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ANALYSIS OF THE BATYCHRON RESEARCH PROJECT

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Abstract: The article presents the research project called 'Batychron'. Batychron is a flexible underwater bell patented by the Gdynia Maritime University as a 'device applicable in hydraulic engineering for underwater transport and diving with the safety of human life' (patent number: PL192265 B1, Int. Cl B63C 7/12; B63C 11/44). Users of this device claim that the Batychron is the most revolutionary invention in the field of human activity underwater. Thanks to its advantages and low price, the Batychron may well become a device as common as the parachute in aviation in the future. The first prototype of the device was made in 2002. In 2021, after almost 20 years of using the Batychron in a marine environment, the Student Special Interest Group of Underwater Research "Sea Quest" operating at the Gdynia Maritime University decided to make a modified (improved) model of the device from modern materials (more durable) and prepare it for real sea trials. The main purpose of the article is to present the Batychron project construction and its application.

Keywords: Batychron, flexible diving bell, operational problems, technical effectiveness, hydraulic engineering, underwater transport.

1. INTRODUCTION

The research project called 'Batychron' [Rutkowski and Korta 2002; Raport 2005; Opis patentowy 2006; Raport 2021; Wniosek RWK/II 2021] was created as part of the scientific activity conducted by the Student Special Interest Group of Underwater Research "Sea Quest" operating at the Gdynia Maritime University, Faculty of Navigation and Department of Navigation. The Batychron, invented by G. Rutkowski & H. Korta (2003/2006) [Raport 2005; Opis patentowy 2006], is a flexible underwater bell patented by the Gdynia Maritime University as a 'device applicable in hydraulic engineering for underwater transport and diving with the

safety of human life' (patent number: PL192265 B1, Int. Cl B63C 7/12; B63C 11/44) [Opis patentowy 2006].

Currently, we observe many innovative projects related to man's widely known underwater activity [*Encyklopedia techniki wojskowej* 1987; Macke, Kuszewski and Zieleniec 2007; Mazurkiewicz 2009; Soliwoda, Kaizer and Neumann 2021; *Encyklopedia PWN* 2022]. In each such project, particular attention should always be paid to safety aspects while maintaining human health and life [Przylipiak and Torbus 1981; Ashcroft 2000; Macke, Kuszewski and Zieleniec 2007; Przepisy 2021]). Users of such devices claim that the Batychron [Rutkowski and Korta 2002; Raport 2005; Raport 2021; Wniosek RWK/II 2021] is the most revolutionary invention in the field of human activity underwater. Thanks to its advantages and low price, the Batychron may well become a device as common as the parachute in aviation in the future.

The article presents the purpose of building such a device, and also presents the issues related to its construction [Raport 2005]. The procedure for mounting the device to the seabed is also explained. The article shows the original photos that were taken by the inventors of the Batychron.

Fig. 1. From the left: Installation of the Batychron during sea trials at a depth of 20 m, the Batychron device stored in a cupboard with diving equipment and transported on a RIB to the test site. The last photo on the right shows a diver in the Batychron during sea trials at a depth of approx. 20 m

Source: Private materials from the collection of G. Rutkowski (2002–2021) [Raport 2005; Wniosek RWK/II 2021].

2. SUBJECT OF THE STUDY

The main initiators and creators of the project were Henryk Korta and Grzegorz Rutkowski [Rutkowski and Korta 2002; Opis patentowy 2006], members of Sea Quest operating at Gdynia Maritime University. A patent has been filed for the Batychron at the Patent Office of the Republic of Poland under number P-352083

as an invention (technical device) used in hydraulic engineering for underwater transport and diving while maintaining the safety of human life.

The application in the Polish Patent Office was made on February 7, 2002 by the Patent Attorney of the Maritime University in Gdynia [Opis patentowy 2006]. The invention was assigned 50% to the Gdynia Maritime University and 50% to Henryk Korta. On January 22, 2003, Gdynia Maritime University bought the patent rights from Henryk Korta, becoming the only owner of the patent. The (inventive) copyrights relate to the device named Batychron according to the claims of UP RP P-352083 and the logo (trademark Batychron) according to the claims filed in the Polish Patent Office under number Z-246116.

The first prototype of the device was made in 2002 of TS501_50 steel belts and PVC foil, which after almost twenty years of use in a marine environment showed high stiffness (especially at low water temperatures) and a relatively low safety factor against breaking and/or stretching of the Batychron's structural elements.

For this purpose, as part of the pre-implementation work of the Innovation Incubator 4.0 (case number RWK / II 4.0 / 7/01/2021) [Rutkowski and Korta 2002], a research team from the Sea Quest operating at the Gdynia Maritime University in the Navigational Department decided to make a modified (improved) model of the device from modern materials (more durable), in particular, made of PTU (Thermoplastic polyurethane) foil and TE 324 Polyester belts, and to prepare it for real sea trials [Wniosek RWK/II 2021]. The main purpose of the article is to present the new Batychron project construction and its application [Raport 2021; Wniosek RWK/II 2021; Wniosek 2021].

A new research project for 2021–2022 called 'Equipment of the Mobile Base of the Marine Emergency Diving Service (MoB MEDS)' [Wniosek RWK/II 2021] was launched in order to create a new Mobile Electromagnetic Mooring System (MEMS) and the new technical structure of the Batychron (see Fig. 2) as a new model of a flexible diving bell, which can also be adopted as a movable underwater diving base.

The new model of the Batychron [Wniosek RWK/II 2021] is also characterised in particular by:

- a lightweight, small, portable device was made that could be used, like a diving bell, to secure underwater works while maintaining the safety of human life;
- a universal device was created with a wide range of applications (underwater transport, securing underwater works and deep-water dives), in both open and internal waters;
- a generally accessible device (cheap, portable) was created and, if possible, can be operated by the smallest number of people (without the need for the assistance of specialised ships equipped with appropriate cranes).

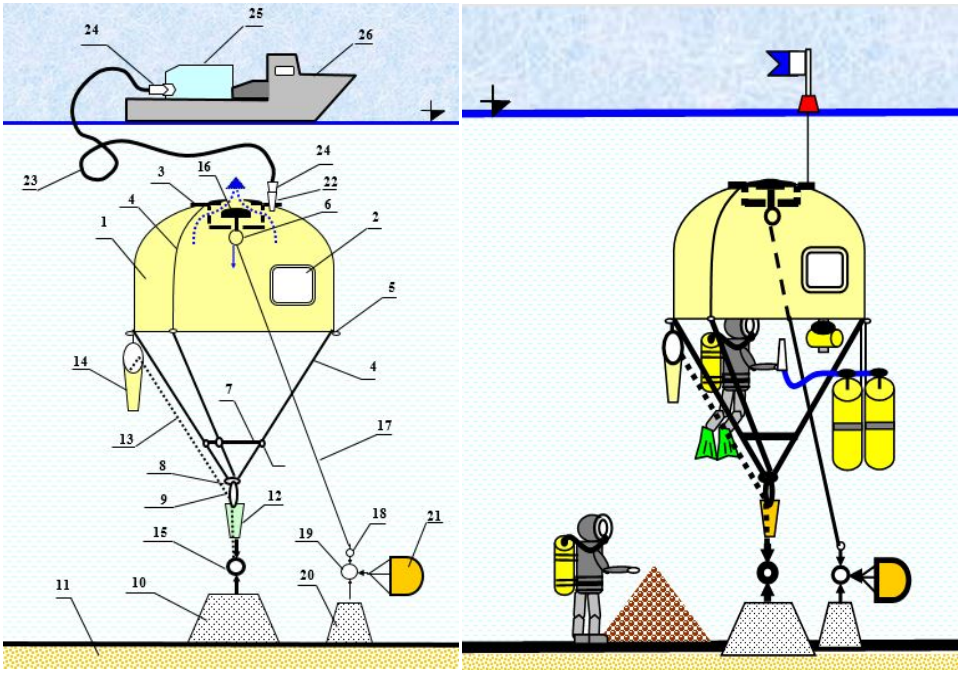

Fig. 2. From the left: construction of the Batychron and the Batychron adapted as an underwater diving base, where: 1. dome, 2. porthole, 3. plate, 4. cable, 5. loop, 6. handle/grip, 7. diving platform, 8. central handle/grip, 9. connector/link, 10. load (sea anchor), 11. seabed, 12. brake, 13. line, 14. sack/bag, 15. connector/link, 16. pressure relief valve, 17. line, 18. loop, 19. connector/link, 20. load (bottom anchor), 21. drogue, 22. pneumatic joint, 23. flexible air hose, 24. pneumatic joint, 25. breathing air supply compressor or optional air cylinder battery (breathing mix), 26. surface vessel

Source: G. Rutkowski own research (2002–2021) [Raport 2005; Opis patentowy 2006; Wniosek RWK/II 2021].

3. ASSESSMENT OF BATYCHRON IN TERMS OF VARIOUS APPLICATION POSSIBILITIES

The Batychron (see Fig. 2) is built of a parachute-shaped (balloon) dome with portholes, made of flexible, gas- and watertight rubberised materials rigged with rock climbing gear. Once anchored to a stable point on the seabed (which could be a wreck, ledge, rock, or special type of anchor), the Batychron is filled with air (breathable gas) and, like a diving bell, maintains this gas cushion under its canopy for a long period of time underwater.

Due to its above-mentioned properties, the Batychron can be used for:

- decompression during deep-water dives and as a means of transport for collecting and retrieving objects submerged underwater;

- the Batychron, in particular, can also be used as a flexible, portable diving bell and a portable (mobile) underwater diving base for securing deep-sea diving and performing underwater works in submerged areas and objects (such as wrecks, coral reefs, flooded cities, archaeological sites, mines, quarries, etc.).

The Batychron also allows you to:

- increase your diving time by four to five times;
- talk underwater;
- reduce costs of underwater works (less expensive equipment and fewer people to perform the task);
- increase the attractiveness of diving.

It is very difficult to mention any other practical application of the Batychron apart from using it as a piece of basic diving gear, because the device could not previously be implemented due to Poland's accession to the European Union, which necessitates too many formal requirements and tests.

4. CONSTRUCTION OF THE BATYCHRON

Underneath the surface of the water, the Batychron has a dome and a plate that completes the dome. Cables spread out from the dome, passing through the loops that ring the edges of the dome. These cables of length not less than 130 cm pass through loops that ring a diving platform mounted under the dome and continue on to the main central handle and connect with fasteners either to the anchoring spots in the seabed or to the brake handle mounted on the cable.

A reserve line is stored in a sack at the edge of the dome. End of the lines finished with a knot is rigged by the connector with the anchor. There is a drain valve in the plate whose moving part is attached to the covered line finished with a loop and fastened with a drogue and/or steady load on the sea bed. The pneumatic connector of the hose mounted on the diving platform has a two-sided pneumatic joint at one end and the other end of that pipe is connected to the power supply of a breathing air apparatus on a boat on the surface of the water.

The upper part of the dome is divided into three, four, five, six or even eight spherical pieces. The advantage of the Batychron is its itility in the open sea as well as in internal waters. The Batychron is a light and mobile piece of equipment that can be set up and operated by a single person and is used to help with underwater work and moving sunken/submerged objects.

5. SURFACE VESSELS

Any surface vessel that is able to carry breathing apparatus and a minimum of one person who is capable of operating at the surface and controlling the diving operations is all that is needed to manage the Batychron.

Communication between the Batychron's crew (divers) and the person on the surface is carried out by the speakers mounted on the diving platform that completes the dome. The speakers are not standard equipment of the Batychron.

Mounting the Batychron kit on the bottom of the seabed can be carried out by one trained person given its light weight (from a few to several kilograms) and small dimensions (the Batychron kit is the shape of a closed umbrella during transport).

The surface vessel whose purpose is to manage the Batychron kit, unlike with traditional equipment such as a diving bell, does not require any additional equipment, e.g. winches, cranes, lifts used for lowering, lifting or other additional activities related to the underwater work. All sorts of vessels can be used to manage the Batychron beginning with rowing boats and ending with bigger dynamic positioning vessels. In this way, the invention can be used on the open sea and in internal waters such as rivers and lakes.

Possessing such a vessel is not a necessary condition that determines proper performance of the Batychron. The same results can be achieved by using the Batychron equipment powered by a shore base installation (e.g. during underwater harbour work) or by converting it into an independent/autonomous underwater station (e.g. using wrecks) (see Figs. 1 and 2).

It must be kept in mind that it is important to obtain proper mooring equipment when using the Batychron with any type of vessel on the open waters or internal waters on which swell, waves or drifting is occurring. The equipment must provide a steady and fixed position within a defined safe area around the Batychron without allowing the power supply to be cut-off from the dome during every dive. This area is defined by a circle whose centre is at the point where the Batychron kit was dropped to the seabed or mooring spot. Taking into account additional space in case of an unforeseen emergency is important. This defined area forbidden for the surface vessel must be plotted in such a way that in any scenario, the divers are protected from any influence of the vessel that is above them.

When bad weather conditions or any other emergency situation require using engines, propeller, thrusters, dragging, heaving or releasing the anchor, this must not in any way interfere with divers. When using the Batychron at significant depths (in recreational and sports diving up to a maximum of 40 m), in open water, in protected areas, or where the seabed, external factors, or the type of work makes it impossible or very risky to anchor or moor the surface vessel, it is advised to use larger surface ships equipped with Dynamic Positioning (DP). The dynamic positioning must enable the surface ship to maintain its position and/or course overhead in all conditions during the dives.

When the depths are below 40 m and the external factors prevent or make it very risky for the surface vessel to anchor or moor, it is advised to use smaller surface vessels with low total drift from wind and current. They can be moored to the anchoring system of the Batychron or another underwater object in the vicinity.

6. SUMMARY

The Batychron is a new generation of diving equipment that allows divers to stay longer underneath the water [Rutkowski and Korta 2002; Raport 2005; Opis patentowy 2006; Wniosek RWK/II 2021]. The advantages of the device, such as its low weight, mobility, lower cost compered to modern diving bells, ease of use, and low number of people required to manage the device, make it a versatile piece of equipment. The applicability of the Batychron kit in underwater projects in any type situation from harbour underwater work to moving submerged objects make it a useful and more cost-effective device than its competition. This invention has the potential to revolutionise diving, making it more spectacular and more accessible to the public [Wniosek RWK/II 2021].

In 2022, the members of Student Special Interest Group of Underwater Research "Sea Quest" operating at Gdynia Maritime University would like to continue their research at the Batychron installation. For this purpose, they applied to the Ministry of Science and Higher Education for funding for a new project called MUDS Base – the Mobile Underwater Diving Support Base [Wniosek 2021]. This project was submitted as part of a scientific competition organised by the Ministry of Science and Higher Education in October 2021 as a new initiative: 'Student Circles Create Innovations'.

Members of Sea Quest hope that their new project will gain financial support in this initiative, which will enable them to continue their research work on their new MUDS Base mobile diving base project using the new Batychron model. As a result of the planned research work in 2022, we would like to create a mobile MUDS Base device, which will be widely used in hydrotechnics for underwater transport and securing exploratory and tourist dives while maintaining the safety of human life.

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