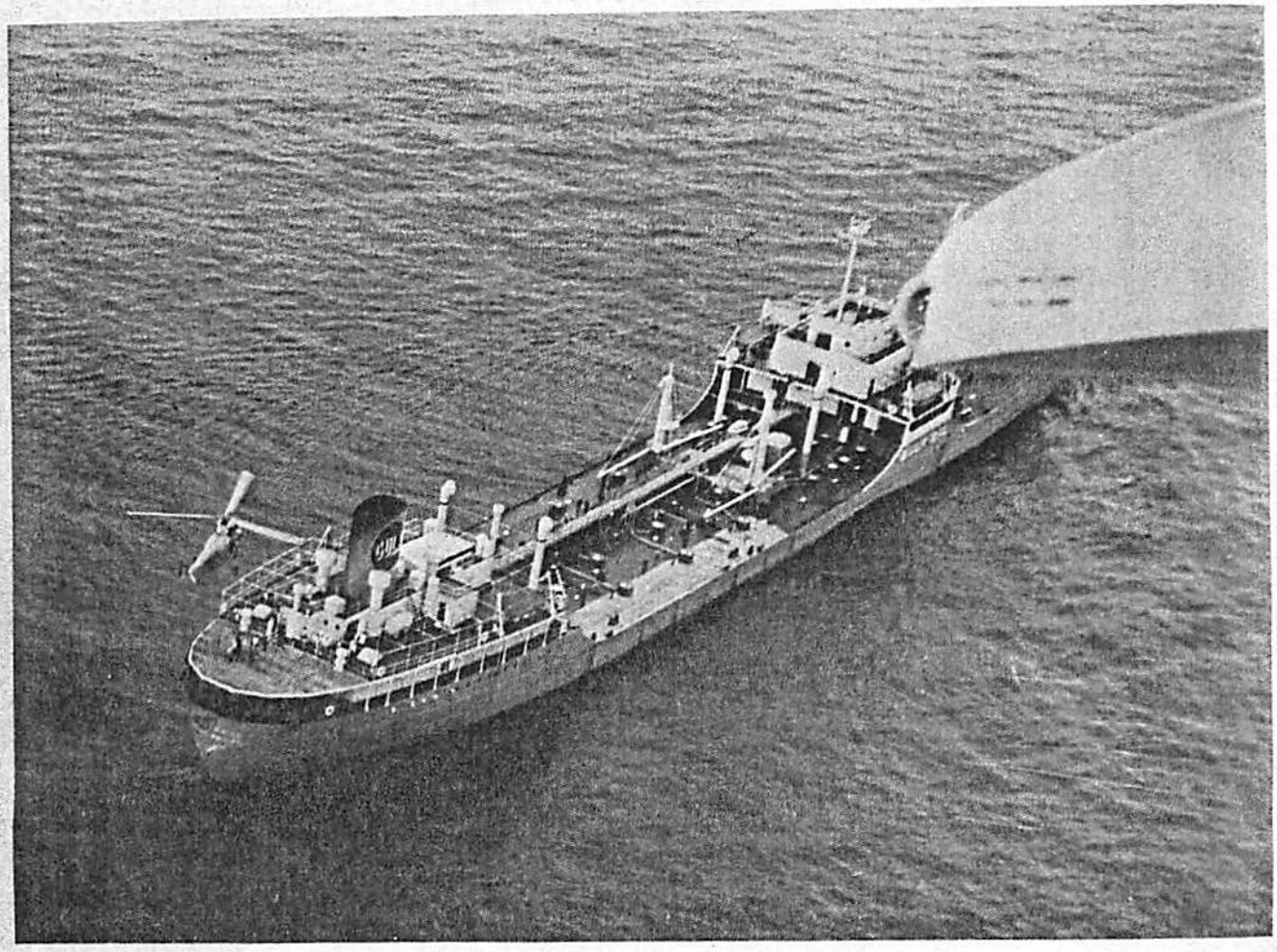
THE HELICOPTER IN RESCUE

By Captain Woodrow W. Vennel, USCG



A U.S. COAST GUARD HO4S helicopter on a mercy mission hovers over the stern of a 551-foot tanker to airlift an ailing seaman.

THE VERSATILE HELICOPTER

THE EVER SO VERSATILE HELICOPTER is one of the more modern equipments maintained by the Coast Guard for operation as a rescue facility. Most of the Coast Guard helicopters are strategically located contiguous to the well-traveled sealanes in general use by seafaring personnel, and to the areas of concentrated small boating activity.

THE HELICOPTER

The word "Helicopter," according to Webster's New International Dictionary, stems from the Greek HELIX, -IKOS, meaning spiral, plus PTERON or wing; and is defined as "a form of aircraft whose support in the air is derived from the reaction of a stream of air driven downward by propellers revolving around a vertical axis."

The helicopter depends upon its rotating wings and the airflow over them for its support. Any change in the airflow, either from a rotational speed difference or a wind change, upsets the fine balance of flight—especially noticeable in hovering. To keep the helicopter suspended over a spot, whether it be a moving ship's deck, or a fixed point, the pilot has many things to do, all correlated together. The left hand controls the height of the helicopter by a change in the pitch of the blades and the speed of their rotation. A change in one requires corresponding change in the other. The right hand controls the direction of movement of the helicopter, backward, forward or sideways. Any movement here affects the lift balance of the helicopter—both hands must act in coordinated relation. Changes made by either or both hands affects the torque input into the rotor. To prevent the helicopter from changing heading—rotating about its center—both feet of the pilot are employed constantly. Any foot movement requires movement of both hands to correct for changed torque. If the hovering maneuver is being performed for a hoist pickup, the pilot must constantly talk on the interphone and radio, to receive or transmit guidance instructions. During the entire operation, his eyes are required inside to monitor the status of flight—but they are also required to observe outside to hold his relative position—he practically maintains a "split watch" with his eyes.

It would be difficult to give a word picture of all the problems associated with the use of helicopters in a search and rescue operation, but some idea of the situation can be seen in the following example.

A TYPICAL STORY

The typical quiet in the Operations Office of one of our Coastal Air Stations in the late afternoon one George Washington's Birthday, was broken by the clanging bell of the "hot line" from the District Rescue Coordination Center. A radar picket ship on station 200 miles southeast of the nearest point of land had run afoul of extremely rough weather, and now had two seriously injured petty officers aboard who required earliest medical attention. Their evacuation appeared necessary if they were to survive, particularly in view of the rough conditions still to be encountered and the lack of proper facilities on board. The vessel requested their removal at 0600 the following morning, at sea, at a rendezvous point to be determined according to sea conditions en route. Weather for the entire area of operations at this time was snow showers, 20- to 35-knot winds, 8- to 10-foot seas, with a forecast for little change. A helicopter removal of these injured persons was practically dictated by the existing weather. The nearest point of land which was served by an airport or other facility from which refueling could be accomplished was 100 miles from the base of the helicopter. A need for a hospital corpsman in the helicopter was dictated by the condition of the evacuees, one of whom suffered a broken back while the other sustained a severe head injury as well as a fractured arm. Forecast weather conditions suggested the need for an additional crewman to assist in the cabin during the contemplated rough weather hoist. The resulting decision proved extremely sound, but now there would be four crewmen in the helicopter—pilot, copilot, hoistman, and corpsman.

SIX MEN ABOARD

At completion of the hoisting operations, six men would be aboard the helicopter. This determined its operating weight for return to a refueling area. As the rendezvous point was unknown at the planning stage, maximum distances for flight had to be considered. The fuel to go that distance, hover sufficient period of time to hoist two persons, and return to a refueling area, set the departure fuel load. With four persons aboard en route to the scene, and six returning, the helicopter would gross out at a heavy operating weight. If a search should be necessary to locate the vessel, then additional fuel would be needed. This would bring the helicopter to maximum operating weight —always frowned upon by experienced pilots, but frequently necessary if the mission is to be accomplished.

THE QUESTION OF DEPARTURE TIME

The question of departure time so that rendezvous would be effected at about 0600 the next morning had to be resolved. Should departure that evening or the next morning be attempted? What weather would be encountered en route to the refueling stop? Would it be better in the morning or worse? Would conditions encountered later cause failure of the mission? Conditions at the moment were such that the mission could proceed to the fueling point; but were adequate rest accommodations available thereat? Could the helicopter be started in the morning if it remained exposed all night in freezing, snowy weather? These and many other questions had to be resolved before the mission could move; not the least of which was what equipment would be used to effectuate the hoist, considering the condition of the two evacuees? In any event, the flight must be made at night in semi-instrument conditions, if rendezvous was to take place at 0600 the following day.

Arrangements were made to depart at about 0330 in the morning—after 5 hours of little but fitful sleep, during which the planning was thoroughly reviewed. Actual departure was made at 0340, in light and intermittent snow showers, arriving at the refueling area one hour and twenty minutes later. To assure sufficient power available to start the helicopter engine, a portable generator was aboard which would be left at the refueling point when departure for rendezvous was made, approximately 1 hour and several cups of coffee later. Rendezvous was accomplished after 35 minutes of flight in company with a Coast Guard fixed wing aircraft which had been directed as escort throughout the overwater portion of the operations. Coast Guard helicopters are not equipped with emergency flotation gear and the use of a fixed wing aircraft for escort is considered desirable to prevent loss of personnel in the event of further emergency.

EN ROUTE TO RENDEZVOUS

En route to the rendezvous, explicit voice radio instructions were issued to the vessel setting forth the need to set, and remain, on the same voice radio frequency, the need for keeping the way of the vessel at minimum for steerage, with the wind on the port bow for ease in holding position for pickup. Additional instructions were

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ABOUT THE AUTHOR

A 1935 GRADUATE of the U.S. Coast Guard Academy, Captain Woodrow W. Vennel, USCG has been closely associated with all types of Coast Guard aircraft. He received his wings from the Naval Air Station, Pensacola, Fla., in 1940.

He commanded the Port Angeles Air Station from April to June 1945 after various flight duties during World War II. In June 1945 he piloted a PBM seaplane to a landing in the Pacific Ocean 500 miles west of Cape Flattery, Wash., to remove a sick sailor from a vessel.

After serving at the Coast Guard Air Station in Brooklyn from July 1945 to August 1946, Captain Vennel reported to Coast Guard Headquarters, Washington, D.C., to duty as Assistant Chief, Aeronautical Engineering Division. He was assigned the additional duty as Coast Guard—Treasury member of the Subcommittee for Divisional Standards Provisional International Civil Aviation Organization, predecessor of the ICAO.

From August 1951 to 1955, he commanded the Coast Guard Aircraft Repair and Supply Base at Elizabeth City, N.C., then commanded the Coast Guard Air Station at Salem, Mass.

While at the Salem Air Station Captain Vennel was awarded a Commandant's Citation for a hazardous helicopter pickup at sea. In July 1957, he became Chief, Aeronautical Engineering Division at Coast Guard Headquarters in Washington, D.C., the position he now holds.

Captain Vennel presented the many facets of the Coast Guard's use of the helicopter in a Panel Discussion of the Marine Section, National Safety Council, at their 1960 annual meeting.

passed describing the pickup methods, and insisting that persons on deck in the vicinity of the hoist operation be limited to those actually required for its performance.

As a matter always requiring attention, the vessel was advised to lower and secure, if possible, all afterstays, whip antennae, booms, lines, etc., that might be cause for entanglement of the hoist cable. She was requested to advise if there would be any rigging of any kind that could not be stowed or housed about the selected area, which could possibly foul the operation. If it was impossible to clear an area sufficient for effecting a hoist without interference, the vessel was requested to so advise. It would then be necessary to place the injured men in a small boat to be towed astern, thus providing the necessary security and safety required in the hoist procedure.

STOKES LITTER

It was directed that the hoists would be made from the afterdeck. The more seriously injured man would be hoisted first by means of the stokes litter. It was explained how the four bridle hooks attached to the lowered stokes litter were to be removed from the four corners. The seaman with the broken back was to be ready and strapped into a stokes litter furnished by the vessel. The hooks as removed from the lowered litter were to be attached to that provided by the ship, corner for corner. When ready in all respects to have the litter hoisted, the deck crew was to signal the helicopter accordingly, and the hoist would be accomplished. No time was to be wasted. The rescue basket would be lowered immediately after completion of the stokes litter hoist and the vessel could proceed after it was clear of the ship's rigging. After lowering this device to the deck, it was to be unhooked. The patient was to be seated in the basket and instructed to hold on to its side rails. When everything was in readiness for pickup, the cable would again be lowered to within reach, and without further ado, was to be attached to the basket at its only attach point, whereupon it, and the patient, would be hoisted to the helicopter cabin.

CAUTION SHOULD BE EXERCISED

The general precautionary rule which must always be emphasized at each operation is that all caution should be exercised so that the deck crew will not attach the hoist cable to anything except that which is to be hoisted, never to the rail, a stay, or other part of the vessel. To have the hoist cable attached to the vessel in any manner may seriously jeopardize the success of the mission, for it will in all probability be necessary to cut the cable from the helicopter.

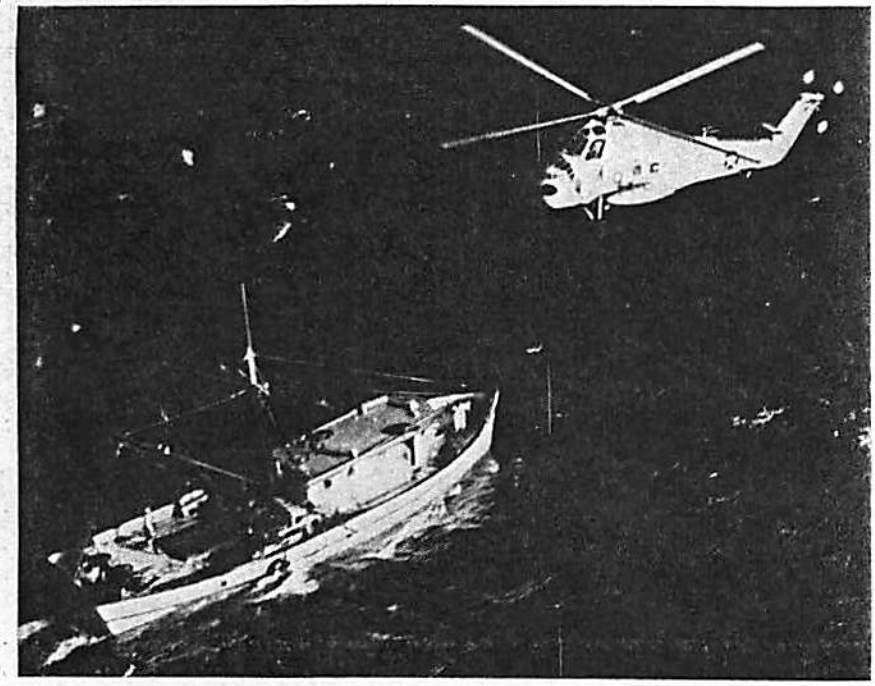
After delivery of all instructions, the vessel was requested to repeat the details so that no misunderstanding would be evident. The 35-minute flight to rendezvous appeared to be very short with all of this activity taking place. The need for a search on the mission was obviated because of vectoring information furnished from the ship's radar. Radar contact was made and an identification turn directed, after which visual contact was made at 11 miles. Radar will not always be available. Such assistance, in fact, should not be considered in computing requirements. However, if your vessel is equipped with radar, vectors furnished can frequently save many valuable minutes of search time. An offer by you to the helicopter pilot is all that is needed.

CONTACT ESTABLISHED

Soon after visual contact was established, it was apparent that the vessel was proceeding at a comfortable hoisting speed of about 7 knots but with the wind on the starboard bow! And after acknowledgment of instructions, too! This discrepancy is easily explained however. In fixed wing aircraft the pilot is always on the left side—in helicopters, the pilot is on the right. A general understanding of fixed wing aircraft discloses that if the pilot is seated on the left side, he could control the situation better with the wind on the starboard bow. The opposite, of course, is the case with helicopters. Adherence to stated instructions is absolutely necessary.

FIRST HOIST

As soon as this discrepancy was corrected, the helicopter proceeded to position itself for the first hoist. This is a teamwork operation with the pilot being assisted by the hoist operator who talks the pilot down into a good hoisting position. The decision to hoist the stokes litter first was based on the limited space available in the cabin and the need for all the maneuvering room possible therein. With three men already in the cabin, picking up a stokes litter and placing it securely in its tiedowns would be quite a feat—thus the decision to hoist the stokes litter first. Although the ship was rolling considerably, no difficulty was encountered with the hoist. The deck crew was alertness itself and demonstrated that the ship's organization was of the highest order. Upon assuming hoisting position, observation disclosed the patient on deck securely strapped in the ship's furnished litter, awaiting hoist. The bridle was quickly released, and reattached to the ship's litter—not more than 30 seconds was required. The entire hoist operation from lowering to securing the litter in the cabin was performed in about 2 minutes.



PUMPS AWAY—Coast Guard HUS–1G HELICOPTER drops a portable pump to a sinking fishing vessel. Five hours later the ship reached port under her own power.

PILOTS PROBLEMS

Only the pilot seemed to have problems. The wind was gusty, the ship rolling heavily—maintaining position was not easy. It was accomplished with some misgivings. Vertigo from watching the constantly heaving, rolling ship was fought off with difficulty. The pilot's sigh of relief was probably audible to those sturdy individuals 40 feet below on the bobbing deck, when the stretcher and its injured occupant were safely inside. To relieve the tension thus generated, the helicopter was flown in a rather large left-hand circle around the portside of the vessel to return and resume a position preparatory to the next hoist operation.

Having first performed a hoist with a rather unwieldy stokes litter on the hook, one would be inclined to conclude the next would be a matter of routine, especially when the ship's crew was performing with such complete reliability. Not so! Although the basket is ultimately more simple to handle, both in and out of the helicopter, the ship's motion was beginning to have its effect. It seemed the helicopter wouldn't stay suspended over that indefinable spot—the cable was being lowered with the basket swaying in a pendulous motion as it was blown in the breeze and acted upon by the increasingly difficult-to-control platform. It finally reached the deck. Again the vessel's crew demonstrated their complete capability for handling the problem—the hook was disconnected promptly then hoisted out of the way to assure that it wouldn't be fastened to some readily available stay or the handrail. The patient seated himself in the basket and with a look skyward awaited the hook which was relowered and promptly attached—but not too soon—for at that very moment, vertigo, the sensation that everything was moving in the wrong direction, took command of the pilot and there was little recourse but to apply a burst of power and climb rapidly, obtaining a new reference for visual control—the horizon. With the hoist operator adequately aware of the situation the cable was reeled in at high speed, to quickly bring the startled passenger into the comparative safety of the now cramped cabin. The hoists were complete, the first part of the mission had been accomplished. It remained now to deliver the patients to the awaiting ambulance on the Naval Hospital lawn. This could not be done however, until a fuel stop had been made; again, at the point of overwater departure.

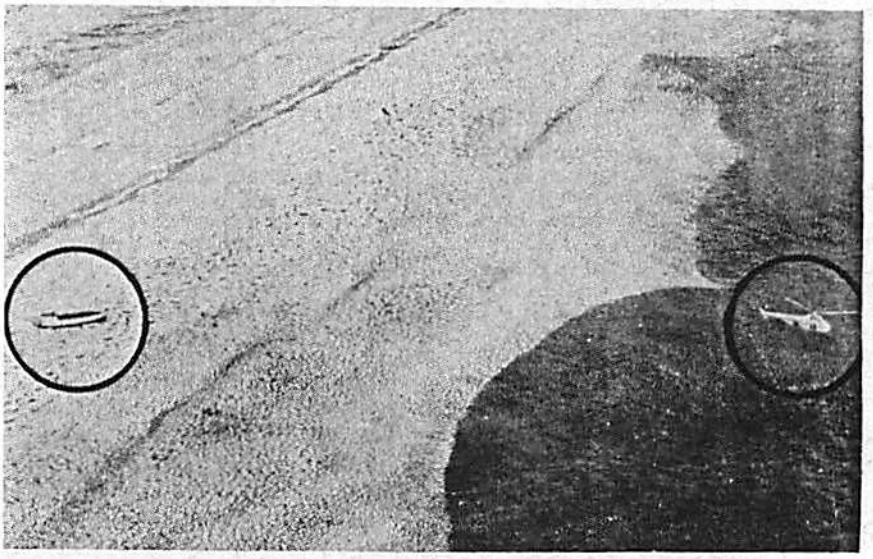


Photo courtesy Traverse City Record Eagle

AN HO4S–3G HELICOPTER from U.S. Coast Guard Air Station in Traverse City, Mich., tows a trapped 42-foot fishing tug one-quarter mile through fields of thick pancake ice and brash and slush ice to safety of open water in the above picture. The metal hulled fishing tug with a white wheelhouse aft was disabled one-half mile off the beach 4 miles west of Seul Choix Point on Lake Michigan, about 10 miles from Manistique.

That insurance item, the auxiliary power unit, was again left behind, to be returned at later convenience.

WHY INSTRUCTIONS ARE DEMANDING

If I may digress for a moment to give you a short word picture of a helicopter pilot's actions while performing this essential operation of hovering, you will more readily understand why he will be demanding, even adamant, in his instructions to a vessel, before he effects a hoist pickup from a ship at sea, or even from a boat under oars or being towed astern. The pilot may make it look like a simple feat—this hovering over a vessel, but let me tell you, it has taken much training, and more practice. A good many gray hairs have been added, not only to his crop but also to those of his associates who have had to qualify him for this seemingly simple feat; including crew members who are performing so faithfully down in the cabin operating this "lifeline" through its hydraulic system, "conning" the pilot into the best hoisting position by means of the "intercom"; and unconsciously heeding the sensations of the hovering helicopter so that he may instantly recognize a pending emergency reaction by the pilot.

One can see that to perform this vital emergency mission the Coast Guard pilot in command of a helicopter will request that certain specific requirements be provided before he will attempt to remove an injured person by hoist from a vessel at sea.

REMOVING AN AMBULATORY PERSON

We have discussed injured personnel removal, but sometimes it is necessary to remove a physically able, ambulatory person for one reason or the other. The actual hoisting operation in either case is similar in requirements. For this latter purpose the helicopter is again ideally suited, and such a pickup can be made by means of the rescue basket or by the rescue sling. The rescue sling is only a padded strap device that we like to call a "horse collar," which it resembles; however, it is placed under the arms, around the chest, and not around the neck! Usually the sling is reserved for use with personnel who are familiar with it, although placards give specific information to permit its use by the uninitiated. On deck, it is handled almost exactly like the basket, in that upon its delivery it is generally unhooked, attached to the wearer; and when ready for hoisting, reattached to the hook. When lowered to a person in the water, the sling remains attached to the hook at all times, so that it will not go adrift. The sling is as useful with a conscious man in the water as it is on deck.

In using the sling the occupant should not attempt to relieve his weight by holding to the hoist cable—

this will only make him less secure in the sling. Another caution that is applicable for all rescue devices used by the Coast Guard for helicopter pickup—never attempt to assist yourself into the helicopter cabin upon reaching the door—the hoist operator is fully competent, and your attempt at help may hinder rather than aid your access to safety. We, in this lifesaving business, are as anxious for your safety as you are. We have found that your safety is greater if you do not attempt to assist your way into the helicopter.

RESCUE SEAT

The Armed Services have recently developed a rescue seat which is basically a three-fluked anchor, so designed that a man in the water can sit on the flukes. It can be towed into position readily by the helicopter, for it offers little drag. Once seated, the person will assume a natural attitude on the flukes and wrap his arms around the stock. This device has been under an improvement program by the Coast Guard to provide more safety. It is now approved as a circular ring at the end of a stock similar to a mushroom anchor. You may find either device in use, depending on the Service providing the helicopter assistance. Either seat requires little or no instruction, as its use will be readily apparent from the obvious features.

NEED FOR IMPROVED COMMUNICATIONS

One of the greatest problems of working the helicopter in a hoist operation around vessels is the need for improved communications. If voice radio is available, it can be used —the difficulty here is the need for a relay, between the point of reception on the vessel, to the crew actually handling the operation. A good ship's organization will usually provide for this need; however, where voice radio is not available, a loud-hailer from the helicopter to the deck is required. The Coast Guard has under development such a device which at this time shows great promise of being able to be heard above the helicopter noise as well as the vessel's internal noise, both of which usually are at a high level. If this device is as effective as tests indicate, it will serve very effectively when working around vessels, small boats under oars, fishing vessels, etc., thus allowing positive and intelligible instructions to be issued to assure satisfactory coordination of the rescue effort.

"TUGBIRD" EQUIPMENT

A recent Coast Guard development presently in use by our operating units is what we call "Tugbird" equipment. Tugbird was conceived for the specific purpose of providing for expeditious arrival of a unit at the scene of distress, for the purpose of relieving an immediately dangerous situation by giving the helicopter a towing capability in reaching the nearest safe anchorage or haven. Specifically, the purpose was stated as: "to develop equipments and operating techniques to successfully tow small boats with the * * * helicopter, in support of Coast Guard Search and Rescue Missions. * * *" The gear is designed to afford the helicopter with a capability of exerting a maximum towing force of 4,000 pounds—sufficient to handle safely a vessel of approximately 400 gross tons. The towing force exerted is always indicated to the pilot giving him necessary flexibility in the operation. The maximum duration of the tow varies, of course, upon the distance from the helicopter's base of operations, and is a function of fuel remaining. The Coast Guard has proof that the usefulness of the capability will be demonstrated best for the benefit of the "rapidly expanding small boating public."

This towing equipment is self-contained in the helicopter and provides about 300 feet of tow cable capable of exerting a force controllable by the pilot, in a sea state of 5, under the most unfavorable wind conditions. A normal release and an emergency release are provided so that the pilot can command the utmost in safety while performing a towing operation. A weak link is also provided to assure the cable breaking at a designated point, should a malfunction fail to indicate that the cable strength is being exceeded. The towing of vesels from 400 tons down to the minimum of a 16-foot outboard has been very successful. Smaller vesels than this cannot be towed with this equipment with any reliance due to the controllability of the helicopter and lack of sufficient drag. Towing speeds vary with the vessel size and tow direction, relative to the wind. A maximum speed of 6 knots has been obtained while towing a 378-ton vessel.

In this towing operation the helicopter will approach the vessel to lower the bitter end of the steel towline to the deck. This should be attached to a forward towing bit through a suitable chock. When securely attached, the helicopter will, on signal, move out sideways to observe the towline lay, and take up the slack until about in proper towing position, where the pilot will turn the helicopter and assume the tow. A precaution is necessary—have no one on deck who is not required. We designed the gear to prevent the towline from parting, but if it should, at some point other than at the release or weak link, it could snap back and possibly create a dangerous situation for either the vessel or towing helicopter. If the pilot releases the tow while under tension, there is no danger; the line snaps back from the helicopter and flakes into the water ahead of the vessel. Do not be alarmed at the angle of inclination of the helicopter, as the normal attitude is about 20° nose down. If the cable parts, or is released under tension, the helicopter, because of basic flight characteristics, goes into a climb, even though in a nose down attitude.

TURNING DIFFICULTIES

Turning difficulties will be the pilot's greatest concern during the operation. You may see the helicopter slack the tow before making a turn, particularly to the left. This is sometimes necessary in certain wind conditions due to insufficient left rudder remaining while under tension of the tow. After a new heading is assumed, the tension will be reapplied and towing continued. You will generally be requested, by voice radio, to assist in the turn with your rudder—if possible.

It has been found that although this specialized towing equipment will not satisfactorily tow a small outboard, they can be most readily towed by attaching a light line to a fitting on the helicopter deck, through the cabin door, to the boat. With this arrangement the helicopter flies sideways to effect the tow, since only short distance tows would be attempted. The pilot has a clear picture of his tow and slow speeds are possible with less effort and practically no danger.

The maximum time you can expect to be towed by helicopter, if the occasion should demand, will not exceed 1 hour, as the fuel consumption is quite high at the power output necessary in the operation. The towing of vessels by helicopter requires no greater precautions by vessel personnel than towing by other means, but the arrival speed of the helicopter should provide you, under most circumstances, with earlier assistance than could be attained by another means.

We in the Coast Guard are continually searching for improved methods and equipment with which to provide, in our total job, the "safety of life and property at sea" for which the Service is dedicated. If a better, or safer "mousetrap" for these purposes is made, we shall make an early investigation of its capability toward fulfillment of our motto, "Semper Paratus."

PROCEEDINGS

OF THE MERCHANT MARINE COUNCIL

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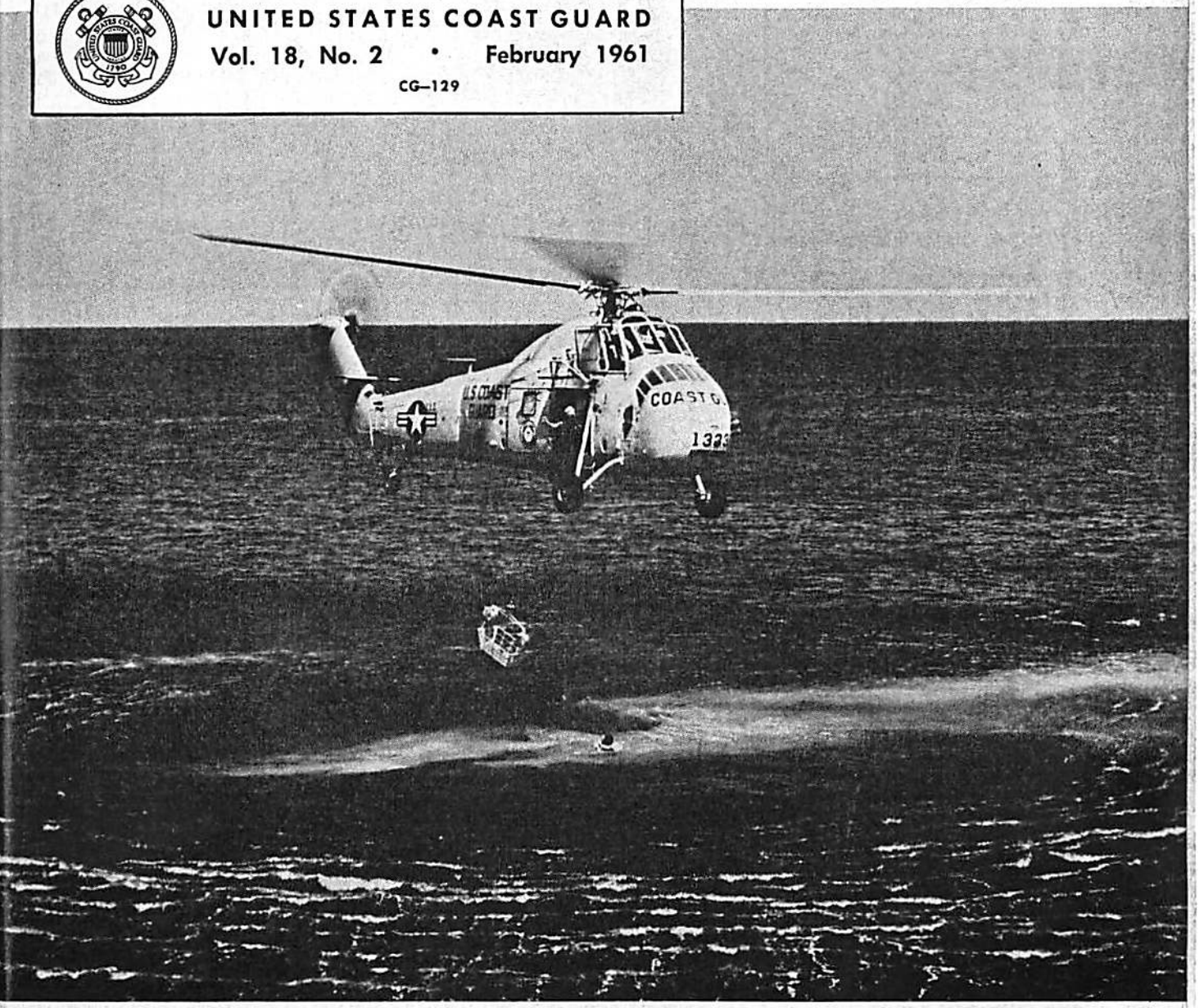

Features

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LEGAL CONSEQUENCES OF THE RULES OF THE ROAD