AUTOMATIC IRRIGATION

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Automatic or mechanical irrigation structures can be used to surface irrigate all or part of many Idaho farms without extensive modification of present systems. The available water may be stretched by use of timer-controlled irrigation structures which automatically terminate irrigation on one portion of a field or farm and direct the water to another area.

It is common practice to use either 12-hour or 24-hour irrigation sets since it is convenient to change the water only once or twice each day. With this arrangement, irrigation is scheduled according to the farmer's work schedule rather than by the soil moisture and the soil characteristics. Many times an irrigation of less than 12 hours or between 12 and 24 hours, would be sufficient to refill the soil root zone. The available water supply could be used on a larger area if water could be changed automatically from one set to another whenever the root zone was refilled. Many farmers have improvised systems and structures of their own to automatically change the water from one irrigation set to another. These are usually controlled by a conventional alarm clock.

Another reason for using automatic structures is to eliminate some of the labor involved in irrigating. At a time when reliable farm help is difficult to obtain, an investment in automatic structures could be an economical alternative for the farmer. Considering the value of labor saved, whether hiring an irrigator or placing a dollar value on one's own time, additional investment in labor-saving equipment will often pay dividends to the operator.

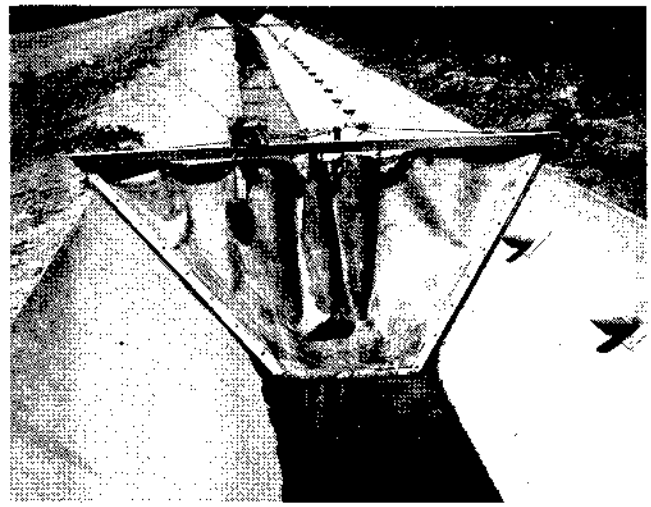

Figure 1. Portable timer-controlled check dam for use in lined ditches.

AUTOMATIC PORTABLE IRRIGATION CHECK

Automatic structures are being developed at the United States Department of Agriculture's Snake River Conservation Research Center near Kimberly, Idaho. These are being tested for use in automatic cutback furrow, graded border, basin, and recirculating systems. A timer-operated check for use in lined ditches is shown in Figure 1.

This portable, lightweight unit may be placed at any location in ditches of the same cross-sectional shape. It consists of a nylon-reinforced, butyl rubber dam, supported in a metal frame designed to fit the cross section of the lined ditch. In the closed position, the top edge of the flexible dam is supported by a drawstring threaded through brass grommets.

A neoprene-impregnated nylon material may be substituted for the butyl rubber dam. This lighter weight material costs loss, but its lifetime is shorter. A 1/8-inch plastic-covered steel cable is used for the drawstring.

A special timer is used for periods up to 12 hours. The timer has a corrosion-resistant movement with a built-in trip for releasing the drawstring. It also has a built-in escapement release. The escapement release is operated by a small float as shown in Figure 1. With this arrangement, the check and timer are reset at any time between irrigations. The timer does not operate

until water enters the ditch immediately upstream from the check. When water fills the ditch, the small float releases the escapement and allows the timer to begin timing the irrigation period. After the preset time has elapsed, the timer releases the drawstring and the check opens automatically.

Automatic-Cutback Furrow Irrigation System

General Operation

An automatic-cutback furrow system, developed at Oklahoma State University, is very efficient in the use of water and practically eliminates irrigating labor when used with automatic check dams. The portable drawstring check is shown in Figure 2 being used in this type of system. As seen in the figure, the ditch is divided into sections, or bays, usually of equal length. Furrow tubes made from metal or plastic pipe are installed in the side of the ditch at the same elevation in each bay. They are installed at a lower elevation in each consecutive bay downstream. An automatic check is placed at the end of each bay.

With this system, a large or primary initial flow in the individual furrows is followed by a reduced or cutback secondary flow halfway through the irrigation set. The high initial flow is needed until water flows through all of the furrows, after which runoff is reduced by reducing automatically the size of the furrow stream. When the check dam is released by the timer, water flows to the next bay downstream and provides a high initial or primary flow in the tubes of that bay. At the same time, a cutback flow resulting from the reduced head or depth of water over the end of the furrow tubes is maintained in the bay immediately upstream.

The irrigator's labor may be utilized efficiently if enough portable checks are available so that they require moving only once or twice a day. Checks may then be picked up and placed in another ditch to irrigate another section of the farm at the beginning or end of each day. The number of acres one irrigator can manage may be increased up to ten or more times with this system, while keeping runoff water to a minimum.

Design and Installation

Procedures for designing an automatic-cutback furrow system are available, and technical assistance may be obtained from the Soil Conservation Service or the Extension Service. Furrow tubes are much easier to install in a newly lined ditch than in an existing one. The system design should be made beforehand so that the newly placed lining may be scored with a "cookie cutter" or a pilot hole made at the location of each furrow tube. After the concrete has set, a hole is made in the lining and the furrow tube is grouted in place. The lined ditch may be constructed on a uniform slope, or it may be constructed in a series of level bays with an elevation drop between each bay. Some contractors install lined ditches of the latter type when requested.

One disadvantage of this system is that the design is not flexible. A furrow tube spacing must be selected which is compatible with the crops most commonly grown. In some cases, if the crop furrow spacing does not correspond with the furrow tube spacing in the ditch, some tubes may be blocked off and not used during a particular season. It is important when installing the furrow tubes that they be placed at the exact design elevation. Elevation errors in placing the tubes change the operating head and, therefore, the discharge from the tube. The system must also be operated with the designed supply flow. Variations of the supply flow for which the system was designed are amplified in the secondary flow discharge, since this flow is more sensitive to head variations than the initial flow.

The cost of this system will vary with the size and spacing of the furrow tubes, as well as the size of the lined ditch. The cost of the furrow tubes and their installation is approximately 75c

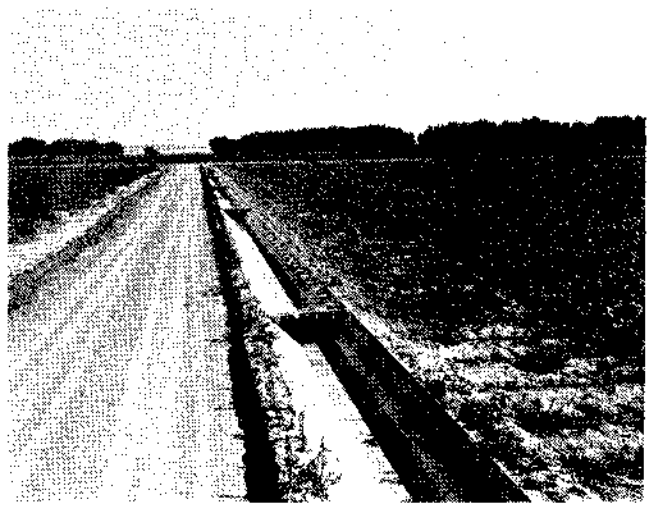

Figure 2. Mechanical check dams being used in an automatic-cutback furrow irrigation system.

to $1.00 per foot of ditch. This is in addition to the regular cost of the slipform-lined ditch, but may become less as construction techniques are perfected. A ditch 2600 feet long, using 2-inch furrow tubes spaced 30 inches apart, has been in successful operation in Colorado during the past two years (Figure 2).

Automatic Check For Unlined Ditches

The drawstring portable check for lined ditches was modified for use in an unlined ditch. This modified check is shown in Figure 3. When used in unlined ditches, the basic check is fitted with side wingwalls and a bottom cutoff. It is installed in the ditch at approximately 45°, the same as when used in a lined ditch. When used in a lined ditch, it is made without the wingwalls, and a rubber seal strip around the edges prevents leakage.

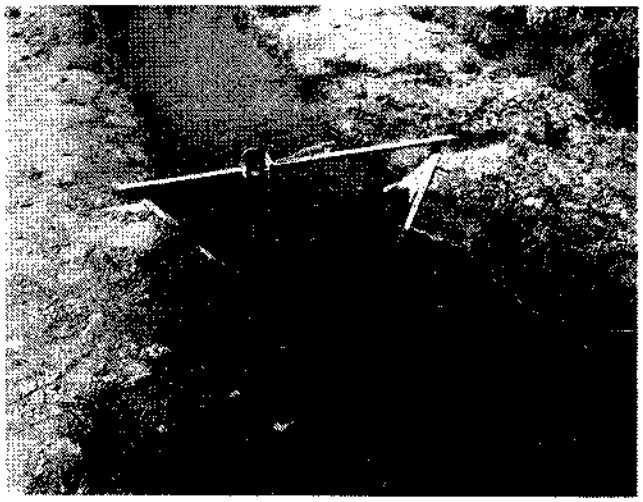

Figure 3. Modified drawstring check for use in unlined ditches.

Automation of Systems Now in Use

Many fields that have a small amount of cross slope and that are relatively flat may be surface irrigated automatically with a minimum of additional investment. One can start with those fields where modifications and additional cost will be smallest, and automate other portions of the farm in succeeding years. This will provide the farmer with the benefits of mechanized irrigation on a portion of the farm immediately, and provide valuable experience for automating other portions of the farm.

Automating furrow irrigation systems is much more difficult than automating border or contour ditch flooding systems. It is difficult to obtain uniform distribution in all furrows unless an automatic-cutback furrow system is installed, or unless furrow tubes are installed in sides of a feeder ditch or distribution bay. Border or contour ditch systems often may be readily converted to automatic operation with little modification.

The timer-operated check dams are well suited for use in the above systems, as well as in diverting water from one ditch to another. When used in border or contour ditch systems, the checks are normally placed in the head ditch. Water in the ditch is raised to a depth so that it flows over the top of check boards placed in turnout structures into the field. The crest or top of the check board is placed so that it is just above the water surface in the ditch when water is being conveyed from one section of the ditch to another. In other words, the check board is high enough to prevent water from flowing onto the field while it is being conveyed past the turnout.

For ditches having relatively flat slopes, or at locations where it is not possible to have the water spill over a crest into the field, a pipe turnout can be used. The pipe turnout is fitted with a drop gate hinged at the top and allowed to fall by its own weight to close the pipe opening when the check gate releases the water for the next set. A similar type of gate may be installed on a metal cutoff wall.

Plan Ahead

An appropriate time for planning and modifying the irrigation system is at the end of the irrigation season. The winter months can be used to build or obtain the necessary automatic checks. The draw-string check structures described here may be obtained commerically, or can be made. Drawings of the checks are being prepared for publication and may be obtained from the author. The structures are relatively simple to construct and may be made in most farm shops. It may be advisable, however, for farmers in a local area to pool their orders for special items to obtain a more favorable price, or to have the units fabricated in a local shop. Some materials are easier and cheaper to obtain in large quantities.

Other structures are being developed, some of which are fully automatic and do not require resetting between irrigations. These will generally

be more costly to install, and the cheaper timer-operated semi-automatic checks will normally receive first consideration. Considering the labor and water which may be saved with automatic irrigation structures, one might well consider installing these when modifications to present irrigation systems are planned, or when improvements are made.

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