relationship over this range. From this equation calculation gives the e.m.f.s at 50°C stages up to 1300°C. Linear interpolation between the points so derived is not more than 1 μV in error, which represents an insignificant error in the temperature reading obtained from the thermal e.m.f.

It will be noticed that Heyne's upper fixed point is only 1083°C, which is well below the 1300°C he claims as the upper limit of calibration by this method, but he shows that the maximum error obtained during extrapolation of results to cover this region is only ± 2° C. Systematic error between 300° and 1300°C is barely 0.1°C which is well within the uncertainty limit of 0.5°C.

Heyne's apparatus, developed for this work, consists of a graphite crucible to contain the molten metal specimens, which are copper, aluminium or zinc of a known high degree of purity. These metals are prevented from oxidising, which would affect their freezing points, by maintaining a reducing atmosphere in several graphite chambers above the crucible. The thermocouples to be tested are protected by surrounding them with a gas-tight tube of pure sintered alumina before insertion in the apparatus. Three thermocouples can be tested simultaneously by using a graphite block as the crucible with three equally spaced holes for the molten specimens.

Heyne points out that his method, although similar in many respects to previous work, offers advantages over the Russian method using antimony in place of aluminium and is simpler than the NBS method using four fixed points (3).

This method of calibration for thermocouples appears to offer a convenient way of checking their accuracy after prolonged service at high temperatures when some drifting is suspected. The apparatus is simple and the freezing points of copper, aluminium and zinc are not difficult to obtain.

F. J. S.

### References

1 W. Heyne, *Feingerätetechnik*, 1964, **13**, (7), 311–315

2 W. Heyne, *Experim. Techn. Physik*, 1964, **12**, (2), 90–99

3 *NBS Tech. News Bull.*, 1961, (March), 44–48

# Platinum Films as Temperature Probes

## FRENCH STUDIES ON AVIATION AND ROCKETRY APPLICATIONS

Increasing efforts by the French aviation industry to develop new aircraft and rockets have led to a considerable volume of research on all aspects of engine design.

Powder propellants present special probems of ignition and to monitor the ignition of powder composites by shock-waves a probe with fast temperature response is needed which also can resist the high temperatures and chemical conditions which may occur.

M. Scagnetti and J. Crabol have described such a probe in *La Recherche Aérospatiale*, 1963, (November-December), 23–30. It consists of a platinum film deposited on a silica support which then is incorporated in the wall of the shock-tube so that it is exposed to the same heat flux between powder and ignited gas as the rest of the tube. It is necessary to allow for the difference between the materials which make up tube and probe and the article explains how this can be done.

The probes are part of a modified bridge circuit and register changes in heat flux as small changes in voltage. These can be converted easily to temperatures in degrees Centigrade and show how the temperature varies continuously over the first millisecond after ignition. A series of probes is used along the length of the shock-tube to study variations at different distances from the orifice.

C. Vautier and A. Colombani (*Compt. rend.*, 1964, **258**, (19), 4706–4709) also report that platinum films act as fast and accurate resistance thermometers over the range from 0 to 500°C. Their films were different in that they were deposited on tungsten filaments but their work confirms that there is considerable scope for further developments in the use of platinum films for temperature measurement.