

15.—Greens should usually either have a tendency to slope upwards from front to back, or should have a plane base. As regards undulations, (a) It should be possible to cut holes over 60 per cent of the surface of a green. (b) As a rule, it should not be necessary for the player to aim outside the circumference of the hole when trying to hole out at a distance of 2 feet 6 inches. (c) The ball should not gain momentum after leaving the head of the club, unless there is ample space in which to lose the additional momentum before reaching the hole.

When in doubt, make a green flatter rather than more undulating. On a green, height is very slight in comparison with length and breadth. An indulation which rises 2 feet above the general level of the putting surface is very pronounced, and yet it may be only 1/45 part of the length of the green, or less. It is partly for this reason that plastocene models, although nice toys, are almost valueless in practical construction.

Make the size of the green depend on the length and character of the shot which should be played up to it.

16.—Hazards should be visible. In general, they should not penalize to the extent of more than one stroke, provided that the stroke out of them is properly played. They should not be so severe as to discourage bold play. In placing hazards it is vital to keep the course navigable for the duffer. It is perfectly possible to do this, and yet to render it interesting and testing for the first-class player.

17.—Regard landscape considerations as of primary importance.

The unpleasantly didactic phrases used in this article have been adopted solely to save space. The points put forward are elementary, and are merely intended for use by beginners as a basis for criticism and endeavor.

---

## Sub-Irrigated Greens at the St. Louis Country Club

STERLING E. EDMUNDS

The chief problems that have confronted all green committees on golf courses located in the Mississippi Valley have come primarily from the variable conditions of moisture characteristic of this section. Courses in these states are not blessed by heavy dews and fogs, which contribute so much to the simplification of green keeping in some other parts of the country. Hence when sub-irrigation was agitated a decade or so ago as promising a solution of the moisture problem, it was eagerly seized upon and widely applied in these parts, particularly with respect to the construction of greens.

After adequate trial it is pertinent to ask, "Has sub-irrigation of putting greens fulfilled all of the hopes of green committees?"

The writer would not attempt to give a general answer, and such comments as are made have reference to experience with two courses near St. Louis, but mainly with reference to the St. Louis Country Club course.

When the St. Louis Country Club decided to move from its old home at Clayton, Missouri, in 1910, to its present location two miles west, the construction of the greens was considered a matter of importance equal to that of the clubhouse itself. All were agreed that they should be sub-irrigated. The course was laid by Mr. Charles B. Macdonald and the



Plan of sub-irrigation system of No. 12 putting green, St. Louis Country Club. The main tile are 6 inches in diameter and the laterals 4 inches

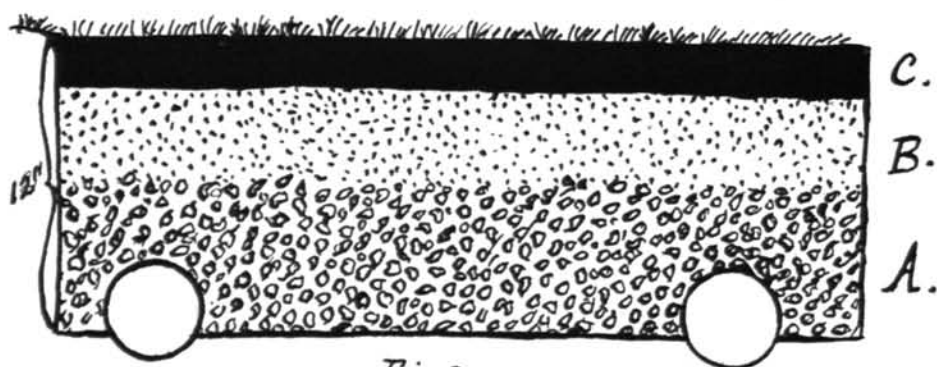


Fig. 2.

Cross-section of a subirrigated putting green, St. Louis Country Club, showing method of construction. (A), Layer of cinders 6 inches in depth. (B), Layer of clay 4 inches in depth. (C), A layer composed of peat with a small percentage of loam, 2 inches in depth.

golf architect, Seth J. Raynor, but the work of construction was left to local hands.

In excavating for the greens the clay subsoil was removed to a depth of 12 inches and the tile laid in grooves cut with a long hand-trowel. In the light of developments since that time it is agreed that there are undoubted advantages in a deeper bed, and in any new construction the beds would be excavated to a depth of 20 inches or more. In the laying of the tile in the Country Club greens 6-inch pipe was used to form the main line, with 4-inch tile laid as laterals. In some of the greens, the system took the form of a continuous one, winding its way back and forth in sinuous fashion, from the inlet to the outlet valve. As to the respective merits of these methods, an examination of the greens fails to reveal any advantage in the one over the other; yet as a practical proposition the effects of stoppage in the continuous system might involve more serious consequences than in the other.

After the laying of the tiles in grooves at the bottom of the excavations, they were covered with coarse cinders, forming a layer of 6 or 7 inches, in the nature of an auxiliary to the drainage system. Cinders were adopted in preference to sand because it was felt that they would stay in place and hold the tile in surer alignment. In addition, the merits of cinders had been proclaimed as a means of obviating the earthworm problem. This latter supposition has not proved correct in our experience, although the worm problem has never reached serious proportions on our course.

On top of the cinders a layer of earth was placed varying in depth from 3 to 4 inches. On top of this the seed bed of about 2 inches in depth was formed, consisting of a mixture of sand, earth, muck, humus, manure and some lime.

The seeds used were a mixture of New Zealand fescue, redtop, crested dog's tail, bluegrass, Rhode Island bent and yarrow. It is an interesting fact that in spite of this extensive variety of seed, which, with the exception of the bluegrass and yarrow, have been applied annually since, the bent grass alone has persisted with the yarrow. There is very little evidence of fescue and redtop. It would be logical to infer, therefore, that bent grasses are the appropriate ones for this section. At any rate we have acted upon this experience in adopting South German mixed bent as the single seed to be used in the future in the reseeding.

Our greens have been relatively free from weeds, due somewhat to their adequate protection against overwash from the fairways and the rough.

The sub-irrigation system is operated by admitting water into the tile and subsequently draining out such as has not seeped into the bed. Inasmuch as the tile is merely laid end to end, with no tight joints, they are liable to clogging and other disorders incident to getting out of alignment, sometimes requiring considerable disturbance to the green in providing a remedy. Furthermore a danger of some serious importance may possibly arise if the system is neglected, through standing water becoming harmful to the growth of grass.

On the whole, our sub-irrigation has been satisfactory, and in connection with it we have been able to maintain very fine greens. However, in view of tests that we have made with surface watering, we are not at all convinced that the same results can not be obtained without sub-irrigation if the bed is properly constructed, and drainage provided otherwise. This seems to have been proved on many golf courses.