Improvement of Motor Performance by Use of High-Efficiency Electrical Steels*

 E $\begin{bmatrix} a & a \\ b & c \end{bmatrix}$ t_1 , $\begin{bmatrix} a & a \\ a & 1 \end{bmatrix}$.

 $\begin{smallmatrix}{\mathbf s} & {\mathbf s$

 S _{i} $=$

The influence of the properties of core materials on the performance of a brushless DC motor and an induction motor, which are representative types often used as drive motors for electric and hybrid vehicles. The efficiency of the brushless DC motor of concentrated winding type can be estimated by the core material iron loss at 400 Hz. By using low-core-loss high-flux-density electrical steels RMHE for this brushless DC motor, efficiencies higher than conventional materials by 0.5–1.0%

were obtained with equivalent torque constants. In the three-phase induction motor, high efficiencies were obtained by using RMA having higher magnetic flux densities. The difference between materials in the distribution of local magnetic field strength, magnetic flux density and core loss in motor cores were clarified by local magnetic properties measurement using a contact probe method.

 $\frac{1}{2}$ originally published in $\frac{1}{2}$

$\frac{1}{2}$ g and $\frac{1}{2}$ $\frac{1}{2}$ of $\frac{1}{2}$ oriented electrical steels. 1.¹²⁾ $A = a + aT_1, A_2, A, T, T, T$ T_1, T_2, T_3

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-\frac{i}{\pi}\frac{a_1^2}{t^2}a_1^3-\frac{B_1^3}{t^3}a_1^3b_1^2+\frac{B_1^2}{t^2}a_1^4a_1^3+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^3}a_1^3+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^4+\frac{C_1^2}{t^2}a_1^2+\frac{C_
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\int_{1}^{3} a^{2} \frac{1}{2} \int_{1}^{3} \frac{1}{2} \int_{1}^{
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 $c_i \rightarrow \overline{a}$ $c_i \rightarrow a_i$ $c_i \rightarrow a_i$ is shown in Fig. 3. \mathcal{A}_5 , \mathcal{A}_6 , \mathcal{A}_7 , \mathcal{A}_8 , \mathcal{A}_9 , \mathcal{A}_9 , \mathcal{A}_9 , \mathcal{A}_9 E_a and E_a materials were separately plotted. It is interested. It is inte apparent that \mathcal{L} is the same constant \mathcal{L}

 $\frac{a_{1}a_{2}}{a_{1}}$ density $\frac{a_{1}}{a_{1}}$, $\frac{a_{2}}{a_{2}}$, $\frac{a_{2}}{a_{1}}$, $\frac{a_{3}}{a_{1}}$, $\frac{a_{3}}{a_{1}}$ A_{n-1} , A_{n-1} , B_{n-1} , B_{n-1}

 F_1 g. 14 Dff_{erse} in distribution of magnetizing force (a), f_1 (b) f_2 and f_3 (c) and f_4 (e) and f_5 (c) between f_6 a 50 $400 (f \cdot A350 - f \cdot 400)$

 F_1 g. 13 D_{inter} of F_2 or \wedge ¹¹ F_3 1, F_4 , F_5 g 50° 400 as $x_1 = a_1$, a

 t_{a} t t_{b} ^D \uparrow 4², \uparrow \uparrow \uparrow 50 \uparrow 400 and 50 A350 and 50 $a \wedge a$ the equal value in the portion. While α 50 $400 a$ 50 $A350 a$ a a $f B$ _{m in the teeth portion, 50 \angle A350 \angle a a_1 a g_1 4} \mathbf{a} in the position. The \mathbf{a} in \mathbf{a} is \mathbf{a} in \mathbf{a} in the state in \mathbf{a} reflect that the fact that fact that f and f B_{50} _t $\frac{1}{4}$ t $\frac{1}{4}$ f^t 50^c 400. T_{max} in loss distribution reflects the distribution of B ; 50 $\left[400\right]$ s a larger value in the term point portion a 50 A350 shows in places larger values in the set λ result, As a result, the initial soft 50 \sim A350 d_{u} $\frac{d_{\text{u}}}{dt}$ d_{u} f 50^R 400 in the whole core. $A = \begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$ far, $A = \begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$ and $A = \begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$ λ_{total} , we find the magnetic flux density distribution of λ_{total} $\sum_{k=1}^{\infty} \frac{1}{k} \int_{-\infty}^{\infty} \frac{1}{k^2} \int_{-\infty}^{\infty}$ λ_{1} and λ_{2} . λ_{3} in λ_{4} in λ_{5} in λ_{6} in λ_{7} B_{50} f Λ_{15} and Λ_{1} and Λ_{2} in prove the efficiency of and Λ_{1} \mathbf{v}_1 , \mathbf{v}_2 and \mathbf{v}_3 interpretation of \mathbf{v}_1 interpretation of \mathbf{v}_2 interpretation of \mathbf{v}_3 $\begin{bmatrix} a' & b' \\ c \end{bmatrix}$ of $\begin{bmatrix} a' & b' \\ c \end{bmatrix}$ subject of f_{μ} , f_{μ} a.

6 Conclusions

 A_n in game diffuse into the in $\frac{1}{2}$ $t_{\rm s}$ e_{rg} $\frac{1}{2}$ a $\frac{1}{2}$ e_nf[']a $\frac{1}{2}$ ¹, ¹¹ DC $\frac{1}{2}$ and an a_n induction motor, and a_n \overline{u} and \overline{v} for \overline{u} electric vehicles. $T_{\rm{max}}$ \approx $S_{\rm{max}}$ $T_{\rm{max}}$ $T_{\rm{max}}$ $T_{\rm{max}}$ (1) $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{3}$ $\frac{1$ **No. 48 March 2003** 45

of a brushless DC motor of the concentrated winding type containing arare-earth alloy magnet can be accu rately estimated by the core material iron loss at 400 Hz. (2) When low-core-loss, high-flux-density electrical steels RMHE are used in the brushless DC motor, efficiency can be improved by 0.5 to 1.0% compared with conventional materials with equivalent torque constants. (3) In a three-phase induction motor, efficiency can be increased by using RMA as a core material, due to its higher magnetic flux density *B*50. (4) Differences between RMA and RM in the distribu tion of local magnetic field strength, magnetic flux density and core loss in motor cores were clarified by the measurement of local magnetic properties using a contact probe method.

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- λ_{max} β_{max} β_{max} β_{max} β_{max} Energy—", *J. Soc. Automot. Eng. Jpn.*, **56**(2002)1, 18
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