

# SPRINKLER IRRIGATION

6-42f



P. N. W. Bulletin, No. 3

May, 1952

ERS

A Pacific Northwest Cooperative Extension Publication

## *Some Points to Think About*

### BEFORE BUYING A SPRINKLER SYSTEM, CONSIDER

1. Its advantages and disadvantages.
2. The amount of water needed and when needed.
3. The costs of installing and operating.

### THEN IF YOU DECIDE TO BUY A SPRINKLER SYSTEM

1. Ask reliable and qualified dealers to prepare a system design that fits your conditions and needs.
2. Insist on a complete system, from pumping plant to sprinklers.  
Do not buy a system piecemeal.
3. Ask for cost estimates.

**Material in this publication prepared jointly by Agricultural Experiment Stations and Agricultural Extension Services:**

**Oregon State College, Corvallis, Oregon**

**The State College of Washington  
Pullman, Washington**

**University of Idaho, Moscow, Idaho**



# SPRINKLER IRRIGATION

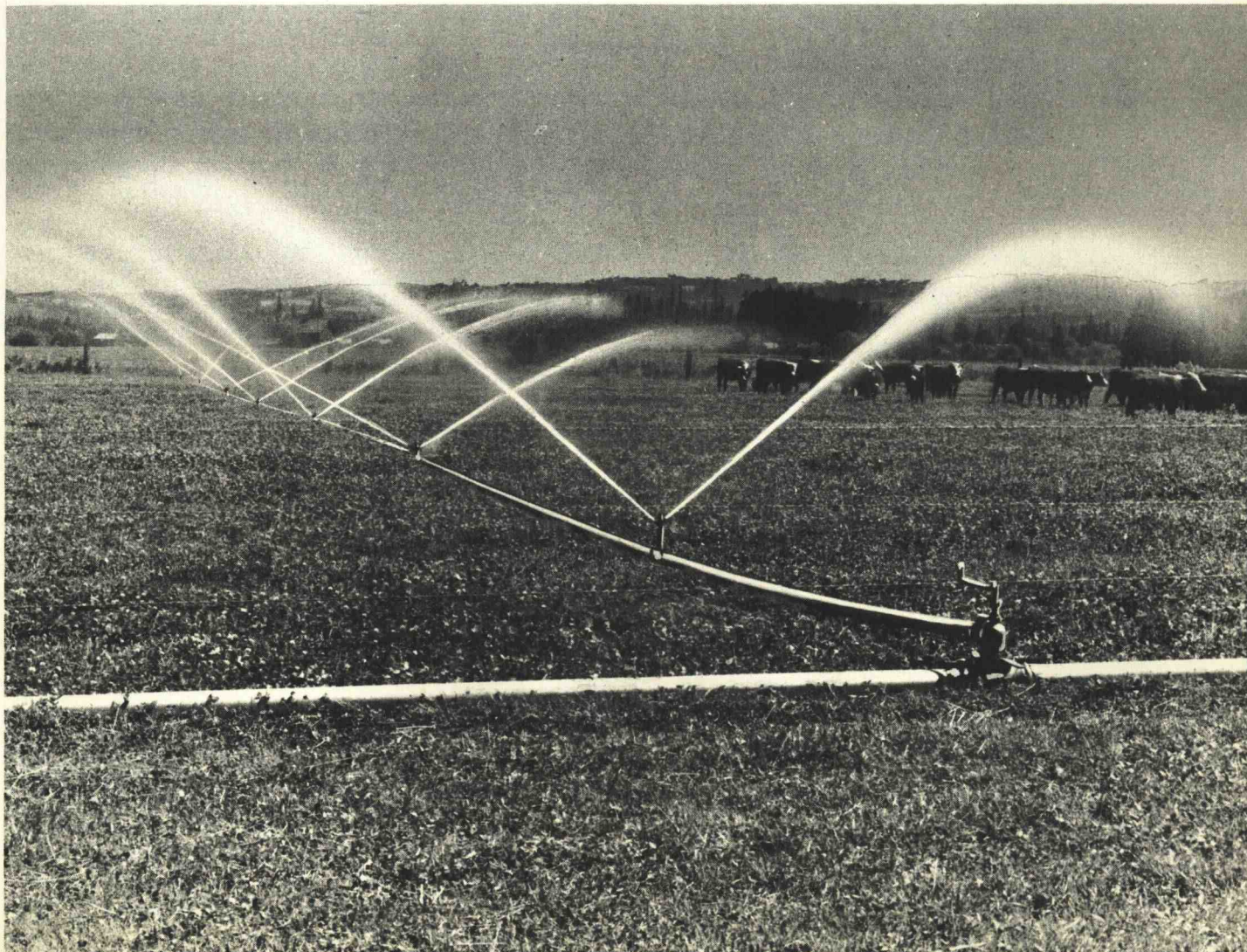
Sprinkler irrigation is gaining in importance as a method of applying water to crops throughout the Northwest. Of the several reasons for this rapid gain in popularity, the principal one is that you can readily adapt it to conditions where surface methods are not successful.

The sprinkler method is particularly well suited to irrigating coarse, sandy, and gravelly soils, especially when these soils are shallow and cannot be prepared correctly for surface irrigation. You can also use sprinkler irrigation quite successfully on steep and irregular

slopes. With few exceptions, you can use it to irrigate any crop grown in the Northwest.

Water applied to the soil by sprinklers is not necessarily better than water put on in furrows or by flooding. The important part of irrigating is to get the right amount of moisture into the soil where growing crops can use it. Any method which accomplishes this without unreasonable waste of water, soil, time, and effort is satisfactory. When conditions are favorable for applying water by a surface method, it may be difficult to justify a change in sprinkling.

**Figure 1. Sprinkling is an important irrigation method in the Northwest.**





# SPRINKLER IRRIGATION COMPARED



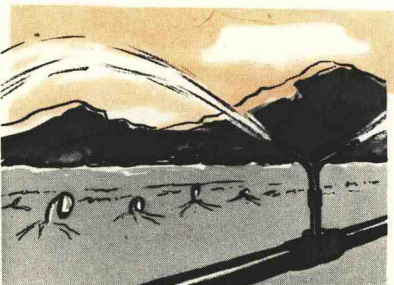
**Land leveling is not necessary.**



**Drainage problems are decreased.**



**Ditches are eliminated.**



**Crops can be "irrigated up."**

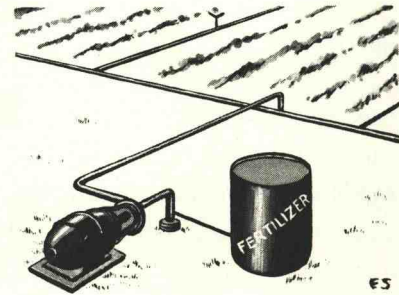
Sprinkler irrigation has both advantages and disadvantages when compared to other irrigation methods. The significance of any one of these depends considerably on local conditions and circumstances.

## *Advantages*

1. **LAND LEVELING IS NOT NECESSARY.** Successful irrigation by surface methods requires that the land be leveled. This often is an expensive operation.
2. **AVAILABLE WATER IS PUT TO BETTER USE.** With surface methods, some water is lost by run-off and by percolating through the soil. A properly designed and operated sprinkler system eliminates surface run-off and deep percolation losses. If water is expensive or water supplies are limited, controlling these losses may be an important advantage in favor of sprinkling.
3. **DRAINAGE PROBLEMS ARE DECREASED.** High water tables, seepage spots, and alkali areas in irrigated land can ordinarily be traced to waste water. Sprinkling reduces the waste of irrigation water.
4. **EROSION IS KEPT TO A MINIMUM.** Whenever water runs from a field, it carries with it some good top soil. Surface methods may cause serious erosion, especially on steep slopes. A properly designed sprinkler system applies water without run-off and eliminates erosion.
5. **DITCHES ARE ELIMINATED.** Sprinkling does away with the need for field ditches. This eliminates the ditchbank weed problem, reduces maintenance, and increases land available for cropping.
6. **SPECIAL SKILLS ARE NOT REQUIRED.** Good surface irrigation generally requires a high degree of skill by the irrigator. No particular skill is required to uncouple, move, and recouple the light aluminum laterals now used commonly for sprinkler irrigation.

# TO SURFACE IRRIGATION METHODS

7. FULL PRODUCTION IS POSSIBLE THE FIRST YEAR. Surface methods depend on well-prepared land and stabilized ditches. It may take 3 years or more to make these developments. When a sprinkler system, ditches and land leveling are not necessary and often you can irrigate the entire farm the first year. This could justify the additional cost of some sprinkler systems.
8. CROPS CAN BE "IRRIGATED UP." Sprinkling permits frequent light applications suitable for *irrigating up* sugar beets, alfalfa, clover, and other crops.
9. FERTILIZER CAN BE APPLIED UNIFORMLY IN THE IRRIGATION WATER. You can apply soluble fertilizers through the sprinkler system with little labor at any time during the season. This is true regardless of the type of pump used.



Fertilizer can be applied uniformly in the irrigation water.



Power costs are continuous.

## Disadvantages

Like other irrigation methods, sprinkling has certain undesirable features.

1. INITIAL INVESTMENT IS HIGH. At the present time, a complete sprinkler system costs from \$75 to \$125 per irrigated acre. These figures are based on systems for areas larger than 20 acres. Systems for small tracts have run as much as \$200 per acre.
2. POWER COSTS ARE A CONTINUOUS EXPENSE. Water under pressure is required to operate a sprinkler system. And pumping to develop this pressure is a continuous cost.
3. MOVING LATERALS IS A DISAGREEABLE AND COSTLY JOB. Laterals must be moved regularly. The soil is usually muddy and the foliage is wet. Relocating a lateral from one set to the next under these conditions is disagreeable. Labor cost to move laterals, though not necessarily higher than the labor costs for other methods of irrigation, is also a large item.
4. A SPRINKLER SYSTEM LACKS FLEXIBILITY. It is designed for one capacity only and is not easily adjusted to emergencies.
5. WIND AFFECTS WATER DISTRIBUTION. Winds distort the spray pattern and increase evaporation.



Moving laterals is a disagreeable and costly job.



Wind affects water distribution.



## Other Points Questioned

Other points regarding the merits of sprinkler irrigation over surface methods are often questioned.

1. DOES SPRINKLING CUT DOWN LABOR COSTS? Sprinkling cuts down labor costs in some cases and definitely not in others. On fields with smooth topography, water can usually be applied with less labor by surface methods. When the topography is rolling, however, or when the slopes are not uniform, less labor may be required with sprinklers.

2. DOES WATER APPLIED BY SPRINKLERS MAKE BETTER CROPS? Water applied by sprinkling is neither wetter nor better than that put on by any other method. In many instances, however, a switch to sprinklers has resulted in improved irrigation. If better irrigation is accomplished by any method, increased crop production results.

### 3. DOES SPRINKLING DAMAGE CROPS?

There has been little damage noted in the Northwest, even where sprinklers are operated both day and night. Damage is possible on some crops, but properly timed irrigation can usually avoid it.

### 4. DOES SPRINKLING SPREAD DISEASE?

Experience has shown that the disease spread by sprinkling has not been serious, but such damage has occurred in some areas.

5. DOES SPRINKLING DESTROY THE EFFECTS OF SPRAYS? The washing off of sprays by sprinkling does not appear to be serious. A good practice, however, is to permit sprays to set for a time before turning on the water.

6. DOES SPRINKLING PREVENT PROPER POLLINATION? Field observations indicate that sprinkling has little influence on proper pollination of crops.

# THE SPRINKLER IRRIGATION SYSTEM

A sprinkler system usually consists of a pumping plant to supply water under pressure; a main-line pipe and laterals to convey the

water; and sprinklers to spread the water over the land.

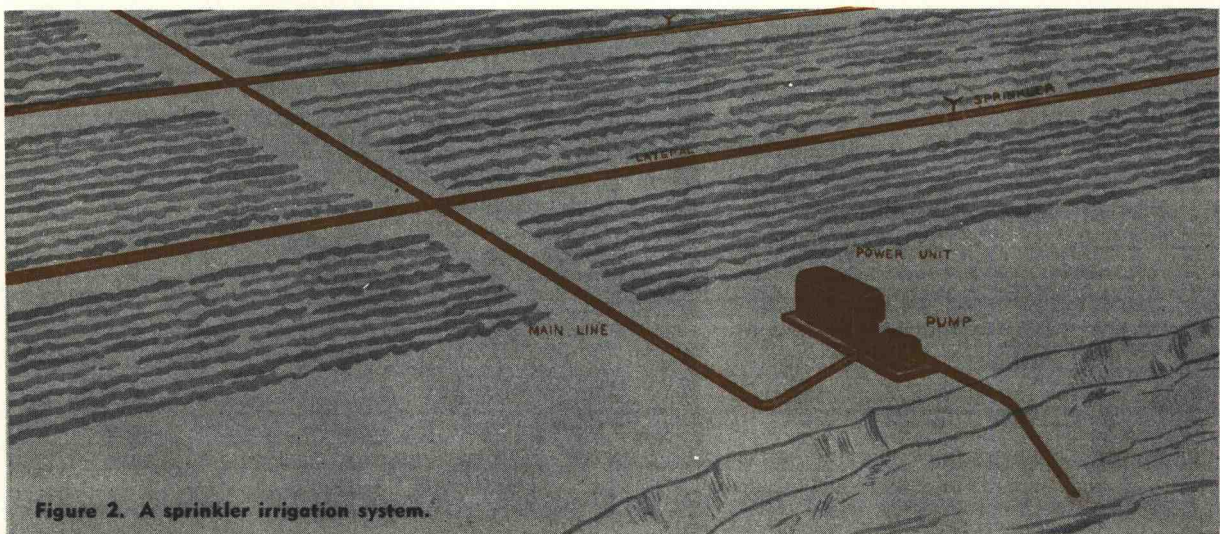


Figure 2. A sprinkler irrigation system.



# The Pumping Plant

The pump and the power unit consisting of either an engine or an electric motor, make up the pumping plant.

## THE PUMP

Most sprinkler irrigation systems are supplied with water from a pond, river, creek, or irrigation ditch. The pump best suited to lift water from such a source is the *horizontal centrifugal*.

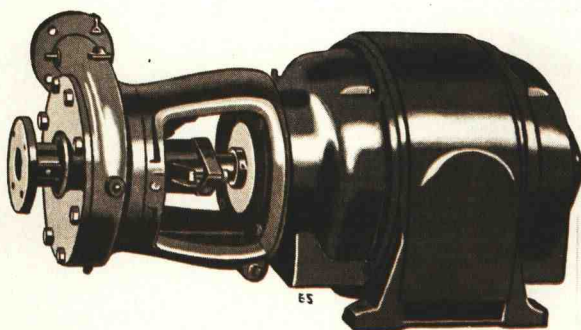


Figure 3. A centrifugal pump.

The centrifugal pump is fairly inexpensive. It has the ability to deliver water in a steady flow and against pressures required for satisfactory sprinkler irrigation. Because of limitations in suction lifts (the pump usually does not draw up the water more than 15 feet), the pump needs to be located as close as possible to the water source.

Where water is to be pumped from a well, the pump best adapted is the *turbine*. The turbine has a vertical shaft which extends to the impeller or impellers below the water surface in the well. Either a pulley or a vertical motor is fitted to the upper end of the shaft above the ground surface. The shaft and impellers are surrounded by the column pipe and the impeller casings. As the impellers force the water upward, the water passes through the

column to the top of the ground and then to the sprinkler pipe system.

The turbine pump is more expensive than the centrifugal. It has the advantage of always being primed. And it is not bothered by suction lift, since the bowls are set low enough in the well to keep them submerged.

There is a pump to fit every need, but any one pump performs efficiently under a narrow range of conditions. For that reason, buy the pump, and the motor or engine required to operate it, as a part of the sprinkler system.

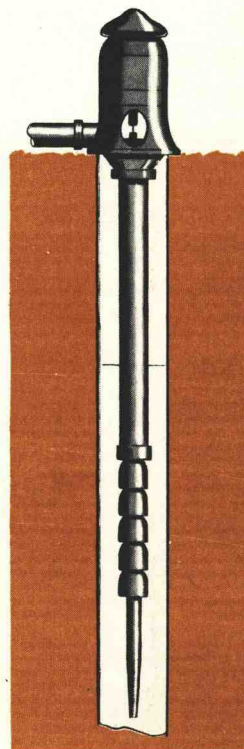


Figure 4. A turbine pump.

## THE POWER UNIT

Convenience and dependability make the electric motor a most desirable power unit to operate the sprinkler system. It requires little attention and is exceptionally well suited for direct connection to the shaft of the pump.

In the Northwest, where electric power rates are low, the electric motor is also economical. Gasoline or diesel engines are used to a limited extent but mostly where electric power is not readily available.

Proper fusing will keep electric motors from burning out by overload or low voltage. And engines should be equipped with controls that stop the engine in case of overheating or low oil pressure.

## Main Lines and Laterals

Pipe lines used to convey water to the sprinklers usually consist of a main line and one or more sprinkler laterals. The main line may be *portable* or *non-portable*; sometimes the pump as well as the pipe line is portable.

Many non-portable main lines are asphalt-dipped steel pipe. In some installations, wood-stave and composition pipes are used. Although they are usually buried, some are left on top of the ground. In either case, Tees and

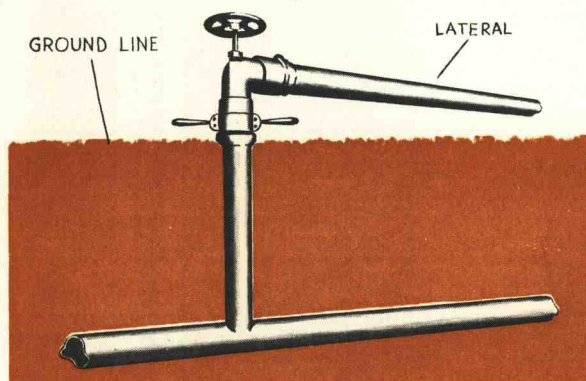


Figure 5. A non-portable main line.

shutoff valves are provided at suitable intervals to permit connection of the sprinkler laterals.

Portable main lines can be steel or aluminum equipped with quick couplers. In many instances, the aluminum main line is seldom moved during the season, even when it is portable.

All of the portable lateral pipes now being sold are aluminum tubing. This metal is light, but strong and durable. The tubing comes in lengths of 20, 30, and 40 feet. Until recently, the 20-foot length was most common for portable laterals. In recent years, more and more 40-foot lengths have come into use, especially in the 2-inch and 3-inch sizes. The 30-foot length is often used for portable main lines.

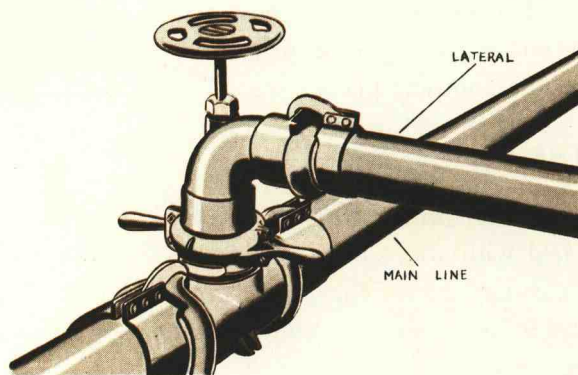


Figure 6. A portable main line.

Entrance of water into a lateral is controlled by a special main-line Tee-valve and a combination valve opener and elbow. The Tees are a part of the main line. You can readily disconnect the valve openers and move them with the laterals from one setting to the next.

After a lateral is assembled, open the valve in the main-line Tee so the water flows into the lateral. Before moving the lateral, close the main-line Tee-valve again. With such an arrangement, you do not need to stop the pump while moving the lateral from one setting to another.

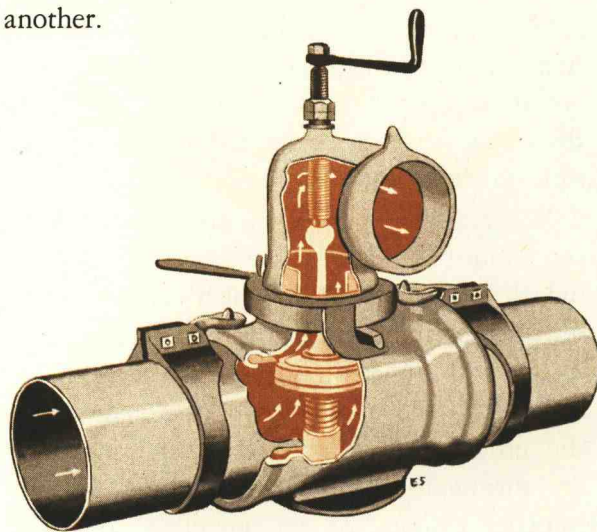


Figure 7. Tee-valve and elbow.



# The Sprinklers

## REVOLVING HEADS

The revolving sprinkler is a device turned by an escaping jet of water. There are several different makes of these rotating sprinklers, but only two or three are in common use in the Northwest today.



Figure 8. A single nozzle sprinkler with female riser thread.

Capacities of rotating sprinklers commonly used vary from 2 to 20 gallons per minute. The smaller sprinklers operate at pressures as low as 10 pounds per square inch, while some of the larger ones operate most satisfactorily at pressures from 40 to 50 pounds per square inch.

The small sprinklers, Figures 8 and 10, have a single nozzle. Their principal use is to irrigate orchards. The larger sprinklers, Figures 9, 11, and 12, have two nozzles, and are designed especially to irrigate field crops.



Figure 9. A two-nozzle sprinkler.

In recent years, sprinklers have been developed with capacities of 200 to 600 gallons per minute each. These large sprinklers operate at very high pressures. They have not yet found acceptance in the Northwest.



Figure 10. A single nozzle sprinkler with spring action.

As a general rule, the larger the nozzle, the higher the pressure required for good distribution. Many sprinklers now used to irrigate field crops operate at pressures between 30 and 50 pounds per square inch. Those used for under-tree sprinkling of orchards operate at pressures of 15 to 30 pounds per square inch.

Nozzles can be replaced quickly. If the spray is too fine, you can install a larger nozzle; and if the drops are too large, you can reduce the size of the nozzle. For under-tree orchard sprinkling, nozzles are also available that eject water at a low angle above the ground.

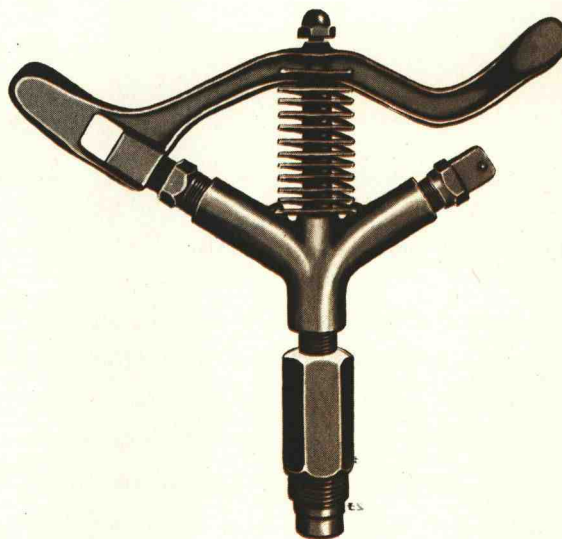
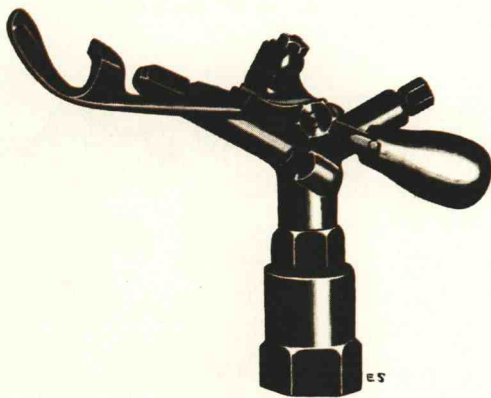
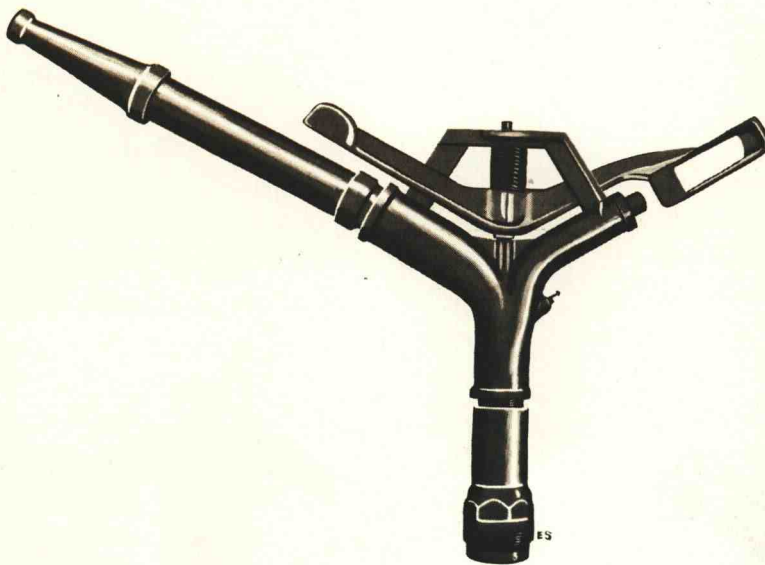


Figure 11. A two-nozzle sprinkler with spring action.





**Figure 12.** A two-nozzle sprinkler with spoon and counterweight action.



**Figure 13.** A large capacity sprinkler.

Sprinkler spacings vary with the size of the sprinkler used. To irrigate field crops in the Northwest, sprinkler spacings are commonly 40 by 60 feet; that is, the sprinklers occur at 40-foot intervals along the laterals, and the laterals are moved 60 feet from one setting to the next. Spacings for under-tree sprinklers in orchards are commonly 20 by 40 feet.

The sprinklers are fitted to small diameter riser pipes. These risers vary in length from 6 inches to 14 feet, depending on the kind of crop irrigated. In the case of a high riser system, the riser and the portable lateral are usually moved separately.

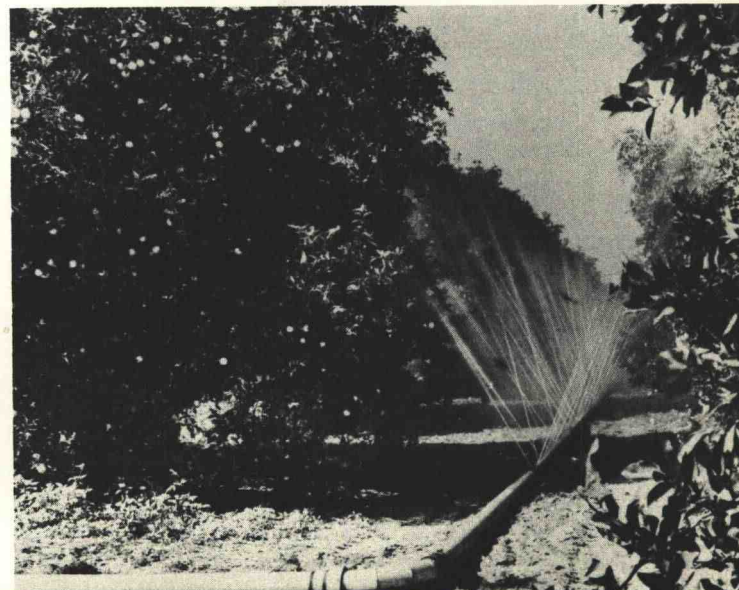
### PERFORATED PIPE

On some systems, the portable pipe has small openings or perforations. These perforated pipe systems apply water quite uniformly along the entire length of the lateral. They are considered to be low-pressure systems,

operating at pressures of from 5 to 20 pounds per square inch. The width of the strip irrigated depends on the pressure, but varies from 25 to 40 feet.

Probably the greatest limitation of the perforated pipe system is its fast rate of applying water to the soil. Application rates vary from  $\frac{1}{2}$  to 2 inches of water per hour, which is too fast for many of our soils to absorb.

**Figure 14.** A perforated pipe.





# FITTINGS MAKE THE DIFFERENCE

Whenever a sprinkler system is referred to by name, the reference is to the name or trade name of the manufacturer of the special fittings. Pumps, motors, engines, steel pipe, aluminum tubing, and even the sprinklers are made at widely separated places by different manufacturers. The makers of the special fittings buy these items already made, and, by using their own fittings, assemble and sell systems that bear their company names.

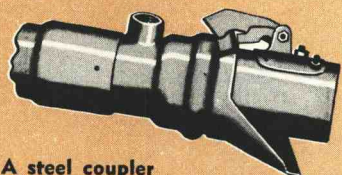
In the Northwest, a number of manufacturers are now making fittings for sprinkler systems. These fittings include couplers, ells, Tees, reducers, Tee-type valves for main-line hydrants, and valve-opener elbows. Couplers appear every 20 to 40 feet along portable sprinkler laterals and, therefore, are the fittings by which you can recognize the make of system easily.

In some respects, the couplers, as well as other fittings, are much alike. All have either one or two replaceable rubber gaskets to prevent the loss of water between the pipe and the coupler when pressure is applied. And nearly all gaskets are made to permit water to drain out whenever the line is shut off and the pressure released.

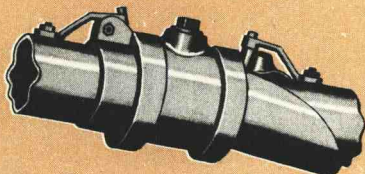
Probably the greatest difference between couplers is the way in which they are fastened to the pipe. Some have a latch on both ends, others are bolted to the pipe on one end, and still others have one end rolled or pressed onto the pipe.

On most systems, the coupler makes a flexible joint which allows the sprinkler pipe to bend or form an angle. Some flexibility is desirable, particularly on rolling land.

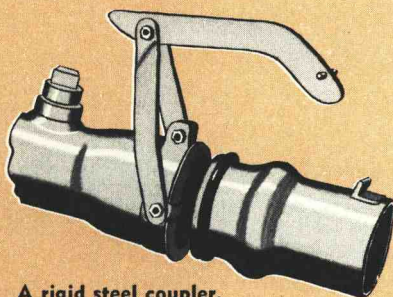
Most couplers have a guide or guard apron that helps keep dirt from being scooped up when the pipe end is inserted.



A steel coupler with one end fastened rigidly.



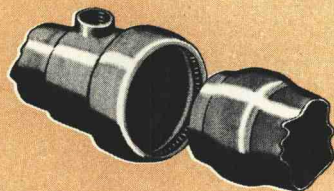
An aluminum coupler with one end fastened, but flexible.



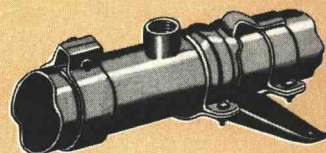
A rigid steel coupler.



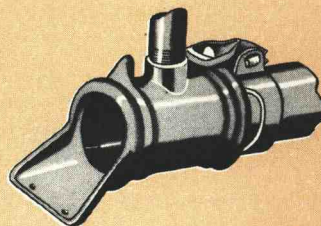
An aluminum coupler, flexible at one end.



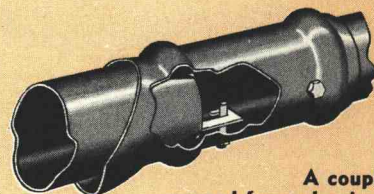
A ball joint coupler without latches.



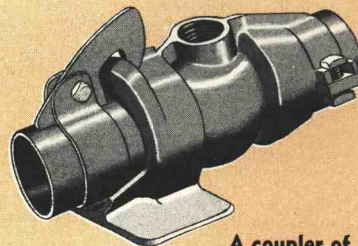
A steel coupler, rigidly fastened at one end.



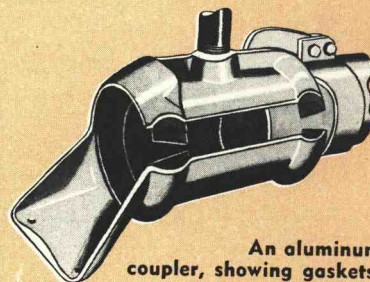
An aluminum coupler with both ends flexible.



A coupler pressed from aluminum tubing with interlock pin.



A coupler of cast aluminum with latch lock.



An aluminum coupler, showing gaskets.



# PROPER DESIGN IS ESSENTIAL

Satisfactory performance of a sprinkler system depends largely on proper design. The best equipment may perform poorly unless the design is good. It is good business to compare the cost of different systems, but do not base final selection on price alone. With lower-priced systems, the pipe sizes or other parts of the system are often inadequate for good performance.

It is usually desirable to purchase the entire irrigation system, including the pump, motor, pipe, and sprinklers, as a unit from one dealer. Only then can a dealer be responsible for the satisfactory performance of the system.

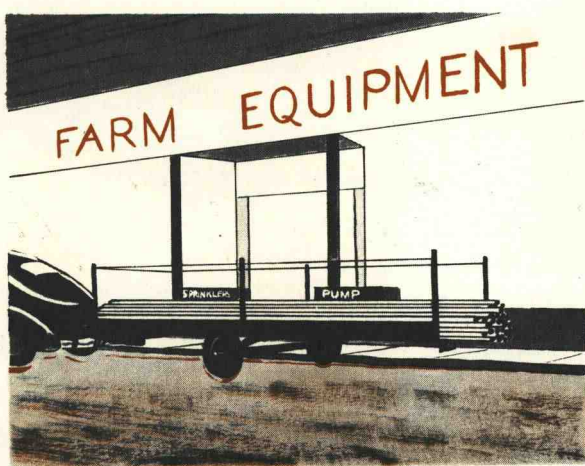


Figure 15. Buy your entire system from one place.

Many of the sprinkler equipment distributors and dealers now have men trained in the design of sprinkler systems. Their services are available to prospective buyers, generally without obligation.

Designing a sprinkler system is complicated and, generally, a buyer should not attempt it. It involves determining suitable depths, frequencies, and rates of applying water; selecting the proper sprinklers and nozzles that fit the desired application rate; determining suitable



Figure 16. Designing a system is complicated.

sprinkler spacings and operating pressures; and, finally, selecting a pump and motor designed to deliver the required amount of water at the desired pressure.

Good performance depends on adequate water, especially when crops need it most. The available supply should permit 5 to 6 gallons of water to be pumped per minute for each irrigated acre. For example, a 40-acre field would take  $40 \times 5$ , or 200 gallons of water each minute, even though you are only irrigating a part of this field at a time.

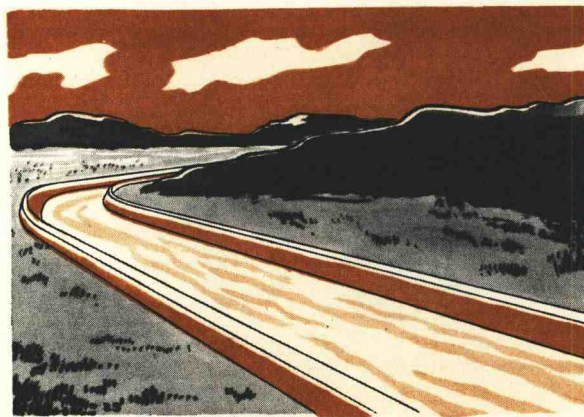


Figure 17. A good water supply must be available.



# SPRINKLER IRRIGATION COSTS

The cost of installing a sprinkler system today generally varies from \$75 to \$100 an acre. Occasionally a large system is installed for less than \$75 an acre. But equally common is the system that costs more than \$100 an acre.

Investment in a sprinkler system can be spread over several years. To determine annual irrigation costs, figure interest on the investment and depreciation on the equipment. As a basis for estimating rate of equipment depreciation, a useful life of 15 years is often used. In addition to interest and depreciation charges are the costs for power, labor, and maintenance.

The following example shows how to ar-

rive at a total annual cost of irrigating with a sprinkler system on a 40-acre field:

## INVESTMENT IN EQUIPMENT

Complete irrigation system, total .....\$3,600

Complete irrigation system, per acre .... 90

## ANNUAL COST PER ACRE IRRIGATED

Interest 5% of \$45 (average investm't) \$2.25

Insurance and taxes 1% of \$45 ..... .45

Depreciation \$90 over 15 years ..... 6.00

Electric energy for power ..... 4.00

Labor for irrigating and attendance .... 8.00

Maintenance of system ..... 3.00

Total annual cost .....\$23.70

# SYSTEM OPERATION AND CARE

As with other irrigation methods, certain fundamentals of operation are necessary when applying water by sprinklers. Start irrigation early in the season and repeat it fairly regularly so the crop never suffers from a lack of moisture. During each irrigation, moisture should penetrate the full depth of the crop root zone.

With the dealer, work out the schedule for moving pipe and arrange to cover all the land with the least labor. The moving time should not interfere with necessary farm work. Follow your selected schedule for good performance from the system.

Before putting the equipment away at the end of the season, inspect it for possible damage. Replace parts that cannot be repaired before the next season.

Sprinkler heads left on the pipe become damaged easily in storage. Remove them from the pipes, check for wear, and place them in boxes or bins. With the sprinkler heads and risers removed, it is much easier to store the pipe.

It is best to store the pipe indoors in a dry, well-ventilated place. Outdoor storage, however, is satisfactory if the pipes are separated by wooden spacers so air can circulate freely about each pipe. The pipe should be at least 6 inches off the ground and slightly tilted for drainage.



Figure 18. Store sprinklers in the tall.

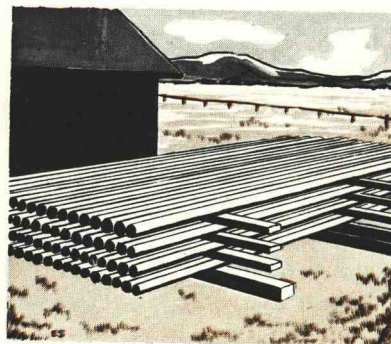


Figure 19. Separate pipe with wooden spacers.



# EQUIPMENT AND OPERATION CHANGES

Sprinkler irrigation is still relatively new and undergoing continual changes. In recent years it has changed from lightweight steel pipe to aluminum tubing. Improvements are also being made in sprinkler heads, resulting in better distribution of water and longer life for nozzles and bearings.

Manufacturers are continually trying to reduce labor costs and eliminate having to move sprinkler laterals by hand. Some farmers use extra lateral lines, while others use the system during only part of a 24-hour day. These solutions allow for leaving the lateral long enough after irrigation to let the soil surface and crop foliage dry. In either case, however, greater investment in equipment is required.

In recent years, some manufacturers have developed equipment designed to move sprinkler laterals by mechanical means. Notable among these developments are the *wheel-move* and the *tractor-move* systems. Both are attempts to overcome the extra labor of the hand-move system.

## THE WHEEL-MOVE SYSTEM

The wheel-move system is designed to carry the sprinkler lateral on wheels with a pipe serving as the wheel axle. The wheels are 42 to 48 inches in diameter and are spaced 40 feet apart along the lateral. When a lateral is to be

moved, the entire line is rolled to the new location with a hand-power ratchet or some other device. In this way, one man can move laterals 600 to 800 feet long in a fairly short time.

The adaptation of the wheel-move system is somewhat limited. It operates best on regularly shaped fields, fairly smooth terrain, and in crops that do not interfere much with the rolling of the pipe and wheels. The wheel-move system has removed some of the extra work of moving the laterals. Under favorable conditions, it also saves labor.

## THE TRACTOR-MOVE SYSTEM

Dragging lengths of lateral pipe with a tractor is not a new idea. It was tried several years ago with copper pipe. One manufacturer in the Northwest has made these systems for the past 3 or 4 years, but only a few are in use today.

In principle, the tractor-move system relies on pulling the laterals lengthwise. If the main line of the system passes through the middle of a field, the lateral is pulled across the main so that settings of the lateral appear alternately on one side and then on the other side of the main.

Where the main line follows along one side of the field, the lateral is broken in the

Figure 20. The wheel-move system.



Figure 21. The tractor-move system.





middle; the lower half is pulled toward the main and the upper half in the opposite direction. The two halves are then again connected by a short flexible hose.

Flexible hose connections are also used to connect the lateral to the main-line hydrants.

Runners placed at intervals along the lateral facilitate dragging the pipe and keep sprinkler riser pipes in an upright position. The

coupling between lengths of lateral pipe is especially designed and rigidly fastened.

The power-move system is obviously limited by crop conditions and field shapes. It has been used with varying degrees of success in orchards with covered crops. The system requires a tractor and usually a second man to assist the tractor driver. These requirements limit its effectiveness as a labor saver.

## SCREENING AND DESILTING

Many sprinkler irrigation systems in the Northwest are supplied with water from streams and irrigation ditches. This water often

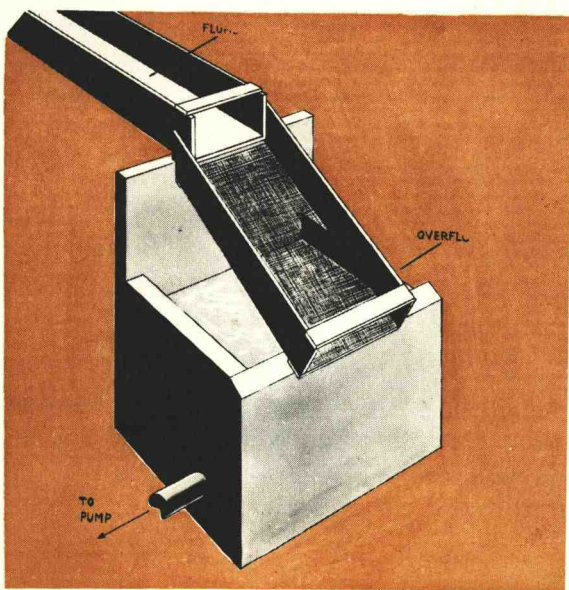


Figure 22. An Idaho trash screening box.

carries trash and silt. When trash gets into the line, the sprinkler nozzles clog. Silt and sand in the water act as abrasives and tend to wear out sprinkler bearings and nozzles.

Screens can usually remove the trash. Several types of screening boxes have been devised. Their effectiveness depends on the kind and amount of trash to be removed. Some success has been achieved with self-cleaning screens. Plans for such screens are available

through the Extension Service.

A large box which permits the velocity of the ditch water to be greatly reduced can remove the silt and sand. As velocity is reduced, more and more silt and sand settle to the bottom of the structure. If both trash and silt occur in the water, a single screening and desilting box can remove them.

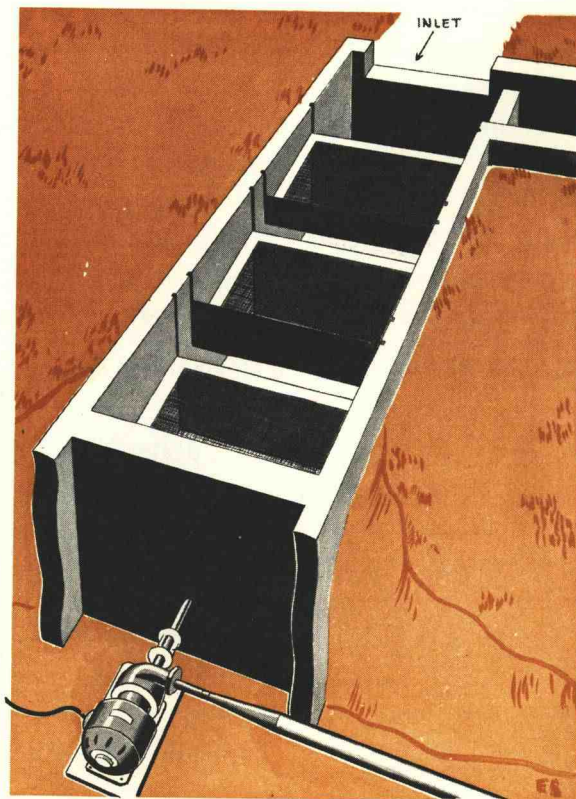


Figure 23. A desilting box.



# *A.S.A.E. Minimum Requirements*

## *Design, Installation, and Performance of Sprinkler Irrigation Equipment*

These minimum requirements, given in brief, are recommended by the American Society of Agricultural Engineers and the Association of Sprinkler Irrigation Equipment Manufacturers.

### **DESIGN AND PERFORMANCE**

*Application Rate.* A portable sprinkler system should apply water at a rate which does not cause run-off. The designer is responsible for the proper rate.

*System Capacity.* For regularly irrigated areas, the system shall meet the peak moisture demands of any crop irrigated.

For supplemental irrigation and/or special uses, the system shall apply a stated amount of water to an area in a specified time.

*Depth of Water Application,* per irrigation, shall be governed by the capacity of the soil and depth of crop root zone.

*Uniformity of Water Application* is affected by both pressure in the line and spacing of sprinklers. Design pressures *should be adhered to as closely as practicable.* Pressure differences along a sprinkler lateral should be limited to 20 per cent of the higher pressure.

*Crop Damage.* Water must be applied so it does not physically damage plants or fruit.

### **DEALER-PURCHASER RESPONSIBILITIES**

#### **DEALER RESPONSIBILITY**

*Proper Design.* When a dealer plans a system, he assumes full responsibility for the proper design.

When a customer furnishes design requirements in writing, the dealer is responsible only for a design which meets the stated conditions.

When a customer furnishes plans and specifications in writing, the dealer's responsibility is limited to supplying equipment which satisfies the requirements.

When the purchaser buys the system piece-

meal, *he relieves all dealers of any responsibility for the system's performance as a unit.*

*Proper Installation.* The dealer assumes full responsibility for the proper installation of the system. He must provide electric motors with overload and low-voltage protection, and supply thermostats that stop engines when water or oil temperatures exceed the safety point.

*Operating Instructions.* The dealer should furnish to the purchaser, in writing, necessary instructions for proper operation.

*Performance Warranty.* When a dealer assumes responsibility for a sprinkler system, a warranty should be furnished, stating specially the performance expected from a specific design serving specific crops and crop acreages as stated by the purchaser and mutually understood to be the basis of design.

*Equipment Warranty.* The dealer, assuming responsibility to install the system, must furnish warranties for replacement of defective parts shown to have failed because of poor-quality materials or poor workmanship.

*Maintenance and Repair Service.* Dealers selling sprinkler irrigation systems should maintain an inventory of replaceable parts and required equipment repair service.

#### **PURCHASER RESPONSIBILITY**

*Operate According to Instructions.* The purchaser assumes responsibility for failure of the system to perform properly, if, after receiving all data furnished by the dealer, he fails to operate the system according to all conditions assumed in the design of the system.

*Care and Maintenance Recommendations.* The purchaser must follow the dealer's recommendations for care and maintenance of the equipment during periods of use as well as non-use.

NOTE: The above material is a condensation. Your County Extension Agent can supply you with a copy of the complete minimum requirements.