**Chapter Four**

# ENGINE TEMPERATURE INSTRUMENTS

The fact that life may have been simpler once does not necessarily mean it was better. Aircraft engine instruments are an excellent example. Since the first tenuous flight, pilots have had some method of checking the well-being of their engines. But the crude instrumentation of bygone days often left much to be desired. Now, most modern engine instruments are both reliable and useful, provided the pilot understands exactly what is being measured and how.

As temperature increases, liquids and metals expand, though at different rates. By welding together dissimilar metals, coiling them, anchoring one end to an instrument case, and attaching the other to an indicator, you have a bimetallic (or solid) thermometer. Light aircraft commonly use this type of outside air temperature gauge. It is usually fitted right through the window or incorporated into the cabin air vent.

Another common nonelectrical temperature measuring device uses the vapor method. A gas-filled, sealed bulb and an expandable (Bourdon) tube are connected to an indicator. The bulb is located where the temperature is to be measured. The pressure inside of it varies with the temperature, causing the Bourdon tube to expand and contract, thus moving the indicator.

More sophisticated electrical temperature indicators are of two basic types: variable resistance and voltage-generated. The variable resistance temperature indicators are based on the principle that a metal's resistance to current flow varies with temperature. When a small, fixed DC voltage is applied to the sensor, some percentage of that voltage, which is determined by the amount of temperature-induced current resistance, passes through the sensor to the indicator. This type of instrument frequently is used to measure outside air temperature, cylinder-head temperature, (CHT) and oil temperature. The obvious drawback is that it requires a source of DC voltage.

The voltage-generation temperature indicator is based on the principle that certain dissimilar metals that are welded together in a loop produce a low DC voltage proportional to the temperature difference between the two ends of the loop (Figure 4-12). The thermocouple (sensor) is composed of a measuring junction where the loop is joined at the engine and reference, or cold junction, inside the instrument case. A compensating spring automatically adjusts for cabin-temperature variations, which might affect the reference end of the loop. Because metals with a very high temperature tolerance may be used, this system becomes ideal for measuring the 1500-degrees C exhaust gas temperatures of the reciprocating engine without requiring an electrical source.

## Exhaust Gas Temperature Gauge

The amount of heat produced by the chemical reaction of combustion varies with the fuel/air ratio. If accurately measured, combustion heat is an important diagnostic tool for the pilot. In the early 1960s, the concept of using exhaust gas temperature (EGT) as an aid to proper mixture control became established. Prior to that the CHT was used, which is a good combustion problem indicator but lacks the accuracy and directness necessary for precise mixture leaning.