INTRODUCTION TO AUTOMATIC WATERING

R. W. SITWELL

Watermation

(Continued from February issue)

To control when and for how long the sprinklers are to operate, some form of automatic valve and control system is required. There are automatic valves available that operate either electrically or hydraulically. Both these are controlled from a programmer which has the following features:

(1) A clock easily adjusted for cycling the system daily, or every other day as required, over a weekly or 2 weekly period at any time during the day or night.

(2) Sufficient number of stations so that the valves used need not be ganged together and can be operated independently of one another.

(3) A sequence timer with a variable time that can easily be adjusted from a minimum of 5 minutes to a maximum of 60 minutes per station. The sequence time to be so arranged that each station can be timed independently.

(4) A semi-automatic performance so that the watering cycle can be started without disturbing the clock setting, thence progress through each station in sequence with automatic shut off at the end of the cycle.

(5) Switch or other form of selector for manual operation of each circuit at random or in sequence independent of the automatic valves.

And

(6) In the case of hydraulically operated valves which are normally open, a safety device to shut off the system in the event of a power failure.

Generally the operation of an automatic valve which is electrically operated is similar to a valve which is hydraulically operated. The disadvantage of the latter is that it is expensive to install as a small bore tube has to be laid between each valve and the controller. With an electrically operated valve a pair of cables is all that is necessary. A further possible problem is that the controller for an hydraulically operated valve contains water and electricity in one cabinet and in the event of a major leak in the hydraulic system a potentially dangerous situation can arise.

The valves used in these systems need to be carefully selected. With any valve a very quick closing action should be avoided as this is likely to cause stress in the pipelines due to surge pressures. A majority of automatic valves are of the diaphragm type and here again care in selection is imperative as in certain cases the flexible portion of the diaphragm is subjected to the full system pressure. Although it will have been designed for this condition, the additional stress to which it is subjected in cases of surge may cause the diaphragm to rupture in which case water is continuously leaked from the system.

With electrically operated valves it is imperative to ensure that the solenoid is designed for underground operation where it may be buried in wet or damp soil. Its coil winding must therefore be watertight and to achieve this they are usually impregnated and potted in epoxy resin.

System Design

Before commencing on the design of any system it is essential that a survey should first be carried out. Assuming only greens and tees, or just greens, are to be watered then it is necessary to measure each area to determine the number and size of sprinklers required. Most sprinklers are available with different nozzle sets which given different ranges and precipitation rates. It is therefore suggested that when examining the areas to be watered one should decide the maximum as well as the minimum requirements in respect of each so that should the conditions vary when the installation is carried out the system allows sufficient margin to cater accordingly. Although the size and shape of each green or tee will to some extent determine the sprinkler requirements there are cases where slope will play an important part, for example, if a green has a distinct slope it may be necessary to deliver a different quantity of water to one side than the other. In this case the sprinklers on one side of the green should be controlled from a separate valve to the sprinklers on the other. Alternatively if it is decided that the green can be successfully watered by running three or more sprinklers simultaneously then differing nozzle sets may be necessary to overcome the different contours.

Pipe work

Having determined the sprinkler requirements at each area it is then necessary to design a suitable network of pipelines. Although these will be determined to some extent by the nature of the ground, density of wooded areas, etc., it is essential that the sprinkler flow and pressure requirements at each green and tee be the paramount factor in finalising pipe routes. An accurate drawing of the course is therefore essential as very few systems can be designed by just walking round the course and taking a few measurements. A normal approach is to mark on a course drawing the sprinkler requirements as well as the height of each area above mean sea level, i.e. the OD level.

Pumping

As it is not permitted to install a pop-up system in this country which is directly connected to the Water Board supply it is necessary, assuming no natural sources are available, for the water to pass through a break tank and then be boosted through the system. The site of the break tank and pumping equipment on many installations is governed by the availability of water and electricity supplies. This should not however be allowed to be the paramount consideration as in many cases both services can be supplied to a site which will offer ideal hydraulic conditions for the system. To achieve this the tank and pumping equipment should either be placed at the centre of the pipework network or at the highest point on the course. By adopting this procedure the system losses can be kept to a minimum which will result in the pump power requirements being kept down; thus saving capital as well as running costs.

Having decided upon the site for the pump and break tank and therefore normally the control equipment it is a straightforward matter to calculate the losses in the system until one is left in the position where it is known that a pump that will deliver x gpm against y feet head will meet the system requirements. Knowledge of pumping equipment and what is available from which manufacturer is now essential as the success or failure of the system can hang on the correct selection of the pumping plant. The final procedure in the design of a water system is the signal cable layout which involves following the pipelines, the cable and pipe being laid simultaneously. However, in a similar way to water flowing through pipes, there is a loss as electricity flows through cables. In order to ensure that there is sufficient voltage available at each solenoid it is often necessary to make adjustments to the cable network.

If the system is to include approach watering then allowance must be made for one or more sprinklers which can either be run concurrently with the sprinklers around the green or can be operated from their own control valve.

If fairway watering is also necessary then the fairways should be shown accurately on the drawing and then depending upon the width and degree of watering required, the number of sprinkler rows on each fairway must be settled. In this country a single row should be quite satisfactory but in hot and tropical climates two, three or even four rows may be required.

In designing any system the fewer the number of sprinklers operated at one time the greater the degree of control which can be obtained. The designer in deciding how many sprinklers can be operated simultaneously has to weigh up the relative merits of separately valved sprinklers to meet the watering requirements against the capital cost involved. A system with each head separately valved, whilst offering precise control, would cost up to twice that of a system which is conventionally valved, i.e. 3, 4, or 5 sprinklers operating simultaneously. When analysing cost against efficiency it becomes quickly apparent that on a financial basis such an arrangement could not be justified.

INSTALLATION

Method of Pipe Laying

Until fairly recently all pipes were layed in open trenches. In the very early days these were all dug by hand but in recent years more advanced techniques have been developed.

The most common machine being the J.C.B. or heavy tractor with front or back digging machine. These machines have the disadvantage of being slow and untidy, the narrowest practical trench width being about 12″.

More recently chain diggers have been developed which will cut a neat 4 to 8″ wide trench to a depth of up to 3 feet. These are either self driven on tracks or wheels, or contain a built in winch from which traction is obtained. These machines will handle most ground conditions including chalk and gravel, but when it is required to trench in rocky ground a heavier type chain is required. This chain has the digging teeth replaced by small percussion hammers. This type of machine has been successfully used in ground which contains rocks which easily shatter. When it comes to hard work such as Bath stone and the like, it has been found that this can be neatly trenched by using a very recent development which is the earth saw. This was originally designed for cutting narrow trenches quickly and neatly across motorways and the like.

It has a large wheel which revolves at high speed and has a large number of small percussion hammers, which are similar to those used on the rock chain. The only disadvantage of using any of these machines is the relatively high maintenance costs. In addition, after cutting the trenches the bottom must be levelled and any sharp objects removed. If the pipes are to be laid in very rocky ground it is essential to ensure that at least 2″ of sand or graded soil is laid under and over the pipes. To safeguard the pipe and control cable it is advisable to allow the back fill to settle over a period of several weeks. Whilst it is appreciated that the ground staff will want to effect reinstatement and re-seeding as quickly as possible, the tendency to roll and ram down trenches should be avoided as any uneveness in the trench bottom will result in fractured pipes.

Moling in

Understandably the cleanest and quickest method of laying pipes is by mole plough. There are a number of sophisticated machines on the market which employ a four wheeled drive vehicle with a vibrating plough mounted on the rear. The only disadvantage with this method is that on wet or soft ground the vehicles may develop wheel spin and tend to slough about. This is particularly noticeable when this machine is called upon to lay pipes of 2″ or larger diameter at depths in excess of 2 feet. The alternative, particularly on hard or heavy ground, is the mole ploughing technique of using a heavy tractor fitted with a winch and a separate mole plough which is simply pulled through the ground. Mole draining has been practiced for a number of years and the mole plough used is a straight adaption. To pull in the pipe an expander, of larger diameter that the pipe, is attached behind the mole with the pipe clamped behind the expander and then pulled in behind the plough.

The control cable should always be fed in from the top, down a cable shoot so that it is laid. If pulled in behind the pipe the resulting tension in the cable can cause breakages as the cable expands and contracts with variations in temperature. This will particularly apply if cable is laid when the ambient temperature is extemely high, for once winter sets in and the ground freezes the cable will start to shrink. If the cable is laid taut in the ground there is a likelihood of fractures resulting.

Materials and Joining Methods

Water pipes can be categorised into three main groups, namely metal, cement and plastic.

In the metal group are:

galvanised steel
cast iron
stainless steel
copper

Of these 4 galvanised steel is the most commonly used today. Its great disadvantage is its almost unpredictable life expectancy which varies according to soil conditions and water hardness. The latter being the predominate hazard due to the build up of deposits which restrict the flow and after a number of years can result in the system pressure being insufficient to operate the sprinkler system. An acid soil will attack the outside of the pipe and the corrosive effect can cause failure after only two years in service. Generally, however, a life of up to 25 years can be anticipated. The handling of this type of material is very often difficult because of its weight, particularly in the larger sizes. Jointing is achieved by threading and it is of course where the pipe is threaded that the protective galvanised coat is destroyed and corrosive attack occurs.

Cast iron pipes are now very much out of fashion because of their weight and difficulty to joint, as well as of course the expense of casting. Jointing is achieved by either flanges or collars which are leaded on site. The latter being a technique which requires a great deal of skill only practiced today by a limited number of plumbers.

Stainless steel and copper, whilst having extremely good corrosion resisting properties can be virtually discounted due to their extremely high cost.

The second group is cement, which is a pipe manufactured from cement, asbestos and silica. The smallest diameter available being 4″ and thus it is not frequently used. It is joined by using compression couplings with rubber 'O' rings, alternatively it is supplied with spigots and sockets which are cemented together. The latter material necessitates the pipe being held rigidly in the trench and thus on sizes below 6″ it is not recommended. The compression fitting will allow a deflection of 3 to 5 degrees which will provide ample flexibility for soil movement, also contraction and expansion. Of course with the cement joints expansion and contraction has to be allowed for.

The final group is the plastics, which comprise the most common in use today. There are three types in this group, namely polythene, Acrylonitrile-Butadiene-Styrene (ABS) and Polyvinyl Chloride (P.V.C.).

Polythene was until recently commonly used as it is extremely flexible, being supplied in coils of varying lengths, thus requiring a minimum of jointing and being easy to mole plough. Its other great advantage is excellent impact strength and a great immunity to rupture from freezing. The disadvantage is however the difficulty to obtain sound jointing as a compression fitting is required with insert. The problems arise when the pipe is put under pressure because any deflection in the pipe will tend to pull the joint apart. A further disadvantage when used on turf watering systems is that its flexibility makes it difficult if not impossible to do a workmanlike job when fitting sprinklers, as its tendency to move results in the sprinkler leaning or rising in the ground so that it fouls the mower.

ABS is finding popularity in the plumbing and ventilating industries as being manufactured from materials used in the production of synthetic rubber it has excellent chemical and physical properties. Namely it is heat resistant to a low extent and has a fairly high resistance to chemical attack. Jointing is by solvent weld, or in the case of thick walled pipe, threading.

The final and most commonly used type is P.V.C. This is derived from coke, lime and salt. It is undoubtedly one of the toughest and most durable thermoplastic pipe made, primarily because of its higher strength and resistance to a greater variety of chemicals. It has been in use since 1940 in various forms, particularly when a plasticizer is used, which results in a flexible end product such as hose. When manufactured as pipe an unplasticized compound is added resulting in a semi-rigid end product. Jointing is achieved by solvent weld or in the case of thick walled pipe, threading.

The solvent weld should always be done when the pipe is both dry and clean. If necessary, the pipe and fitting should be cleaned with a thinner, or rubbed thoroughly with an abrasive cloth. The solvent should then be applied to the pipe spigot, then the fitting and finally to the spigot for a second time. The two should then be pushed together firmly and held for at least ½ minute. The solvent should be applied evenly and with a thin coat. Too thick a coat will weaken the pipe. Any surplus solvent should be wiped from the pipe. The pipe should then be left to lie undisturbed for at least 30 minutes and in the case of 2″ and above, pressure should not be placed on it for at least 24

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hours. After joining it is advisable to leave the pipe in the air to dry for at least 4 hours, as burying too soon has on occasions resulted in the pipe failing after a year or two in service.

The solvent when applied correctly attacks the pipe and causes it to melt. When two 'melted' areas come into contact and are allowed to set, the resulting weld should be the strongest section in the pipe as it has double wall thickness.

Control Cable Installation

The control cable is normally installed with the pipe, either by mole ploughing or by trenching. Due to the high coefficient of expansion of copper it is essential that the cable is not pulled tight, but is left with expansion and contraction coils. When jointing the cables, care must be exercised to ensure that the joints are watertight and that there are no leakages to earth.

Although solenoids used on irrigation systems are rated at 24 volts and require a current varying between $\frac{1}{4}$ and $\frac{1}{2}$ amp, it is advisable to check and recheck the joints to ensure the resistance is minimal.

Control Installation

Following on from the cable installation comes the installation of the control equipment.

In addition to the irrigation programmer the installation also requires a pump starter, which is controlled from a signal put out by the irrigation programmer. It is also essential that a mains fused switch is incorporated in the circuit so that all the control equipment can be isolated for maintenance.

Finally it is essential to bear in thermoplastic pipe made primarily bemind that in any pump house, there is an abundance of water and that this coupled with electricity can be lethal; thus always ensure that each component is properly earthed.

COMMISSIONING

After the system has been installed and before the sprinklers are set in operation it is essential that all the pipelines are thoroughly flushed of all stones and other matter. The more thorough the flushing the less trouble with blocked sprinklers will result during the commissioning period.

In general the commissioning should be carried out in close collaboration with the Green Keeper who will be responsible for running the system as it is during this period that invaluable experience can be obtained. Commissioning should not just mean running the system to ensure that it works, but also checking the coverage and precipitation on each irrigated area because although nozzle settings to meet the original survey notes may have been installed, a final adjustment is often called for. Commissioning may therefore need to extend over a period of one or two weeks, so that an accurate assessment of precipitation patterns can be made prior to the system being handed over.

SERVICING

In general the system should require a minimum of service.

The Green Keeper should ensure that the grass around each head is kept well trimmed to avoid interference with the jets.

On a new installation the turf may settle after the installation has been completed and if necessary the level should be made up to ensure that the sprinkler head will not foul the mowing machine.

With sprinklers of the impact type a regular check should be made to ensure that there is not a build up of sand, etc., in the casing which can damage the bearings.

If pumps are fitted with packed glands and grease nipples then maintenance instructions as issued by the pump manufacturer should be complied with. Generally, attention at the beginning of each season should be all that is required.

To ensure correct watering times are set for the system it is often a good idea to examine core samples taken from the irrigated area at regular intervals to ensure that the field capacity is being maintained and good root depth is being maintained.

At the commencement of each watering season it is recommended that the system should be started manually and set to run for 3—6 minutes per green. The sprinklers should then be observed to ensure that they operate correctly.

Any malfunction of the sprinklers can normally be attended to by the Greenkeeper, assuming suitable spares are held in stock.

Any malfunction of electrical equipment should be reported to the installer for attention.

Appendix

In order to limit sprinkler overlap and therefore avoid saturating the centre of a golf green, a long range sprinkler will be an advantage as fewer sprinklers can be used to obtain total coverage. 4 or 5 sprinklers each arcing over the same area will inevitably result in higher precipitation at the centre of the green than will be obtained from 3. The other areas of the green being covered by the arcs of 2 sprinklers only.