Home Made Irrigation Devices

by

H. E. Murdock and J. R. Barker

Figure 3, Log Grader.
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INTRODUCTION.

Crop yields are materially influenced by the farming methods used and by the thoroughness with which these methods are carried out. Especially is this true for the yield of crops under irrigation. Irrigated crops must produce greater yields than dry land crops on account of the large investment, annual maintenance cost, cost of preparing land, and cost of irrigation.

The expense of preparing land for irrigation is a permanent investment which if properly incurred will yield a high rate of interest. To get the highest yield water must be distributed evenly. The surface of the soil must be smooth. The soil must be loose so the water will penetrate, and methods of irrigation should be used which will insure even distribution. When the work is properly done the water will be easily distributed and the waste will be a minimum.

CLASSIFICATION.

The devices used for preparing land for irrigation may be classed according to their use under the following heads:

1. Clearing.
2. Breaking.
4. Leveling.
5. Preparing the land for the different methods of irrigation.
7. Checking and diverting the water.

1. CLEARING.

Sage brush can be easily broken off at the ground surface by the method commonly called “railing.” This consists of dragging a railroad rail over it using a strong team at each end. The rail is dragged twice over it. The second time in the opposite direction to the first. Sometimes when a rail is not available a heavy timber is used but the results are not quite so satisfactory. Straight rails are generally used but it has been claimed that they give a little better satisfaction and are more effective in tearing out and breaking off the brush if bent in a V shape. The little sage brush that remains unbroken after this treatment can easily be plowed under or cut off with a mattock. After railing, the sage brush is raked into piles for burning. In districts where the soil blows very badly the sage brush is left in windrows 30 to 50 feet apart for a year or two to serve as a windbreak while the intervening land is cultivated.

There is also a type of sage grubber called the “Twin Falls Grubber.” This consists of heavy steel knives suspended from a rigid frame work carried on two wheels. The knives are set in the form of a V with the point ahead. They are arranged so
that they can be adjusted to cut a few inches beneath the surface. This implement can not be used successfully in stony ground.

2. BREAKING.

Breaking the land and plowing under small vegetation is done with manufactured implements and requires tractors or large teams for power. Home-made implements are not used at present for this work.

3. GRADING.

The most expensive operation on most farms is the grading down of the high places and filling in the low places. A contour survey is very desirable in helping to locate high and low places and almost a necessity when leveling to a true surface for some methods of irrigation. Loose soils will not generally require plowing before grading is done but for heavy soils a disk or plowing is necessary. It is not necessary or even desirable to give the final preparation to the land the first year for the method of irrigation which will ultimately be used, because it is not always easy to determine the best method until it is irrigated once or twice, because most arid soils settle some when water is applied to them, and because it gives the farmer a chance to use returns from the first crop in the final preparation of the land. However, it must be kept in mind that some definite irrigation system should ultimately be used and that the better the land is prepared for that system the easier and more cheaply will be the work of irrigation.

There is a variety of tools suited for grading land and the ones best adapted to any particular job will depend on the amount

![Figure 1, Scraper.](image-url)
of earth to move and on the length of haul. For long hauls and large amounts the Fresno or some wheeled scraper is the best implement. When this is necessary the land over which the hauling is to be done should not be plowed before the grading. For short hauls and lesser amounts, the buck scraper, figure 1, and log grader, figures 2 and 3, are very efficient implements. The buck scraper consists essentially of a scraper board 10 to 16 feet long and 2 feet wide, shod along the cutting edge with a steel face, and a tail board with a lever and quadrant for setting the angle of the cutting board. The smaller size requires four horses and the larger size six horses.

The log grader consists of several 2-inch planks bolted together. The front plank is made in a wedge shape and is bolted on with the wide edge down. To do the best work there must be a steel plate on the front edge as shown in figure 2. It can be made in three or more lengths of 10, 16, and 20 feet, requiring four, six, and eight horses respectively.

The board across the top acts as a lever and when the driver desires to have the grader cut deeper he steps forward; when a low place is reached and he desires to dump the load he steps back and tilts the forward edge up which gradually dumps the dirt.*

*Bills of material for home-made implements are included in the back part of this circular.
4. LEVELING.

The purpose of leveling devices is to plane the surface and even up the small inequalities left by the plow and grader. The land must be plowed before the leveler will work to advantage. Leveling, or floating, as it is sometimes called, must be done at a time when the soil is rather dry, as it will roll up when too wet. The leveler or float should pulverize the clods and pack the soil as well as even up the surface. The leveler is one of the most important and useful implements in irrigation farming and should be used every time the land is prepared for a crop.

Levelers are constructed in many forms but to do the best work they should be at least three times as long as wide. The usual size for four horses is 6 feet wide by 18 feet long. Two runners or side pieces 2x8 or 2x10 inches by 18 feet are placed on edge and cross pieces are fastened between and at right angles to the runners. The center cross piece can be made stationary or to act as a grader blade with a handle as shown in figure 4 so the driver can cut high places and dump the dirt in low ones.

Rollers can also be attached, as shown in figure 4, which will help to pulverize and pack the soil. The front and rear cross pieces have a slant backward toward the bottom of 1 horizontal to 4 vertical. Sometimes the side pieces are extended back beyond the rear cross piece four or five feet so that when a hole or low place is crossed the runners hold the rear cross piece up while the dirt dragged by it is deposited in the low places. Fields should be floated both ways to insure a good seed bed and a smooth surface for irrigation.
3. PREPARING LAND FOR DIFFERENT METHODS OF IRRIGATION.

a. Ridgers.

The border method of irrigation consists in irrigating strips of land confined between low flat levees extending in the direction of the steepest slope. Water is turned in at the upper end of the strip and travels toward the lower end in a thin sheet. These levees or ridges which confine the water to the strip are first made with a Fresno scraper driven back and forth across the piece at right angles to the direction of the levees and earth gathered evenly between levees. The earth is dumped at each levee forming a rough ridge. This ridge is then shaped up with a device similar to the one shown in figure 5. The strip of land between the borders should be level crosswise. The borders should not be made with a plow because a depression at the side of the levee will gather the water and convey it directly down the slope as a ditch. After the levees are shaped with a ridger they should be gone over lengthwise with a two-section drag harrow in such a manner that one section will drag on each side of the levee. When finished the border will be from six to eight inches high, and eight feet wide, and will not interfere with seeding and harvesting of crops. Another machine used to make levees is shown in figure 6. This large machine ridger is used by the Canada Land & Irrigation Co. in Alberta, Canada. It is 50 feet wide and gathers the soil over the entire surface of a strip of that width.
In some sections of Montana where the precipitation is very limited and where there are no running streams available from which to divert water for irrigation, it is desirable to hold all the water possible in the soil. A method which has become popular is to build a series of contour dikes, on land that is smooth
and does not have more fall than one foot in one hundred. The water is diverted into the first miniature reservoir, called a check, and by means of a spillway on the end of the dike, the water pours into the next check and so on. The method is essentially the same as the contour check method used in the southern states for the irrigation of rice, and is described in another circular recently issued by the Extension Service.

The dikes forming the checks are generally plowed, throwing a couple of furrows each way, and then smoothed up with a diker similar to the one shown in figures 7 and 8. It consists of two 2x12 inch planks 12 feet long, joined by cross pieces 8 feet long, and a V-shaped piece made of 2x12-inch planks 12 feet long. The V-shaped piece is fastened to the runners at the front end and the pointed end is fastened on top of a cross piece at the rear.

This size will make a dike eight feet wide at the base and one foot high. If a greater height is desired the runners would have to be made wider which would elevate the apex of the V and make a dike as high as the runners.

c. Furrowers and Corrugators.

The furrow or corrugation method of irrigation is used for irrigating alfalfa, grain and other field crops, as well as for gardens and orchards. (See figure 9). It consists essentially of irrigating in small furrows which generally run down the steepest slope. The furrows for field crops are from one and one-half to four feet
apart and from three to six inches deep depending on the crop and soil. Generally, the more compact the soil the closer they are spaced in order to give the water a chance to soak between them, but in very sandy soil there is very little sidewise movement of the moisture and this method of irrigation is not well
Corrugations are sometimes used as an aid to spread water in the flooding system of irrigation. Furrows are generally made from six to eight inches deep with some kind of plow, and are employed for row crops and orchards. Corrugations are made with a corrugator or marker not over six inches deep and are employed for hay and grain crops. The amount of water used in each furrow will depend on the slope and length of the furrow. The length of the furrow or distance between distribution laterals will in turn depend on the slope and kind of soil. The amount of water used is between 1-100 and 1-15 cubic foot per second for each furrow. In other words a cubic foot per second is divided between fifteen to one hundred furrows. After the water has run nearly through the furrow the amount is cut down so that it will have time to soak between the furrows without much wasting at the lower end.

Grain is seeded and before it comes up the furrows are made. The furrows do not cause much inconvenience when harvesting as the machinery is generally run in the direction of the furrows.

Figures 10 and 11 show a home-made corrugator. The double runner has an advantage over the single runner because it will not clog so much where weeds, stubble and brush are troublesome. The front runner acts as a cleaner and gives the rear one, which is shod with a steel plate, a chance to make a good clean furrow. The one shown in the cut is adjustable for depth but not for

Figure 11, Corrugator.
spacing of furrows. The device shown for raising it out of the ground when turning at the ends and transporting to and from the fields is very convenient. Corrugators have been made for three and four corrugations, but they do not work very satisfactorily and are generally abandoned for the two-runner type.

6. DITCHING.

The system of irrigation generally practiced in Montana requires a system of ditches which commands the higher parts of the field. They are spaced so the fields can be flooded between them. One system is to build the laterals down the steepest slope spaced two to four rods. Dams are put in wherever necessary and the water spreads out between them. This system requires no preliminary work for location. The laterals do not need to be big because the slope is so large. On the other hand, it requires the greatest amount of work for the irrigator because it is difficult to spread the water, as it tends to run back into the lateral.

Another method is to build ditches on a small grade, following almost the contour lines. The grade to be used will depend on the velocity desired and size of ditch. A light soil will not stand a very great velocity and should have a moderate grade. It is not recommended to use a grade of less than \( \frac{1}{2} \) inch per rod or 0.25 foot per hundred feet where the required fall is available. A grade of one inch per rod or 0.5 foot per hundred feet will generally give more satisfactory results. For any greater grade than 0.5 foot per hundred feet it will be difficult to get the water to flow out of the ditch at any place except just above the dam. Water is flooded from one ditch to the other through enough cuts in the ditch bank to cover the entire surface. Where sod banks may be had, as in pasture and hay fields, it is not advisable to cut the bank. The ditch is run to a flat grade and dams are put in at intervals backing the water up so it flows over the banks in a thin sheet. This is called "brimmins over." The bank in this case is very evenly graded and sodded to prevent washing. The one great trouble with ditches made on a slight grade is that very little attention is given to their size and the irrigator finds himself compelled to make most of the ditch with his shovel at a period when he most needs his time for other work.

Still another method is to run the ditches diagonally across the slope. This falls between the other two methods mentioned. It does not require instrument work to lay out the ditches but it calls for more labor in spreading the water during irrigation.

Size of Ditches. A ditch made with a 14-inch bottom plow on a grade of \( \frac{1}{2} \) inch per rod or 0.25 foot per hundred feet will carry 2-3 of one cubic foot per second. The same size ditch on a grade of one inch per rod or 0.5 foot per hundred feet will carry
9-10 of one cubic foot per second. To carry 1 1-3 cubic feet per second the same size ditch must be put on a grade of 2 inches per rod or one foot per hundred. A ditch made with a 16-inch bottom plow on a grade of ½ inch per rod will carry one cubic foot per second; on a grade of one inch per rod 1 1-3 cubic feet per second and on a grade of 2 inches per rod 2 cubic feet per second. A ditch made with a bottom width of two feet on a grade of ½ inch per rod will carry 3 cubic feet per second; on a grade of 1/4 inch per rod 4 cubic feet per second, and on a grade of 1 inch per rod 6 cubic feet per second. For these ditches the average depth of flow is about 5, 6 and 9 inches respectively. If the banks are too low or the ditch is not kept clean to the given width their capacity will be reduced accordingly.

The devices commonly used for cleaning ditches of this kind are called “V crowders” or “go devils.” They do not work entirely satisfactorily because it is difficult to clean a ditch that is flat on the bottom with the “V crowder.” One with a V-shape bottom as generally built has a less carrying capacity than one with a flat bottom for the same amount of earth removed. There are ditchers now on the market which will make a flat-bottom ditch and these are recommended for use wherever possible, however, where it is not possible the “V” crowder does fairly satisfactory work. Figure 12 shows a “V” crowder. Note that it may be made to clean different size ditches by adjusting the wing.

Figure 12, V-Crowder.
Levels.

To apply the water in irrigation with the least trouble and expenditure of time, the ditches should be run to the proper grade; and weirs, headgates, gages and other devices should be properly installed before the water is ready for the ditches. To accomplish this requires the use of levels. One method of running ditches is to plow a furrow and turn the water in and then dig out and change where necessary until the water will run. This method is very wasteful of the irrigator’s time, and the work comes when his time is most needed elsewhere because, in most cases, water is not to be had until it is delivered for the crops. Another method is to run the ditches to grade with an instrument, build them and put in necessary headgates and other structures in order to be prepared when it is time to irrigate so that a minimum of time will be required at that period.

Several home-made devices have been used for running ditches with a measure of success but where possible it is recommended that an architect’s or surveyor’s level be used. Some of the more common home-made levels are the triangle and plumbob, the carpenter’s level mounted on a frame, and the “U” tube.

a. The Triangle and Plumbob.

This form of home-made level is rather common for running ditches to grade. It requires very little outlay to make one. Figure 13 illustrates this level. Large staples are used to prevent the plumbob from swinging excessively. The length of block at one end depends on the desired grade of the ditch and the length of the base. Table 1 gives the size of block for different lengths of base and for different grades.

<table>
<thead>
<tr>
<th>Grade in inches per rod</th>
<th>Grade in feet per 100 feet</th>
<th>Length of Block E for base AB 12 feet long</th>
<th>Length of Block E for base AB 16 1/2 feet long</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>.25</td>
<td>9/16</td>
<td>1</td>
</tr>
<tr>
<td>3/4</td>
<td>.38</td>
<td>11/16</td>
<td>1 1/2</td>
</tr>
<tr>
<td>1</td>
<td>.51</td>
<td>13/16</td>
<td>1 3/16</td>
</tr>
<tr>
<td>1 1/4</td>
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<td>15/16</td>
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<td>17/16</td>
<td>1 7/16</td>
</tr>
<tr>
<td>2</td>
<td>1.01</td>
<td>19/16</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: Length to nearest 1-16 inch.

Adjusting the Plumbob. The adjusting of the plumbob consists in marking the place where it will rest when the base of the triangle is level. To do this drive two stakes into the ground, at a distance apart equal to the length of the base of the triangle. The tops of the stakes should be on the same level. Place the
ends of the base of the triangle on the stakes. Hold the triangle vertical and mark the place where the plumbob comes to rest. After this point is obtained the block of wood is attached to one end for giving the grade. If no instrument is at hand for determining whether the tops of the stakes are at the same level proceed as follows: Drive the stakes as nearly level as possible, place the triangle on them and mark the place where the plumbob comes to rest. Reverse the triangle and mark the point where it now comes to rest. Make a permanent mark on the base midway between these two. This is the point where the plumbob rests when the base is level.

Method of running grade lines. Assume that the starting point is the upper end of the ditch. The end of the base of the triangle having the block E attached, (figure 13) is pointed down grade, the other end being placed where the ditch is to start. The end down grade is now moved up or down hill until the plumbob rests on the mark indicating that the base is level. The level then is resting on two points between which the grade is an amount equal to the width of the block E. The lower point is then indicated by driving a stake or by shoveling out a shovel full of dirt from near the lower end. The triangle is then picked up and carried forward placing the rear end where the forward end rested and the operation repeated until the entire ditch is surveyed.
Figure 14 shows a frame equipped with a carpenter’s level. The principle on which it works is the same as the triangle and plumbob. The level on top is adjusted so that the bubble is in the center when the bottoms of the legs are at the same level. The method of adjusting is to drive two stakes into the ground with the tops at the same elevation and a distance apart equal to the span of the legs. Place the carpenter’s level in position on the frame and adjust it so the bubble will stand in the center. This adjustment may be done with a screw inserted under one end of the carpenter’s level in the frame which holds it.

The operation is the same as with the triangle and plumbob, the level bubble indicating when the frame is level. The legs of the frame are the same length, and a block the width of which may be determined from Table 1, is attached to the end of one leg. This leg should go forward when running the ditch down grade. The carpenter’s level should first be adjusted correctly. To make this adjustment place it on two stakes approximately level. If the bubble does not come to the center drive the high stake down until it does stand in the center. Reverse the level on the stakes. If the bubble does not come to the center bring it half way to the center by driving the high stake down. This gets the tops of the stakes on a level. Then adjust the bubble vial so the bubble will stand in the center. Test the level by reversing it on the stakes and if additional adjustment is necessary proceed as outlined above.

c. The “U” Tube.

Faster work can be done with the “U” tube shown in figure 15 than with the two home-made levels described above, but grades as low as 0.25% or ½ inch per rod should not be attempted with
an instrument of this kind. It consists essentially of a quarter-inch pipe bent in the form of a letter U. The two ends are fitted with water gages and then mounted on a convenient form of tripod. When the pipe is filled with a liquid until the glasses are partly filled, the surface of the liquid in both glasses will be at the same elevation. The level shown in the cut is a patented instrument but the principle has been used for years. The level may be used the same as an architect's or engineer's level which is as follows: Set the instrument up at some convenient place along the line of the ditch near the starting point. A rod similar to the one shown in figure 15 is held by one man called the "rodman," at the place where the ditch is to start, the lower end
of the rod level with the surface of the water. Another man, called the "levelman," sights over the level of the water surfaces in the two glasses. A reading on the rod is taken at the place where the line of sight intercepts the rod and the target is moved to this reading. The target should be raised before the rodman goes forward an amount depending on the distance between stations and the grade of the ditch. Assume for example the distance between stations to be 50 feet and the desired grade of the ditch is one inch per rod or 0.5 foot per hundred feet. The target should be raised 3 inches or 0.25 foot. The rodman now paces off a distance of 50 feet in the general direction the ditch is to run. The distance between the stations depends upon the accuracy desired and the roughness of the ground. The rougher the ground and the more accuracy required the shorter the distance paced. The rod is now placed down for a trial. If the target is not level with the line of sight over the instrument on first trial, which will not often occur, the rodman moves up or down the slope at right angles to the ditch line, until the right point is located. A stake is driven in the ground or a shovel full of earth removed to locate this point and the rodman moves on. Before he gets out of range of the levelman, which he will do very quickly with an instrument of this kind, he remains at a station on the ditch which has been located as described while the instrument is carried forward and set up below him. A reading is taken similarly to the one taken in starting the line. The rodman moves forward and additional points on the ditch are secured. This process is continued until the grade line is finished. The ditch is now plowed connecting the points located. If more accuracy is desired the distance should be measured instead of paced but for ordinary work pacing the distance will give sufficient accuracy.

There is another method of using the "U" tube shown in the cut which is much faster than the one described above. The first step is to locate the target on the rod. To do this the level is set up and the rod is held up near the level with the bottom at the same elevation as the bottom of the level. The target is placed at the point on the rod at which the line of sight over the water surfaces in the gage glasses hits it. For running down grade it is then moved up an amount equal to the proposed grade in the ditch in the length between the points determined. When running up grade the target is moved down. The rodman now paces off the distance along the ditch line and the point found by trial where the target is level with the line of sight over the instrument. This point is marked by the rodman. The levelman now moves forward to this point and sets up the level while the rodman paces off the distance along the ditch to another point which is located in the same manner.
7. CHECKING AND DIVERTING THE WATER.

Permanent ditches as employed in some methods of irrigation such as corrugation, border and others, should have permanent headgates, check boxes and turn-out boxes, in order to have complete control of the water at all times. Other systems require headgates and division boxes at the main supply ditches, and dams for diverting the water into the field laterals.

a. Headgates.

Headgates are used in the main supply canal for diverting water to the farm head ditches. They are a part of the canal system and are built and installed at the time the canal is built. The materials of which they are to be built, and the types are generally decided by engineers or by men experienced in that line of work.

b. Lateral Headgates.

Lateral headgates are placed at the heads of laterals in the supply ditch for diverting the water into the laterals. They are sometimes called two or three-way boxes because the water can be diverted two or three ways on leaving the box. Figure 16 is a two-way box. They are installed in places in laterals where it is desired to divert the water in two or more directions.
Concrete is also used to make lateral headgates. A structure of this material is more permanent and does not require the upkeep and replacement that wooden structures require.

c. Check Boxes.

Where a series of diversions are made along a ditch into several strips or several series of furrows as in the border or corrugation method of irrigation, some means must be provided to raise the water surface in the lateral. This is done by means of a check box as shown in figure 17. The method of taking the water through the ditch bank into the border strips differs in different localities, but any tube with a slide gate for regulating the amount of water will work satisfactorily.

d. Dams.

Many kinds of dams have been made, all of which serve the same purpose, which is to divert the water from one lateral to another or from a distribution lateral onto the land which it serves. Dams are made of dirt, canvas, steel, straw and manure. Dirt dams generally prove unsatisfactory unless they are permanent or are of sod so that they will not wash out. They are usually made with a shovel but may be made with an implement called a dammer, somewhat similar to a single shovel plow.
The canvas dam has proved to be very efficient because it is easily transported and because it will work in almost any irrigation ditch if made large enough. They are usually made about the same size for all ditches. The canvas should be about 4 feet long by 3 feet wide and the rod should be about 6 feet long. Figure 18 shows a dam of this kind. Note that the rod is an iron pipe. The canvas is sewed in a loop at the top through which the pipe extends. In use this iron pipe may be bent in the center of the ditch to allow water to flow over the dam. Where it is not desired to divert all the water this provision allows some of the water to go over without danger of washing out the whole dam. Canvas dams should be taken out of the ditch and dried when not in use. They will last many seasons when cared for properly but soon rot when left in the wet soil.

Steel dams are generally too heavy to handle and are not, therefore, recommended. Straw and manure is a very valuable asset to an irrigator especially in light soils. A load distributed along the laterals before irrigation starts will save many hours of labor in shoveling. It may be used to regulate the flow in furrows through ditch banks as well as to help make dams for diversion.
The materials used in the construction of the different devices illustrated in this circular are listed below. It is believed that this arrangement will help the farmer when ordering materials to build any of the devices. The list does not include materials such as nails, screws, bolts, etc.

a. Buck Scraper Figure 1.

<table>
<thead>
<tr>
<th>No. of pieces</th>
<th>Size, inches</th>
<th>Length, feet</th>
<th>Purpose</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>2x12</td>
<td></td>
<td>Cutting blade</td>
</tr>
<tr>
<td>1</td>
<td>2x8</td>
<td>5</td>
<td>Tail board</td>
</tr>
</tbody>
</table>

Other Material: 1 steel plate $\frac{1}{2}$ inch x 3 inches by length L, tilting device consisting of lever and quadrant. The hitch.

b. Log Grader Figures 2 and 3.

<table>
<thead>
<tr>
<th>No. of pieces</th>
<th>Size, inches</th>
<th>Length, feet</th>
<th>Purpose</th>
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<tbody>
<tr>
<td>4</td>
<td>2x8</td>
<td>L</td>
<td>Body</td>
</tr>
<tr>
<td>1</td>
<td>2x8</td>
<td>L</td>
<td>Beveled cutting blade</td>
</tr>
<tr>
<td>1</td>
<td>2x12</td>
<td>L</td>
<td>Center piece</td>
</tr>
<tr>
<td>1</td>
<td>2x4</td>
<td>L</td>
<td>Center piece</td>
</tr>
<tr>
<td>1</td>
<td>2x10</td>
<td>B</td>
<td>Foot board</td>
</tr>
</tbody>
</table>

Other Material: Two large eye-bolts, for fastening the timbers together, the eye of the bolt put on the forward side for hitching short chains.

c. Leveler Figure 4.

<table>
<thead>
<tr>
<th>No. of pieces</th>
<th>Size, inches</th>
<th>Length, feet</th>
<th>Purpose</th>
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</thead>
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<tr>
<td>2</td>
<td>2x12</td>
<td>18</td>
<td>Runners</td>
</tr>
<tr>
<td>3</td>
<td>2x12</td>
<td>6</td>
<td>Crosspieces</td>
</tr>
<tr>
<td>2</td>
<td>2x12</td>
<td>6</td>
<td>Foot board</td>
</tr>
<tr>
<td>2</td>
<td>6 to 12 diam.</td>
<td>6</td>
<td>Rollers</td>
</tr>
</tbody>
</table>

Other Material: Four $\frac{3}{8}$ inch diameter steel rods 9½ feet long for braces. $\frac{1}{4}$ inch by 3 inches by 6 feet steel plate for cutting edge of center crosspiece.

d. Ridger Figure 5.

<table>
<thead>
<tr>
<th>No. of pieces</th>
<th>Size, inches</th>
<th>Length, feet</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
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<td>2</td>
<td>2x12</td>
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<td>Runners</td>
</tr>
<tr>
<td>4</td>
<td>2x12</td>
<td>8</td>
<td>Top</td>
</tr>
<tr>
<td>1</td>
<td>2x4</td>
<td>6 to 8</td>
<td>Front crosspiece</td>
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<tr>
<td>1</td>
<td>2x4</td>
<td>18 to 24</td>
<td>Rear crosspiece</td>
</tr>
</tbody>
</table>

Other Material: Irons for bracing as shown in figure 5.

e. Dikel Figures 7 and 8.

<table>
<thead>
<tr>
<th>No. of pieces</th>
<th>Size, inches</th>
<th>Length, feet</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2x12</td>
<td>12</td>
<td>Runners</td>
</tr>
<tr>
<td>3</td>
<td>2x10</td>
<td>8</td>
<td>Crosspieces</td>
</tr>
<tr>
<td>1</td>
<td>2x6</td>
<td>8</td>
<td>Upright crosspiece</td>
</tr>
<tr>
<td>2</td>
<td>2x12</td>
<td>12</td>
<td>For &quot;V&quot;</td>
</tr>
</tbody>
</table>

Other Material: Hitches and irons for bracing as shown in figure 5.

f. Corrugator Figures 10 and 11.

<table>
<thead>
<tr>
<th>No. of pieces</th>
<th>Size, inches</th>
<th>Length, feet</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2x6</td>
<td>2 to 4</td>
<td>Crosspieces</td>
</tr>
<tr>
<td>12</td>
<td>2x12</td>
<td>2</td>
<td>Furrowers, 3 joined together for each furrow.</td>
</tr>
<tr>
<td>2</td>
<td>2x6</td>
<td>8</td>
<td>Top side pieces</td>
</tr>
<tr>
<td>2</td>
<td>2x6</td>
<td>6</td>
<td>Side pieces joining front and rear furrowers.</td>
</tr>
<tr>
<td>2</td>
<td>2x4</td>
<td>6</td>
<td>On each side of tongue</td>
</tr>
</tbody>
</table>
HOME MADE IRRIGATION DEVICES

Other Material: One tongue 6 feet longer than the ordinary tongue so as to extend back on top of corrugator, 2 small wheels, may be binder truck wheels. Steel rod for raising and lowering corrugator on wheels, 2 steel shovels for facing rear furrowers. Irons for bracing as shown in figures 10 and 11.

No. of pieces Size, inches Length, feet Purpose
1 2x12 3 Short side of “V”
1 2x12 3 Wing
1 2x4 2 Handle

Other Material: ¼ inch by 12 inches by 2 feet steel to face point of ditcher. Strap iron for bracing and regulating size, as shown in figure 12. Hinges for fastening wing.

No. of pieces Size, inches Length, feet Purpose
1 1x4 2 Top of frame
1 1x4 1½ Upright
1 1x4 2 Braces

Other Material: Carpenter’s level. Short block (see table 1 for length), 3 large staples, 1 plumbob.

No. of pieces Size, inches Length, feet Purpose
2 1x6 11 to 16 Long side of “V”
4 1x4 3½ Crosspieces
2 1x4 2 Gates

Note: This will make a box 8 feet long, 3 feet wide and 2 feet high, the main channel and a division 3 feet long, 3 feet wide and 2 feet high. This will be large enough for the ordinary irrigation head up to about 4 cubic feet per second.

No. of pieces Size, inches Length D Purpose
3 2x12 2 ft. Through
2 2x12 2 ft. Cut off wall
1 2x10 3 ft. 4 in. Across top and bottom of trough
2 2x4 3 ft. 4 in.
1 2x2 1 ft. 4 in. Holding flash board
2 2x8 1 ft. Flash boards