TB09

Performance and Applications of a High-speed Small PMgenerator

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This paper considers a high-speed low-power small permanent magnet (PM)generator for aerospace applications where environmental requirements are very severe. Alnico magnet has low temperature coefficient of remanent flux density and maximum service temperature, and is suitable for this application.

The cross section of the proposed generator is shown in Fig. 1. The stator has four series concentrated solenoidal windings to generate a single-phase output. The design uses a one-piece forged or cast rotorto withstand the high centrifugal forces of high-speed operation. As can be seen from Fig. 1, the rotor supports the Alnico magnets on its outer surface and the arrows indicate the direction of magnetization.

The steady-state performance is analyzed by the finite element method[1]. The predicted RMS voltages are compared with experimental measurements as shown in Fig. 2. It can be seen that they show a close agreement between them. Fig. 3 shows the load characteristics for the generator at 3 different speeds with resistive loads. The results indicate that at low speed, the inductance has less influence to voltage regulation than at high speed, as expected. A regulator circuit for the rectified output of the generator is shown in Fig. 4. It gives a constant output of about 10 V under various speeds (see Table 1).

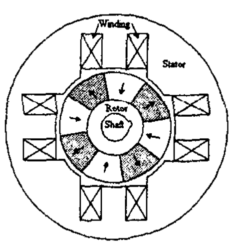

Fig. 1. Cross section of the generator.

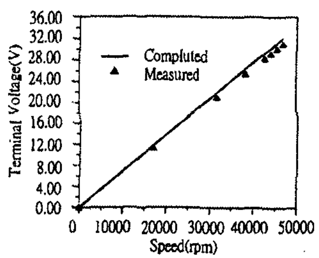

Fig. 2. Open circuit characteristics.

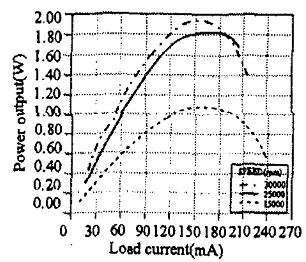

Fig. 3. Power output at resistive load.

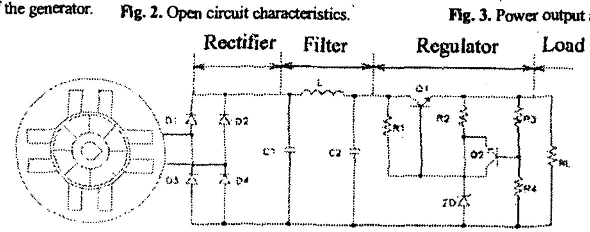

Fig. 4. A regulator circuit for the generator.

TABLE 1 A regulator circuit output voltages

Speed (rpm)	14000	15000	16000
Output voltage (V)	10.03	10.26	10.456

REFERENCES

[1] *Flux2D User's Guide*, Version 7.4, Magsoft Corporation, Troy, New York, U.S.A., 2000.

TB10

Design and Construction of a Claw-pole PM Dynamo

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This paper aims to develop a claw-poled permanent magnet (PM) dynamo for the generation of electric power for bicycles [1]. Fig. 1 shows the construction of the machine. The stator consists of two claw-pole teeth. The top tooth is not located at the same pitch as the bottom tooth. This staggered tooth is used to guide flux from one pole to another pole. Inside these two pieces there is a phase coil of copper wire on a nylon bobbin. A hollow, cylindrical core steel is located inside between claw-poled teeth them is used as flux path. The rotor consists of a steel yoke and a ring shaped NdFeB magnet. This assembly is centered by a pin type shaft that is stacked into the hub.

The design of the machine is done with the aid of electromagnetic field analysis based on the finite element method (FEM). The prototype dynamohas been simulated under no-load and load conditions. Fig. 2 shows the flux distribution. To simulate a lamp load of 6 V, 3 W, a resistor of 12 Ω is connected at the terminals of the dynamo. The comparison between the predicted and measured of the open circuit voltage and voltage across the 12 Ω resistor under five speeds is given in Table 1. The comparison is seen to be excellent.

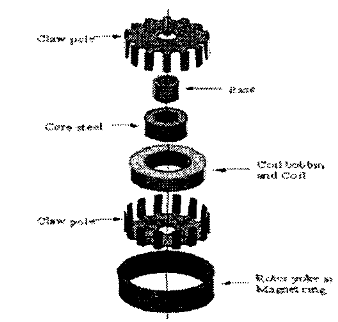

Fig. 1. The construction of the machine.

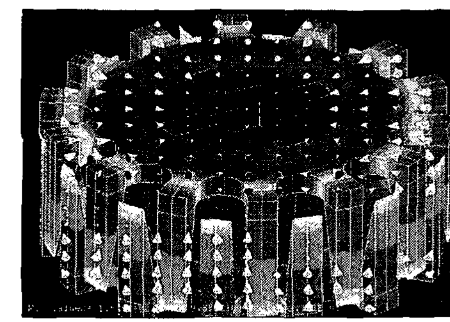

Fig. 2. The flux distribution.

Table 1. Comparison between predicted and measuredl terminal voltages

Speed (rpm)	40		80		120		160		200	
	FEM	Test	FEM	Test	FEM	Test	FEM	Test	FEM	Test
No load (V)	5.20	5.26	10.48	10.19	15.59	15.06	20.79	20.12	25.99	25.90
12 ohm (V)	3.43	3.24	5.23	5.02	5.97	5.79	6.36	6.13	6.59	6.33

REFERENCES

[1] T. Kenjo and S. Nagamori, *Permanent-Magnet and Brushless DC Motors*, Clarendon Press, Oxford, pp. 174, 1985.