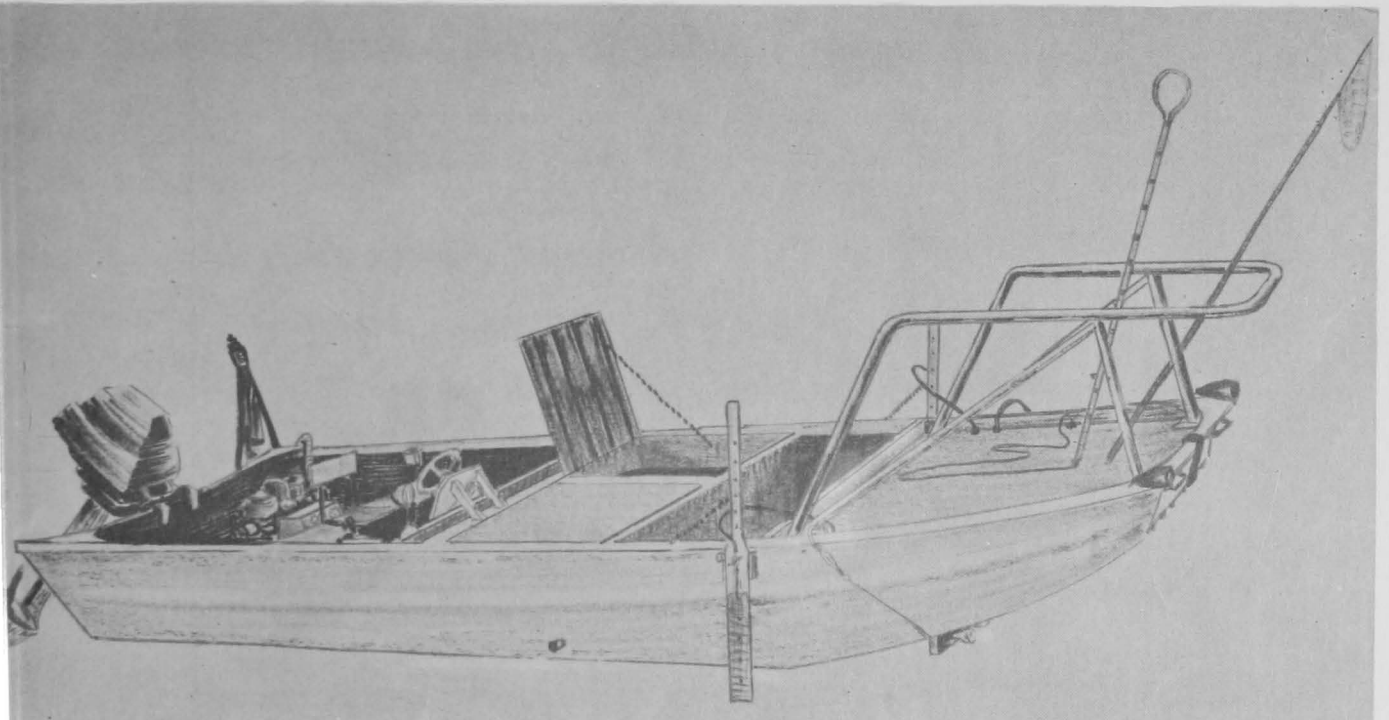


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AN ELECTROFISHING BOAT WITH A VARIABLE VOLTAGE PULSATOR FOR LAKE AND RESERVOIR STUDIES



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

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Cover drawing by Col. Dick Turner

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**AN ELECTROFISHING BOAT
WITH A VARIABLE VOLTAGE PULSATOR
FOR LAKE AND RESERVOIR STUDIES**

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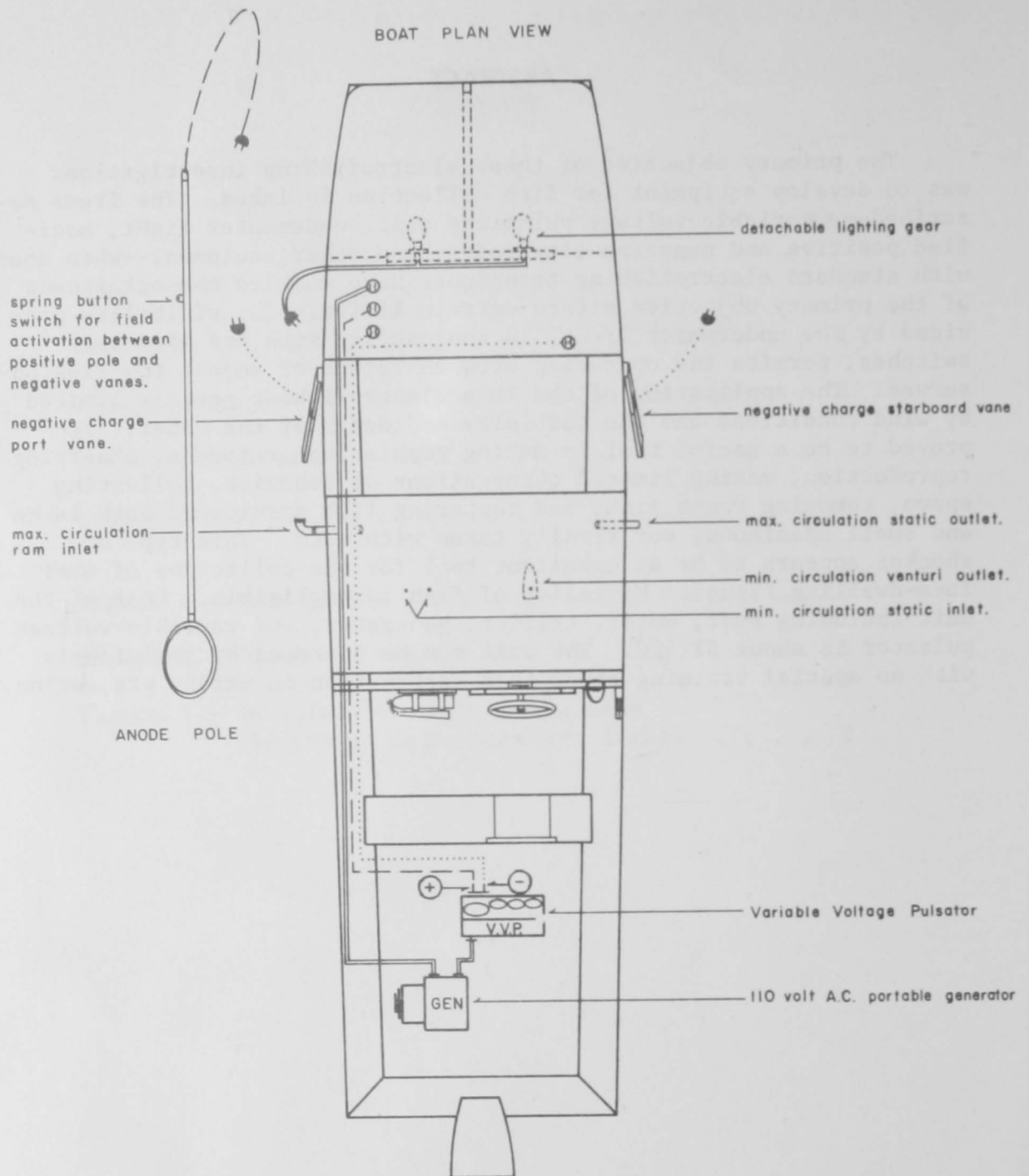
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ABSTRACT

The primary objective of these electrofishing investigations was to develop equipment for fish collection in lakes. The items described--a variable-voltage pulsating unit, underwater light, modified positive and negative electrodes, and other equipment--when used with standard electrofishing techniques have enabled the attainment of the primary objective within certain limits. The visibility provided by the underwater light, in conjunction with the electrode switches, permits the operating crew to select or reject the fish observed. The application of the lake electrofishing gear is limited by wind conditions and the turbidity and depth of the water. It proved to be a useful tool in making population estimates, observing reproduction, making limited observations of behavior, collecting spawn, removing rough fish, and capturing fish species of both large and small specimens, not readily taken with nets. This type of shocker appears to be an excellent tool for the collection of most lake-dwelling fishes. Mortality of fish is negligible. Cost of the unit including boat, motor, trailer, generator, and variable-voltage pulsator is about \$1,500. The unit can be operated by individuals with no special training other than instruction in safety precaution.



LEGEND: (—) 110 volt A.C.; (---) positive charge of split current; (.....) negative charge of split current; twist lock receptacle ⊙; twist lock plug ⊕

Figure 1.--View of boat plan, Yellowstone electrofishing boat.
Drawing by Col. Dick Turner.

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Fishery biologists working in lentic waters have long been in need of fish collection gear that could be used to select fish of a desired species or size. The prototypes of the equipment described here were developed to meet this need during a series of trout investigations in high mountain reservoirs in Colorado and on Yellowstone Lake. The electrofishing equipment and techniques were improved as more versatile apparatus became available. The refinements were incorporated into the Yellowstone shocker. Other units for lake shockers with somewhat different designs and objectives have been described in recent fishery literature.

Witt and Campbell (1959) described electrofishing in lakes and reservoirs of Missouri. Their equipment consisted of five electrodes mounted on a boom ahead of the boat, lights for night work, and a 110-volt, alternating current generator. They reported excellent results and documented the fact that nocturnal electrofishing was three times more productive than daytime efforts. Soon after, Smith et al (1959) described electrofishing apparatus which utilized a 230-volt, 2,500 watt, direct current, portable generator. It was equipped with a rheostat to provide control of voltage within a range of 70 to 230 volts. Included was a portable interrupter which, by means of a 3-tube electronic circuit, operated a relay and produced a square wave with a duty cycle of 0.50 to 0.90, at frequencies of 20 to 300 interruptions per minute. The authors described the principal limitation of this unit as "an inability to induce electrotaxis in more than a small percentage of fish, while immediately narcotizing the remainder."

EQUIPMENT AND DESIGN

An important component of the Yellowstone shocker is a variable voltage pulsator which modifies the current energizing the shocker. It was developed in Colorado and was described in detail by Rollefson and Tanner^{1/}. It enables an operator to vary the output of a single phase, 60-cycle, 115-volt, alternating-current generator. The

^{1/} Rollefson, Max D., and Howard A. Tanner 1961. The development of improved electrofishing equipment. Unpublished report, Colorado Dept. of Game, Fish and Parks.

UNDERSIDE PERSPECTIVE

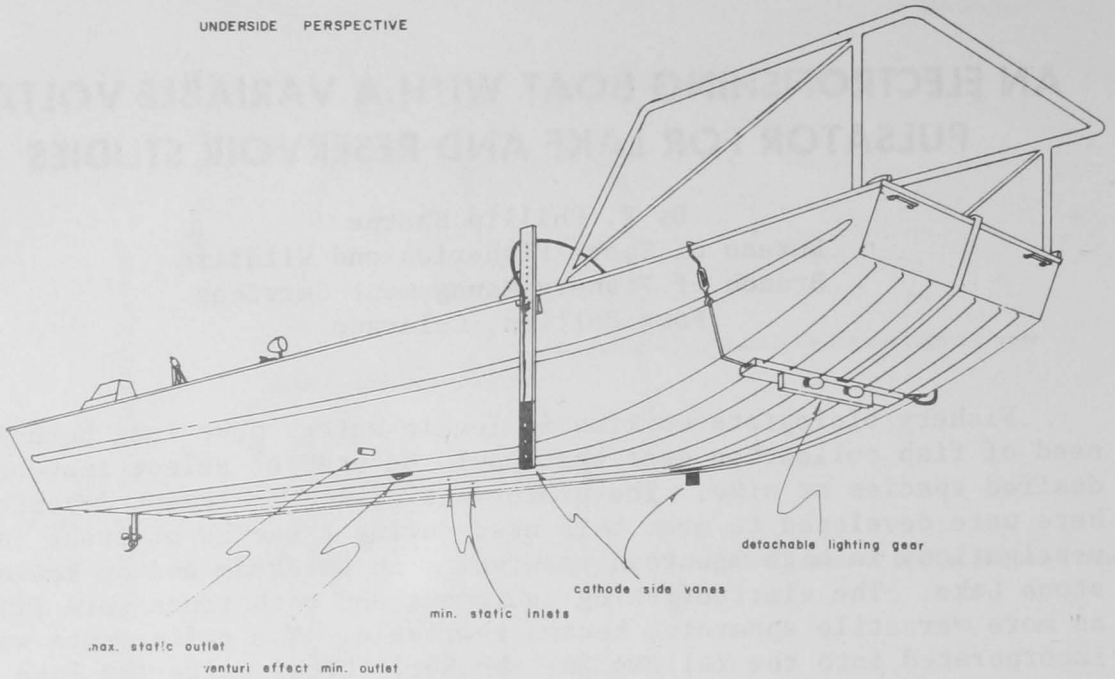


Figure 2.--Underside view, Yellowstone electrofishing boat. Drawing by Col. Dick Turner.

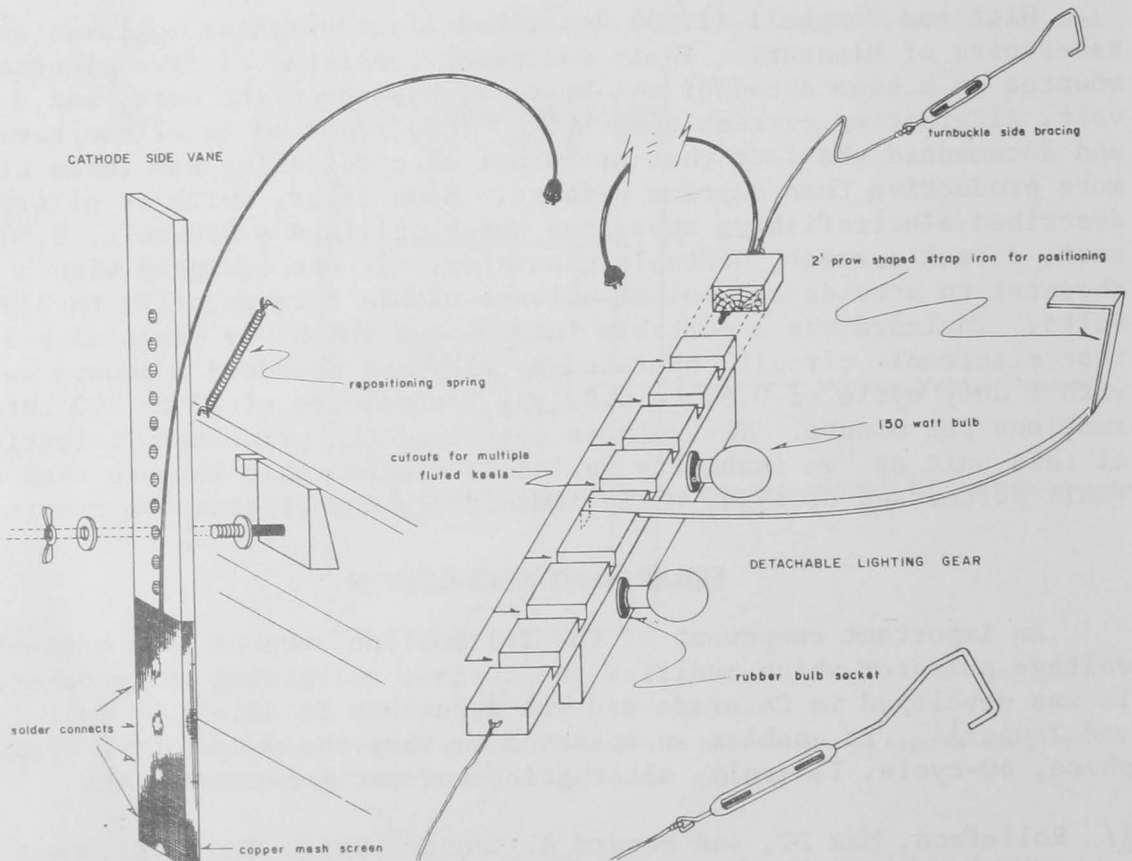


Figure 3.--Detailed drawings of negative electrodes and underwater lights. Drawing by Col. Dick Turner.

generator must have a minimum output capacity of 1200 watts. A multitap transformer permits selection of 50 to 700 volts in 50-volt increments of alternating current or rectified current. The rectified current is half-wave alternating current which serves, in effect, as pulsed direct current of 60 pulses per second and 50-percent duty cycle.

The lake shocker is mounted in a custom-built, 16-foot, aluminum boat which has a live-well for captured fish under the middle seat (Figure 1). Water circulates through the well by means of holes in the bottom and sides (Figure 2).

An underwater lighting system was adapted from a type which is employed by whitefish spearers on inland lakes in Michigan. It is similar to a unit described by Latta and Myers (1961). Lights are supported underwater by a removable, keel-fitting frame which is clamped by a bow strap and turnbuckles over the gunwales about 2 feet aft of the bow (Figure 3). The frame can be detached while the boat is on the water. The circuit to two rubber sockets is separate from the electrodes. The bottom of the boat is painted a high-gloss white to serve as a reflector.

The illumination is provided by two ordinary 150-watt bulbs which can be safely turned on or off in or out of the water. No shields or reflectors are needed on them, and maintenance is negligible

The negative electrodes consist of copper window screen wrapped tightly around the lower 18 inches of paddle-shaped sections of fir 4 feet long which are attached to the sides of the boat by bolts and wing nuts to permit adjustment of their penetration into the water. They are located slightly forward of the live-well, and springs are attached to return them to desired positions after obstacles are encountered. The conductor from each electrode is connected to female twist-lock plugs at each side of the boat.

The handle of the single positive electrode is a 1.5-inch oak dowel 10 feet long. A 3-foot piece of 3/4-inch copper tubing forms the conductive portion of the electrode. A permanent circuit was installed from the generator position forward to an outlet in the bow. The positive electrode connection is made at this outlet and

1/ (Continued) The variable-voltage pulsators are manufactured and marketed by Coffelt Electronics Company of Littleton, Colo. The unit weighs approximately 27 pounds and costs \$325. Trade names referred to in this report do not imply Government endorsement of commercial products.

runs to a treadle switch which is controlled by the operator. The conductor runs down the electrode handle to a hand microswitch and is joined to the loop of copper tubing.

Twist-lock plugs are used on all connections. The foot treadle switch used by the forward man to control the on-off application of current is a major safety feature.

A long handle dip net is used to facilitate easy pick-up of stunned fish. Netting material should be suitable for the size of fish to be recovered.

The boat is powered by a small outboard engine which is equipped with remote controls. The rear seat is designed to allow the operator to be forward of the utilities, and is equipped with a swivel seat for convenience of the driver. An extension pipe on the generator muffler carries exhaust fumes to the rear and away from the outboard operator. The variable-voltage pulsator is placed adjacent to the generator with the control panel easily accessible. The lid to the live-box is divided and hinged, and one side is opened for depositing fish in the box as they are collected. The lid also prevents water from splashing on equipment immediately behind the box. The forward seat has been modified to form a work deck 4 feet long.

EQUIPMENT OPERATION

Three men are required to operate this electrofishing boat. One man operates the outboard and the control panel of the VVP. The second man, who selects and recovers the fish, stands on the forward deck with the electrode operator. The third man is forward of the net man and is stationed in a position so that he has maximum visibility of the illuminated area. He operates the positive electrode and controls the electrical current with the treadle and hand switch. A guardrail, 3 feet high and 4 feet on the sides, of 2-inch aluminum pipe, serves as support as well as a safety factor. The boat is driven slowly through shallow areas of 2 to 12 feet in depth, depending on visibility, and is operated at or near the maximum depth of visibility, working toward the shore.

Excellent results are obtained when the operator can see the fish and move the positive electrode near, or beyond the fish before switching on the current. The fish are then electrotaxized and it is a simple matter for the net man to make the pick-up. It is often possible to pick up several fish in one sweep of the net. Good results have also been achieved when turbidity forces the crew to shock without seeing the fish. In this situation the positive electrode is lowered into the water and the current is switched on and

off every few seconds. Fish are recovered as they are attracted to the positive electrode near the surface of the water.

During the past six years, many lakes of different water types were shocked with high degree of efficiency. Their resistivities ranged from 800 to 45,000 ohms. Also, warmwater and coldwater fishes were collected successfully in impoundments in Tennessee, North Carolina, South Carolina, and Arkansas.

Yellowstone Lake is optimum for use of the shocker. Large numbers of cutthroat trout, 3 to 18 inches long, were captured in the summer of 1963, and no losses were incurred. Under average shocking conditions, 75 to 100 adult cutthroat trout are captured per hour. All species of fish encountered were readily attracted to the positive electrode.

SAFETY PRECAUTIONS

It is important that the following safety features be observed.

Boat and equipment:

1. Make certain that there are no shorts in the electrical equipment especially in the variable voltage pulsator.
2. Have a nonskid surface on the deck.
3. Have electrical wiring out of the way.
4. Have first aid kit and approved fire extinguisher.
5. Use Coastguard approved lights and hand spotlight.
6. Use properly insulated wiring.
7. Use female terminating plugs.
8. Divert generator exhaust fumes away from boat.

Operators:

1. Be familiar with safety switches and other safety equipment
2. Review established emergency procedures before operation.
3. All operators should wear rubber boots and approved life jackets and electrician's rubber gloves.

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