FISH80 FISH STUNNER

DANGEROUS SHOCK HAZARD

This device may be illegal to use in certain states-Check with your fish and game department

SPECIAL NOTE If using in a pond or still water it will be necessary to increase the conductivity of the water. This is easily done by throwing in several handful of sea salt or equivalent in the area you are shocking. For those wanting to clean out farm ponds it will be necessary to use up to 50 pounds of sea salt per acre. This amount of salt will not harm anything but will temporarily increase the mineral content of the pond water where it will conduct much better. Wait about an hour for the salt to dissolve before using.

Your FISH8 survey fish stunner is intended for survey tagging and population evaluation of certain target species. The system is designed to operate from a 12 volt battery and draws 2 amps at max output. Unit is shock circuit protected and utilizes our highly efficient induction charging and switching to obtain the high peak currents necessary for the high conductivity often found in brackish waters. A power adjust controls the duration oft the pulse on time hence the current flowing in the water. The pulse repetition rate it factory set at 25 pulses per second. The ratio of the pulse on to off time is controlled by the power adjust control. The output voltage with a load of 500 ohms is over 300 volts peak at a corresponding current of over 1/2 amps!!. ***No load voltage rises to a high value and open circuit operation must be avoided.*** 500 ohms corresponds to a water resistance representing a typical fresh water pond found in southern New Hampshire.
At these parameters the power dissipated into the water is around 25 watts and is effective up to 10 feet from the boat.

Higher voltage units are available but will require a signed "HAZARDOUS EQUIPMENT DISCLAIMER" available on request.
The effectiveness of the system is dependent on the following:

1. Is there the target fish within the area?

2. Are the fish bottom dwellers?

3. The fish size. Larger fish are easier to stun than the smaller ones!

4. Water temperature may be to cold. This is important for proper operation.

5. Use of the correct drag line, chains, wire mesh weights for the particular target fish. Several examples are shown in this data.

Please note the system utilizes a floating output that means you do not have to use the electrical system of the boat or the boat itself as any electrode. You may however choose to do this for certain applications. This is simply done by connecting the negative output lead to the -12vdc input or craft common forcing a grounded return.
A floating output provides a certain degree of safety for the operator as he must make actual contact with both output leads simultaneously to get shocked. If you now ground one of the output leads it is very possible to get shocked just by being in water inside the boat and making accidental contact with only one of the output leads

Preliminary Testing of the Device to Verify Proper Operation.

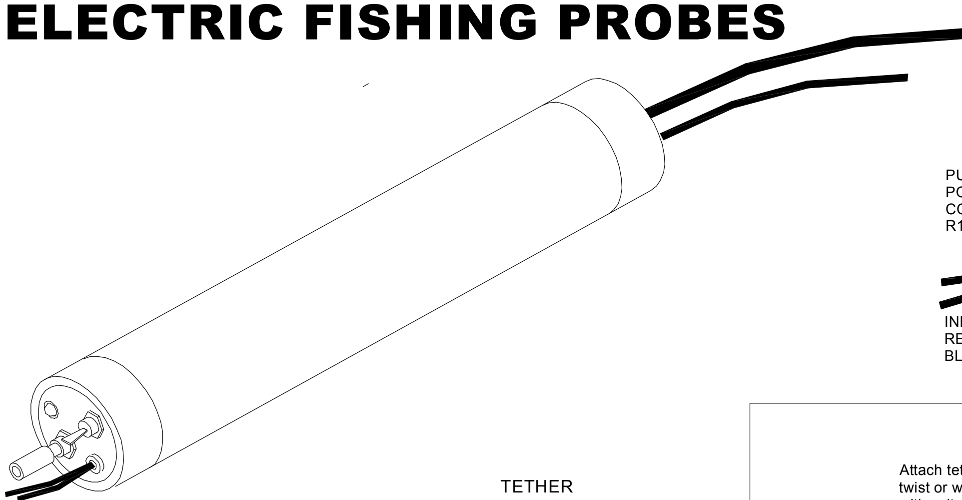
1. Connect output to a household 15 watt 115 vac flourescent lamp.

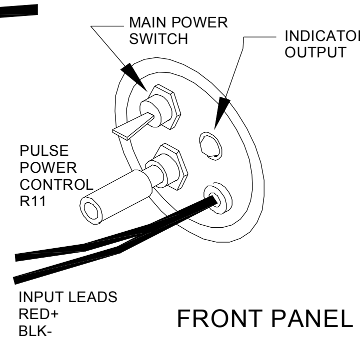
2. Connect input to a 12vdc source or battery capable of supplying 2amps.

3. Turn on power switch and rotate control noting bulb lighting and getting brighter as control is turned clock wise. Note the output indicator LED lighting.

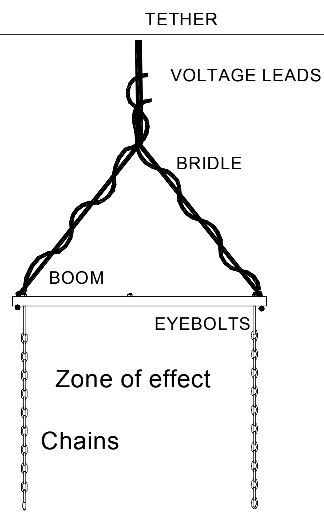
4. Connect up to required electrodes and test on target fish.

ELECTRIC FISHING PROBES

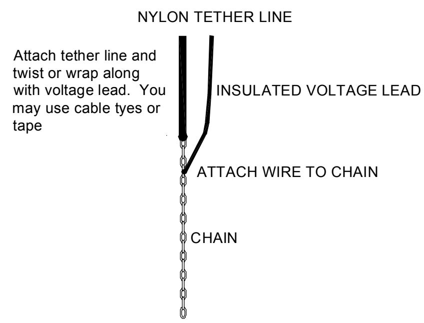




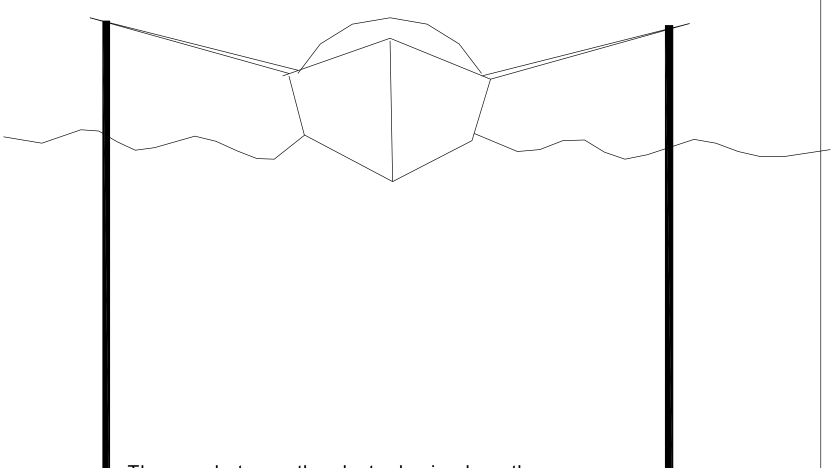
FRONT PANEL



A multi drag line may be made by using a insulated boom and eyebolts to attach the chains. Electrical contact can now be made to each chain by the two output leads creating an electric field between the chains. Any fish between the chains will experience the effect. A tether bridle is made from nylon rope with voltage lead taped or tye wrapped to secure. Note that this approach should not be uesd in waters with a lot of bottom debris that can snag the device.

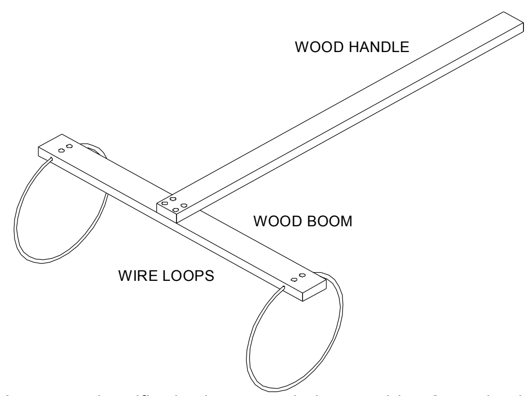


SINGLE SECTION DRAG LINE
ELECTRODE FOR BOTTOM FISH



The area between the electrodes is where the fish will be affected. Most fish will swim towards the positive electrode where as they get closer they become stupified and stunned. The above sketch shows the use of the floating out put approach where no ground is required either to the boat or externally.

You may ground the negative lead using the boat or motor as the contact now requiring only the use of one drag line electrode.



A survey electrifier is shown made by attaching 2 conductive loops mounted at the ends of a wooden boom piece. Our test model was made as shown with a seperation of approx 3 feet between loops. One loop is connected to the positive output lead and the other to the negative. There is no grounding used as current must only flow between the loops. The handle was made from a 6 foot length of 1 x 3 pine with 4 screws attaching it to the boom section. The bare wire loops were pressed fitted into pre-drilled holes through the boom where they were epoxied in place. We used $\frac{3}{16}$" copper tube with approx 18" diameter for our model as it is reasonably self supporting and can be easily reformed if accidentaly bent.

The voltage feed wires can also be slid into the holes for the loops or can attached to the loops by soldering or a wire clamp. The voltage leads are ran up along the sides of the handle where they are connected to the shocker. We actually mounted the shocker and 8 D cell batteries to the handle making a completely self contained system. The voltage leads are taped or clamped into place.

Biological Applications of Voltage Impulses in Electrical Fishing

A. *Reaction of Fish to Direct Current Pulses*

When direct current is applied thru the water in a fish tank, it is observed that most fish swim toward the + anode, but, before reaching it, are usually stupefied and turn upside down. When the current is switched off, they ‘recover and swim away.

There are several phases of reaction as the current is gradually increased.

The **first** visible reaction of fish in a parallel position to the current direction is vibration of their bodies to the current. But if the fish are at right angles to the current, they turn towards the anode.

The **second** reaction occurs when the fish in a parallel position to the current, swim toward the anode. If the fish are in a transverse position to the current, then the body axis of the fish turns parallel to the direction of the current when turned on. But the fish do not in all cases swim toward the anode. That will only occur when a new pulse is given. This second reaction is called galvanotaxis.

The **third** reaction occurs when the fish turn on their sides, toward the anode, and are no longer able to move of their own accord. This reaction is called galvanonarcosis.

TABLE-1 shows the pulse values needed to induce the above-mentioned reactions. The threshold values of the pulses are constant and reproducible for fish of the same species and size. No reaction can be observed from pulses below that given for the first reaction. ***It is significant that these pulse threshold values decrease with the increasing size of the fish.*** The voltage between the head and tail is referred to as the “body voltage”. See TABLE-2.” It amounts, in the case of trout far instance, to 0.4 volt for the first reaction, to 1.2 volts for second reaction, and to 2 volts for the third reaction. Since large fish receive a greater voltage in the water than smaller ones, they can be influenced more quickly and by relatively smaller voltages (TABLE-3).

Fish which receive a lower voltage than that required for galvanotaxis can escape from the field. ‘

TABLE- *I*

VALUES *(#)* OF THE CURRENT DENSITY FOR FRESH-WATER AND SEA FISH

Species of Fish	Length (cm)	Weight	First Reaction #	Second Reaction #	Third Reaction #
Stickleback	*5-6*	*3-4*	*0.48*	*1.88*	*3.94*
Loach	*10-12*	*7-9*	*0.08*	*1.55*	*2.43*
Plaice	*20-22*	*95-100-*	*39.91*	*44.34*	*70.95*
Steinpicker	*8-10*	*14-16*	*18.18*	*50:99*	*115.00*

TABLE -*2*

RELATION OF **BODY** LENGTH TO PULSE THRESHOLD VALUES FORTHE FIRST GALVANOTAXIS AND GALVANONARCOSIS WITH THE MINNOW *(Phoxinus laevis)*°

Length group(mm)	Number of fishes	Medium length (mm)	Rirst Reaction	Galvanotaxis	Galvanonarcosis
15-20	*5*	*19*	*0.19*	*3.30*	*4.74*
21-30	*17*	*24*	*0.18*	*3.13*	*4.74*
31-40	*10*	*36*	*0.13*	*3.32*	*3.94*
51-60	*7*	*57*	*0.11*	*1.43*	*2.50*
61-75	*14*	*66*	*0.13*	*1.28*	*2.15*

TABLE -3

RELATION BETWEEN FISH LENGTH AND CURRENT DENSITY

Length of fish	Current intensity	Current density in water	Voltage at the electrodes	Voltage in the electric field	Body voltage between head and tail
(cm)	IZAff	#	vaff	v~nlcrn	Vfr
3.0	123.0	2.49	11.2	0.476	1.429
3.2	114.0	2.31	10.4	0,425	1.360
4.1	87.8	1.78	8.0	0.342	1.399
4.7	75.6	1.53	6.9	0.293	1.380
5.0	77.4	1.57	7.0	0.301	1.500
5.6	64.6	1.31	5.9	0.251	1.410
5.9	61.4 .	1.24	5.6	0.238	1.405
6:0 ,	60.2	1.22	5.5	0.234	1.402
6.3	58.1	1.18	5.3	0.225	1.420
6.4	55.9	1.13	5.1	0.217	1.390
7.4	49.3	1.00	4.5	0.192	1.420
7.8	47.1	0.955	4.3	0.183	1.430
8.0	43.8	0.890	4.0	0.170	1.360
9.0	39.5,	1.800	3.6	0.153	1.385
10.5	32.9	0.666	3,0	0.128	1.340

Constancy of body voltage for roach (Leuciscus rutilis), Crucian carp (Carassius vulgaris), and bleak (Alburnus lucidus), with alternating current at 50 cps.

B. *Reaction of Fish to Alternating Current*

When alternating current is used, the fish do not swim toward one of the two electrodes, as they do in the case of direct and interrupted direct current (which will be explained later). They take a transverse position to the direction of the current between the two electrodes, namely in such a way that they tap off a minimum voltage. This phenomenon is called *oscillotaxis.*

The colors of the body of a fish narcotized by alternating current fade owing to a pigment contraction. Moreover, most of the fish (for instance, trout, carp, tench, catfish, etc.) undergo a kind of “hypnosis” after the current is switched off. They do not return immediately to normal swimming position, but stay for some minutes in a lateral or dorsal position. When “hypnosis” vanishes, the fish swim away as they do in the case of direct current.

C. Reaction of Fish to Interrupted Current

When using direct current pulses of rectangular form (Fig.-1) or pulsating current in the form of a condenser discharge (Fig. 4), or in the form of a quarter sinus wave (Fig-3), more or less heavy vibrations occur in the fish body, depending on the number of pulses used per time unit. As soon as the pulse threshold for the galvanotaxis is reached, the fish turns and swims toward the anode. This happens with all above-mentioned forms of pulsating currents, except when the current is increased slowly and then decreased steeply. In the latter case, the fish turn toward the cathode, and narcosis occurs in the same way as with direct current.

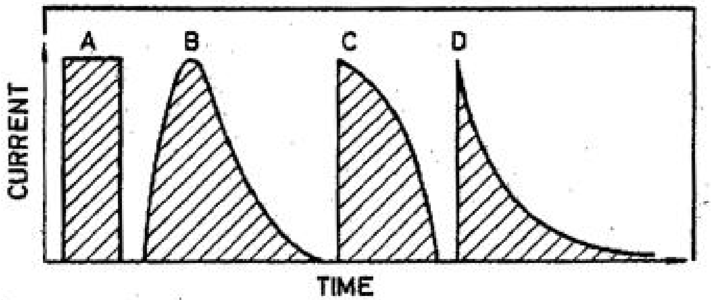


FIG. E14-1. Various current impulses (according to Kreutzer [343)). A-rectangular pulse, B-unperiodic pulse, C-part of a sinus-curved pulse, D-capacitor discharge. By permission from P. F. Meyer-Waarden, "Electrical Fishing," Food and Agriculture Organization of the United Nations, 1957.

By simple algebraic derivation from the formula for the sphere surface one obtains the equation developed by Kreutzer [343, 344, 345] for catching fish in sea water (see Fig. E14-2). The extension of the equipotential lines can be spherical in sea water as well as in conducting fresh water with corresponding electrode shapes and application.

D. *Main Types of Pulses Used in Electrical Fishing*

Owing to the conditions of conductivity in sea water, it is quite obvious that: one cannot work with alternating and direct currents. According to investigations already made, it would be necessary to produce up to approximately 10,000 kw to obtain an electrical fishing range (spherical range) of a radius of only 10 meters. In such a case it is only possible to operate with short pulsesr, such as those of electric fishes. Only 200 to 300 kw would then be required for the same effect. Leduc operated with a current of 100 periods, namely with, impulses of 1 millisec duration, followed by current interruptions of 9 millisecs each. The body voltage of the fish in case of such currents requires an effective; value substantially .smaller than when normal direct current is used. The peak value of voltage used by Leduc amounts to from 1.5 to 2.5 times the body voltage required in the case of normal direct current.

However, as these rectangular impulses with greater pulses of 10 to 20 kamp and 1.5 to 3.5 kv cannot be produced economically, Kreutzer began [343], in the first experiments he made in electrical fishing in 1947, to use currents produced by capacitor discharges with a steep rise and a gradual decrease. It is to his credit that lie recognized then that the shape of the individual impulse is essential. Figure E14-I shows a survey of the several types of impulses. The curve forms A and B are less suited to electrical fishing than the curves C and D. The curve C is specially used to block fish or to guide them in a desired direction by means of--movable gear. It is similar to the type of pulse produced by the electrical eel (Fig. E 14-3).

Curve D is the most effective form of pulse for attaining galvanotaxis. Most fish react to these pulses anodicallv_

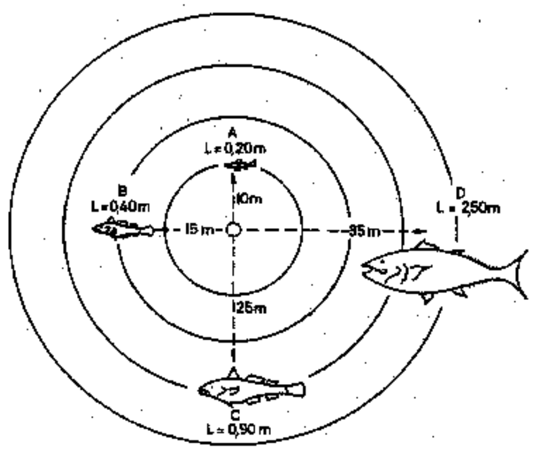


Fig. E14-2. The formula for computing the electrical catching area in sea water (Kreutzer) is:

R=(ILK/4piG)exp1/2

R = catching area (distance from the electrode in meters), I = current potential in water in amp, L = length of the fish in meters, G = body voltage in volts, K, =,specific resistance of sea water (0.3 ohm X meter).

The electrical energy expended for the ranges in this diagram was about 250 kw. Aherring, B, Ccod, D-tuna. By permission from P. F. Meyer-Waarden, "Electrical Fishing," Food and Agriculture Organization of the United Nations, 1957.

Fig. E14-3. Curve shapes of impulses transmitted by the electrical eel (Electrophorus electricus) (300 to 600 volts).

E. *Rate of Pulse*

Moreover, the number of pulses per time unit is decisive for the efficiency of the pulsating current, a fact already recognized by Kreutzer in his first experiments. The pulse rates at which fish are narcotized with the minimum of electrical energy differ considerably for the various species as well as for fish of varying sizes (Table E14-4 and 5). The values found for the narcotizing impulse thresholds are not to be considered as absolute, but as relative values, as they have been measured for certain sizes of fish arid a certain water temperature. They change according to the temperature, the physiological condition of the fish and the size of the fish. The basic differences between the species of fish, however, are maintained.

TABLE E14-4

NARCOTIZING Pulse THRESHOLDS FOR FRESH-WATER, FISH

Species of fish	Average length (cm) .	Voltage of the individual pulse required for galvanonarcosis° (volts)	Narcotizing pulse threshold values’ (impulse rate/ sec)
Rainbow trout *(Salmo gairdnerii)*	15-17	6.5	80
Carp *(Cyprinus carpio)*	12-15	7.5	50
Catfish *(Ameiurus nebulosus)*	14-16	11.5	40
Eel *(Anguilla anguilla)*	20-22	13.5	50
Goldorfe *(Idus melanotus)*	*IS-15*	7.5	30
Stone Perch *(Acerina cernua)*	14-16	7.5	50
White bream *(Blicca bjorkna*	12-15	11.5	40
Minnow (Phoxiieus *loevis)*	7-9	8.5	90
Stickleback *(Gasterosteus, oculeatus)*	6-7	13.5	100
Perch *(Perca fluviatilis*	12-14	9.5	70
Schlammpeitzger *(Misgurnus fossilis)*	24-27	9.5	40
Tench *(Tinca tinca)*	16-18	7,5	40

‘According to Halsband.

‘Note: Size of the experimental basin, 35 x 22 x 22 cm; size of electrode, 22 x 22 em; water temperature, -I- 15°C.

°Measured between the electrodes.

dCapacitor discharge with form D: see Fig. E14-1. .

F. Narcotizing Impulse Threshold

Fish within a specific area remain stunned when they are affected by impulse rates which are above the threshold values required for narcotizing them. But if the impulse rates are kept below the limit which narcotizes them, then the fish swim from a larger area toward the anode and, when they are close to it, become narcotized. With a low pulse rate the required electrical energy is reduced by half as compared with the purely stupefying method. That fact is of great importance to electrical fishing. And because different species of fish react differently to varying pulse rates, and as the threshold values of the pulse rates are known, it is possible to select the fish to be caught by electricity within a certain range according to size and kind. The term “narcotizing pulse limit” was formulated by KreutzerHe was also the first to recognize the importance of this idea for electrical fishing.

TABLE E14-5

NARCOTIZING PULSE THRESHOLDS FOR SEA-FISH AT WATER TEMPERATURE OF -I- IS°C

Species of fish	Average length (cm)	Voltage of the individual pulse galvanonarcosis	Narcotizing pulse threshold hold values required for(impulse rate/ sec)	
A. According to Halsband°				
Fatherlasher (Myxocsphalus scorpius)	15-19	6.2	40	
Eelpout (Zoarces viviparus)	17-21	10.0	60	
Plaice (Pleuronectes platessa)		23-26	10.0	30
Sea burbots (Ciliata mustela)		16-17	11.5	60
Smelt (Osmerus eperlanus)	I 5-22	12.0	50	
Flounder (Platichthys Pleuronectes flesus)	16-20	11.5	40	
B. According to Kreutzer				
Herring of medium size	-	-	45	
Cod of medium size	-	-	25	
Red tuna (200-300 kg)	-	-	7-10	

°Measured in the experimental basin 35 x 22 x 22 cm; size of electrode 22 x 22 cm.

The importance of the size of the fish in relation to the narcotizing pulse limit can be explained as follows (Fig. E14-4). Each pulse causes a vibration of the muscles in the fish. If the next pulse occurs before the mechanical movement caused by the preceding pulse ends, the muscles are continuously stimulated and cramp sets in. This phenomenon is slower irt developing in larger fish because larger masses of muscle have to be moved, and big fish do not, therefore, require such a quick sequence of pulses to produce cramp as small fish. Of course, a small fish can also be narcotized electrically at low pulse rates, but the length of the pulses must be substantially greater or the pulse voltage must be greater, and that would mean deviating from the desired minimum of electrical energy, at which the necessary effect would just be reached.

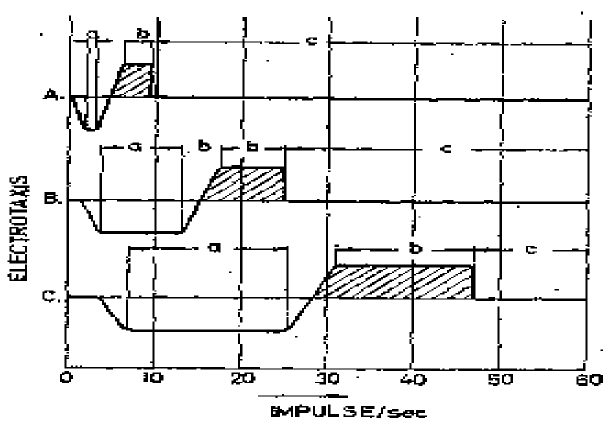


Fig. E144. Influence of impulses per second on various fish (according to Kreutzer [343]). A-tuna, B-cod, C-herring. (a) Possibility of escaping, (b) Swimming towards the anode, (c) Electro narcosis. By permission from P. F. Meyer-Waarden, "Electrical Fishing," Food and Agriculture Organization of the United Nations, 1957.

The battery gear developed by the Institut fur Kusten-und Binnenfischerei, Hamburg, does not operate with a vibrator, transformer or converter, but with current taken from a 12 volt battery which is passed over a switch shaft specially designed for the .purpose (Fig. E14-5). The switch shaft is driven by a small motor. When it turns on around 360°, the capacitors are switched twice in parallel and twice in series. Forty capacitors loaded in parallel and discharged in series thus produce a peak voltage of 480 volts. By turning the switch shaft either quickly or slowly the impulse rate (in contrast to the previously mentioned pulse gear) can be altered in any desired way and the gear adjusted to a certain extent to catching the various species and size of fish. By switching to several sets of capacitors, the impulse period can be adjusted and thus the gear can be adjusted to varying conductivities of water. This impulse gear can also be used in larger waters. For that purpose it must; depending on the area of the water, have correspondingly greater energy. This can be attained by (a) a larger size of the gear, or (b) connecting the gear to gasoline generators of 0.6 to 5.0 kw.

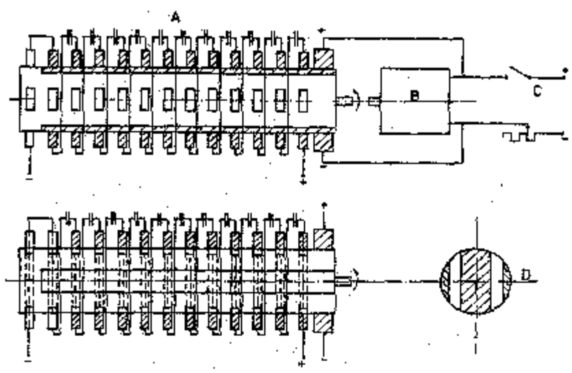
The blocking or driving effect is now being used in fresh water for the following purposes:

(a) As barriers for controlling the migration of Chinese crabs.

(b) To prevent fish from being driven into turbines and pumps of hydroelectric plants, dams, etc.

(c) For guiding fish to fishways and into new river systems.

(d) For fencing off water areas which are to be managed (for anglers, etc).



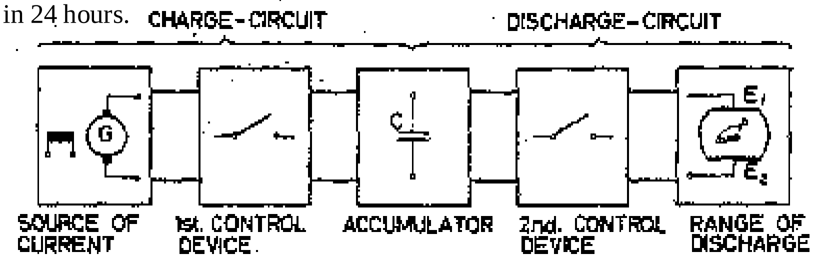
E14-5. Diagram showing connection of an impulse gear designed by Halsband and Ploger [337]. According to the number and size of capacitors the gear can be used for fishing in fresh waters (with conductivity values of 1000 to 15,000 ohms x cm, and also for killing fish in sea water. However, the range in sea water is only 1.5 to 2 meters radius. The gear operates with 12 and 24 volt batteries respectively. Aswitch, B-motor, C-battery, D-axis of the switch. By permission from P. F. Meyer-Waarden, "Electrical Fishing," Food and Agriculture Organization of the United Nations, 1957.

As the Chinese crab *(Eriocheir sinensis),* originally from China, is considered a great pest to shore installations and gear, electrical experiments were carried out in Germany to kill or damage the young Chinese crabs which are born in the North Sea and ascend the rivers in Spring in immense swarms. A similar attack was made on the old crabs descending to the sea for spawning.

Fences were designed similar to the electrical screens in rivers, bearing in mind that it is the particular characteristic of Chinese crabs to wander along the river bottoms, and the electrical fence was installed on the bottom across the river. Two wires were used, about 40 cm (16 inches) distant from each other. Later it proved practical to install a second pair of electrodes between the first, so that each of the interior electrodes was 16 cm (64 inches) from the nearest outer electrode. A galvanized 8 sq mm iron cable consisting of 11 wires, strengthened by a 3 sq mm bright copper wire, was used to prevent a big drop in potential. As the river Elbe was 330 meters (2800 ft) in width at the place of experiment and the unavoidable drop in potential threatened the efficiency of the fence, a second current supply was installed in the middle of the electrical fence by using an underwater copper cable of 2 x 35 sq mm in cross section. The electrodes were fastened with clasps to oakwood blocks of 400 x 80 x 30 mm. The chain was anchored by means of large stones at about 10 meter (33 ft) intervals to prevent it being driven away by the relatively strong current of the river. In this way three electrical fields were produced. Crabs, which entered the electrical field during an interruption of the current, got no further, at best, than the interior electrical field, where they usually grabbed, in a state of cramp, the two electrodes situated at 8 cm (3j inches). Numerous electrical shocks finally killed them. Three methods were investigated, all of which worked successfully. The first used alternating current which was interrupted by a cam switch; the second operated with pulsating current; and the third used, like the first, alternating current, but it was controlled by a 2-thyratron ignition system.

For the latter method a similar device is used as for a fish barrier. From the lighting circuit the current is passed over an ignitron, which is controlled by a thyratron, with adjustable frequencies, and sent into the chains of electrodes. The ignitron potential of the ignitron amounts to 300 to 500 volts. The diagram of connections is shown in Fig. E14-6. It was found that 30 to 40 pulses per minute were particularly effective for damaging the crabs. The advantage of the equipment used is its reliability.

As mentioned above, all three methods were successful. While all the crabs were not killed outright, all of them entering the electrical field lost their limbs and usually died in 24 hours.



Fir,. E14-6a. Basic principle of producing impulse current (according to Haier 1334]). By permission from P. F. Meyer-Waarden, "Electrical Fishing," Food and Agriculture Organization of the United Nations, 1957.

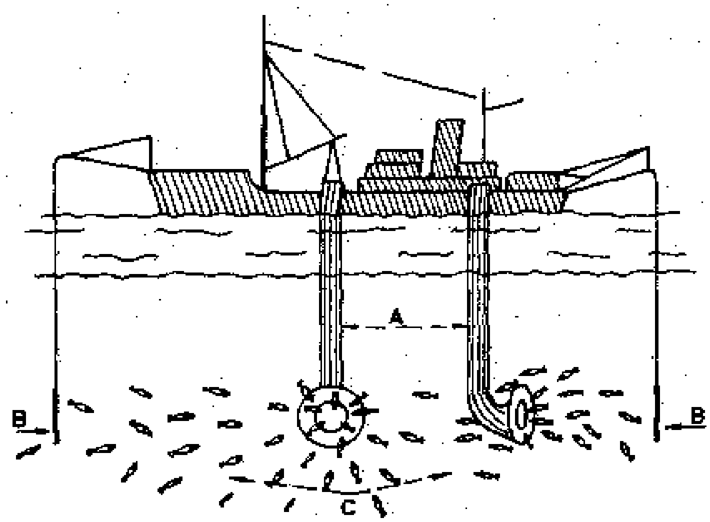
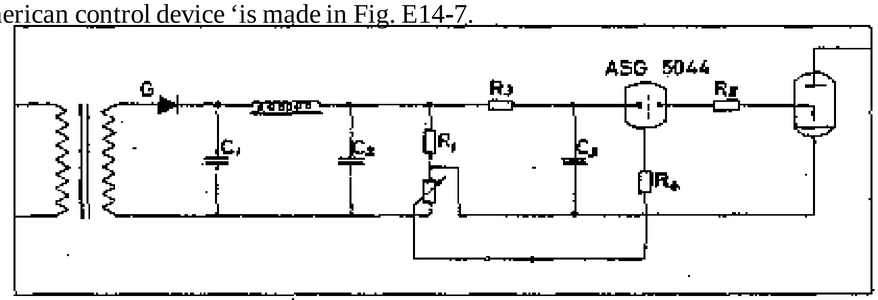


Fig. E14-6b. Diagram of electrical fishing (according to Skoskiewicz [3581). A-Fish section pump; B-Electrode; C-Electrical field. By permission from P. F. Meyer-Waarden, "Electrical Fishing," Food and Agriculture Organization of the United Nations, 1937.

In larger rivers with stronger currents, such as the river Elbe, these installations meet some difficulties. The fencing wires get easily covered with sand, thus reducing their efficiency. The wires must be lifted from time to time to shift the sand. A comparison between a German and an American control device 'is made in Fig. E14-7.



E14-7a. Diagram of a controlling device for Chinese crab or fish barriers. C,, C2 and C$-capacitors; G-rectifier; R,, Re, R4 and R6 rheostats; ASG-ignftron. By permission from P. F. Warden, "Electrical Fishing," Food and Agriculture Organization of the United Nations, 1957.

FIG. E14-7b. Diagram of an American controlling gear. The gear produced impulse current by means of a tube system. Several governing tubes (american thyratron) and a discharge tube (american ignitron) are built in. The current produced is quadratic. Compare the diagram of a german barrier in Fig. E14-7a. By permission from P. F. Meyer-Waarden, "Electrical Fishing," Food and Agriculture Organization of the United Nations, 1957.