ON THE INITIAL PERMEABILITY OF A ROD SHAPED SINGLE CRYSTAL OF IORN PLASTICALLY STRAINED

By

M. Botros, *Faculty of Enginering, Ein Shams University,*
R. Sadek Nashed, *Higher Industrial Institute, Minia.*

Stewart(1) constructed a theoretical magnetization curve of a rod-shaped iron crystal under tension. The curve (fig. 1) consists of three straight parts; OA, AB and BC where O is the origin. OA and BC have small inclinations with respect to the effective field axis, while AB is nearly parallel to the magnetization axis. Stewart deduces that the slope of OA does not change with the variation in the applied tension, i.e. the initial permeability remains constant. Increasing the tension only moves AB further away from the intensity axis.

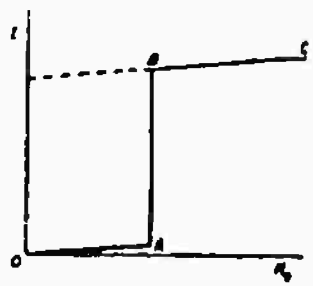
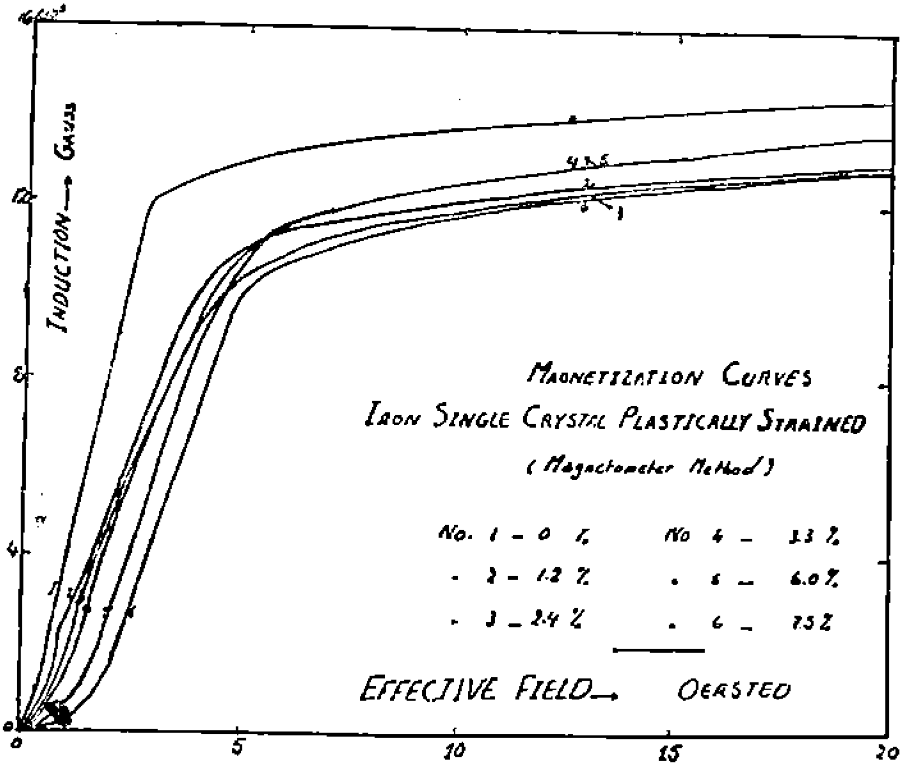


Fig. (1)
Typical magnetization curve for single crystal under tension (schematic).

The authors have determined the magnetization curve for a rod shaped single crystal of iron under plastic strain (fig. 2) the effects of increasing the plastic strain is a decrease in the initial permeability and a turning of the magnetization curve away from the intensity axis. The second effect conforms to Stewart's theory but the decrease in the initial permeability does not. In the authors' view this is due to the neglect by Stewart of the role played by closure domains. The authors think that the stituation is better described by Becker's(2) work which shows tyat the magnetization near the origin will be less for high stress than for a low stress, although the conditions of the experiment are somewhat different from Becker's idealized conditions.



Data for Fig. 2

He = Effective Field (Oersted)

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B = Induction (Gauss)

REFERENCES

1. Stewart, K.H. (1949) : Physica. V. 15 p. 235.
2. Becker, R. (1932) : Physik. Zeits. V. 33 p. 905.

Hu	1 He	1 B	2 He	2 B	3 He	3 B	4 He	4 B	5 He	5 B	6 He	6 B
±0.7	±.15	±750	±0.15	±50	±.15	±50	±.15	+50	±.15	+50	±.15	±50
0.71	0.26	750	0.40	500	0.49	350	0.48	350	0.57	200	0.63	100
1.41	0.43	1650	0.69	1200	0.79	1000	0.82	850	1.06	500	1.16	300
2.12	0.67	2400	0.87	2100	1.00	1800	1.07	1500	1.39	1050	1.52	750
2.83	0.85	3300	1.09	2900	1.26	2500	1.34	2150	1.70	1600	1.85	1200
3.54	1.03	4200	1.33	3700	1.47	3300	1.56	2850	1.95	2300	2.12	1800
4.24	1.16	5150	1.65	4300	1.70	4050	1.70	3650	2.11	3050	2.35	2350
4.95	1.32	6050	1.87	5150	1.93	4800	1.92	4350	2.28	3800	2.52	3050
5.66	1.54	6850	2.20	5750	2.24	5450	2.14	5050	2.55	4450	2.69	3700
6.37	1.74	7700	2.46	6500	2.53	6100	2.42	5650	2.78	5150	2.90	4350
7.07	1.87	8650	2.72	7250	2.81	6750	2.63	6350	2.97	5850	3.16	4900
7.78	2.07	9500	2.96	8000	3.08	7450	2.87	7000	3.19	6550	3.36	5500
8.49	2.27	10350	3.27	8650	3.40	8100	3.20	7550	3.39	7300	3.57	6150
9.20	2.49	11200	3.63	9250	3.69	8750	3.40	8300	3.72	7850	3.80	6750
9.90	2.74	11950	3.94	9900	4.03	9300	3.71	8850	3.85	8650	3.97	7100
10.61	3.23	12300	4.34	10450	4.39	9850	3.93	9550	4.10	9300	4.14	8100
11.32	3.77	12600	4.80	10850	4.86	10250	4.26	10100	4.46	9800	4.38	8700
12.03	4.38	12750	5.36	11100	5.35	10600	4.66	10550	4.71	10450	4.67	9200
12.73	4.98	12900	5.92	11350	5.89	10850	5.08	10950	5.06	10950	4.84	9850
13.44	5.57	13150	6.53	11500	6.43	11150	5.58	11250	5.58	11250	5.26	10200
14.15	6.21	13250	7.15	11650	7.05	11250	6.09	11550	6.10	11500	5.72	10550
15.56	7.50	13350	8.40	11900	8.26	11600	7.24	11900	7.27	11850	6.78	10950
16.98	8.88	13500	9.69	12100	9.53	11850	8.43	12200	8.45	12200	7.95	11300
18.39	10.19	13650			10.83	12000	9.66	12500	9.70	12450	9.14	11550
19.81	11.53	13800	12.36	12400	12.13	12200	10.95	12650	11.01	12600	10.37	11800
22.64	14.21	14050	15.04	12650	14.79	12450	13.55	13000	13.57	13000	12.09	12200
25.17	16.92	14250	17.75	12850	17.51	12650	16.17	13300	16.24	13200	15.49	12450
28.30	19.67	14400	20.50	13000	20.23	12800	18.82	13550	18.82	13550	18.07	12800