A FISH RELEASE CAPSULE FOR RESEARCH IN TURBINES

by

Richard N. Duncan

Winston E. Farr

and

Chester O. Wheeler

September 1964

FISH-PASSAGE RESEARCH PROGRAM
U.S. Bureau of Commercial Fisheries
Seattle, Washington

INTRODUCTION

One of the objectives of research on mortality of fingerling salmonids in large Kaplan turbines is to determine the relationship of the rate of mortality to the zone of fish passage through the turbine. To examine this relationship it was necessary to develop a device that would simultaneously release groups of fish at separate and specific locations within a turbine intake. A special fish-release capsule described in this report was developed and evaluated for use in these turbine studies.

EQUIPMENT

Basically, the fish-release capsule is an aluminum tube 47 inches long and 6 inches wide (internal diameter). It is equipped with a remote-controlled rear door and perforated front section, and a water circulation system to maintain fish in good condition until release. In operation the capsule is lowered by cable to the desired depth and location in an intake where the fish are released on command by activating a solenoid release mechanism.

The solenoid mechanism releases the rear door and front section. A compression spring attached to the front section initiates its opening and the action is completed by water pressure in the body of the capsule. This pressure also forces the rear door open and flushes the fish into the turbine intake. A release capsule in an open and closed position is shown in figure 1.

A system of 1/4-inch steel rods connects the front section to the body and links the rear door and front section to the solenoid release mechanism (fig. 2). Stops on two of the rods prevent the front section from becoming completely detached from the body. Tight closure of the rear door against the body to minimize leakage is accomplished with adjustable-coupling inserts in the rods.

An electrical cord attached to the capsule provides current for activating the solenoid, for operating a water circulation pump, and for verifying the operation of the release mechanism. The system operates from a standard 110 volt a.c. supply through a central control panel. The circuitry of the panel provides a means for opening the capsules individually or in groups, for checking the units for premature opening, and for verifying that each capsule has functioned properly.

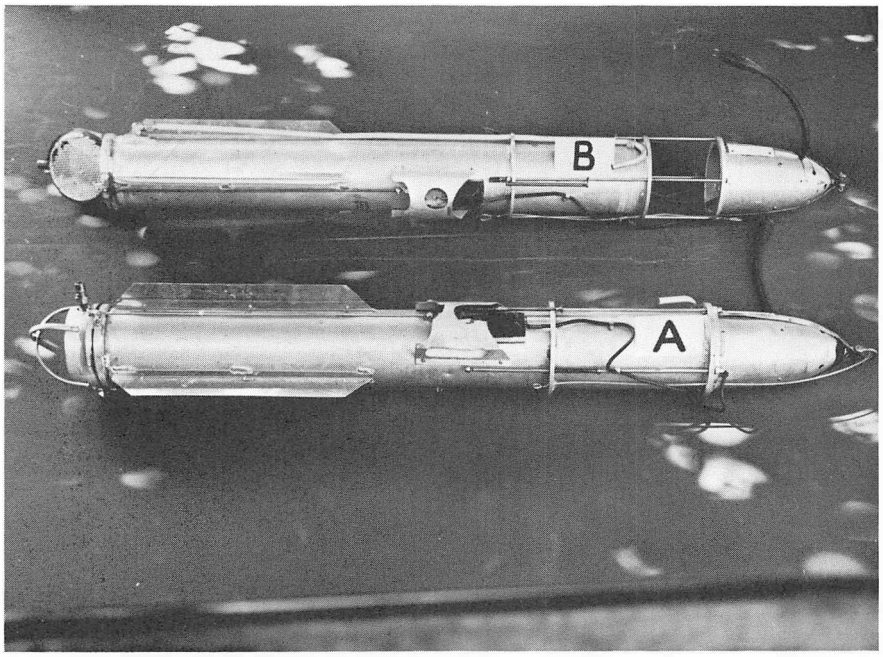

Figure 1.--Fish-release capsule in closed (A) and open (B) positions.

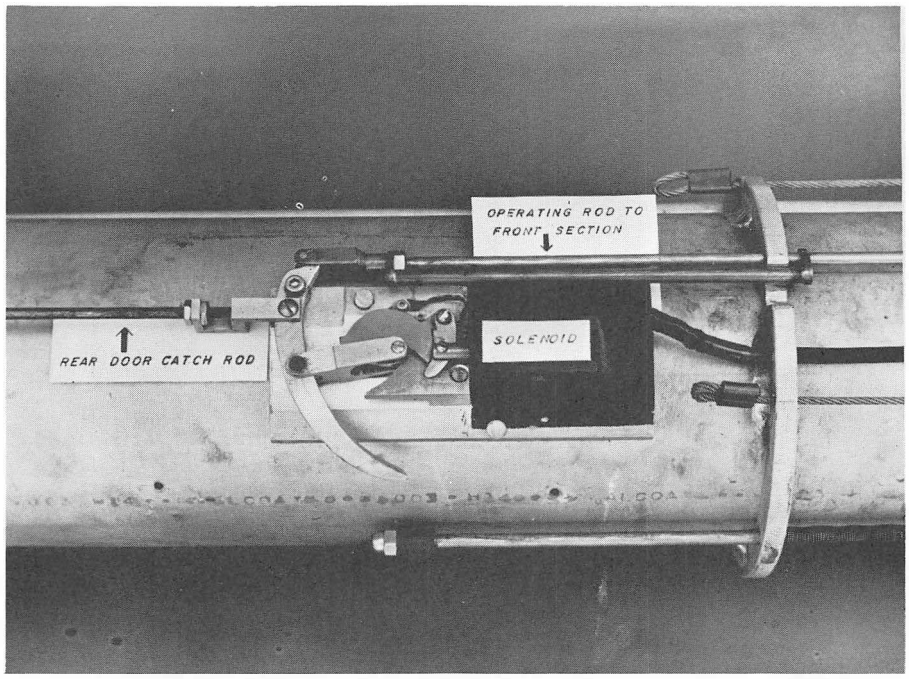

Figure 2.--Solenoid assembly that triggers the opening of the release capsule.

For verifying the operation of the capsule, a magnetically operated switch is incorporated in the capsule circuitry. A magnet fastened to the rod operating the front section is in close proximity to this switch when the capsule is closed and completes the solenoid circuit. When the solenoid is activated to open the capsule, the magnet is moved away from the switch and the circuit is broken. A circuit check made with the control panel voltmeter indicates the condition of the circuit.

Fish are loaded into the capsule through a 3-inch diameter hose inserted into the front opening (fig. 3). This hose is connected to a holding pen, with a funnel bottom and the fish and water are released into the capsule simultaneously. During the loading operation, the front section is opened by unfastening the operating rod from the release assembly.

An overflow pipe is inserted into the capsule to serve as a water outlet when fish are being transferred. The position of the discharge end of the overflow pipe (fig. 3) controls the depth of water in the capsule when loading fish.

Evaluation

Evaluation of the release capsule was conducted by holding and releasing groups of fish in both low and high velocities. These tests were conducted in a flume located at the U.S. Army Corps of Engineers Hydraulic Laboratory at Bonneville Dam. The capsules were tested in velocities of 0.2 to 8.5 feet per second and their action observed through a large viewing window. A holding pen was attached to the downstream end of the flume to capture the released fish for further observation. In all tests, the water circulation pump in the capsule was operating. Fish used in the tests were chinook fingerlings (*Oncorhynchus tshawytscha*) ranging in length from 70 to 125 mm.

Six tests were conducted to determine if fish could be released from the capsule into a high velocity water flow without harmful effects. A group of 450 fish were divided randomly in nine groups of 50 fish each. Three of these groups, used as controls, were subjected to the same handling as those used in tests, but were returned to the hatchery and retained in holding pens. The release of 50 fish from a capsule into water flowing at 8.5 f.p.s. constituted a single test. Test fish were removed from the flume within 3 minutes after release, returned to the hatchery pond, and held 4 days for observation.

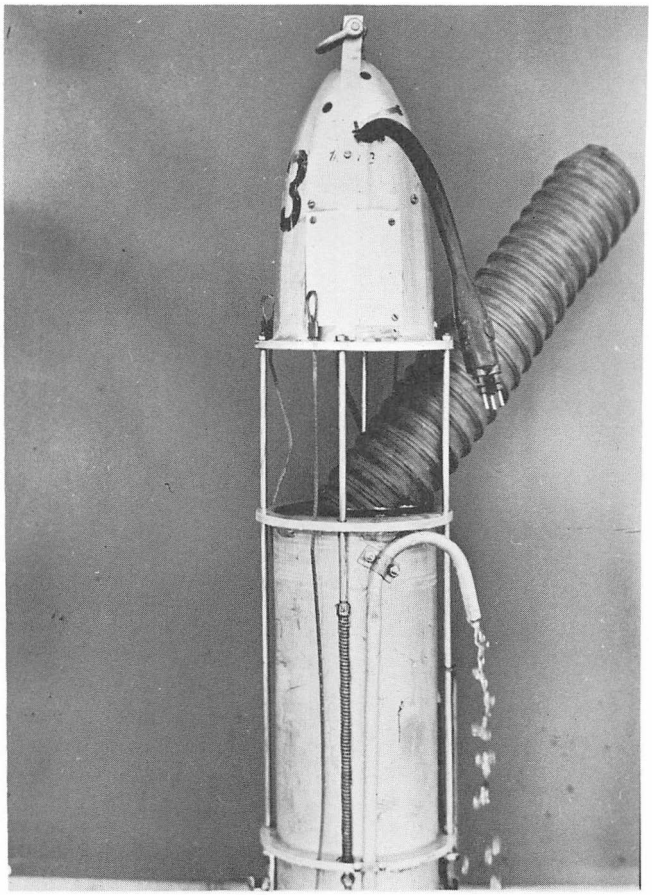

Figure 3.--Fish transferred to fish-release capsule through flexible hose. Position of overflow pipe discharge controls water depth within capsule.

In order to examine capsule capacity, tests were conducted in which capsules containing 150 fish each were held in water velocities of 8.5 f.p.s. and 0.2 f.p.s. for a period of 3 hours. During this time the water was circulated by the pump within the capsule. After these tests, the fish were held 4 days to determine whether delayed mortality would occur.

Following these laboratory tests, capsules were deployed in turbine intakes and draft tube exits to evaluate recovery equipment at Bonneville Dam. Over 25,000 fish (about 100 in each capsule) were released during these studies. The operation of the capsules and the success in positioning the units at desired depths was closely observed.

There was no indication that the fish-release capsule created any harmful effects to the fish released in these laboratory experiments. The employment of capsules in turbine intakes and draft tube exits revealed that they could be positioned and that fish could be released with little difficulty.

LITERATURE CITED

Wheeler, Chester O.
1963. Solenoid release for remote operations. U.S. Fish and Wildlife Service, Progressive Fish Culturist, vol. 25, no. 4, p. 215-216.