INTRODUCTION TO AUTOMATIC WATERING

R. W. SITWELL
Watermation

It is reputed that an expert on the care and maintenance of sports turf, when asked the question "How do you make grass grow?" replied, "wet it ?". Appreciating that there are other factors governing the growing of grass, let us consider the need for water. It is a fact that to survive, any crop requires water in varying degrees in order that it may feed.

Accepting therefore that water is required, and on highly cultivated areas in quantities greater than those obtained from natural rainfall, there exists a need to water artificially.

Why therefore automatic watering? To consider the advantages it is necessary to appreciate the water requirements of the area to be watered. These requirements will not only be dependent upon the nature of the soil but also on the climatic conditions which vary day to day as well as the natural contours of the ground.

How much ?

Taking these factors into account the amount of water to be applied weekly to maintain an average root depth of 9" on a golf green can vary from as much as 1" on a light sandy soil in a moderate climate to as little as ½" or less on a heavy soil. In hot climates these figures are increased whilst in a cold climate they decrease. Whilst charts are available in differing forms which will act as a guide, these do not take into account the construction of the area to be irrigated, i.e. drainage arrangements, and thus to a greater or lesser extent the precipitation required is a matter of trial and error. Taking all these factors into account and bearing in mind that each green may have a different drainage factor it is only with experience that the Greenkeeper will know how much water has to be applied to any particular green.

Having established that the application of water is a fairly precise exercise let us consider the alternatives to automatic watering.

Manual problems

Assuming water mains have been laid to each green, watering is accomplished by either portable sprinklers or by a man with a hose spraying the area almost ad lib. Taking the former, these are usually of the single or twin nozzle impact type and due to their relatively poor performance require moving two or more times in order to cover the whole area. Due to the increase in the popularity of golf, courses are now heavily played which of course means that when a golfer approaches a green that is being watered and the sprinkler is unattended, he will either move the sprinkler so that it does not interfere with his game, or turn it off altogether. More often than not on leaving the green the golfer forgets to replace or turn the sprinkler on again

Two Firsts in 1973

Ransomes International Golf Tournament and the B.G.G.A. First British Turfgrass Symposium.

Our pictures recall some of the highlights and personalities of these two important events at Ipswich last October.

so that watering becomes entirely hit and miss. The alternative is to water at night when there are no golfers about but this involves the Greenkeeper being out on the course at all hours moving sprinklers, which from his point of view must become extremely inconvenient and from the Club's point of view extremely expensive. There are courses which adopt the policy of turning the sprinklers on last thing at night and turning them off again first thing in the morning but of course this means only part of the green is watered and in a lot of cases the green is virtually unplayable for a greater part of the following day, as far too much water has been laid resulting in flooding.

Wastage

Considering therefore the use of portable sprinklers it is quite apparent that the unauthorised movement and turning off and on of sprinklers results in uneven, as well as under and over watering, the former and latter possibly causing disease, whilst the third leads to shallow root depth and weak grass. Apart from the natural aggravation for the Greenkeeper, this will tend to result in loss of revenue to the Club as no golfer wants to play on bad greens and furthermore unnecessarily high water bills due to the obvious wastage. In addition the cost of labour charges has to be added but this is incalculable as the time involved will depend upon the layout of the course and therefore the distance between greens, the number of times the sprinkler needs to be moved which again will vary depending upon the strength and direction of the wind and the frequency of outside interference with the sprinklers. A further factor is the number of sprinklers which can be operated at any one time.

Pressures

On many such installations the sprinkler system is operated direct from the water company main which of course means that the golf course supply is being shared by the nearby town or village. As will therefore be appreciated the pressure will vary according to demand by other users and thus the watering time should be varied accordingly. In terms of figures a sprinkler with a 5/32″ nozzle will put out $4\frac{3}{4}$ gpm at 60 p.s.i. but only $3\frac{3}{4}$ gpm at 40 p.s.i.; thus instead of applying 500 gallons per green in a given period of time only 400 will have been actually used; thus inadvertently under-watering.

The alternative to sprinkler usage is to employ a man to water the green with an open ended hose. This invariably means that unless the man is careful some areas are over watered whilst others are under watered. Also the heavy rate of application, which always exceeds the rate at which the ground is capable of absorbing the water, results in considerable run off as well as pools forming in all the low spots. This of course means that where the water gathers the area is over watered and susceptible to disease. The only advantage that hand watering has over sprinkler watering is that it ensures that the watering period is not interfered with by outside parties. However, when this is compared with the labour costs involved it is quickly appreciated that it is a luxury that cannot be justified financially and even if the finance is available, the shortage of suitable man power which can be spared from other work quickly over-rides the financial availability.

Evaporation

In addition to the foregoing it must be borne in mind that there is in this country an urgent need to ensure that

Continued on page 19

we conserve our water resources. Manual watering, be it by sprinkler or hand, in the main means watering by day, during which time losses in evaporation and transpiration are taking place. Depending upon the area temperature, the humidity and wind, the rate of evaporation can be extremely high. It is not possible to calculate the rate of evaporation but at times it is believed to be as high as 25 or 30%. This means that for every 1000 gallons which passes through the meter, 250 or 300 gallons are lost to the atmosphere. Evaporation also takes place at night but the rate is negligible.

Other Losses

Transpiration is another loss which has to be taken into account. The word is derived from the latin trans (over, across) + spirare (to breathe). Transpiration occurs during day time hours. It is a form of evaporation from the plant itself. As warm, dry air passes across the leaf surface water in the leaf evaporates off through the pores. Although these pores open and close, observation has shown that they are open during the day time when the air is dry but closed during the night when the air is moist. Transpiration can be extremely high—example. A mature apple tree of the Grimes Golden variety are known to lose water at the rate of 15 litres per tree per hour.

A final loss is through photosynthesis which simplified is the absorbtion of water through the roots plus carbon dioxide from the air to form carbohydrates (or simply sugar) in the leaves with oxygen being given off. As the name implies photosynthesis is a function of light and can be summarised chemically as:—

$$6CO_2 + 6H_2O = C_6H_{12}O_6 + 6O_2$$

Summary

Day time watering results in high evaporation losses, high transpiration losses, wasted water due to outside interference, over, under and uneven watering, leading to disease and weak grass and high labour costs.

Night time watering by manual means involves high labour costs, or in the case of sprinklers that are left on all night, wasted water due to puddling, uneven and partially sodden greens.

Taking all these factors into account there is obviously a strong case for automatic watering providing that it can meet the following basic principles:

(1) It gives even coverage.

(2) It operates during night time hours.

(3) It is reliable.

(4) It is correctly applied.

Design and Manufacture of Equipment

Before considering the different designs of turf watering sprinklers let us consider the aims to be achieved.

(1) The sprinkler shall be reliable.

(2) It shall give even coverage.

(3) It shall be robust.

(4) It shall be manufactured from non corrodible materials.

(5) Where segment or part circle sprinklers are used it shall have an arc which is easily adjustable to suit the particular configuration of the turf to be watered.

Continued on page 23

(6) The sprinkler shall have an acceptably long range and stroke.

Considering these aspects in more depth:

(1) Reliability means that the sprinkler must operate for the correct period of time, which is of course a function of control and hence from the sprinkler aspect it must have a strong driving action; thus ensuring that it is not susceptible to sticking or erratic movement. In the case of segment or part circle sprinklers it must have a reliable changeover mechanism which ensures that it does not dwell or stick at the end of each segment.

(2) Even coverage is a function of reliable operation, as a sprinkler that has a fragmented or erratic movement will apply more water during its period of dwell than it will during periods of movement.

(3) A sprinkler which is to be buried in the ground will be subjected to outside forces and must therefore be of sufficient strength and design to stand the occasional knock and pressure when passed over by machinery and golfers. Due to the ingress of sand in top dressing and bunkers, pop-up sprinklers are known to remain in the operating position after operation and thus may be struck by a mowing machine. If manufactured from low impact strength materials the sprinkler will more often than not sustain damage to such an extent that it has to be replaced. Similarly, sprinklers walked over by a golfer wearing spiked shoes must have tops of a material which will not be punctured or broken. As far as the body design is concerned there should be sufficient bearing surfaces to prevent the sprinkler from being pressed into the ground when run over by machinery. Immediately after installation and for the first two years or so, no sprinkler should be subjected to heavy downward forces as the ground will not have had time to settle and consolidate after excavation.

(4) To some extent water and soil contain corrosive elements and thus sprinkler equipment should be manufactured from materials which are resistant to corrosive and galvanic action. For instance, the sprinkler manufactured in mild steel would in some soil, and when handling some waters, have a life expectancy of a week or even less. This is why sprinklers are in the main manufactured from bronze which has a high corrosion resistance factor. There are of course many different grades of bronze and it is important that the manufacturer is aware of this. A leaded bronze, i.e. bronze with a high lead content, is more susceptible to corrosion than a lead free bronze; the latter is often known as phosphor bronze or gunmetal. In addition to bronze, other materials are used in the construction of sprinkler heads. These must again be carefully selected to ensure that the presence of dissimilar materials does not set up a galvanic or electrolytic action whereby particles of material from one component are deposited on to another resulting in weakening of the former leading to failure. In general stainless steel should be employed as the other metallic material, as bronze and stainless steel are immune to this type of attack. Bearings, etc., are usually a form of nylon or similar material which is well known for its resistance to attack and has a hard, low friction working surface. Sprinklers are available in a variety of different casing materials ranging from plastic at the bottom end of the scale to bronze at the top end of the scale. The alternatives in common use are cast iron or aluminium, both of which normally have a heavy pro-

tective coating of vinyl or galvanised steel, are used for the sprinkler casing. The plastic has the advantage of being cheap to manufacture whilst the bronze has the advantage of excellent corrosion resistance properties and high impact strength. The others represent a happy medium in so far as they are not too expensive to manufacture but at the same time the protective coating ensures a good resistance to corrosion whilst the material offers a high impact strength. If care is exercised in the handling of the coated variety their life will be as long as those in the expensive bronze.

(5) Very few greens are uniform in shape and thus in order to ensure that sprinklers are set so that they water just that part of the area that is necessary a sprinkler should have a fully adjustable arc. A number of sprinklers are available with a preset arc and whilst in many cases this can be adjusted after installation, it is often necessary to dismantle the sprinkler beforehand. From the operator's point of view it must inevitably be more convenient if adjustments can be made whilst the unit is in operation as this will ensure that the correct setting is achieved. In certain instances a need arises to water the surrounds as well as the green itself and if this can be effected easily it must be to the advantage of the Greenkeeper.

(6) Whilst the range and stroke of the sprinkler are not critical, a relatively long range of say 50 to 60 feet or more will be seen later to be an advantage,* whilst the stroke, which is usually about $2\frac{1}{2}$", must be sufficient to ensure that when in operation the surrounding grass does not interfere with the nozzles or the operating mechanism.

In general two forms of sprinkler are available for golf course watering installation. The first is the impact operation type, whilst the second has a gear train which is driven by a turbine. The impact operated type obtains its movement by the action of the jet of water striking a spoon which, pivoted about the centre, swings out tightening a coil spring and then returns as the spring unwinds knocking the sprinkler round. Both full circle and part circle sprinklers of this type rely on this action but for the part circle unit the return is achieved by a changeover mechanism which limits the amount by which the spoon can be swung out. It is therefore driven back by the force of the jet of water being emitted from the nozzle.

The second type has a gear train that imparts a steady, powerful rotation to the nozzle. Water enters the base of the head through a diffuser that converts the stream into high velocity jets, which are then impinged against a turbine-like rotor spinning at about 3000 rpm. Gear reductions in the order of 5000 to 1 cause the nozzle to make one revolution every 2 or 3 minutes at torques ranging upward of 35" pounds. The part circle models incorporate a reciprocating gear mechanism that oscillates the nozzle back and forth over a predetermined arc. While the geared heads are usually more expensive, because of the greater number of parts and precision manufacturing, they do give a steady drive ensuring even precipitation. However, in view of the problems associated with altering the arc they are not often as favourable as the impact operation type, the arc of which is set by altering two spring clips.

* see appendix.

to be concluded in next issue.