Mechanized Wheel and Belt Screens for Farm Irrigation Turnouts

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ABSTRACT

ROTATING wheel and traveling belt trash screens were developed for farm canal turnouts to prevent trash and debris from entering farm irrigation systems. They are driven by electric motors or water-powered paddle wheels. The screens are particularly useful for automated irrigation systems. The head loss is small, and they are not adversely affected when the farm delivery is terminated by automated downstream valve closures while canal turnouts remain open. Different screens, bearings, and bushings were tested for this application. Hydraulic tests were conducted to determine head losses with different wheel screens.

INTRODUCTION

Many irrigation systems require water relatively free of debris to prevent clogging of furrow discharge outlets, gated pipe openings, sprinkler nozzles, and other irrigation equipment. Debris-free water is particularly important for automated systems because they operate unattended for extended periods of time. Poor water distribution and inadequate irrigation caused by clogged flow openings result in decreased yields.

Many types of screening devices are used to remove trash and weed seed from irrigation water. Some of these are discussed by Coulthard et al. (1956), Bergstrom (1961), Pugh and Evans (1966), and Bondurant and Kemper (1985). Where elevation head is available, a flat horizontal screen placed below a drop is one of the most widely used and effective screens. However, most automated surface irrigation systems supplied by gravity utilize all of the available elevation head at canal turnouts, and the head lost from a screen which requires a drop cannot be recaptured or utilized in the system.

Another consideration is that automated systems may not receive water continuously from the delivery system. A horizontal screen located beneath a drop at a field turnout would become submerged or flooded if water continued to flow from the open turnout with no place to go when automated valves close downstream. A specially designed farm turnout using a float valve and/or a stand is needed when the farm delivery is terminated by automated valves. A stand extending above the elevation of the water surface in the canal is often used as a pump sump or an inlet structure. However, it usually is not practical to place a screen inside such stands or sumps because they are not self-cleaning and trash would accumulate inside the stand. Self-cleaning screens are needed which are not adversely affected when water deliveries are terminated while canal turnout gates remain open. Rotating, drum-type screens, mounted in front of farm turnouts, are effective but are relatively high cost and extend in to the canal or stream channel where they can obstruct ditch cleaning equipment. Many irrigation districts do not allow structures or attachments to turnouts which hinder canal cleaning and maintenance operations.

The purpose of this paper is to describe rotating wheel and belt type trash screens that are particularly well suited for automated systems, do not require drops or significant head losses for operation, and are not adversely affected when water deliveries are terminated while farm canal turnout gates remain open.

ROTATING WHEEL SCREENS

A rotating wheel screen consists of a motor-driven, spoked wheel, such as a bicycle wheel, mounted on a frame and installed in front of a farm canal turnout as shown schematically in Fig. 1. The wheel is mounted with its axle at approximately the canal's normal water surface elevation. The frame is attached to the concrete headwall of the turnout by hook-type brackets such that it hangs in front of the turnout opening. It is not permanently attached and can be easily removed if desired. Since the wheel and frame are relatively narrow, they do not protrude into the canal so as to interfere with canal cleaning equipment. The wheel screen can also be installed on turnouts with pipe inlets located near the bottom of the canal. An enclosure is constructed around the turnout and extended in front of it such that water can enter through a screen wheel mounted near the top of the enclosure. Thus, water is drawn from the upper portion of the canal and drops inside the enclosure to the turnout inlet. Water diverted from the top of the canal naturally excludes bed load sediment that may otherwise enter the turnout if water were drawn from the bottom portion of the canal near the inlet.

A screen to filter trash from the water is mounted on the upstream side of the wheel. The screen is supported by a 12 x 12 mm (1/2 x 1/2 in.) galvanized hardware cloth attached to the wheel spokes behind the screen. As the wheel rotates, the screen, hardware cloth, and spokes tend to lift water above the canal's water surface as one

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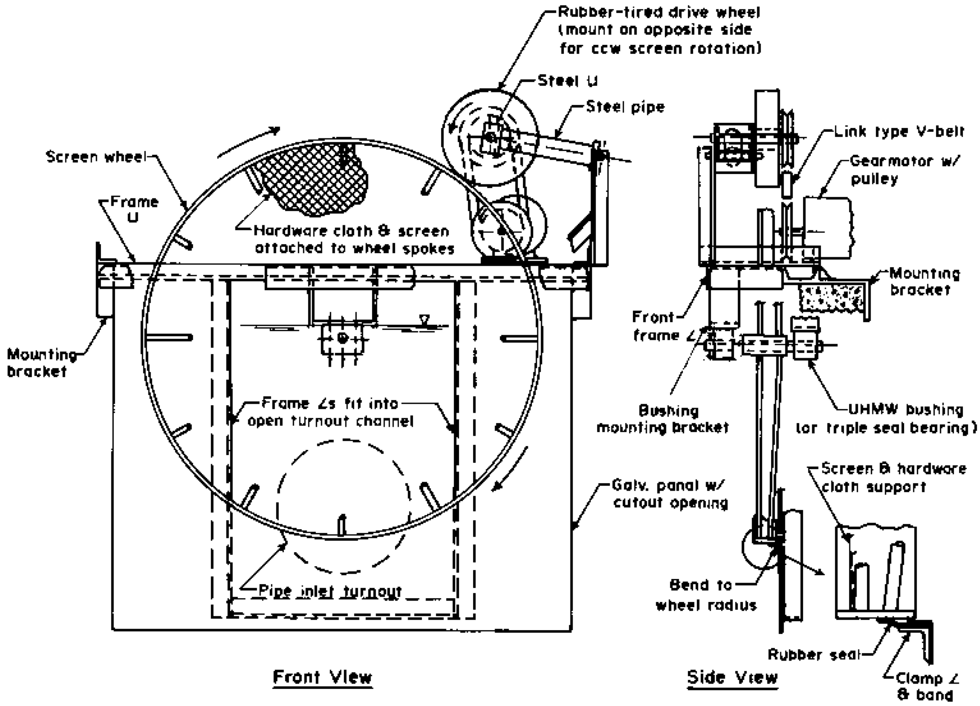


Fig. 1—Schematic drawing of a rotating wheel trash screen.

side of the wheel rotates out of the water. This creates a continuous secondary flow of water through the screen from the back side and gives the screen its self-cleaning action as seen in Fig. 2. The rotational speed of the wheel needs to be sufficient to provide a minimum peripheral speed of about 90 m/min (300 ft/min) to provide good self-cleaning action. Some trash collects around the center portion of the wheel where the peripheral speed is low; however, this represents a relatively small area of the screen and does not significantly affect its operation. Initially, a brush was used to clean the screen, but because of the screen's self-cleaning action, it was removed. A protective grid can be placed in front of the machine if needed to protect the wheel from large floating debris.

The screen wheel is driven by a friction drive wheel powered by an electric motor or a water-driven turbine or paddle wheel. In remote locations, it may be feasible to power the motor with solar-charged batteries. The drive wheel is a rubber-tired steel wheel commonly used on floor trucks*. It is 200 mm (8 in.) or 250 mm (10 in.) in diameter with a pully bolted to one side. To provide the required peripheral speed, the rotational speed of the pulleys is about 145 nd 115 rpm, respectively. A chain and sprocket drive and a pulley and belt drive were tested first; however, neither were satisfactory. The belt twisted and slipped when wet and was replaced by a chain-and-sprocket drive. However, both the chain and sprocket wore so rapidly because of abrasive sediment particles in the water that they had to be replaced after only two months' use. A round 16 mm (5/8 in.) diameter polyurethane drive belt was also tested. Although the design tensile strength of the belt was much greater than that required to drive the screen wheel, the belt stretched excessively and came off the pulleys.

The friction drive wheel was originally mounted on the gearmotor output shaft with the motor spring-loaded to provide the necessary contact pressure. However, the output shaft bushing on some motors failed; the shaft for this application must have roller or ball bearings when the drive wheel is mounted directly on it. The 0.12 kW (1/6 hp) gearmotor used on one bicycle wheel screen has needle bearings and has performed satisfactorily for over three years with the drive wheel mounted on the output shaft. The motor-mounted friction drive was replaced with a belt-driven wheel mounted on an idler arm as shown in Figs. 1, 3, and 4. This drive performed much better than all previous drive systems. It reduces stress on the motor shaft and is the preferred method for driving all wheel screens. The belt tension naturally provides the necessary contact pressure to drive the screen wheel and can be supplemented with a tension spring, if necessary. A special 16 mm (5/8 in.) link type vee belt† is used to drive the friction wheel. This belt is suited for the environment in which it operates since it is oil, water, and heat resistant. However, its tension must be adjusted frequently during the first several weeks of operation until its initial stretch is gone.

A 60 mm (2.4 in.) wide, double layer rubber seal

*McMaster Carr Supply Co., Los Angeles, CA.

Fig. 2—Custom-built 1070 mm (42 in.) diameter rotating wheel screen showing its self-cleaning action.

†Pacific Belting Industries, Inc., Los Angeles, CA.

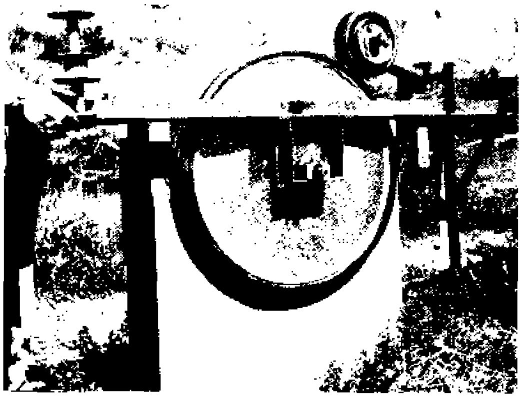


Fig. 3—Paddle-wheel-driven bicycle wheel screen showing typical construction. Bushings on later models are mounted beneath the bracket.

contacts the outside periphery of the screen wheel as shown in Fig. 3 to prevent water and trash from bypassing the screen. A 38 mm (1.5 in.) diameter rubber tube in a slightly stretched lay-flat position worked well for this purpose.

A spacer or thrust washer is used behind the wheel hub to transfer the wheel's side thrust force to the bearing or bushing. A wheel that has been sitting idle may need to be turned part way around by hand to "break it loose" when first started. The screen will then clean itself of accumulated trash after running for a few minutes. A protective cover over the motors is recommended to shield them from precipitation and the sun. Also, it is advisable to place a safety guard around the friction drive wheel if children can get near it. Wheel screen machines should be painted to extend their life.

Screen Wheels

Several types of wheels can be used for this purpose. Some light duty wheels from old farm implements or carts may be satisfactory. Those tested on Research Center and farmer turnouts include: (a) a 710 mm (28-in.) diameter front bicycle wheel and tire, Fig. 3; (b) a 1070 mm (42-in.) diameter custom-built wheel, Fig. 2; and (c) a commercially-built 750 mm (30-in.) cart wheel, Fig. 4.

The wheel for the bicycle wheel screen is made in England for a "tourist" bicycle by the Raleigh Co. It is more rugged and has a larger diameter than most bicycle wheels and can be obtained from many bicycle shops. The wheel is driven by a 0.12 kW (1/6 hp), 135 rpm gearmotor with a 200 mm (8 in.) friction drive wheel at about 39 rpm. With good drive wheel alignment and adequate tire pressure, the bicycle tire will last two seasons running continuously. An inner tube sealing material should be placed inside the tire to prevent gradual air loss. This is the lowest cost mechanized screen tested.

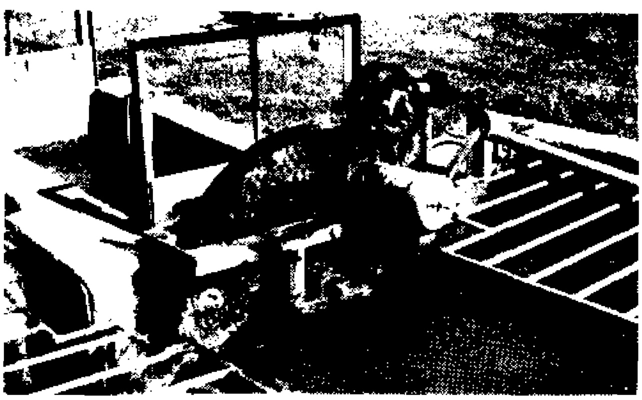
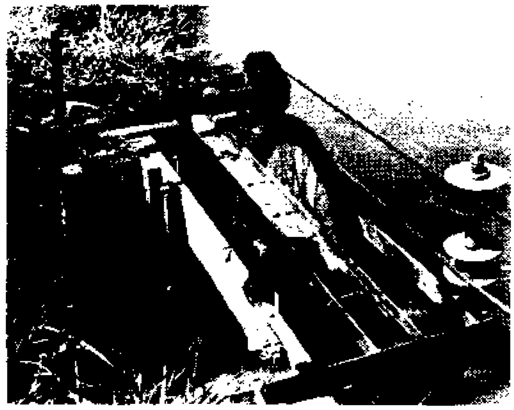


Fig. 4—Wheel screen made from a commercial cart wheel with a plastisol-covered rim.



(a)

(b)

Fig. 5—Paddle-wheel-driven bicycle wheel screen (a) and paddle wheel drive (b).

Irrigation laterals are often checked at farm turnouts to provide the necessary water surface elevation for farm deliveries. At these locations, there is often a drop in the canal lateral that can be utilized to power a paddle wheel. The bicycle wheel screen shown in Fig. 5 is powered by an undershot paddle wheel at a canal drop. The paddle wheel is 500 mm (20 in.) diameter, 450 mm (18-in.) long and has 12 blades. It is mounted on a movable support frame that is clamped to the canal drop structure. The paddle wheel turns about 80 rpm with approximately 0.3 m (12-in.) of head above the wheel centerline. With a drive pulley diameter ratio of 1.9, the peripheral speed of the screen wheel is about 94 m/min (308 ft/min). The drive belt is guided by idler pulleys. If the canal carries large pieces of debris or trash, a protective guard is needed to prevent plugging or damage to the paddle wheel. Also, clearance must be provided to allow debris to bypass beneath or around the support frame.

The wheel screen shown in Fig. 2 uses a custom-built wheel to obtain a larger flow capacity. It is driven by a 0.19 kW (1/4 hp), 135 rpm gearmotor and a 10-in. diameter rubber-tired drive wheel. The screen wheel's rotational speed is about 27 rpm. Generally, this wheel is about the largest size that is practical for this application. Care must be taken when constructing wheels for these screens that the wheel runs true and is not out-of-round.

The wheel screen shown in Fig. 4 uses a 750 mm (30 in.) diameter commercially-built cart wheel driven by a 0.19 kW (1/4 hp), 135 rpm gearmotor. The rim of this wheel was coated with plastisol, a tough, wear-resistant, baked-on plastic that has the appearance of rubber. A "tread" burned into the coating increased its contact friction with the drive wheel. The coating can be applied at a nominal cost‡ and protects the wheel rim from rushing and provides a good contact surface for a rubber-tired friction drive wheel.

Bearings and Bushings

Bearing or bushing service conditions are quite severe because fluctuating water surface elevations often cause them to operate at times both partially and fully submerged. Sediment in the irrigation water also accelerates bearing wear. The original bicycle wheel bearings wore out completely in less than four months. Without additional lubrication beyond that provided by the manufacturer, triple seal pillow block ball bearings wore out in one season on the 1070 mm (42 in.) wheel. With biweekly lubrication, they were still in good condition after one season's use.

Polyurethane and UHMW (Ultra-High Molecular Weight) polyethylene bushings wore rapidly when they ran dry and out of the water. However, these materials have good wear properties when used continuously underwater for lubrication. UHMW bushings used on the cart wheel screen (Fig. 4) and lubricated biweekly were in good condition, though lightly scored, at the end of one season after operating out of the water most of the time.

The test results indicate two alternatives for this application: (a) UHMW bushings or (b) triple seal pillow block bearings lubricated at least biweekly and preferably weekly. The UHMW bushings are preferred since they can last as long or longer than the pillow block bearings and cost much less. They are relatively inexpensive and can be obtained from bearing distributors or certain plastics suppliers§. They are simply made from a rectangular block of material and bolted directly to the bottom of the mounting bracket (see Fig. 3). The hole for the axle shaft is drilled and reamed 0.4 to 0.5 mm (0.015 to 0.020 in.) oversize. The axle shaft is stainless steel to provide a smooth wear surface and to avoid corrosion. The screen wheel should be designed so that the bushings operate below the water surface so as to be water-lubricated; otherwise, they must be lubricated frequently. Once the bushings are lubricated, they must continue to be lubricated to purge dirt and sediment particles that accumulate in the grease. Copper lubrication tubes with grease fittings are installed to the bushings (or bearings) for lubrication. Polyurethane bushings used on the traveling belt screen discussed later are still good after five years' use underwater.

‡Acme Mfg. Co., Inc., Filer, ID.

§Diversified Plastics, Missoula, MT.

Screen Materials

Screening materials tested included aluminum, bronze, fiberglass, galvanized wire, glass-filled polyester||, and stainless steel. Fine mesh fiberglass and aluminum screens were more easily damaged and tended to develop rips and snags after several months' use. Bronze, stainless steel, and polyester screens were the most durable; however, they were also the most costly.

Polyester screen is available in a variety of different size openings. Those we used had 2.5 mm (9 x 9 mesh/in.) and 3.2 mm (6 x 6 mesh/in.) openings. Care must be exercised to prevent screen damage when nearby ditchbank weeds are burned. Polyester screen has a slick surface which sheds trash easier than most other materials. However, to achieve the same open area, wider mesh is needed for the polyester screen because the polyester fibers or strands are larger. Thus, to exclude a given size material, metal screens require less head because of their larger flow area for a given size mesh. This is an advantage since it results in less force on the bottom portion of the wheel and a smaller thrust load on the bushings, particularly for large diameter wheels. Polyester screen in small quantity lots costs about \$55 to \$70/m^2 (\$5 to \$6.50/ft^2).

Stainless steel is the most durable material for this purpose and can be obtained from manufacturers# or some steel or metal specialty distributors. It costs about \$27/m^2 (\$2.50/ft^2) in 20 mesh size. Bronze costs less and is satisfactory where it is compatible with the irrigation water. Galvanized welded wire or hardware cloth for the screen is not recommended because it has a rough surface and does not shed trash as readily as polyester or smooth woven-wire screens.

The large custom-built wheel with a polyester screen is used on a farm turnout located near the end of a debris-filled irrigation canal. The canal receives debris-laden tailwater from upstream farms such that the debris becomes concentrated near the end of the canal. The wheel screen effectively prevents this material from entering an irrigation pipeline system. Prior to installation of the wheel screen, automated furrow outlet and gated pipe openings became clogged with trash even though a commercial screen having 1/8-in. openings was used. Brushes on the screen pushed some debris through the openings, which plugged furrow outlets in the distribution system. After the wheel screen was installed, plugging by trash was minor. The wheel screens all need to be brushed periodically, particularly later in the summer when algae tends to collect on the screen.

Hydraulic Characteristics

Laboratory tests were conducted to determine the head loss through a bicycle wheel screen for different flow conditions and screen sizes from which to determine flow coefficients. The screens tested are described in Table 1. A series of head loss measurements were made at different flow rates for each test, first for free flow, and then at different degrees of submergence as the downstream water depth was progressively increased.

Rotating wheel screens naturally operate at high degrees of submergence. The cross sectional flow area of

||Appleton Wire Co., Appleton, WI.

#City Wire Cloth Co., Paramount, CA.

TABLE 1. DESCRIPTION OF SCREENS TESTED IN THE LABORATORY.

Screen material	Opening size designation	Percent open or flow area
Galvanized hardware cloth	12 x 12 mm (½ x ½ in.)	84
Galvanized hardware cloth	6 x 6 mm (¼ x ¼ in.)	79
Bronze	5.5 x 7.1 mesh/cm (14 x 18 mesh/in.)	67
Aluminum	6.3 x 7.1 mesh/cm (16 x 18 mesh/in.)	66
Polyester	2.4 x 2.4 mesh/cm (6 x 6 mesh/in.)	53
Polyester	3.5 x 3.5 mesh/cm (9 x 9 mesh/in.)	51
Stainless steel	7.9 x 7.9 mesh/cm (20 x 20 mesh/in.)	46

the wheel increases with submergence, and under these conditions, the head loss is relatively small. The flow area is represented by the area of the segment shown in Fig. 6 whose height is the water depth, h, above the bottom of the wheel. Thus, the flow area of the wheel may be expressed as:

$$A = r^2 \left(\frac{\pi\theta}{360} - \frac{\sin\theta}{2}\right) \quad \text{[1]}$$

where A = cross sectional flow area of the wheel, L^2
r = wheel radius, L

$$\theta = \text{the angle between the two radii} = 2\,[\cos^{-1} 1 - (h/r)] \quad \text{[2]}$$

Data from the tests were used to determine the value of C in the general flow equation:

$$Q = CA\sqrt{2gh_L} \quad \text{[3]}$$

where Q = flow rate, L^3/T
C = flow coefficient
g = acceleration of gravity, L/T^2
h_L = head loss through the trash screen wheel, $(h_1 - h_2)$, L.

Coefficient C was determined from a rearranged form of equation [3] for different flow rates and degrees of submergence. The coefficients were plotted semi-logarithmically vs submergence, S, as shown in Fig. 7 for

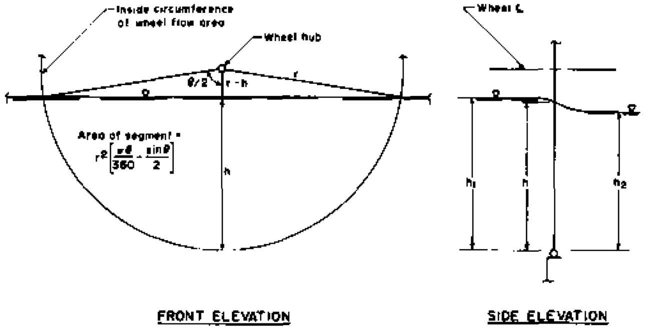


Fig. 6—Definition sketch showing flow area and head loss for a rotating wheel screen.

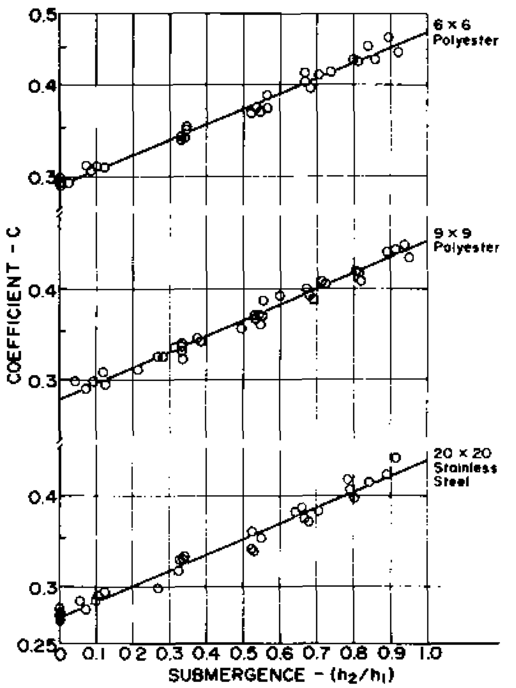


Fig. 7—Representative plots of the coefficient C vs. submergence for wheel screens with selected mesh sizes.

each screen. They can be expressed as a function of submergence by

$$C = a\,e^{b\,S} \quad \text{[4]}$$

where a and b are empirical constants and submergence $S = h_2/h_1$. Expressions for estimating both a and b in terms of screen open area percent, P, with P expressed as a decimal value P/100 were determined as

$$a = 0.19\,e^{0.77\,P} \quad \text{[5]}$$

and

$$b = 0.39 + 0.2\,P \quad \text{[6]}$$

Combining equations [4], [5], and [6] gives a general expression for C

$$C = 0.19 \exp(0.77\,P + 0.2\,PS + 0.39\,S) \quad \text{[7]}$$

Rearranging and combining equations [3] and [7] gives a general expression for head loss:

$$h_L = \frac{1}{2g}(Q/A)^2\,[0.19 \exp(0.77P + 0.2PS + 0.39S]^{-2} \quad \text{[8]}$$

Because many submerged flow depths and wheel cross section flow areas are possible for a given flow rate, h_L cannot be determined directly. However, if the upstream water surface elevation can be determined, and assuming a relatively high degree of submergence (0.8 to 0.95), the head loss for a given condition can be estimated from equation [8] with sufficient accuracy for most practical purposes. Since the drawdown at high degrees of submergence is relatively small, h is nearly equal to h_1, and when referenced to the bottom of the wheel opening,

TABLE 2. APPROXIMATE FLOW CAPACITIES FOR ROTATING WHEEL SCREENS.

Wheel Diameter		Stream size		
Millimeter	Inch	L/s	Cu ft/s	Gal/min
650*	26	28	1	450
750	30	56	2	900
900	36	85	3	1350
~~1070~~	~~42~~	~~100~~	~~3.5~~	~~1575~~

*Also bicycle wheel.

Largest feasible size is 36 inches diameter. If this is not large enough for a given condition, then use traveling belt screen.

the same value can be assumed for each when estimating h_L. The head loss can be expected to increase slightly as trash accumulates in the center of the wheel, or later in the season as algae accumulates on the screen before it is brushed. Flow capacities for different sizes of rotating wheel screens are shown in Table 2. For flows larger than those shown, the traveling belt screen discussed later is recommended.

Although wheel screens normally do not operate with freeflow, the coefficient in equation [4] for free flow conditions when submergence, h_2/h_1, approaches zero, is equal to a. The value of h, from which to determine the flow area, was approximately 0.96 h_1 to 0.98 h_1 for wheels with screens covering a hardware cloth support.

TRAVELING BELT SCREEN

One of the first trash screens tested was the traveling belt type shown in Fig. 8 which fits in front of a farm canal turnout and excludes trash from the farm water supply. This machine consists of a traveling belt screen made from balanced weave, woven-wire, conveyor belting. The belt travels on two plastisol or rubber-covered drums. It is driven from the upper drum with a 0.19 kW (1/4 hp) gearmotor and either a chain and sprocket or vee belt and pulley drive. The speed of the driving drum is 13 rpm which provides a screen speed of about 6 m/min (20 ft/min) with a 150 mm (6 in.) diameter driving drum. Since this speed was satisfactory, the screen was not tested at other speeds. A speed about 12 to 15 times faster should provide self-cleaning action, but would significantly increase wear on the screen and other components. Water-lubricated urethane bushings are used for the lower drum, which always operates submerged, while the upper drum is supported by pillow block bearings. The machine can be either permanently mounted to the turnout structure or supported with brackets that fit over the top of the structure headwalls in the same manner as the wheel screens so that it can be readily removed.

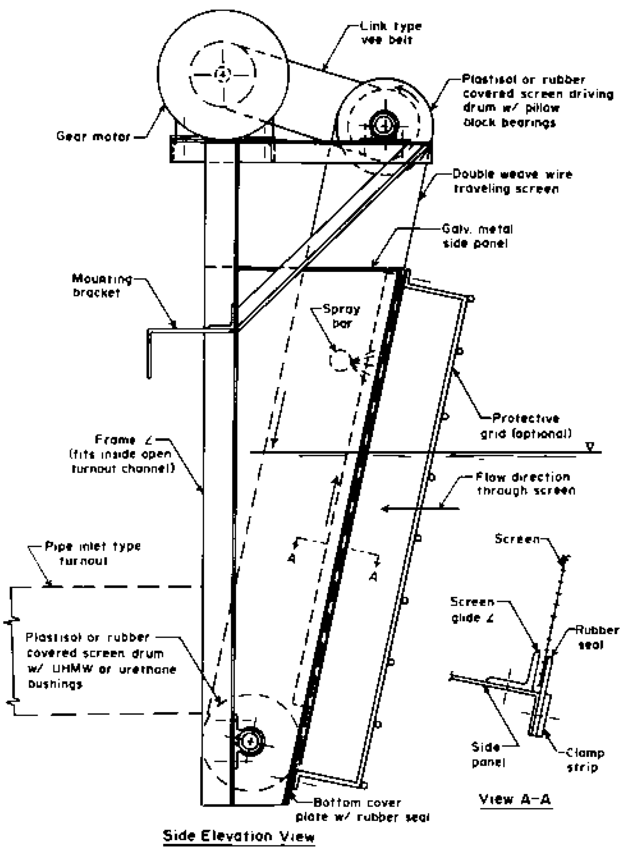


Fig. 8—Schematic drawing of a traveling belt type trash screen.

Fig. 9—Traveling belt type trash screen made from double weave, woven-wire, conveyor belting.

A polyester screen was first used, but the screen was destroyed twice when canal maintenance crews burned weeds along the canal. The polyester screen was well suited for this application, since it was originally designed for certain industrial conveyor belt applications, and it sheds trash relatively easily. It was replaced with the woven wire conveyor belting shown in Fig. 9. Wire conveyor belting for this type screen is available in a large variety of wire diameters and mesh sizes. Belting in the size range from 16 to 20 gauge type 304 stainless steel with openings from 6.4 to 2.8 mm (0.25 to 0.11 in.) is satisfactory for these small farm type screens. The cost of belting obtained in quantities for several screens is reasonable, and varies from about $100 to $325/m² ($10 to $30/ft²) depending upon quantities and mesh size. The screen belt for the machine shown in Fig. 9 is 0.6 m (2 ft) wide x 2.4 m (8 ft) long. The overall machine cost is similar and may be even less than a wheel screen with a custom-built wheel.

A spray bar located behind the upward traveling belt is used to clean the screen. A brush mounted in front of the belt was also used but was not as efficient as the spray bar because pieces of trash missed by the brush would occasionally go over the top of the screen. Trash removed from the screen falls back into the canal. The spray bar is especially convenient when water is available from a nearby pump. Otherwise, an auxiliary pump is needed unless a brush is used for cleaning. This type screen was as effective as the rotating wheel screens when a spray bar was used for cleaning. It is particularly useful: (a) where the lateral space required for a wheel screen is limited, (b) where the diameter of a wheel with sufficient depth below the water surface would be too large to be practical, (c) for flows larger than about 100 L/s (3.5 cfs), or (d) in locations where a sprinkler or pump is used so that pressure can be made available for a spray bar. Head loss data for this screen was not obtained.

A protective grid of No. 10, 100 x 100 mm (4 x 4 in.) reinforcing steel mesh may be placed in front of the screen to keep large pieces of debris away from the belt. The screen shown in Fig. 9, used for about five years, has been effective in preventing trash and debris from entering an irrigation system where automated furrow outlets are used. Larger, similarly-built traveling belt screens are commercially available for canals.

SUMMARY

When automated irrigation systems are supplied from canals, trash screens are needed that (a) will not be adversely affected when farm deliveries are terminated by downstream valve closures while canal turnout gates remain open, and (b) do not require a drop. Mechanized screens which mount on the upstream side of a canal turnout were developed and field tested for this purpose. One was a rotating wheel type which consists of screen-covered, spoked wheels, such as bicycle or cart wheels, mounted on a frame in front of the farm turnout. They are powered by electric motors or water-powered paddle wheels and are driven by a belt-driven friction drive wheel. The wheel screens are self-cleaning if their rotation speed is sufficient to provide a minimum peripheral speed of about 90 m/min (300 ft/min). Another screen was a traveling belt type. The five different experimental screens tested were all effective in preventing trash in canals from entering the farm irrigation systems.

Fluctuating canal water surface elevations and sediment cause severe service conditions for bearings or bushings on the rotating wheel screens. Low cost UHMW (Ultra-High Molecular Weight) polyethylene bushings are preferred when they can operate underwater so as to be self-lubricated. Sealed pillow block bearings lubricated biweekly lasted about the same length of time as grease-lubricated bushings operating out of water; however the bearings were much more costly to replace.

Screening materials tested included aluminum, bronze, fiberglass, galvanized welded-wire or hardware cloth, glass-filled polyester, and stainless steel. Stainless steel screen is the most durable and is recommended. Other, less costly materials can be used, but need to be replaced more often. Polyester screens shed trash better than other materials but are the most costly. They are susceptible to damage when ditch banks are burned, but otherwise are durable. Aluminum and fiberglass were more easily damaged and only lasted several months. Galvanized wire is not recommended because its welded joints and rough surface do not shed trash very well.

Laboratory tests were conducted to determine head loss through a bicycle wheel screen for different flow rates and degrees of submergence. Flow coefficients, which vary semi-logarithmically with submergence, were determined and can be used to estimate head loss through rotating wheel screens with different screen materials by assuming a submergence value of approximately 0.9.

A traveling belt type screen which uses balanced weave, woven-wire conveyor belting was also tested. This screen was effective in preventing trash from entering the irrigation system, especially when a spray bar for cleaning was used. It can be used for flows greater than about 100 L/s (3.5 cfs), where lateral space for a wheel screen is limited, or where an unduly large screen wheel would be required.

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