

zirconium, etc. These processes are generally carried out on a much smaller scale than those already described, and it should not be necessary to go into details. There is, however, a growing interest in these more "rare" elements, and the future will no doubt also bring improved and rationalized methods of production.

The possibilities for large-scale expansion of the metallurgical industry in India are almost inexhaustible. A good start has already been made by the proposed plans for increased production of iron and steel by the electric pro-

cess. Carbide and ferro alloy furnaces are also under consideration. Furthermore, projects have been drawn up for several large hydro-electric power plants, and many districts are favourably situated with regard to further harnessing of water power.

The Indian industry should, therefore, be in a position to attain a high standing in the electrometallurgical field.

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## AN ACCURATE PRESSURE GAUGE EMPLOYING MEASUREMENT OF SURFACE STRAIN ON DIAPHRAGMS

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THE simplicity and accuracy with which surface stresses can be measured by means of bonded wire strain-gauges prompted us to investigate whether the measurement of surface-strains produced on diaphragms (as distinct from the customary deflexion measurements) could be adapted to accurate measurement of high pressure. The preliminary results obtained in this investigation are set out here and it can be seen from these results that the

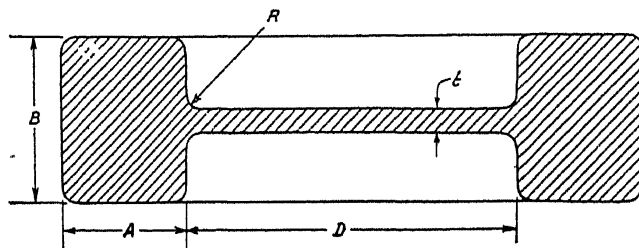


FIG. 1

method proposed is indeed capable of high accuracy.

integral holding-rims and appropriate fillet radii, as shown in Fig. 1, were employed. These were accurately machined out of thick plates of spring steel, clamped at the rim in high pressure unions and work-hardened *in situ* by subjecting them repeatedly to cycles of high and low pressures. The dimensions of the diaphragms employed and their maximum service pressures are given in Table I.

Two well matched strain-gauges (Tinsley's) each of about 200 ohms resistance, were mounted with Durofix, one almost centrally on the diaphragm to measure the strain and the other on the union-nut to compensate for variations in ambient temperature. The variations in the resistance were measured to within  $4 \times 10^{-4}$  ohms with a direct-current bridge of the Callendar-Griffith type, using as null indicator a Moll reflection galvanometer of high sensitivity. With this equipment surface strains could be measured correct to  $\pm 1$  micro-inch per inch.

As reference gauge a Budenberg Standard

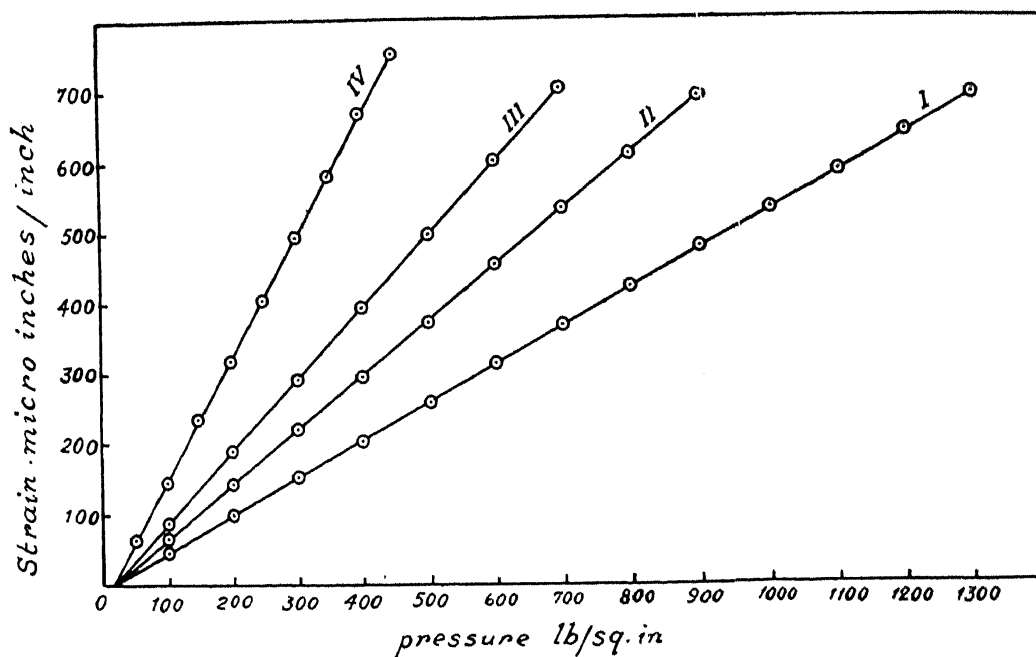


FIG. 2

As plain discs, clamped at the edge, did not yield reproducible results, diaphragms with

Test gauge with ten-inch dial and reading up to 2,000 lb. per sq. in. was employed. The