

A14-098

Development of Teaching Aids for Rotating Electrical Machinery

旋轉電機教具的研製

隊伍名稱

轉吧企鵝罐！/ Rolling！Penguindrum

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作品摘要

本作品是以「直流脈衝電源」代替「交流電源」的創新設計概念，利用「手動操作」的模式，將旋轉電機「連續」快速的動作方式，分解成「離散步級」的手動操作模式，使學生能由手動操作過程，一步一步體會出旋轉電機的動作原理。轉子採用永久磁鐵、定子是6組線圈組成A、B、C三相線圈，如圖1線圈擺放位置必須彼此相差120電機度。本企劃將一個週期的交流弦波電源，區分為12個工作區域，則每一個工作區間為30電機度。為了方便原理解說與模型設計，如圖2本企劃使用三相交流方波電源代替三相交流弦波電源，三相方波電源會有三種不同位準的輸出電壓。當定子線圈通入三相直流脈衝電源後，可產生旋轉磁場帶動轉子轉動，實際操作時旋轉電機教具最高轉速

可達1800rpm。

本企劃以「兩種不同顏色的LED燈」代表「定子線圈」通電後產生磁力線的方向與磁場的極性，如圖3學生可藉由LED燈色彩變化的可觀測性，使學生能由一步一步操作的過程，觀察每一階段LED燈顏色的亮滅變化，以了解三相線圈建立旋轉磁場的步驟。由於LED燈具有絢麗的視覺效果，更能吸引學生注意，提高學習動機與效果。本企劃研製的旋轉電機教具，相關成果將可推廣到高職、科技大學等，對電機機械的教學與人才培育會有很大的助益。

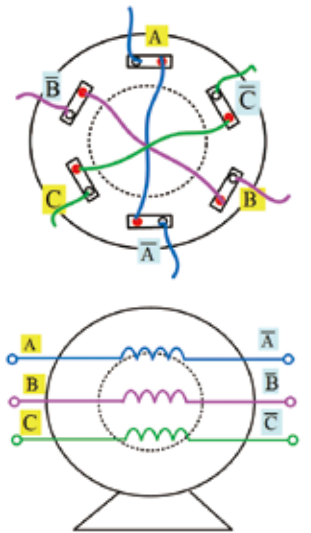


圖1 > 旋轉電機模型的電磁線圈接線圖



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研究領域

馬達驅動控制與控制晶片的設計。

Abstract

This device is based on an innovative concept that substitutes "Pulsed DC power supply" for the "AC source". In manual operation mode, we break down the "continuous" rapid action of rotating electrical machinery into the "discrete" step-by-step manual operation mode. Through hands-on operations, students get to know the principles of motor actions step-by-step. We used permanent magnet as rotor and constructed stators with six coils, showing in figure 1. Three sets of coils must be mutually spaced at 120 degree intervals. We divided one AC sinusoidal period into 12 working sectors, so that each sector has 30 degree. Showing in figure 2, we replaced the three-phase sine wave ac power with three-phase square wave ac power, making it easier to explain the model, given that the three-phase square wave power has three different output voltage levels. When the stator coil is connected to three phase pulsed DC power supply, it generates a magnetic field, causing the rotor to rotate. In actual operation, the motor simulation device could speed up to 1800 rpm. This project utilized two different colors of LED to represent the directions of magnetic lines of force and to indicate the magnetic field generated by the stator coil, showing in figure 3. Students can take advantage of the LED light changes to understand how the three-phase coil established a rotating magnetic field. The colorful blinking LED lights can effectively attract students' attention and significantly enhance their learning motivation and efficiency. This LED motor model could be used in vocational schools and universities and would be of great assistance in electric machinery courses and personnel training.

order coil	1	2	3	4	5	6	7	8	9	10	11	12
A	1	1	1	0	-1	-1	-1	-1	-1	0	1	1
B	-1	0	1	1	1	1	1	0	-1	-1	-1	-1
C	-1	-1	-1	-1	-1	0	1	1	1	1	1	0

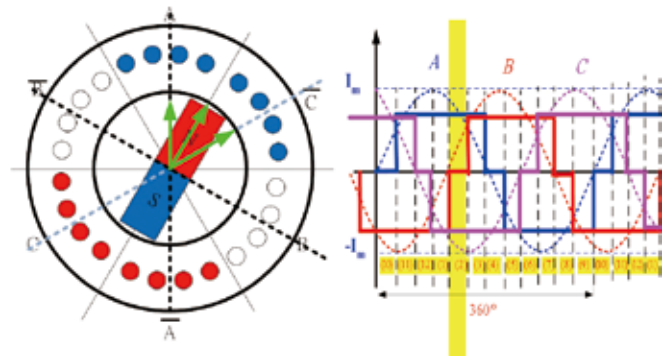


Fig.2 > Diagram of magnetic field produced by three-phase square wave AC power

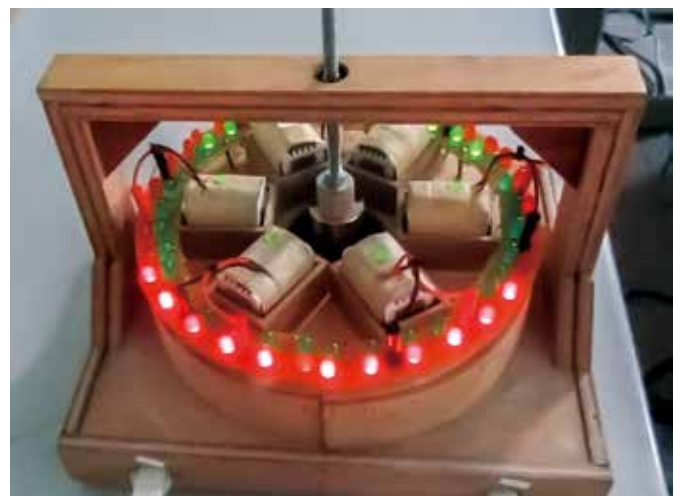


Fig.3 > Splendid visual effects of the LED motor model