without any plastic. That is out in the open, simply by keeping them covered with water. Some cuttings would root far more readily if they had a greater light intensity, which could be provided by eliminating the plastic and shade.

MR. C. S. INGELS (Henry Nurseries, Henry, Ill.): Do you have any trouble with the nozzels plugging up and, if so, how do you get to the nozzles to clean them out without damaging the cuttings? How often do you check the apparatus?

MR. TEMPLETON: Yes, we have trouble with the nozzles clogging. I suppose we always will have trouble with low capacity nozzles. We have to clean about two per cent of them each day. We check them every morning. The boys simply walk down the lines of beds and look in a small square hole which is provided for inspection purposes. They turn the system on so all of the nozzles are spraying. If a nozzle is spraying, it is all right. If they find one that is not spraying, they mark the place and come back later. The nozzles are easily cleaned.

MR. HOOGENDOORN: There is a new apparatus, called the Evis Water Conditioner, which it is claimed will remove the minerals from the water. This should eliminate all nozzle trouble. It costs about $95.00.

CHAIRMAN FILLMORE: We are very grateful to Mr. Templeton for bringing the model of the Phytotektor to this meeting and for his excellent discussion of this method of rooting cuttings, however we must proceed to the next speaker.

The next discussion will be presented by Charles E. Hess, a graduate student at Cornell University, who will describe a simple timing device for controlling lights and nozzles.

Mr. Hess described a simple and inexpensive time clock for regulating mist in plant propagation procedures. (Applause)

A Simple and Inexpensive Time Clock for Regulating Mist in Plant Propagation Procedures

Charles E. Hess and William E. Snyder
Cornell University, Ithaca, New York

In the field of horticulture, time clocks are used to extend the length of day by turning lights on at dusk and turning them off again after the desired daylength is reached and for cyclic control of mist for plant propagation.

Three different timers were designed, built, used and then discarded in the development of the timer to be described. The first three timers failed to meet all the requirements of a practical instrument, namely, simplicity, economy, availability of parts and adaptability. This timer, therefore, is the result of testing three different designs, selecting the desirable components of each and combining them into an economical and efficient instrument.

The final design includes some of the features of the earlier models and is very adaptable. The timer is actually two timers in one. One part controls the overall operation, that is it turns the timer on for any duration, such as on at eight in the morning and off at four in the afternoon. The second part controls the on and off periods of mist in such a way that repeated cycles of any duration can be obtained, for example—cycles consisting of two minutes of mist and four minutes without mist. The two timers can be used separately or together as it is here. Also since this timer controls the flow of electricity, it can be adapted to control any system which requires regularly repeating flows of current over any given period of time. When used to control the flow of water, a magnetic valve, called a solinoid valve, is a necessary component in order to shut off the water supply to the spray nozzles.

Simplicity can best be shown by describing the five steps in the building of the timer. Basically the timer consists of a motor with concentric shafts, one makes one revolution per day, the other one revolution per hour. Disks are attached to these shafts, and on the disks are projections which activate microswitches.

The first step is to cut two disks from 1/16 inch plastic, aluminum, or similar material, one having a diameter of 8¼ inches, the other six inches. The larger disk, which is attached to the one revolution per hour shaft, is divided into 120 sections. Therefore each section is equivalent to 30 seconds. A hole is drilled in the middle of each section ⅜ inch from the edge. (Drill size approximately 3/32 inch.) The small disk, to be attached to the one revolution per day shaft, is divided into 24 sections, each section representing an hour. A hole is also drilled in the middle of each 24 hour section ⅜ inch from the edge. (See Fig. 1)

The second step is to make the pieces which when attached to the disk will activate the microswitch. The projections for the one rph disk was made the same size as the divisions on the disk. The authors made a pattern on the same type of material from which the disk was cut. Before cutting the pieces apart, two holes were drilled in each piece—the first hole in the same position as that on the disk, i.e. in the middle, ⅜ inch from the edge, and the second hole immediately behind the first. The small amount of material remaining between the two holes is then drilled out thereby leaving a slot. The pieces are then cut apart. The same procedure is followed for making the projections for the one revolution per day disk. The hour sections were used for a pattern.

The number of projections required depends upon the type of cycle desired. For example if it is desired to have 30 seconds of mist every 20 minutes, operating eight hours a day, these "thirty-second" projections are needed on the one rph disk and eight "hour" projections are required on the revolution per day disk. Also by placing two "thirty-second" projections together, one minute of continuous mist can be obtained; three projections equal a minute and a half, etc. It is possible, therefore, by using various combination of "thirty-second" projects to vary the mist period from 30 seconds on and 59½ minutes off to an hour of continuous mist. Similarly, the overall operation can range from one hour on and 23 hours off to 24 hours on.

The projections are attached by using small machine screws. When it is desired to decrease the length of the "on" cycle, the screws are loosened and the projections are pushed back so they are flush with the edge of the disk or they may be removed entirely. Correspondingly, to increase the "on" cycles, the projections need only to be added or to be pushed out to extend beyond the edge of the disk.

The third step is to attach the disks to the timer. The revolution per day disk is attached first. A flange with an interior diameter equal to that of the shaft is attached to the disk with the same size machine screws as used for attaching the projections. A small pulley may be used if a flange is not available, however, it is necessary to remove the upper half of the pulley in order to leave room for the other disk. Holes are drilled in the lower half of the pulley and the disk, and the parts are held together with machine screws. The flange or pulley is also held together with machine screws. The flange or pulley is held to the shaft by set screws provided in the collar. The revolution per hour shaft has flattened sides and is threaded, therefore no flange is required. A hole is cut in the disk to correspond exactly with the shaft. The disk is fitted on and held in place with a nut.

The fourth step is to construct a container for the timer and provide for the attachment of the microswitches. The authors suspended the timer between two wooden bars. The bars were attached to the sides of the timer box. Next a bottom is fitted and screwed in place so that it may be removed if it becomes necessary. The microswitch for the revolution per disk is fitted onto the bottom of the timer box. Wooden blocks were used to bring the level of the microswitch lever even with the disk. The distance from the disk to the switch is adjusted so that an extended projection will turn the switch on Since the timer motor does not have enough force to throw heavy switches it is of utmost importance that the switches are of a type which require the least amount of force to activate them. The authors found a single pole, single throw microswitch very successful. It is supplied by the same company which supplied the timer motor. The microswitch for the revolution per day disk is located on the wooden bars which support the timer. It may be necessary to solder a thin piece of metal to the arm of the switch so that it will be wide enough to make contact with the disk. A wooden block cannot be used here because the side of the microswitch would interfere with the disk and its projections. (See fig. 2)

Wiring is the final step. The diagrams are shown in Figure 3. Four terminals are required: two for the incoming power and two for the power going to the solinoid. Wires from the timer are attached to the incoming power terminals. Next a wire from the outside power terminal is attached to the microswitch activated by the revolution per day disk. A wire from the "normally on" side of this microswitch is connected to

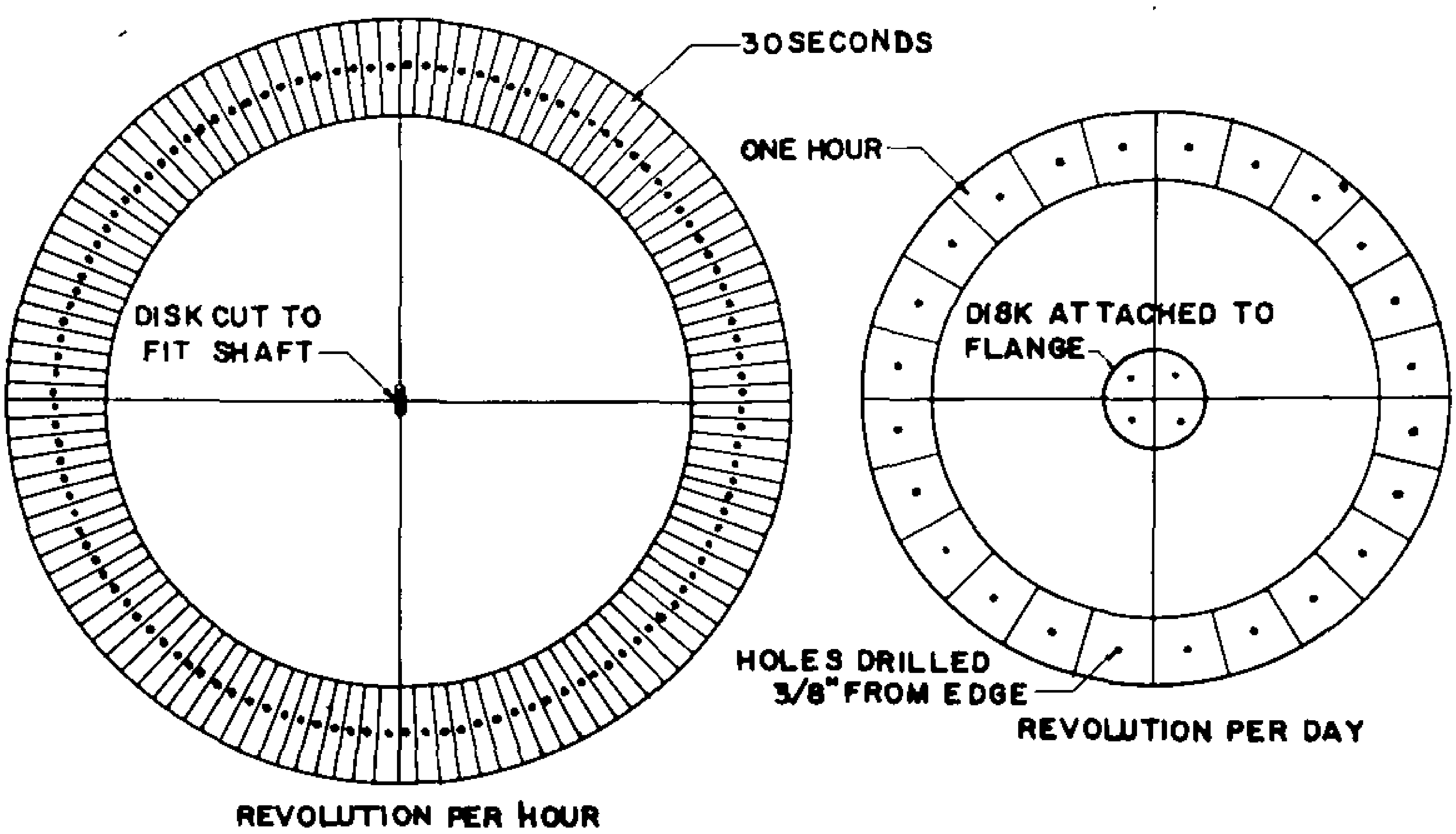

FIG 1 REVOLUTION PER HOUR AND DAY DISKS

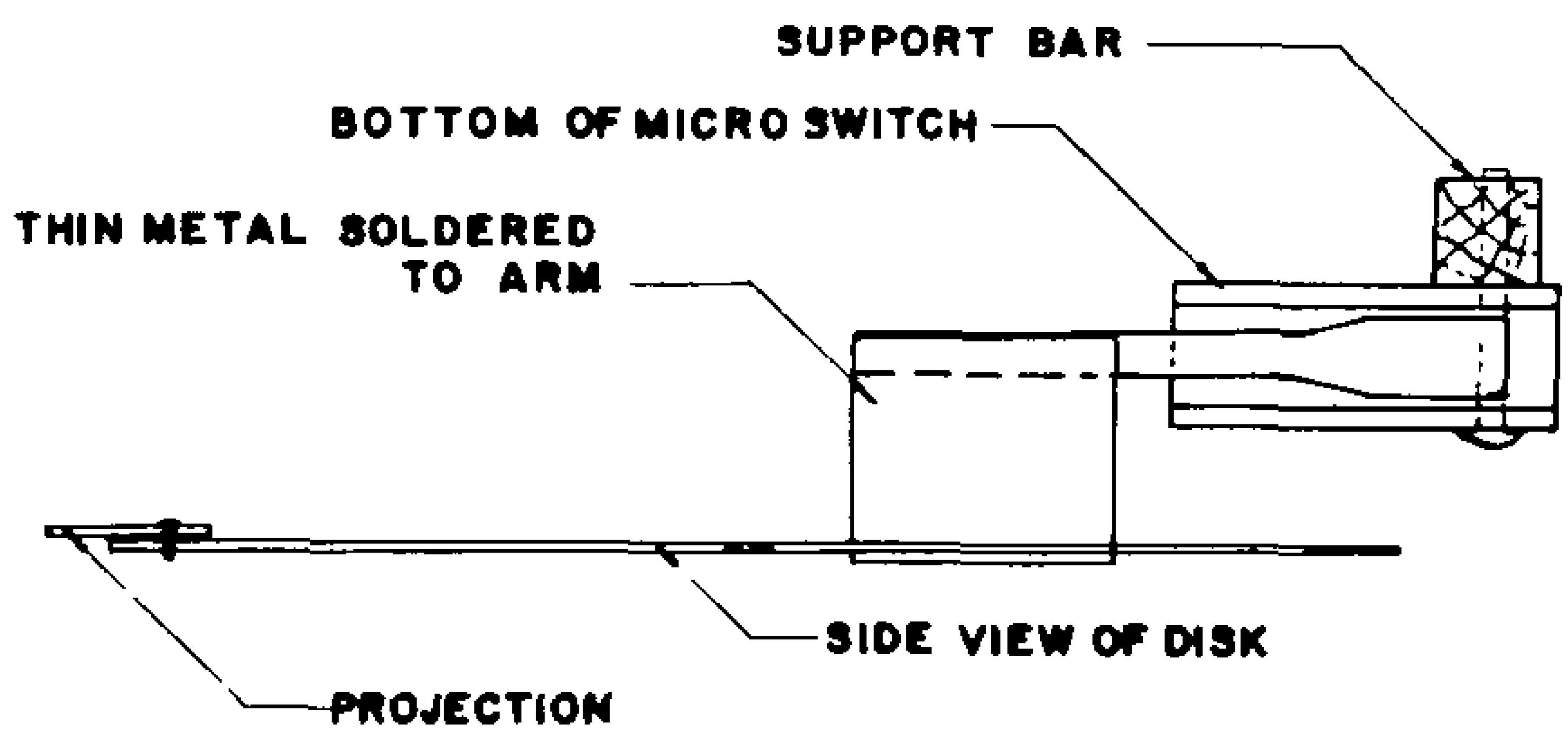

FIG 2 ATTACHING REV PER DAY MICRO SWITCH

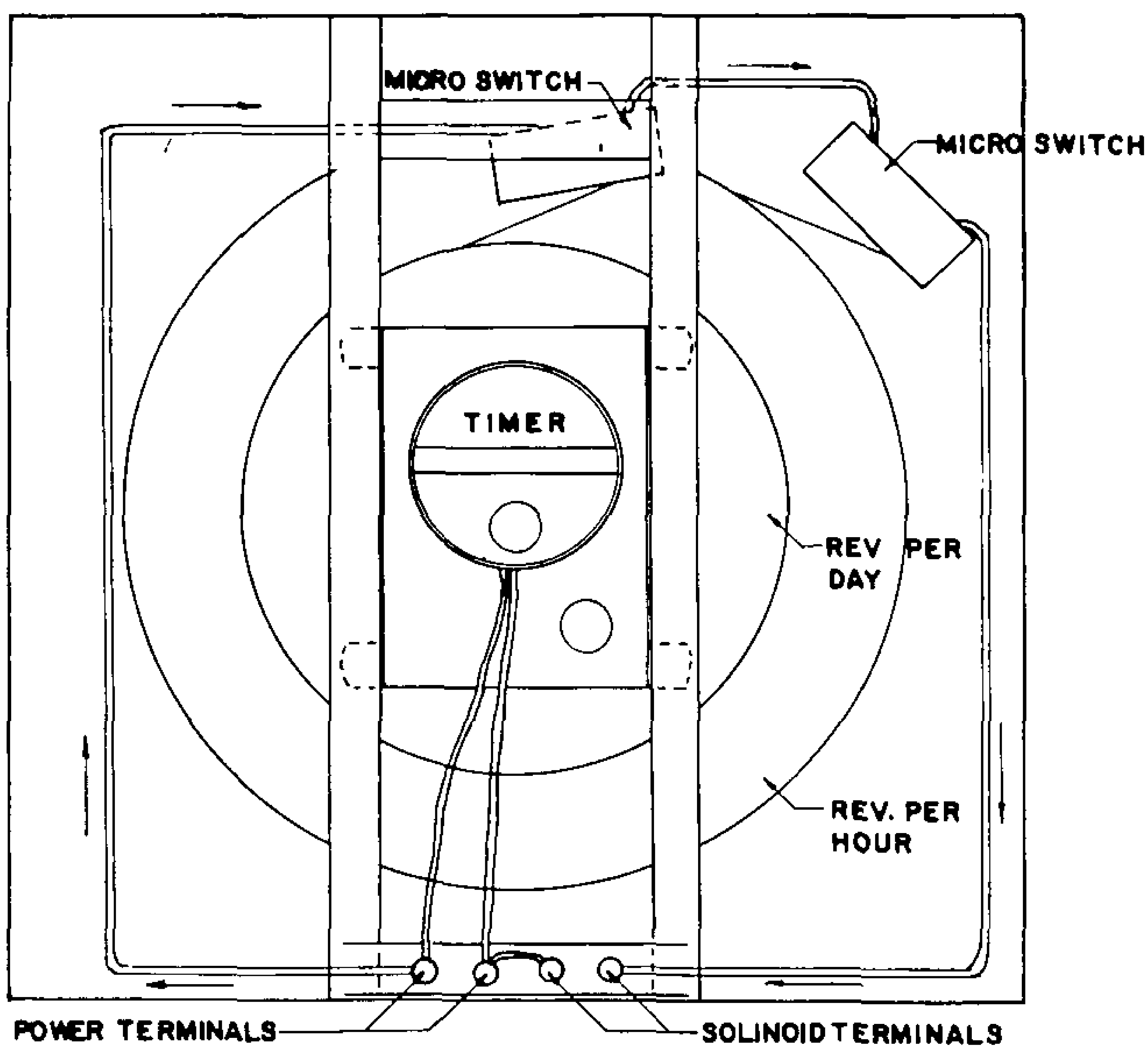

FIG 3 ARRANGEMENT OF MICRO SWITCHES AND WIRING

the microswitch activated by the revolution per hour disk. A wire from "normally open" side of this switch is attached to one of the terminals which go to the solinoid. Finally, a wire from the inner incoming terminal is attached to the second outgoing or solinoid terminal. Thus the first switch controls the overall operation and the second the cycles of mist.

This completes the timer other than attaching the solinoid wires, setting the time by means of a shaft and a knurled nut provided with the motor, and plugging in the power line.

Economy and availability of parts are the last two factors to be considered. Economy is shown by table 1 which lists the cost of the basic parts and gives an approximation of the cost of labor.

The timer motor and microswitches, although probably obtainable from any electronics supply firm, were purchased by the authors from Herbach and Rademan, 1024 Arch Street, Philadelphia 7, Pennsylvania.

TABLE 1. COST OF MATERIALS

Timer motor		$ 6.75
2 microswitches .40 ea.		.80
Material for disks and container		3.00
Total		10.55
Labor: 5 to 9 hours	5.00 to	10.00
Entire cost approximately	$15.00 to	20.00

CHAIRMAN FILLMORE: This is an ingenious timing device which has been described by Mr. Hess. Thank you very much for the information.

MR. TEMPLETON: Do you use this in connection with any other device, such as a humidistat which would cut off the timer during rain?

MR. HESS: The timer has been used for cuttings and preliminary work for grafting. We did have humidistats placed in the area considered to be most critical, that is, in the area where the cuttings were. When the mist is on moisture filters into the humidistat and it takes a considerable period for this to dry off. The plants will dry off before the humidistat becomes effective in starting the mist. It is possible that by proper placement, a humidistat could be effective.

DR. SNYDER: A question was asked of Mr. Templeton concerning the cleaning of the nozzles. Will you describe the mechanism of the nozzles used by us this summer?

MR. HESS: There are several things which can be said about these nozzles. The main thing is that by reducing the time the mist is on, we used less water, thereby both prolonging the life of the nozzle and reducing the possibility of clogging. During the preliminary work this past summer, we used cycles consisting of two minutes on and four off. Under conditions of continuous mist, 63 gallons of water were used during a twelve hour period, but with the cyclic system, only 21 gallons of water were used.

We used a nozzle which has a cleaning device in it. When the nozzle shuts off, the nose is drawn into the body by a spring and there is a prong or needle which penetrates the aperture of the nozzle. These nozzles were very good and we haven't had any trouble with clogging so far. However, they are expensive nozzles, retailing for $8.00 each.

PRESIDENT WELLS: What mediums were used?

MR. HESS: The medium we used was peat and sand in proportion of one-third peat to two-thirds sand. I think that actually the medium is not too important with regards to mist. It might be thought that the medium will become waterlogged and deficient in air. There are two factors involved here: first, as the mist goes through the air, it picks up quite a bit of oxygen. Secondly, when the mist is off, the water is draining from the cuttings, penetrating the medium, and draining from the bench. In the experiments which we ran, we found less basal rot on those cuttings under the mist than those which were propagated in a closed case and in an open bench.

It may also be that there are a certain number of fungus spores washed off the leaves by the mist. That is where this idea of getting a film of water, water which actually drips off the leaves, comes into play. Among the beneficial effects from the mist may be removal of fungus spores, increased aeration of the medium, and cooling of the tissue.

* * * *

CHAIRMAN FILLMORE: Since Mr. Spencer B. Chase is not present this evening, we will proceed to the last of the speaker-exhibitors. Roger W. Pease, of West Virginia University, is a holly enthusiast and one of the early supporters of the Plant Propagators Society. I am certain that he will present a very interesting discussion on the use of overhead irrigation of holly.

Mr. Roger W. Pease presented his paper, entitled: "The Response of Rooted Cuttings of *Ilex opaca* to Overhead Irrigation in a Lath House." (Applause)

The Response of Rooted Cuttings of Ilex opaca to Overhead Irrigation in a Lath House[1]

ROGER W. PEASE

University of West Virginia, Morgantown, W. Va.

During the wet season of 1951 rooted cuttings of *Ilex opaca*, transplanted in April from the rooting cold frame to a clay soil, averaged 5.4

[1]Published with the approval of the Director, West Virginia Agricultural Experiment Station, as Scientific Paper No 479.