Letters to the Editor

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A Magnetic Material of High Coercive Force

IN making magnetic measurements on mineral powders, we found that certain iron ores, heated in reducing gases at about 600° C. for a short time and then passed over a high-intensity magnetic separator, could not be demagnetised in the customary manner. Complete demagnetisation was successful only under the following conditions: (1) high initial demagnetising fields; (2) slow reversals of the decreasing demagnetising field; and (3) packing the powder to prevent motion of the individual grains.

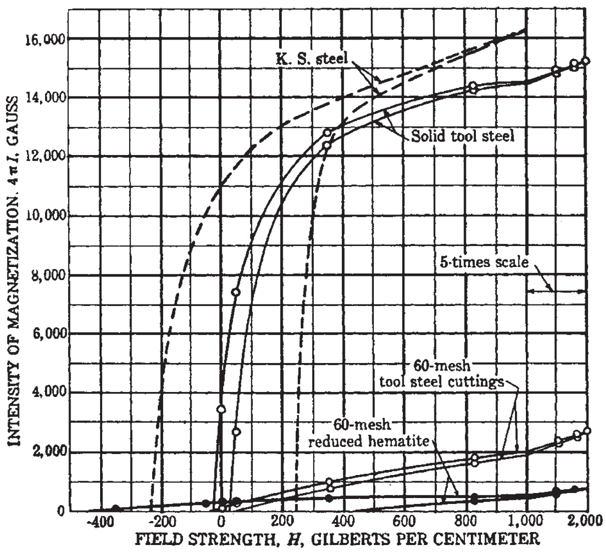

FIG. 1. Comparison of magnetic properties of 'reduced hæmatite' and *K.S.* steel.

Qualitative estimates of the coercive forces involved were so exceptionally high that a quantitative determination seemed desirable. For this purpose, we have devised a modified isthmus method for obtaining hysteresis loops with $H_{max.}$ up to 4,700 gilberts per centimetre. The coercive force of a number of samples of 60-mesh reduced hæmatite powders as determined by this method varies from 200 to 425.

Successive field strengths H (gauss or gilberts/cm.).	Intensity of magnetisation ($4\pi I$ gauss).		
	Rod No. 12 (solid)[1].	Rod No. 12 (60-mesh hack-saw cuttings)[2].	Reduced hæmatite[3].
2000	15200	2732	784
1800	15144	2608	748
1500	15022	2405	704
825	14342	1777	595
350	12807	1084	482
50	7340	364	367
0	3413	168	340
−50	−2676	−17	313
−350	−12239	−839	119
−825	−14417	−1636	−306
−1500	−15020	−2351	−647
−1800	−15139	−2587	−731
−2000	−15200	−2732	−784

[1] A rod 0·80 cm. diameter cut from No. 12 tool steel, after quenching from 530°–560° C. (7·72 gm. per c.c.).
[2] From No. 12 (solid) by collecting the cuttings obtained on sawing the rod into pieces (2·64 gm. per c.c.).
[3] 60 mesh (2·04 gm. per c.c.).

The sample that shows the highest coercive force—$H_c = 425$—was prepared by heating 60-mesh Minnewas martite from the Mesabi range in a reducing atmosphere for half an hour at 550° C.; after treatment, the sample contained approximately 27 per cent FeO. The hysteretic data for this sample, as well as for a tool steel in the shape of solid rod and of 60-mesh hack-saw cuttings measured in the same apparatus, are given in the accompanying table. The half-loops of the hysteresis curves for these three sets of data are shown plotted in Fig. 1, compared on the same scale with the half-loop for *K.S.* magnet steel as given in the "International Critical Tables", vol. 6, p. 389, Fig. 20.

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Application of Magneto-Striction Effect to the Observation of Work-Hardening of Steel Wires

A STEEL wire was suspended in a solenoid which was excited by direct current. Embracing the wire at the central part of the solenoid was a search coil of 4,000 turns in circuit with a ballistic galvanometer of long period of swing. When a load was applied to the wire a throw of the galvanometer was obtained and the magnitude of the change of flux linkages corresponding to this throw was found to be related to the magnetising force of the solenoid by a curve such as that shown in Fig. 1. It will be seen that this curve passes through a maximum value and also that there are two values of the magnetising force for which the change of flux linkages is zero. For each value of the applied load, a curve such as that shown in Fig. 1 was obtained.

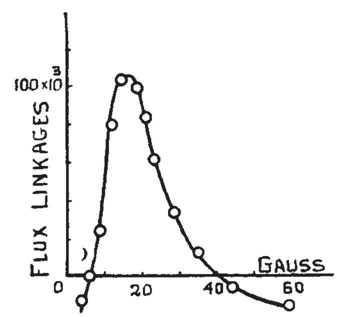

FIG. 1.

Tests were carried out on a group of steel wires each 0·116 in. in diameter as used for wire ropes, supplied by a well-known manufacturer of such ropes. Of these wires two were work-hardened by winding over a pulley 3½ in. in diameter and straightening out again—this process being repeated twelve times in the case of each of the two wires. The remaining wires were left in the normal condition as used in the manufacture of a new rope.

In Fig. 2 are shown representative results of the ballistic tests on one of the work-hardened wires and on one of the normal wires. In this graph the maximum values of the changes of flux linkages as obtained from curves such as those shown in Fig. 1