EVOLUTION OF HYDRODYNAMIC CAVITATOR

ЭВОЛЮЦИЯ ГИДРОДИНАМИЧЕСКОГО КАВИТАТОРА

Ph.D, Ivanov E., Russia, Nizhniy Novgorod, Nizhny Novgorod State Agricultural Academy, Associate professor,
email: ivanov.e.g@mail.ru

Abstract: *The original design of a cavitator is a volute (snail) with a tangential inlet connected to the pump and an axial outlet which is attached to the body in the form of a cylindrical tube, which ends with a braking device and a central hole connected to inlet of the pump. Proposal: 1) to equip cavitator with axial gas extractors in the volute (snail) and at the output from the body, 2) exclude the snail (volute) from the construction and control the interaction of flows by dividing stream leaving the pump into two parts and then merge them in the camera in front of body, 3) organize an axial jet in body with the required structure by using ring nozzles, 4) reduce a vortex component of the current by installing a second straightening snail (scroll) before the body, 5) design the pump as an active generator of elastic vibrations of useful frequencies while maintaining its primary function; - separate it with antivibration bushing.*

Keywords: *PUMP, CAVITATOR, ACOUSTICS, WAVE, CAVITY, COLLAPSE, ENERGY, COMPACTION, EVOLUTION*

1. Introduction

Acoustic-gravitational technologies are based on sound field irradiation of liquid media. When passing through each point of liquid of the sound wave vacuum phase a liquid is broken with formation of vapor cavitation cavities. At the subsequent passing of semiperiod of manometric pressure each of these cavities collapses. Collapse is accompanied by walls opposite movement with a speed of 1500 m/s and at the point of collapse energy is concentrated both in space and in time. The energy density at the point of collapse reaches the values comparable with the level of energy density in the thermonuclear reactions with the local temperature rise of up to 6 - 10 000 degrees (fig. 1).

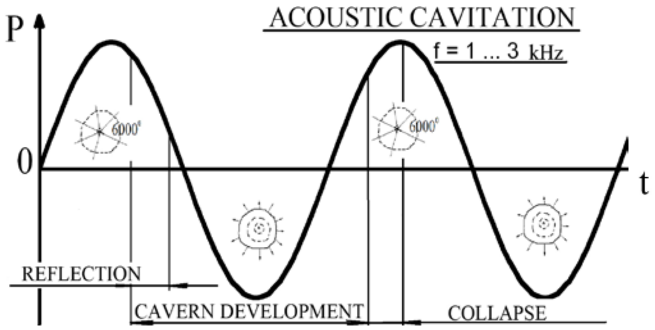

***fig. 1.** Acoustic cavitation*

Furthermore, the secondary elastic waves, their interference from different sources, the processes at the interface of the liquid - vapor inside cavities as well as at the boundaries of solid bodies - all this leads to more deformation of liquid and inclusions in it, mixing at molecular (nano-) level, thermal, ionizing, impulse and other forms of impact at 1 000 - 3000 times per second around treated space.

It was found that in passing to a deeper level of impacts even ordinary substances are beginning to show unusual effects and properties. For example, water which is the most common liquid in the world and present in every living organism (particularly in the gray matter of the brain), acquire special properties after acoustic-cavitation processing: interacts in another way with plant seeds during their germination (fig. 2), stimulates the growth of plants under irrigation to a greater extent than untreated water; has a prolonged effect after watering; when processing it generates more heat than has been expended on the process of acoustic cavitation (fig. 3).

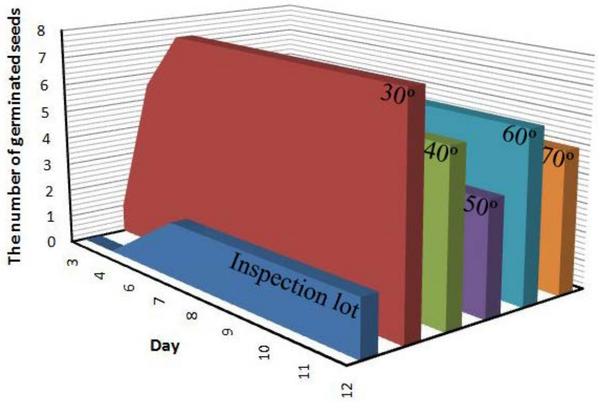

***fig. 2.** Germination of the seeds*

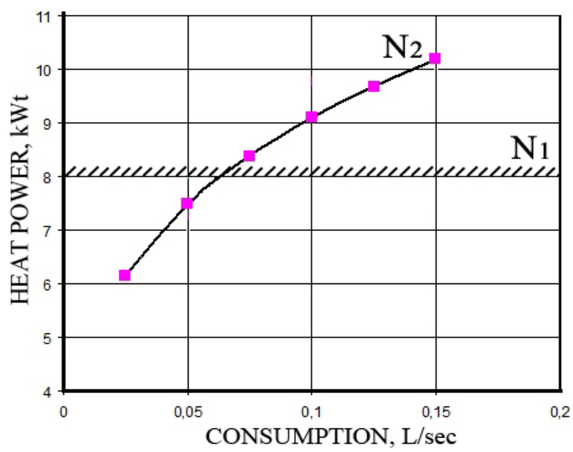

***fig. 3.** Thermal efficiency of the cavitator*

2. Preconditions and means for resolving the problem

Such means of influence on liquid medium can significantly intensify the existing technological processes and implement previously impossible ones. The following range of functions tested by the author can be offered in agriculture:

- **grinding organic material such as**:
- - turf in order to isolate gummats and create fertilizers;
- - bones of farm animals;
- - grain to produce artificial milk for weaned cubs;
- - when germinating and grinding grain for food purposes;
- **treatment of petroleum products;**
- **disinfection:**
- - in water supply;
- - when washing the milk lines without chemicals;
- - when disposing waste, manure and sewer drains;

- thickening and coagulation:
- - dough in the bakery industry;
- - sapropel when removing it from the bottom of reservoirs;

- high efficiency water heating:
- - in heating;
- - when watering livestock;

- processing of milk:
- - for the purpose of pasteurization;
- - homogenisation;
- - to obtain new dairy products;

- **treatment of seeds,** which will:
- - improve and speed up germination;
- - manage the growth rates of various phases of development;
- - manage the process and timing of planting;
- - regionalize southern crops;
- - process hard viable seeds;
- - process seeds for winter sowing, and etc.

For the implementation of acoustic cavitation treatment of liquids can be used:

- piezoelectric and magnetostrictive emitters (but their use is limited by the power capabilities of crystals (up to 1 kW);
- hydrodynamic jet devices (have too broad frequency range);
- liquid whistles;
- liquid siren.

All hydrodynamic devices may be of any type of power, but their common disadvantage is that they provide a low proportion of transition of the input mechanical power into sound one (maximum - six per cent).

The original design of a hydrodynamic cavitator is a helix (snail) with a tangential inlet and an axial body in the form of a cylindrical tube connected to the inlet of the pump (fig. 4).

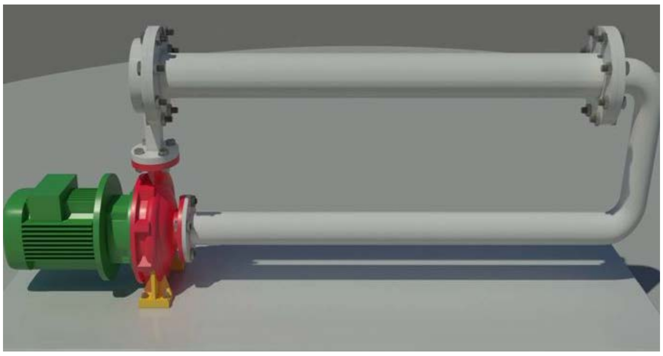

***fig. 4.** Hydrodynamic cavitator*

When working in the water elastic waves are radiated in the volute (spiral) due to the interaction of the input stream with its circumferential portion – that is, an emitter (fig. 5).

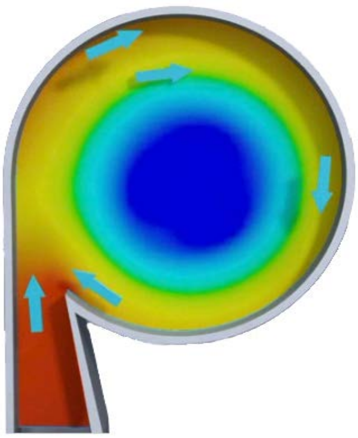

***fig. 5.** Emitter of the cavitator*

The advantage of this design is the presence of the body, it is possible to create in it a standing acoustic wave under the condition of equality of its length to integral number of wave half-lengths of the calculated frequency (fig. 6).

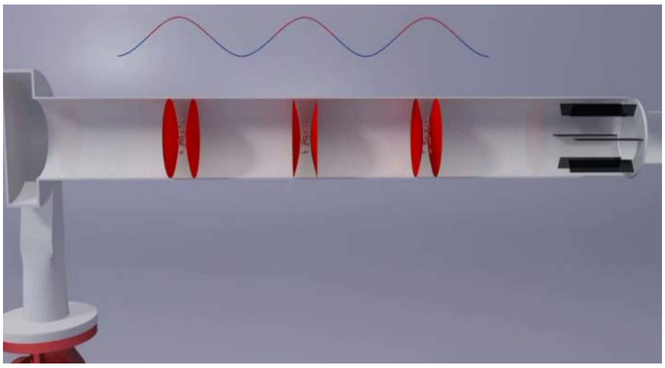

***fig. 6.** Body of the cavitator with a standing wave*

Standing wave involves lengthening of the acoustic signal, produced in the volute, in amplitude. Moreover, its presence allows various processes.

3. The problem solution

In order to fully realize these advantages, it is necessary, first, to isolate the body from the rest of metal structures by elastic cuffs [1].

This will prevent dissipation of energy of useful acoustic signal in the adjacent elements of the device and protect it from the pump and drive noises. Secondly, the body of cavitator should be made of ringing, "bell" materials which provide a slow lowering of signal, and thus more efficient use of the input acoustic energy. Thirdly, it is proposed to make the return pipe between the output of the body and the pump inlet in the form of several sequential enclosures that provides multiple water treatment during one cycle of the circulation flow (fig. 7).

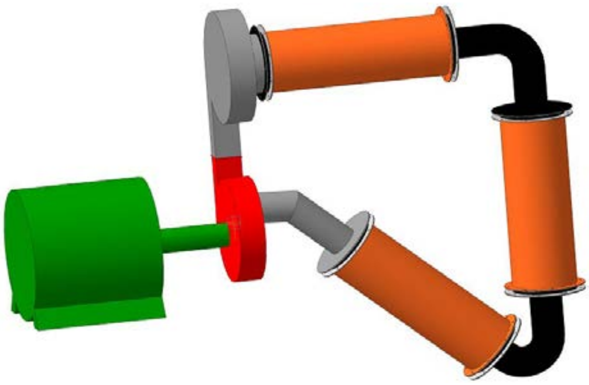

***fig. 7.** Multihull option of a hydrodynamic cavitator*

Along with these measures the efficiency of hydrodynamic cavitators can be improved by:

- reduction of hydraulic losses in the working environment in the body..

Elimination of the vortex component of the flow in the body (up to 50% of total energy consumption) increased the efficiency of water heating by 45%. One way to implement this action - straightening the flow after the helix by means of the second additional counter helix to which tangential output body is attached [2] (fig. 8).

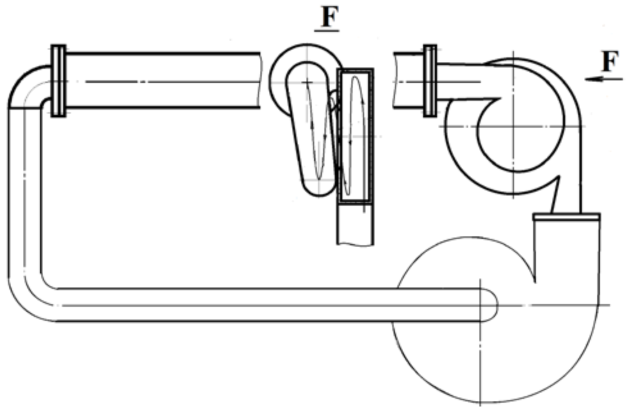

fig. 8. *The construction of the vortex cavitator with straightening of the flow at the output of the snail*

Another way is an axial entry of the transit flow into the body through the end of the snail by means of the multi-ring nozzle [3] (fig. 9).

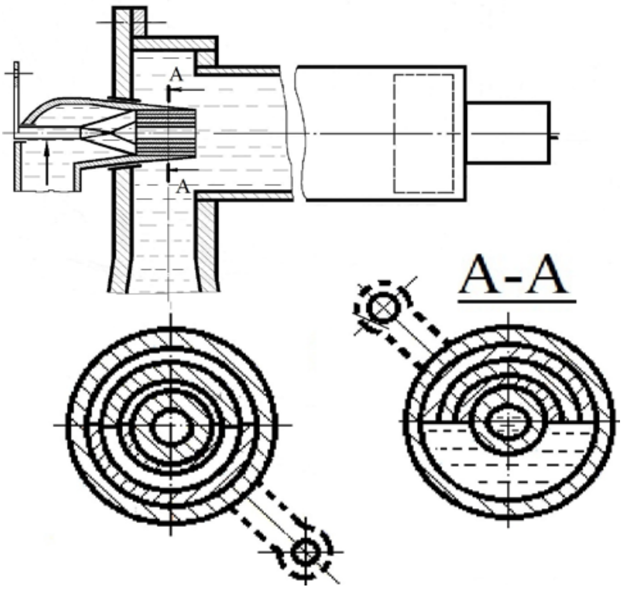

fig. 9. *Axial input of the transit flow through the multislit nozzle*

The proposed design of the nozzle allows to create a specific structure of the axial flow and to eliminate the vortex component of the main circulation flow and the return axial flow Rossby, and to counteract the effects of the gas component, which is released from the dissolved working fluid [4] (fig. 10).

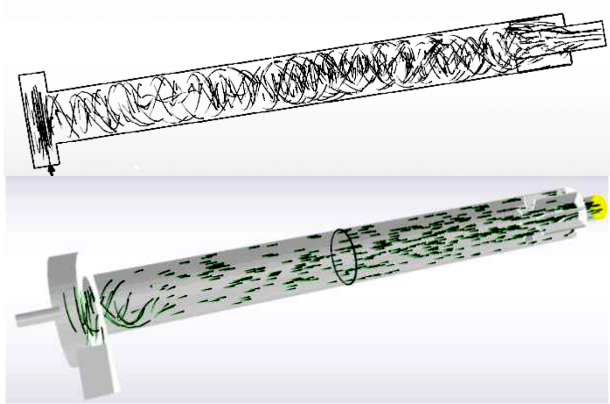

fig. 10. *Changing the structure of the vortex flow in the body at the axial input of the transit*

- air, released due to cavitational destruction of crystal hydrates, must be removed from the working process after working fluid passing antinodes of the standing wave. To perform this function, we offer a collector near the axis of the body outlet, through which you can collect other light fractions [5] (fig. 11).

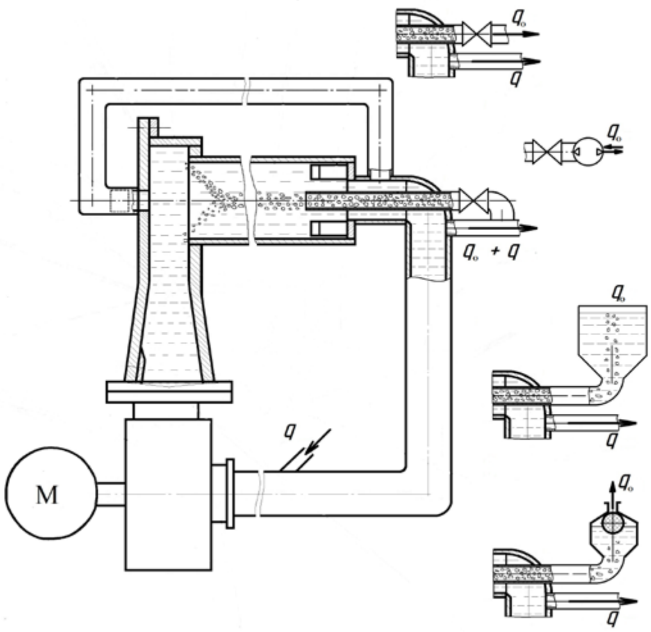

fig. 11. *Collecting the evolved gas at the outlet of the body of the cavitator*

Removal of the gas component out the workflow also increases the degree of water heating to 45-50%.

If the air can not be completely removed, we propose to change the diameter, wall thickness and elastic properties along the length of the body [6].

- reduction of hydraulic losses in the volute (30-35%) can also be achieved by eliminating the vortex component by passing to the other options for the establishment of an acoustic signal:

- - simple interaction of submerged jets in a confined space [7] (fig. 12);

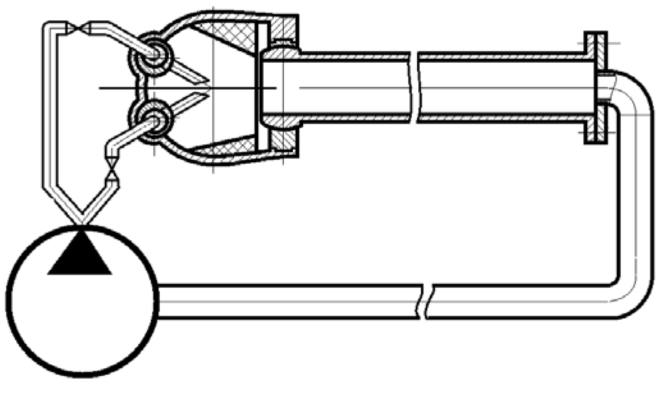

fig. 12. *Irrotational hydrodynamic cavitator*

- - use the dome volume periodically renewed and destroyed. Eliminating hydraulic losses of the vortex motion of the fluid in the volute is realized in the growth of the amplitude of the generated acoustic signals. This increases the size of the vacuum cavities, consequently, the energy level at the point of collapse [3] (fig. 13.).

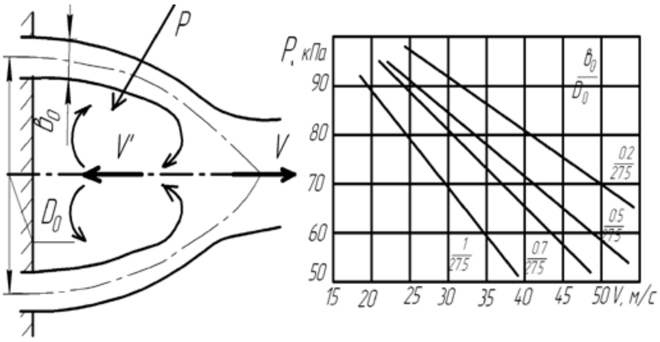

fig. 13. *Creating an acoustic signal by periodically destroying dome*

- increasing the amplitude of generated signal can also be achieved through the counter flows in the spiral, which will provide not only a partial mutual periodic compression of jet streams, but also their periodic mutual destruction [8] (fig. 14).

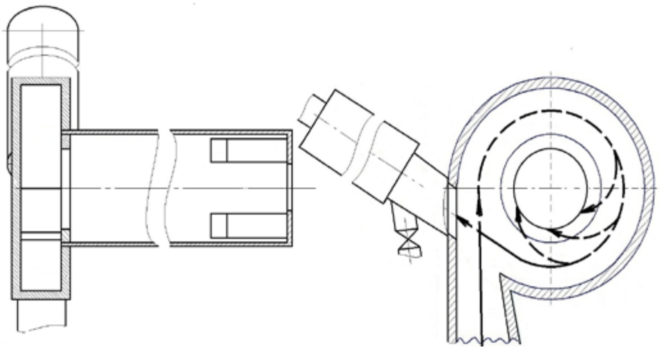

fig. 14. *Vortex cavitator with intersecting streams*

- improving the quality of the signal providing a more efficient implementation of the acoustic energy can be achieved by installing an additional flexible petal in the helix tongue, that is at the confluence of the input and circular flows (fig. 15).

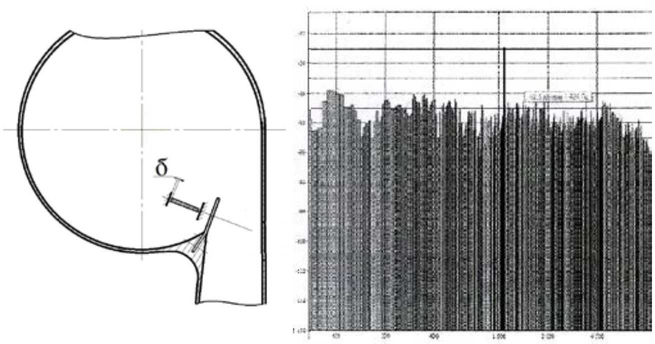

fig. 15. *Petalled activator of interaction of flows in the volute and the amplitude-frequency characteristics*

This petal excludes mutual penetration of high-energy parts of the flow into each other and thus provides their most complete interaction, which is expressed in the growth of the amplitudes of calculated frequencies only [9]. Control of the parameters of the input stream also allows to strengthen intensity of the signal produced [10].

- creating additional functions of a force pump - it creates pressure and simultaneously generates acoustic signals and produces additional cavitation treatment of the working fluid [11] (fig. 16).

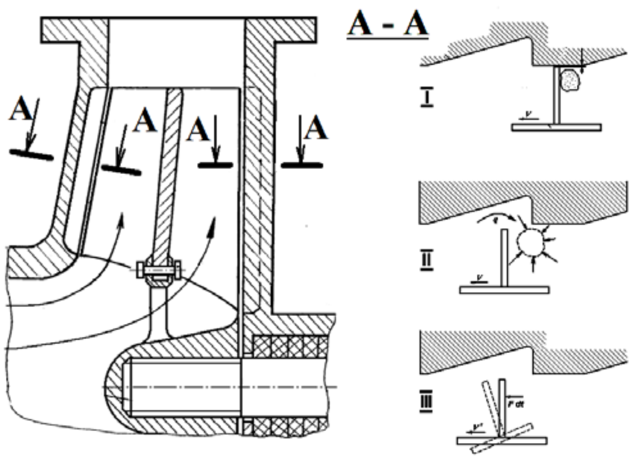

fig. 16. *Variant of a pump with the function of creating an acoustic field*

4. Conclusion

Increasing the functional qualities of a hydrodynamic cavitator is the first stage of its development.

The next stage of adaptation of the original device to the specific technological operations requires its further development in various areas of use. Implementation of these studies and the achievements of other authors will create a basis for a wide industrial use of the cavitation technology.

5. Literature

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