

[Fig. 6]

	Before process	After process (975°C)
Br (kG)	14.5	14.3
iHc (kOe)	11.3	23.1
(BH)max (MGOe)	50.5	49.9
Weight increase ratio (%)	—	0.45
(BH)max+iHc	61.8	73

[Fig. 7]

	Dy configura- tion	Dy surface area/sintered magnet surface area	Br (kG)	iHc (kOe)	(BH)ma x (MGOe)	(BH)ma x + iHc
Non-film	—	(non-treated)	14.6	10.5	51.8	62.3
	Bulky (1mm ϕ)	5.3E-05	14.6	11.8	51.6	63.4
	Bulky (1mm ϕ)	7.0E-05	14.6	14.5	52.4	66.9
	Bulky (1mm ϕ)	1.1E-04	14.6	19.8	51.6	71.5
	Bulky (1mm ϕ)	5.7E-04	14.6	19.8	51.6	71.5
	Bulky (2mm ϕ)	2.1E-03	14.6	21.6	52.1	73.7
	Bulky (2mm ϕ)	6.5E-03	14.6	22.1	52.0	74.1
	Bulky (5mm ϕ)	1.2E-02	14.6	23.9	51.5	75.4
	Bulky (5mm ϕ)	6.4E-02	14.6	23.6	52.0	75.7
	Bulky (5mm ϕ)	1.8E-01	14.6	23.7	52.0	75.6
	Bulky (3mm ϕ)	7.0E-01	14.6	23.7	51.8	75.6
	Bulky (1mm ϕ)	1.4E+00	14.6	23.8	52.1	75.9
	Granular (0.4 mm)	6.7E+00	14.6	23.7	51.9	75.6
	Granular (0.4 mm)	1.1E+01	14.6	23.5	52.2	75.7
	Granular (0.4 mm)	6.8E+01	14.5	22.7	51.4	74.1
	Granular (0.01 mm)	1.6E+02	14.5	21.4	51.4	72.8
	Granular (0.01 mm)	5.6E+02	14.5	20.9	51.7	72.6
	Granular (0.01 mm)	1.6E+03	14.4	19.6	51.0	70.5

Film	Granular (0.01 mm)	4.8E+03	13.8	15.4	46.9	62.3
	Granular (0.01 mm)	6.0E+03	13.7	14.5	45.1	59.6

[Fig. 8]

	Average grain diameter of sintered magnet (μ m)					
	0.5	1	2	3	4	5
Br (kG)	14.1	14.3	14.4	14.8	14.7	14.4
(BH)max (MGOe)	47	50	52	54	53	51
iHc (kOe)	40	36	34	32	31	30
Optimum vacuum vapor processing hour (hr)	72	24	18	12	10	8
	Comparativ e Example	Present Invention				

[Fig. 8 (continued)]

Average grain diameter of sintered magnet (μ m)								
6	7	8	9	10	12	15	20	25
14.2	14.4	14.8	14.9	15	15.2	15.2	15.2	13.8
48	51	53	54	55	58	58	58	46
27	30	32	34	34	32	32	30	25
6	5	2	1	1	1	1	1	1
Comparativ e Example	Present Invention							Comparativ e Example

[Fig. 9]

	Vacuum vapor processin g	Compo- nent of magnet	Optimu m vapor processi n-g time	Br (kG)	(BH)max (MGOe)	iHc (kOe)	Evaluat ion of corrosio -n resistan ce
Embodi- ment 4	Not-perfo rmed	27Nd-1 B-0.05	—	14.4	51.2	11.4	6 hr or less
	Performe d	Cu-0.05 Ga-0.1 Zr-bal. Fe	2	15.5	59	18	120 hr or more
Compar- ative ExAMPL e 4a	Not-perfo rmed	27Nd-1 Co-1B-	—	14.3	51	11.3	24 hr or less
	Performe d	0.05Cu- 0.05Ga- 0.1Zr-b al. Fe	10	15.3	58	17	120 hr or more
Compar- ative ExAMPL e 4b	Not-perfo rmed	27Nd-4 Co-1B-	—	14.4	52	11.1	48 hr or more
	Performe d	0.05Cu- 0.05Ga- 0.1Zr-b al. Fe	22	15.2	56	16.5	120 hr or more
Compar- ative ExAMPL e 4c	Not-perfo rmed	27Nd-8 Co-1B-	—	14.4	52	11	72 hr or more
	Performe d	0.05Cu- 0.05Ga- 0.1Zr-b al. Fe	32	15.1	55	16.4	120 hr or more

[Fig. 10]

		Temperature of vapor processing (°C)							
	Not-vapor processing	750	800	850	900	950	1000	1050	1100
Br (kG)	14.2	14.3	14.6	14.7	14.8	14.9	14.7	14.6	14
(BH) _{max} (MGOe)	49	49.5	50	52	54	54	54	51	48
iHc (kOe)	14.5	15.8	22	24	26	27	26	24	16
Weight increase before and after vapor processing (wt%)	—	0.01	0.05	0.1	0.3	0.4	0.6	0.8	1.5
	Comparative Example	Present Invention							Comparative Example

[Fig. 11]

		Temperature of vapor processing (°C)							
	Not-vapor processing	850	900	950	1000	1050	1100	1150	1200
Br (kG)	14.2	14.3	14.6	14.7	15.3	15.4	14.7	14.6	13
(BH) _{max} (MGOe)	49	49.5	50	52	57.4	58.1	54	51	40
iHc (kOe)	14.5	15.8	21	23	29	30	29	28	8
	Comparative Example	Present Invention							Comparative Example

[Fig. 12]

	Average grain diameter of sintered magnet (μ m)					
	0.5	1	2	3	4	5
Br (kG)	13.9	14.3	14.4	14.6	14.6	14.3
(BH)max (MGOe)	46.5	50.5	51	52.8	52.2	50.5
iHc (kOe)	40	36	34	32	31	30
Optimum diffusing process hour (hr)	72	36	18	12	8	8
	Comparative Example	Present Invention				

[Fig. 12 (continued)]

Average grain diameter of sintered magnet ($\mu\text{ m}$)								
6	7	8	9	10	12	15	20	25
14.1	14.4	14.8	15	15.1	15.2	15.2	15.2	13.8
48	51	54	55.1	55	56	56	56	46
27	30	32	32	32	32	31	30	25
6	4	2	1	1	1	0.5	0.5	1
Comparative Example	Present Invention							Comparative Example

[Fig. 13]

	Vacuum vapor processin g	Compo- nent of magnet	Optimu m vapor processi n-g time	Br (kG)	(BH)max (MGOe)	iHc (kOe)	Evalua- tion of corrosio n resistan -ce
Embodi- ment 8	Not-perfo rmed	28Nd-1 B-0.05	—	14.4	51.2	11.4	6 hr or less
	Performe d	Cu-0.05 Ga-0.1 Zr-bal. Fe	2	15.4	58	19.5	120 hr or more
Compar- ative Exempl e 8a	Not-perfo rmed	28Nd-1 Co-1B-	—	14.3	51	11.3	24 hr or less
	Performe d	0.05Cu- 0.05Ga- 0.1Zr-b al. Fe	10	15.2	57	18.2	120 hr or more
Compar- ative Exempl e 8b	Not-perfo rmed	28Nd-4 Co-1B-	—	14.4	52	11.1	48 hr or more
	Performe d	0.05Cu- 0.05Ga- 0.1Zr-b al. Fe	22	15.1	55	17.4	120 hr or more
Compar- ative Exempl e 8c	Not-perfo rmed	28Nd-8 Co-1B-	—	14.4	52	11	72 hr or more
	Performe d	0.05Cu- 0.05Ga- 0.1Zr-b al. Fe	32	15	54	17	120 hr or more

[Fig. 14]

	Temperature of processing chamber (°C)	Temperature of sintered magnet (°C)				
		750	800	850	900	950
Br (kG)	900	14.3	14.6	14.7	14.8	14.9
(BH)max (MGOe)		49.5	50	52	54	56
iHc (kOe)		15.8	21	23	24	26
Br (kG)	850	14.3	14.6	14.7	14.8	14.9
(BH)max (MGOe)		49.5	50	52	54	56
iHc (kOe)		15.8	22	24	26	27
Br (kG)	800	14.3	14.6	14.7	14.8	14.9
(BH)max (MGOe)		49.5	50	52	54	56
iHc (kOe)		15.8	22	24	26	27
Br (kG)	750	14.3	14.6	14.7	14.8	14.9
BH)max (MGOe)		49.5	50	52	54	56
iHc (kOe)		15.8	22	24	26	27
		Comparative Example	Present Invention			

[Fig. 14 (Continued)]

Temperature of sintered magnet (°C)					
1000	1050	1100	1150	1200	1250
14.7	14.6	14	13.5	12	11
54	51	48	44	30	21
25	23	21	12	8	4
14.7	14.6	14	13.5	12	11
54	51	48	44	30	21
26	24	22	12	8	4
14.7	14.6	14	13.5	12	11
54	51	48	44	30	21
26	24	22	12	8	4
14.7	14.6	14	13.5	12	11
54	51	48	44	30	21
26	25	24	12	8	4
Present Invention			Comparative Example		

[Fig. 15]

	Average grain diameter of sintered magnet (μ m)					
	0.5	1	2	3	4	5
Br (kG)	13.9	14.4	14.4	14.7	14.7	14.4
(BH)max (MGoe)	46.5	51.5	52	53.6	53.3	51.5
iHc (kOe)	36	34	32	30	29	28
Optimum diffusing process hour (hr)	72	36	18	12	8	8
	Comparative Example	Present Invention				

[Fig. 15 (continued)]

Average grain diameter of sintered magnet ($\mu\text{ m}$)								
6	7	8	9	10	12	15	20	25
14.1	14.5	14.9	15.1	15.2	15.3	15.3	15.3	13.8
48	52	55	56.1	56	57	57	57	46
25	28	30	30	30	30	29	28	23
6	4	2	1	1	1	0.5	0.5	1
Comparative Example	Present Invention						Comparative Example	

[Fig. 16]

	Vacuum vapor processin g	Compo- nent of magnet	Optimu m vapor processi n-g time	Br (kG)	(BH)max (MGOe)	iHc (kOe)	Evaluat ion of corrosio n resistan ce
Embodi- ment 11	Not-perfo rmed	21Nd-7 Pr-1B-0	—	14.4	51.2	10.8	2 hr or less
	Performe d	.05Cu-0 .05Ga-0 .1Zr-bal . Fe	4	15.4	58	20.5	120 hr or more
Compar- ative ExAMPL e 11a	Not-perfo rmed	21Nd-7 Pr-1Co-	—	14.3	51	11.2	12 hr or less
	Performe d	1B-0.05 Cu-0.05 Ga-0.1 Zr-bal. Fe	10	15.2	57	18.2	120 hr or more
Compar- ative ExAMPL e 11b	Not-perfo rmed	21Nd-7 Pr-4Co-	—	14.4	52	11.0	36 hr or more
	Performe d	1B-0.05 Cu-0.05 Ga-0.1 Zr-bal. Fe	22	15.1	55	17.4	120 hr or more
Compar- ative ExAMPL e 11c	Not-perfo rmed	21Nd-7 Pr-8Co-	—	14.4	52	10.8	48 hr or more
	Performe d	1B-0.05 Cu-0.05 Ga-0.1 Zr-bal. Fe	32	15	54	16	120 hr or more

[Fig. 19]

			Heating temperature of metallic material (°C)			
		Temperature of magnet (°C)	750	800	850	900
Comparative Example	Br (kG)	1150	13.5	11.0	10.5	10.5
	(BH)max (MGOe)		30.1	25.1	24.7	24.4
	iHc (kOe)		8.9	6.9	6.9	7.0
Present Invention	Br (kG)	1100	14.3	14.4	14.4	14.4
	(BH)max (MGOe)		49.5	49.9	52.0	54.0
	iHc (kOe)		12.3	17.9	23.9	26.0
	Br (kG)	1000	14.3	14.6	14.6	14.8
	(BH)max (MGOe)		49.5	49.8	51.9	54.0
	iHc (kOe)		12.1	18.9	24.0	26.0
	Br (kG)	900	14.3	14.6	14.7	14.8
	(BH)max (MGOe)		49.5	49.8	51.8	53.9
	iHc (kOe)		12.2	16.5	23.3	25.5
	Br (kG)	800	14.3	14.6	14.6	14.6
	(BH)max (MGOe)		49.5	49.9	52.0	53.7
	iHc (kOe)		12.0	17.0	23.9	25.9
Comparative Example	Br (kG)	750	14.3	14.3	14.3	14.3
	(BH)max (MGOe)		49.5	49.2	49.3	49.3
	iHc (kOe)		12.1	11.9	12.0	12.1
			Comparative Example	Present Invention		

[Fig. 19 (Continued)]

Heating temperature of metallic material (°C)						
950	1000	1050	1100	1150	1200	1250
10.7	10.8	11.0	10.7	10.7	10.9	9.8
24.3	23.5	23.2	22.1	21.5	21.3	16.9
6.9	6.9	7.0	7.0	6.3	5.2	3.0
14.4	14.3	14.3	14.3	14.2	14.0	11.0
56.0	53.9	49.8	49.5	48.3	48.0	21.0
26.9	26.7	26.0	25.9	23.9	15.9	14.3
14.9	14.7	14.3	14.4	14.3	14.0	11.0
56.0	53.9	50.9	49.5	49.2	47.8	20.9
26.9	26.3	26.3	26.0	23.9	16.0	15.3
14.9	14.7	14.6	14.4	14.4	14.0	12.5
56.0	53.9	50.8	50.2	50.1	48.0	36.3
26.5	26.0	25.7	25.6	23.8	15.9	15.5
14.7	14.7	14.6	14.6	14.4	14.0	13.1
55.9	53.8	52.8	52.1	50.3	47.9	39.1
26.9	25.8	25.4	24.8	23.9	15.9	15.4
14.3	14.3	14.3	14.3	14.3	14.3	12.3
49.3	49.2	49.3	49.2	49.2	49.2	20.9
12.0	11.9	11.9	11.9	11.9	11.9	11.9
Present Invention						Comparative Example

[Fig. 20]

		Average grain diameter of sintered magnet (μ m)					
		0.5	1	2	3	4	5
Br	(kG)	13.9	14.4	14.4	14.7	14.7	14.4
(BH)max	(MGOe)	46.5	51.5	52	53.6	53.3	51.5
iHc	(kOe)	36	34	32	30	29	28
Optimum diffusing process	hour	72	36	18	12	8	8
		Comparativ e Example	Present Invention				

[Fig. 20 (continued)]

Average grain diameter of sintered magnet (μ m)								
6	7	8	9	10	12	15	20	25
14.1	14.5	14.9	15.1	15.2	15.3	15.3	15.3	13.8
48	52	55	56.1	56	57	57	57	46
25	28	30	30	30	30	29	28	23
6	4	2	1	1	1	0.5	0.5	1
Comparativ e Example	Present Invention							Comparativ e Example

[Fig. 21]

	Vacuum vapor processin g	Compo- nent of magnet	Optimu m vapor processi n-g time	Br (kG)	(BH)max (MGOe)	iHc (kOe)	Evaluat i-on of corrosio -n resistan -ce
Embodi- -ment 16	Not-perfo rmed	21Nd-7 Pr-1B-0	—	14.4	51.2	10.8	2 hr or less
	Performe d	.05Cu-0 .05Ga-0 .1Zr-bal . Fe	4	15.4	58	20.5	120 hr or more
Compar- -ative ExAMPL e 16a	Not-perfo rmed	21Nd-7 Pr-1Co-	—	14.3	51	11.2	12 hr or less
	Performe d	1B-0.05 Cu-0.05 Ga-0.1 Zr-bal. Fe	10	15.2	57	18.2	120 hr or more
Compar- -ative ExAMPL e 16b	Not-perfo rmed	21Nd-7 Pr-4Co-	—	14.4	52	11.0	36 hr or more
	Performe d	1B-0.05 Cu-0.05 Ga-0.1 Zr-bal. Fe	22	15.1	55	17.4	120 hr or more
Compar- -ative ExAMPL e 16c	Not-perfo rmed	21Nd-7 Pr-8Co-	—	14.4	52	10.8	48 hr or more
	Performe d	1B-0.05 Cu-0.05 Ga-0.1 Zr-bal. Fe	32	15	54	16	120 hr or more

