, with intent to injure the person who had underwritten a policy of insurance thereon; in violation of Section 2271, Title 18, United States Code.

OVERT ACTS

1. On or about the 6th of May 1953, the owner offered another man the sum of $500 to burn his boat.
2. On or about the 8th day of May 1953, the other man accepted the offer of the owner to burn the boat.
3. On or about the 10th day of May 1953, at the boatyard the owner showed the conspirator how to operate the boat and instructed him how to destroy it by fire on the high seas offshore from Jacksonville Beach, Fla.
4. On or about the 11th day of May 1953, another man agreed to assist in destroying the cruiser by fire.
5. On or about the 11th day of May 1953, at a point approximately 1½ miles offshore at Jacksonville Beach, Fla., on the high seas the men did destroy by fire the cabin cruiser.
6. On or about the first day of June 1953, the owner filed with the insurance company carrying the insurance policy on his boat, a claim in the amount of $6,500 for the destruction by fire of the boat.

COUNT TWO

On or about 11 May 1953, upon the high seas and on waters within the admiralty and maritime jurisdiction of the United States, in the Southern District of Florida, the owner did willfully and corruptly destroy and

cause to be destroyed a vessel, to wit, a 30-foot cabin cruiser of which he was owner, with intent to injure the person who had underwritten a policy of insurance thereon; in violation of Section 2272, Title 18, United States Code.

COUNT THREE

On or about 11 May 1953, upon the high seas and within the territorial waters of the United States, in the Southern District of Florida, the owner of a private vessel, to wit, a 30-foot cabin cruiser known as the ---------- did willfully permit the destruction of said vessel; in violation of Section 2274, Title 18, United States Code.

On the 9th day of June 1954, after the Government had completed testimony in its case against him before a trial jury in district court, the owner of the boat pleaded guilty under count one, conspiring to destroy a vessel with intent to fraudulently collect the insurance proceeds, Title 18, United States Code 2271. Following the guilty plea to the conspiracy count, the Government dropped the second and third counts. The maximum punishment authorized for the second count is life imprisonment. The two accomplices were given suspended sentences as described above. The owner of the boat was given one week from the date of conviction to set his affairs in order, at the termination of which he was to report to the United States marshal to begin the execution of sentence.

"C'MON IN!--THE WATER'S FINE!"

(Courtesy Maritime Reporter)

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