Speed-up and more production are the keynotes in about everything nowadays. Chickens now go on a mass-production basis, so do growing plants. Here's how controlled heating coaxes the lowly tomato to go to work throughout the entire calendar year

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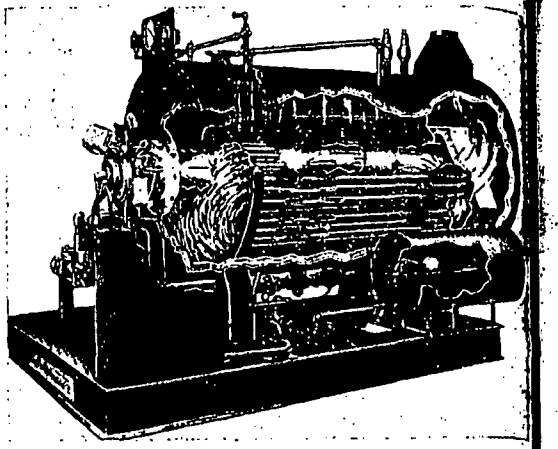

SECTIONAL VIEW of the automatic, gas-fired, packaged boiler that supplies a controlled atmosphere for ideal tomato-growing plus source of soil-sterilizing steam

Packaged Gas-Fired Heating Boiler Extends Old Sol's Growing Season

► OHIO LEADS THE NATION in growing vegetables under glass. There are now more than 800 acres of greenhouses for vegetable production, and 8200 more under glass for growing flowers and other ornamental vegetation. At the 1952 Ohio Water Clinic* it was estimated the water used in these greenhouses exceeded 60 acre-inches per year. Some appetite for a still-growing industry!

Impressive as this water need is, the industry has still other specialized problems all its own. The major ones are maintaining the proper temperature and sterilizing the soil for the particular vegetable or flower under growth. Both are naturals for a good heating plant. Here is a good example from one up-to-date greenhouse for raising tomatoes.

When the 1902 single-retort underfeed stoker boiler at our greenhouse was ruled no longer safe for service above 15 psi, we decided to go to a fully-automatic heating plant. We put in a 5000-lb-per-hr gas-fired automatic package-unit steam generator, photo, above. It is designed for 50 psi operation and gives us enough steam for a high-pressure supply to sterilize the ground and kill weed seeds between plantings. Let me tell you, it takes plenty of steam to heat a glass-enclosed greenhouse during the harsh Lake Erie winters. What's more, our growing area for tomatoes under glass measures about seven-tenths of an acre, so we've got a heavy heating load.

Heating steam has to be supplied most of the year. We hold inside temperature at 58 F throughout the winter. Then during the milder weather we keep a daytime temperature of 65 F and a night temperature of 62 F. These conditions apply until about July 1.

As you can guess, we asked for and got special safeguards on the boiler installation. We have a pressure switch on it to control a bedroom alarm bell that rings out in case of a nighttime failure. An entire crop can be lost in 30 minutes with a loss of heat during a cold, subzero Cleveland winter.

BOILER OPERATION

Here is how our boiler plant runs. We supply the natural gas available throughout our area (1050 Btu per cu ft) to our new package steam generator. The old boiler stands by, kindled and ready for emergency use, should anything go wrong with our new setup.

This setup features the 3-pass, horizontal, firetube boiler whose workings show plainly in the cutaway above. Flame area occupies a cylinder-like tube in the center of the packaged unit. Combustion products move along under the pressure of incoming gas, about 7 in. wg, toward a rear refractory target wall, through a lower segment of tubes toward the front of the boiler. Then they reverse and move back toward the rear through two lateral sections of tubes to the breeching. They leave the boiler proper at a temperature of about 500 F at full firing rate.

Automatic Controls. As we mentioned earlier, we felt our greenhouse business made it necessary to have a full complement of automatic operating and safety controls. We carried the same idea over into our electrically controlled auxiliaries and power services. All electrical equipment, including motors and controls, is installed and wired into the power and the control circuits. Then all relays, motor-starting switches, overload and short-circuit protection are mounted in a splashproof steel cabinet at the right side of the operating platform, photo facing page.

The automatic firing sequence is well thought out and highly reliable. (*Editor's Note: See Automatic-Fired Boiler Precautions, this issue, p 92.*) On startup we have the air blower come on first for a purging period. Then the gas-electric pilot comes on. After the pilot is established the gas valve opens and if ignition takes place, the pilot kicks out. If the pilot does not take hold for the proper period, a flame-sensing device prevents the main gas valve from opening.

The burner, too, carries several safety precautions. For instance, the burner can start only if it is in the low-fire position. An interlock in the air-supply damper prevents the burner from starting unless the damper is in the low-fire position. What's more, the burner has a calibrated modulating control that proportions air to fuel for peak combustion efficiency over the 30-100% load range.

Low water cutoff, electronic flame scanner, forced-draft-fan failure or excess steam pressure have special connections wired into the burner circuit so the burner automatically cuts off on a signal from any one of them. To the burner this information appears as an operating defect and so the unit shuts down to allow clearing or correcting the fault in safety.

The feedwater cycle similarly came in for all possible precautions. An automatic boiler feed system is located on the right rear of the boiler base, photo, facing page. It consists of an atmospherically vented condensate receiving tank for both city water makeup and heating-system condensate with a motor-driven boiler feed pump.

PROCESS PROBLEMS

The jobs of soil-sterilizing and atmosphere-heating that the boiler does are very interesting. In fact, the sterilizing phase puts a real test on the boiler. We take the full 50-psi output and directly condense it in the soil through porous tiles buried in the soil. In the photo above showing interior of the greenhouse, you see the feed pipes to these tiles. When the steam goes into the soil it's lost forever and the boiler operates on a 100% cold makeup. This sterilizing goes on, a bay at a time, between planting seasons.

When the sterilizing operation is in full swing we cover the soil with tarpaulins and push in steam to raise soil temperature to about 212-215 F, and then hold it there for 4 to 6 hr. What we do to determine proper soil temperature and be sure it's been held long enough is to put a raw potato on the ground under the tarpaulin. When the potato is cooked the soil is considered sterile and ready for the next planting.

The tomato plants themselves are raised from seed. The seedlings we transplant several times to increase root strength. Then they are arranged for the last time in what we call the production stage. We guy them vertically, photo above, to overhead trusses. When the plants reach the full height of the guy wire we turn them downward and they keep on growing.

When the time is right for pollination we tap the plant stalks lightly. This is one place where Mother Nature needs a helping hand. Because there are no air currents or pollinating insects within the greenhouse we have to substitute this tapping action. When the fruit's ready for harvesting we pick the tomatoes, sort them and place in baskets for direct sale in the Cleveland market.

Our controlled climate will let us reach this market more often.

*First Ohio Water Clinic, Ohio State University, Feb 11-13, 1952.

GREENHOUSE INTERIOR. Author and his wife are in front of a typical healthy crop. Soil-sterilizing piping runs along the floor, heating pipes run along the side walls

PACKAGED STEAM AIDS FOR GREENHOUSE SERVICE

- Hold greenhouse temperature at 58 F minimum throughout winter months
- Restrict top temperature to 65 F during mild days and 62 F at night
- Provide ideal climate, automatically, and do it within a regulated range
- Sound alarm, day or night, if something happens to the boiler, in time to effect emergency steps to save the crop
- Supply ample source of sterilizing steam to the soil to kill off all parasitic weed growths before new seedings and plantings take place