ELECTRO FISHING, USING A BOAT AS THE NEGATIVE

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ABSTRACT

The use of an aluminum boat as the electrode on streams and rivers is quite simple and is as effective as the electrodes suspended from the side of a boat. This eliminates the need of any electrodes hanging over the side of the boat and allows the operator to work efficiently through trash and submerged obstacles. It is necessary, if using direct current or pulsed direct current, to connect the negative lead to the aluminum hull of the boat instead of to the electrodes suspended on each side.

The individual items required and their use in this operation, e.g., variable voltage pulsating unit, modified negative and positive electrodes and others, are described. The cost of the unit, including boat, motor, trailer, variable voltage pulsator, miscellaneous and safety items, is approximately $2,000.00. Safety items are listed and described to assist in eliminating shock hazards.

ELECTRO FISHING, USING A BOAT AS THE NEGATIVE

The use of an aluminum boat as the electrode on streams and rivers is quite simple and is effective as the electrodes suspended from the side of a boat. It is necessary, if using direct current or pulsed direct current, merely to connect the negative lead to the aluminum hull of the boat instead of to the electrodes suspended on each side. This eliminates the need of any electrodes hanging over the side of the boat and allows the operator to work efficiently through trash and submerged obstacles.

No one electrode design may be best for a given set of field conditions. The design requirements found from actual experience require the gear to be flexible. Design compromise is indicated for every new set of field conditions. In addition, factors such as the boat speed and water depth must be taken into consideration. If the ultimate in maintaining a desired field strength, generator voltage, and peak output power are followed, it is evident that only the effective area of the electrodes will need to be varied in some manner in order to operate in waters of different resistivity. The electrode spacing need not be varied as long as the generator voltage remains constant.

The electrode must allow the boat to maneuver easily, produce a field of maximum volume with the desired field strength and shape, and yet not have a weak periphery that will startle fish away before they can be overcome by the main field strength. Such an electrode design, while depending on common sense, must also involve certain electrical principles such as the utilization of maximum generator power at all times. Maximum volume shocked is a direct consequence of keeping the generator power at the rated maximum output. The effective volume shocked is proportional to the generator power output times the water resistivity divided by the square of the desired average field strength.

Alumimum boats have many advantages, the most important being lightness and mobility, especially for floating operations; and the presentation of a large negative surface area to the water. One problem in highly resistant waters is the fact that a large negative surface area must be used in order to get adequate electricial current passing through the water.

In using the boat as the negative we have found it quite simple to attach a heavy battery clamp to the negative output lead from the variable voltage pulsator (VVP), and to use this to hook up the boat hull as the negative. In using the boat as the negative, one must either be certain that no electrical potentials exist either between the electrodes or the pulsing unit frames and the boat. Otherwise, a short will be produced whenever these two units come in contact with the aluminum boat. If such a potential does exist, it is no great problem to electrically insulate the generator and pulsing unit from the boat.

The generator ground, the negative output lead of the VVP, and the aluminum boat have to be tied to one side of the generator output connector, and the positive lead of the VVP must be well insulated from the boat. Also, the generator should have a fuse or circuit breaker installed as close to the generator as possible. By doing the above, it gives everything inside the boat a common ground and therefore eliminates some of the shock hazard. We have installed plywood floors in our boat, which reduces the shorting danger and also strengthens the bottom of the boat.

The positive electrode consists of a ten-foot section of 1¼-inch lightweight dowel. A two-foot section of ½-inch copper tubing forms the conductive portion of the electrode. A permanent circuit was installed from the generator position to a female outlet in the rear and front of the boat. The wire runs through the electrode handle and is joined to the loop of copper tubing. A 16-amp. pressure release switch is built into the positive handle and must be pressed for contact to be made.

The operator of the positive should be the most experienced, agile and alert man in the crew. The positive should never pass close to those holding on to the boat, and great care should be taken not to touch the positive to the aluminum boat, which causes a direct short. Protection against damaging the equipment in case of such a short can be achieved by placing fuses in the circuits.

Being involved in a direct short between the positive and negative electrodes is the greatest human danger. We have never had this happen, and cannot see how, with properly indoctrinated fishing crews, this could ever occur. In this operation we use a "dead-man" type switch to control the passage of electrical current to the electrodes. This "dead-man" switch is perhaps the best safety device in the whole system. In this way, active pressure must be applied to the switches in order to have electrical current passing between the electrodes. The switch that we use is a Switchmat by Recorda. It requires five pounds of force for 110 volts up to 100 watts, is 3/8 inch thick and waterproof. The Switchmat is connected to the VVP between the transformer and the diodes. Obviously, this "dead-man" switch is never turned on until the positive electrode is fixed in fishing position.

The variable voltage pulsator (VVP), is used to energize the shocker. With this piece of equipment the operator can modify the output of single phase, 60-cycle, 115 or 230-volt A.C. generators. A multitap transformer permits voltage selection of from 50 to 700 volts in 50-volt increments and through half-wave rectification of alternating current yields, what is in effect a pulsed direct current of 60 pulses per second and a 50-percent duty cycle. With the VVP, using 230 volts A.C., it is capable of producing from 50 to 700 volts, and 0.1 to 3.0 amps. Using 230 volts A.C. and converting to direct current half-wave, which has a maximum of 300 volts, we try to operate with 1.0 to 1.5 amps. This we have found to be adequate and most efficient for all species of fish.

When the power leaves the VVP the wires are split, the negative is connected to the boat with the battery clamp, and the positive is connected to the portable 10-foot lightweight dowel.

The live-well is mounted near the center of the shocker boat and is capable of holding 90 gallons of water. During the normal course of work on streams the well displaces approximately 25 to 30 gallons of water. Water circulates through three intake holes and one outlet hole located in the bottom of the well.

An underwater lighting system was adapted to use during night work. The wooden frame was constructed with grooves to fit under the boat and against the keel. The circuit to three 150-watt household light bulbs is separate from the electrodes and is connected directly to the 115-volt outlet on the generator. The underwater lights are removable and are supported by shock-cord that fastens to eye bolts located on the side of the boat. These lights can be safely turned on or off in or out of the water. No shields or reflectors are needed.

A ten-foot section of 1¼-inch lightweight dowel is used as the pick-up net. The frame to support the ¼-inch nylon minnow netting is made of ¼-inch aluminum rod for strength and lightness.

The boat is usually powered by a small outboard motor (in our case a 5½ h.p. Evinrude). A motor guard was designed from a 4-tine manure fork to protect the propeller while working in streams. An extension pipe of flex-tubing connects to the muffler exhaust of the generator and is extended over the rear of the boat. This carries the exhaust fumes to the rear and away from the operator.

SAFETY PRECAUTIONS, USING THE ALUMINUM BOAT AS THE ELECTRODE

1. Instruct all personnel in the fundamentals of electricity.
2. Thoroughly familiarize all personnel with all phases of the equipment and its operation.
3. Make sure that all equipment is in good condition and properly used.
4. Never work alone.
5. Treadle switches or dead-man switches should be used on all boat shockers so that the circuit will be broken if the operator falls overboard.
6. Rubber gloves should be worn and extreme caution should be practiced in connecting and disconnecting plugs.
7. Be sure that no electrical potentials exist either between the electrodes or the pulsing unit frames and the boat.
8. The installation of plywood floors in the boat reduces the danger of shorting.
9. Do not touch the positive electrode to the aluminum boat.
10. Have a non-skid surface on the deck.
11. Place electrical wiring so that it is out of the way.
12. Use properly insulated wiring.
13. Use female terminating plugs.
14. Divert generator exhause fumes away from the boat.
15. The generator ground, the negative output lead of the VVP, and the aluminum boat will have to be tied to one side of the generator output connector and the positive lead of the VVP must be well insulated from the boat.
16. The generator should have a fuse or circuit breaker installed as close to it as possible.
17. Everything inside the boat should have a common ground.

MAJOR EQUIPMENT INVOLVED IN SETTING UP THE OPERATION

ALUMINUM BOAT

CF 1648 Polar Craft Commercial Fishing Boat

Length	15′ 11″	Side	20″
Bottom	48″	Transom	58″
Beam	63″	Weight lbs.	206

Items built into the boat:

a. Five-foot wash-out deck capable of supporting four men.
b. A 40-inch-high guardrail on three sides with the back side (stern) open, made of 1¼-inch aluminum pipe, sufficiently braced to support four men. (This guard rail goes around the 5-foot wash-out deck.)
c. Back edge of the back seat should be approximately ten inches from the transom.
d. A built-in live-well 30″ by 48″ with square sides and a split top, both lids opening toward the stern. Lids should have hasps attached in order to be able to fasten to the live-well when traveling. Three inlet valves and one outlet valve built into the live-well.

e. Back of the live-well should be approximately 76″ from the transom.

f. A removable ⅝″ marine plywood floor to cover complete bottom except where the live-well sets.

COST $498.00

GENERATOR

1962, Model 8HY 2-cycle engine, Homelite generator. 230 volts A.C., 180-cycle, 3-phase A.C. plus 115 volts D.C., 3000 watts capacity. 115 VDC capacity 21.7 amps, 230 VAC 7.5 amps.

COST $630.00

VARIABLE VOLTAGE PULSATOR[1]

Model No. 11, input voltage 115 volts A.C. 60 cycle, 230 volts A.C. 60 cycle, output current 0-4 amps to 250 volts A.C., 1.5 amps from 250 to 700 volts A.C., 0-4 amps to 150 volts pulsating D.C., 1.5 amps from 150 to 300 volts pulsating D.C.

The VVP can be varied from 0 to 700 volts A.C. and from 0 to 300 volts half-wave 60 cycles per second in 25 and 50 volt steps. The unit contains an automatic electronic circuit breaker to protect it against overload or short circuits in that when the overload or short circuit condition occurs, the circuit breaker will automatically turn the output voltage off, and at the end of five seconds, will turn it back on if the overload or short circuit has been removed.

COST $325.00

DEAD-MAN SWITCH

Switchmat by Recorda, 78B x 365, 18 x 30 inches, $21.84, Catalog No. 230 B, page 365, Allied Radio, 100 North Western Avenue, Chicago 80, Illinois. The mat requires 5 pounds of force for 110 volts up to 100 watts. Mat is ⅜ inch thick and comes with a 10-foot cord attached. The 10-foot cord is attached to the switchmat and leads to the VVP. The inside of the VVP has an added low voltage 15 amp relay, a 6.3 volt A.C. transformer, and the necessary connectors. The wires from the relay lead to a female outlet on the front of the pulsator. The relay is called a PC2A-6VD relay, cost $5.95, P6134 6.3-volt transformer, cost $2.05 and the two Hubbell connectors $2.77. The use of a 6-volt relay is an added safety advantage. Also the relay circuitry is completely isolated from the rest of the VVP. The mat is waterproof.

TOTAL COST $32.61

FIRE EXTINGUISHER

K-Kidde Kompact, pressurized dry chemical fire extinguisher. Marine-type United States Coast Guard type B:C Size I. Made by the Walter Kidde and Company, Incorporated, Belleville, New Jersey 07109.

COST $4.50

VOLT-OHM-METER

1963, Model 310, Triplett, The Mighty Mite VOM. Ranges DC Volts 0-3, 12, 60, 300, 1200, (20,000 ohms per volt) AC Volts 0-3, 12, 60, 300, 1200, (5,000 ohms per volt) DC Milliamperes 0.6, 6, 60, 600, (250 MV) Ohms 0-20,000, 200,000, 2 Meg., 20 Meg.

COST $42.00

DEFINITION OF TERMS USED IN ELECTRO FISHING

ALTERNATING CURRENT — (abbreviated a.c.) Electromotive force that periodically reverses the current flows first in one direction through the circuit and then in the other. Such is called alternating electromotive force, and the current is called alternating current.

AMPERES — The flow of electric current is measured in amperes. One ampere is equivalent to the movement of many billions of electrons past a point in the circuit in one second.

[1] The variable voltage pulsators are manufactured and marketed by Coffelt Electronics Company, of Littleton, Colorado.

ANODE — The positively charged conductor is usually a metal plate or cylinder (surrounding the cathode) and is called an anode or plate. Like the other working parts of a tube, it is a tube element or electrode.

CATHODE — If a thin wire or filament is heated to incandescence in a vacuum, electrons near the surface are given enough energy of motion to fly off into the surrounding space. The higher the temperature, the greater the number of electrons emitted. The general name for the filament is cathod.

CURRENT — The movement of ions or electrons constitutes the electric current.

DIRECT CURRENT — (abbreviated d.c.) In picturing current flow it is natural to think of a single, constant force causing the electrons to move. When this is so, the electrons always move in the same direction through a path or circuit made up of conductors connected together in a continuous chain. Such a current is called a direct current.

ELECTRICAL CHARGE — The quantity or charge of electricity represented by the electron is, in fact, the smallest quantity of electricity than can exist.

ELECTRIC CURRENT — The movement of ions or electrons.

ELECTROMOTIVE FORCE — The electric force or potential (called electromotive force, and abbreviated e.m.f.) that causes current flow.

FLUX DENSITY — The number of lines in a chosen cross section of the field is a measure of the intensity of the force. The number of lines per unit of area (square inch or square centimeter) is called the flux density.

GROUND — An actual earth connection to that point in the circuit should not disturb the operation of the circuit in any way. The term also is used to indicate a "common" point in the circuit where power supplies and metallic supports (such as a metal chassis) are electrically tied together.

HALF-WAVE RECTIFIER — During the half of the a.c. cycle when the rectifier plate is positive with respect to the cathode, current will flow through the rectifier and load. But during the other half of the cycle, when the plate is negative with respect to the cathode, no current can flow. The current always flows in the same direction but the flow of current is not continuous and is pulsating in amplitude.

LINES OF FORCE, OR FLUX LINES — A field can be pictured as being made up of lines of force, or flux lines. These are purely imaginary threads that show, by the direction in which they lie, the direction the object on which the force is exerted will move.

MHO — The unit of conductance is the mho. A resistance of one ohm has a conductance of one mho, a resistance of 1,000 ohms has a conductance of 0.001 mho, and so on.

MICROMHO — A unit frequently used in connection with vacuum tubes is the micromho, or one-millionth of a mho. It is the conductance of a resistance of one megohm.

MILLIAMPERES — When direct current is used it is usually not so large, and it is customary to measure such currents in milliamperes. One milliampere is equal to one one-thousandth of an ampere, or 1,000 milliamperes equal one ampere.

NEGATIVE — The type of electricity associated with the electron.

OHMS — Resistance is measured in ohms. A circuit has a resistance of one ohm when an applied e.m.f. of one volt causes a current of one ampere to flow.

POSITIVE — The nucleus has an electric charge of the kind of electricity called positive, the amount of its charge being just exactly equal to the sum of the negative charges on all the electrons associated with that nucleus.

PULSATING CURRENT — They convert the direct current into an alternating current (and sometimes the reverse) at frequencies varying from well down in the audio range to well up in the superhigh range. The conversion process almost invariably requires that the direct and alternating currents meet somewhere in the circuit. In this meeting, the a.c. and d.c. are actually combined into a single current that "pulsates" (at the a.c. frequency) about an average value equal to the direct current.

RESISTANCE — Given two conductors of the same size and shape, but of different materials, the amount of current that will flow when a given electromotive force is applied will be found to vary with what is called the resistance of the material. The lower the resistance, the greater the current for a given value of electromotive force.

RESISTIVITY — The resistivity of a material is the resistance, in ohms, of a cube of the material measuring one centimeter on each edge. One of the best conductors is copper, and it is frequently convenient, in making resistance calculations, to compare the resistance of the material under consideration with that of a copper conductor of the same size and shape.

VOLT — The unit of electromotive force is called the volt.

VOLT-OHM-MILLIAMMETER — (abbreviated v.o.m.) Since the same basic instrument is used for measuring current, voltage and resistance, the three functions can readily be combined in one unit using a single meter. The v.o.m., even a very simple one, is among the most useful instruments for the amateur. Besides current and voltage measurements, it can be used for checking continuity in circuits, for finding defective components before installation, open or otherwise defective resistors, etc. — shorts or opens in wiring, and many other checks that, if applied during the construction of a piece of equipment, save much time and trouble. It is equally useful for servicing, when a component fails during operation.

WATT — Power, the rate of doing work, is equal to voltage multiplied by current. The unit of electrical power, called the watt, is equal to one volt multiplied by one ampere. Common fractional and multiple units for power are the milliwatt, one one-thousandth of a watt, and the kilowatt, or one thousand watts.

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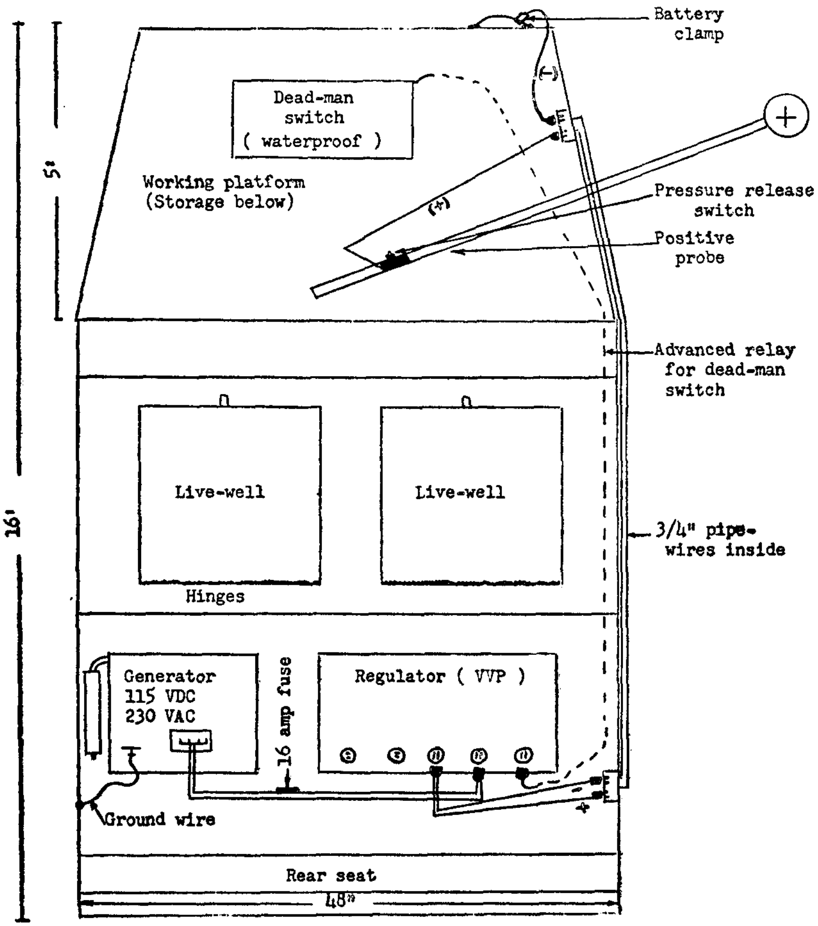
DIAGRAM OF THE ELECTRO FISHING BOAT



Back of boat

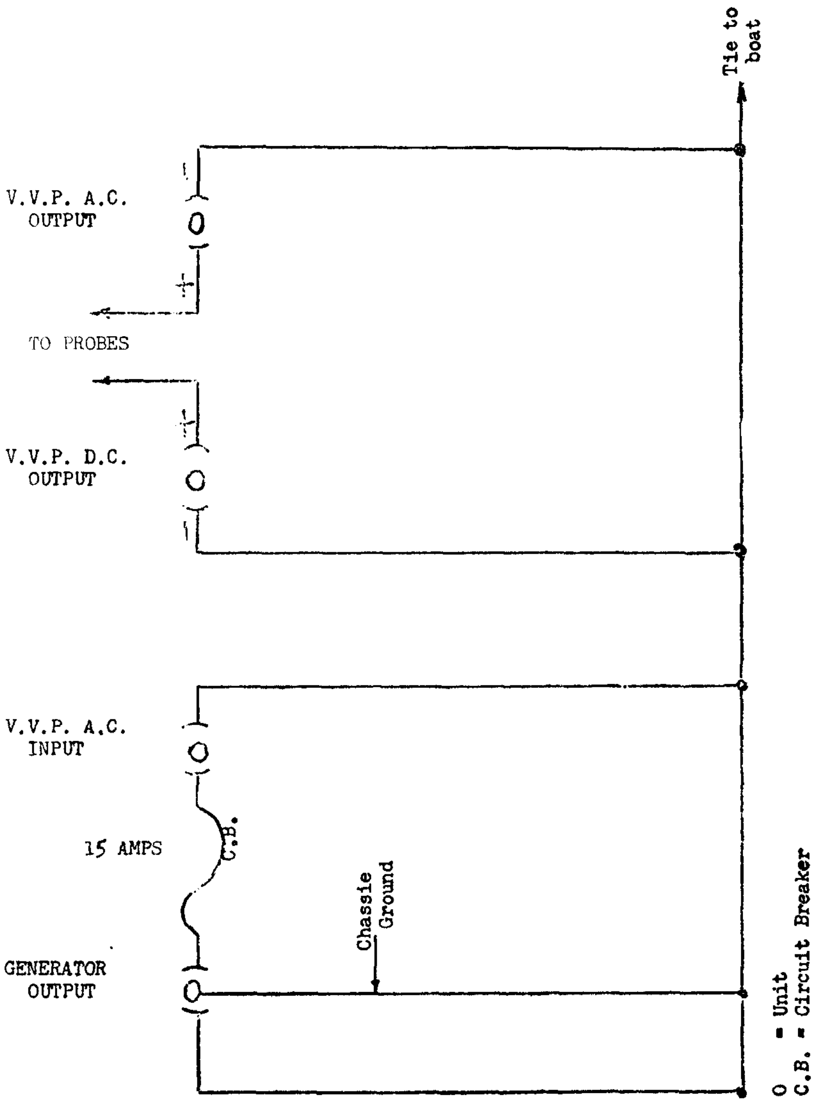
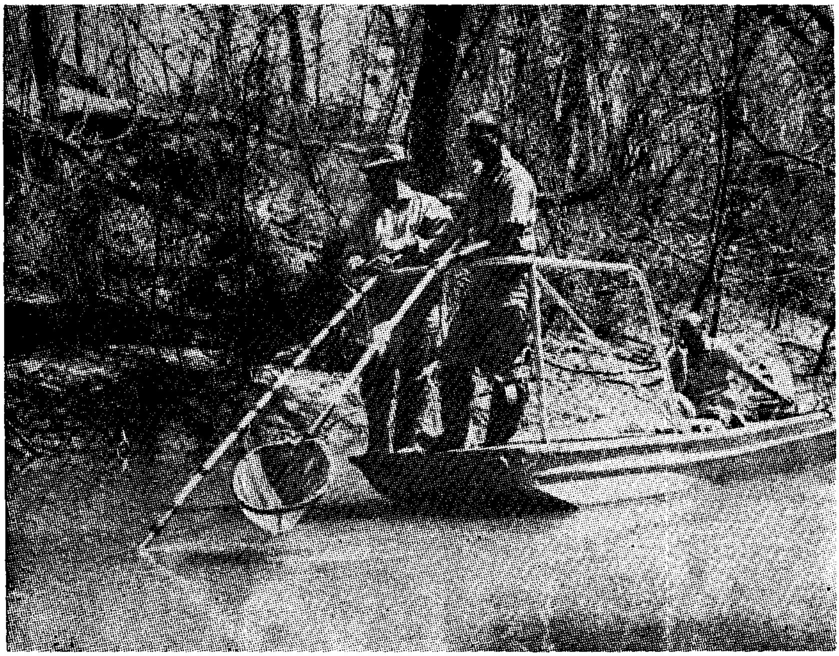
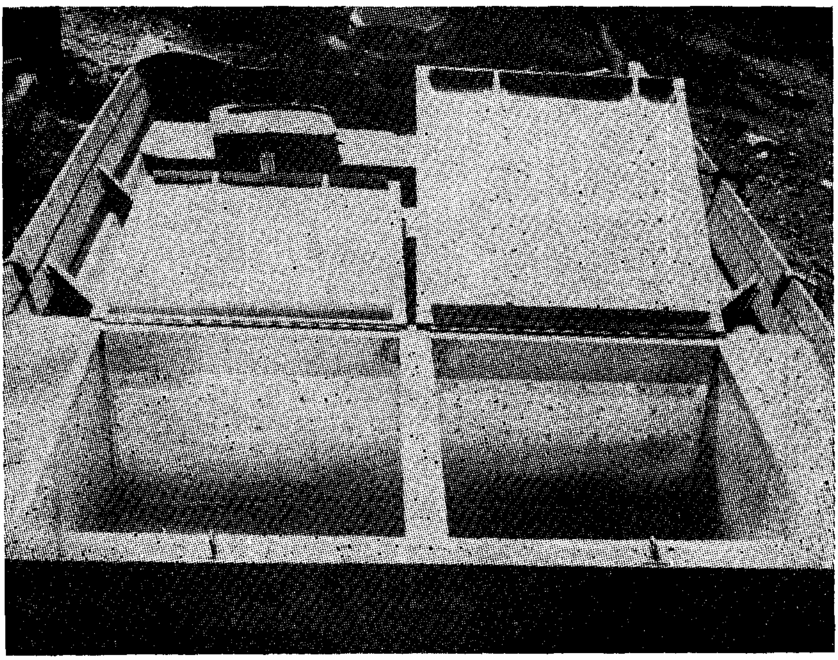


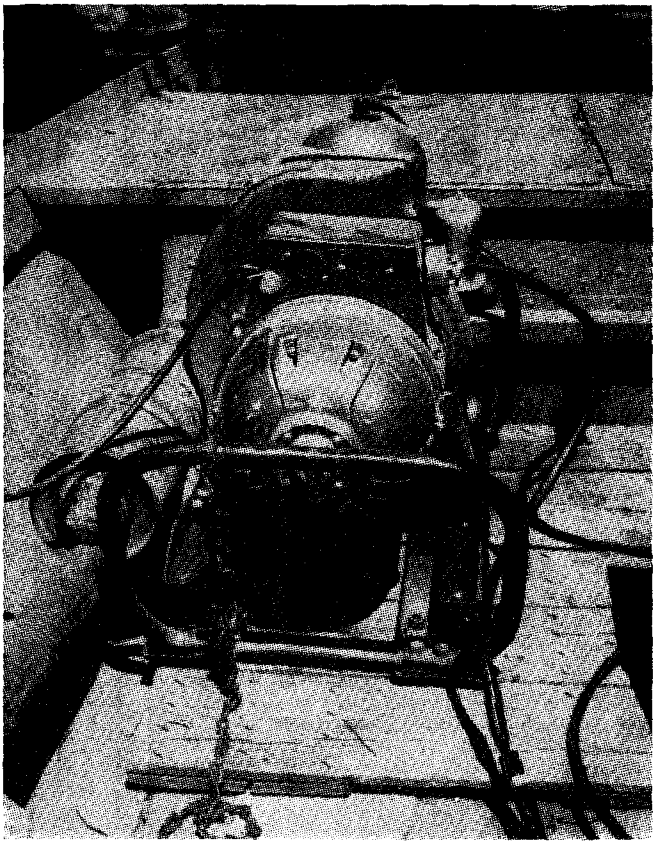
DIAGRAM OF WIRING ON THE ELECTRO-FISHING BOAT



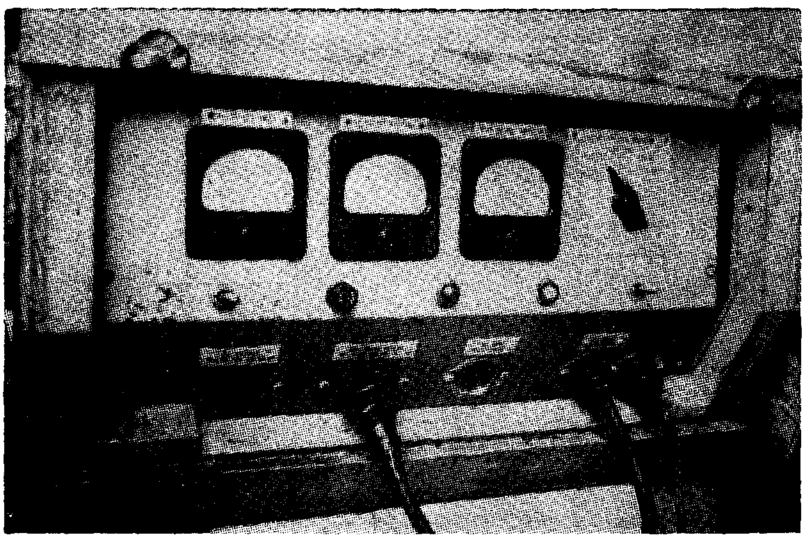
ALUMINUM ELECTRO FISHING BOAT IN OPERATION



LIVE-WELL



115-230 VOLT GENERATOR, EXHAUST PIPE, AND WIRING



VVP WITH INPUT AND OUTPUT WIRES HOOKED UP