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NASA TECH BRIEF

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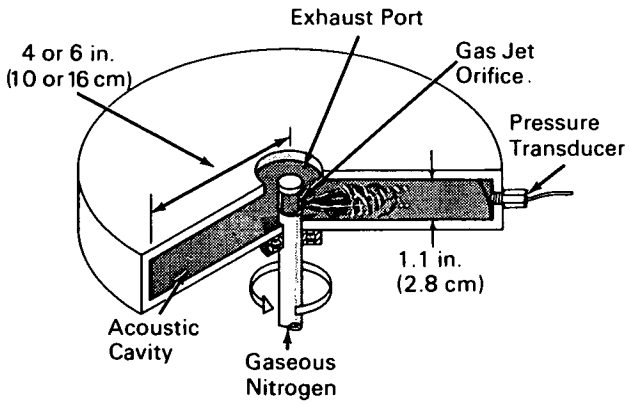
Novel Wave Generator Adaptable to Indoor Surfboarding

A simple method of creating strong acoustic waves was devised during research on rocket engines. Preliminary tests have shown that the analogous method of generating waves in a confined body of water is equally effective. The method and type of wave structure created suggest a novel facility for water sports, including surfboarding.



Schematic of Acoustic Generator.

In the rocket engine research, spinning (strong, travelling) acoustic waves or modes were created by rotating a radial jet of gas at the center of a short cylindrical chamber (see fig.). The wave crests are radially aligned and rotate within the cylinder like the spokes of a wheel. The number of waves generated, as well as their amplitude and rotational speed, depend upon the rotational speed of the jet, the jet flow rate, the number and configuration of jet orifices, and the size of the chamber. Essentially, the jet rotates at the speed of the spinning mode or wave. This test apparatus is used to study the dynamic behavior of physical and chemical phenomena related to rocket engine propulsion systems.

The spinning acoustic mode generated is not common, and the analogous mode in a body of water is not known to exist from natural causes. Preliminary tests have shown that spinning modes can be generated in water by rotating submerged radial water jets at the center of a circular pool. Usually, only standing waves or modes exist in bodies of water. Liquid sloshing in a tank is one example of a standing mode—the liquid merely rises and falls, with little or no wave progression. The spinning mode, however, is a travelling mode, for which the waves progress continuously, similar to surf advancing toward a beach. Wave height approaches maximum at the circumference of the pool and diminishes toward the center. Rotational speed depends on the depth of water. At the circumference, wave velocity is comparable to natural wave velocities in equivalent depths of water.

The power required to maintain these resonant mode waves in water is approximately one-tenth of that required to generate a progression of new waves of the same height. Thus, for example, operating a circular surfing facility with resonant mode waves continually rotating about the center would require about 10% of the power needed to generate comparable waves in a conventional facility where the waves progress to a shore line and are absorbed.

Notes:

1. Technology on travelling transverse resonance in pools of water is beyond the immediate scope of NASA. Engineering development of the concept of a facility for water sports such as surfboarding therefore remains to be performed; however, a short film supplement to this Tech Brief has been prepared to illustrate this technique for generating waves in a confined body of water. A technical paper, "Strong, Traveling, Transverse Acoustic Modes Generated by a Rotating Gas Jet," by M.F. Heidmann, AIAA Journal, Volume 5, No. 11, pp. 2105-2107, November 1967, may be of assistance in

(continued overleaf)

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such development because of the close analogy between water and acoustic waves.

2. The circular and compact configuration of such a water sports and surfing facility makes it adaptable for enclosure. Thus, climate conditions need not be considered in locating the facility. The concept is also adaptable to small circular pools. Rather than surfboarding, the objective would be to provide a diversion from the normal quiescent water activity.
3. The following documentation may be obtained from:

   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)

   Reference:
   NASA-TN-D-4380 (N68-16998), Performance Study of a Rotating Gas Jet Generator for Strong Traveling Transverse Acoustic Modes

4. Technical questions may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: TSP70-10563

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

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Source: M. F. Heidmann and B. R. Phillips
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(LEW-11096)