There is also a threat of carbon monoxide (CO) poisoning if the exhaust stack leaks inside the shroud. During preflight, it is always a good idea to check exhaust-stack seams to assure that the welds are solid; any leakage within the engine compartment may cause the cabin to fill with CO. It is impossible to check the exhaust weld within the heater shroud, though, and it provides a direct route for CO to travel into the cabin. The best safety measure is to put an inexpensive carbon monoxide detector in every airplane. When exposed to CO, the colored pad turns from orange to black in fifteen minutes or less, depending on the amount of carbon monoxide, alerting the pilot to a serious hazard.

Combustion Heater

If you think there ought to be a better way, you're right; there is. It's called a combustion heater, and most multiengine airplanes have one. But why don't singles? For the most part, airframe manufacturers feel it is too expensive to put combustion heaters in single-engine aircraft. So, at least for the time being, only multiengine pilots will have the luxury of instant heat.

Piper installs Janitrol combustion heaters exclusively in all of its twin-engine aircraft built after 1964. Janitrol shares the rest of the market with Stewart Warner's Southwind heater. The fundamentals of aircraft combustion heating haven't changed much over the years. According to the *Aircraft Heating Digest*, Volume 1, Number 1, published by Janitrol Aircraft in February, 1949, there are four main requirements: fuel for combustion, air for combustion, ignition to start combustion, and air to carry away the heat produced by combustion. That was true for the DC-3, and it's still true for modern aircraft.

Heat is produced by burning a fuel/air mixture in a heater combustion chamber. This is somewhat of a mixed blessing, because while it conveniently uses fuel drawn from the aircraft fuel tanks, it also reduces the aircraft's range when the heater is in use. Nonetheless, when you get into a cabin that is below freezing and can have near instantaneous heat without even starting an engine, a little less range—at least to this northerner—doesn't seem so bad.

The Janitrol heater uses a spray nozzle to send regulated, atomized fuel/air mixture into the heater combustion chamber. There, a high-voltage spark plug powered by the aircraft's electrical system provides continuous ignition. Because aircraft attitude and altitude always are subject to change—sometimes rapidly—Janitrol uses what it calls the "whirling flame" principle. The fuel/air mixture enters the combustion chamber tangent to the chamber's surface as depicted in Figure 11-2. This forces the airflow to spin and mix with itself, causing a stable, continuous flame pattern. The burning gases flow the length of the combustion tube, double back over the outside of the chamber, go through a crossover passage to an outer radiating area, travel down the length of the heater one more time, and finally exit through the exhaust.

The cabin ventilation is ducted separately between the combustion air chambers. Though the two airflows never mix (to do so would lead to CO poisoning), the ventilating air does contact several surfaces heated by the combustion air, causing heat transfer. Several other components round out the system. An electric fuel pump is necessary,