

The Brandon replacement packing rings prevent damage over time that occurs with conventional packing rings due to start-up, thermal distortion, and shaft vibration. The efficiency loss due to original packing rings is assumed to progress linearly from 0% to its maximum efficiency loss of 1% after 5 years. The Brandon steam packing rings prevent this gradual loss in efficiency.

**Electronic Octane®.** Electronic Octane®, developed by John A. McDougal, is an ignition control system used in automotive internal combustion engines. This system senses the onset of predetonation ("knocking" or "pinging") caused by either carbon deposits, valve and spark timing, and/or wall temperatures, and provides feedback parameters in order to retard the spark advance as necessary in individual cylinders. Predetonation or knock, if allowed to continue, is destructive to automotive engines.

The design of conventional vacuum control spark ignition systems overcompensates for the potential for knock in one or two individual cylinders by reducing the spark advance more than necessary for the rest of the cylinders that are operating normally. This reduces engine efficiency in order to prevent knocking in the one or two cylinders that require more control than the others. At a mid-RPM range of 2800 RPM, a 2.2% efficiency gain is expected for engines with the individual knock control system compared to a "global" knock control system. In addition, a lower octane can be used.

**Thermefficient-100®.** Thermefficient-100® was developed by Harry E. Wood and is a high efficiency gas-fired water heater that allows most of the total heat of combustion of the unit to be utilized (Fig. 7.2). A direct-contact heat exchanger using packed rings or a similar adaptation operates in a counterflow arrangement such that the combustion product's exhaust temperature is very close to the temperature of the incoming water. In conventional water heaters the latent heat of vaporization of the combustion produced water is totally lost.

The Thermefficient-100® system has a thermal efficiency close to 100% compared to approximately 70% for conventional water heaters. The design allows heated water to collect at the bottom of the water storage tank with no start-up time required for water temperature to increase to normal operating temperature. The Thermefficient-100® system is very compact requiring only 32% of the floorspace of a conventional water heater of equivalent capacity.

### 7.2.3 Energy Consumption and Savings

The annual energy savings and cumulative savings for sales of the three technologies is shown in Table 7.2. In total, it is estimated that these technologies saved 0.14 Quads of energy between 1981 and 1993. In 1992, it is estimated that these three technologies saved 0.041 Quads of energy, and the total for 1993 is likely to have been greater.