SEPTEMBER 1966

USGA GREEN SECTION RECORD

A Publication on Turf Management
by the United States Golf Association

WATERING A GREEN

A sprinkler system in operation on the 11th at Sunningdale Country Club, Scarsdale, N.Y.

USGA GREEN SECTION RECORD

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Irrigation Systems-Operation

A Panel Discussion

At USGA Green Section's 1966 Conference on Golf Course Management, New York.
William H. Bengeyfield, Moderator; Herb Clarke, Carlyle Regele, Joe Lee, Panelists.

Before we can enter into a discussion of the operation of irrigation systems, perhaps one should define the types of systems we find on golf courses today.

A manual operation is one requiring the operator to set each sprinkler manually by hose or quick coupling and then manually turn on the water flow valve. In some instances, the turn on operation is not necessary as the lines may already be under pressure.

The semi-automatic system uses remote control valves to activate the sprinklers (either pop-ups or quick couplers) but the controller has no timing device of its own and requires the human hand for activation, total time, and turn off.

Automatic irrigation involves permanently placed sprinkler heads, piping, remote control valves, control wiring or tubing, and a controller that automatically turns valves on and off at a preset time and on preselected days or nights.

Are Automatc Systems Really "Automatic"?

Unfortunately, some have concluded that an automatic system requires only the flick of a switch and the irrigation problem is forever solved. Nothing is quite that simple. The automatic system requires just as much (if not more) of the golf course superintendent's time as any other system. He must constantly check sprinkler head operation and insure uniform coverage of each head. He must know the daily irrigation requirements of his entire course as dictated by ever-changing weather patterns. With such a system, the golf course superintendent becomes THE irrigator; the intricate mechanism only carries out his precise orders; and, to use the system properly, he must thoroughly understand its capabilities and limitations. His judgment is final and will not be altered that night. Indeed, this is one of the main advantages of automatic irrigation. The superintendent is the operational boss. He need not depend upon someone else's judgment.

Uniform Playing Conditions

To achieve the goal of uniform playing conditions (i.e. uniform irrigation levels) throughout the golf course, the automatic system must be properly designed, engineered, and installed. Since the sprinkler heads are in a fixed position, they can't be relocated nightly to compensate for low pressures, wind changes, or for correcting excessively dry or wet areas. This work must be done by the designer and engineer during installation. For this reason, proper design

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This is the third issue of the USGA Green Section Record devoted primarily to the subject of golf course irrigation. Other material on this topic appeared in the March and the May issues. One article in the March issue dealt with designing irrigation systems and another with factors influencing irrigation. The sources of water supply was discussed in the May issue, along with the economics of certain irrigation systems.

and engineering are absolutely necessary.

Often clubs become interested in automatic systems and, once involved, their only thought is to accomplish the work at the lowest possible cost. The question of cost, not uniform coverage, is emphasized. Frequently this type of "economy" is supported by those suppliers or contractors who have something to gain if a sale is made; any sale. The final result is an inadequate system and great disappointment. Sprinkler heads are too widely spaced (abut 70 feet seems maximum); a one- or two-row system is installed where a three-row system is usually needed; volume and pressures are off because of improper pipe size, etc. "You cannot build a cheap palace" is a quote worth remembering.

The Basic Components

Why should this paper, supposedly devoted to system operations, concern itself with design, engineering, installation, and cost factors? Simply because they are the essential, basic components of good operation. Without sound design, sound engineering, and sound installation, there is no operational factor worth considering.

The manufacturers of automatic irrigation equipment have largely solved the technical problems. Like the golf cart, automatic irrigation is here to stay. It is now up to the consumer to insist that it be properly used. Obviously, much new equipment and many new terms have come into use. Briefly, let us cite a few of the basic components:

Controllers: The automatic controller acts as the brain of the automatic system. The superintendent determines the day, the hour, and the total time each group of sprinklers (usually 3 to 5) will operate. The controller supplies the signal when the remote control valves are to be opened and closed. Controllers must be of the same type (i.e. electric or hydraulic) as the remote control valves.

Electric Control Valves: An electric impulse activates a solenoid or heat devise which opens or closes the control valve. Electric wire connects each control valve to a particular station at the controller.

Hydraulic Control Valves: Water pressure, or the relief of it, determines if the control valve is to open or close. Hydraulic tubing connects each control valve to a particular station at the controller.

Sprinkler Heads (Pop-Ups): Once the remote control valve opens, water enters the lateral line and its pressure causes the sprinkler heads on the line to rise and start operation. The head moves through a 360-degree arc (usually), applying water in an even pattern. The sprinkler head is driven by water pressure and/or velocity in one of 3 ways: cam driven, gear driven, and impact (kicker arm) drive.

When the desired time has elapsed, the controller signals the remote control valve to close, pressure drops in the lateral line, and the sprinklers return to the "rest" position. Water in the lateral line will then drain through the lowest sprinkler head on the line, frequently causing a very wet area near the head. To overcome this problem, a small valve is installed in or under each sprinkler head to prevent the leakage or line drain.

With this equipment, properly designed, engineered, installed, AND in the hands of one who understands the principles of good turfgrass management, the irrigation "problem" is eliminated. It now becomes an irrigation "practice"; and, as we know, practice makes perfect.

Water Systems-Engineering and Installation

A Panel Discussion

At USGA Green Section's 1966 Conference on Golf Course Management, New York.
Marvin H. Ferguson, Moderator; Graham Daniel, Austin Miller, J. B. Moncrief, Panelists.

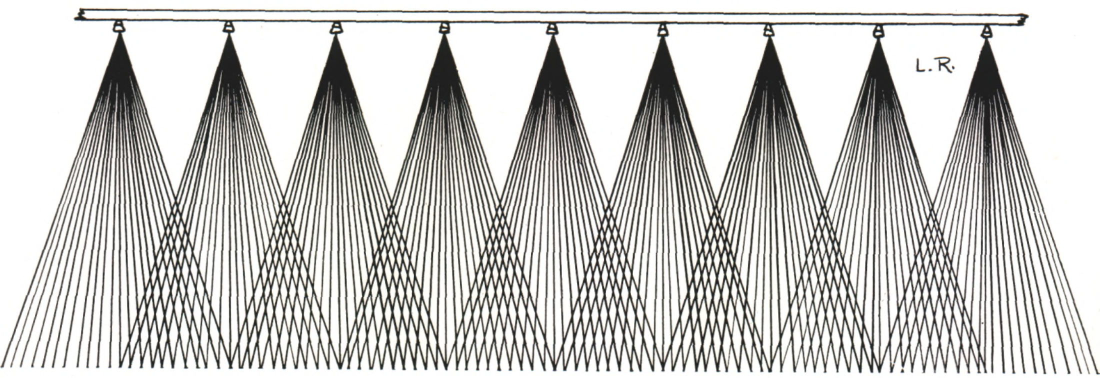
Users of irrigation systems indicate repeatedly that many faults in their systems can be attributed to poor engineering or poor installation. Complaints about types of pipe can often be traced to methods of handling or installation rather than to faults in the pipe itself. Similarly, poor coverage is not always attributable to improper sprinkler design or improper spacing; it may be caused by mismatching the supply pump and the distribution system. This panel has answered questions on a variety of subjects relating to the proper engineering and installation of irrigation systems. The following account purports to summarize the answers provided by panel members.

Q. In arranging for the installation of an irrigation system, who represents the interests of the club?

A. Very frequently the chairman of the green committee or some other individual chosen as chairman of a special committee will act as the club's representative. Usually this person will not have any special knowledge that would equip him to deal professionally with the problem. He goes to the local dealer in golf course irrigation supplies and tells of his club's interest in an irrigation system. The dealer may then suggest that he or the sprinkler manufacturer he represents can provide a plan for an irrigation system without cost to the club, provided the club purchases the necessary supplies through the dealer.

The dealer may make such an offer in good faith and the customer may find that the deal represents a bargain. On the other hand, the club may not be satisfied with the performance of the completed irrigation system. When club members go back to the

A good spray pattern—a turf management must.



dealer, he may point a finger at the installer; the installer may blame the materials, or vague language in the specifications, or the wrong type of sprinklers. The point is that the club may never learn where the fault lies. The members simply have on their hands an irrigation system that does not meet their expectations and they don't know how to solve the problem.

The consensus appears to be that a club's first step should be to hire an independent design engineer. This person serves the same function as an architect in the building trades. He has nothing to sell except a good design and supervision of the installation. This man draws the plan, writes the specifications, helps the club with bid procedures, and inspects the job as it progresses. If there is any malfunction, he can determine whether it is caused by materials, design or installation and he can have the fault corrected.

Golf club committees can then deal with one person and this person can see that they get the type of system they need. Most dealers in irrigation supplies agree with this approach. Their business is to sell supplies. Happy customers are good for business. Conversely, if a system is unsatisfactory, the name that usually sticks in the minds of observers is the one which appears on the cover plate of the sprinkler head.

Q. Are moisture sensing devices such as gypsum blocks and tensiometers useful in turfgrass irrigation?

A. It seems likely that refinements and improvements of such devices may in the future make them useful in practical installations. At the present time, they are useful as research tools and in some limited ways lend themselves to practical application. There appears to be no place for them on any broad scale at the present.

Q. Discuss the merits of the various kinds of pipe available for use in golf course irrigation systems.

A. This is a big and controversial question.

Let us start with cast iron pipe. It has been a standard for comparison for many years. It has a long history of trouble-free use and for that reason it is specified for many municipal water supplies. Despite its many outstanding qualities, it has a few drawbacks. Cast iron is heavy and relatively expensive with respect to original cost. Rubber ring seal joints have served to simplify installation. There is some problem of scaling with certain types of water. Some cast iron pipe is cement-lined and this solves the problem of scaling or rust.

Galvanized pipe in smaller sizes has been usd a great deal, but it is more frequently subject to corrosion than other types. On the other hand, it is strong and relatively easy to work.

Asbestos-cement pipe for use in the larger lines on golf courses has become more popular. This pipe requires considerable care in handling. It must be bedded in stone-free soil or sand and where turns are made, blocking is required so that surge and vibration do not cause shifting. Provided adequate attention is paid to these details, asbestos-cement pipe performs very well. Because of the inert nature of the material, excellent flow characteristics are maintained over a long period of time.

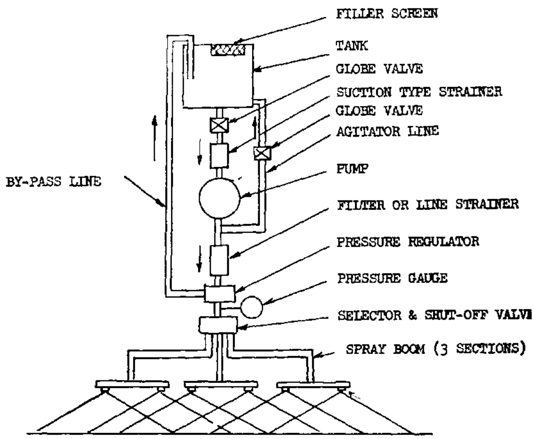
Plastic pipe is being used rather widely in conjunction with asbestos-cement. The most popular of the plastics is polyvinyl chloride (PVC). Plastic, like asbestos-cement, is inert and very smooth inside so that friction loss is relatively low and flow characteristics will remain good for many years.

Criticism of plastic pipe has resulted from splitting and from the fact that it sometimes pulls apart at joints. It seems likely that careless handling is responsible for most of these troubles. Joints are made by solvent welding. The pipe must be clean and dry and it must be allowed to "set" before being subjected to movement or twisting. The time required for hardening or setting of the weld is influenced by temperature, and of course dampness or light rain can make the job extremely difficult.

In summary, it appears that plastics and asbestos-cement pipe both require careful handling and definite procedures, but when this care is accorded the installation process, these kinds of pipe perform very well indeed.

Q. When a water system is installed over the golf course, is it important to be able to cut off parts of the course so that when repairs are made one doesn't have to drain the whole system?

A. Yes. A well-planned golf course irrigation system will permit the isolation of certain portions of the course. Ideally, these cut-off valves should be spaced very close together so that only a small portion of the system would require draining. Practically, however, such valves are quite expensive, and they contribute somewhat to friction losses in the line. It is usually satisfactory to place valves in such a way that the system supplying two or three holes can be isolated.



Schematic diagram indicating the essential parts of a sprayer

Q. When specifications are written for water system installation, is it not important to specify the scheduling and timing of various operations? To illustrate the point I'm trying to make, let me cite the experience of my club. We contracted the installation of the system to a contractor who enjoys a good reputation. However, he had other jobs in progress and he subcontracted much of the work at our course. One subcontractor dug the ditch. His contract apparently called for a specific number of feet of ditch. He came to the course, dug as much ditch as he could in a day and left. He was also responsible for backfilling the ditches, and when the pipe was laid for one section of the course, we expected that he would do the backfilling. The ditching contractor, however, contended that there was no time specified and he would do the backfilling when he came to dig more ditch.

In the meantime, rains washed out the ditches, mud was scattered over our low fairways and the golf course was just about unplayable. This isn't the end of our sad story, but this much will serve to make my point.

We eventually got a good water system and we are happy with it. The club would gladly have paid a few more dollars, though, to have had the job done in an orderly fashion so that the golf course would not have been torn up all summer.

A. The gentleman's question just about answers itself. It is important to have your design engineer specify any scheduling requirements that may be pertinent in your case.

Q. We've talked a great deal about sprinklers, spacing, design, pipes, and matters of that sort. What can the panel tell us about pumps? What about location, sizes, and types?

A. Let's start with location. Hopefully, the water supply will be located somewhere near the center of the area to be irrigated. Because of friction loss considerations, the shorter the distance water must be pumped, the more efficient the equipment.

The most popular type of pump is the centrifugal type. Such a pump has a good water "pushing" capacity but a poor "pulling" ability. Therefore water should be pushed uphill and through the pipes. It should not be located in such a way that a great deal of suction is required to lift water from the supply to the pump.

Pump sizes can be calculated by any competent irrigation engineer. Because neither pumps nor power sources operate at the peak efficiency at which they are generally rated, it may be necessary for your designer to make generous allowances when calculating the sizes you need.

At many golf courses, one large pump is used for most of the irrigation and there is one small auxiliary pump for standby duty. We feel that it is better to have two medium sized pumps. These can be used together for peak loads, but either probably can provide sufficient water to keep the golf course alive in the event one must be shut down for repairs.

Q. This isn't really a question but an observation. Drawings showing the plan of an irrigation system ought to be accurate. The drawings our contractor left with the club show that all the hydraulic control tubes of our automatic system are at least eighteen inches underground. Last summer, our superintendent started scarifying an area where we intend to build a practice putting green. The tractor drawn chisel was being operated at a depth of 8 or 10 inches when it caught a bundle of these hydraulic control tubes. Here were sixteen broken tubes. They are not color coded. There was no way of telling which ends fitted together. One of our statisticians figured out that there were 255 possible combinations. There weren't supposed to be any tubes in that area.

A. It is rare when a system is installed exactly as the plan indicates. Therefore, the club should insist that it be provided with a plan showing the system "as installed." An "as planned" drawing can be not only misleading but dangerous if the installation varies from it.

A view of a fairway sprinkler in operation.

A Closer Look at Watering

By Holman M. Griffin, Agronomist

The objective of watering turf is to maintain sufficient moisture in the soil for satisfactory growth and performance of the grass. In order to do this we must periodically replenish the moisture lost to drainage, plant use and evaporation, and maintain moisture in the full depth of the effective rooting of the grass. The big question to be answered before we can effectively cope with watering turf is:

"How much water does the turf need?"

If you can even come close to answering this question, then you truly have a green thumb as well as a keen grasp of turf problems. I hope that this review of some of the factors involved in the watering of turf will help your maintenance program and stimulate your thinking to aid you in making your decision of how much water the turf needs.

Just how water is absorbed and used by the plant is a science in itself and not all of the processes are clearly understood. However, we should be aware of the factors that influence these processes.

Water in a plant has many functions and composes 80 to 90 percent of the plant structure, so we must rightfully place great importance on the maintenance of adequate moisture for plant use.

Although this is true for all grasses, all grasses do not necessarily require the same amount of water. Considering only water requirements, we can group the grasses into three general categories: (1) Drought-tolerant, (2) Intermediate drought tolerance, and (3) Moisture-loving, with little or no drought tolerance. The more deep-rooted grasses such as Bermuda fall into the drought-tolerant class because their extensive root system is able to forage deeply for moisture. Fescue also falls into the drought-tolerant class because of its ability to curl its leaves and thereby reduce water loss from the stoma. Buffalo and bluegrass have rhizomes where some moisture is stored, which gives them moderate to good drought tolerance.

Most bluegrasses fall into the intermediate class while annual bluegrass, rough bluegrass, and creeping bent fall into the moisture-loving class because of shallow rooting or the inability to store or conserve absorbed moisture. Even though we understand these differences in drought tolerance of the grass, we must also consider such factors as soils, temperature, humidity, wind, and fertilization.

Soils greatly affect the watering program by their different capacities for moisture retention. Soils are classed roughly as clays, loams, and sands. This is the order of their ability to retain moisture. The permanent wilting percentage, or that point at which moisture is held by the soil with a force of approximately 15 atmospheres, is reached much sooner after an application of water to a sand than to a clay. Loam ranks between them.

The permanent wilting percentage of a soil is mentioned because this represents the maximum point of moisture stress to which the turf should be subjected. At this point, a plant will regain turgidity in most of its leaves when sufficient moisture is applied to the soil. Turf can survive and even absorb limited amounts of water at soil-water contents below the permanent wilting percentage. But if no water is added to the soil the turf will pass through the wilting range and quickly reach the ultimate wilting point. Then it dies.

Again considering the soils, the wilting range—from first signs of wilt to the ultimate wilting point—is narrower in coarse-textured soils than in fine-textured soils. Within this range, no plant growth occurs.

It might seem that since we should never allow the soil moisture content to reach the permanent wilting percentage that the answer to watering problems is to apply large amounts of moisture, or apply water frequently. However, this is not the case. Frequent or heavy applications of water exclude oxygen from the soil and thereby influence the rate at which moisture is absorbed by the plant. If drainage is excellent, some of the water loving types of grass, such as *Poa annua* and creeping bent, may survive on the oxygen in fresh water.

However, if drainage is poor and the water in which the oxygen has been depleted is unable to move down out of the root range to allow room for fresh water, oxygen soon becomes a limiting factor and the turf wilts.

In general though, water fills the available pore spaces in a soil and excludes oxygen in quantities sufficient for proper root functions. If insufficient oxygen is present in the root zone, this in itself causes the root cells to become less permeable to water and the moisture intake is greatly reduced. Thereby a plant may suffer from a lack of moisture even though the soil around it is saturated.

Since plants seem to absorb moisture best at or near field capacity, this is the level which we should strive to maintain. However, since water does not quickly reach equilibrium in most soils throughout even a 4-inch root zone, we are unable to maintain this level by simply watering frequently to replace the lost moisture. In the interest of good soil aeration, we should allow the soil moisture content to drop almost to the wilting range before more water is added and then the entire root zone should be recharged with fresh water. In this way the plants will always have adequate moisture and oxygen for proper growth while frequent watering would tend to exclude oxygen near the surface before the soil moisture could reach equilibrium in the root zone.

It is therefore important to observe the turf and note how long it takes the turf to begin wilting after a good watering. After observing the turf for a time and using a soil probe to check penetration and moisture depth, we can work out a pattern of watering which will supply the proper amount of moisture in the manner described previously. Although general rules about turf water requirements, such as one inch per week, are a good starting point for estimating quantities, the actual application should be more accurately determined.

Water should never be applied faster than the soil can absorb it. Otherwise we may lose a high percentage of the moisture applied through runoff and get very little penetration into the root zone of the turf.

After working out a good pattern of watering based on the characteristics of the soil we must then consider other factors, such as climate and fertilization. These will change the turf requirement.

With so many factors involved and interacting on each other, it is clear that water applications can never be reduced to a simple schedule. It must be based on the changeable needs of the grass plant to be effective.

We have often observed wilting of a green on a clear, hot, dry, or windy day. This may occur because moisture content of the soil is low. Or it may well be because the rate of transpiration of the plant is exceeding the rate of water absorption. Cloud cover, temperature, humidity and wind all have an effect on transpiration of the grass plant. As a rule, lack of cloud cover, increased temperature, low humidity and wind movement all increase transpiration of the plant as well as evaporation of water from the soil. Therefore, we must consider the influence of these factors and make adjustments for them in our watering program.

Temperature is probably the climatic factor of greatest concern, since either extreme may cause a deficiency of moisture in the plant system. At high temperatures, the rate of water loss from the plant is increased and the supply in the soil must be adequate or the plant will wilt. Quite often, golf course superintendents syringe greens in hot weather to keep them from wilting. It should be emphasized that the purpose of syringing is not to add moisture (except when extremely shallow rooting exists) but, rather, to reduce the temperature of the grass and surrounding microclimate with as little water as possible.

On the other hand, a reduction in temperature slows down transpiration and less water loss occurs from the plant. Also the viscosity of the soil water is increased and the permeability of the absorbing cells is decreased, making it more difficult for the plant to obtain the moisture it needs from the soil. When the soil is frozen, virtually no water passes from the soil into the plant.

We can now see that climate has a definite influence on the watering program and that any factor or combination of factors mentioned may change the water use of the plant.

Last, we should consider fertilization. Fertilization temporarily increases the need for water because of the action of osmotic pressures on the plant when the soil solution becomes more concentrated with solutes. Since osmotic pressures seek to equalize the concentration of solutions on both sides of a semi-permeable membrane, which is in this case the cell walls of the roots, and the movement of water is from the lower concentration to the higher one, then the addition of fertilizer may initially decrease the plant's absorption of water. It does this by increasing the concentration of solutes in the soil solution to a point greater than the concentration of solutes in the plant fluids or cell sap.

Provided the rate of fertilizer application is not too high, the plant usually adjusts to this situation very quickly and no permanent detrimental effects take place. Because of the process just explained, we should always water-in applications of fertilizer to help make it available to the plant as well as to make sure the soil solution does not become too concentrated.

Although I have just explained how fertilizer increases the need for water in plants, this effect is temporary. In the long run, proper fertilization will greatly aid the plant in its use of water. Experimental work has proven that plants which are properly supplied with nutrients actually require less water for growth and development. The mistaken belief that water can be substituted for fertilizer is altogether too common.

I have touched on the subject of watering and water use only lightly, but I hope that these facts will help to stimulate ideas, give a better idea of the principals involved and help someone to better answer the question: "How much water does the turf need?"

Automatic Irrigation

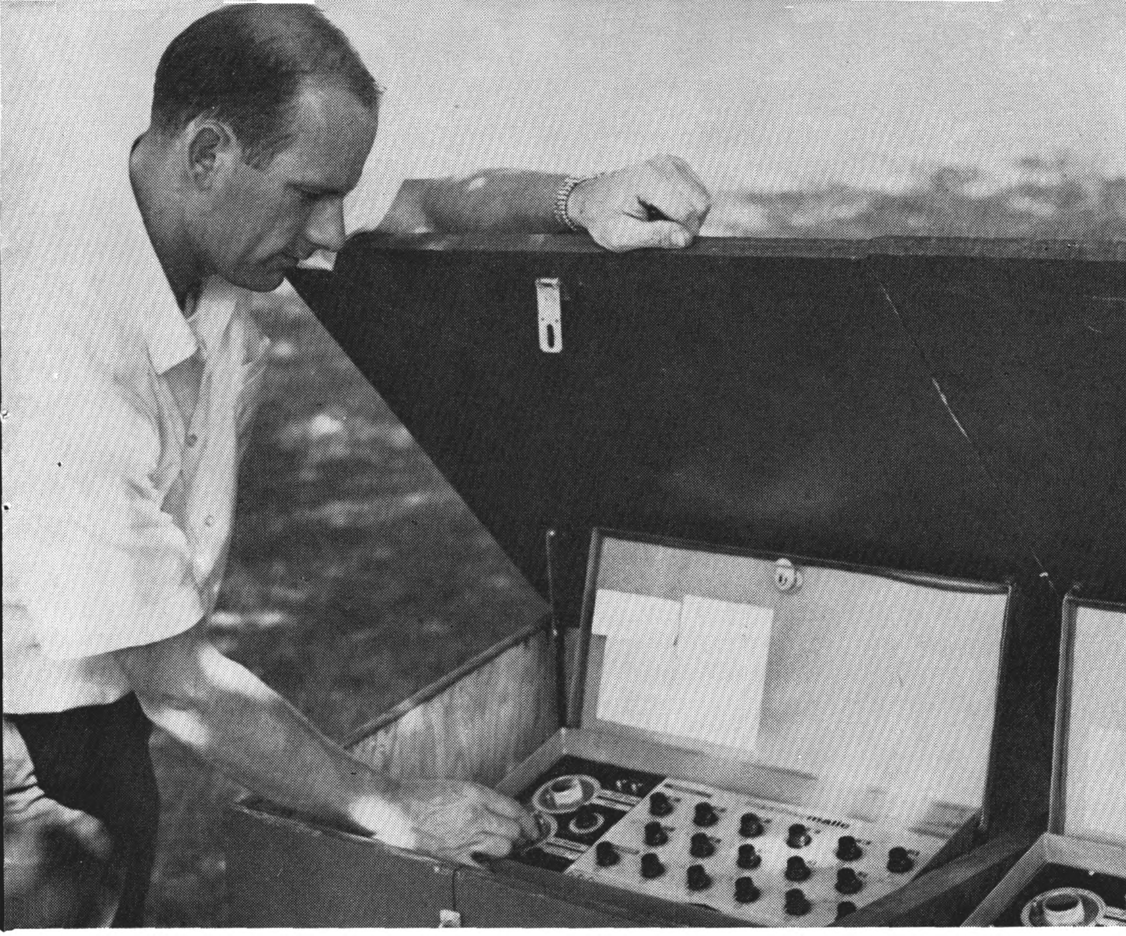
By **Robert R. DePencier,** Golf Course Superintendent, Sunningdale C.C., Scarsdale, N.Y.

Our Sunningdale Country Club now boasts of a completely automatic irrigation system. This is the Superintendent's "dream system," and I feel this way even though the quick coupler system that we used prior to conversion was extremely good. The old system had a capacity discharge of 3000 gpm at 85 psi. The logical question is: "why convert when you have such a good system?"

Our reasons were: To have greater accuracy and variable control of moisture so that we can water when we need to and where we need to; to use less water and so reduce our water bill; to reduce our labor costs which annually amount to $4,500, and now there should be little or no labor involved; and most important is the fact that there is less chance for human error.

In our conversion we re-piped eight fairways, using transite. On other fairways we used the original galvanized iron pipe which was installed in 1955. We have an 8-inch main which runs about 1,000 feet then breaks off to a 6-inch line which runs about 5,000 feet to all fairways. This then breaks off to 4-inch, 3-inch, and 2-inch pipe in fairways. On tees we have galvanized pipe, 1¼-inch and 1½-inch in size, and around greens we have 1½-inch and 2-inch PVC pipe.

In converting we used approximately 300,000 feet of No. 12 and No. 14 underground wire. We installed



The author, Supt. DePencier, makes an adjustment at one of his control points.

190 fairway heads, each valved individually using a direct burial valve. Each green and tee was valved separately. Greens have a perimeter system of three to five heads depending on the size of the green. Valves are placed down the center of the tees, and heads were selected separately for each tee. We have 14 gate valves so that any section could be shut-off when future repairs are needed. The cost for conversion was $56,000 and this included heads.

System Control

We have four points on the course from which I can see all heads in operation. We have finger tip control over the amount of water used by each station, and each can be set from zero to 60 minutes. We have 12 controllers each with 17 to 23 stations. Each controller can be set up for a water program of 14 days. The number of controllers must be tailored to the availability of your water supply. The number of sprinkler sections programmed to operate at the same time is altered according to available water supply. The volume must be adequate to allow the watering cycle to complete itself within the shortest allowable time.

Water Supply

Like every course in the Northeast, we try to be self-sufficient in water supply and so have developed a storage capacity for 5,000,000 gallons of water on the course property. We did this by constructing two ponds, one across No. 17 fairway which runs into the larger one constructed in a natural valley on the fourth hole. The smaller pond is about 5,000 square feet in surface area and is 12 to 14 feet deep. The larger pond covers an acre and is 20 to 25 feet deep. 15,000 cubic yards of soil were removed and all this soil was used to improve our practice fairway, which is located in a low area of poor drainage, and to enlarge the tee. This soil enabled us to raise the practice area about three feet. The cost of pond construction was $25,000.

We now collect all water that runs-off from 26 acres of natural drainage and direct flow into the ponds; also, the run-off from the parking area and entrance road is directed into the drainage pattern into the ponds; also, we have a well that pumps 55 gpm for 15 hours daily and so produces ½ million gallons per week; and finally, there are natural springs within the pond area that produce 15 gpm. The pond spills over at 10 gpm and follows a natural brook which winds through the property adjoining the club.

We had to do some re-piping in order to bypass the seven city meters and to connect the system to the main line. It also was necessary to re-pipe all drinking fountains, to relocate a few, and to put in a few new ones—all connected to the city line. Together with the new pump house, this cost came to $20,000.

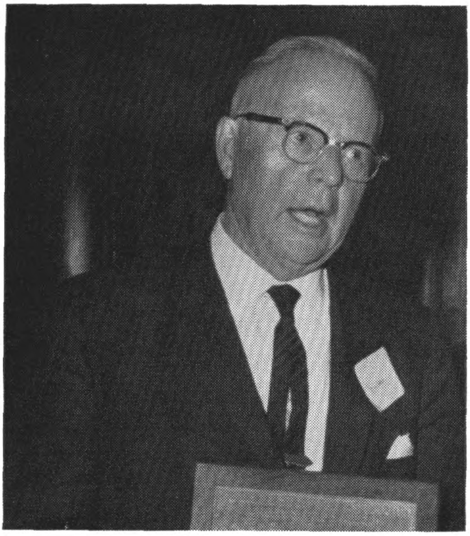
Trenching

The contractor was responsible for lifting and replacing all sod, trenching, and clean-up. Two Davis trenchers were used, one on tracks, and one on rubber. The latter was for short radius runs, around greens and tees, while the former was used to cut the line down the center of fairways. The pipe was installed to a depth of 18 to 24 inches, and all wire at least 12 inches. Before back-filling, I inspected all work to insure that it was done to my satisfaction, stone removal, grade, depth, etc. All work was done by the contractor, our crew was not involved. To firm the soil before replacing sod over lines, a powered vibrating tamper was used.

Coverage

I believe our system was well designed and carefully installed. We now have 1,000 gpm at 125 psi and can water tees, greens, and fairways with approximately one inch of water in less than one week with no interference to play. Our schedule for irrigation is from 9 P.M. through 6 A.M. We use impact type sprinklers and our pattern covers at least 15 feet into the rough on both sides of each fairway. We feel we have taken a step forward with full automation.

Watering the front tee on the 3rd hole at Sunningdale.



O. J. NOER 1890-1966

It is our sad duty to note the passing of O. J. Noer. Mr. Noer died in Milwaukee on July 12, 1966.

Mr. Noer's contributions to improved playing conditions on golf courses are immeasurable. He had visited many of the nation's golf courses in more than thirty years devoted to advising clubs about maintenance problems.

O. J. was a member of the Green Section Committee for many years and in 1963 he was honored with the USGA Green Section Award for work with turfgrass.

COMING EVENTS

Sept. 13	Northern Michigan Turfgrass Conf. Traverse City Country Club Traverse City, Michigan
Sept. 13	Mississippi Turfgrass Assn. Annual Fall Meeting Jackson Country Club Jackson, Mississippi
Sept. 21	Rocky Mountain Regional Turfgrass Assn. Equipment Exposition City Park 23 Ave. Denver, Colorado
Sept. 28	Arizona Turfgrass Conference Randolph Park Tucson, Arizona
Sept. 28-29	Lawn & Turf Conference University of Missouri Columbia, Missouri
Oct. 4-6	University of Florida Turfgrass Management Conference Ramada Inn Gainesville, Florida
Oct. 19-21	Central Plains Turfgrass Conference Kansas State University Manhattan, Kansas
Oct. 26-28	Northwest Turfgrass Conference Salishan Lodge Gleneden Beach, Oregon

USGA GREEN SECTION RECORD
40 East 38th Street, New York, N. Y. 10016

TURF TWISTERS

MOWING FREQUENCY

Question: How often should putting greens be mowed? (UTAH)

Answer: We think as often as possible; seven days a week if manpower is available. However, a minimum schedule of four days a week during the active growing season is urged. If you can gain an additional mowing or two each week, all the better for golf and your members. The mowing operation not only cuts the grass, but it smooths the putting surface, removes spike marks, small imperfections and litter.

PLANTING SEASIDE BENT

Question: Do you have printed material regarding the planting and care of Seaside bentgrass? (OKLAHOMA)

Answer: Little has been written specifically about Seaside bentgrass in recent years. It generally requires the same care as other bentgrasses.

It is planted by seed. A seeding rate of 2 lbs. per 1,000 sq. ft. is usually recommended. Seed should be broadcast uniformly over a carfully prepared surface and then raked lightly or topdressed with a very light topdressing.

Seaside bent is composed of many plant types and after a few years the stronger plants tend to take over at the expense of weaker ones. Therefore after about 5 years a Seaside bent green becomes spotted in appearance and the variations may sometimes present management difficulties because of differing cultural requirement among strains. Therefore, while the broad genetic base of Seaside bent makes it extremely adaptable, the diversity of types also presents some problems.

INCREASING ROOT DEPTH

Question: The roots on our bentgrass putting greens are very shallow and consequently we must water very frequently. How can we increase rooting depth? (MISSOURI, KANSAS, ARIZONA)

Answer: Studies by Dr. Jim Beard at Purdue have shown that soil temperature is the major factor influencing the root growth of bentgrass. The best advice we can give in a few words is to insure adequate drainage and aeration, try to promote deep rooting in cooler seasons by good fertility and judicious irrigation, and then water as necessary to prevent wilting during the summer months. There is no known way of "making" roots grow deeper during the summer months.