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A plastic craft for underwater observations

The Ships Technology Department of the Gdańsk Technical University has developed an under water vehicle for the observation of fishing gear in operation, for the use of the Marine Fisheries Institute in Gdynia. The unit has the shape of a sphere its internal diameter being 1400 mm and external diameter — 1520 mm, made of polyester and glass laminate. It can be immersed to a depth of more than 500 m, but its normal operating depth is 200 m.

An experimental model, scale 1:1 was constructed in 1975 and tested in May 1976. Tests included immersion to more than 570 m and repeated immersion to 250 m. The cabin was not destroyed because of the limited depth of the sea area where tests were carried out.

Tested was also the strength of the cover installed on the prototype unit, by immersing it to a depth of 300 m, i.e. 1.5 times deeper than the maximum operating depth of 200 m. Test pressure of this value is required by all the classification societies which supervise the construction of underwater craft. After testing the cover was mounted in the bearing structure of the unit.

In the end of 1977 another prototype, called GRZES was tested to confirm that the unit operates properly both on the surface and under water. Also the correctness of the design assumptions was confirmed then.

Technical data

Crew complement — 2 (pilot and observer)
Immersion time (for the air regeneration media reason):
normal — 8 hours
full — 32 hours
Length o.a. — 4 m
Breadth — 2 m

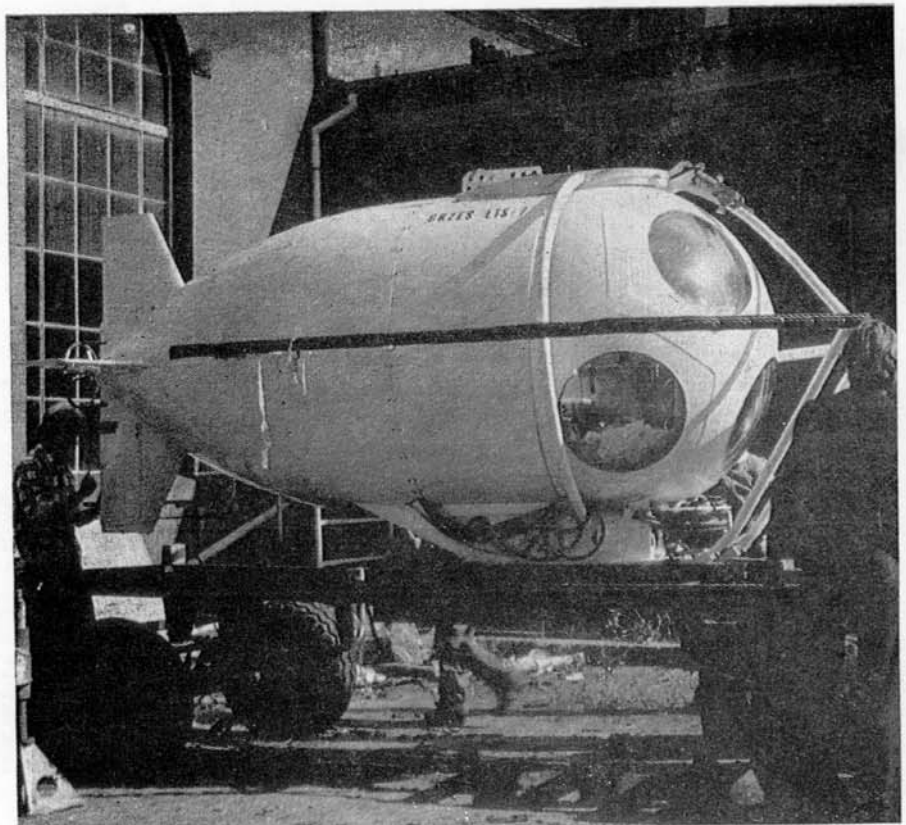


Fig. 1. LTS-7 GRZES underwater unit — general view

Height	— 2 m
Weight in the air	— 3 t
Displacement	— 3 m ³
Useful weight	— 150 kg
Speed under water	— towed — 5 knots — with the craft's own drive — 2.5 knots

Hull

Bearing frame. Steel structure, hot galvanised and painted designed to connect together all the unit's elements and

to make its base at the same time. The guard rail with tubes protecting the cabin against blows is connected to the frame.

Hull. Streamlined, made of polyester-and-glass laminate, designed to protect the deck installations and to improve the flow of water around the craft. The hull incorporates ballast tanks which constitute its integral part. The aft, self-supporting part of the hull has vertical and horizontal stabilisers, with teflon

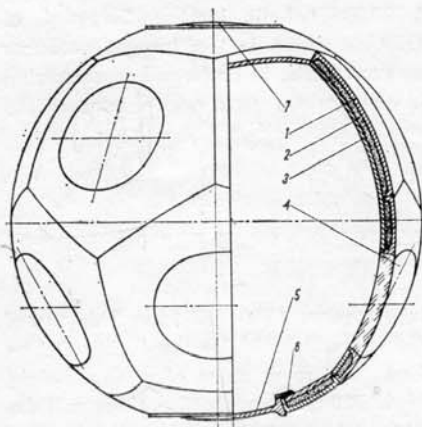


Fig. 2. Resistance cover construction: 1 — external cover, 2 — spacer of balsa wood, 3 — internal cover, 4 — porthole, 5 — bottom hatchway cover, 6 — mounting ring with rubber washer.

direction steering gear bearings laminated into the vertical stabiliser elements.

Displacement tanks. Since the unit is equipped with a great number of me-

chanical elements and a relatively big storage battery, all placed outside the crew cabin, it was necessary to introduce some balancing elements. These have the form of spherical tanks made of polymer-and-glass laminate by the contact method. The tank diameters are 425 and 320 mm.

Crew cabin. Thanks to the application of a spacer element in the cover design, a cabin of a small weight but excellent thermal insulation could be obtained. The cabin is made up of twelve pentagonal elements which facilitates prefabrication and construction of the spacer structure. Fig. 2 shows diagrammatically the cross-section of the cover.

Openings for hatchways and portholes (illuminators) have been obtained by appropriately shaping the external surface. All the opening diameters are 520 mm. The portholes are made of metal-plex plates (glued together), of a total thickness of 65 mm. After having been formed by the underpressure method, they were glued into the earlier prepared openings. In the present version the

cabin has five portholes. The laminate elements of the resistance cover are painted with epoxide and polyurethane dyes.

In the cabin top and bottom there are holes with steel covers. The top hole is the hatchway to the cabin — its minimum diameter is 460 mm. Through the bottom hole all the conduits to be led to the cabin (electric, air, oxygen and hydraulic) are passed. It also serves to secure the cabin to the bearing frame. The emergency hydraulic installation serves to release the tow rope and the permanent ballast and container with the storage battery, in case of emergency. The installation is supplied by means of a hand pump, and the working pressure is 15.0 MN/m². Hydraulic servos play the role of the executive elements.

The control gear hydraulic) consists of three separate hydraulic systems with gear pumps, driven by an electric motor which is common for the steering gear and the trimming installation, as well as the variable ballast installation.

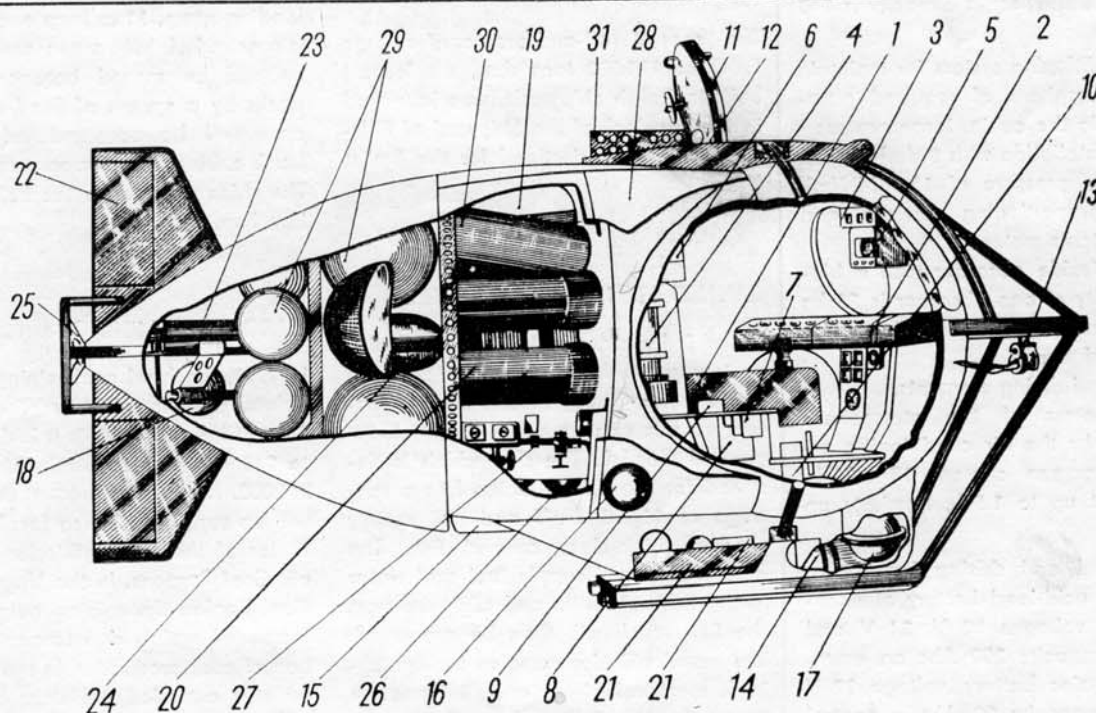


Fig. 3. Arrangement of elements and devices: 1 — steering board, 2 — control board, 3 — set of compasses and rudder inclination indicators, 4 — CO₂ absorber, 5 — echosounder, 6 — set of equipment for radio and underwater communication, 7 — communication equipment power sources, 8 — silver-and-zinc emergency battery, 9 — control valves for the towrope and emergency ballast release installation, 10 — hand-operated hydraulic pump, 11 — seal ring (circular cross-section), 12 — hatch cover, 13 — reflector, 14 — permanent ballast, 15 — main storage battery container, 16 — hydraulic generator, 17 — fore trim tank, 18 — aft trim tank, 19 — rigid tank for variable ballast, 20 — flexible tanks for variable ballast, 21 — depth rudder foil, 22 — direction rudder foil, 23 — steering gear, 24 — drive motor, 25 — propeller, 26 — cylinders with compressed air, 27 — oxygen and compressed air distribution board, 28 — water ballast tank, 29 — additional buoyancy tank, 30 — container with electrical equipment, 31 — skackle unit.

The steering gear is used to drive the rudders and the direction and depth finders. The foils are controlled through electronic control systems which incorporate foil deflection indicators. Steering is effected by means of the steering rod. Pressure in the installation is 1.2 MN/m².

The trimming installation is designed for longitudinal balancing of the unit and for changing the trim angles within $\pm 10^\circ$. Changes in the centre of gravity are effected by pushing mercury between the bow and aft trim tanks. The weight of mercury in the installation is about 50 kg, maximum pressure 0.5 MN/m².

The variable ballast installation serves for determining accurately the buoyancy of the unit. Buoyancy can be adjusted within ± 30 kg. Maximum pressure in the installation is 2.0 MN/m².

The water ballast installation includes the ballast tanks with the control valves and a compressed air installation. The air, at a pressure of 15.0 MN/m², is stored in six 8 dm³ cylinders. It serves for blowing through the ballast tanks during emergence. The air is supplied to the tanks at a reduced pressure of 0.5 MN/m². Ballast tanks capacity is 140 dm³.

The air-conditioning system for maintaining an atmosphere of required parameters inside the cabin, incorporates:

- oxygen installation with 8 dm³ oxygen reserve at a pressure of 15.0 MN/m², including proportioning devices and oxygen contents meter;
- carbon dioxide absorber with a blower. Capacity of one absorber is 20 kg of the absorbing stuff – sufficient for four hours of work;
- cooling and drying elements.

The parameters of the atmosphere maintained by the air conditioning system are: oxygen content 18...20%, CO₂ content up to 1.5%, humidity up to 90%.

The electrical and driving installation includes an acid-lead battery of accumulators of voltages 12 V, 24 V and 36 V and capacity 300 Ah; an emergency silver-zinc battery, voltage 12 V and 24 V, capacity 20 Ah; a control board in the crew cabin; a container with equipment for controlling the drive motor; a container with the motor including a planetary gear, the propeller shaft and the propeller (motor rating 1.5 kW); and the hydraulic pumps drive motor (rated 1.5 kW).