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Measurement of irrigation water - How to make and use the 90 degrees V-notch

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HOW TO MAKE AND USE THE 90 DEGREES V-NOTCH

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WHEN irrigating by means of a pump delivering water from a river or creek, the first thing to be done is to have the area to be irrigated surveyed. From this survey it can be seen where the head-ditch will have to be placed. Where the land slopes away from the river, there is generally a high ridge between the river and this land. The right position for the head-ditch is just over the ridge, away from the river as shown in Fig. 1. This is necessary to prevent erosion of the bank in the event of a break occurring in the head-ditch. As soon as the head-ditch has been set out, the position of the stilling pool is indicated, as this is at the highest point on the head-ditch. This point is sometimes at the beginning, or somewhere towards the middle of the head-ditch.

The position for the pump is now selected; this will be near a good pool with a slope which will allow easy access, and room enough for good installation; close to the water and not too far above the water-level. About 15ft. above the water-level is the limit to get the best results from the pump.

The next step is to set out the delivery pipe-line, from the stilling pool to the pump, in a straight line, avoiding bends and angles.

The survey will show, how many acres can be irrigated and how much water will be needed, and hence the size of the pump. And this again decides the size of all the piping. All this information is available to farmers through the Irrigation Branch of the Department of Agriculture which, in addition, will supply a precise lay-out,

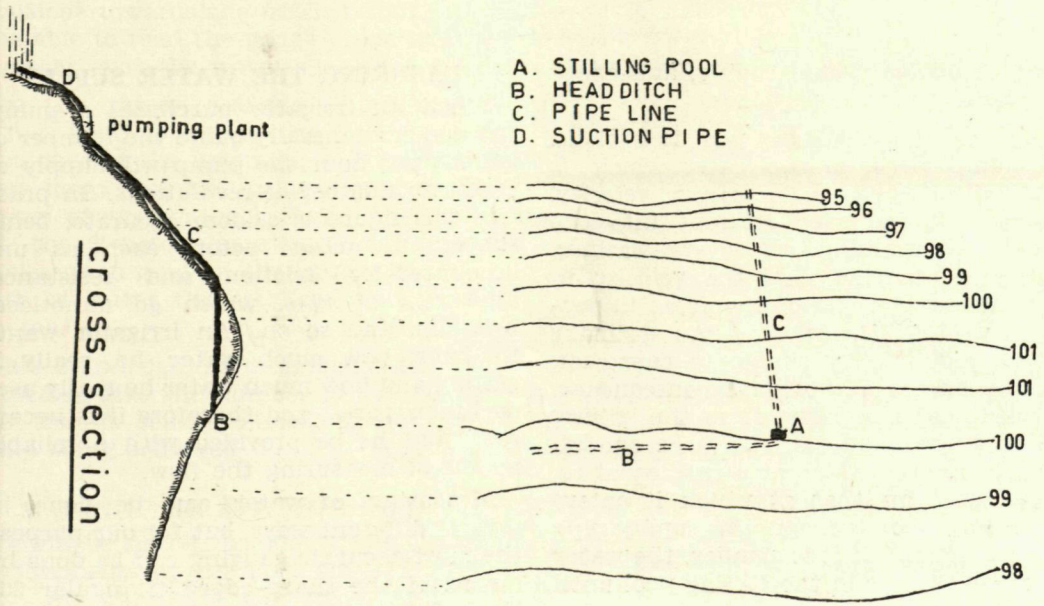

Fig. 1.—Diagram showing desirable positions for pump, stilling pool, head-ditch, etc.

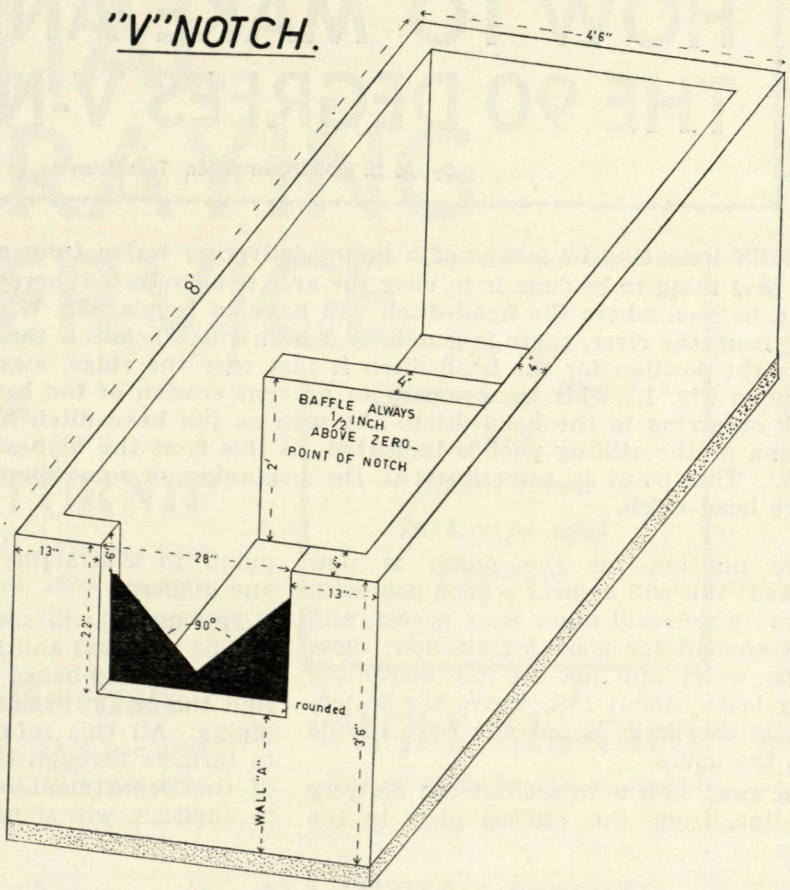

Fig. 2. — Isometric drawing showing details of stilling pool with V-notch.

and give advice as to grading, and check the grading as it takes place.

The need for a stilling pool is obvious. The pump gives to the water which is being discharged a whirling velocity, which, if it were led straight into the head-ditch, would cause severe washing away and scouring, and the velocity in the head-ditch would be too great to permit control of the water. An ordinary stilling pool is very simple to construct, and the size is of no great consequence, provided that the outlet from the stilling pool into the head-ditch is large enough to discharge the water at a rate equal to, or greater than that at which it enters the stilling pool through the supply pipe from the pump. If it is smaller, the water will of course rise in the stilling pool until it flows over the sides.

MEASURING THE WATER SUPPLY

When an irrigator purchases a pump, the makers generally quote the number of gallons per hour the pump will supply at a certain number of revolutions. In practice this figure is seldom accurate, being subject to many factors such as unaccounted-for friction and resistance, alteration of revs. which go unnoticed, belt slip, and so on. An irrigator wants to know how much water he really is getting and how much water he really uses on his pastures, and therefore it is necessary that he be provided with a reliable means of measuring the flow.

Measuring of water can be done in several different ways, but for our purpose the most accurate gauging can be done by means of the sharp-edged triangular 90° V-notch.

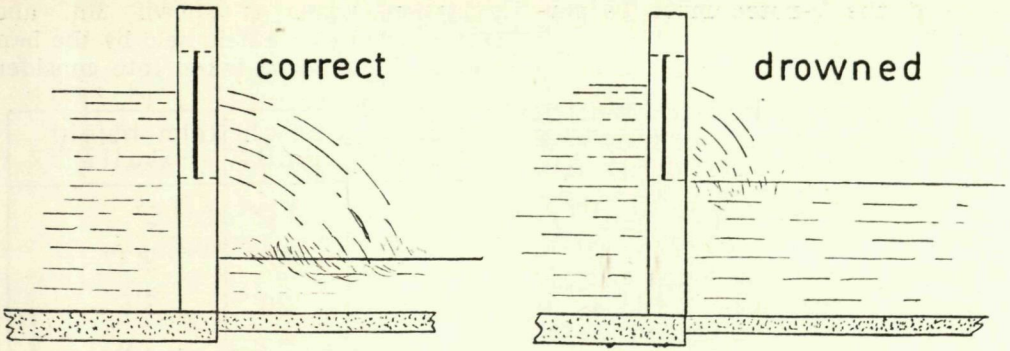

Fig. 3.—At least eight inches of free fall is required on the outflow side of the notch.

Such a V-notch can be installed permanently at the end of the stilling pool (see, Fig. 2) and every drop of water before it enters the head-ditch, passes through this notch.

To ensure the proper working of the V-notch, the all-important factor is that the water leaving the notch must have a free fall of at least 8in. If this is not provided, the notch cannot gauge accurately and may even become "drowned," and useless. (Fig. 3.)

When due attention is paid to this free fall, then the only other thing needed is to place a graduated scale in the stilling pool a short distance back from the V-notch, so as to be out of the area where downslope towards the notch occurs. And to be able to read the gauge properly, it is necessary that the water should be calm.

For this reason a baffle is put in the stilling pool, to check the velocity and turbulence of the incoming water. As the water flows over the baffle, it leaves the surface of the water between the baffle and the V-notch practically calm and enables us to read on the gauge the exact depth of water that is flowing over the V-notch.

This knowledge, as described later, can be used to give the number of gallons per hour that is being pumped, or the acre-inches being delivered.

MAKING THE STILLING POOL

As will be seen from Fig. 2, the outside measurements of the pool are 8ft. x 4ft. 6in. All walls are 4in. thick and the bottom is 3in. thick. The baffle is 4in. thick and is located 3ft. from the V-notch end of the pool and 4ft. from the end which takes the delivery pipe from the pump.

The delivery pipe may enter through the end or the side, near the bottom of the pool, and always behind the baffle.

The depth of the pool will be influenced by the depth of the head-ditch. In the diagrams we have shown this as 12in. (Figs. 2 and 4) but this can be variable and Table A shows the wall heights for four different depths of head-ditch.

For the 12in. deep head-ditch we excavate to a depth of 15in. which is the 12in. actual depth plus 3in. for the thickness of concrete at the bottom of the pool.

Concrete Used.

The stilling pool requires about 39 cubic feet of concrete made from 1 part cement; 1½ parts sand and 3 parts coarse aggregate. About 9 cubic feet will be needed to put in the bottom of the pool.

The V-notch.

This is made from an 18in. x 32in. sheet of heavy-gauge flat iron such as could be obtained by flattening a section cut from a 44 gallon drum. The actual notch is cut on a perfect right-angle (90 degrees) and is 13in. deep and 26in. wide as shown in Fig. 4. The point at the lowest part of the notch is 3in. above the concrete, and a 2in. flange below this, and at the sides of the plate, is inserted into the concrete to hold it firmly in position.

The edges of the V are bevelled to a knife-edge with the bevel on the outside or downstream side of the pool. The

shoulders of the V-notch must be perfectly level.

The Gauge.

Used in conjunction with the V-notch is the graduated scale previously referred to. This is simply a length of flat iron, steel rod, or piping inserted as a permanent fixture in the concrete to indicate the depth of water flowing through the notch.

It is located between the baffle and the notch and far enough from the baffle to be out of the area where the surface of the water curves downards in the outflow. A suitable position is close to the wall and about a foot back from the notch.

The gauge is set firmly in the concrete bottom of the stilling pool and should be painted, preferably with a bitumastic paint, to prevent rust damage.

The nought or zero mark on the gauge must be on exactly the same level as the lowest portion of the notch where it comes to a point. An accurate method of ensuring this is to fill the pool and allow the water to run until it ceases to overflow the notch. The zero mark is then made on the gauge at water-level and the inch and half-inch marks put in above this point.

Building the Walls.

After the layer of concrete has been put down at the bottom of the excavation, the walls at the sides and back are built up, leaving an opening for the delivery pipe.

The front wall, marked "A" in Fig. 2 needs particular care in its construction. It is first built up to a height of 12in. for a 12in. deep head-ditch (Fig. 4). As the head-ditch in this case is intended to act as an irrigation ditch, the level of the irrigation water is shown 3in. above ground level where it is held by the banks and this had to be taken into considera-

depth ditch	height wall "A"	total height walls
6"	14"	3'
9"	17"	3'3"
12"	20"	3'6"
15"	23"	3'9"

Table A.—Wall heights for different depths of head-ditch.

tion when allowing a full 8in. free fall from the V-notch.

The wall "A" is therefore built to a height of 12in. + 3in. + 5in. or a total height of 20in. and the plate for the V-notch is embedded 2in. so that the lowest portion of the V is 3in. above the concrete. At this stage check the shoulders of the V for level and ensure that the bevel is facing outward.

Now continue to build up the front wall by adding the two side-pieces leaving a space of 28in. in between them to take the 26in. wide V with a 1in. shoulder at each side.

To facilitate the free flow of water from the V, the cement below the V has its edge rounded off, as indicated on Fig. 2.

The Baffle.

This, as stated earlier, is located four feet from the delivery pipe end of the pool and is 4in. thick. It is carried up to a

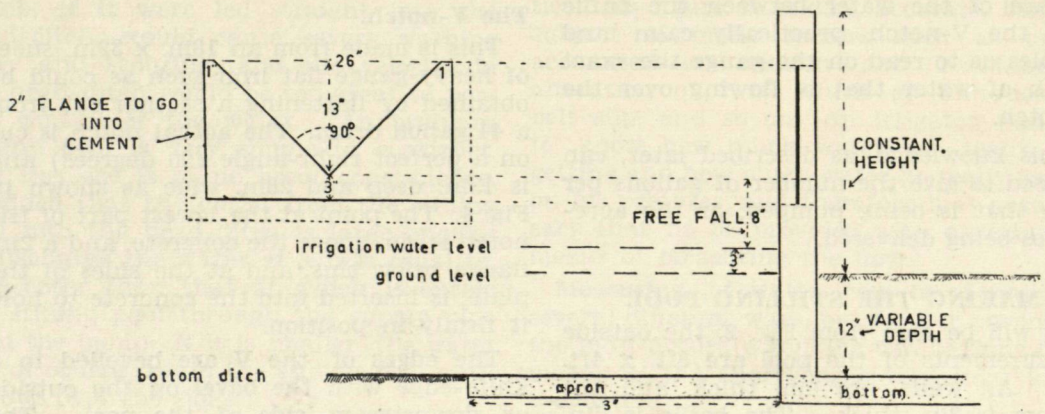

Fig. 4.—Details of the V-notch.

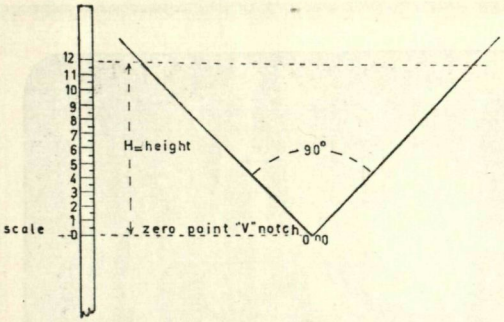

Fig. 5.—Installing the gauge.

height of 1in. above the lowest point of the notch. The baffle does not have to be watertight and may be built of bricks or blocks if desired.

Protection.

Provision must be made to protect the head-ditch from erosion caused by the water falling from the V-notch. A cement apron is laid down so that it is level with the bottom of the head-ditch (see Fig. 4). The side walls of the ditch at this point are also protected by a concrete facing.

MEASURING THE FLOW

To find out how many gallons per hour the pump is delivering, or what this means in terms of inches to the acre, it is only necessary to read the gauge showing the depth in inches of the water passing through the V, and then to refer to Table B.

For example, if the water is up to the 10in. mark, the output is 36,032 gallons per hour or approximately 1.6 inches per acre per hour. At 6½in. the output is 12,400 gallons or half an inch per acre per hour.

TYPES OF DITCHES

Three types of ditches are used in irrigation.

Head ditches receive the water from the Government supply channels or from pumps. They are much bigger than the ordinary irrigation ditches, although they often serve as irrigation ditches and are generally laid so that they are almost following the contour lines but with a gentle fall. They can be deeper than the ordinary irrigation ditches.

Irrigation ditches are the ordinary ditches from which water is taken off to irrigate the pastures, etc. They are small ditches and are usually shallow with banks which hold water above the level of the ground to be irrigated. Irrigation ditches usually are built with only slight fall so that stops are unnecessary.

Connecting ditches usually link up the irrigation ditches and sometimes have so much fall that series of stops have to be inserted. As water is not taken directly from the ditches, this does not matter.

TABLE B.—SHOWING GALLONS AND ACRE-INCHES PER HOUR.

Scale Reading.	Gallons per Hour.	Inches of Cover per Acre per Hour (approx.).
1	292·5	....
1½	335·1	....
2	668·2	....
2½	1,070·4	....
3	1,860·0	0·07
3½	2,684·0	0·11
4	3,692·0	0·16
4½	5,053·0	0·2
5	6,515·0	0·3
5½	8,262·0	0·3
6	10,221·0	0·4
6½	12,400·0	0·5
7	15,006·0	0·6
7½	17,803·0	0·8
8	20,802·0	0·9
8½	24,126·0	1·0
9	27,710·0	1·2
9½	31,719·0	1·4
10	36,032·0	1·6
10½	41,738·0	1·8
11	45,611·0	2·0
11½	50,462·0	2·2
12	56,609·0	2·5
12½	62,405·0	2·8