

# 611-2375 (35-185) Water Hammer

## Warranty, Replacement Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

## Introduction:

The Water Hammer is based on a problem first diagnosed by Lorenzo Allievi in August 1902. At a power generation plant in Papigno (Turni) in Italy, routine maintenance was being done on a pipe. When the pipe was closed off, an explosion occurred. As the explosion had done major damage to the plant, Lorenzo was assigned the task of determining what happened. Lorenzo determined that if a valve is closed suddenly at the end of a pipe system, a water hammer wave propagates in the pipe. This not only leads to a loud bang, it can lead to damage if the kinetic energy of the moving water is large enough. Moving water in a pipe has kinetic energy proportional to the mass of the water in a given volume times the square of the velocity of the water.

$$\text{kinetic energy} = (\text{mass})(\text{velocity}^2)$$

or

$$\text{kinetic energy} = (\text{volume})(\text{velocity}^2)$$

## Procedure:

Practice before demonstrating as it takes a little finesse.

- 1) Hold the Water Hammer in

such a way that the pointed bulb end is pointing upward.

- 2) Lower the hammer quickly about 15cm and quickly stop. You should hear a sharp clink.

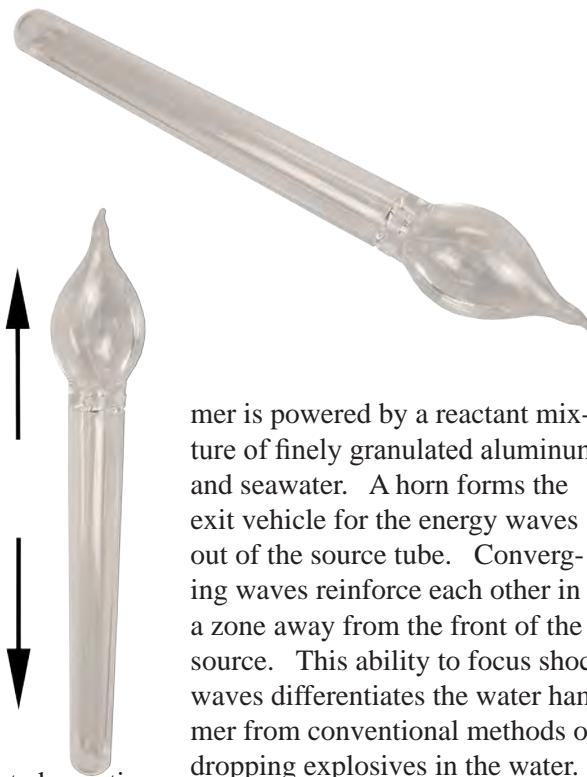
## Discussion:

The 25cm long Water Hammer has been filled with water and then most of

the air has been evacuated, creating a partial vacuum. In a vacuum, the water acts like a solid and just as a fork makes a clink on a wine glass, the water makes a similar clink in the water hammer.

## Modern uses of the Water Hammer wave effect:

According to the Editorial Staff of "Military Research Reorganization Consolidates Technologies, Goals," *SIGNAL*, July 1999, 23-25, The Water Hammer effect can be used as a weapon for underwater combat or mine clearing. The device is comprised of a phase array of shock tubes to generate and focus underwater shock waves into a pressure pulse exceeding 2,000 psi. In effect, it is an underwater attack trumpet, destroying objects hundreds of meters away, with sound. NOTE: The explosive wave generator for the Water Ham-



mer is powered by a reactant mixture of finely granulated aluminum and seawater. A horn forms the exit vehicle for the energy waves out of the source tube. Converging waves reinforce each other in a zone away from the front of the source. This ability to focus shock waves differentiates the water hammer from conventional methods of dropping explosives in the water.

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