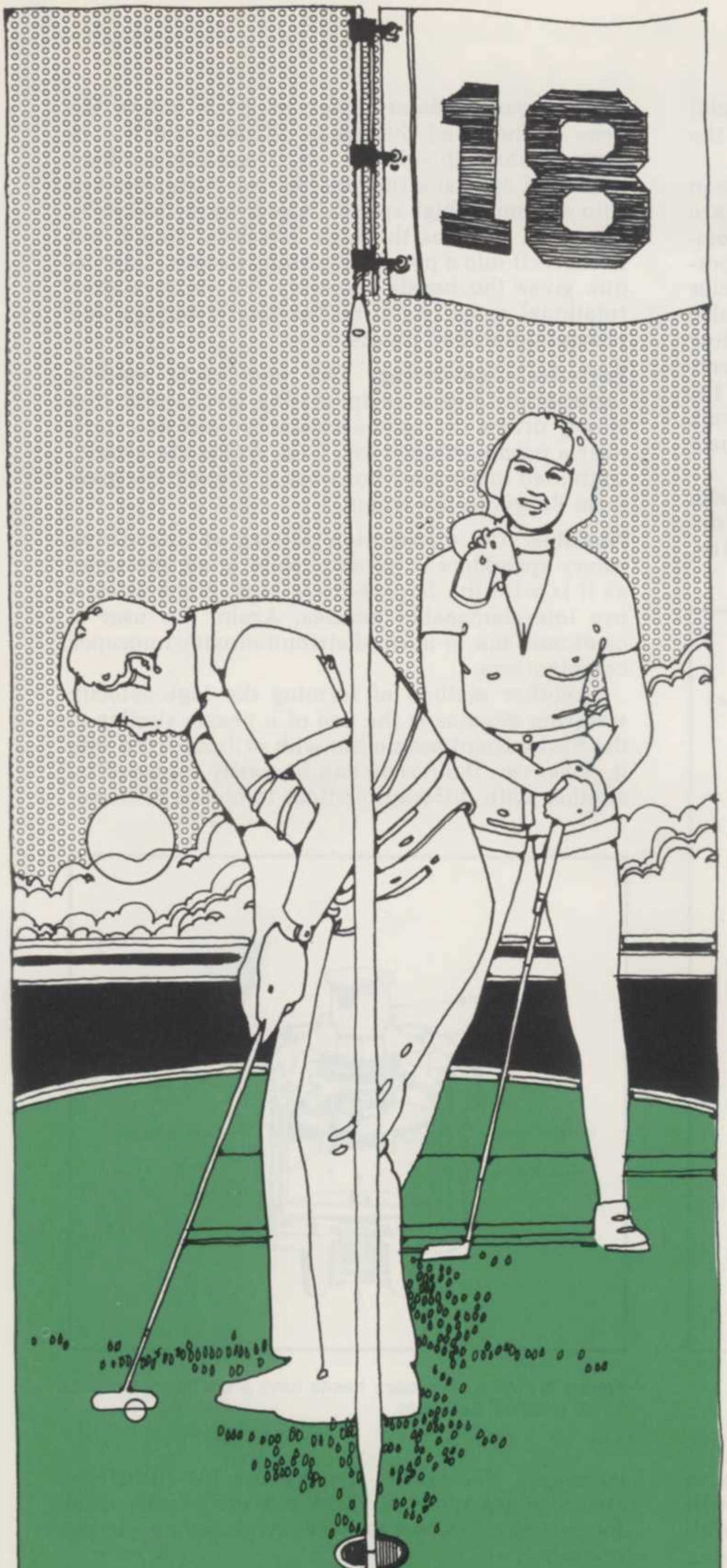

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pact rotaries (both full-circle and part-circle) where the coverage falls within the range of the "inner" nozzles previously described.

Most brands of impact rotary heads are made in several different physical sizes. The nozzles are changeable, thus allowing each model to accommodate several different orifice sizes. It is important to note that while different size nozzles provide varying coverage diameters, each size also requires different water pressures and flow volumes to operate correctly. There is some overlap in the capabilities of various nozzles. Table 1 is a typical data table. It is included to demonstrate the varying performance of nozzles in impact rotary sprinklers.

To accomplish the distribution pattern with two-nozzle sprinklers the manufacturer determines the best combination of nozzles.

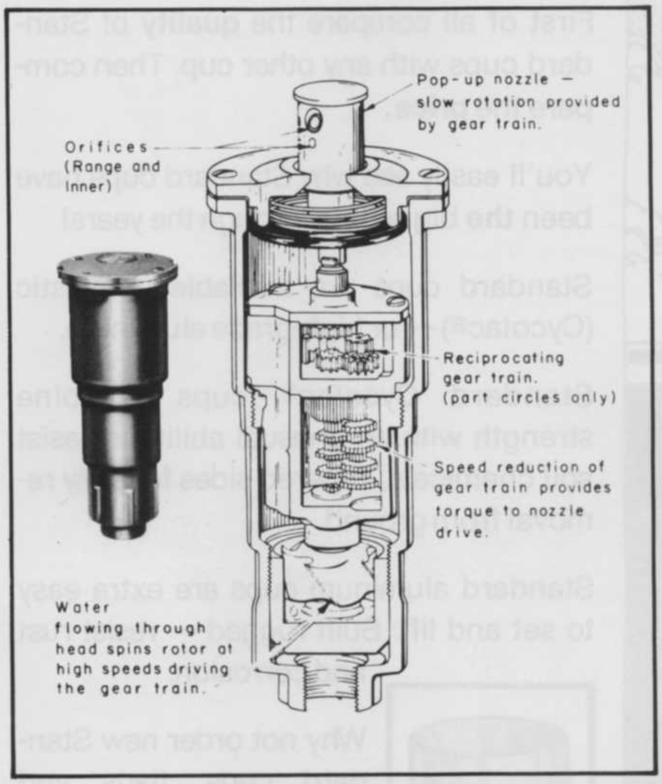

Figure 7: Gear-Drive heads provide a steady rotation and good coverage.

Caution should be used when changing nozzles in the field. Incorrect nozzle combinations will upset the distribution, resulting in areas with deficient coverage. Some nozzles are available with an adjustable "diffuser-pin" to provide a means of changing the distribution and coverage within reasonable limits. Two other cautions should be noted: (1) Use nozzle sizes for which water pressure and flow volume can be supplied according to the recommendations of the manufacturer. (2) Design in accordance with performance table minimum *and* maximum pressures beyond which a nozzle should not be used.

GEAR-DRIVE HEADS. Gear drive rotary heads provide a steady, powerful rotation to the sprinkling streams. Water under pressure enters the base of the head through a diffuser which converts it into high velocity jets. These jets are then impinged against a turbine-like rotor causing it to spin extremely high speeds. A gear train, driven by the rotor, reduces the high rotational speed and converts it into a powerful turning torque. This torque gives the nozzle-assembly the relative slow rotational speed required for good coverage and precipitation. See Figure 7.

Part-circle reversing. The part-circle models incorporate a gear reciprocating mechanism that slowly drives the nozzle-assembly back and forth over a predetermined arc. Gear trains are usually contained in separate housings to protect the gears from debris in the water.

Nozzling. The distribution pattern of Gear-Drive rotary sprinklers is accomplished much the same as it is with the Impact-Drive type. Some models use interchangeable nozzles. Again, the user is cautioned not to upset distribution with improper combinations.

Another method of forming the high-velocity watering streams is the use of a nozzle similar to the Spray Head nozzle but with orifices fixed into it. However, the nozzle can be easily replaced by another with different orifices to obtain different

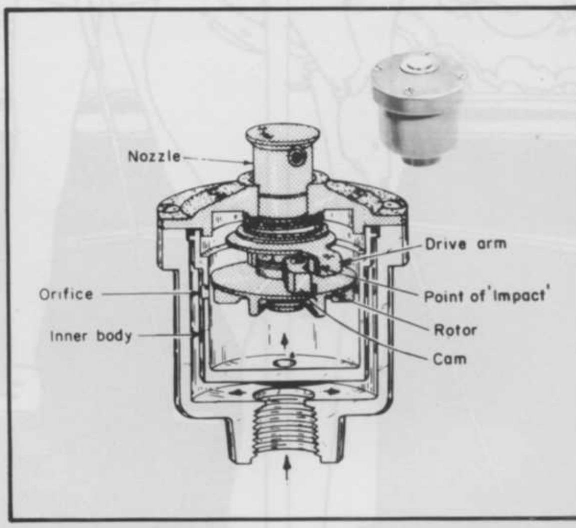

Figure 8: Cam-Drive rotary heads have a continuous rotation for all practical purposes.

coverages. Generally, the orifices for full-circle coverage are opposed. When two orifices are used for part-circle coverage, they are placed one above the other.

OTHER DRIVE TYPES. The most common rotary head drives, other than the two preceding, are the "Cam-Drive" and "Ball-Drive."

Cam-Drive Rotaries. Figure 8 illustrates a rotary sprinkler employing cams mounted directly on a rotor. Jet-streams, formed by water under pressure passing through orifices in an inner body, impinge against the rotor spinning it at high speed. As the rotor spins, the cams are swung outward by centrifugal force. On each rotation of the rotor, the cams strike a drive arm attached to the nozzle,

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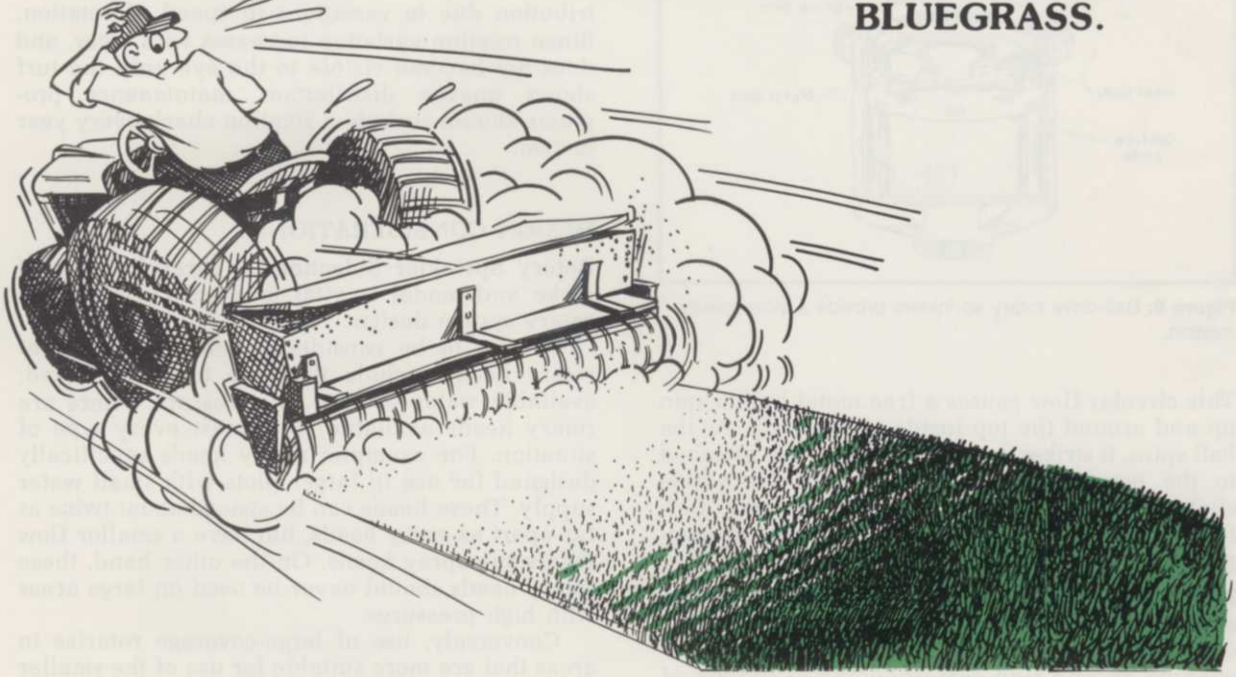

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causing a slight rotation. Upon impact, the cams swing inward instantaneously to pass the drive arm. Because of the high speed of rotor rotation and the number of cams, nozzle rotation is continuous for all practical purposes.

Ball-Drive Rotaries. Figure 9 illustrates a sprinkler utilizing a spinning metal ball to provide the power to rotate the nozzle. Water under pressure enters the head through a plate with angular openings located in the base of the head. This action causes the water to spin at high circular velocity.

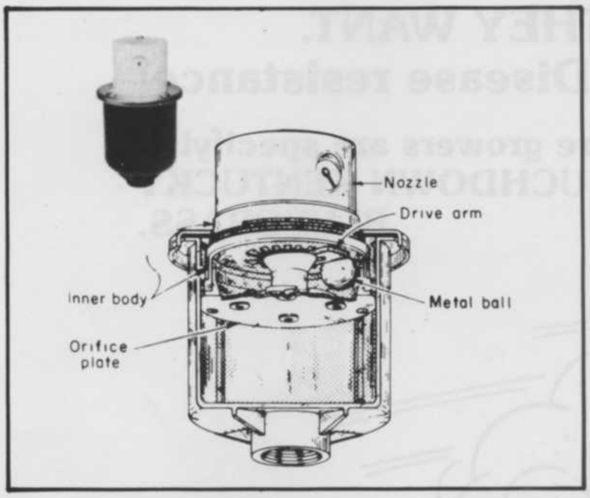


Figure 9: Ball-drive rotary sprinklers provide a slow steady rotation.

This circular flow causes a free metal ball to spin up and around the top inside of the body. As the ball spins, it strikes a projecting drive arm attached to the nozzle. Each impact rotates the nozzle slightly. The impacts occur so rapidly that, in effect, a slow, steady, rotation is seemingly accomplished.

Part-circles. Many cam and ball-drive sprinklers employ a hood over and around the nozzle to provide part-circle coverage. The hood has a milled-opening on one side corresponding to the arc of coverage. During nozzle rotation, the sprinkling streams are "blocked-out" as they enter the unmilled portion of the hood. The running clearance between the hood and nozzle can cause some degree of puddling near the head.

EFFICIENCY. The water distribution of rotary systems is not as good as with spray systems because even the slightest breeze will bend or whip the long streams. For this reason, additional compensation must be made for the velocity and direction of the prevailing wind in each locale. Since this condition becomes more acute with the longer range heads, the trend is toward closer spacing and shorter throw.

Most designers, today, agree that 65 ft to 75 ft spacing is the most effective and economical for large areas; even for golf course. Aside from better performance, as compared to larger spacings requiring greater diameters of coverage, these medium spacings offer some cost advantage. The decreased flow and pressure requirements for smaller heads permit smaller piping and greater zone flows. An added advantage is that the smaller coverage heads have a slower precipitation rate.

Since the precipitation rate of rotary systems averages only 1/5 to 1/3 of spray systems, the time required to provide the same amount of irrigation will average about four times longer.

The longer watering schedule and resultant evaporation losses associated with slower precipitation, plus a less even distribution of moisture, would seem to make rotary systems somewhat less desirable. However, the economy to be realized on projects involving acreage minimizes these deficiencies to a large extent. Other factors also minimize these deficiencies: (1) night watering reduces evaporation, and (2) effects of wind on coverage are reduced with longer watering periods because, in most locales, wind varies in velocity and direction constantly.

Christian, in his bulletin on extensive research of impact rotary sprinkler precipitation, reported that these sprinklers are subject to uneven distribution due to variations in speed of rotation. Since rotation variation increases with wear, and does not become visible to the eye until the turf shows uneven distribution, maintenance programs should include a rotation check every year or two.

DESIGN CONSIDERATIONS

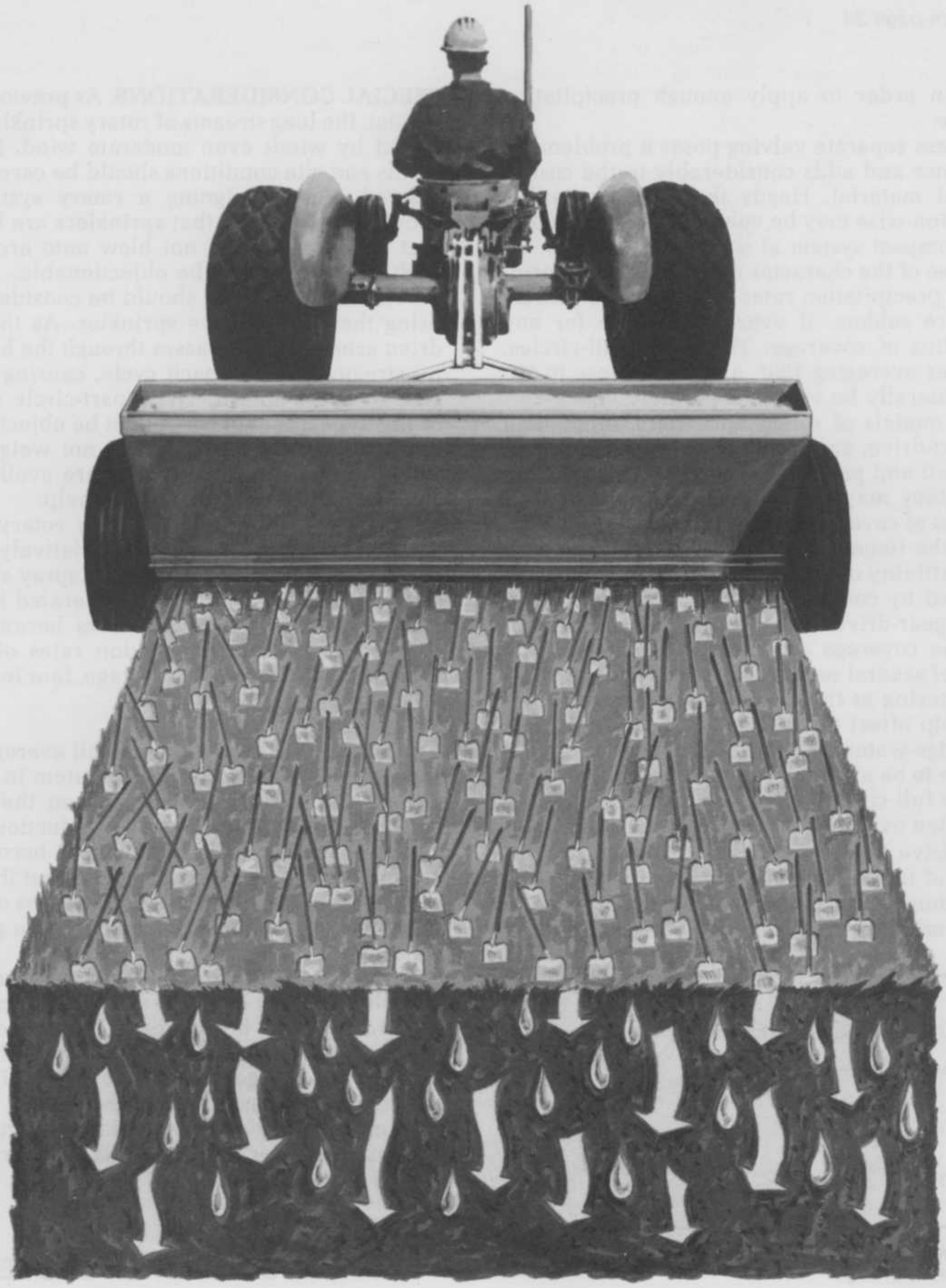
Rotary Sprinkler Selection. A careful choice of make and model is vital to a good, economical rotary system design.

Factors to be considered before selection of rotary heads include the area to be sprinkled; available water volume and pressure. There are rotary heads available for almost every type of situation. For example: rotary heads specifically designed for use in larger plots with small water supply. These heads can be spaced about twice as far apart as spray heads, but have a smaller flow than some spray heads. On the other hand, these rotary heads should never be used on large areas with high pressures.

Conversely, use of large-coverage rotaries in areas that are more suitable for use of the smaller coverage heads, even though the water supply is adequate, will result in a totally undesirable system. With bordered areas, due to overlap required, water waste usually increases as the sprinkler diameter of coverage increases.

Zoning. Pop-up rotary systems, like spray systems, are valved and operated in zones, or sections. This procedure avoids overloading the water supply. Again, the number of heads in each zone depends on the volume of water available and the pressure.

Precipitation. The full and part-circle rotary heads of many models are not balanced to provide uniform rates of precipitation. For example, some have the same nozzle orifices for full and fractional circles. Consequently, quarter-circle heads will apply twice as much water as half-circles and four times as much as the circular ones; half-circles will apply twice as much as circular heads. Obviously, each type (full, halves and quarters) must be valved separately from the other types in this case. Otherwise, certain areas will have to be



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flooded in order to apply enough precipitation elsewhere.

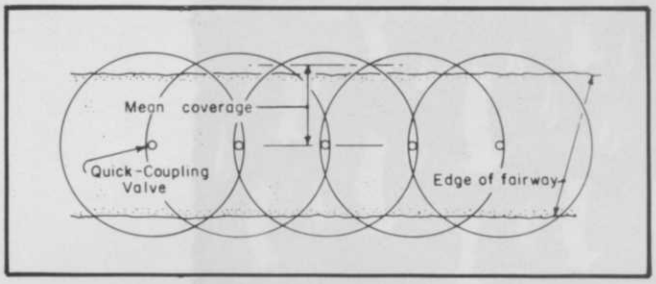
Needless separate valving poses a problem for the designer and adds considerably to the cost of labor and material. Heads that are compatible precipitation-wise may be valved together, making a more compact system at substantial savings.

Because of the character of impact rotary sprinklers, the precipitation rates of full and part-circle models are seldom, if ever, compatible for any given radius of coverage. Therefore, full-circles, part-circles averaging 180°, and those close to 90° should generally be valved separately.

Many models of rotary sprinklers, other than the impact-drive, are available with precipitation rates of full and part-circles compatible to the extent that they may be valved together. However, their areas of coverage are usually limited as compared to the impact sprinklers.

Compatibility of precipitation cannot always be determined by comparing flows. For example: at least one gear-driven rotary has a "dwell" at each end of the coverage arc built in the head. This "dwell," of several seconds, provides needed additional watering at the edges of the coverage pattern to help offset the effects of wind. This additional "edge-watering" causes the flow rate of a half-circle to be about more than one-half the flow rate of the full-circle. However, tests show that the precipitation over the watered area is compatible.

Gear-drive heads which provide a "dwell" at each end of the coverage arc, and compatibility of precipitation and pressure requirements between full and part-circle models, are favored for irrigating parks, school grounds, etc. This is particularly true when pressure requirements of the sprinklers enable operation with city water supply without the need of booster pumps.



Quick-coupling systems in fairways should be spaced to spray head to head for adequate coverage.

Caution. Before valving different types of sprinklers together, consider pressure requirements in addition to precipitation rates. For example: even though two sprinklers have the same precipitation rate, one may require 35 lb/in^2 water pressure at the base of the head while the other requires 60 lb/in^2. Obviously, a piping system cannot be designed to handle this disparity.

Spacings. Coverage ratings and spacing are generally given for still air which must be derated to compensate for prevailing winds in the locale of the system. A *standard formula for spacing deration is not feasible because of the varying stream characteristics of different sprinklers.* Use recommendations provided by each manufacturer for his equipment.

SPECIAL CONSIDERATIONS. As previously pointed out, the long streams of rotary sprinklers are affected by wind; even moderate wind. Prevailing winds and site conditions should be carefully considered when designing a rotary system. Care should be exercised that sprinklers are located so that the streams will not blow onto areas where such watering would be objectionable.

This same concern should be considered when using the impact drive sprinkler. As the impact-drive arm swings, it passes through the high-velocity stream twice on each cycle, causing some degree of "back-splash." With part-circle sprinklers of this type, the "splash" might be objectionable if placement of the sprinklers is not weighed carefully. Some heads of this type are available with anti-back-splash devices which help.

It should be noted that with rotary systems, there are almost always some relatively confined areas that must be watered with spray sprinklers. The spray sprinklers must be operated independently from the rotary sprinklers because of the large variance in precipitation rates of the two types of sprinklers; on an average, four to one.

COST FACTORS

The cost of a rotary system will average 50 to 70 percent of the cost of a spray system in the same property. The differential between the two systems tends to diminish with a reduction of area, and increases as the sprinkled area becomes larger. The principal reason for this is that the ratio of part-circle to full-circle heads increases as the property becomes smaller, requiring more perimeter watering.

Unlike spray heads, the unit material cost for part-circle rotary heads is somewhat greater than for circular ones; however, the area of coverage is only one half as large in the case of half heads and one-fourth as large for quarter heads. Therefore, the cost per square foot of coverage is considerably more than two times greater for half heads and four times for quarter heads. These ratios may vary with model.

QUICK-COUPLING SYSTEMS

While the least expensive quick-coupling systems are no longer being installed to any extent. In the past, they have been used primarily in golf courses, large parks and other extremely large properties, when lowest initial cost was the principal consideration. Many of these systems, particularly in golf courses, are being converted to automatic rotary systems.

However, the components of these systems are still used frequently in conjunction with spray or rotary systems.

(1) As a temporary means of watering areas in which it is not economical to install a regular system; such as areas to be redeveloped at a later date, etc.

(2) On pressure mains of a system to provide water for a myriad of uses other than normal sprinkling. For instance, deep-watering newly-planted trees.

Continues on page 69

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LANDSCAPE CONTRACTOR MARKET STATISTICS

To get a handle on the statistics of the landscape contractor market, WEEDS TREES & TURF randomly surveyed its readership in this profession.

According to John S. Shaw, executive director of the Associated Landscape Contractors of America, there are 5,000 to 7,000 bona-fide landscape contracting firms in the United States. The magazine has 4,700 landscape contractors in its circulation. We sent questionnaires to 1,000 of them and 144 were returned. This represents approximately three percent of the market, a statistically significant percentage.

The sample firms' answers indicate slightly more emphasis toward construction as opposed to maintenance. Construction with trees and ornamentals exceeds that with turf. Maintenance, however, is predominantly in the turf area. The percentage of firms doing design is below the percentage of firms doing construction types of landscaping.

Residential work makes up an average of 65 percent of business for landscape contractors according to the survey. Commercial jobs account for an average of 28 percent. Fifty-three percent of the respondents do an average of 25 percent of their business with general contractors or developers. Only four percent indicated involvement in land reclamation.

Correlating the type of work done with whom it is done for indicates the dominant kind of work done by landscape contractors is residential construction.

The vast majority (87 percent) own their equipment. Nine percent said they lease some of their equipment. Landscape contractors spend an average of $10,585 for equipment in a year. Projected to the total number of contractors in the circulation, a total expenditure for the industry of $49,000,000 is derived.

The number of pieces of various types of equipment based upon survey returns indicates the importance of the landscape industry to equipment manufacturers. The most commonly owned types of equipment are pick-up and dump trucks, tractors, rototillers, tractor mowers, manual (trim) mowers, and aerators. A third of the respondents own a backhoe. Approximately one out of five firms own hydromulchers, sod harvesters, and fork lifts. Roughly a tenth own flat-bed trucks, trenchers, bulldozers, and tree spades.

Equipment buying takes place primarily in the months of January through March.

Chemical expenditures averaged

Percentage of landscape contractors performing various services.

design	76%
seed bed preparation	64%
seeding	81%
sodding	78%
hydromulching	21%
ornamental planting	90%
tree planting	84%
turf maintenance	63%
tree pruning	8%
ornamental pruning	3%

Percentage of landscape contractors buying equipment and chemicals by month.

	Equipment	Herbicides	Fertilizer	Insecticide	Fungicide	Soil Amendments	Growth Regulators	Adjuvants	Surfactants
January	13%	6%	6%	4%	5%	3%	9%	8%	7%
February	18%	12%	10%	8%	9%	4%	13%	17%	17%
March	21%	23%	18%	21%	20%	16%	22%	29%	24%
April	9%	14%	14%	18%	16%	18%	13%	17%	17%
May	6%	13%	7%	10%	14%	11%	9%	17%	14%
June	4%	6%	7%	9%	8%	9%	13%	4%	3%
July	6%	5%	4%	9%	8%	7%	4%	0%	3%
August	5%	7%	9%	8%	9%	8%	0%	0%	0%
September	6%	8%	11%	4%	5%	13%	4%	4%	3%
October	3%	4%	7%	4%	3%	7%	4%	0%	0%
November	3%	3%	5%	2%	2%	4%	4%	4%	7%
December	5%	1%	1%	1%	1%	0%	4%	0%	3%

Watch For These Profiles In Coming Issues

Nursery Wholesaler — May
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Parks — October
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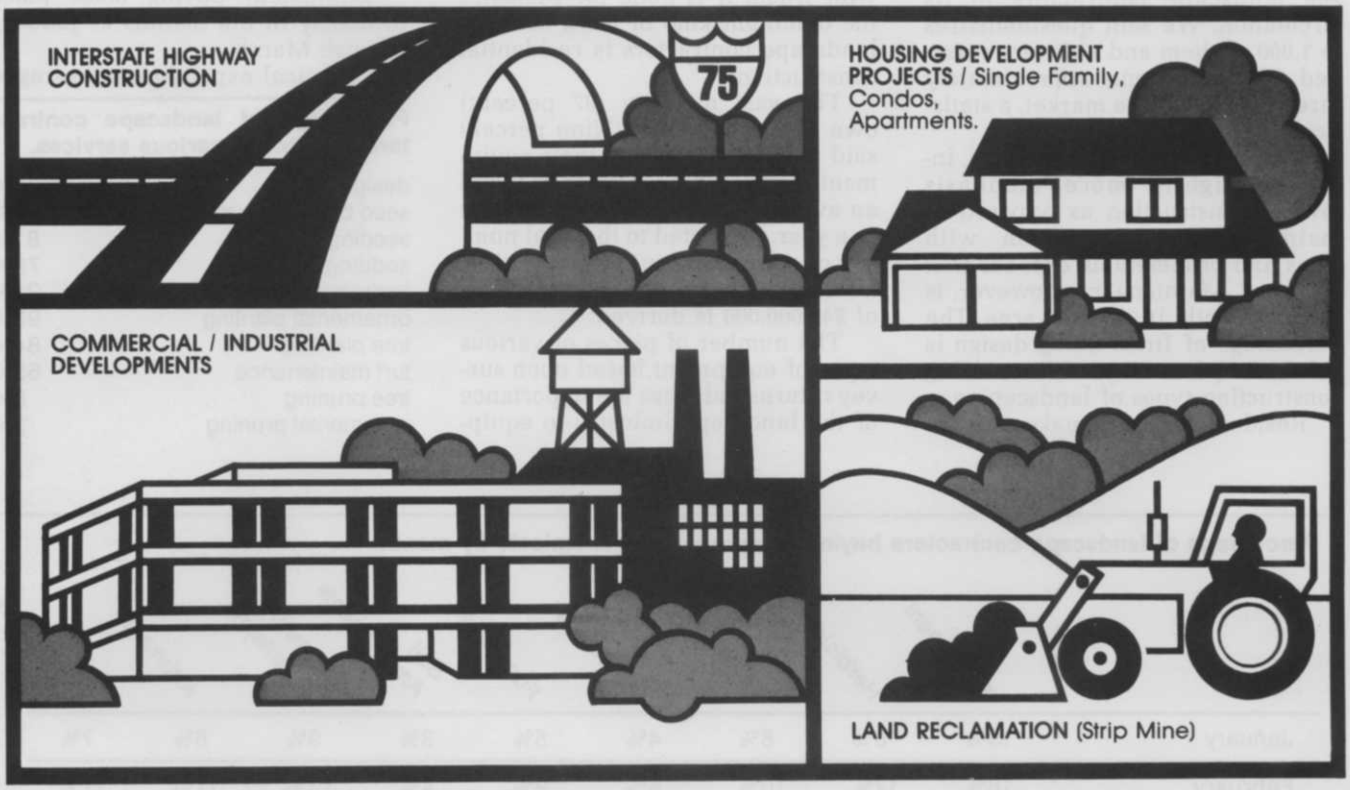

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