

Different sections of each bar were then subjected to a thorough microscopic examination and its micro-structure studied. As would be observed from the details of microscopic examination in Table I those bars which had passed the "Scragging" test exhibited tempered martensitic structures with practically no or a little feathery free Ferrite which had separated during quenching for hardening. Failed bars showed feathery Ferrite formation at the grain-boundaries.

Brinell and Vickers Pyramid Hardness measurements were taken at the ends and centres of the bars on the surface as well as on the cross sections of the bars.

Some typical results obtained during the above tests are recorded in Table I.

From the results of the above experiments it would be observed that fast quenching rates applicable in water-quenching even from 850° invariably gave satisfactory "Scragging" test results whilst oil quenching failed to give satisfactory response in the "Scragging" test in some cases from temperatures as high as 975°C. Water-quenching cannot, however, be recommended for commercial practice owing to the dangers it involves of distortion, warpage, cracking, etc., in particular for high carbon compositions. For low carbon compositions upto 0.40% carbon water-quenching may be safely employed. The above tests were conducted under ideal laboratory conditions of oil bath, regulated heating, one bar singly heat-treated at a time, etc. In commercial practice, the spring bars have to be heat-treated in batches and not singly. Thus although oil-quench from 850°C. have yielded in some cases satisfactory results in the "Scragging" test, in commercial practice higher hardening temperatures of 900°C. or above would be most essential for satisfactory hardening and "Scragging" test performance.

Before, however, finalizing the commercial heat-treating procedure, it would be best to conduct individual laboratory experiments in the first place and to formulate the commercial procedure in the light of the foregoing results obtained. It may also be pointed out here that in comparison with plain-carbon spring steels silico-manganese spring steels require much greater care and attention, e.g. renewal and stirring of oil or water bath, uniformity of heat-treating temperatures and soaking, quick and proper manipulation of the transfer of the steel to the quenching media, etc. Silico-manganese steels are highly sensitive to these heat-treatment abnormalities.

Another factor for which separate research will be necessary, is the effect of "Austenitic grain Size" on the hardenability of silico-manganese spring steel bearing in mind that fine-Austenitic grained Steels are of shallow hardening types and coarse-Austenitic grained of deep hardening types. With an optimum Austenitic grain size much lower oil or water hardening temperatures may be quite feasible eliminating thereby risks of over-heating, decarburization, distortion, warpage, macro- and micro-cracking, etc., accompanying high-temperature heat treatments.

1. Colbeck and Hanson, *J. I. S. I.*, 1924, 109, No. I, 377.
2. Andrew, *Ibid.*, Discussion on the above paper, p. 395.
3. Baker, *Ibid.*, 1903, No II, p. 312.
4. Hadfield and Osmond, *Ibid.*, 1890, No. I, p. 62.
5. Andrew and Richardson, *Ibid.*, 1935, 131, No. I, 129.
6. Burns, *Ibid.*, 1932, 125, No. I, 363.
7. Charpy and Cornu, *Comptes Rendus*, 1913, 25, 1240.
8. *Ibid.*, 1913, 117, 319; *Revue de Metallurgie*, June 1915, 12, 493.
9. Vigoroux, *Comptes Rendus*, 1913, 116, 1374.
10. Guillet, *J. I. S. I.*, 1906, No. II; *Precise Metallographie; Les industries Metallurgiques, a l'avant guerre.*

### GRANT FOR CANCER RESEARCH

A grant of £1865 (Rs. 24,837) has been made by the British Empire Cancer Campaign to Oxford University to be used for cancer research.

Professor A. D. Gardner, Regius Professor of Medicine at Oxford, in announcing this stated

that during research into chemical substances a new sideline has been found and Sir Robert Robinson, Waynflete Professor of Chemistry at Oxford, had wished to explore this, and for this purpose had applied to the British Empire Cancer Campaign for funds.