



Screening irrigation water

AUTHOR(S)

British Columbia Dept. of Agriculture Agricultural Engineering Division, T. L. Coulthard, H.O. Lacy, J.C. Wilcox

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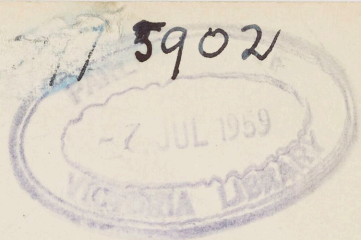
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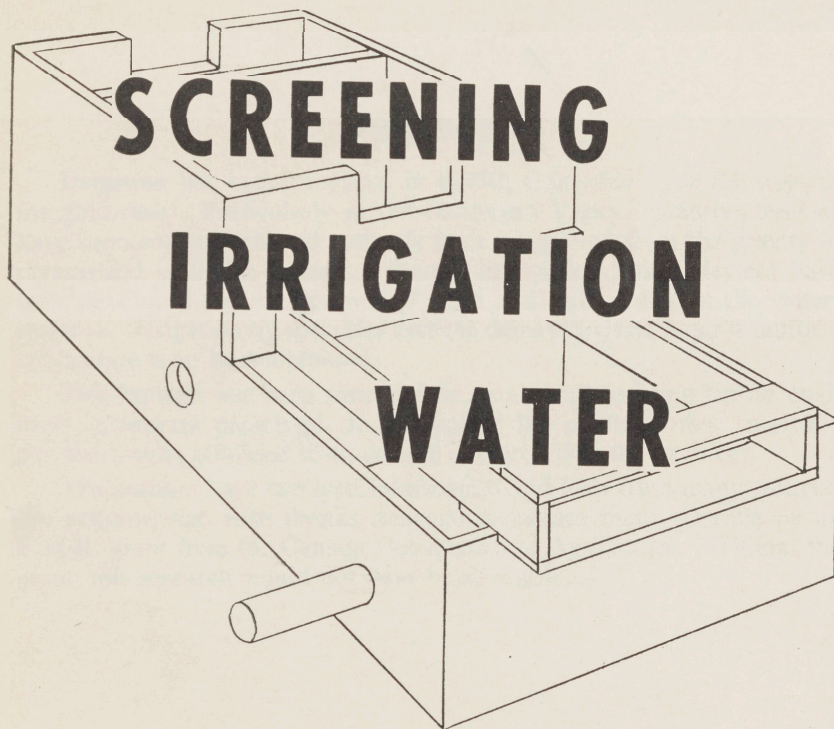
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Authors

T. L. COULTHARD, J. C. WILCOX, AND H. O. LACY



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FOREWORD

Irrigation has been practised in British Columbia since the days of the gold-rush. Particularly in the Okanagan Valley, extensive systems have been constructed and methods have progressed from the gravity to pressurized sprinkler systems. During this period, many devices have been developed for the removal of trash and sediment from the water-supplies. Irrigation by sprinkler systems demands clean water if uniform application is to be maintained.

This bulletin has been prepared in an attempt to bring before engineers, extension personnel, and irrigators the methods now employed and the results obtained from current research into the problem.

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Screening Irrigation Water

BY T. L. COULTHARD,* J. C. WILCOX,† AND H. O. LACY‡

INTRODUCTION

In most irrigation systems, floating trash, weed seeds, and suspended solids are a vexing problem. Some irrigation districts in British Columbia have been successful in constructing adequate screening devices; others are still grappling with the situation. In open-flume and surface distribution methods, suspended or small particles are not critical. Sprinkler systems now added to the original distribution structures require more accurate screening. Slow rates of water application over a long period of time require small sprinkler nozzles. Delivery nozzles of three thirty-seconds to one-eighth inch demand clean water for efficient distribution and to reduce time lost in removing and cleaning sprinkler nozzles.

The material in this bulletin is arranged in two sections. Screening devices for surface distribution methods generally require the output of large volumes of only relatively clean water. Small particles of floating trash or suspended silt are not likely to clog distribution channels. However, the removal of weed seeds is desirable in all systems. Where ditches and canals supply subsequent sprinkler systems, further screening is necessary.

For closed "pressurized" systems supplying sprinklers, screening becomes more essential. The size of suspended soil particles or floating trash must certainly be smaller than the smallest size of nozzle on the distribution-line. Although small enough for passage through the nozzle, excess silt and sand particles present a further problem—namely, wear. Some sprinkler nozzles have been found to double their orifice size in one season owing to silt-laden water-supplies.

Many methods and types of screening devices have been used by irrigators and irrigation organizations in British Columbia for many years. A preliminary survey of present irrigation practices, trash problems, and existing screening methods was conducted. The methods that have so far proved best are outlined on following pages.

* T. L. Coulthard, Professor and Head of Agricultural Engineering and Mechanics Department, University of British Columbia.

† J. C. Wilcox, Officer in Charge, Plant Nutrition Laboratory, Canada Department of Agriculture, Summerland Experimental Farm.

‡ H. O. Lacy, Agricultural Engineer, Canada Department of Agriculture, Ottawa, former student at University of British Columbia.

OPEN "GRAVITY" SYSTEM SCREENING

Headwater Take-out

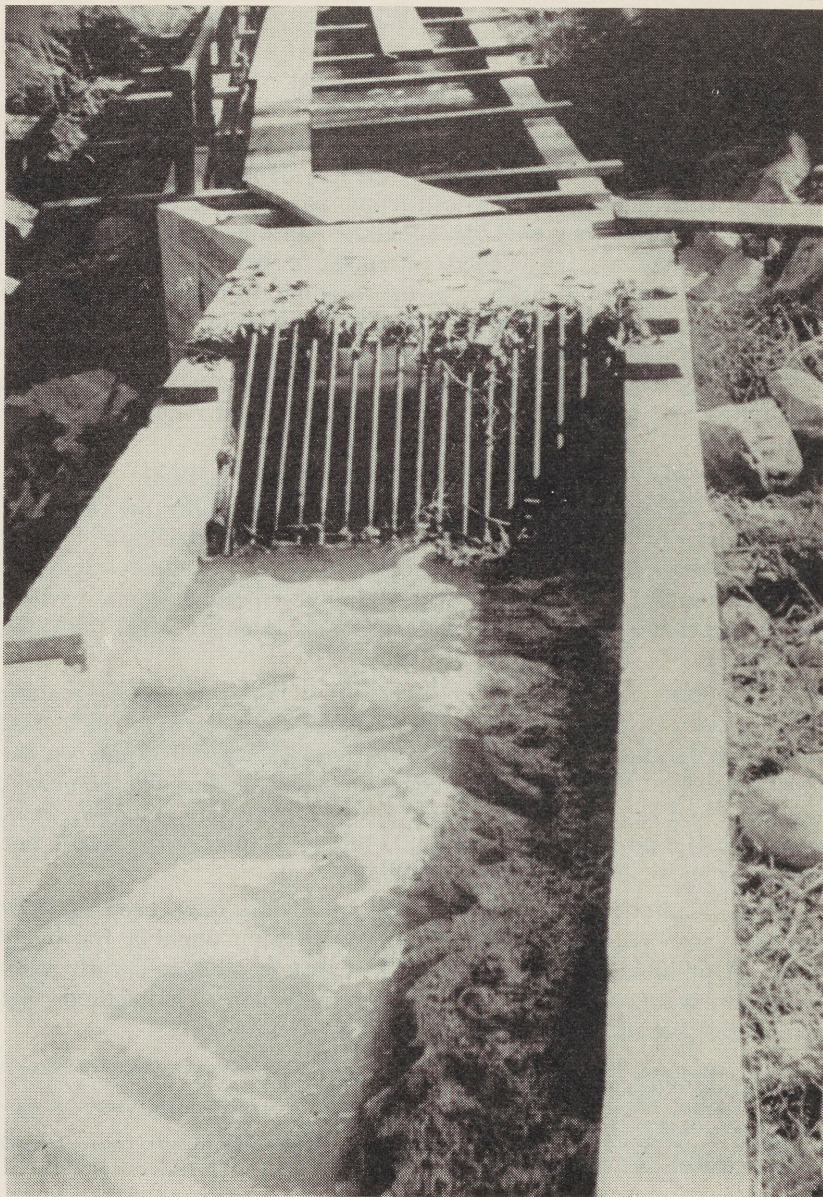


Fig. 1. District screening.

Fig. 1 shows a coarse "diversion" box grate employed at the river "take-out" location for a district irrigation system. This grate removes only large trash such as tree limbs, shrubs, and similar floating debris. Daily inspection is required during the high-water or freshet season. Placing the grate at an inclined angle to the direction of flow aids the system in keeping the grate cleared.

Overpour Weed-type Screen with Settling-box

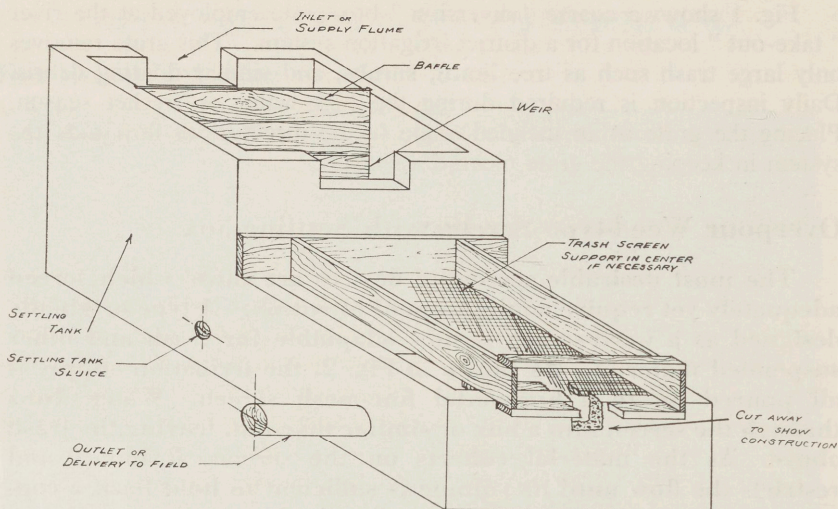
The most desirable screening devices are those which screen adequately yet require a minimum of attention. A type originally designed as a weed-screen is now adaptable for trash and other suspended material. As shown in Fig. 2, the irrigation supply is all poured on to a horizontal fine-mesh screen. Water flows through the screen into a box or similar take-out, leaving the trash above. As the material collects on the screen, it builds and restricts the flow until its volume is sufficient to hold back a considerable head of water. When the head of water becomes large, the trash material is pushed off the end of the screen by the force of the water and flow resumes its normal pattern through the screen.

Two requirements are necessary: (1) A fine screen, preferably of brass (approximately 40 mesh), to prevent clogging, and (2) the water-supply must be at a high enough elevation to pour down on to the screen. *Where this method can be used, it is recommended in preference to those described later as it is simpler to construct, cheaper, and requires even less attention.* Table 1 shows the dimensions of a desilting box and weir for the overpour type.

Table 1.—Suggested Dimensions for Desilting Boxes¹

Capacity			Width of Box, Ft.	Length of Box, Ft.	Weir Notch Crest Length, Ft.
C.F.S.	Imp. G.P.M.	U.S. G.P.M.			
0.5	187	225	4' 0"	4' 0"	2' 0"
1.0	375	450	5' 0"	6' 6"	2' 0"
1.5	563	675	5' 0"	9' 6"	2' 6"
2.0	750	900	6' 0"	10' 6"	2' 6"

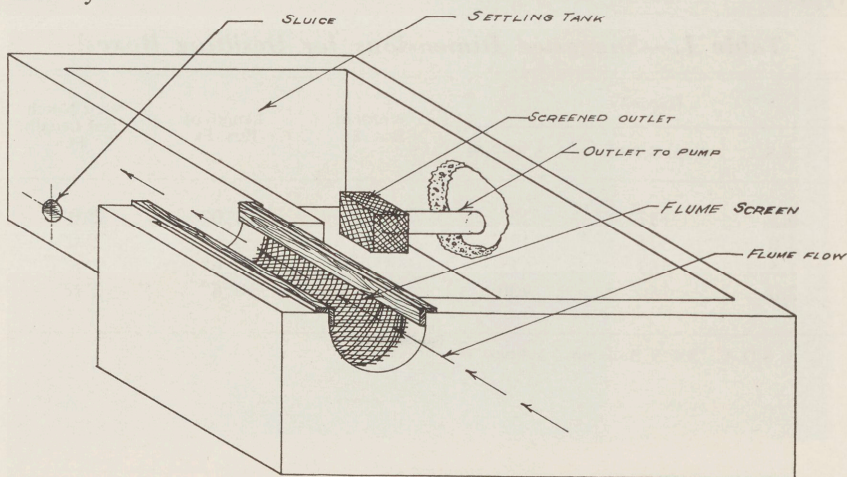
¹ U.S.D.A. S.C.S. Bull. No. 7-L-14000-31.



EXTERNAL HORIZONTAL TRASH SCREEN
Fig. 2

Flume Screening

Another type of self-cleaning screen is one that can be installed in an elevated flume. The grower's take-out box may act as a settling-box for sand and fine material. Trash will continue to be carried in the flume to the farthest extremity of the flowing water. Where it can be used, this type is simple, reasonably cheap, efficient, and requires a minimum of attention. This type requires approximately 4 square feet of 40-mesh screen surface per 100 imperial gallons per minute of delivery.



FLUME TAKEOUT SCREEN AND TANK

Fig. 3

Since the screen is placed in the takeout box, the problem of proper elevation or amount of water passing through the screen is automatically controlled. Only the amount of water required by the irrigator passes through the screen and loose trash is carried by the velocity of water proceeding down the flume system, eventually being removed at the waste outlet.

Settling and Screening Box

This structure serves two purposes—as a settling-tank and as a means of screening floating or suspended debris. Fig. 4 shows an installation which is termed a “longitudinal” flow type. Water enters at the end of the “tank” and filters through a screen which is erected longitudinally down the centre. This method is one of the most desirable settling systems and appears to require the least maintenance since the water continues to flow in the same general direction as the screen. This latter feature permits higher stream velocities, reducing the over-all box size in respect to outflow volume.

The size of screen openings required depends on the type of irrigation distribution system. If the outlet is a long open flume or ditch forming a main lateral for an irrigation district, the screen openings can be as large as 1 inch. Since trash can drop into an open flume, the water will eventually need screening again by individual growers. If the outlet is a grower's flume for furrow irrigation, the screen mesh should not be greater than 4×4 . If the outlet is a pipe leading directly to one or more sprinkler systems, the mesh should not be greater than 8×8 .

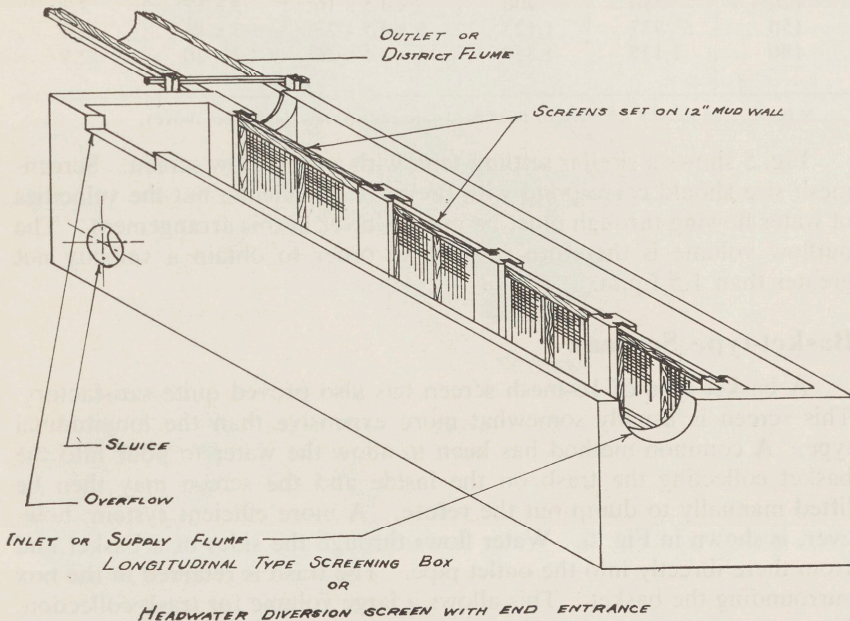


FIG. 4

In no case should the openings be as large as the smallest sprinkler nozzle. A 1/8-inch nozzle requires a mesh 8 x 8 or, better still, 16 x 16. Galvanized screening is frequently used because of its low initial cost. It is not, however, as desirable as the longer-wearing and more durable bronze or brass screens. Copper may also be used but will be more pliable and of weaker strength than brass.

The screens should be installed on a low supporting wall. The wall serves to form a compartment for accumulated sand and silt. This reduces the loading on the screen as the deposits settle to the box-bottom.

The size of box is determined by the volume rate of water required by the grower or growers at peak demand. Table 2 indicates the respective dimensions in order that velocities through the screen may be held below 3.5 feet per minute. Velocities in excess of this rate do not allow efficient settling of the suspended sediment.

Table 2.—Proposed Inside Dimensions for Settling and Screening Tank with Screens Longitudinal

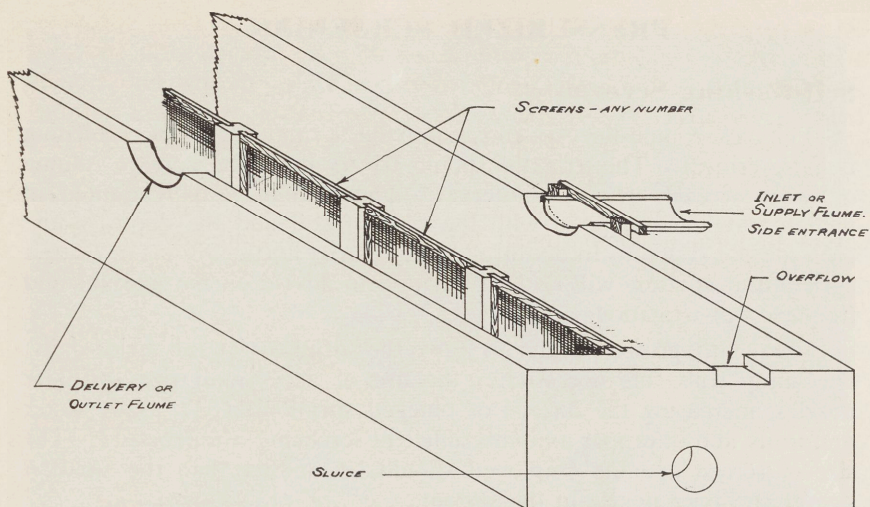
Flow Rate			Dimensions		Velocity of Water through Screen, F.P.M.
C.F.M.	Imp. G.P.M.	U.S. G.P.M.	Tank, Ft.	Screen, Ft.	
30	187	225	4 x 4 x 4	2.5 x 4	3.0
60	375	450	4 x 4.5 x 8	3 x 7	2.9
90	563	675	5 x 4.5 x 11	3 x 9	3.3
120	750	900	5 x 4.5 x 16	3 x 12	3.3
150	937	1,125	6 x 4.5 x 23	3 x 18	2.8
180	1,125	1,350	6 x 4.5 x 26	3 x 20	2.9

N.B.—Screen to be 8 x 8 mesh or finer hardware cloth (see explanation above).

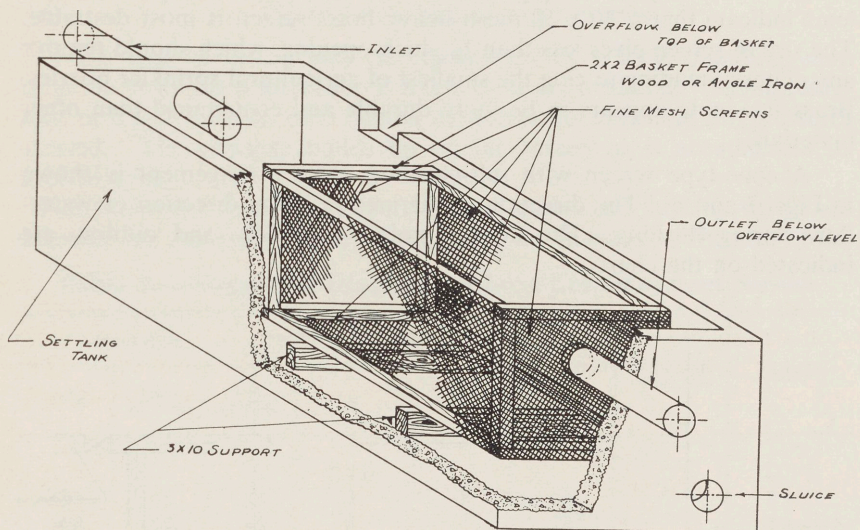
Fig. 5 shows a similar settling-tank with a cross-flow screen. Screen-mesh size should correspond with previous statements, but the velocities of water flowing through must be much slower in this arrangement. The outflow volume is therefore reduced in order to obtain a velocity not greater than 1.5 f.p.m.

Basket-type Screens

A basket type of 16-mesh screen has also proved quite satisfactory. This screen is usually somewhat more expensive than the longitudinal type. A common method has been to allow the water to pour into the basket collecting the trash on the inside and the screen may then be lifted manually to dump out the refuse. A more efficient system, however, is shown in Fig. 6. Water flows through the sides of a basket and from there directly into the outlet pipe. The trash is retained in the box surrounding the basket. This allows a large volume for trash collection, less water-pressure against the screen, and less frequent attention.



HEADWATER DIVERSION SCREEN WITH SIDE ENTRANCE
Fig. 5



EXTERNAL BASKET SCREEN
Fig. 6



PRESSURIZED SCREENING

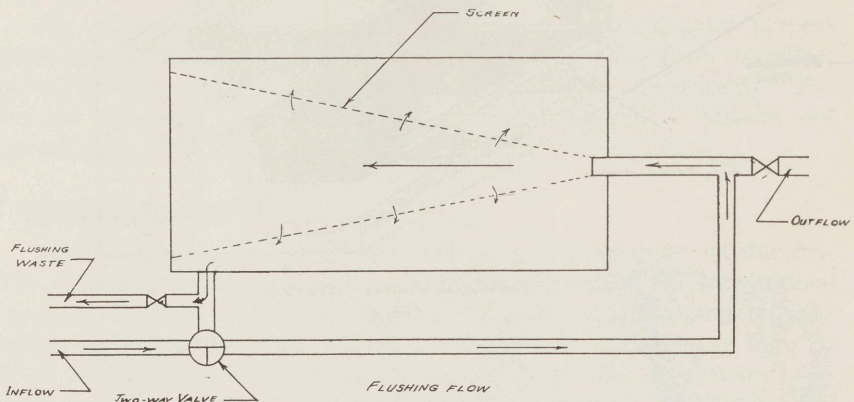
Self-flushing Screens

For closed pipe-line systems supplying sprinkler nozzles, screening is more critical. The irrigator should try to apply the correct volume of water at each irrigation interval. The amount, usually quoted in inches, should correspond with the type of soil and the depth of the crop rooting system. In doubtful cases, district horticulturists or district agricultural advisers will be in a position to advise on the amount and frequency of irrigation.

Frequently growers prefer to move the sprinkler laterals twice daily. On sandy soils this necessitates the use of very small size sprinkler nozzles, increasing the hazard of plugged sprinklers. To apply water uniformly and in proper amounts, efficient screening is a necessity. The size of screen opening employed should be smaller than the smallest size of sprinkler nozzle in the system.

Finer-mesh screens must be used in pressurized sprinkler systems to remove either organic trash or suspended mineral particles. It is also advisable to use a settling-tank somewhere in the system before the water enters the pressure pipe-line. Tests conducted on sprinkler systems indicate that a 20 x 20 mesh heavy brass screen is most desirable. The size of screen gives less than $\frac{1}{64}$ -inch opening, which should remove any material tending to clog the smallest of agricultural sprinkler nozzles. Brass screening appears to be more durable and economical than other materials.

A cone-type screen with self-cleaning valve arrangement is shown in Figs. 7 and 8. The direction of the arrows is the direction of water-flow during flushing. The normal points of inflow and outflow are indicated on the chart.



SELF-FLUSHING PIPELINE SCREEN
Fig. 7

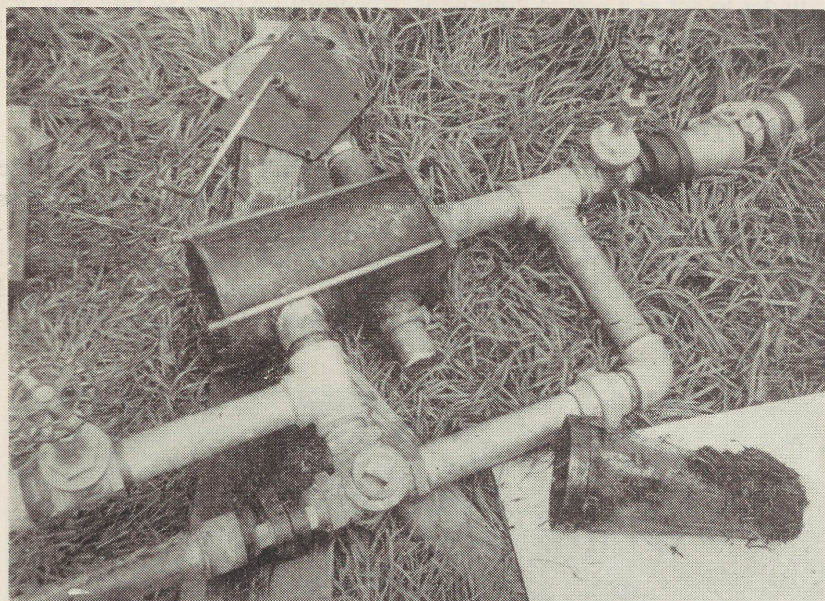


Fig. 8. Self-flushing screen arrangement.

This type of screen may be constructed by a local plumbing-shop or in the farm home workshop if a few tools are available. Reinforcing-rods or a grid must be used behind the screen to withstand the pressures exerted. The pressure builds up on the screen as it accumulates its load of trash.

A two-way valve with properly placed outlet and flushing valves are essential for this arrangement as shown in the diagram. The size of the

Table 3.—Suggested Dimensions for a Closed-system Screen

Flow Rate			Screen Dimension in Inches			Pipe line Sizes, In.	Cylinder
C.F.M.	Imp. G.P.M.	U.S. G.P.M.	d	D _s	L		
							D L
2.4	15	18	3	5	14	2	6 x 16
4.8	30	36	4	7	14	3	8 x 16
7.2	45	54	4	10	14	3	11 x 18
9.6	60	72	5	10	19	4	12 x 21
14.4	90	108	5	12	25	4	14 x 27
19.2	120	144	7	13	30	6	16 x 32

d=diameter of small end of cone.

D_s=diameter of large end of cone.

L=length of long axis of cone.

Metal cylinder to encase the conical screen.

D=inside diameter of casing.

L=inside length of casing.

cylinder to act as a screen housing is dependent on the flow rate of water passing through the system. The sizes necessary may be determined from the total sprinkler delivery and by reference to Table 3.

Barrel-type Screening

Frequently on pressurized water-lines a barrel type of screen may be used as shown in Fig. 9. This arrangement allows for some settling as well as screening. A cylindrical screen inside requires periodic attention, this detail varying with the amount of silt and trash carried at various seasons in the supply-water. These devices are usually equipped with blow-off valves to release the material that accumulates in the bottom of the drum.

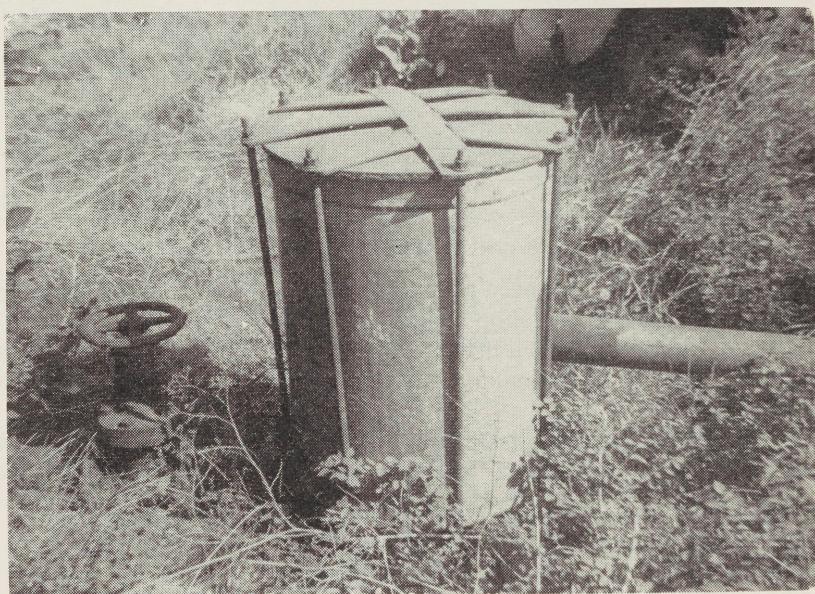


Fig. 9. Barrel-type screen.

Stationary Pipe-line Screens

Conical sock-type screens for insertion in main or lateral pipe-lines are available commercially. These require cleaning periodically, depending upon the amount of trash or sediment carried in the water-supply. Many irrigators clean the lateral-line screens each time a move is made. This type of screening is satisfactory in most cases but is more time-consuming than the self-flushing method.



