HEATING GREENHOUSES BY HOT WATER AND STEAM*

For heating small ranges of greenhouses some of the cast-iron hot-water boilers, although they are comparatively high priced, will prove satisfactory and in the end economical, as they will be more durable than wrought-iron boilers, especially if the latter are made in the form of box coils from ordinary gas pipe. The joints of the latter being screwed together will expose more or less of the threads, and as a result may not last more than two or three years, although with heavy pipe the life of the pipe boiler may be seven or eight years, if care is taken not to have any of the threads exposed. For larger ranges where hot water is used, tubular boilers may be employed and will give good satisfaction, especially if the tubes are placed so as to fill the shell of the boiler. Although these boilers are made of wrought iron, the tubes are thicker than those commonly used for coil boilers and the tubes, being riveted rather than screwed into the boiler heads, will be quite durable. Although not to be recommended for very small ranges, a considerable saving in the amount of pipe required for radiating surface in the houses can be made if the system is placed under pressure. Although there is hardly any limit to the size of the plant in which hot water under pressure may be used, a majority of the greenhouse men prefer steam for ranges of the size that will make the use of a night fireman desirable. While it will require rather more careful attention than a hot-water system, steam as a means of heating greenhouses has some advantages.

For ranges of houses with less than 10,000 square feet of glass only one heater will be desirable, but if the amount of glass exceeds this, two or more should be employed. The heaters should be so arranged that either one can be cut out from the system in case of accident and for the purpose of making repairs. Having more than one heater, under such conditions, will oftentimes prevent serious loss. During the fall and spring months only one heater will be required, the other being held in reserve for use during the severe weather in winter.

PIPING.

For piping houses for hot water circulation there has been a marked change in the kind of pipe used in the last twenty years. Instead of the old fashioned four-inch cast iron pipes, wrought iron pipes from one and one-quarter to two inches in diameter are used for the coils. In some cases the coils include both the flow and return pipes, but more commonly the water is carried to the further end of the house in pipes of a somewhat larger size, which are there connected with the returns. Although larger pipes are occasionally used, the usual size for the flow pipes is either two or two and one-half inches, the former being used for coils containing about 200 square feet of radiation, while the latter will supply 350 feet. When the heater can be sunk so as to be below the level of the greenhouse floor, a fairly good circulation can be secured with all of the pipes under the benches; but better results can be obtained when the flow pipes are carried as high as possible, and the use of overhead flows becomes almost necessary where it is not possible to lower the heater. One or two of the flow pipes can be carried upon each of the rows of purlin and ridge posts, and others, if necessary, upon the walls. The radiation supplied by the returns will be rather more effective when arranged in horizontal coils than when the pipes are placed one above the other, but from the fact that when the coils, in whole or in part, are carried upon the posts of the side walls they are out of the way, the vertical coil is often used. While good results will be secured whether the flow pipe is carried with an upward or a downward slope, the results, if anything, seem to favor a down-hill system. The slope should be merely enough to free the pipes of air, for which an outlet must be provided at the highest point. It is an excellent plan, especially when the closed system is used, to connect the highest point of each flow pipe, or the highest point of the common system, with the expansion tank. The returns should always be laid with a slight slope toward the boiler, but if the larger sized pipes are used and are properly supported, this need not be more than one inch in twenty feet, the object being to carry the pipes as high as possible, and at the same time have a sufficient slope to permit the air to escape.

HEATING BY STEAM.

The arrangement of the pipes where steam is employed is quite similar to that in the hot water system, the particular difference being that the size is considerably smaller for both the flow and returns. The return pipes need not be larger than one and one-quarter inches, and for small houses very good results can be secured with one-inch pipe. As a rule, a two-inch supply pipe will answer for an ordinary house 20 x 100 feet, except where high temperatures are desired. In the steam system there should be an automatic air valve at the lower end of each of the coils, and for controlling the heat valves are necessary upon both the supply and drip pipes, while in the hot water system only one valve is necessary, although two will be desirable in case there should be occasion at any time to cut off the coil in order to make repairs upon it. In the steam coils it is also well to have several of the pipes provided with valves in order that one or more of them may be cut off to control the heat. In estimating the amount of radiating surface that will be required, it is customary to consider that one square foot of surface will be sufficient for three of exposed glass, if the house is to be carried at 60 degrees, with hot water, and that it will answer for four or five if 50 or 40 degrees, respectively, is to be maintained. With steam heat one foot of radiation will be ample for five and one-half square feet of glass in houses to be heated to 60 degrees, for seven and one-half if 50 degrees is to be maintained, while only one foot of radiating surface to nine square feet of glass will be required in houses that are to be heated to 40 degrees. The above figures will be found substantially correct in sections where the usual winter temperature does not drop below zero, and where the houses are well built and with a comparatively small amount of wall surface.

*From a paper read by Professor L. R. Taft, of the Michigan Agricultural College, before the Missouri State Horticultural College.