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Reduction of Total Harmonic Distortion using Multipulse Cycloconverter

Jinesh Derawala, Rushang Parekh, Abin Thomas, Krunal Shah

Jinesh Derawala: Student, Electrical Engineering, SRICT, Gujarat, India
Rushang Parekh: Student, Electrical Engineering, SRICT, Gujarat, India
Abin Thomas: Student, Electrical Engineering, SRICT, Gujarat, India
Krunal Shah: Professor, Electrical Engineering, SRICT, Gujarat, India

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Abstract - *The need for use of cycloconverter (AC to AC converters) is in controlling a.c motors at low speed drive especially in high power application. When designing such type of converters, output will be having the problem of power quality. Hence to improve power quality and reduce the total harmonic distortion to specific standards pulse numbers should be increased. The project includes the MATLAB/SIMULINK model of cycloconverter on different pulses. Pulse number will increase to reduce total harmonic distortion. Comparison will be made after completing the simulation process. The control strategy of supplying the firing pulses is based on the cosine wave crossing method. The MATLAB/SIMULINK model for the control circuits to perform the procedure of this strategy will be constructed. The cycloconverter will operate satisfactory having either number of pulses. By Increasing number of pulses of cycloconverter will rectify the output waveforms of cycloconverter and will nullify the harmonic effect, which result in improvement in output power factor. good agreement with them, which indicates that the system is reliable.*

KeyWords: MULTIPULSE CYCLOCONVERTER, MATLAB/SIMULINK, TOTAL HARMONIC DISTORTION, POWER QUALITY, AC TO AC CONVERTER

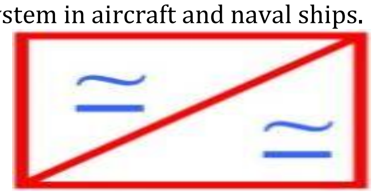
1.INTRODUCTION

An electrical drive which consists of electric motors. Now a day in modern electric drive system power electronic converters are used as power controller. In drives system, it consists of two types: (a) AC drives and (b) DC drives.

For the Application purpose, AC drives are widely used for adjustable speed control, frequent starting, better speed regulation, braking and reversing. And the DC drives are also used for some important application such as paper mills, mine winders, hoists, elevators, printing presses, traction, textile mills, machine tools, cranes and rolling mills. For the industrial applications development of high performance motor drives are very essential. AC drives are less costly and less complex as compared to the DC drives, so it is widely used in industrial applications.

1.1 History of Cycloconverter

A device which convert input power a one frequency to output power at different frequency is called as cycloconverter. The basics of this converters were proposed by Hazeltine in 1926 and first cycloconverter was built in 1930s using mercury arc valves for converting standard 50Hz supply to single-phase 16.66Hz supply for use in ac traction system in Germany.
Nowadays Cycloconverter used in large-power-low-speed variable voltage variable-frequency ac drive in cement and steel rolling mills as well as in variable-speed constant-frequency system in aircraft and naval ships.



(Symbol of Cycloconverter)

1.2 Types of Cycloconverter

1.2.1 Step-up cycloconverter: The output frequency (fo) is more than the supply frequency (fs).
1.2.2 Step-down cycloconverter: The output frequency(fo) is lower than than the supply frequency (fs).

1.3 Operating Principle

1.3.1 Single-phase to Single-phase Cycloconverter

Introduction of operation principles of cycloconverter should be started with single-phase to single-phase cycloconverter. Cyclo-converter are two inversely connected rectifiers. Suppose for getting ¼ of input voltage at the output, for the 1st two cycles of Vs the positive converter operates, supplying current to the load and it will rectify the input voltage. In the next two cycles the negative converter operates supplying current in the inverse direction. When any one of the converters operates, the either is disabled, so that there is no current flowing between both the rectifiers. In the above figure, Vs represents input supply voltage and Vo is the required output voltage which is ¼ of supply voltage.

1.3.2 Three-phase to Single-phase Cycloconverter

Similar to that of converters, three-phase to single-phase cycloconverter applies rectified voltage to the load. Positive Cycloconverters will supply positive cycle and negative converters will supply negative cycle of current only. The Cycloconverters can be operated in any of the four quadrants, positive voltage and negative current rectification modes, negative voltage positive current and negative voltage and negative current, inverting modes. The direction of current will indicate the operation of either converter supplying power to the load. When there is a change in current direction, the converter currently supplying current is disabled and the other converter is enabled.

1.3.3 Three-phase to Three-phase Cycloconverter

There are two normal functioning is provided in three phase configurations as delta and wye. The three-phase converters are mainly used in machine drive systems running three-phase synchronous and induction machines.

2. CONTROL STRATEGIES

From the above operation of cycloconverter we saw that average output can be controlled by varying the output frequency of converter via varying the switching pulse given to the thyristor of each bridge of cycloconverter. We can change the frequency and get desire speed and torque. To control output frequency of any cycloconverter there exist 3 control strategy given as follows:

1) By controlling switching pulse using microcontroller
2) By controlling the switching pulse using PWM technique and
3) By controlling the switching pulse using analog triggering method

2.1 By controlling the switching pulse using microcontroller

The switching pulse given to thyristor bridge of each cycloconverter is controlled by programming the microcontroller. The programming is done taken reference to duty cycle and time delay given to it.
The microcontroller is so programmed as to generate the desire pulse. The output of microcontroller is a pulse. The high pulse will trigger the thyristor and will close the thyristor and the switch act like in close condition. The triggering of pair of thyristor is so done that the multiple is obtain on either side. So to get the frequency division of 2,3,4,5 and so on.

2.2 By controlling the switching pulse using PWM technique

In this control strategies, the ON and OFF time of the cycloconverter is determined by the value of the Output frequency. The maximum and the minimum output frequency is dependent on the ON and OFF time of the cycloconverter. In this strategy the cycloconverter bridge is turned ON and OFF to control output frequency.
In this type of control strategy, the pulse is generated by comparing the triangular wave to constant signal. The pulse is generated when the two of the signal intersects. So to control the firing angle of the thyristor the amplitude of DC signal is varied.

2.3 By controlling the switching pulse using analog triggering method

In this type of control strategy, the AC carrier signal is compared with constant DC signal. The AC carrier signal is given from AC source and DC constant is given from DC source. When AC signal is compared with constant DC source the pulse is generated at intersection point of the two signal as shown in figure below the AC carrier signal is compared with DC constant of + or – V volts, the intersection point of both the signal is generated with a pulse. This pulse is then given to the thyristor this pulse will trigger the thyristor. This method is quite easier then above two methods as the comparison of two signal will be done in a comparator and the error signal generated is the pulse given to the thyristor for triggering it. Just a we don't need any programming or wave generator like in microcontroller triggering method and PWM triggering techniques respectively. The AC carrier signal is taken from the AC source and DC signal is taken from the DC source.

3. CONCLUSIONS

By varying the frequency(decreasing) the speed of an AC motor is decreased and the torque of the motor is increased proportional to decrease in speed without dealing with loss of power.

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