

ICEBREAKER UNIT

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Abstract: This article views issue of liquidation of ice jams on the rivers. The article gives new method of destroying jams that is referred to ice technology based on the use of powder explosion energy carried out by means of engineering structures. Ice-crushing unit is designed for liquidation of jams through creation of stronger dynamic effect under ice cover and has a stronger bearing frame and ice-crushing tool.

Key words: Ice jams • Syr Darya • Spherical shell • Control cable • Operating principle

INTRODUCTION

Ice jams- aggregations of ice in the riverbed are often on the rivers flowing from the south to the north in the process of spring ice drift. Ice jams cause reduction of river cross-section and lead to increase in water level at the places of origin and are sometimes higher and may result in floods. The most negative consequences of water jams are floods, damage to waterworks and river crafts.

On the Syr Darya in South-Kazakhstani region jams may cause potential floods to more than 18 thousand km², including 24 settlements with population over 76 thousand people, 3 production objects, more than 20 km of motor roads of republican status, 80 km of power lines, dozens of bridges and in Kzyl-Orda region potential floods may damage over 1 thousand km² including 75 thousand hectares of agricultural lands, 25 km of motor roads, 15 settlements with population over 100 thousand people, dozens of bridges, over 800 km of power lines and communication lines. Syr-Darya River flows from the south to the north; main area of drain formation is strongly regulated. In the lower course of riverbed with plain ground and long-term water withdrawal for irrigation upon permanent bordering with dams turned out to be higher than local environment. Based on general characteristics most possible reasons of floods can be: ice jams formation in narrowing of bed and it curves as well as at bridge passages upon

increased water passes from Shy Darya basin in winter upon its overflow, connected with uncoordinated actions of hydro economic services of Kyrgyz Republic and the Republic of Kazakhstan for regulation of river flow in the upper course in high-water years. Rupture of dams occurs on the same conditions. Quick and severe freeze in South Kazakhstan, active ice formation and occurrence of jams upon increased water drain from Syr-Darya basin in cold period.

Research: The problem of spring ice jamming is currently actual for the rivers in the Republic of Kazakhstan.

Struggle against river jams is carried out through the following methods:

- Forecasting of jam place in advance and its strength;
- Preventive measures on management of formation and drain process of ice material (for instance, arrangement of jam in non-dangerous for national economy place);
- Struggle with already formed jam [1].

The proposed arrangement for liquidation of jams is directed to solving issues of more effective struggle with river jams.

For the purpose of liquidation of ice jams explosion method is currently applied when explosive is blown either under ice or inside the jam. Disadvantage of such method is high-energy expenses, requirement for human

safety, environmental effects. This article views new way of ice jams destruction that refers to ice-technology based on use of powder explosion energy that is carried out by means of engineering structures [2-4].

Unit refers to ice technology and relates to technology of jam liquidation through arrangement of dynamic action under ice cover, consists of strong bearing frame and ice crushing tool supplied with floatage and displacement system.

It is achieved by strong spherical bearing frame of and ice crushing tool that facilitates ice destruction.

Unit consists of bearing frame 1, spherical shell 2 welded to the bearing frame, shaft inside the bearing frame, located inside the spherical shell with attached joint 4, cover 5 is welded to spherical shell, ice crushing tool is attached to shaft 3, engines 7 are attached to bearing frame, control block is installed in the shell, PU closing plug and spark gap 10 are located on the bottom of ice

crushing tool, power 11 is inside ice crushing tool, air is supplied to spherical shell through air pipe 12, unit is controlled through control cable and power supply 12 and video camera 14.

Operating principle. Powder is put into one third of ice crushing tool (tool is reusable), ice crushing tool is isolated and inserted into closing plug, that is in turn isolated and inserted into ice crushing unit (tool is loaded). Ice crushing tool is lowered into shaft. Unit is lowered to water, afterwards valve is opened and upcoming water squeezes air out of the shell and unit merges. By operating engines with handle we achieve the required point of jamming and open valve completely, shell is filled with water and unit merges completely. Through power supply flashover is sent for inflammation of powder inside ice-crushing unit that is followed by shoot. Than compressor is turned on, air is supplied to shell and squeezes water out, the unit emerges and afterwards process is repeated.

Icebreaker Unit:

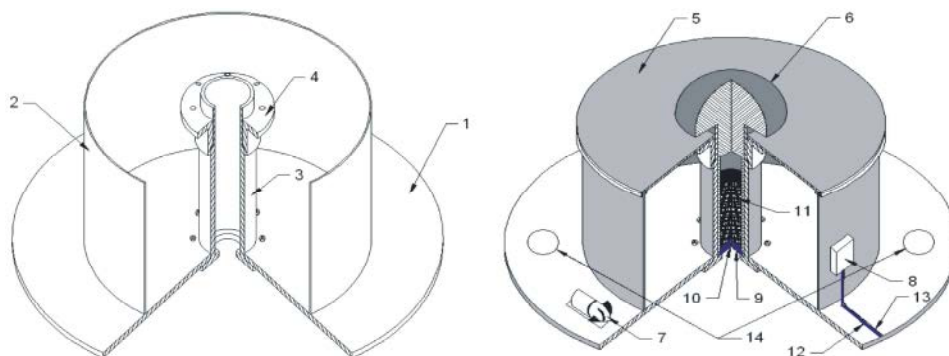


Fig. 1: Unit layout: 1 – bearing frame, 2 – spherical shell, 3 – shaft, 4 – joint, 5 – cover, 6 – ice crushing tool, 7 – engines, 8 – control block, 9 – PU closing plug, 10 – spark gap, 11 – powder, 12 – air pipeline, 13 – control cable and power cable, 14 – video cameras.

Some Parts of the Icebreaker Unit:

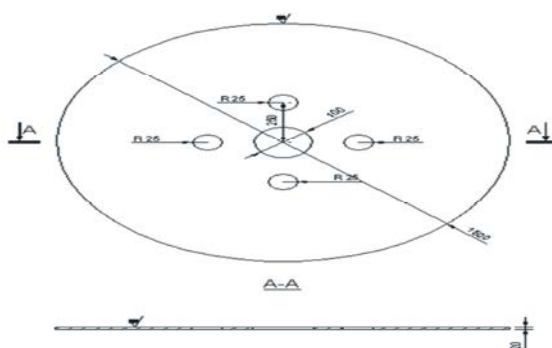


Fig 2: Bearing frame

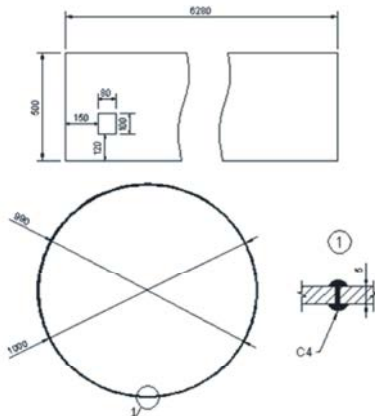


Fig. 3: Spherical shell

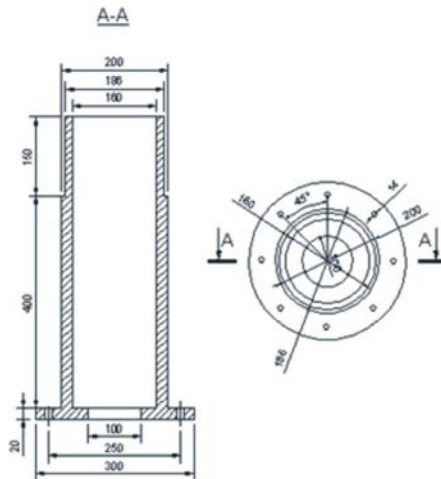


Fig. 4: Shaft

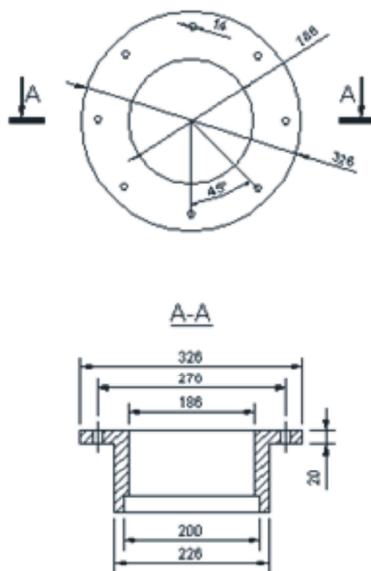


Fig. 5: Joint

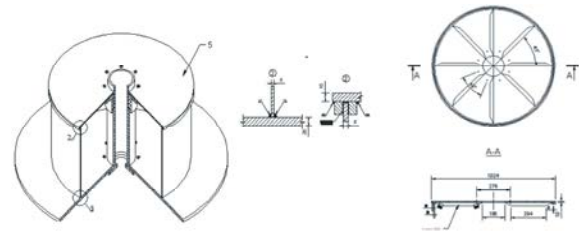


Fig. 6: Cover

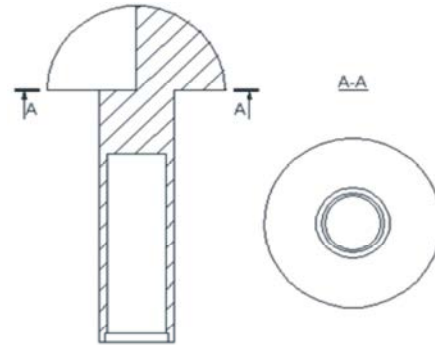


Fig. 7: Ice crushing tool

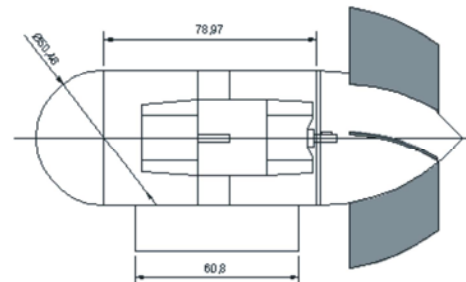


Fig. 8: Engines (direct current motor 4Pf1 12Sb04, weight 4.5 kg)

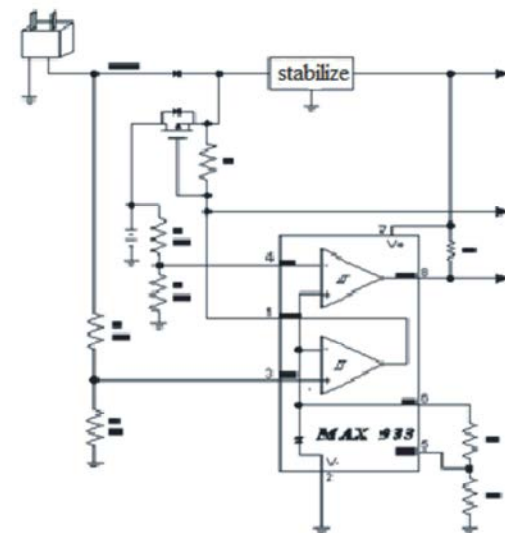


Fig. 9: Control block

CONCLUSION

Ice crushing unit is designed for liquidation of jams through arrangement under ice cover higher dynamic effect, contains bearing frame and ice crushing tool, equipped with floatage and displacement system. Ice crushing unit contains spherical bearing frame and ice crushing tool with attached system of air pipeline and power supply, providing power and air to ice crushing unit, spark gap is installed inside the bearing frame for supply of flashover under the said scheme for inflammation of powder inside the ice crushing tool [1].

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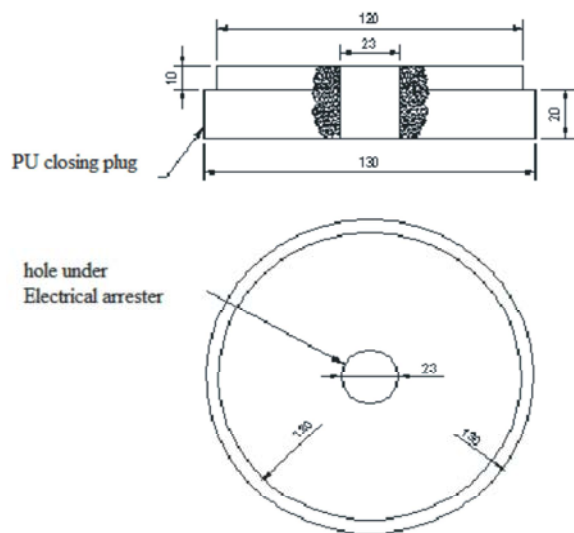


Fig. 10: PU closing plug

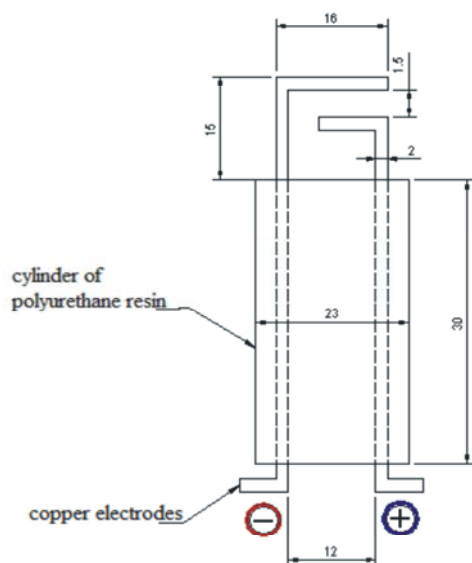


Fig. 11: Spark gap