cient of friction. For soft powders (low rate of strain hardening) the coefficient of friction reaches a maximum at a higher compacting pressure than for hard powders.

5. For a die with smooth interior wall, frictional shear stresses may be reduced to practically zero by the use of wall lubricants.

6. Because of elastic deformation of a die during pressing, rigidity rather than strength is a necessary criterion for die design. Elastic bulging of a die results in the formation of laminar cracks.

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Rectangular Hysteresis Loops of Co-Ni-Fe Alloys

R. A. CHEGWIDDEN*

In view of the current interest in magnetic materials having rectangular hysteresis loops, as for example those obtained with the grain oriented 50 nickel 50 iron alloys,[†] we wish to call attention again to the results obtainable with the permivar (Co-Ni-Fe) alloys heat treated in a magnetic field.

Data taken from direct current measurements made prior to and during World War II give the typical values shown below for two of the permivar alloys. Fig 1 and 2 show the hysteresis loops for these samples.

The first sample above consisted of small rings punched from 0.014 in. sheet stock. These rings were heat treated at 1000°C for one hour in a hydrogen atmosphere and then cooled with the furnace to 750°C at which point they were subjected to a magnetic field of 15 oersteds maintained during cooling to room temperature. The molybdenum permivar sample consisted of a spirally wound core of 0.001 in. tape. The heat treatment was the same except that box annealing methods were used and no hydrogen atmosphere was employed. Even better properties might be expected using hydrogen. The heat treating temperatures and cooling rates are not critical. Rectangular hysteresis loops produced in other permivar alloys by heat treatment in a magnetic field were described earlier.^{1,2}

Properties similar to those described

FIG 1—Hysteresis loop for 0.014 in. permivar rings (43 Ni 34 Fe 23 Co) heat treated in a magnetic field.

FIG 2—Hysteresis loop for 0.001 in. molybdenum permivar tape core (34 Ni 34 Fe 29 Co 3 Mo) heat treated in a magnetic field.

Nominal Composition	Thickness	B _{max}	B _r	B _r /B _{max}	H _c	Approx. μ _{max}	ρ
43 Ni 34 Fe 23 Co	0.014 in.	15650	15600	0.995	0.07	150,000	20
34 Ni 34 Fe 29 Co 3 Mo	0.001 in.	15200	14500	0.955	0.19	72,000	52

B_{max} = flux density in gauss at H = 20 oersteds

B_r = residual flux density in gauss

H_c = coercive force in oersteds

μ_{max} = maximum permeability

ρ = resistivity in microhm-cm

above are realized in permivars manufactured by conventional methods. Drastic cold working which in practice limits the final thickness and is gen-

erally expensive may thus be avoided. This information may be of interest to those concerned with magnetic alloys and the development of contact rectifiers, magnetic amplifiers and so on.

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* Magnetics Research Dept., Bell Telephone Laboratories.

† Orthonol, Orthonik, Deltamax and similar materials.

¹ References are at the end of the paper.