Some examples of cobalt-platinum rotors are shown in the illustration on page 115. The largest is built up from a cobalt-platinum centre piece and duralumin end pieces, the latter forming the shaft. In the smaller sizes there is no step from the rotor diameter to the bearing diameter, one solid piece of cobalt-platinum being used. The weight of the smallest rotor, $\frac{1}{8}$ inch in diameter and 1.5 inches long, is only $\frac{1}{6}$ ounce. The cost of this in a small synchro makes its use a possibility on economic grounds.

Conclusion

The work described above indicates that cobalt-platinum is a suitable material for use in very small two-pole permanent magnet rotors. In synchro applications, looking to the future, it may be possible to use rotors needle-like in size and dimensions, and cobalt-platinum would be a good material of which to make them. For it has been shown that when a cylinder is magnetised across a diameter it forms an almost ideal two-pole rotor, whose angular position may be uniquely registered and transmitted by Hall elements suitably placed in its field.

The investigation was initiated in the laboratories of Muirhead & Co Ltd, and is continuing at the University of New South Wales.

References

1 J. C. Maxwell, "A Treatise on Electricity and Magnetism", Oxford University Press, 1873

2 B. Inglis, Ph.D. Thesis (in preparation): A Study of Hall Effect and Related Phenomena, with Particular Reference to Position Control Servo-mechanisms (University of NSW)

3 G. W. Donaldson, The Application of Hall Effect to Control Synchros, *Electronic Engng*, 1963, **35**, No. 423, May

Stability of Platinum Metal Thermocouples

HIGH TEMPERATURE TESTS IN VACUUM

The drift in calibration of platinum : 13 per cent rhodium-platinum thermocouples when they are heated for long periods in oxidising or neutral atmospheres is due almost entirely to contamination by impurities picked up from the alumina protection tubes. Careful tests by B. E. Walker and his collaborators at the United States Naval Research Laboratory in Washington, D.C., reported in 1962 (abstracted in *Platinum Metals Rev.*, 1963, 7, 38), showed that of these impurities iron was by far the principal cause of trouble.

These investigators have now studied the behaviour of platinum, rhodium-platinum, and other platinum metal thermocouple elements in order to assess their reliability when heated to between 1000° and 1700°C in vacuum (B. E. Walker, C. T. Ewing and R. R. Miller, *Rev. Sci. Instruments*, 1965, **36**, (5), 601–606).

Not unexpectedly, the changes after heating with various grades of alumina in vacuum are found to be not significantly different from the changes after heating in argon. Moreover, in both vacuum and in neutral atmospheres, the changes due to contamination by iron are at least one order of magnitude greater than in an oxidising atmosphere.

The change in calibration after 120 hours in a vacuum of 5×10^{-5} Torr was only significant at temperatures above 1200°C. At 1600°C the contamination of a pure platinum element in contact with a grade of alumina containing 0.07 per cent of iron resulted in a change in the calibration at 860°C of 2000 microvolts; but with alumina containing 0.03 per cent iron the change was only 400 microvolts.

Pure platinum elements were very much less stable than the alloy elements, the wires becoming rapidly more stable as the rhodium content increased. The 20 per cent rhodium alloy was apparently quite resistant to the effects of contamination at least for periods up to 120 hours at 1600°C under the most severe conditions of test.

No evidence at all was found that preferential volatilisation of platinum or rhodium contribute at all to the instability of platinum metal thermocouples in vacuum (or, indeed, in air or any other atmosphere).

J. C. C.