FACEPLATE

FALL 1972

English and American teamwork demonstrated at Alverstoke . . . see page 27

FACEPLATE

Vol. 3 No. 3

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. . . the official magazine for the divers of the United States Navy.

CONTENTS

NEW TOOLS TESTED AT NCEL

Engineer Ron Brackett and Ensign Tony Parisi of the Naval Civil Engineering Laboratory at Port Hueneme, California (NCEL), plunged into the Laboratory's outdoor test tank and swam down to the 750-pound granite boulder that rested on the bottom. With a surface powered hydraulic rock drill (photo a), Brackett bored a 3/4-inch hole in the rock and inserted an expandable rock bolt, to which he fastened an eye nut. Then, after attaching a zippered lift device to the eye nut, the two men inflated the device using a spare SCUBA bottle. Soon the lift device was sufficiently buoyant to raise the heavy rock, which the divers easily maneuvered across the tank (photo this page).

The entire operation took slightly less than five minutes to complete. This is typical of the work being done at NCEL to develop, test and evaluate underwater tools and power systems for Navy operations. In this case, the task not only demonstrated the effectiveness of the rock drill, but also substantiated the concept of the variable buoyancy zippered lift device as a simple yet efficient means of lifting and moving heavy objects in the sea.

In the NAVSHIPS program at NCEL, commercially available hydraulic pumps, rigging, load handling and mechanical cutting equipment are being evaluated to improve the Navy's underwater salvage capability. The program is based on in-depth studies made to determine the areas most worthy of development. It has a dual objective; first, to provide the Navy with diver-operated hydraulic tools, and second, to develop hydraulic salvage equipment for operation with submersibles.

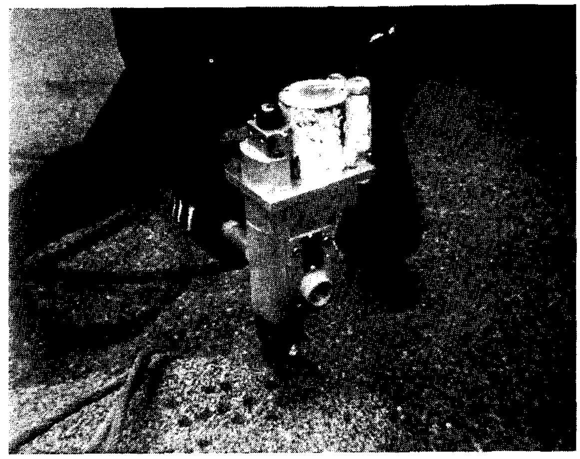
To get the hardware-oriented part of the program underway, the NCEL project personnel, with the aid of experienced NAVSHIPS salvors, defined the most important underwater work functions which can be accomplished with hydraulic equipment. In order of usefulness, these are: rigging and load handling, bolting, mechanical cutting, tunneling and excavating, grappling, and drilling and tapping.

Rigging and load handling equipment tested includes hydraulic cylinders for jacking and pulling, and a small hydraulic winch. The single-acting jack with various extensions, end connectors and accessories is typical of the hydraulic sets sold to industrial firms.

A pressure compensated winch with a hydraulic power handle was tested. The winch, which weighs only 13 pounds in the water, has a line capacity of 50 feet of 3/8-inch diameter rope. During the tests, it was used to drag a wire rope across the bottom.

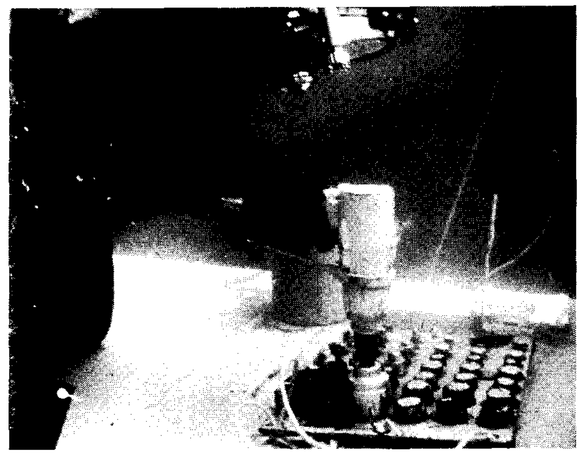
Both hydraulic and pneumatic impact wrenches were tested. While the pneumatic tool proved to be light and relatively easy to handle, it had definite depth limitations and required excessive maintenance. The hydraulic impact wrench (photo b) was found to be very effective for drilling, tapping, and bolt and nut impacting.

Several different kinds of hydraulic cutters were evaluated by NCEL, including wire rope and bar stock cutters for use with diver-operated pumps, an open-centered wire rope cutter, and an abrasive saw. The diver-powered wire rope cutter, capable of cutting 1 1/8-inch diameter IWRC rope, averaged from about one minute to slightly under two minutes to cut each of the variety of wire ropes and steel rebars tested. The rotary abrasive cutter was designed for remote operation from an unmanned submersible, and is not suitable for diver use. However, design criteria for a diver-held hydraulic powered abrasive cutting saw have been developed by the engineers, and a "Skil" type saw has already been assembled and tested.



a

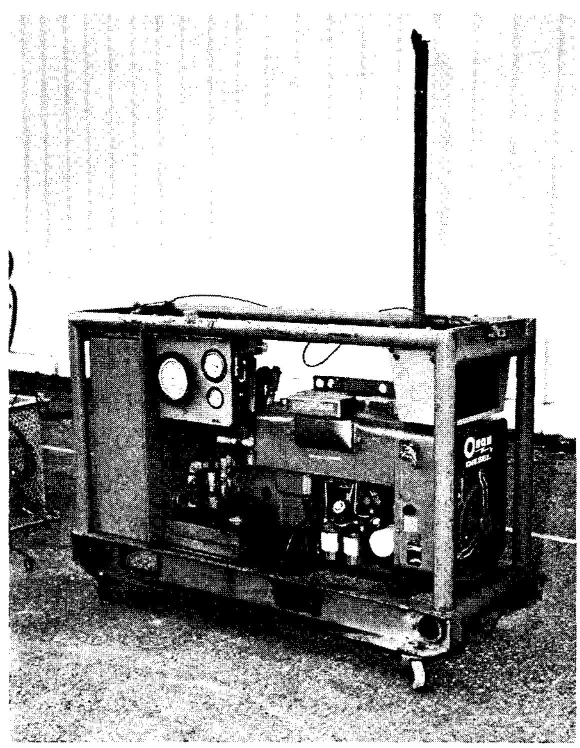
Another type of cutting tool tested is the chain saw. The tasks consisted of crosscutting and ripping 18-inch long cuts in both two and four-inch-thick planks. Recommendations made included modifying the handle and adding an adjustable dog to enable the diver to exert force directly in line with the saw chain and thus gain more leverage.



b

Naturally, it is not possible to consider automatic diver tools without looking at power sources. As part of the NAVSHIPS program, NCEL is also engaged in the investigation of hydraulic power supply for underwater salvage operations. There are three basic methods of getting power to the tools, each with its special advantages and disadvantages.

The first method is to transmit diesel generated hydraulic power (photo c) from a surface ship to the undersea work site. This is the easiest to use in some respects, since there are few deployment problems. Powering the tools is simply a matter of lowering hydraulic hoses to the site. The main disadvantage is that this system loses its effectiveness as the depth increases. Pressure drop and accumulator effect increase with hose length, making these systems generally less effective beyond 250 feet. Also, because of the difference in the specific gravity of hydraulic oil and seawater, pressure differential can force seawater into the hydraulic systems of the tool when the power is turned off. Surface support must be constant as well.



c

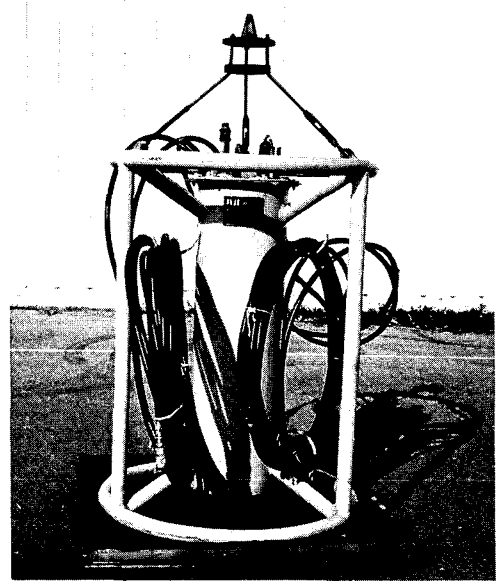
The second power system supplies electric power, again from a surface vessel, to the 440V AC electric motor used to drive the hydraulic pump on the bottom. This reduces power losses. Seawater intrusion is not a problem because the motor pump unit is pressure compensated. Deployment problems may arise, however, in view of the fact that the support vessel must be equipped to raise and lower the bottom components, weighing about 1000 pounds in air and 600 pounds in the water. Again, constant surface support is required.

The third method is the seafloor battery-powered submersible unit (photo d), which can operate independently of the surface during the life of the batteries. These units have very low transmission losses and are pressure compensated so that no water can intrude. On the other hand, this is the heaviest unit of all, and therefore the most difficult to deploy. It also has a finite energy capacity, limited by the amount stored in the batteries, which must eventually be recharged, either on the bottom or by returning them to the surface.

NCEL has experimented with all three types of power supply. While final component selection is dependent upon the user's particular requirements and resources, diesel and electrically operated hydraulic power sources can be designed that will greatly increase the ability of the diver to perform work underwater.

The test and evaluation program, involving additional tools and equipment, is a continuing effort at NCEL, and fleet delivery of tool packages is expected in Fall, 1972. Much useful data has been acquired and the program is producing results in both recommendations for improvements in existing tools and in the designing of new and advanced versions more suitable for underwater work. From time to time the Laboratory produces detailed technical reports covering different aspects of its underwater diver tool program. These reports are available to most concerned and qualified persons, and are recommended reading for those interested in exploring the subject at greater depth than is possible here. For further information, contact John Quirk, SUPSALV Coordinator, Naval Civil Engineering Laboratory, Port Hueneme, Calif. 93043; Telephone: 805 982-5062 or Autovon 360-5062.

We will explore other noteworthy programs at NCEL in the next issue of FP. Keep reading.



d

RADM Dietzen Becomes Deep Submergence Systems Program Coordinator

Rear Admiral Walter N. Dietzen, Jr., USN, assumed the post of Deep Submergence Systems Program Coordinator on 1 July 1972, replacing RADM M. H. Rindskopf, USN.

RADM Dietzen will administer the Program aspects of Deep Submerged Systems. In this capacity, he is responsible for providing policy guidance and requirements for the Navy Diving Program. He is also responsible for the coordination of Deep Submergence Systems Programs which include:

Rescue and Escape
Search and Recovery
Large Object Salvage
Man-In-The-Sea
Bio-medical Aspects of Diving

RADM Dietzen is an Annapolis graduate, Class of 1945. His career has encompassed a wide variety of assignments, including two war patrols with USS TIRANTE (SS 420), and command of the submarines USS CUBERA (SS 347), USS SCAMP (SSN 588) and USS WOODROW WILSON (SSBN 624). He earned a Master's Degree from ICAF, and has served in BUPERS (Enlisted Distribution Branch), and as Deputy Director of Submarine Warfare (OP 31) in the office of CNO. While RADM Dietzen was Deputy Director, OP 31, the deep submergence program expanded from a collateral duty of OP 31 to the office of the Deep Submergence System Program Coordinator OP-03U (now OP-23).

In July 1970, he was promoted to RADM and was assigned as Chief of the Navy Section, Joint United States Military Mission for Aid to Turkey, where he served until June 1972.

FACEPLATE extends a warm welcome to this distinguished Naval Officer.

SOUNDINGS

Our Loss

Since the fall of 1970, FACEPLATE has been in the very capable hands of Carol Jess as managing editor. Under her direction, the magazine has grown in size, improved in technical accuracy and overall appearance. Now, unfortunately, we are losing her to other responsibilities. We wish her best luck and say thank you for a job more than well done.

KMB-8/9—USN MKI Mask Used in Wrecks and Tanks

Activities having permission to use the Kirby-Morgan KMB-8/9 or U.S. Navy Mark I Masks are authorized to use them to enter wrecks, submarine tanks and other confined spaces provided the diver is fully trained and qualified in the use of the equipment, voice communications are maintained and all good diving practices and safety precautions for this type of diving are followed. This policy will appear in a forthcoming change to the Diving Manual.

Accessories for use with KMB-8/9/USN Mark I Mask.

Activities authorized to use the KMB-8/9 or U.S. Navy Mark I mask should use the accessories listed below:

(a) Mask, KMB 8 or 9

(b) Air Hose, Deep diver hose, Hewitt-Robins Inc. Specification No. 23–0152, 3/8" ID x 27/32" OD, Female O_2 fitting on one end, male O_2 fitting other end, (US Divers Part No. C-4001-00, fitting not included unless specified) (200 ft lengths)

(c) Communication wire, three cable No. 16 wire, shielded, neoprene rubber cover, Bronco Cable, with 3 pin Marsh and Marine Female connectors one end, male connector other end (200 ft lengths)

(d) Come Home Bottle, 72 cu. ft. steel

(e) First stage regulator and hose assembly for come home bottle. (US Divers Part No. C-3100-24)

Supply Technical Assistance

Supply technical assistance available to diving activities such as cross referencing and validation of Federal Stock Numbers may be obtained by telephoning the below listed activities:

Spare Parts Control Center	Washington Navy Yard
Mechanicsburg, Pa.	Supply Technical
Diving Program Manager	Washington, D.C.
Mr. Newcomber	Mr. Wesley Singleton
Autovon 8-277-2151	Autovon 8-288-2408
	-2437

Hunley First

Recently four men were graduated from the first official Navy Second Class Divers' course held by USS HUNLEY on Guam. The school conducted by HUNLEY Diving Officer P.E. Kern and Master Diver P.E. Davidson, consisted of eight weeks intensified underwater training and classwork. CAPT H.S. Clay, Commanding Officer of the USS HUNLEY (AS-31), presented advancement certificates to FA Kevin Barry, SN Dennis Johnson, SN Thomas Meier, and FA John Kimberger. Originally, the class convened with 16 people with the above men successfully completing the course. Pictured above from left to right are CAPT Clay, CWO Kern, FA Barry, SN Johnson, SN Meier, BMC Aliff (DV), and FA Kimberger kneeling. All graduates are attached to HUNLEY except SN Meier who is attached to SRF, Guam.

SALVAGE LESSONS LEARNED

SALVOPS of Cargo Vessel. While salvaging a C-4 type cargo vessel that had been mined, considerable difficulty was encountered in attempting to lower the water level in a cargo hold.

The initial hull survey revealed a three-foot-diameter hole in the starboard side of number four cargo hold. This hole was soft patched prior to the arrival of the salvage ship. The salvage ship determined that it would be necessary to dewater the cargo hold and off-load cargo to bring the hole above water for the installation of a solid welded metal patch to enable the ship to return to sea. A lighter was placed on the port side to facilitate cargo off-loading and the transfer of salvage pumps.

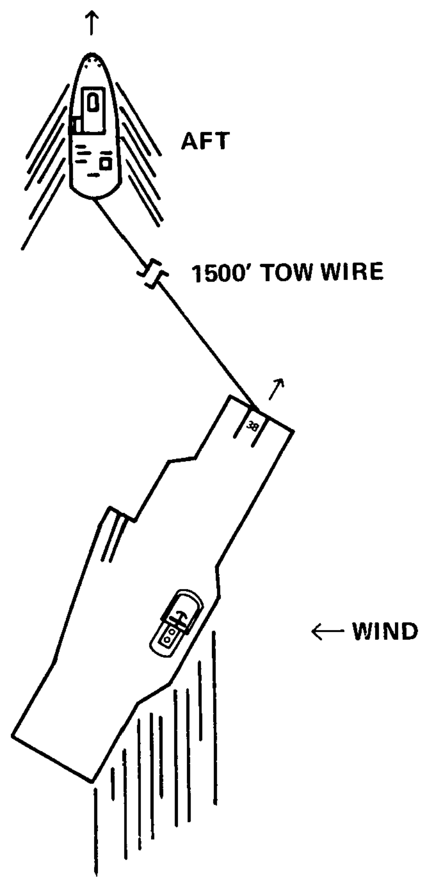
While off-loading cargo and transferring two six-inch salvage pumps, divers from the salvage ship conducted a systematic hull survey and no additional holes were found. The pumps were positioned and initial efforts resulted in a five foot drop in the water level. However, no further progress was possible with these two pumps. The soft patch was recalked and another hull survey was conducted. Again, no additional holes were found, although they were suspected. The port side of number four hold was not inspected, however, since the lighter was moored in that area. More cargo was off-loaded and additional pumps were transferred until a total of four six-inch salvage pumps were on board, with three pumps usually in use at one time. The water level dropped slowly until the suspected hole was discovered. This one foot in diameter hole was also in number four hold directly opposite the hole in the starboard side, and was evidently caused by an object projected by the same explosion that caused the three foot hole in the starboard side.

The following lessons were learned as a result of this time-consuming operation:

a. The necessity for a complete and thorough hull survey of damaged vessels. Although the movement of the lighter would have temporarily slowed the cargo off-loading the hole in the port side would have been discovered sooner. Consequently, it may not have been necessary to transfer the extra pumps. Dewatering would certainly have proceeded at a much faster rate.

b. That whenever a vessel is mined or subjected to any type of explosive force(s) the probability of holes on both sides of the ship from shrapnel effect is extremely high and all missile/shrapnel paths/trajectories should be thoroughly investigated.

Carrier Towing Tips. When towing Essex Class Carriers, serious problems may be encountered with wind velocity of 18 knots and above, if the desired course results in the wind blowing on Carrier's beam. If this situation exists, the Carrier will attempt to turn into the wind. (See illustration below.) This can cause a sudden sheering action if the Carrier is hit broadside with a sudden gust of wind of about 25 knots. With a constant wind the Carrier will eventually settle into a towing position as depicted below resulting in difficulty in maintaining course, a heavy strain on tow wire and slower SOA. When wind velocity increases to 18 knots and above, towing ship should attempt to take a course which will result in the relative wind on the Carrier's bow or stern or as close as possible. This depends, of course, on navigational situations.



NEW HARD HAT ON THE WAY

by
W.A. Danesi

The Navy hard hat diver has truly been the forgotten man in the diving community. He has accomplished incredible tasks with equipment that has not been substantially changed since its introduction in the mid 1800's.

While existing equipment usually performs in an adequately safe manner, there is considerable room for improvement. The Office of the Supervisor of Diving is sponsoring a development program to improve the equipment available for the hard hat diver.

The initial phase of the program consisted of an extensive survey of available equipment and the recommendation of improvements. As a result of this, the following design changes were suggested:

- —lightweight helmet
- —improved recirculation
- —acoustic noise reduction
- —self-donning
- —positive reserve gas
- —linear controls
- —combined air or mixed gas capability
- —improved weight matrices
- —materials
- —integrated dress

With these improvements in mind, a prototype hard hat diving system was completed, designed to be compatible with all types of swim dress. This system consists of an undergarment for thermal protection with a lightweight comfort breastplate worn directly over it. This comfort breastplate is used primarily to distribute the jocking loads of the helmet comfortably over the diver's shoulders. A dry suit worn over these two items has a special metal neck ring attached to the suit by a clamp. The neck ring rests on the comfort breastplate but is not attached to it. The suit neck ring has a breechlock mechanism that mates with the helmet breech ring which is bonded to the helmet. Worn over all these items is a lightweight polypropylene fabric overgarment which serves as chaffing gear, and as a means of distributing jocking loads. It also incorporates weight pockets.

The overgarment has a special webbing arrangement sewn into it to distribute the jocking loads. Weight pockets attached at the diver's thighs allow reduction of the weight at the diver's feet. This reduction allows use of lightweight rubber boots with weighted insoles which will improve the diver's mobility. The harnessing over the diver's shoulders and above the waist weight pockets of the overgarment is a separate harness for attaching the scrubber recirculator system.

The scrubber/recirculator system with an attached bail-out or emergency gas supply is attached at the rear. The helmet is made of fiberglass with two Lexan view ports. The rear of the helmet incorporates a horizontal shelf for attachment of all the gas lines, air or mixed gas, plus the communications lines. The final system will probably incorporate a lightweight plastic cover and shroud over the scrubber recirculator to prevent fouling.

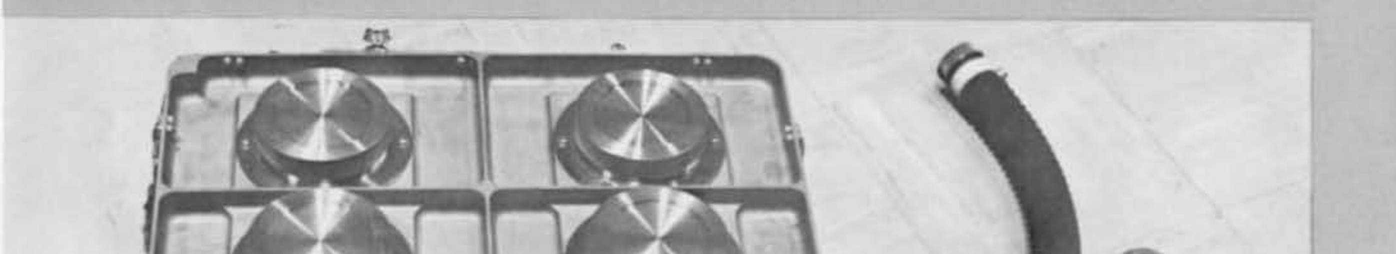
The most significant design improvements for the advanced system are in the helmet and recirculator. The critical requirements in the helmet were to lower the noise level and to improve circulation characteristics. The helmet uses two gas flow systems, one for air or open cycle conditions at shallow operation depths, and a separate mixed gas or recirculator system for deeper missions. When operating open cycle the gas flows from the inlet fitting to the control valve in a tube along the inner wall of the helmet. An expansion chamber filter provides muffling and acoustic deadening of the gas flow noise. A sintered metal filter reduces inlet air noise and a muffler uniformly distributes gas flow across the view port for prevention of fogging. In addition, a removable acoustic foam liner attached to the inner surface of the helmet is used to further lower noise levels. With the recirculator or mixed gas flow pattern, gas is gradually expanded in a duct after it enters the helmet. The gas flows uniformly across the view port and enters the exit duct. As this gas is drawn from the helmet it passes through a venturi which aspirates gas from the perforated tube in the bottom of the helmet. Thus, high level carbon dioxide mixtures which might accumulate near the neck ring are swept out into the scrubber.

A hundred years later...

The recirculator design involves better recirculation ratios, more efficient carbon dioxide removal, longer duration and efficient operation over wide temperature extremes. The scrubber/recirculator consists of a scrubber to remove carbon dioxide and a recirculating valve, an emergency gas bottle, a "k" valve, and gas ejector. The scrubber utilizes Kydex material for the main body and has built in inlet passages, support saddles for the bailout bottle, and gas ejector plenum made of the same material. The cover is made from stainless steel and has four fill ports. The cover need only be removed to thoroughly clean the filters and case. Filling is normally accomplished through the four ports.

The scrubber is of a rectangular construction with a double pass gas flow through separate chambers, an upper and lower chamber. This concept allows pre-dive filling of half loads for short duration dives.

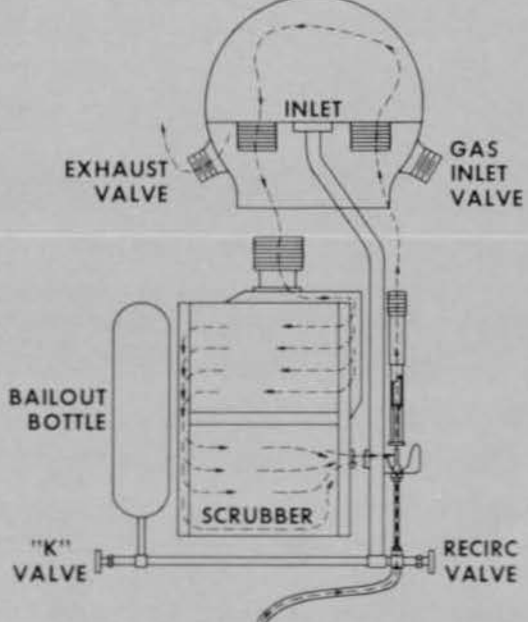
The system can operate under a number of flow conditions. In the normal recirculator mode for mixed gas, the umbilical gas supply comes into the recirculator valve through a check valve and into the gas ejector, mixes with the recirculated gas, and flows up to the helmet, through the helmet inlet duct, across the view



port, out the helmet exhaust duct, and back through the scrubber. Should a malfunction occur in the ejector, the diver can change to open cycle operation by opening the helmet gas control valve. In the event the gas supply is interrupted, the diver can open his bailout bottle valve and continue operation in the normal recirculator mode. In the event the scrubber should be flooded and the surface supply is interrupted, he can go to an emergency open cycle mode.

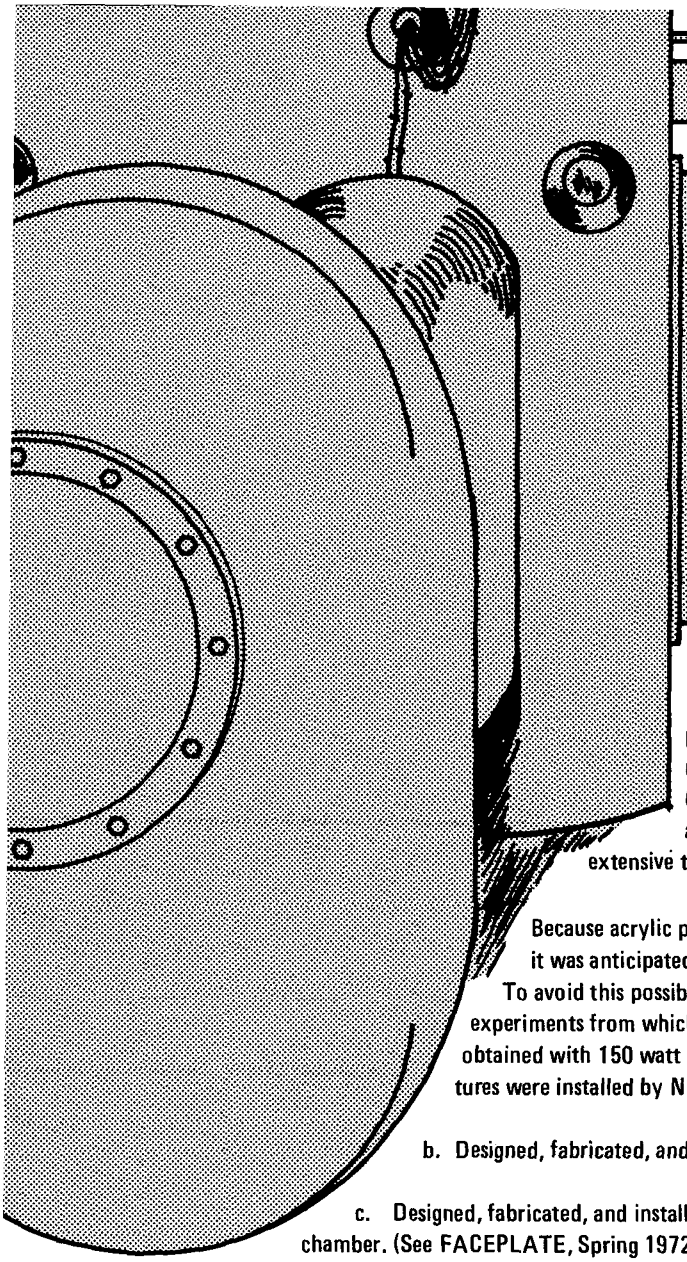
The components making up the recirculator (ejector, scrubber, control valve) and the helmet (inlet control, noise muffling system, exhaust valve, gas distribution system, non-return valve) were individually tested. Gradually each part was assembled and the combined subassemblies tested. The assembled helmet and recirculator were each tested, and finally the helmet/recirculator was tested as a system.

A technical evaluation by the Navy Experimental Diving Unit is currently underway and is scheduled to be completed by 15 Dec 1972. The TECHEVAL calls for 330 man-dives ranging from shallow depths to 300' in water conditions ranging from excellent visibility on hard sand bottom to no visibility in six feet of mud. Water temperatures will range from 29° (F) to 80° (F) during the TECHEVAL and at least 100 of the man-dives will be conducted from an ASR in the open sea.



Normal Recirculator Mode

OPEVAL is scheduled to begin in April, 1973, and it is hoped that production units will be introduced to the fleet sometime in late 1973 or early 1974.



NEDU Undergoes Facelift

From May 1971 until July 1972 both of the hyperbaric chambers at NAVXDIVINGU were shut down for repair, refit, and modification. In addition to the physical work done on the complexes, a material certification program was initiated to ensure that both complexes would be certifiable upon completion of these repairs and modifications.

The following work was done by Portsmouth Naval Shipyard, New Hampshire:

a. Designed, fabricated, and installed 3 insert viewports in the recompression chamber, 6 in the wetpot, and 5 in the igloo. These viewports are made of acrylic plastic, the concept of which was developed by the Naval Civil Engineering Laboratory, Port Hueneme, California. Prior to installation and hydro testing at NEDU, each viewport insert underwent a series of extensive tests to ensure its safety for manned applications.

Because acrylic plastics such as Plexiglass have a tendency to lose strength at high temperatures, it was anticipated that heat from the external light fixtures would soften the acrylic viewports. To avoid this possibility, Portsmouth Naval Shipyard designed testing apparatus and ran a series of experiments from which it was determined that maximum lighting efficiency with minimum heat was obtained with 150 watt "Cool-Ray" flood lights at a standoff distance of 13 inches. The lighting fixtures were installed by NEDU personnel.

b. Designed, fabricated, and installed one utility flange in each recompression chamber, wetpot, and igloo.

c. Designed, fabricated, and installed two fire protection penetrators in each igloo and in No. 6 recompression chamber. (See FACEPLATE, Spring 1972 for an explanation of this system.)

d. Designed, fabricated, and installed two Travelav water penetrators in each igloo. These are the same Travelavs as used in the Mk I Deep Dive System.

e. Designed, fabricated, and installed two Travelav vent penetrators in each igloo.

f. Designed, fabricated, and installed two reefer coolant penetrators in each igloo. The design of these penetrators was critical because the hull material has a ductility transition temperature of approximately 30–40°F. This temperature is the point at which certain steels change from a ductile substance to a brittle substance.

It is now known, for example, that this was the cause of World War II Liberty Ships breaking up during winter in the North Atlantic. The hulls of these ships had reached the ductility transition temperature. To prevent the hyperbaric chamber hull from ever reaching this temperature, a stainless steel sleeve was installed over the refrigerant lines. The sleeve was designed to have a long path for conduction heat transfer with respect to a narrow cross sectional area. Common insulating materials would not have worked due to the ability of helium to leak through seemingly sealed areas that exist with normal insulations.

g. Designed, fabricated, and installed four gas line penetrators in each igloo.

h. Rebuilt two electrical penetrators connecting the wetpot and igloo, and provided one spare penetrator.

i. Provided two electrical assemblies each composed of two pieces of mineral insulated wire connected by six feet of shielded pair flexible cable.

j. Remachined ten 36-inch and two 48-inch diameter hatches and provided gaskets for submarine type hatch seal. Replaced packing glands on dogs with O-ring type seal in order to eliminate a recurring leakage problem.

k. Sandblasted and painted one primer coat of inorganic zinc on the inside and outside of both complexes.

l. Magnetic particle tested all existing welds on both complexes and repair welded doubtful areas.

m. Visually inspected the hull and repaired all surface defects deeper than 1/16-inch.

n. Designed, procured from Hahn and Clay and installed one medical lock in each igloo. This has cut down the expense considerably of supplying food and other items to the divers.

Personnel at the Navy Experimental Diving Unit accomplished the following tasks in the refurbishment process:

a. Installed a water filtration system in each wetpot. This system operates at a working pressure of 445 psig and was hydrostatically tested to 667 psig (1500 fsw).

b. Installed a Lochinav Gas Fired Boiler in the basement to heat the wetpot water supply. The boiler capacity is 60 gpm at 10.5 ft Hd.

c. Installed one reefer in each igloo. The refrigerant is composed of 60% propylene glycol and 40% water.

d. Installed one Travel/Shower in each igloo.

e. Relocated environmental control board and modified gas control board for each complex. This allows for consolidation of the manpower necessary to run the diving station.

f. Improved the oxygen dump system for each complex by putting a surge tank on the outside of the chamber.

g. Installed external light fixtures as described previously. There is no longer any internal lighting in either complex.

h. Cleaned and hydrotested all gas piping.

i. Hydrostatically tested each complex.

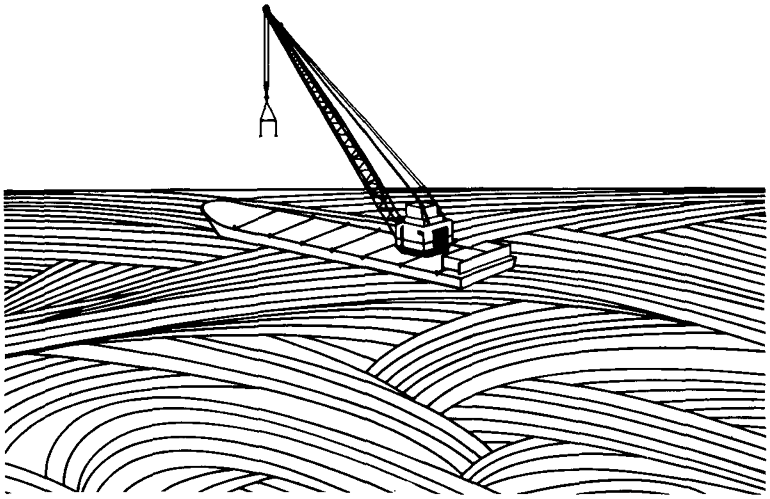
j. Painted each complex and all piping.

k. Designed and installed one seal sleeve in each tunnel connection. This is an all welded seal designed to prevent gasket blowout and is not a load carrying member of the hull system.

l. Modified deck plates, replaced drain valves and filled igloo bilges with concrete and sealed it with RVT sealant.

Following modifications, both complexes were hydrostatically tested to 625 psig. During the hydro tests, the stresses at critical locations throughout the complexes were monitored by an array of strain gages. The strains and, therefore, the corresponding stresses were found to be within acceptable limits.

Since June 5, 1972, NEDU has successfully completed three 100-foot saturation dives. Most recently, on July 20, the first 1000-foot dive was successfully completed.



Salvors In The Far Pacific

by
Denis E. Irons

Office of the Supervisor of Salvage

The requirement for a highly effective, rapid response salvage capability in all areas of the world has never been more evident than in recent years. The wide operating range of the fleet as well as the tremendous increase in commercial shipping have necessitated a commensurate increase in resources and expertise for ship salvage.

The Murphy Pacific Marine Salvage Company has, for many years, provided a valuable salvage service in the continents of the Americas. It is, however, in the international theatre, specifically the western Pacific, where the need for a viable salvage posture has become most urgent.

Since the end of World War II, the Supervisor of Salvage has maintained a stand-by contract with the Luzon Stevedoring Corporation of Manila for back up material support to U.S. Navy salvage operations. This original contract had been initiated in 1948 essentially to preclude the high cost of shipping the large quantities of gasoline driven salvage equipment back to the U.S. after the war. This equipment could be used by Luzon on a no-cost basis. The only contract condition was that Luzon provide this equipment to the U.S. Navy in the event it was required.

Then, and for many years thereafter, the Luzon Stevedoring Corporation remained a relatively small enterprise. As the waters of the western Pacific became the primary means of transportation for the trade of goods and material between countries, Luzon too began to grow, with the result that they are now one of the largest ocean freight businesses in the Philippines.

Succeeding Supervisors of Salvage have monitored this growth and in 1972, Captain E.B. Mitchell, the present Supervisor of Salvage, studied the Luzon performance record and decided that their experience in salvage (averaging about one job per month) plus their expansive, modern and efficient organization qualified them to play a more active role in the U.S. Navy's salvage mission.

After a preliminary visit to Luzon by Capt. Mitchell and CDR William Milwee, Assistant Supervisor of Diving, an agreement for more extensive services was reached. With the assistance of the Contracting Officer from NSD Subic Bay, the final signing of the contract took place in May, 1972.

Through this contract the Supervisor of Salvage can task Luzon to provide the services of its 154 tugboats, 602 barges, its shipyard or its extensive inventory of salvage equipment to a salvage operation in the Philippines, western Pacific, southeast Asia, Indian Ocean or elsewhere, including war zones.

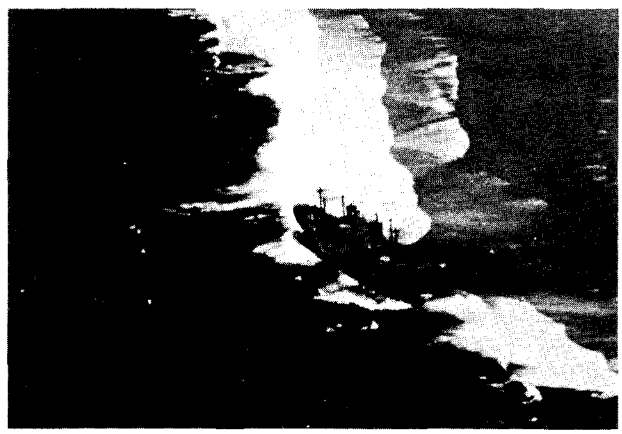
It wasn't quite two weeks after the signing of the contract that the Supervisor of Salvage tasked Luzon to perform a crucial service.

Under the Water Quality Improvement Act of 1970, the U.S. Coast Guard took over responsibilities, from the owners, for the M/V SOLAR TRADER which had been aground on West Fayu Island in the Trust Territories of the Pacific since December, 1971. The vessel was constantly leaking its fuel of heavy diesel oil in the area which serves as the breeding grounds for the Filipino sea turtle. These turtles are the basic protein food staple for the natives of the surrounding islands.

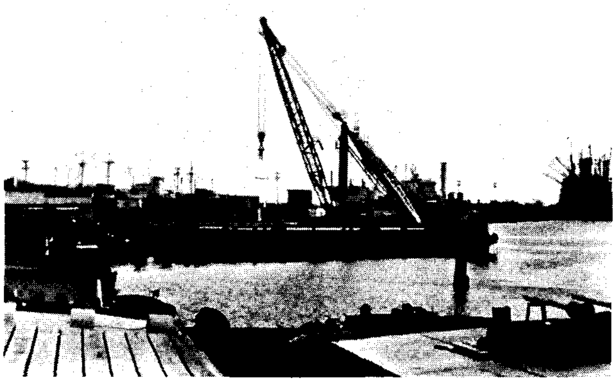
After the Coast Guard requested Supervisor of Salvage assistance in the matter, Mr. Denis Irons, oil pollution abatement expert from the Office of the Supervisor of Salvage and Lt. William Key, Salvage Officer from SRF Guam were sent to the scene to assist the Coast Guard and provide on-the-spot direction of the fuel removal efforts.

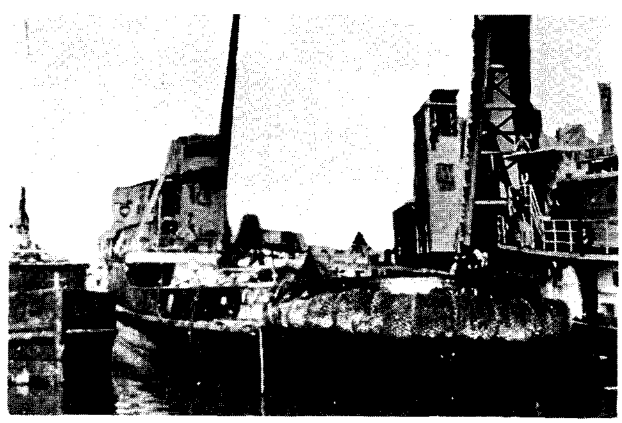
After an initial survey was conducted in the company of Capt. Ebelio Villena, Salvage Master for Luzon, an oil removal salvage plan was developed. Luzon Stevedoring Corporation was tasked to provide all the necessary men, boats and equipment to remove over 100,000 gallons of residual fuel from the vessel. Part of the salvage plan directed Luzon to deploy oil containment boom and collection skimmers around the vessel as a preventative measure in the event oil was spilled on the water during the removal operation.

The value of a salvage services contract with the Luzon Stevedoring Corporation was thus proved at the outset. A continuing relationship with this organization will result in many dollar savings for the government and a highly effective salvage force in the far Pacific.

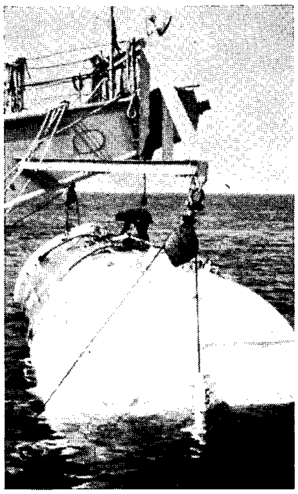


Right, m/v SOLAR TRADER aground off West Fayu Island in the Trust Territories of the Pacific. Bottom left, a view of a portion of Luzon's large shipyard. Bottom right, one of Luzon's 154 tug boats.



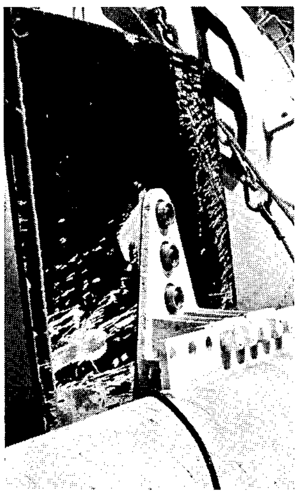


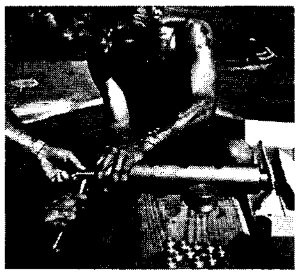
Large O

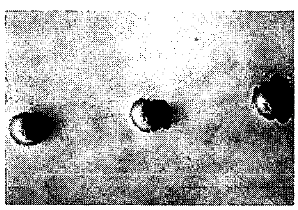


Aiming for a practical and effective advanced salvage system, the Large Object Salvage System project was begun to combine and integrate various technologies developed under separate long term Exploratory Development programs. Developed by the Naval Coastal Systems Laboratory (NCSL), the major component of the system is a new rigid salvage pontoon that is capable of being deballasted using three separate gas systems: compressed air supplied by hoses from shipboard compressors; gaseous nitrogen supplied by a self-contained cryogenic nitrogen (LN_2) system also developed by NCSL; and gaseous hydrogen generated by a self-contained hydrazine (N_2H_4) system, developed by the Naval Civil Engineering Laboratory.

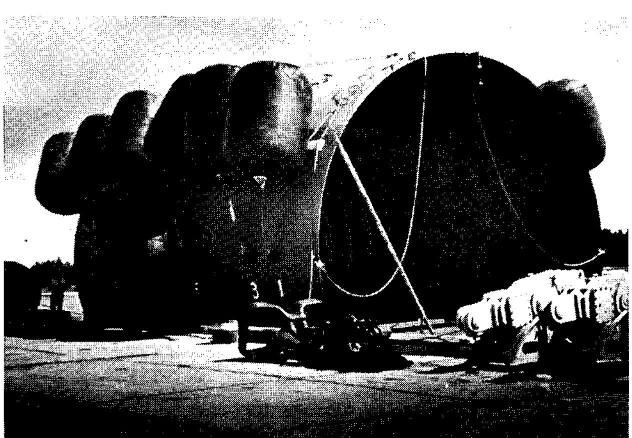
The pontoon itself is composed of three internal compartments. The two end compartments are dry and contain the gas generation systems. The center compartment is floodable and contains a rotatable standpipe which is used to maintain any desired water level, thereby determining the amount of buoyancy supplied by the pontoon. The pontoon is 15 feet in diameter by 45 feet long. It displaces approximately 200 tons of water and weighs slightly more than 100 tons, providing a lifting capability of nearly 100 tons. At present the pontoon can be attached to an object by using explosively-fired studs or a combination of padeyes and turnbuckles. The whole system is remotely controlled by a console mounted on a surface support ship and has only one cable, the control umbilical, running to the pontoon from the surface.



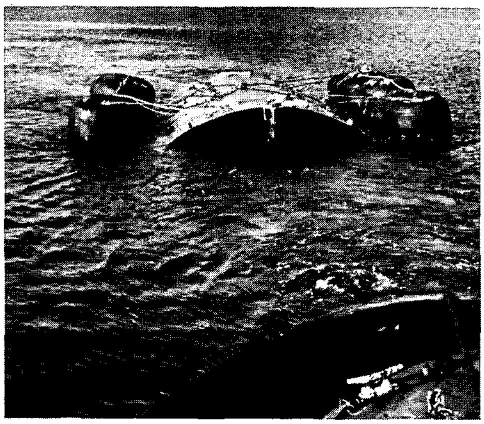




The integrated system was tested during simulated salvage operations in the Gulf of Mexico off Panama City, Florida, with LT Keith C. Roberts, SUPSALV Representative West Coast, as the On-Scene Commander. Battelle Memorial Institute, Columbus Laboratories, provided engineering assistance and documentation. During the August—September 1971 operation the air deballasting system was used. The Naval Undersea Research and Development Center (NUC) assisted SUPSALV in developing the rigging and handling system used in this operation. The liquid nitrogen and hydrazine deballasting systems were utilized during the July—August 1972 operation. The object that was recovered was a simulated section of a submarine hull. As such, it is a 240° segment of a circle 35 feet in diameter, 48 feet long, and having a submerged weight of approximately 65 tons.



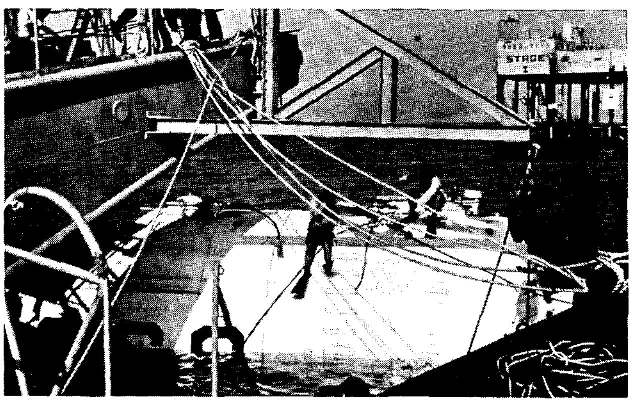
The operation of Summer 1972 utilized the YMLC-4 (WINDLASS) and a YC barge for the at-sea operations. The YMLC-4, manned by Murphy-Pacific personnel, served as the control center and provided a platform for

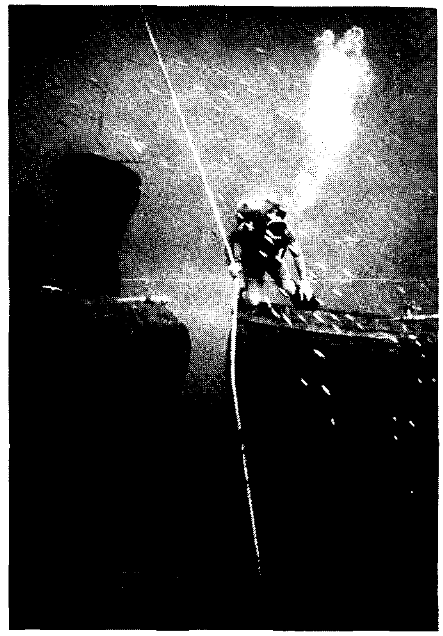


all rigging and handling operations. All diving operations were conducted from the barge, giving the divers easy access to the water and preventing interference between the diving and handling operations. The object was towed to the site supported on 8.4 ton collapsible pontoons, attached to lowering lines running over the bowhorns of the YMLC, and lowered to the bottom by deflating the 8.4 ton pontoons sequentially. The pontoon was towed to the site and guidelines were run from the object through hawse pipes at the ends of the pontoon to the YMLC. The pontoon was then lowered to the object and attached to it with turnbuckles (explosive studs were also used during the air deballasting system test) by divers. Following attachment the deballasting system was activated and the pontoon/object was raised to the surface and then placed back on the bottom. At this point the pontoon was detached from the object, raised to the surface, and towed back to port for refurbishment. This sequence was followed for each of the three deballasting systems.

By Dale Uhler
Office of the Supervisor of Salvage

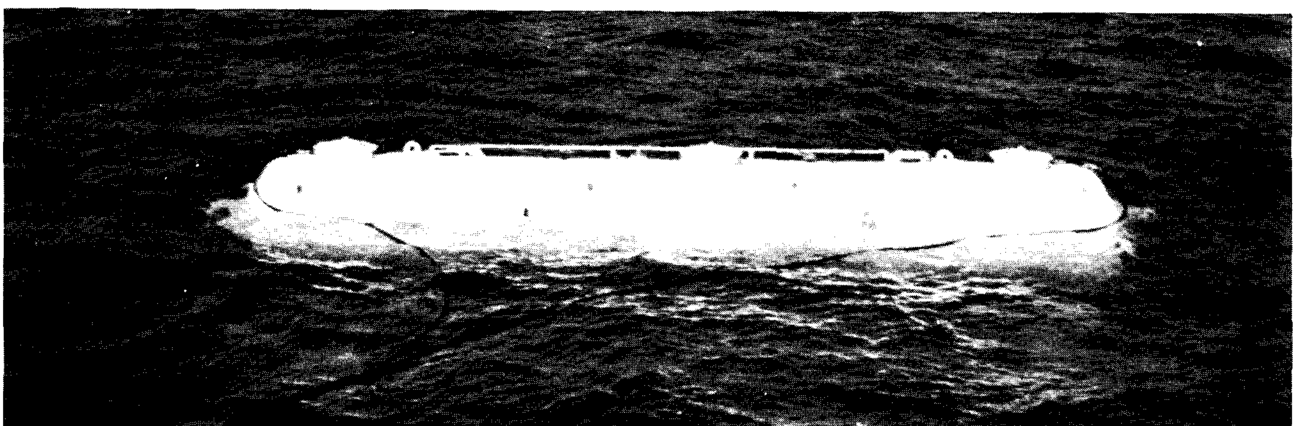
bject Salvage System





These tests were considered highly successful. The rigid pontoon has been returned to NCSL where further improvements will be installed, including thrusters to allow positioning from the surface without the aid of divers. More testing will occur in the future to make this effective salvage device available as soon as possible.

Photo coverage provided by COMBATCAMGRULANT.



The second of a three-part series dealing with the experts of unconventional warfare. Part I covered SEAL Teams and UDTs. This installment presents the next four specialized groups.

SPECIAL GROUPS

BEACH JUMPER UNITS

Beach Jumper Units were commissioned in World War II in response to a critical need for an amphibious organization proficient in certain specialized communications. The mission of the Beach Jumpers involves Fleet-wide training. The units are characterized by a high level of competence in electronics and psychological warfare. In Vietnam, BJU Detachments have participated in the propaganda aspect of the Chieu Hoi Program, an operation that offers amnesty to V.C. defectors in exchange for information and weapons. The Beach Jumpers have developed effective psychological warfare techniques in cooperation with similar organizations in the other Armed Services and act as the Navy's Test and Evaluation Unit in related matters. At present, BJU-1 and BJU-2 deploy detachments to and work in an advisory status with various Fleet Commands.

COASTAL RIVER SQUADRONS

Recently, the Boat Support Units became the nucleus for formation of the Coastal River Squadrons (COSRIVRON) under the newly established Naval Inshore Warfare Command. The mission of COSRIVRON units is coastal surveillance and interdiction support of Naval Inshore Warfare operations, developing, testing and evaluating tactics and future generation high speed craft for operations in coastal and restricted water warfare and training of other units including foreign Navy men, in coastal and riverine warfare and technology. To augment the regular contingent in the event of mobilization, Naval Reservists are trained during weekend drills. Most of the regulars are veterans of Vietnam coastal and river combat operations.

On the East Coast, COSRIVRON TWO consists of the Hydrofoil Patrol Gunboat TUCUMCARI (PGH-2), three patrol gunboats and five fast torpedo patrol boats. These craft are highly maneuverable and capable of speeds in excess of 40 knots. The squadron will also include one landing craft utility boat and assorted types of high speed small craft used in support of UDTs and SEALs. The aluminum hulled TUCUMCARI recently conducted a six month deployment to Europe to demonstrate the U.S. Navy's advanced hydrofoil technology to various NATO navies. Among the Distinguished visitors was the

Royal Navy's First Sea Lord, Admiral Sir Michael Pollack at Portsmouth, England. Climaxing this deployment, the TUCUMCARI logged over 300 hours of foilborne operation, and with her support ship, WOOD COUNTY, had transited over 14,000 miles. In late August 1971 she logged her 1,000th hour of foilborne operation while flying at over 50 knots, and was accompanied by the firing of green flares and the wailing of a siren.

WARFARE PART II

INSHORE UNDERSEA WARFARE GROUPS

Naval Inshore Undersea Warfare Groups (IUWG), also under the Naval Inshore Warfare Command, are composed of Mobile Inshore Undersea Warfare Surveillance Units which safeguard friendly forces in coastal and harbor areas against enemy submarines, swimmers, and high speed surface forces. Utilization of highly sophisticated mobile electronic equipment enables these units to detect, classify and localize activity.

When operating with amphibious forces, they provide close-in anti-submarine detection for ships in the amphibious anchorage. Other duties include harbor surveillance and training of reserve units. Continuing expanding research and development programs insure progress in the mobile devices safeguarding our continental shelf, coastal and inshore areas.

NAVAL BEACH GROUPS

The Naval Beach Groups (NBG) are composed of Beachmaster Units (BMU) and Assault Craft Units (ACU). The spirit of the men making up these units is exemplified by the words on their insignias: "This Beach is Mine," "United We Land" and "Initiative, Dependability and Cooperation." These mottoes are indicative of the extraordinary collective skills and abilities of this force. Beachmaster Units provide lighterage to the Amphibious Task Force Commander to assist in the ship-to-shore movement of a reinforced division landing during and after the assault.

The work of the Naval Beach Groups begins 60 to 90 days prior to invasion. Charts of the proposed landing area are studied as well as all reconnaissance reports and any other available data. From this study, determination is made of the best spot for landing personnel and equipment.

The Beachmaster Unit is highly equipped, self-sustaining and thoroughly trained in land combat and living under field conditions. They wear the combat green of the landing force with which they make the landing. They come ashore with combat packs and infantry weapons.

The basic tasks of the beach party include maintaining communication with designated Naval Commanders, Navy Control Units, and communication within the division beach party. They control all landing craft and amphibious vehicles in the vicinity of the beach from the surf line to the high water mark. The Beach Party coordinates the re-embarkation of equipment, troops, and supplies with the Shore Party Commander and the Amphibious Task Force Commander. With assistance from the Salvage Officer, they also control boat salvage and accomplish emergency repairs to landing craft.

As an example, BMU-2 is tactically organized to support a Division Landing on four numbered beaches. During normal peacetime periods, BMU-2 provides Beach Party Teams in support of the one-in-three rotation of the Amphibious Squadrons in the Caribbean and Mediterranean. At any given time, there are at least two teams deployed. During MED or CARIB turnover as many as four teams are deployed and one other Beach Party Team engaged in support of local training operations on local beaches. The BMU-2 Operations Department is tasked with providing all visual and radio communications, maintenance or communications equipment, intelligence and photographic services, and tactical and operations plans in overall support of the unit. The First Lieutenant's Department provides rated and non-rated deck force personnel, camp gear, and ordnance equipment in support of the deploying and locally utilized Beach Party Teams.

The Engineering/Transportation Department maintains both self-propelled rolling stock and non-self-propelled equipment. Each Beach Party Team deploying or utilized as local support teams is issued LARC V's trucks, jeeps, water buffaloes, and other equipment. The LARC V is a valuable piece of equipment to the Beach Party Team. It is used for a variety of jobs, such as helping boats off the beach, fire fighting, de-watering, and safety and rescue.

The LARC V used by BMU-2 is different from those maintained by the U.S. Army in that a 500 gallon per minute salvage pump, a kingpost arrangement for raising LCM type ramps, and a pusher bow for salvage operations on and off the beach are specifically installed.

The Administrative/Personnel Department and the Supply Department round out this highly-trained and professional unit. Every year, amphibious assault landing exercises are held on both the East and West coasts. In July of 1971, Naval Beach Group Two and Underwater

Demolition Team Twenty-One were two of six participating units under Commander Amphibious Task Group, Amphibious Squadron Ten, putting on the demonstration at Camp Pendleton, California. Other units of the Task Group included the USS INCHON (LPH 12), USS CORONADO (LPD 11), USS DESOTO COUNTY (LST 1171) and Tactical Air Support Squadron TWENTY-ONE. Air Support was provided by Attack Squadron EIGHTY-FIVE, HELICOPTER COMBAT SUPPORT SQUADRON SIX and MARINE HELICOPTER SQUADRON MEDIUM TWO-SIXTY-FOUR.

Approximately 325 Naval Reserve Officers Training Corps Midshipmen Second Class participated in the Assault on a fortified beach. An attack squadron of aircraft and Naval gunfire softened enemy defenses while the Amphibious Task Group prepared to land troops, equipment and supplies by Marine Corps tracked vehicles, landing craft and helicopters. Underwater Demolition Team members cleared the beach and inshore area of obstacles.

These exercises are open to the general public, and observers are given a unique opportunity to witness the expert and split-second timing of the techniques used in assaulting fortified positions and the employment of helicopters in providing supply and medical support to the ground forces.

The conclusion of this series will appear in the Winter issue of FP, covering Assault Craft Units, Navigation Aids Support Teams, and Harbor Clearance Units.

Naval Inshore Warfare Program Manager "IRISH" FLYNN Leaves NAVSHIPS

LCDR Cathal L. "Irish" Flynn left NAVSHIPS in August 1972 to begin a two year program in Asian Studies at American University, and was relieved by LCDR I.C. LeMoyne.

As the Naval Inshore Warfare Program Manager, LCDR Flynn was responsible for a wide variety of swimmer and diver related projects and programs. The few efforts listed here only begin to illustrate the broad spectrum of LCDR Flynn's contributions to the Naval Inshore Warfare Program:

- Mark 7 Swimmer Delivery Vehicle (SDV)
- Doppler Navigation System for SDV
- Obstacle Avoidance System (OAS) for SDV
- Deck Shelter for Mark 7 SDV
- Reorganization of Mark 8 SDV Development Plans
- Closed Circuit Mixed Gas Diving Program
- Tests, Evaluation and Procurement of Mark 6 Mod 1 Mixed Gas Diving Apparatus
- Development of 1630 Class LCU conversion to Amphibious Swimmer Delivery Vehicle (ASDV)
- Cold Water Protection for Swimmers; Development simulator and conduct of Human Factors Study
- Allowance List of Approved Equipment for Inshore Warfare Groups

"Irish" enlisted in February 1960, graduated from OCS in June 1960 and completed UDT training in October 1960. He then served as Platoon Officer with UDT ELEVEN until November 1963. From November 1963 to June 1965, LCDR Flynn served as Detachment Officer in Charge with SEAL TEAM ONE in Vietnam. The next two years "Irish" served as OPNAV's Assistant for Swimmer Operations, Special Warfare Branch, OP-34. July 1967 to January 1968, he was Detachment Executive Officer for SEAL TEAM ONE in Vietnam. His next assignment was as Commanding Officer UDT TWELVE, January 1968 to July 1969. LCDR Flynn then attended the Naval War College Command and Staff Course from August 1969 to June 1970. Since July 1970, "Irish" has been at NAVSHIPS as the Naval Inshore Warfare Program Manager.

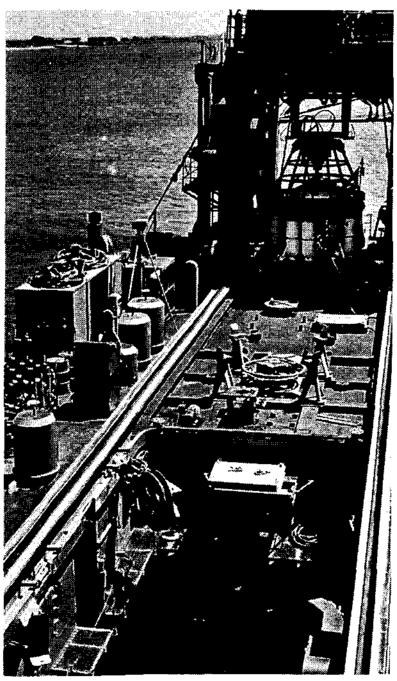
After completion of the two year Asian Studies Program at American University, LCDR Flynn will attend the Defense Language Institute for one year learning Mandarin.

World Record divers, 1010 ft.
Top, left to right:
HT1 (DV) R.H. Fine
HM1 (DV) J.C. Kleckner
HM1 (DV) R.L. Pershin

Bottom, left to right:
ENC (DV) R.L. Cave
LCDR F.E. Eissing

MK 2 MOD 0 SETS A WORLD DIVING RECORD

by LT R.H. Parrish, CEC
Harry R. Rueter
Office of the Supervisor of Diving

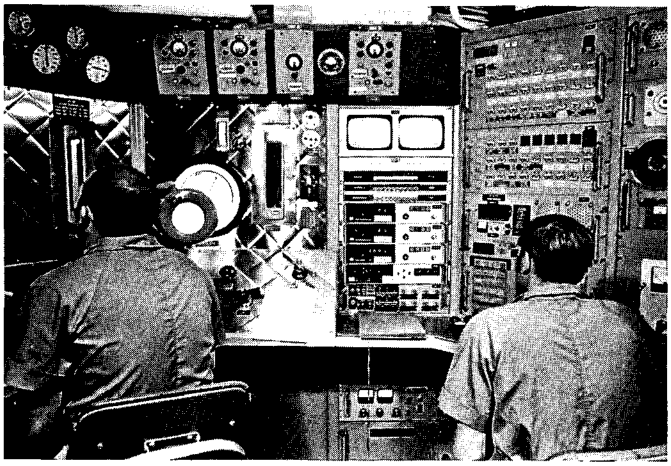


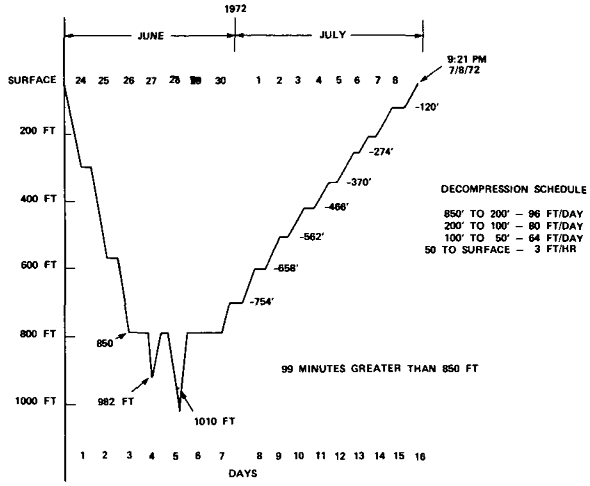
In early July 1972, the Deep Diving System MK 2 MOD 0 concluded an Operational Evaluation (OPEVAL) for the fleet. The system completed a successful open sea saturation dive to a maximum depth of 1010 feet off southern California's San Clemente Island. This dive was the last in a series of fifteen open-sea dives required for the OPEVAL and represents the deepest diver penetration of the open-sea to date. Earlier in the OPEVAL series, there were dives to 180, 300, 600, and 945 feet.

This successful dive series has proven the effectiveness and reliability of the DDS MK 2 as an open-sea saturation deep diving system.

The DDS MK 2 series is composed of two identical, independent complexes each consisting of a double lock Deck Decompression Chamber (DDC), a Personnel Transfer Capsule (PTC), a Life Support System (LSS) and a Main Control Console (MCC). During normal saturation diving operations the DDC is capable of supporting five saturated divers for a fourteen day mission including decompression time (approximately 24 hours for each 100 feet of dive) at depths to 850 feet. The DDC contains bunks, sanitary facilities and a work area, serving as the divers' "home," complete with music, movies, reading material and hot meals.

The PTC is an elongated sphere seven feet in diameter which serves as the "elevator" between the DDC and the work site. It is capable of excursions up to 150 feet greater than saturation depth. The PTC supports four divers for eight hours under normal conditions, or 24 hours in an emergency. The PTC is raised and lowered from the support vessel ELK RIVER (IX-501) by a two-inch-diameter





Profile of World Record At-Sea Dive

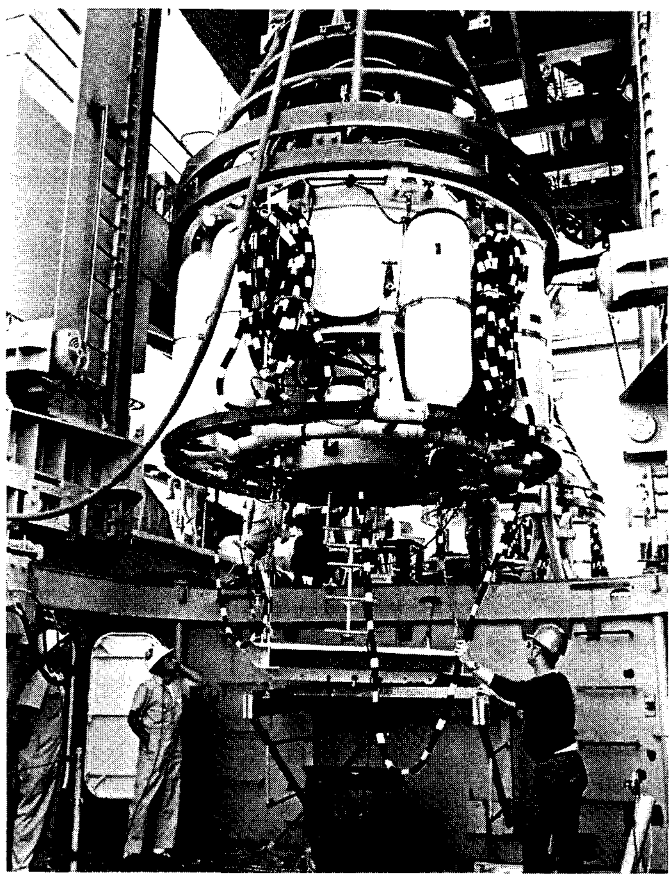
Above, left, Main Control Console of the Deep Diving System. Below, Personnel Transfer Capsule being readied for submergence.

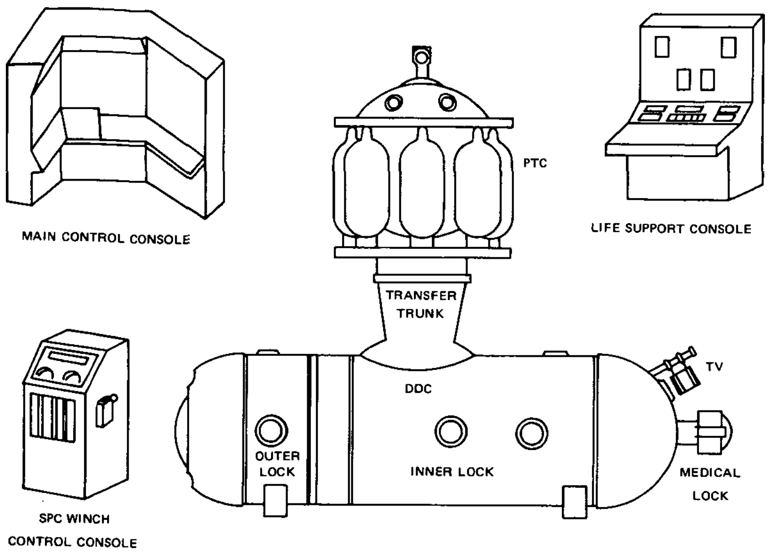
strength, power and communications cable (SPCC) which supplies electrical power and communications to the PTC. A separate umbilical provides the divers' breathing gas and hot water for PTC and diver heating. Metabolic oxygen and mixed gas for emergency breathing are contained in external PTC flasks as well as pressure compensated containers for power transformers and batteries.

The LSS removes carbon dioxide and odors from the DDC atmosphere and regulates temperature and humidity.

Each Main Control Console (MCC) serves as the control central and monitoring station for each complex. Some of the more important MCC functions include DDC gas control, television monitoring (dives, PTC and DDC), electrical power control and monitoring for PTC and DDC, communications control and recording between divers, PTC, DDC and topside support personnel, and supervision of system and divers.

The divers' bodies were saturated to the working depth in the DDC while the support vessel (IX-501) covered the fifty-five miles to the San Clemente Island moor site. Following





Major Units — DDS MK 2 MOD 0 Principles of Operation

Divers to 945 ft.
Top, left to right:
BMC (DV) J. Ramos
AX-2 (DV) C. Delucchi
Bottom, left to right:
HTCS (DV) G.J. Apodaca
HMC (DV) C. Morris
MM1 (DV) D.L. Rodocker

a pre-dive check of the PTC and all other equipment, four divers entered the capsule (PTC) leaving one in the DDC to assist in recovery should an injury occur. After transfer to the center open well by an overhead gantry crane, the umbilicals were attached and the PTC lowered to twenty feet, released from the PTC holding basket and stopped at fifty feet where surface support divers made a final thorough check of the capsule exterior prior to descent to the work site.

Since an excursion below saturation depth was required in the 945 and 1,010 foot dives, the PTC was pressurized from the external helium flasks. This action occured after being lowered to within 50 to 100 feet above the saturation depth. Descent then continued to the new PTC depth. During the 1,010 feet dive the capsule was pressurized to 990 feet with the divers descending an additional 20 feet in depth. Whenever making an excursion of this type the saturation depth must be considered the "surface." Additional inert gas absorbtion will occur as in a sub-saturation dive. Bottom time is limited by no-decompression limits calculated for various excursions depths and times. In an operation of this scope, some problems naturally arose which had to be effectively dealt with to assure success. In the medical area, the significant problems included the excessively cold thermal environment of divers breathing HeO_2 alleviated by the use of hot water suits and heated inspired gas; the vocal distortion of divers in high helium atmosphere, helped by the Helle – manufactured Helium unscrambler; and the effects of the helium syndrome, including tremors in the extremities and loss of dexterity, which was helped simply by the divers' awareness and physical compensations. The technical problems included such things as helium leaks in valves, packing, and gages which were controlled by replenishing the helium supply; the cracking of the double-lipped gaskets, used to seal

DDS MK 2 MOD 0 Capabilities

DEPTH:	PTC	1000 FEET (MAX.)
PRESSURE:	PTC	378 PSIG/850 FEET OF SEA WATER (INTERNAL OR EXTERNAL)
	DDC	378 PSIG (INTERNAL)
PERSONNEL:	PTC	4 MEN
	DDC	4 MEN FOR 14 WORKING DAYS, PLUS DECOMPRESSION TIME FROM 1000 FEET (DESIGN PARAMETER); EMERGENCY CONDITIONS: 34 MEN FOR 48 HOURS (MAX.)
SUBMERGED ENDURANCE:	PTC	4 MEN FOR 8 HOURS (24 HOURS-EMERGENCY)
COMPRESSED GASES:	PTC	HELIUM, OXYGEN, HELIUM/OXYGEN, AIR
	DDC	HELIUM, OXYGEN, HELIUM/OXYGEN, AIR
SPC CABLE WINCH:		
SPC CABLE DIMENSIONS:		LENGTH – 1,400 FEET; DIAMETER – 2 INCHES
HAULING CAPACITY:		30,000 LB. @ 10 FEET PER MINUTE (MAX.), OR 3,000 LB. @ 100 FEET PER MINUTE (MAX.)

against pressure which was relieved by the use of single-lipped gaskets; and the electrical current in the equipment grounding to the ocean, which required extreme care to alleviate. (Water blocks and oil filled cables will probably be used in the future to eliminate this problem.)

The diving phase was completed and decompression began with ascent rates commencing at ten feet per hour and progressively slowing to three feet per hour as the surface is approached.

The following U. S. Navy personnel and civilians presently associated with these operational accomplishments and coordinated team work are listed below:

CDR D. Disney, Head of Diving Div.
LCDR F. Eissing, Diving Officer/Eng'r.
LCDR D. McMillan, Diving Med. Officer
LCDR B. Peck, O-in-C, 1X-501
Jim Clinkenbeard, Proj. Engr. for NUC's Support of 1X-501
LT G. Sniffin, Maintenance Officer and Diving Officer
LT R. Lynch, Supply Officer
LT T. Cullison, Training Officer
LT J. Allen, Safety Officer
LT D. Smith, Admin. Officer
HTCS (DVM) Wm. Mesplay, Master Diver
EMC (DV) R. Auen
IC-1 (DV) K. Drapper
IC-1 (DV) S. Kimbrell
ET-1 J. Morris
EM-1 A. Mercado
MMC (DV) L. Trujillo
HT-2 (DV) J. Patterson
HT-1 (DV) R. Fine
MM-1 (DV) J. Myers
ENC (DV) R. Cave
HTC (DV) E. Alexander
GMGC (DV) G. Powell
HTC (DV) J. Spurlock
EN-2 (DV) T. Miller
ENCS (DV) H. Reece
QMC (DV) F. Delaoliva
EN-1 (DV) K. Graber
GMGC (DV) T. Jenkins
BM-1 (DV) G. Gunn
HMC (DV) J. Jorren
HM-1 (DV) J. Kleckner
MM1 (DV) R.L. Pershin
HMC (DV) K. Hardy
HMC (DV) A. Cooper
SKC (DV) H. Hicks
SK-2 J. Weaver
FN A. Garcia
HTCS (DV) G. Apodoca
MM-1 (DV) D. Rodocker
AX-2 (DV) D. Delucchi
BMC (DV) J. Ramos
HMC (DV) C. Morris
PH-2 (DV) B. Douthit
EN-1 (DV) R. Haas
HT-1 (DV) J. Schmaltz
BM-2 (DV) C. Penn

In addition to those above special mention should be given to LT G. Shipp and HTCM (DVM) L. (Chips) Hurley who are not presently with the MK 2 MOD 0 system but who devoted considerable effort and time over and above the call of duty to prepare the Diving System for Fleet Acceptance. Upon completion of the OPEVAL the DDS Mk 2 Mod 0 will be assigned to the newly formed Naval School, Deep Diving Systems, Submarine Development Group One.

The Mark 2 Mod 1 Deep Diving System was developed by the office of the Director of Ocean Engineering and Program Manager, Deep Submergence Systems Project. This Diving System is presently being installed on the ASR 21/22 Class Submarine Rescue vessel.

Commodore S.H. Packer, Commander Submarine Development Group One, was presented a plaque by Mr. Harry Rueter, NAVSHIPS OOC representative, for CAPT E.B. Mitchell, Director of Ocean Engineering and CDR J.J. Coleman, Supervisor of Diving. The award was given to commend the outstanding support and performance in diving and salvage operations of SUBDEVGRUONE. The presentation took place in July, 1972, aboard the IX-501 ELK RIVER, the support ship for the Deep Diving System MK 2 MOD 0, during one of its record breaking manned saturation dives in the open sea off southern California's San Clemente Island. Witnessing the presentation is LCDR F.S. Eissing, Diving Officer and Engineer of the DDS MK 2 MOD 0.

Underwater Breathing Apparatus Compared

by Lt. Thomas Hawkins
NAVXDIVINGU

The Navy Experimental Diving Unit recently sponsored tests of advanced closed circuit, underwater breathing apparatus' designed and developed by BioMarine Industries (CCR-1000); General Electric Corporation (MK 10, MOD 5); and the Westinghouse Corporation (CCM-1).

Testing was accomplished on a joint and comparative basis for the purposes of exploring a possible replacement for SCUBA now utilized by Naval Inshore Warfare Underwater Demolition and Sea-Air-Land (SEAL) Teams. The open-sea test series was conducted at the Naval Station, Roosevelt Roads, Puerto Rico, and in the Hampton Roads operational area at NAB, Little Creek, Virginia.

Commands providing assistance and test personnel were the NAVXDIVINGU, Naval Inshore Warfare Commands, Atlantic and Pacific, Underwater Demolition Team TWENTY-ONE and SEAL Team TWO.

Each of the three closed-circuit apparatus' evaluated employed an electronic sensor control system that produced a reference voltage which corresponded to a pre-set Partial Pressure of Oxygen (PO_2) level. The PO_2 level was determined and adjusted prior to making test dives. In general, the sensor action determined the exact amount of oxygen required by the diver and injected that amount into the closed-cycle system.

In addition to the electronic sensor control system, each of the apparatus' tested was comprised of a structural frame and cover, CO_2 scrubber assembly, pneumatic assembly, breathing circuit, and wrist and chest display units.

Primary displays were worn on the divers' wrists and consisted of a series of indicator lights which continually signalled the status of the oxygen in his breathing mixture to the diver. A diluent of nitrogen (N_2) was utilized throughout the test series. Each apparatus included an alarm light on the wrist display which alerted the diver of a sensor failure, high or low oxygen level, or the occurrence of low battery voltage. The secondary display consisted of a rotary switch and/or meter display which allowed the operator either underwater or on the surface, to check the status of his oxygen sensors and batteries.

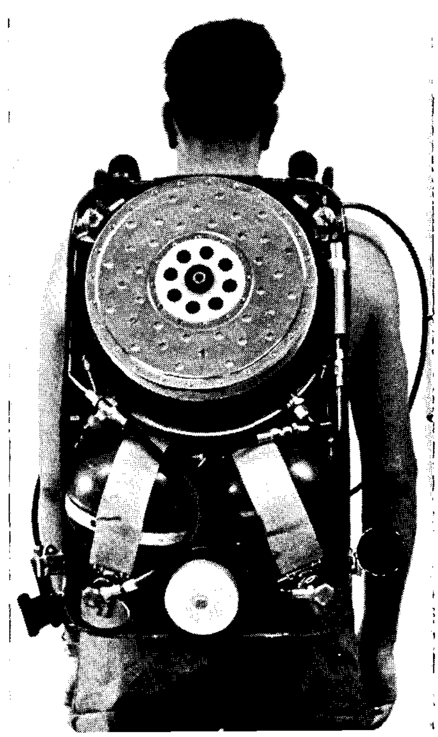
Each apparatus employed a pneumatic assembly which consisted of gas storage cylinders, cylinder valves, regulators, solenoid valves, by-pass valves and associated lines and fittings. The O_2 gas cylinder was located on the right side of the units and the diluent gas on the left side. By means of the valve and regulators, each gas was automatically introduced into the breathing circuit when required. Manually operated bypass valves were provided in the event of a malfunction of the automatic gas mode, and the diluent gas was introduced into the breathing circuit by means of a hydrostatically operated valve. The diluent add valve was essentially a second stage regulator.

The breathing circuit was composed of the mouthpiece assembly, inhalation and exhalation hoses and check valves, breathing bag assembly or diaphragm, manifold assembly, and CO_2 scrubber. The General Electric MK 10 MOD 5 employed a disposal CO_2 baralyme absorbent cartridge, while the BioMarine CCR-1000 and the Westinghouse CCM-1 both employed a recharageable baralyme canister assembly.

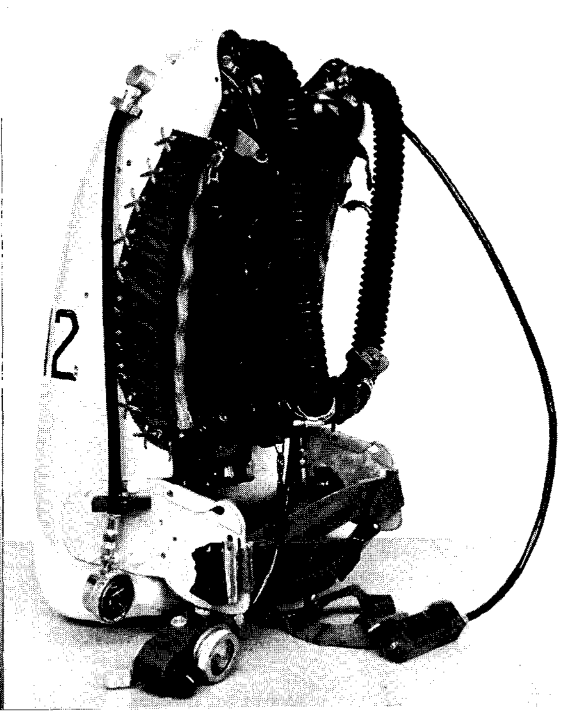
All of the open-sea tests were accomplished under supervised conditions which required the test subjects to swim a predetermined time or distance along a triangular jackstay course 3000 yards in length, to dive to maximum depths of 160 feet and to perform Swimmer Delivery Vehicle (SDV) mission profiles. Approximately 390 hours total bottom time were logged in accomplishing the evaluation.

The results of these tests are being evaluated with regard to human engineering and compatibility with existing equipment. Upon completion of this, recommendations will be made in an effort to continually improve the diver's equipment and environment.

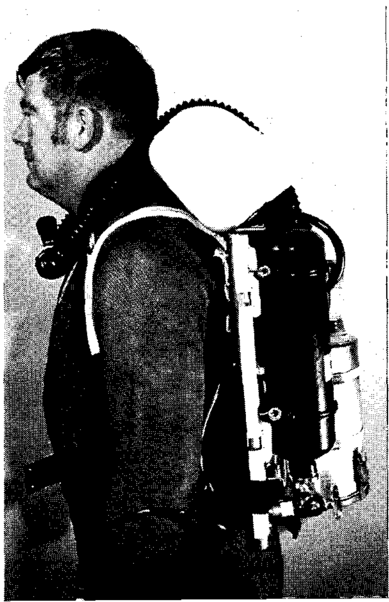
BioMarine CCR-1000 SCUBA

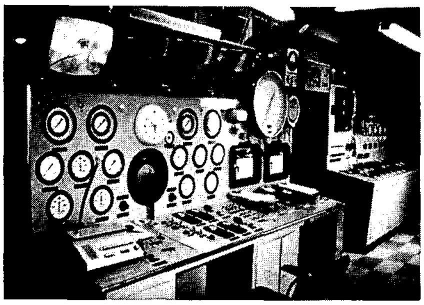


Westinghouse CCM-1 SCUBA



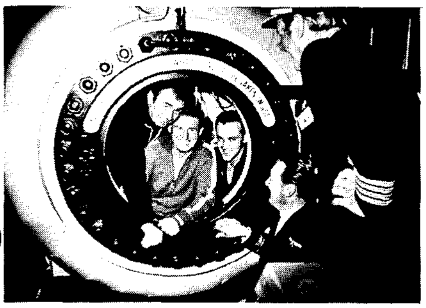
General Electric MK 10 Mod 5 SCUBA





USN/RN 1000 FT DIVE AT ALVERSTOKE

by LCDR James C. Bladh, USN



Above, top, Control Console at Alverstoke
Above, middle, CDR A.G. Worsely, RN, Superintendent of Diving, congratulates the three successful divers, left to right, American SCPO Bill Winters, Englishmen LCDR Peter Cobbey, and CPO Ginger Andrews.
Above, bottom, CAPT E.B. Mitchell, Director of Ocean Engineering, and CDR Worsley congratulate the divers.
Below, the men prepare for the depths.

In a continuation of the practical efforts being undertaken under the Information Exchange Program B-12, a thousand foot cold water dive was undertaken at the Deep Trials Unit, Alverstoke, England, in June by the U.S. Navy and Royal Navy.

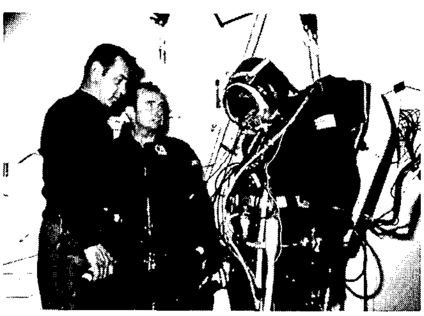
The purpose of the dive was a final evaluation of the Mark 10 Mod 4 closed-circuit mixed-gas underwater breathing apparatus before undertaking deep open sea dives. Royal Navy interest stemmed from possible use of the Mark 10 with their planned saturation system.

A team of five divers from NEDU trained a team of Royal Navy divers in the use and maintenance of the Mark 10 and all the associated equipment. The final team, LCDR Peter Cobbey RN, CPO Ginger Andrews RN, both of the Mark 1 Deep Dive Team and SCPO Bill Winters USN of the Admiralty Experimental Diving Team, entered the chamber and began compression at 1430 on 19 June. A group of American and British technical and medical personnel were topside standing watches and operating equipment. The first step of the dive was rapid compression to 300 feet. Each diver performed one swim at this depth to check all systems and equipment; then compression was continued to 1000 feet.

During the first three days at 1000 feet numerous difficulties were experienced with equipment and instruments outside the chamber. The water heating and chilling system which had been specially installed and modified for this dive was particularly troublesome. On Sunday, June 25, however, the trend changed, and a series of successful dives began. In the next three days over twenty one hours of diving were logged. All equipment intended for Fleet delivery functioned perfectly.

Decompression began on 27 June after a final chiller pump failure made further chilling of the wet pot impossible.

The dive was a success despite the numerous difficulties encountered with the support system. In addition to being a realistic display of U.S. Navy and Royal Navy cooperation, the dive showed that the Mark 10 Mod 4 is capable of reliably supporting a working diver at 1000 feet in cold water for more than four hours. The practicality of the Mark 10 for use in quick and easy saturation diving was demonstrated. Also it was shown that experienced divers completely unfamiliar with the Mark 10 apparatus can be effectively trained in its operation and use in a brief period.



AIR COMPRESSORS

By
Richard Hansen
Office of the
Supervisor
of Salvage

Because of its wide pressure range the reciprocating compressor is used far more often in diving system applications than the rotary compressor. With staging, a reciprocating compressor can supply the high flow rate and pressure that are required to support surface-supplied diving systems. It also can attain operating pressures well in excess of the charging pressure needed for self-contained underwater breathing apparatus (SCUBA).

System flow rate and pressure (See FACEPLATE, Summer 1972) are fundamental considerations in establishing compressor requirements for support of a diving system. However, other factors must be considered before selecting a particular compressor to do the job. It is important to understand both the inlet conditions and the processes that occur within the compressor.

The compressor control mode must be established. The object is to ensure that the diver will never operate at a depth where pressure equilibrium may occur between the upper and lower limits of a start-stop or load-unload type controller. As a general rule, it appears desirable to establish the lower pressure limit slightly above the maximum pressure required at the diving station.

A reciprocating compressor is usually rated at the working pressure stated on its nameplate. However, it will probably never operate at its rated pressure because the control system will unload or stop the compressor when it builds up to this pressure. The rated pressure is also an unreliable indicator of the compressors capacity because it is based on standard conditions of temperature, barometric pressure, relative humidity and air density at the inlet. Actual inlet conditions differ from the standard. The quantity of air supplied to the compressor will vary relative to the variance in actual inlet conditions thus altering the compressor's capacity. For example, compressor capacity increases if barometric pressure and relative humidity are above standard conditions and temperature drops below standard.

Recognizing the effects of actual inlet conditions and that many compressors are not rated, it is necessary to work with the defined displacement of the compressor to arrive at the capacity. The displacement of the first stage is the significant volume in estimating the capacity of the compressor. This is the only stage that will ordinarily obtain air from the atmosphere. Therefore, it is evident that the capacity cannot exceed that entering the first stage. The displacement volume can be simply established; it is a function of piston diameter, stroke length and RPM.

Clearance volume must now be approximated to determine compressor capacity because it, too, limits capacity. When a compressor makes its compression stroke, it does not sweep or clear the entire volume of the cylinder. That portion, above the piston or diaphragm, which is not swept, is called the clearance volume. Although it exists in all compressors, it is generally greater in the smaller, lower capacity units because the valve cavities are a larger percentage of the displaced volume.

Most small compressors are unrated. The only data available for obtaining capacity are: piston diameter, stroke length and RPM. With the displacement volume established, the clearance (unswept) volume can be estimated by using the section view of the compressor's first stage when available. Figure 1 relates the displacement volume required to deliver 100 CFM of atmospheric air at various discharge pressures with clearance volumes ranging from 2% to 8%. This figure may be used to estimate capacity of unrated compressors if the clearance volume can be established. The 2 to 8% clearance is normal for commercially applied units, but small compressors may have clearance volumes approaching or exceeding 15%.

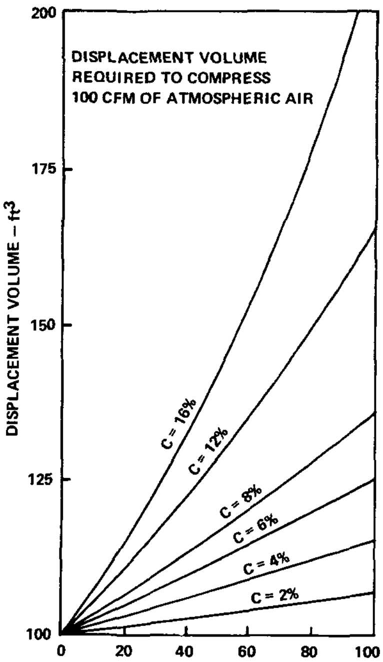


FIGURE 1

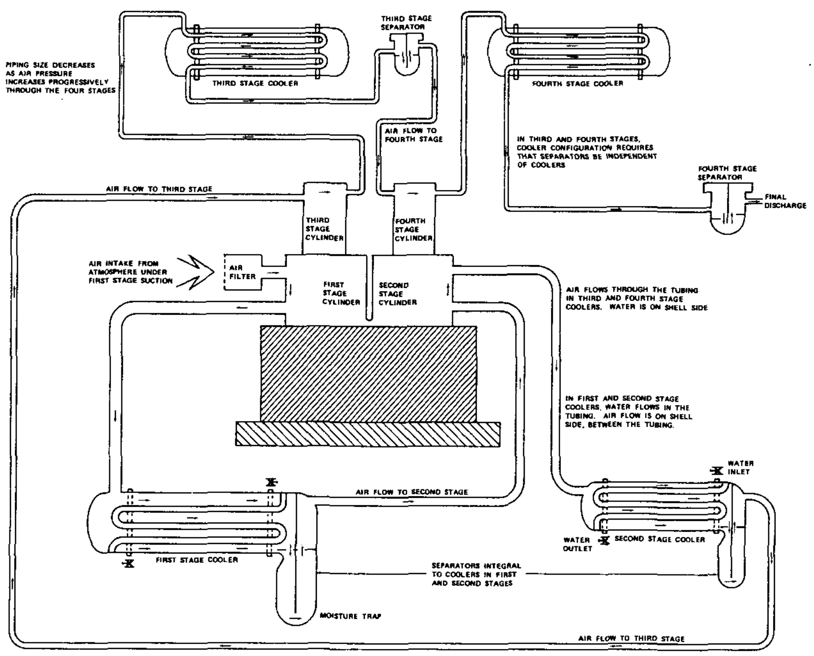


FIGURE 2

Figure 2 illustrates the flow of air through a four-stage compressor. There are several things to keep in mind when considering the number of stages required for a particular application. The stages should be limited to only those that are necessary to provide the required system pressure while maintaining reasonable temperatures in the air compressed. The greater the number of stages the lower will be the temperature of the air compressed. However, this desirable condition is more than offset by another consideration. As the number of stages increases, so does the potential for contamination. Lubricants are usually introduced into the higher stages at a more rapid rate than into the lower stages. Adding unnecessary stages only aggravates the problem of contaminants.

Figure 3 depicts the cycle of a compressor, showing the processes of compressing air, discharging it to a receiver, and renewing the air supply from the atmosphere to complete the cycle. The receiver pressure can be construed as the pressure in the subsequent stage of the compressor. In studying the figure, note how this pressure can vary. It can range from virtually zero to the rated pressure in each stage of the compressor, depending on the position of the piston. In other words, the capacity of the compressor will range from nearly total displacement at zero downstream pressure to as little as 50 percent of the displacement at the rated pressure of the first stage.

Any compressor will operate to the downstream pressure. This implies that, if no flow losses exist, air entering at inlet conditions will leave at a pressure equivalent to that in the receiver, air bank or downstream system. This characteristic is significant in considering the disposition of the water that is condensed during compression of the air. Inter coolers and after coolers must be designed, not only to remove the heat of the compression of the air, but also to reduce the temperature of the water vapor. They must have adequate heat transfer capability to accommodate the latent heat of the water that is condensed. This additional requirement is substantial.

It is important that condensation be confined to the compressor. Moisture should not be allowed to migrate downstream where it can collect in receivers, diver's hose or breathing apparatus. All reciprocating compressors provide some method of cooling the compressed air between stages. They usually have traps to collect the condensate. These exchangers have, for the most part, been designed for operation within a limited pressure range. If the pressure varies from this range, as it often does in the application to a breathing gas system, moisture will migrate downstream of its design collection point.

Back pressure controls installed downstream of staged compressors can alleviate this problem. They help maintain interstage and outlet pressures at or near rated pressure, thus causing condensation and emulsification products to collect in the traps within the compressor. The effect of such controls is somewhat like squeezing a sponge. As the pressure is applied, the volume of air decreases and its moisture content drops proportionately.

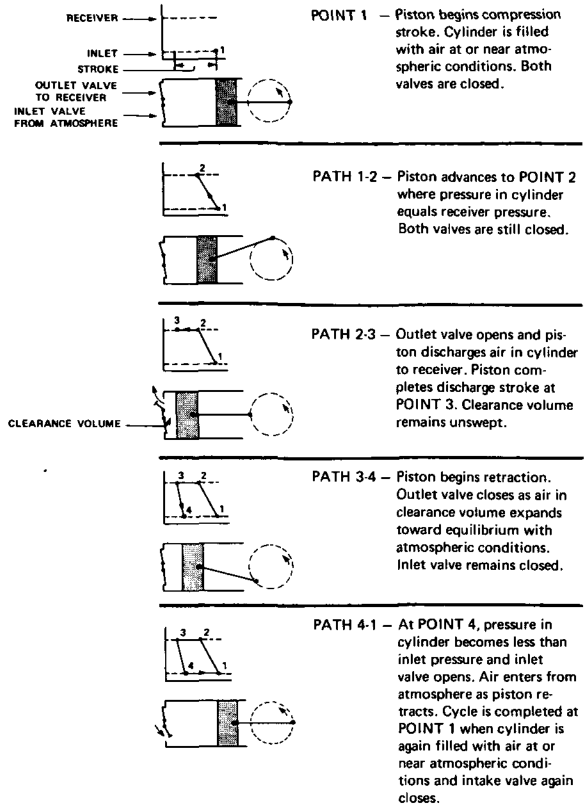


FIGURE 3

The importance of pressure controls has been clearly indicated through an analysis of their effects on the performance of a compressor relative to the collection of condensate. The amount of condensate migrating down stream decreases substantially when controlled back pressure is applied. The same analysis also highlighted the significance of heat exchanger design. The heat exchanger duty, if designed only for the rated pressure of the compressor, will be inadequate in downstream stages to condense the water vapor and more will migrate into the system or storage bank. Here again, inlet conditions are important. Increases in the temperature and humidity of inlet air increase the difficulty of controlling condensate within the system. It is therefore desirable to locate the compressor to minimize inlet temperature and humidity.

Nothing is more fundamental in a diving system than to ensure an adequate supply of breathing gas during all conditions encountered in the diving mission. It can only be ensured through the methodical application of principles of engineering. We must relate compressor capacity to the flow of air to the diver and the pressure needed at the diving manifold to maintain the required flow rate. Moreover, having established these basic requirements, we must examine the compressor as a total system before making a final selection for a particular application. That is, we must consider the compressor's inlet conditions, the internal processes of compression and heat exchange, the potential effects of these processes downstream and the requirements for controls.

the Old Master says...

The average person

takes oxygen for granted. He never thinks about it. It's just part of the air he breathes. He can't see it, smell it or taste it. Neither can a diver. But, unlike the average person, a diver cannot afford to take oxygen for granted. That stuff in the green compressed gas cylinder sustains his life. It can also take life away if it isn't handled carefully. There are two sides of O_2. It is the diver's business to learn all he can about both of them.

Oxygen has two unique characteristics that make it important. It makes life possible and it makes combustion possible. Its combustion-supporting property makes it highly useful as a power source, and also makes it exceptionally dangerous. The continuing hazards of diving and salvage work arise in large part from the fact that so many conditions can combine to produce oxygen-deficient or oxygen-rich atmospheres. It can be a blessing or a curse depending on how it is controlled.

Almost all O_2 is produced at "air separation" plants through a fractionating process. That is, the oxygen is separated from the other two principal gases in air, carbon dioxide and nitrogen. It is also a cryogenic process in that the air is liquified by reducing its temperature to -312°F. The liquid oxygen is collected at the bottom of the fractionating column. It is then returned to a gaseous state and stored under pressure in compressed gas cylinders designed according to Department of Transportation (DOT) and military specifications.

The oxygen cylinder in most common use is a DOT 3AA2400 cylinder with a normal capacity of 200 standard cubic feet (SCF) of oxygen. The valve threads of the hose connections are uniquely designed, according to military specifications so that only an oxygen valve will fit them.

Pure oxygen, itself, is nonflammable. The liquid oxygen produced by the cryogenic process is inherently pure. However, all materials that are flammable in air burn much more vigorously in O_2. Some hydrocarbons such as oil and grease burn with nearly explosive violence if ignited. The hazards of such contaminants are very real, as any diver will attest who has seen an uncontrolled oxygen-fed fire. Even small quantities of hydrocarbons in the presence of oxygen can produce severe reactions. The power of oxygen to support combustion is an essential factor in designing and maintaining oxygen storage systems. All combustible materiels, especially oil and grease, and all sources of ignition must be kept from contact with high O_2 concentrations.

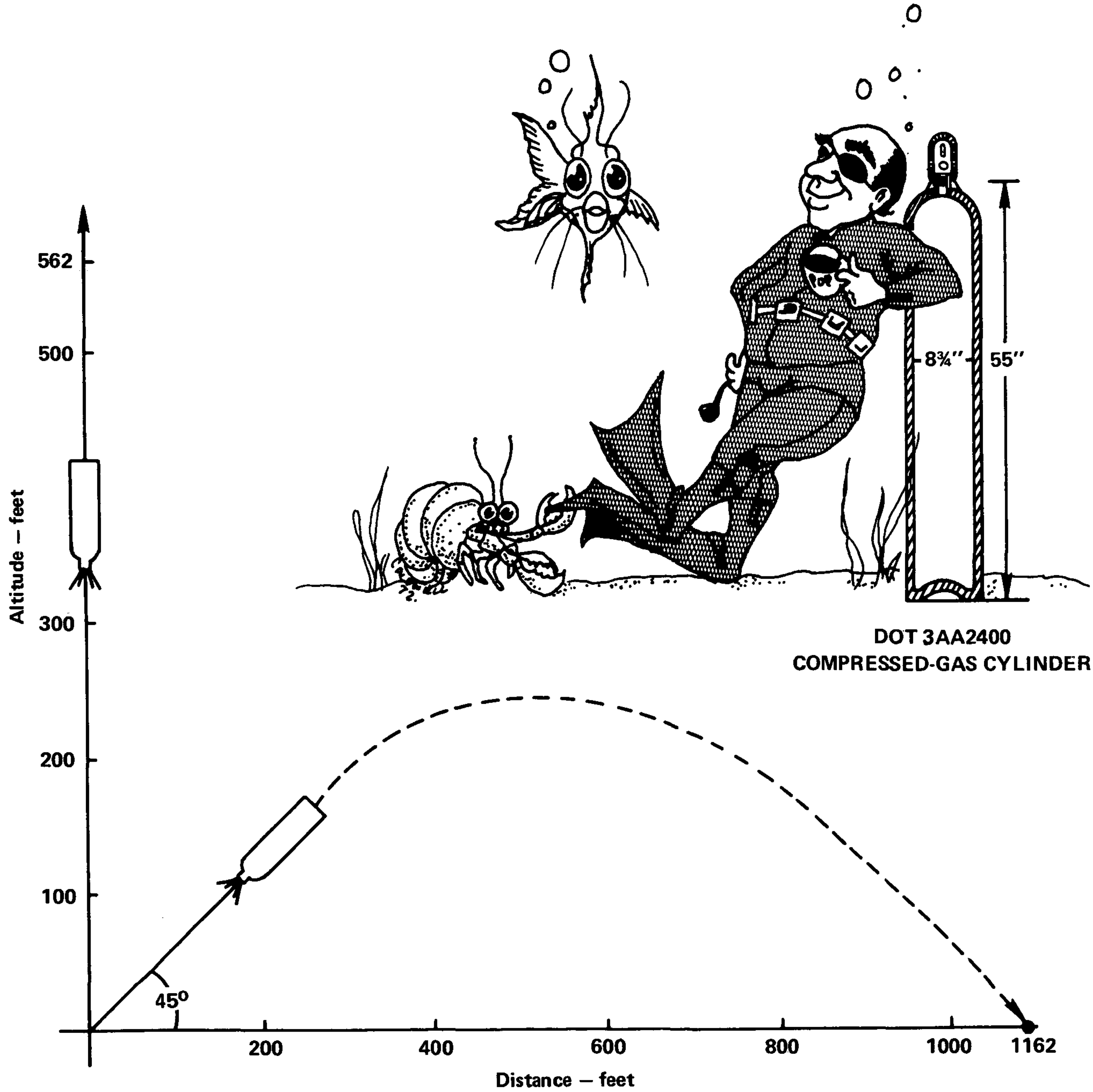
That green cylinder positioned at the recompression chamber holds more oxygen than you think. Combine it with nitrogen in the 21%—79% proportions found in normal atmospheric conditions and it will keep you alive and healthy for 330 hours. Your body is a highly efficient consumer of fuel, when you think about it. At a speed of 50 miles per hour your compact car consumes the same amount of oxygen in a little less than 30 minutes. The reason, of course, that one cylinder can store so much oxygen is that the gas is stored under great pressure.

This creates another hazard which can be easily overlooked. A cylinder charged with a gas at high pressure can become a lethal missile with terrifying suddenness if mishandled. It not only generates enormous thrust but its flight path is as erratic as that of a pricked ballon. A recent accident report described the effects of a cylinder that discharged while being transported in a car. It smashed through the rear of the car, went through the windshield and ripped the steel top before it finally exited the vehicle. It then penetrated the side of a house, leaving a neat little hole in the process, and came to rest inside, against the building's foundation. The flight path was estimated to be greater than 1500 feet before the energy of the discharging gas was finally spent.

The report appeared so incredible that calculations were made to determine the potential thrust of an uncontrolled cylinder. The calculations showed that, for a fully charged cylinder weighing 150 pounds, a thrust of 1340 pounds could be developed at MACH I through the valve connection. This thrust if applied vertically would drive the cylinder 562 feet in the air. If applied at 45°, the cylinder, would travel 1162 feet. (See graph.)

It is apparent that protection of the cylinder valve is essential. This is the function of the valve-protection cap. Every cylinder, full or empty, should have its cap on at all times except when it is connected for actual use. The cap's use is to prevent the valve from being knocked off should the cylinder topple. The cylinders must always be handled and transported with extreme care. Manhandling is the greatest potential hazard because people drop things. The use of hand trucks with pneumatic tires is essential as a means of eliminating or reducing this danger.

You will find safety regulations for handling compressed gas cylinders and gases, including oxygen, in the U.S. Navy Diving Manual. Look them up, study them and apply them. And make sure you treat that green flask with the respect it deserves. It's got your life inside it.



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